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Office of
Fissile Materials Disposition

United States Department of Energy

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Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Summary

December 1996

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Attention: Storage and Disposition of Weapons-Usable Fissile Materials
Final Programmatic Environmental Impact Statement/Summary

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ABSTRACT: This document analyzes the potential environmental consequences of alternatives for the long-term storage (up to 50 years), including storage until disposition, and disposition of weapons-usable fissile materials from U.S. nuclear weapon dismantlements under the responsibility of the DOE. Long-term storage of nonsurplus inventories of weapons-usable plutonium (Pu) and highly enriched uranium (HEU) are required for national defense purposes, while the disposition of surplus weapons-usable Pu is necessary in order to implement our national nonproliferation policy. In addition to the No Action Alternative, this PEIS assesses three storage alternatives (that is, upgrade at multiple sites, consolidation of Pu, and collocation of Pu and HEU) at six DOE candidate sites located across the country. These sites are Hanford Site, Nevada Test Site, Idaho National Engineering Laboratory, Pantex Plant, Oak Ridge Reservation, and Savannah River Site. Although they are not candidate sites for storage, Rocky Flats Environmental Technology Site (RFETS) and Los Alamos National Laboratory are assessed for the No Action Alternative. For the disposition of surplus Pu, three alternative categories (that is, deep borehole, immobilization, and reactor) with nine primary alternatives are assessed at several DOE and representative sites for analysis purposes. Evaluations of impacts on site infrastructure, water resources, air quality and noise, socioeconomics, waste management, public and occupational health and safety, and environmental justice are included in the assessment. The intersite transportation of nuclear and hazardous materials is also assessed. DOE's Preferred Alternative is identified in this Final PEIS. The Preferred Alternative for storage is a combination of No Action and Upgrade Alternatives for the various DOE sites, and phaseout of Pu storage at RFETS. The Preferred Alternative for disposition of surplus Pu is to pursue a disposition strategy involving a combination of immobilization and reactor alternatives, including vitrification, ceramic immobilization, and existing reactors.

PUBLIC INVOLVEMENT: The DOE issued a Draft PEIS on March 8, 1996, and held a formal public comment period on the Draft through June 7, 1996. In preparing the Final PEIS, DOE considered comments received via mail, fax, electronic bulletin board (Internet), and transcripts of messages recorded by telephone. In addition, comments and concerns were recorded by notetakers during interactive public meetings held during March and April 1996 in Denver, CO, Las Vegas, NV, Oak Ridge, TN, Richland, WA, Idaho Falls, ID, Washington, DC, Amarillo, TX, and North Augusta, SC. Comments received and DOE's responses to those comments are found in Volume IV of the Final PEIS.

DOE/EIS-0229

Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Summary

United States Department of Energy
Office of Fissile Materials Disposition

December 1996

FOREWORD

This Summary of the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (PEIS) contains revisions and changes from the Draft PEIS Summary in response to comments, and information regarding the Department's Preferred Alternative. The Draft PEIS Summary has also been reorganized to provide a clear description of the environmental impacts of the Preferred Alternative and the comparison of storage and disposition alternatives including the Preferred Alternative.

The bar charts used in the Draft PEIS Summary to show impacts of various resources have been removed and replaced with narrative descriptions including pertinent data. New sections have been added to present the environmental impacts and cumulative impacts of the Preferred Alternative. Finally, a summary of major issues identified during the comment period and changes to the Draft PEIS is provided. Changes to the Draft PEIS Summary are denoted by sidebars (vertical lines adjacent to the text) in this Final PEIS Summary to facilitate review by the reader.

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LIST OF ACRONYMS AND ABBREVIATIONS

ANL-W	Argonne National Laboratory-West
APSF	Actinide Packaging and Storage Facility
ARIES	Advanced Recovery and Integrated Extraction System
BWR	boiling water reactor
CANDU	Canadian Deuterium Uranium
DNFSB	Defense Nuclear Facilities Safety Board
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DWPF	Defense Waste Processing Facility
EIS	environmental impact statement
ESA	*Endangered Species Act*
ES&H	environmental, safety, and health
FFTF	Fast Flux Test Facility
FMF	Fuel Manufacturing Facility
FONSI	Finding of No Significant Impact
GBZ	glass-bonded zeolite
Hanford	Hanford Site
HEU	highly enriched uranium
HEU EIS	*Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement*
HLW	high-level waste
ICPP	Idaho Chemical Processing Plant
IMNM EIS	*Environmental Impact Statement, Interim Management of Nuclear Materials*
INEL	Idaho National Engineering Laboratory
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LWR	light water reactor
MEI	maximally exposed individual
MOX	mixed oxide
NEPA	*National Environmental Policy Act* of 1969
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System

NRHP	National Register of Historic Places
NTS	Nevada Test Site
NWPA	*Nuclear Waste Policy Act*
ORR	Oak Ridge Reservation
Pantex	Pantex Plant
PEIS	programmatic environmental impact statement
PFP	Plutonium Finishing Plant
PRA	Probabilistic Risk Assessment
PSD	Prevention of Significant Deterioration
PWR	pressurized water reactor
R&D	Research and Development
RCRA	*Resource Conservation and Recovery Act*
REA	regional economic area
RFETS	Rocky Flats Environmental Technology Site
ROD	Record of Decision
ROI	region of influence
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SRS	Savannah River Site
Stockpile Stewardship and Management PEIS	*Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*
Storage and Disposition PEIS	*Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*
TRU	transuranic
TSP	total suspended particulates
TSR PEIS	*Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling*
VRM	Visual Resource Management
WIPP	Waste Isolation Pilot Plant
WSA	Weapons Storage Area
Y–12	Y–12 Plant
Y–12 EA	*Environmental Assessment for the Proposed Interim Storage of Highly Enriched Uranium Above the Maximum Historical Storage Level at the Y-12 Plant*
ZPPR	Zero Power Physics Reactor

CHEMICALS AND UNITS OF MEASURE

cm	centimeter
Cs	cesium
Cs-137	cesium-137
CsCl	cesium chloride
gal	gallon
ha	hectare
H_2O	hydrogen oxide, or (light) water
in	inch
kg	kilogram
km	kilometer
l	liter
lb	pound
m^3	cubic meter
mi	mile
MLY	million liters per year
mrem	millirems
PM_{10}	particulate matter less than or equal to 10 microns in diameter
Pu	plutonium
Pu-238	plutonium-238
Pu-242	plutonium-242
PuO_2	plutonium dioxide
t	metric ton
tons	short tons
UO_2	uranium dioxide
yd^3	cubic yards
yr	year

METRIC CONVERSION CHART

To Convert Into Metric			To Convert Out of Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor
exa-	E	1 000 000 000 000 000 000 = 10^{18}
peta-	P	1 000 000 000 000 000 = 10^{15}
tera-	T	1 000 000 000 000 = 10^{12}
giga-	G	1 000 000 000 = 10^{9}
mega-	M	1 000 000 = 10^{6}
kilo-	k	1 000 = 10^{3}
hecto-	h	100 = 10^{2}
deka-	da	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	μ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}
femto-	f	0.000 000 000 000 001 = 10^{-15}
atto-	a	0.000 000 000 000 000 001 = 10^{-18}

Summary

S.1 INTRODUCTION

The end of the Cold War created a legacy of weapons-usable fissile materials both in the United States and the former Soviet Union. Substantial quantities of these materials, including plutonium (Pu) and highly enriched uranium (HEU), are no longer needed for defense purposes. Further agreements on disarmament between the United States and Russia may increase the surplus quantities of these materials. The global stockpiles of weapons-usable fissile materials pose a danger to national and international security in the form of potential proliferation of nuclear weapons and potential environmental, safety, and health consequences if the materials are not properly safeguarded and managed.

In September 1993, President Clinton issued the *Nonproliferation and Export Control Policy* in response to the growing threat of nuclear weapons proliferation. Further, in January 1994, President Clinton and Russia's President Yeltsin issued a *Joint Statement Between the United States and Russia on Nonproliferation of Weapons of Mass Destruction and Means of their Delivery*. In accordance with these policies, the focus of the U.S. nonproliferation efforts in this regard is five-fold: to secure nuclear materials in the former Soviet Union; to ensure safe, secure, long-term storage and disposition of surplus fissile materials; to establish transparent and irreversible nuclear reductions; to strengthen the nuclear nonproliferation regime; and to control nuclear exports.

To demonstrate the U.S. commitment to these objectives, the President announced on March 1, 1995, that 200 metric tons (t) (220 short tons [tons]) of U.S. fissile materials, 38.2 t (42.1 tons) of which is weapons-grade Pu (as stated in the Department of Energy's [DOE's] Openness Initiative of February 6, 1996), had been declared surplus to the U.S. nuclear defense needs. The United States is proceeding with plans and actions to ensure the continued safe, secure, and environmentally sound storage of its own weapons-usable fissile materials and is cooperating with Russia in an effort to reduce the risk of nuclear weapons proliferation. Additionally, DOE and its national laboratories have recently completed a joint study with Russia on technical options for the disposition of weapons-usable Pu.

Weapons-Usable Fissile Materials
(Covered in the Programmatic Environmental Impact Statement)

All isotopes of Pu (except plutonium-238 [Pu-238]) and HEU that contain at least 20 percent uranium-235.[1]

A key element of DOE's decisionmaking is a thorough understanding of the environmental impacts that may occur during the implementation of the proposed action. The *National Environmental Policy Act* of 1969 (NEPA), as amended, requires Federal agencies to prepare an environmental impact statement (EIS) on all major Federal actions significantly affecting the quality of the human environment. In following this process, DOE has prepared the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (Storage and Disposition PEIS) to analyze various storage and disposition alternatives and to provide the necessary background, data, and analyses to help decisionmakers and the public understand the potential environmental impacts of each alternative. The results of the environmental analyses, together with information from technical and economic studies, nonproliferation analysis, and public input, will form the basis for DOE's decisions, which will be given in a Record of Decision (ROD) to be issued no sooner than

[1] Does not include spent nuclear fuel, irradiated targets, uranium-233, or Department of Defense (DoD) weapons program material in use.

30 days after publication of the Environmental Protection Agency's Notice of Availability of the Final PEIS. This process will also provide the United States with the basis and flexibility to implement Pu disposition efforts either multilaterally or bilaterally through negotiations or unilaterally as an example to Russia and other nations.

THE PROPOSED ACTION

The Department proposes to take the following actions for U.S. weapons-usable fissile materials:

- Storage—provide a long-term storage system (for up to 50 years) for nonsurplus Pu and HEU that meets the Stored Weapons Standard[2] and applicable environmental, safety, and health standards while reducing storage and infrastructure[3] costs

> *Stored Weapons Standard*
>
> The high standards of security and accounting for the storage of intact nuclear weapons should be maintained, to the extent practical, for weapons-usable fissile materials throughout dismantlement, storage, and disposition.

- Storage Pending Disposition—provide storage that meets the Stored Weapons Standard for inventories of weapons-usable Pu and HEU[4] that have been or may be declared surplus
- Disposition[5]—convert surplus Pu and Pu that may be declared surplus in the future to forms that meet the Spent Fuel Standard,[2] thereby providing evidence of irreversible disarmament and setting a model for proliferation resistance

> *Spent Fuel Standard*
>
> The surplus weapons-usable Pu should be made as inaccessible and unattractive for weapons use as the much larger and growing quantity of Pu that exists in spent nuclear fuel from commercial power reactors.

The Department's inventories of Pu and HEU are located at a number of DOE sites, including Hanford Site (Hanford), Idaho National Engineering Laboratory (INEL), Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), Oak Ridge Reservation (ORR), Pantex Plant (Pantex), Rocky Flats Environmental Technology Site (RFETS), and Savannah River Site (SRS). These weapons-usable fissile materials are divided into two categories: surplus and nonsurplus. Surplus materials include those the President

---

[2] Modified from *Management and Disposition of Excess Weapons Plutonium*, National Academy of Sciences, 1994.

[3] Includes electrical power, fuel, transportation network requirements, and safeguards/security.

[4] The Storage and Disposition PEIS covers long-term storage of nonsurplus HEU and storage of surplus HEU pending disposition. Until storage decisions are implemented, surplus HEU that has not gone to disposition will continue to be stored pursuant to, and not to exceed the 10-year interim storage time period evaluated in the *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y-12 Plant, Oak Ridge, Tennessee* (Y-12 EA) (DOE/EA-0929, September 1994) and Finding of No Significant Impact (FONSI).

[5] Disposition of surplus HEU is addressed in a separate document, the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE/EIS-0240, June 1996).

has declared surplus to national defense needs in response to recommendations from the Nuclear Weapons Council (made up of representatives from DOE, the DoD, and the Joint Chiefs of Staff) and those that may be declared surplus in the future. The nonsurplus materials include naval nuclear fuel, strategic reserves, programmatic materials (non-weapons research and development [R&D], weapons R&D, and other programmatic materials), and weapons program materials in use, as shown in Figure S.1–1. Weapons program materials in use are not within the scope of the PEIS. The forms of the weapons-usable fissile materials are primarily pits and secondaries (weapons components bearing Pu and HEU, respectively) and metals and oxides of Pu and HEU.

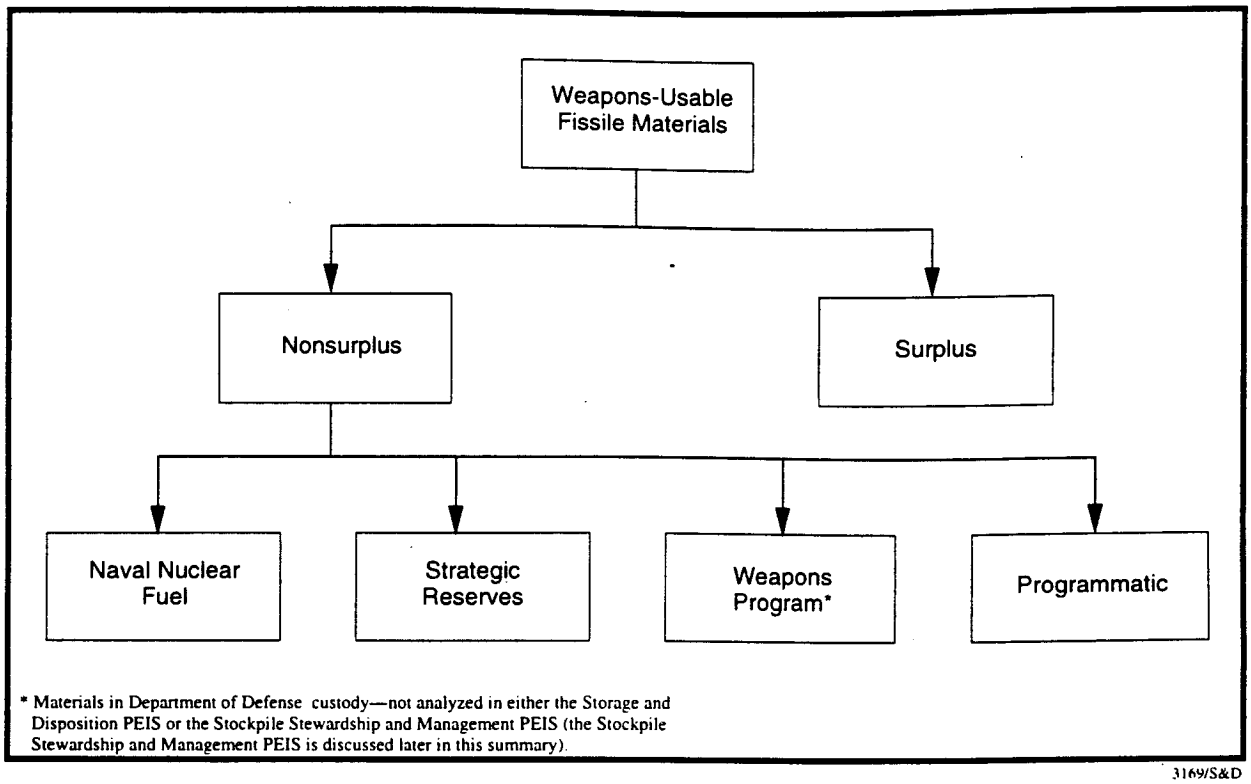

Figure S.1–1. Weapons-Usable Fissile Material Categories.

PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The purpose of the proposed action is to implement the President's *Nonproliferation and Export Control Policy* in a safe, reliable, cost-effective, and timely manner. DOE is proposing a comprehensive program to accomplish this purpose by providing an exemplary long-term storage system for weapons-usable fissile materials, eliminating the stockpile of surplus weapons-usable Pu, and establishing the technical and program infrastructure that will provide for disposition of the surplus weapons-usable Pu in the United States.

The weapons-usable fissile materials declared surplus by the President (March 1995) are in various compositions and forms. A storage plan is needed to provide continued adequate control of these surplus materials and any that may be declared surplus in the future, from now through final disposition, as well as management and long-term storage of nonsurplus fissile materials that will not be subject to disposition. Approximately 89 t (98 tons) of Pu (reported in DOE's Openness Initiative on December 7, 1993) and 994 t (1,095 tons) of HEU (reported in DOE's Openness Initiative on June 29, 1994) were produced by the United States during the period its production facilities were in operation. Some of these materials have been used in weapons or for other programmatic purposes, some of the remainder have been declared surplus, and additional materials could be declared surplus in the future. Disposition of surplus Pu is needed to reduce reliance on

institutional controls and to provide visible evidence of irreversible disarmament. Therefore, a comprehensive long-term storage and disposition action is needed to ensure that weapons-usable fissile materials are properly managed and to prevent the potential increase of environmental, safety, and health risks. DOE also recognizes the need to strengthen national and international arms control efforts by providing a storage and disposition model for the international community. This action will enhance U.S. credibility and flexibility in negotiations on bilateral or multilateral reductions of surplus weapons-usable fissile material inventories.

SCOPE OF THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

The Storage and Disposition PEIS analyzes the direct, indirect, and cumulative environmental effects of reasonable alternatives for the long-term storage of nonsurplus Pu and HEU, the storage of surplus Pu and HEU pending disposition, and the disposition of surplus Pu. A separate DOE document, *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (HEU EIS), addresses the disposition of surplus HEU. The HEU EIS (DOE/EIS-0240) was issued in June 1996, and the ROD published on August 5, 1996.

The Storage and Disposition PEIS includes analyses of storing 89 t (98 tons) of Pu and 994 t (1,093 tons) of HEU (reported in DOE's Openness Initiative referenced above). The PEIS also analyzes the disposition of a nominal 50 t (55.1 tons) of Pu, including the 38.2 t (42.1 tons) of Pu that has been declared surplus as well as Pu that may be declared surplus in the future (although the exact quantity of Pu that may be declared surplus is not known at this time). The locations of the surplus material in the DOE complex are shown in Figures S.1–2 and S.1–3.

The Storage and Disposition PEIS assumes that the weapons-usable fissile material is in a stabilized form; the PEIS begins, as a starting point, after stabilization has been completed. DOE is currently in the process of stabilizing and repackaging weapons-usable fissile materials and placing them in safe, secure storage awaiting decisions on long-term storage and disposition. For Pu, this is being accomplished in accordance with the corrective actions identified in DOE's *Plutonium Vulnerability Management Plan* (DOE/EM-0199). This plan was developed in response to an assessment in DOE's *Plutonium Working Group Report* (DOE/EH-0415) and recommendations by the Defense Nuclear Facilities Safety Board (DNFSB) in DNFSB Recommendation 94-1. In addition, Pu materials will also meet the *Criteria for Safe Storage of Plutonium Metals and Oxides* (DOE-STD-3013-94), a DOE standard for long-term storage (at least 50 years) of these materials. Similarly, the HEU materials requiring long-term storage will meet criteria for safe storage of HEU metals and oxides; these criteria are under development at this time. Appropriate environmental documentation will be prepared, as necessary, for stabilizing and repackaging the Pu and HEU materials to meet respective long-term storage criteria.

Following the discontinuance of nuclear weapons material production, large quantities of residues remained as a result of the chemical and thermal processes used to separate and purify Pu. Examples of residue forms include some impure oxides and metals, halide salts, combustibles, ash, sludges, and contaminated glass. To meet requirements of DOE's *Plutonium Vulnerability Management Plan,* as well as various compliance agreements with State and local regulatory agencies, some Pu residues must be stabilized. As a result of the stabilization process, portions of the residues will potentially be concentrated and stored. These concentrates may be in a form and concentration (greater than 50 percent Pu by weight) that is weapons-usable and are therefore included in the PEIS.[6]

The Storage and Disposition PEIS pertains to weapons-usable fissile materials that meet all of the standards and criteria previously described. Fissile materials present in spent nuclear fuel or irradiated targets from reactors

[6] As a result of the stabilization process, there will also be non-weapons-usable Pu or HEU contaminated wastes or residues (less than 50 percent Pu by weight) that would not be within the scope of the PEIS. On November 19, 1996, DOE announced its intention to prepare an EIS on the *Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* (61 FR 58866). This EIS will evaluate the potential environmental impacts associated with reasonable management alternatives for certain Pu residues and all scrub alloy currently stored at RFETS.

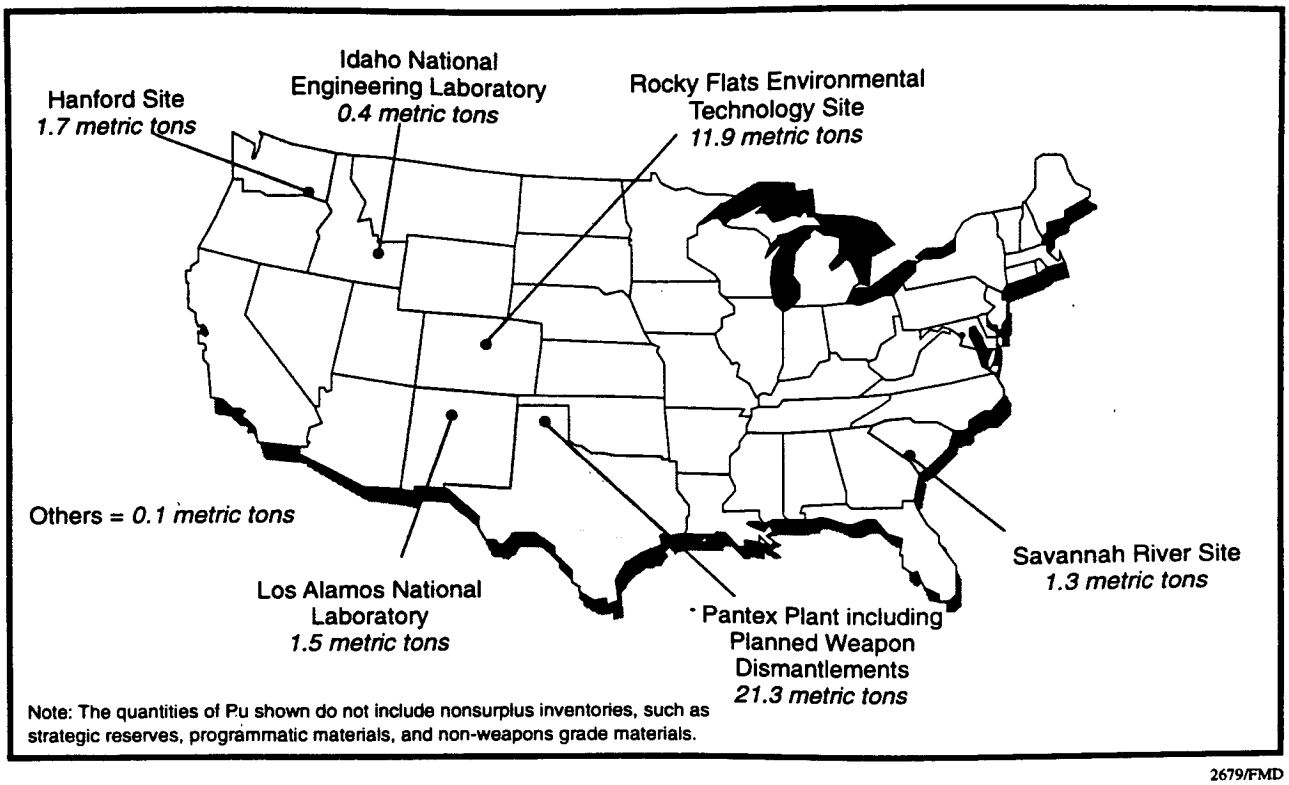

Figure S.1–2. Department of Energy Locations With Surplus Weapons-Grade Plutonium Inventories in September 1994.

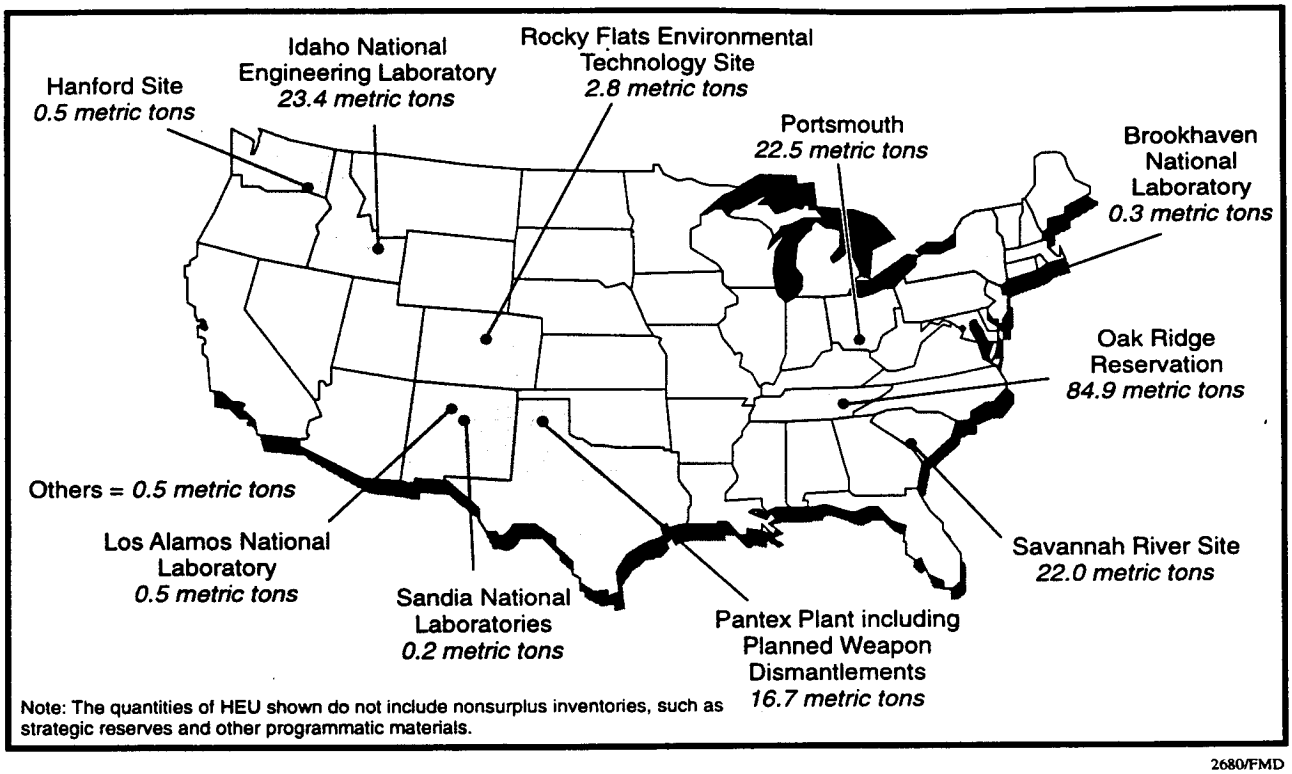

Figure S.1–3. Department of Energy Locations With Surplus Highly Enriched Uranium Inventories on February 6, 1996.

are not covered in the PEIS; they are not considered weapons-usable because separation of the relevant isotopes from these highly radioactive materials requires significant remote chemical processing. Reprocessing and extraction of Pu from spent fuel is not proposed, and is beyond the scope and the fundamental nonproliferation purpose of the program covered by the PEIS.

DECISIONS TO BE MADE

The Storage and Disposition Draft PEIS was circulated for public review and comment from March 8 through June 7, 1996. Eight public meetings in the vicinity of DOE sites under consideration for the Proposed Action, and in Washington, DC, were held during the comment period. Approximately 8,700 comments were received from other Federal government agencies, State and local governments, Native American tribes, special interest groups, and the public. These comments, along with DOE's responses, became a part of the Final PEIS. DOE also made available for public review, the results of the technical, cost and schedule analyses in July and October 1996, as well as the nonproliferation analysis in November 1996. Along with the PEIS, these analyses will support a formal ROD regarding Pu and HEU storage and surplus Pu disposition. [Text deleted.] These decisions are as follows:

For storage:

- The strategy for long-term storage of nonsurplus weapons-usable Pu and nonsurplus HEU
- The strategy for storage of surplus Pu and surplus HEU pending disposition
- The storage site(s) and (if appropriate) facilities

For disposition:

- The strategy and technologies for disposition of surplus weapons-usable Pu

The Department, with interagency coordination, will then issue the ROD. Following the ROD, subsequent tiered and project-specific NEPA documents will be prepared. The tiered NEPA reviews will analyze alternative locations for disposition activities.

Plutonium Immobilization

A process that converts Pu to a chemically stable form for disposition. The forms analyzed in the PEIS include glass (through vitrification), ceramic (through ceramic immobilization), and glass-bonded zeolite (through electrometallurgical treatment).

Mixed Oxide Fuel

A blend of uranium dioxide [UO_2] and plutonium dioxide [PuO_2] that produces a fuel suitable for use in a nuclear reactor to generate electric power.

Light Water Reactor

A nuclear reactor in which circulating water consisting of light water (hydrogen oxide [H_2O]) is used to cool the reactor core and reduce the energy of neutrons created in the core by fission reactions. All commercial reactors in the United States are LWRs.

Canadian Deuterium Uranium Reactor

A Canadian nuclear reactor in which the circulating water consists of heavy water (deuterium oxide). Deuterium is an isotope of hydrogen having twice the mass of hydrogen. All commercial reactors in Canada are heavy water reactors.

S.2 PREFERRED ALTERNATIVE

STORAGE

The Department's Preferred Alternative for storage is to reduce, over time, the number of locations where the various forms of Pu are stored, through a combination of storage alternatives in conjunction with a combination of disposition alternatives. DOE would begin implementing this Preferred Alternative by moving surplus Pu from RFETS as soon as possible, transporting the pits to Pantex as early as 1997, and the non-pit Pu materials to SRS beginning in 2002. Over time, DOE would store Pu in upgraded facilities at Pantex and in an expanded, planned new facility at SRS, and store nonsurplus HEU and surplus HEU pending disposition in upgraded and consolidated facilities at ORR. Storage facilities would also be modified, as needed, to accommodate international inspection requirements consistent with the President's *Nonproliferation and Export Control Policy*. Accordingly, DOE's Preferred Alternative for storage would call for the following actions:

- **Phase out storage of all weapons-usable Pu at RFETS beginning in 1997; move pits to Pantex, and non-pit materials to SRS.** At Pantex, DOE would repackage pits from RFETS in Zone 12, then place them in existing storage facilities in Zone 4, pending completion of facility upgrades in Zone 12. At SRS, DOE would expand the planned new Actinide Packaging and Storage Facility (APSF), and move non-pit Pu materials from RFETS, after stabilization at RFETS, to the expanded APSF upon completion. The small number of pits currently at RFETS that are not in shippable form would be placed in a shippable condition in accordance with existing procedures prior to shipment to Pantex. Additionally, some pits and non-pit Pu materials from RFETS could be used at SRS, LANL, and LLNL for tests and demonstrations of aspects of disposition technologies (see Preferred Alternative for disposition as discussed later in this section). All non-pit weapons-usable Pu materials currently stored at RFETS are surplus.

- **Upgrade storage facilities at Zone 12 South (to be completed by 2004) at Pantex to store those pits currently stored at Pantex, and pits from RFETS, pending disposition. Storage facilities at Zone 4 would continue to be used for these pits prior to completion of the upgrade.** This action would place pits at a central location where most pits already reside and where expertise and infrastructure exist to accommodate pit storage.

- **In accordance with the Preferred Alternative in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (Stockpile Stewardship and Management PEIS), store Strategic Reserve pits at Pantex in the facilities discussed above. To the extent not reflected above, store Strategic Reserve materials in accordance with the Preferred Alternative in the Stockpile Stewardship and Management PEIS.**

- **Expand the APSF (Upgrade Alternative) at SRS to store those surplus, non-pit Pu materials currently at SRS and surplus non-pit Pu materials from RFETS, pending disposition** (see Preferred Alternative for disposition as discussed later in this section). The APSF would be built by 2001 pursuant to the *Final Environmental Impact Statement, Interim Management of Nuclear Materials* (IMNM EIS) (DOE/EIS-0220) and ROD, and the expansion to accommodate RFETS material would be completed by 2002. The RFETS surplus non-pit Pu materials would be moved to SRS after stabilization is performed at RFETS under corrective actions in response to recommendation 94-1 by the DNFSB, and after completion of the APSF expansion. This action would place non-pit Pu materials in a new storage facility, in a location with existing expertise and Pu handling capabilities and where potential disposition activities could occur (see Preferred Alternative for disposition as discussed later in this section). Strategic pits currently located at SRS would be stored in accordance with the Preferred Alternative in the Stockpile Stewardship and Management PEIS. There are no strategic non-pit materials currently located at SRS.

- **Continue current storage (No Action) of surplus Pu at Hanford and INEL, pending disposition** (or movement to lag storage[7] at the disposition facilities). This action would allow surplus Pu to remain at the sites with existing expertise and Pu handling capabilities, and where potential disposition activities could occur (see Preferred Alternative for disposition as discussed later in this section). There are no nonsurplus weapons-usable Pu materials currently stored at either site.

- **Continue current storage (No Action) of surplus Pu at LANL, pending disposition** (or movement to lag storage at the disposition facilities). This Pu would be stored in stabilized form with the nonsurplus Pu in the upgraded Nuclear Material Storage Facility pursuant to the No Action Alternative for the site.

- **Take No Action at the Nevada Test Site (NTS).** DOE would not add Pu to sites that do not currently have Pu in storage.

- **Upgrade storage facilities at the Y–12 Plant (Y–12) (to be completed by 2004, or earlier) at ORR to store nonsurplus HEU and surplus HEU pending disposition.** Existing storage facilities at Y–12 would be modified to meet natural phenomena requirements, as documented in *Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities* (Y/EN-5080, 1994). Storage facilities would be consolidated and the storage footprint would be reduced as surplus HEU is dispositioned and blended to low-enriched uranium, pursuant to the HEU EIS. Consistent with the Preferred Alternative in the Stockpile Stewardship and Management PEIS, HEU strategic reserves would be stored at the Y–12 Plant.

DISPOSITION

The Department's Preferred Alternative for the disposition of surplus Pu is to pursue a disposition strategy that allows for immobilization of surplus weapons Pu in glass or ceramic forms and burning of the surplus Pu as mixed oxide (MOX) fuel in existing reactors. The disposition of the surplus Pu using these technological approaches would depend on the results of future technology development and demonstrations, site-specific environmental analyses, and detailed cost proposals as well as nonproliferation considerations. The results of

[7] Lag storage is temporary storage at the applicable disposition facility.

these efforts and negotiations with Russia and other nations will ultimately determine the timing and extent to which either or both technologies are deployed.[8]

Under this Preferred Alternative, the U.S. policy not to encourage the civil use of Pu and, accordingly, not to itself engage in Pu reprocessing for either nuclear power or nuclear explosive purposes will not change. Although under the Preferred Alternative some Pu may ultimately be burned in existing reactors, every possible means will be pursued to ensure that Federal support for this unique disposition mission does not encourage other civil uses of Pu or Pu reprocessing. The United States, however, will maintain its commitments regarding the use of Pu in civil nuclear programs in Western Europe and Japan.

Proceeding with this strategy would provide increased flexibility to initiate Pu disposition promptly, and help assure disposition efforts could be accomplished in a timely manner. Establishing the means for expeditious Pu disposition would also help provide the basis for an international cooperative effort that can result in reciprocal, irreversible Pu disposition actions by Russia. DOE's preferred disposition strategy signals a strong U.S. commitment to reducing its stockpile of surplus Pu, thereby effectively meeting the purpose of and need for the Proposed Action.

To accomplish the Pu disposition mission, DOE would consider, to the extent practical, new as well as modified existing buildings and facilities for portions of the disposition activities. The PEIS analyzes new facilities for most disposition alternatives to obtain bounding environmental impacts. DOE would analyze and compare existing and new buildings and facilities for the technologies chosen as part of this strategy in subsequent, tiered NEPA review. In addition, all disposition facilities would be designed or modified, as needed, to accommodate international inspection requirements consistent with the President's *Nonproliferation and Export Control Policy*. Accordingly, DOE's Preferred Alternative for Pu disposition involves the following strategy and supporting actions:

- **Immobilize Pu materials using vitrification or ceramic immobilization.** The immobilization technology could be used for processing pure or impure forms of Pu. Vitrification or ceramic immobilization could include the can-in-canister variant, which could utilize the existing high-level wastes (HLW) and the Defense Waste Processing Facility (DWPF) at SRS, or new facilities at Hanford or SRS. DOE would continue the R&D leading to the demonstration of the can-in-canister variant at the DWPF using surplus Pu.

- **Convert Pu materials into MOX fuel for use in existing reactors.** Pure materials including pits, pure metal, and oxides could be converted without extensive processing into MOX fuel for use in existing commercial reactors. Other, already separated forms of surplus Pu would require additional cleanup (not reprocessing of spent nuclear fuel). The MOX fuel would be used in existing light water reactors (LWRs) with a once-through fuel cycle, with no reprocessing and subsequent reuse of the spent fuel. If partially completed LWRs were to be completed by other parties, they would be considered for this mission. The MOX fuel would be fabricated in a domestic, government-owned facility at a DOE site.

  The Department would retain using MOX fuel in Canadian Deuterium Uranium (CANDU) reactors in Canada in the event that a multilateral agreement to use CANDU reactors is negotiated among Russia, Canada, and the United States. DOE would engage in a test and demonstration for CANDU MOX fuel as appropriate and consistent with future cooperative efforts with Russia and Canada.

With regard to the above, for purposes of analysis of an approach involving a combination of both technologies, approximately 70 percent of the surplus Pu was identified to be in forms (metals and other pure forms) suitable

[8] Through these efforts, the President would be provided the basis and flexibility to initiate disposition efforts either multilaterally or bilaterally through negotiations or unilaterally as an example to Russia and other nations.

for MOX fuel. The actual percentage and timing for disposition of the surplus Pu using either or a combination of both of the technological approaches would depend on the results of international agreements, future technology development and demonstrations, site-specific environmental assessments, and detailed cost proposals to be completed within the next 2 years. The results of these efforts, as well as nonproliferation considerations and negotiations with Russia and other nations, will ultimately determine the timing and extent to which either or both technologies are deployed for disposition of surplus Pu. In the event both technologies are deployed, and because the time required for Pu disposition using reactors would be longer than that for immobilization, it is probable that some surplus Pu would be immobilized initially, prior to completion of reactor irradiation for other surplus Pu. Deployment of this strategy would involve the following supporting actions:

- **Constructing and operating a Pu vitrification or ceramic immobilization facility at either Hanford or SRS.** DOE would analyze alternative locations at these two sites for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review. SRS has existing facilities and infrastructure to support an immobilization mission, and Hanford has existing plans for constructing and operating immobilization facilities for the wastes in Hanford tanks. DOE would not create new infrastructure for immobilizing Pu with HLW or cesium (Cs) at INEL, NTS, ORR, or Pantex.

- **Constructing and operating a Pu conversion facility[9] at either Hanford or SRS.** DOE would collocate the Pu conversion facility with the vitrification or ceramic immobilization facility discussed above. In subsequent, tiered NEPA reviews, DOE would analyze alternative locations at Hanford and SRS, for constructing new or potentially using modified existing buildings.

- **Constructing and operating a pit disassembly/conversion facility[10] at Hanford, INEL, Pantex, or SRS.** DOE would not add Pu to sites that do not currently have Pu in storage. Therefore, two sites analyzed in the PEIS, NTS and ORR, would not be considered further for Pu disposition activities. DOE would analyze alternative locations at Hanford, INEL, Pantex, and SRS for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review. DOE would demonstrate the Advanced Recovery and Integrated Extraction System (ARIES) concept at LANL for pit disassembly/conversion beginning in fiscal year 1997.

- **Constructing and operating a domestic, government-owned, MOX fuel fabrication facility at Hanford, INEL, Pantex, or SRS.** DOE would not add Pu to sites that do not currently have Pu in storage. Therefore, two sites analyzed in the PEIS, NTS and ORR, would not be considered further for Pu disposition activities. The MOX fuel fabrication facility would serve only the finite mission of fabricating MOX fuel using surplus Pu for the purpose of Pu disposition. DOE would analyze alternative locations at Hanford, INEL, Pantex, and SRS, for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review.

Depending upon decisions in the ROD and pursuant to appropriate NEPA review(s), DOE would continue R&D and engage in further testing and demonstrations of Pu disposition technologies which may include: dissolution of small quantities of Pu in both glass and ceramic formulation; experiments with immobilization equipment and systems; fabrication of MOX fuel pellets for demonstrations of reactor irradiation at INEL; mechanical milling and mixing of Pu and feed forms; and testing of shipping and storage containers for certification, in addition to the testing and demonstrations previously described for the can-in-canister immobilization variant

[9] The Pu conversion facility would convert surplus non-pit Pu material (using a wet chemical process) into a metal or oxide form suitable for use at the next facility in the disposition process.

[10] The pit disassembly/conversion facility would dissemble, reshape, and convert surplus Pu pits (using a dry chemical process) into an unclassified metal or oxide form suitable for use at the next facility in the disposition process. In addition, some non-pit Pu material may also be processed in this facility.

and the ARIES. These tests and demonstrations would slightly reduce the quantity of RFETS pit and non-pit materials to be stored at Pantex and SRS, respectively.

The storage and disposition actions proposed for various DOE sites by the Preferred Alternative are summarized in Table S.2–1.

Table S.2–1. Storage and Disposition Actions Proposed by the Preferred Alternative

Action	Hanford	NTS	INEL	Pantex	ORR	SRS	RFETS	LANL
Storage								
No Action	X[a]	X[b]	X[a]					X[a]
Upgrade				X[c]	X[d]	X[e]		
Phaseout							X	
Disposition[f]								
Pit Disassembly/Conversion	X		X	X		X		
MOX Fuel Fabrication	X		X	X		X		
Pu Conversion	X					X		
Immobilization	X					X		

[a] Pending subsequent tiered NEPA decisions for disposition of surplus Pu.
[b] NTS does not currently store either Pu or HEU.
[c] For storage of those pits currently at Pantex and pits from RFETS.
[d] For storage of HEU only.
[e] For storage of only those Pu materials currently at SRS and non-pit Pu materials from RFETS.
[f] "X" denotes potential sites for locating the disposition facilities pending subsequent tiered NEPA decisions. Only one of each facility is needed for accomplishing the disposition mission.

S.3 DEVELOPMENT OF ALTERNATIVES

The Storage and Disposition PEIS analyzes a number of reasonable alternatives for storage and disposition in addition to the No Action Alternative. DOE used a screening process along with public input to identify a range of reasonable alternatives for the storage and disposition of weapons-usable fissile materials. The process was conducted by a screening committee that consisted of experts from DOE assisted by technical advisors from DOE's national laboratories and other support staff. The committee was responsible for identifying the reasonable alternatives to be evaluated. It compared alternatives against screening criteria, considered input from the public, and used technical reports and analyses from the national laboratories and industry to develop a final list of alternatives.

The first step in the screening process was to develop criteria against which to judge potential alternatives. The criteria were developed for the screening process based on the President's *Nonproliferation and Export Control Policy* of September 1993, the *Joint Statement Between the United States and Russia on Nonproliferation of Weapons of Mass Destruction and the Means of Their Delivery* of January 1994, and the analytical framework established by the National Academy of Sciences in its 1994 report, *Management and Disposition of Excess Weapons Plutonium*. The criteria include resistance to theft and diversion; resistance to retrieval and reuse; impact to environment, safety, and health (ES&H); public and institutional acceptance; timeliness and technological viability; cost-effectiveness; international cooperation; and additional benefits. The criteria were discussed at the public scoping workshops, and participants were invited to comment further using questionnaires. The questionnaires allowed participants to rank criteria based on relative importance, comment on the appropriateness of the criteria, and suggest new criteria. Details on how the screening process was developed and applied, and the results obtained from the process, were published in a separate report, the *Summary Report of the Screening Process* (DOE/MD-0002, March 1995). Figures S.3–1 and S.3–2 show the results of the screening process for the long-term storage and the disposition options, respectively, including the

options that were selected as reasonable alternatives for analysis in the PEIS, the options that were disqualified and eliminated, and the reasons for disqualification and elimination (given in parentheses).[11]

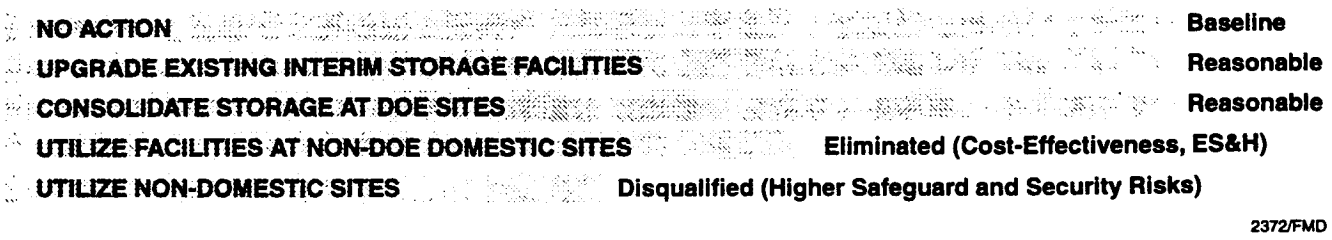

Figure S.3–1. Results of the Screening Process—Long-Term Storage Options.

Development of Long-Term Storage Alternatives

For storage, DOE began with five potential alternatives (see Figure S.3–1), including the No Action Alternative. The screening process identified two action alternatives as reasonable: (1) upgrade storage facilities and (2) consolidate storage at DOE sites. The second alternative was later refined and converted into two alternatives: consolidate Pu storage at one site (while HEU storage remains at ORR), and collocation of Pu and HEU storage at one site. [Text deleted.] Subalternatives and options were also added (see discussions in next section). In addition, the Preferred Alternative for storage (discussed previously) was developed and reflects a combination of the Upgrade Alternative, sub-options, and the No Action Alternative.

To select candidate sites for long-term storage, DOE used a separate set of siting criteria consistent with those used in the evaluation of sites for reconfiguration of the Nuclear Weapons Complex in February 1991. The siting criteria included population; ES&H; socioeconomics; transportation; and site availability and flexibility. The process resulted in six candidate storage sites: Hanford, NTS, INEL, Pantex, ORR, and SRS.

Development of Long-Term Storage Subalternatives

With the exception of weapons program materials in use, the Storage and Disposition PEIS analyzes the environmental impacts of reasonable alternatives for long-term storage of all surplus and nonsurplus weapons-usable fissile material categories (see Figure S.1–1). In DOE's Stockpile Stewardship and Management PEIS, a portion of the nonsurplus weapons-usable fissile materials, namely the strategic reserve materials and the plutonium-242 (Pu-242) materials used for weapons R&D, is analyzed for long-term storage. The Preferred Alternative in the Stockpile Stewardship and Management PEIS is to move Pu-242 currently stored at SRS to LANL for long-term storage. The Storage and Disposition PEIS includes a subalternative analyzing the environmental effects of each long-term storage alternative without the strategic reserve materials and weapons R&D materials.[12] Preparation of these two documents is being closely coordinated to ensure that all necessary information is available to the decisionmaker. Preferred alternatives are being presented to the Secretary of Energy on both PEISs for the Secretary's decisions and the publication of the RODs.

Because of the cleanup agreement for RFETS, the proximity of RFETS to the Denver metropolitan area, and the fact that three out of the five most vulnerable facilities identified in DOE's *Plutonium Working Group Report on Environmental, Safety, and Health Vulnerabilities Associated With the Department's Plutonium Storage* (DOE/EH-0415, November 1994) are located at the site, RFETS is considered as a storage site only under the

[11] Following issuance of the screening report, two changes were made during subsequent meetings of the screening committee; that is, options I6 (glass material oxidation/dissolution system) and R1 (Euratom MOX fuel fabrication/reactor burning) were eliminated.

[12] The Storage and Disposition PEIS also analyzes the "umbrella" option, for each storage alternative, of storing strategic reserves and weapons R&D material together with other nonsurplus material.

STORAGE OPTIONS		
S1	NO DISPOSITION ACTION (CONTINUED STORAGE)	Baseline
S2	RADIATION BARRIER ALLOY (STORAGE)	Eliminated (Open-Ended, ES&H)
DIRECT DISPOSAL OPTIONS		
D1	DIRECT EMPLACEMENT IN HLW REPOSITORY	Disqualified (Retrievability, Timeliness)
D2	DEEP BOREHOLE (IMMOBILIZATION)	Reasonable
D3	DEEP BOREHOLE (DIRECT EMPLACEMENT)	Reasonable
D4	DISCARD TO WASTE ISOLATION PILOT PLANT	Disqualified (Capacity)
D5	HYDRAULIC FRACTURING	Disqualified (Technical Viability)
D6	DEEP WELL INJECTION	Disqualified (ES&H)
D7	INJECTION INTO CONTINENTAL MAGMA	Eliminated (Technical Viability, ES&H)
D8	MELTING IN CRYSTALLINE ROCK	Disqualified (Technical Viability)
D9	DISPOSAL UNDER ICE CAPS	Disqualified (Technical Viability, ES&H)
D10	SEABED (PLACEMENT ON OCEAN FLOOR)	Disqualified (ES&H)
D11	SUB-SEABED EMPLACEMENT	Eliminated (Technical Viability)
D12	OCEAN DILUTION	Disqualified (ES&H)
D13	DEEP SPACE LAUNCH	Eliminated (Retrievability, ES&H)
IMMOBILIZATION OPTIONS (WITH RADIONUCLIDES)		
I1	UNDERGROUND NUCLEAR DETONATION	Disqualified (ES&H, Licensing/Regulatory)
I2	BOROSILICATE GLASS IMMOBILIZATION (RETROFITTED DWPF)	Eliminated[a]
I3	VITRIFICATION (BOROSICLICATE GLASS IMMOBILIZATION [NEW FACILITY])	Reasonable
I4	CERAMIC IMMOBILIZATION	Reasonable
I5	ELECTROMETALLURGICAL TREATMENT	Reasonable
I6	GLASS MATERIAL OXIDATION/DISSOLUTION SYSTEM	Eliminated (Technical Maturity)
REACTOR AND ACCELERATOR OPTIONS		
R1	EURATOM MOX FABRICATION/REACTOR BURNING	Eliminated (Timeliness)
R2	EXISTING LWRs	Reasonable
R2A	PARTIALLY COMPLETED LWRs	Reasonable
R3	EVOLUTIONARY OR ADVANCED LWRs	Reasonable
R4	NAVAL PROPULSION REACTORS	Disqualified (Transparency)
R5	MODULAR HELIUM REACTORS	Eliminated (Technical Maturity)
R6	CANDU HEAVY WATER REACTORS	Reasonable
R7	ADVANCED LIQUID METAL REACTORS WITH PYROPROCESSING	Eliminated (Technical Maturity, ES&H)
R8	ACCELERATOR CONVERSION/MOLTEN SALT	Eliminated (Technical Maturity)
R9	ACCELERATOR CONVERSION/PARTICLE BED	Eliminated (Technical Maturity)
R10	EXISTING LWRs WITH REPROCESSING	Disqualified (Theft/Diversion, Policy)
R11	ADVANCED LWRs WITH REPROCESSING	Disqualified (Theft/Diversion, Policy)
R12	ACCELERATOR-DRIVEN MODULAR HELIUM REACTORS	Eliminated (Technical Maturity)
R13	ADVANCED LIQUID METAL REACTORS WITH RECYCLE	Disqualified (Technical Maturity, Policy)
R14	PARTICLE BED REACTORS	Eliminated (Technical Maturity)
R15	MOLTEN SALT REACTORS	Eliminated (Technical Maturity)

[a] In this option, the present DWPF at SRS would have a new, specially designed melter installed. Much of the supporting equipment would require major retrofitting for this application because DWPF was not designed for criticality control. Retrofitting the DWPF would create additional total personnel radiation exposure and would significantly interfere with its mission to stabilize and treat HLW, resulting in delays and cost escalation. Note that eliminating this "DWPF Upgrade" variant does not preclude other DWPF-related variants of the Vitrification and Ceramic Immobilization Alternatives (such as adding an adjunct melter adjacent to the DWPF or the can-in-canister approach in the DWPF) if these other variants do not introduce increased radiation or Pu criticality concerns into the DWPF. Can-in-canister at a retrofitted DWPF is discussed in Appendix O and would be examined along with other site-specific alternatives in subsequent NEPA review tiered from the PEIS.

Note: ES&H=Environmental Safety and Health.

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Figure S.3–2. Results of the Screening Process—Surplus Plutonium Disposition Options.

No Action Alternative in the Storage and Disposition PEIS. For other long-term storage alternatives, existing Pu stored at RFETS (approximately 12.9 t [14.2 tons], as stated in DOE's Openness Initiative of December 7, 1993) would be moved to one or more other Pu storage sites. Therefore, DOE developed a subalternative under the Upgrade at Multiple Sites Alternative to analyze the storage of all or some Pu from RFETS at each candidate site. The phaseout of Pu storage at RFETS is also analyzed.

Two other locations, LANL and LLNL, also store quantities of Pu material. As of September 1994, LLNL stored 0.3 t (0.3 tons), and LANL stored 2.7 t (3.0 tons) of Pu. Quantities at LLNL are weapons R&D and operational feedstock materials not surplus to government needs; consequently, none of the Pu stored at LLNL falls within the scope of the Storage and Disposition PEIS. Some Pu material at LANL does fall within scope of the Storage and Disposition PEIS. Approximately 1.5 t (1.7 tons) of Pu material at LANL have been declared surplus to national security needs. As a result, storage of the current Pu inventory at LANL is analyzed under the No Action Alternative. Because LANL is not a candidate storage site, environmental impacts associated with a partial phaseout at LANL and relocation of the surplus Pu material to one or more of the candidate storage sites, is analyzed.

Development of Disposition Alternatives

For disposition, DOE began with 37 potential alternatives (see Figure S.3–2), including the No Disposition Action in which the surplus Pu would remain in long-term storage. Using the same general criteria as those for long-term storage, DOE identified 11 alternatives for surplus Pu disposition, including deep borehole (immobilization), deep borehole (direct emplacement), vitrification (borosilicate glass immobilization), ceramic immobilization, electrometallurgical treatment, glass material oxidation/dissolution, Euratom MOX fuel fabrication/reactor burning, existing LWRs, partially completed LWRs, evolutionary or advanced LWRs, and CANDU reactors. Upon further study of supply/demand conditions for Euratom MOX fuel and due to lack of maturity of the technologies for glass material oxidation/dissolution, DOE deleted the glass material oxidation/dissolution and the Euratom MOX fuel fabrication/reactor burning alternatives. However, MOX fuel fabrication (but not reactor burning) at European facilities remains a reasonable short-term option for the Existing LWR Alternative. Therefore, a total of nine reasonable disposition alternatives in addition to the No Disposition Action and the Preferred Alternative, were selected for analysis in the PEIS. These alternatives were grouped into three categories: Deep Borehole, Immobilization, and Reactor.

Facilities under each alternative within the Immobilization and Deep Borehole Categories could be designed such that they could disposition all the surplus Pu over their operating lives. Each disposition alternative under the Reactor Category would consist of reactors that could use all the MOX fuel produced from surplus Pu. However, existing surplus Pu comes in various forms, and some of these forms may not be suitable for conversion to MOX fuel without specialized chemical processing. The Preferred Alternative for disposition of surplus weapons-usable Pu, discussed previously, involves a combination of disposition alternatives.The Storage and Disposition PEIS identifies the reasonable long-term storage and disposition alternatives as follows:

Deep Borehole

A borehole extended several kilometers below the water table into ancient, geologically stable rock formations.

Storage:

- Storage Alternatives
  - Preferred Alternative (Combination)
  - Upgrade at Multiple Sites Alternative
  - Consolidation of Pu Alternative
  - Collocation of Pu and HEU Alternative
  - No Action Alternative

- Candidate Storage Sites
  - Hanford
  - NTS
  - INEL
  - Pantex
  - ORR
  - SRS

Environmental impacts of each storage alternative and the No Action Alternative are analyzed for each of the six candidate storage sites, to allow (1) the comparison of impacts by site for each alternative and (2) the comparison of impacts by alternative for each site. As a result, decisions can be made to select a single storage alternative for all sites or a combination of different alternatives for different sites.

Disposition:

- Preferred Alternative (Combination)

- Deep Borehole Category
  - Direct Disposition Alternative
  - Immobilized Disposition Alternative

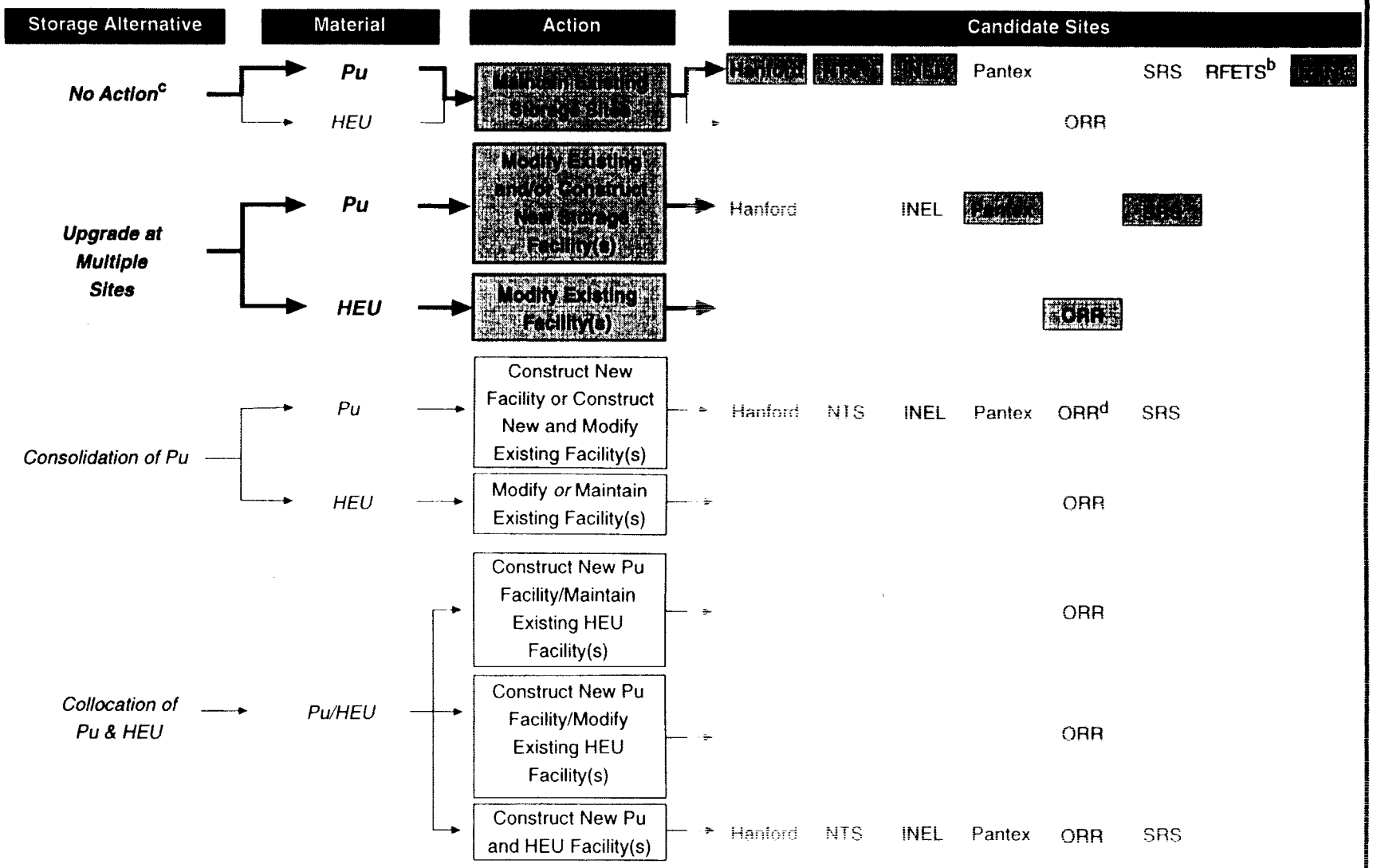
- Immobilization Category
  - Vitrification Alternative
  - Ceramic Immobilization Alternative
  - Electrometallurgical Treatment Alternative

- Reactor Category
  - Existing LWR Alternative
  - Partially Completed LWR Alternative
  - Evolutionary LWR Alternative
  - CANDU Reactor Alternative

- No Disposition Action

The Storage and Disposition PEIS analyzes the reasonable alternatives in addition to the No Action Alternative. For the No Action Alternative, all weapons-usable fissile materials would remain in storage at existing sites using proven nuclear material safeguards and security procedures. For the No Disposition Action Alternative, all weapons-usable fissile materials would remain in storage. The conceptual structures for the long-term storage and disposition alternatives, including the Preferred Alternative (in boldface text and shaded boxes), are presented in Figures S.3–3 and S.3–4, respectively. A more detailed description of these alternatives follows.

[Text deleted.]



[a] Although NTS does not currently store either Pu or HEU, the No Action Alternative is included here as a basis against which other storage and disposition alternatives are analyzed.

[b] As part of the Preferred Alternative, Pu storage at RFETS would be phased out with pits sent to Pantex and non-pit materials sent to SRS.

[c] Under the No Action Alternative, DOE would not undertake any new construction projects except those that are considered part of ongoing site operations to ensure continued safe, secure storage. However, any new facility construction deemed necessary to maintain safe, secure storage would be addressed in appropriate, individual site specific NEPA documents and site development plans.

[d] If Pu is consolidated at ORR, the presence of the HEU material already residing at the Y-12 Plant would create a HEU collocation condition and is therefore portrayed as the Collocation Alternative.

Note: Bold text and shaded boxes indicate Preferred Alternative.

Figure S.3–3. Long-Term Storage Alternatives, Including the Preferred Alternative for Storage.

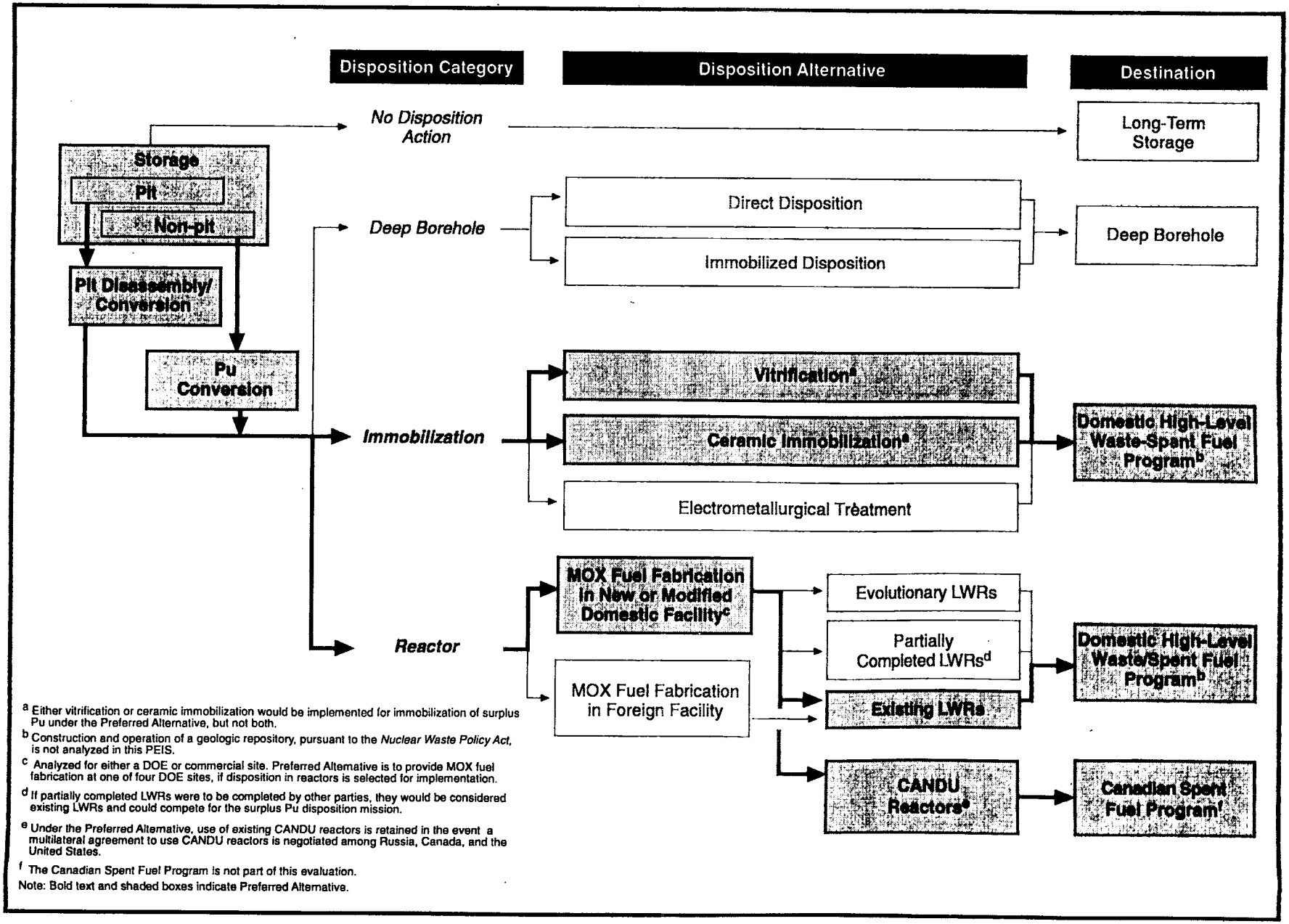


Figure S.3–4. Surplus Plutonium Disposition Alternatives, Including the Preferred Alternative for Disposition.

S.4 DESCRIPTION OF ALTERNATIVES

S.4.1 LONG-TERM STORAGE ALTERNATIVES AND RELATED ACTIVITIES

No Action

[Text deleted.]

Under the No Action Alternative, all weapons-usable fissile materials would remain at existing storage sites. Maintenance at existing storage facilities would be done as required to ensure safe operation for the balance of the facility's useful life. Sites covered under the No Action Alternative include Hanford, INEL, Pantex, ORR, SRS, RFETS, and LANL. Although there are no weapons-usable fissile materials within the scope of the PEIS stored currently at NTS, it is also analyzed under No Action to provide an environmental basis against which impacts of the storage and disposition alternatives are analyzed. The Preferred Alternative for storage calls for No Action at Hanford, INEL, and LANL pending disposition.

Preferred Alternative

The Preferred Alternative for storage is described in Section S.2.

Upgrade at Multiple Sites

Under this alternative for storage, DOE would either modify certain existing facilities or build new facilities, depending on the site's requirements to meet standards for nuclear material storage facilities, and would utilize existing site infrastructure to the extent possible. These modified or new facilities would be designed to operate for up to 50 years. Pu materials currently stored at Hanford, INEL, Pantex, and SRS would remain at those four sites, and HEU would remain at ORR. This alternative does not apply to NTS because NTS does not currently store weapons-usable fissile materials that are within the scope of the PEIS.

A subalternative of relocating portions of the Pu inventory from RFETS and LANL (for a total of 14.4 t [15.9 tons] according to DOE's Openness Initiatives of December 7, 1993, and February 6, 1996, respectively) to one or more of the four existing Pu storage sites is analyzed. Storage without strategic reserve and weapons R&D materials is also included as a subalternative.

Within some of the five candidate storage sites under this alternative, there are one or more storage options. A summary of these options is presented in Table S.4.1–1.

Table S.4.1–1. Long-Term Storage Options for the Upgrade at Multiple Sites Alternative[a]

Candidate Site	Storage Option
Hanford	Modify Existing Fuels and Materials Examination Facility for Pu Storage, or Construct New 200 West Area Facility for Pu Storage
INEL	Modify Existing and Construct New Argonne National Laboratory-West Facilities for Continued Pu Storage
Pantex (Preferred Alternative)	Modify Existing Zone 12 South Facilities for Continued Pu Storage
ORR (Preferred Alternative)	Modify Existing Y–12 Plant Facilities for Continued HEU Storage
SRS (Preferred Alternative)	Modify New Actinide Packaging and Storage Facility for Continued Pu Storage

[a] Proposed storage facility locations were primarily based on optimal use of existing facilities, and are in accordance with current site development and utilization plans and proposals.

Consolidation of Plutonium

Under this alternative, Pu materials at existing sites would be removed, and the entire DOE inventory of Pu would be consolidated at one site, while the HEU inventory would remain at ORR. Again, the four sites with existing Pu storage are candidate sites for Pu consolidation. In addition, NTS and ORR are candidate sites for this alternative. Consolidation of Pu at ORR would result in a situation in which inventories of Pu and HEU are collocated at one site; this alternative is therefore analyzed as the Collocation Alternative at ORR.

A subalternative to account for the separate storage without strategic reserve and weapons R&D materials is also included. Storage options for the six candidate sites under this alternative are presented in Table S.4.1–2.

Table S.4.1–2. Long-Term Storage Options for the Consolidation of Plutonium Alternative

Candidate Site[a]	Storage Option
Hanford	Construct New Pu Storage Facility Adjacent to 200 East Area
NTS	Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel, or Construct New Pu Storage Facility in Area 6
INEL	Construct New Pu Storage Facility Adjacent to the Idaho Chemical Processing Plant
Pantex	Construct New and Modify Existing Zone 12 South Facilities, or Construct New Pu Storage Facility in Zone 12 South
SRS	Construct New Pu Storage Facility Adjacent to Z Area

[a] Consolidation of Pu at ORR results in a collocation condition with HEU. See ORR Collocation Alternative in Table S.4.1–3.

Collocation of Plutonium and Highly Enriched Uranium

Under the Collocation Alternative, the entire DOE inventory of Pu would be consolidated and collocated at the same site as the HEU inventory. The six candidate sites are Hanford, NTS, INEL, Pantex, ORR, and SRS.

A subalternative for the separate storage without strategic reserve and weapons R&D materials is also included. Storage options for the six candidate sites under this alternative are presented in Table S.4.1–3.

Table S.4.1–3. Long-Term Storage Options for the Collocation of Plutonium and Highly Enriched Uranium Alternative

Candidate Site	Storage Option
Hanford	Construct New Pu and HEU Storage Facilities Adjacent to 200 East Area
NTS	Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel, or Construct New Pu and HEU Storage Facilities in Area 6
INEL	Construct New Pu and HEU Storage Facilities Adjacent to the Idaho Chemical Processing Plant
Pantex	Construct New Pu and HEU Storage Facilities in Zone 12 South
ORR	Construct New Pu Storage Facility Northwest of Oak Ridge National Laboratory and Maintain Existing (No Action) HEU Storage Facilities at Y–12 Plant, or Construct New Pu Storage Facility Northwest of Oak Ridge National Laboratory and Modify Existing HEU Storage Facilities at Y–12 Plant, or Construct New Pu and HEU Storage Facilities Northwest of Oak Ridge National Laboratory
SRS	Construct New Pu and HEU Storage Facilities Adjacent to Z Area

S.4.2 PLUTONIUM DISPOSITION ALTERNATIVES AND RELATED ACTIVITIES

[Text deleted.] The disposition technologies analyzed in the PEIS are those that would convert surplus Pu into a form that meets the Spent Fuel Standard. For the purpose of environmental impact analyses for the various disposition alternatives, both generic and specific sites are used to provide perspective on these alternatives. Under each alternative, there are various ways to implement the alternative. These "variants" (such as the can-in-canister[13]) are shown in Table S.4.2–1 to provide a range of available options for consideration.

The first step in Pu disposition is to remove the surplus Pu from storage, then process this material in a pit disassembly/conversion facility (for pits, a component of nuclear weapons) or in a Pu conversion facility (for non-pit materials). The processing would convert the Pu material into a form suitable for each of the disposition alternatives described in the following sections. The pit disassembly/conversion facility and the Pu conversion facility are assumed to be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the potential environmental impacts of constructing and operating these facilities.

No Disposition Action

A "No Pu Disposition" action means disposition would not occur, and surplus Pu-bearing weapon components (pits) and other forms, such as metal and oxide, would remain in storage in accordance with decisions on the long-term storage of weapons-usable fissile materials.

Preferred Alternative

The Preferred Alternative for disposition is described in Section S.2.

Deep Borehole Category

Under this category, surplus weapons-usable Pu would be disposed of in deep boreholes that are drilled at least 4 kilometers (km) (2.5 miles [mi]) into ancient, geologically stable rock formations beneath the water table. The deep borehole provides a geologic barrier against potential proliferation. A generic site is used for the construction and operation of a borehole complex where the surplus Pu would be prepared for emplacement in the borehole. This complex would consist of five major facilities: processing; drilling; emplacing/sealing; waste management; and support (security, maintenance, and utilities).

Direct Disposition

Under the Direct Disposition Alternative, surplus Pu would be removed from storage, processed as necessary, converted to a form suitable for emplacement, packaged, and placed in a deep borehole. The deep borehole would be sealed to isolate the Pu from the accessible environment. Long-term performance of the deep borehole would depend on the stability of the geologic system. A generic site is used for the borehole complex to analyze the environmental impact of this alternative.

Immobilized Disposition

Under the Immobilized Disposition Alternative, the surplus Pu would be removed from storage, processed, and converted to a suitable form for shipment to a ceramic immobilization facility. The output of this facility would be spherical ceramic pellets containing Pu, facilitating handling during transportation and emplacement. The ceramic pellets (about 2.54 centimeters [cm] [1 inch {in}] in diameter and containing 1 percent Pu by weight) would then be placed in drums and shipped to the borehole complex. At the deep borehole site, the ceramic

[13] In the can-in-canister variant, cans of Pu glass or Pu ceramic would be placed in a DWPF canister or a DWPF type canister. This canister would then be filled with borosilicate glass containing HLW. This variant is described in Appendix O of the Final PEIS.

Table S.4.2–1. Description of Variants Under Plutonium Disposition Alternatives

Alternatives Analyzed	Possible Variants
• Deep Borehole Direct Disposition	• Arrangement of Pu in different types of emplacement canisters.
• Deep Borehole Immobilized Disposition	• Emplacement of pellet-grout mix. • Pumped emplacement of pellet-grout mix. • Pu concentration loading, size and shape of ceramic pellets.
• New Vitrification Facilities	• Collocated pit disassembly/conversion, Pu conversion, and immobilization facilities. • Use of either Cs-137 from capsules or HLW as a radiation barrier. • Wet or dry feed preparation technologies. • An adjunct melter adjacent to the DWPF at SRS, in which borosilicate glass frit with Pu (without highly radioactive radionuclides) is added to borosilicate glass containing HLW from the DWPF. • A can-in-canister approach at SRS in which cans of Pu glass (without highly radioactive radionuclides) are placed in DWPF canisters which are then filled with borosilicate glass containing HLW in the DWPF (See Appendix O of the Final PEIS). • A can-in-canister approach similar to above but using new facilities at sites other than SRS.
• New Ceramic Immobilization Facilities	• Collocated pit disassembly/Pu conversion, and immobilization facilities. • Use of either Cs-137 from capsules or HLW as a radiation barrier. • Wet or dry feed preparation technologies. • A can-in-canister approach at SRS in which the Pu is immobilized without highly radioactive radionuclides in a ceramic matrix and then placed in the DWPF canisters that are then filled with borosilicate glass containing HLW (See Appendix O of the Final PEIS). • A can-in-canister approach similar to above but using new facilities at sites other than SRS.
• Electrometallurgical Treatment (glass-bonded zeolite form)	• Immobilize Pu into metal ingot form. • Locate at DOE sites other than ANL-W at INEL.
• Existing LWR With New MOX Facilities	• Pressurized or Boiling Water Reactors. • Different numbers of reactors. • European MOX fuel fabrication. • Modification/completion of existing facilities for MOX fabrication. • Collocated pit disassembly/conversion, Pu conversion, and MOX facilities. • Reactors with different core management schemes (Pu loadings, refueling intervals).
• Partially Completed LWR With New MOX Facilities	• Same as for existing LWR (except that MOX fuel would not be fabricated in Europe).
• New Evolutionary LWR With New MOX Facilities	• Same as for partially completed LWR.
• Existing CANDU Reactor With New MOX Facilities	• Different numbers of reactors. • Modification/completion of existing facilities for MOX fabrication. • Collocated pit disassembly/conversion, Pu conversion, and MOX facilities. • Reactors with different core management schemes (Pu loadings, refueling intervals).

pellets would be mixed with ceramic pellets containing no Pu and fixed with grout during emplacement. The deep borehole would be sealed to isolate the Pu from the accessible environment. Long-term performance of the deep borehole would depend on the stability of the geologic system.

Although a generic site is used for the borehole complex in this alternative, the ceramic immobilization facility is assumed to be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the environmental impact of the facility.

Immobilization Category

Under this category of alternatives, surplus Pu would be immobilized to create a chemically stable form for disposal in a geologic repository pursuant to the *Nuclear Waste Policy Act* (NWPA).[14] The Pu material may be mixed with HLW or other radioactive isotopes and immobilized to create a radiation field that could serve as a proliferation deterrent, along with safeguards and security comparable to those of commercial spent nuclear fuel, thereby achieving the Spent Fuel Standard. All immobilized Pu would be encased in stainless steel canisters and would remain in onsite vault-type storage until a separate geologic repository pursuant to the NWPA is operational.

Vitrification

Under the Vitrification Alternative, surplus Pu would be removed from storage, processed, packaged, and transported to the vitrification facility. In this facility, the Pu would be mixed with glass frit and the highly radioactive isotope cesium-137 (Cs-137) or HLW to produce borosilicate glass logs (a slightly different process, using HLW, would be used for the can-in-canister variant discussed in Appendix O of the Final PEIS). The Cs-137 isotope could come from the cesium chloride (CsCl) capsules currently stored at Hanford or from existing HLW if the site selected for vitrification already manages HLW. Each glass log produced from the vitrification facility would contain about 84 kilograms (kg) (185 pounds [lb]) of Pu.

The vitrification facility is assumed to be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the environmental impact of this alternative.

Ceramic Immobilization

Under the Ceramic Immobilization Alternative, surplus Pu would be removed from storage, processed, packaged, and transported to a ceramic immobilization facility. In this facility, the Pu would be mixed with nonradioactive ceramic materials and Cs-137 or HLW to produce ceramic disks (a slightly different process, using HLW, would be used for the can-in-canister variant). Each disk would be approximately 30 cm (12 in) in diameter and 10 cm (4 in) thick, and would contain approximately 4 kg (9 lb) of Pu. The Cs-137 or HLW would be provided as previously described.

The ceramic immobilization facility is assumed to be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the environmental impact of this alternative.

Electrometallurgical Treatment

Under the Electrometallurgical Treatment Alternative, surplus Pu would be removed from storage, processed, packaged, and transported to new or modified facilities for electrometallurgical treatment. This process could immobilize surplus fissile materials into a glass-bonded zeolite (GBZ) form. With the GBZ material, the Pu is in the form of a stable, leach-resistant mineral that is incorporated in durable glass materials.[15]

[14] Also referred in the PEIS as a geologic, permanent, or HLW repository.

[Text deleted.]

Reactor Category

The reactor alternatives considered in the Storage and Disposition PEIS would utilize surplus Pu in MOX fuel for use in non-defense reactors. The irradiated MOX fuel would meet the Spent Fuel Standard to reduce the proliferation risks of the Pu material, and the reactors would also generate revenues through the sale of electricity. MOX fuel would be used in a once-through fuel cycle, with no reprocessing or subsequent reuse of spent fuel. The spent nuclear fuel generated by the reactors would then be sent to a geologic repository pursuant to the NWPA.

Because the United States does not have a MOX fuel fabrication facility or capability, a dedicated facility would likely have to be constructed or modified at a U.S. Government or existing commercial fuel fabricator's site. The surplus Pu from storage would be processed, converted to PuO_2, and transferred to the MOX fuel fabrication facility. In this facility, PuO_2 and UO_2 (from existing domestic sources) would be blended and fabricated into MOX pellets, loaded into fuel rods, and assembled into fuel bundles suitable for use in the reactor alternatives under consideration. The PEIS evaluates the potential environmental impacts of the MOX fuel fabrication facility at the six DOE sites and at a generic commercial site. MOX fuel fabrication at existing European facilities would be a viable option in the near-term to meet the initial fuel needs of the Existing LWR Alternative, pending availability of a domestic MOX fuel fabrication facility.[16]

Existing Light Water Reactor

Under the Existing LWR Alternative, the MOX fuel containing surplus Pu would be fabricated and transported to existing commercial LWRs in the United States, where the MOX fuel would be used instead of conventional UO_2 fuel. The LWRs employed for domestic electric power generation are pressurized water reactors (PWRs) and boiling water reactors (BWRs). Both types of reactors use the heat produced from nuclear fission reactions to generate steam that drives the turbines and generates electricity. The Storage and Disposition PEIS assumes a throughput of 3 to 5 t/year (yr) (3.3 to 5.5 tons/yr) for disposition of surplus Pu; three to five LWRs would be used. A sample of operating reactors (eight PWRs and four BWRs built after 1975) was compiled to obtain generic operating characteristics for environmental analysis of this alternative.

It is possible that an existing LWR can be configured to produce tritium, consume Pu as fuel, and generate revenue through the production of electricity. This configuration is called a multipurpose reactor. Environmental analysis of the multipurpose reactor is included in Chapter 4 of the *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (TSR PEIS) (DOE/EIS-0161, October 1995). In the TSR PEIS ROD (December 1995), the multipurpose reactor was preserved as an option for future consideration. Information on the Fast Flux Test Facility (FFTF) at Hanford and the costs and benefits of the multipurpose reactor is presented in Appendix N of the Final PEIS.

Partially Completed Light Water Reactor

Under the Partially Completed LWR Alternative, commercial LWRs on which construction has been halted would be completed. The completed reactors would use MOX fuel containing surplus Pu. The characteristics of

[15] The Department has recently issued a FONSI (61 FR 25647) and decision to proceed with the limited demonstration of the electrometallurgical treatment process at Argonne National Laboratory-West (ANL-W) at INEL for processing up to 125 spent fuel assemblies from the Experimental Breeder Reactor II (100 driver and 25 blanket assemblies). Although this alternative could be conducted at other DOE sites, ANL-W is described in the PEIS as the representative site for analysis. The National Research Council prepared a report called *An Evaluation of the Electrometallurgical Approach for Treatment of Excess Weapons Plutonium* (National Academy Press, Washington, DC, 1996). The results of this evaluation will be considered in DOE's decision-making process for Pu disposition.

[16] European MOX fuel fabrication would only be available in the near-term, and is not a part of the Preferred Alternative.

these LWRs would be essentially the same as those of the existing LWRs discussed in the Existing LWR Alternative. The Bellefonte Nuclear Plant located along the west bank of the Tennessee River in Alabama is used as a representative site for the environmental analysis of this alternative. Two reactor units (such as those at the Bellefonte Nuclear Plant) would be needed to implement this alternative.

Evolutionary Light Water Reactor

The evolutionary LWRs are improved versions of existing commercial LWRs. Two design approaches are considered in the Storage and Disposition PEIS. The first is a large PWR or BWR similar to the size of the existing PWR and BWR. The second is a small PWR approximately one-half the size of the large PWR. Two large or four small evolutionary LWRs would be needed to implement this alternative.

Under each design approach for this alternative, evolutionary LWRs would be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the environmental impact of this alternative.

Canadian Deuterium Uranium Reactor

Under the CANDU Reactor Alternative, the MOX fuel containing surplus Pu would be fabricated in a U.S. facility, then transported for use in a commercial heavy water reactor in Canada. The Ontario Hydro Nuclear Bruce-A Generating Station identified by the Canadians is used as a representative site for evaluation of this alternative. This station is located on Lake Huron about 300 km (186 mi) northeast of Detroit, Michigan. Environmental analysis of domestic activities up to the U.S./Canadian border is presented in the PEIS. The use of CANDU reactors would be subject to the policies, regulations, and approval of the Federal and Provincial Canadian Governments. Pursuant to Section 123 of the *Atomic Energy Act*, any export of MOX fuel from the United States to Canada must be made under an agreement for cooperation between the two countries. Spent fuel generated by a CANDU reactor would be accommodated within the Canadian spent fuel program.

S.5 APPROACH TO ENVIRONMENTAL IMPACT ANALYSIS

The environmental impact assessment addresses the full range of natural and human resource, and issue areas pertinent to the sites considered for the long-term storage and disposition alternatives. The resource/issue areas are land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, waste management, intersite transportation, and environmental justice.

A region of influence (ROI) for each resource/issue area is identified and analyzed for each candidate site for long-term storage and each analysis site for disposition. Land resources address land use; land-use compatibility with existing land-use plans, controls, and policies; and the potential for visual resource impacts. Site infrastructure impacts are assessed by comparing the electrical power, fuel, and transportation network requirements against the existing capacities at each candidate site. Air quality and noise impacts focus on air pollutants and noise emissions and their compliance with the National Ambient Air Quality Standards, State air quality standards, and local government standards for noise.

For water resources, the water consumption requirements of each alternative were compared to the availability of surface and groundwater sources at each site, the potential effects of wastewater discharges on surface and groundwater quality are evaluated, and the site's location relative to floodplains assessed. Similarly, geology and soils are evaluated in terms of site suitability and soil erosion potential. Biological resources are evaluated in terms of the potential for impacts to terrestrial and aquatic resources, wetlands, and threatened and endangered species. Cultural and paleontological resources addresses the potential for disturbance to prehistoric, historic, Native American, and paleontological resources. The employment and income effects of new job creation and the attendant demands on community services and local transportation are analyzed for socioeconomics.

Both the public and onsite worker exposure to ionizing radiation and hazardous chemicals and the resultant increase in cancer fatality risk to public and occupational health and safety are assessed for normal operations and accident conditions. The analysis of radiation impacts includes consideration of National Emission Standards for Hazardous Air Pollutants (NESHAPs). The widely used algorithms for estimating the risk of latent cancers from radiation are based on high dose rates, and impacts are then extrapolated to low rates by presumed linear response models. These models are known to overestimate the risk for low dose rates. For the purposes of presentation in the PEIS, the impacts calculated from the linear model are treated as an upper bound case, consistent with the widely used methodologies for quantifying radiogenic health impacts. This does not imply that health effects are expected. Moreover, in cases where the upper bound estimates predict a number of latent cancer deaths that is greater that 1, this does not imply that the latent cancer death(s) are identifiable to any individual.

The additional wastes generated by each alternative are compared to existing and planned treatment, storage, and disposal capacities for potential impacts to waste management. Waste management assumptions are based on current site practices and are contingent upon decisions to be made following completion of the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE/EIS-0200).

The increased number of potential fatalities from truck accidents during the transportation of weapons-usable fissile materials among the various DOE sites and proposed facilities is evaluated for intersite transportation. Environmental justice addresses the potential for disproportionately high and adverse impacts to minority and low-income populations within 80 km (50 mi) of the sites.

The Storage and Disposition PEIS analyzes six candidate sites for the long-term storage of weapons-usable fissile materials. These sites are Hanford, NTS, INEL, Pantex, ORR, and SRS. These same sites were also used to evaluate the construction and operation of various facilities required for the disposition alternatives. These facilities include the pit disassembly/conversion and the Pu conversion facilities common to all disposition alternatives, the MOX fuel fabrication facility common to all reactor alternatives, the ceramic immobilization facility for the deep borehole alternative, the glass vitrification and ceramic immobilization facilities, and the Evolutionary LWR Alternative.

Other sites analyzed for Pu disposition are the ANL-W site at INEL for the Electrometallurgical Treatment Alternative and the Bellefonte Nuclear Plant for the Partially Completed LWR Alternative. These sites are used for analysis only and do not represent a DOE proposal or preference. Alternative sites may be analyzed in subsequent NEPA documents. A generic borehole site is evaluated for the alternatives in the Deep Borehole Category.[17] The Existing LWR Alternative analysis uses generic operating characteristics developed from 12 operating LWRs within the United States, and impacts are assessed using a generic site that was developed based on a composite of existing sites.

S.6 PREFERRED ALTERNATIVE SUMMARY OF IMPACTS

This section summarizes the maximum site impacts that would result at Hanford, INEL, Pantex, and SRS from combining the Preferred Alternative for storage with the Preferred Alternative for disposition at each of these sites. The Preferred Alternative identifies these sites as possible locations for all or some Pu disposition activities. The siting, construction, and operation of disposition facilities and variants would be covered in future tiered NEPA analyses. To the extent practical, DOE would use modified existing buildings and facilities for portions of the disposition activities. The use of existing buildings would reduce the environmental impacts and resource usages identified in this section.

[17] If either Borehole Alternative were selected, DOE would prepare a siting study and tiered NEPA documentation to identify and assess impacts of potential alternative borehole sites. DOE would analyze and compare existing and new buildings and facilities for the technologies chosen as part of the Preferred Alternative in subsequent, tiered NEPA review.

The preferred strategy for disposition is a combination of alternatives which includes operating existing reactors with MOX fuel and immobilization of some of the surplus Pu. The impacts from the operation of most of the existing domestic LWRs would not affect DOE sites. For purposes of analysis, approximately 70 percent of the surplus Pu, which is high purity material, could be readily converted into MOX fuel for use in nuclear reactors. The Preferred Alternative is to use existing reactors. DOE would retain using CANDU reactors in the event of a multilateral agreement among Russia, Canada, and the United States. For purposes of analysis, approximately 30 percent (low purity Pu) would be immobilized in glass or ceramic forms although much of it could be purified with chemical processing and used as MOX fuel in reactors. Disposition by use in reactors would require the construction of a MOX fuel fabrication facility and a pit disassembly/conversion facility at DOE sites. Disposition by immobilization would require the construction of a Pu conversion facility and an immobilization facility (either ceramic immobilization or vitrification) at a DOE site. Four DOE sites (Hanford, INEL, Pantex, and SRS) would be potential locations for MOX fuel fabrication and pit disassembly/conversion facilities, and two sites (Hanford and SRS) for the Pu conversion and immobilization facilities.

The following sections describe the total life cycle impacts that would result from the implementation of the Preferred Alternative at the DOE sites identified for potential placement of the disposition facilities. The analysis conservatively assumed a maximum impact scenario where two or four new disposition facilities could be built at the same DOE site. For immobilization, the analysis conservatively uses impacts from the ceramic immobilization facility since they are generally larger than the impacts from the vitrification facility. If existing facilities (such as the DWPF at SRS and the FMEF at Hanford) were used for some of the disposition activities, the impacts would be reduced.

Land Resources

Collocating disposition facilities at Hanford, INEL, Pantex, or SRS would likely minimize land-use impacts due to the sharing of land resources. In addition, optimal use of existing buildings and facilities would occur where possible. All four sites would have adequate land area to accommodate the facilities. Most disposition facilities would be separated from the site boundary by a 1.6-km (1-mi) buffer zone. For all four DOE sites, construction and operation would not affect other onsite or offsite land uses. No prime farmlands exist onsite. Construction and operation would be compatible with site, State, and local land-use plans, policies, and controls. This section describes the impacts to land resources from constructing and operating the Preferred Alternative storage and disposition facilities for each site.

Hanford Site. Plutonium materials would continue to be stored at the Plutonium Finishing Plant (PFP) in the 200 West Area, pending decisions on their disposition. The potential pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be located on vacant land in the 200 Area adjacent to 200 East. The total area disturbed during construction would be approximately 191 hectares (ha) (472 acres); operation would require approximately 133 ha (329 acres). Construction and operation of the facilities would conform to existing and future land use plans as described in the current *Hanford Site Development Plan* and ongoing discussions in the comprehensive land-use planning process.

Construction and operation of these facilities would also be consistent with the industrialized landscape character of the 200 Area and with the current Visual Resource Management (VRM) Class 5 designation. The ceramic immobilization facility or MOX facility could have stack plumes that could be visible from public viewpoints with high sensitivity levels, including State Highways 24 and 240 and the city of Richland; however, the proposal would be compatible with the existing industrial character of the Hanford area.

Idaho National Engineering Laboratory. Plutonium materials would continue to be stored at the Idaho Chemical Processing Plant (ICPP) and at ANL-W in the Zero Power Physics Reactor (ZPPR) and Fuel Manufacturing Facility (FMF) vaults, pending decisions on their disposition. The potential pit disassembly/conversion and MOX facilities would be located on undeveloped land within or near the ICPP security area. The total area disturbed during construction would be approximately 135 ha (334 acres);

operation would require approximately 93 ha (230 acres). Construction and operation would be consistent with the *Idaho National Engineering Laboratory Site Development Plan*, which designates the ICPP as situated within the Central Core Area/Prime Development Zone at INEL.

Construction and operation of these facilities would also be consistent with the industrialized landscape character of the ICPP and with the current VRM Class 5 designation. The MOX facility may have stack plumes that could be visible from off-site public viewpoints; however, the proposal would be compatible with the existing industrial character of the area.

Pantex Plant. Buildings 12-66 and 12-82 in Zone 12 South would be modified to accommodate the long-term storage of Pantex pits and RFETS pits under the Preferred Alternative. Construction and operation would require less than 1 ha (2.5 acres) and conform with the current *Pantex Site Development Plan*, which includes as part of its master plan the Fissile Material Storage Facility in Zone 12. Zone 12 is also the potential location for the pit disassembly/conversion facility. Construction and operation would require less than 14 ha (35 acres) and conform with the Pantex Site Development Plan, which designates Zone 12 for weapon assembly/disassembly. The total area disturbed during construction would be approximately 135 ha (334 acres); operation would require approximately 93 ha (230 acres). When completed, the potential MOX fuel fabrication facility would be located on previously undeveloped land in Zone 11, which is currently designated for applied technology. However, Pantex could revise the site development plan to accommodate the potential MOX facility.

The existing Zone 12 VRM Class 5 designation would not change due to the Preferred Alternative. The MOX facility in Zone 11 may have stack plumes that could be visible from off-site viewpoints; however, the proposal would be compatible with the existing site industrial character of the area.

Savannah River Site. The APSF in F-Area would be modified to accommodate the long-term storage of SRS non-pit Pu material and RFETS non-pit Pu material for the Preferred Alternative. Approximately 191 ha (472 acres) of vacant land in the F-Area would be disturbed during construction of the pit disassembly/conversion, Pu conversion, MOX fuel fabrication, and ceramic immobilization facilities. The completed facilities would occupy approximately 133 ha (329 acres). Construction and operation would conform with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the Plan, current F-Area land use is designated industrial operations, while the future land-use category is primary industrial mission. Although the proposal would convert undeveloped land, forested land, and a very small portion of National Environmental Research Park lands, the action would conform with site land-use plans.

Construction and operation of the upgrade storage, pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities would be consistent with the industrial landscape character and current VRM Class 5 designation of the F-Area. Construction and operation of the MOX facility would change the current VRM Class 4 designation of the proposed site north of the P-Reactor Area to Class 5. The ceramic immobilization and MOX facilities may have stack plumes; however, because of hilly terrain, visual effects to public access roads with high sensitivity levels would not be apparent.

Site Infrastructure

The resource requirements for the construction of the proposed facilities are not expected to exceed site capabilities for any of the sites evaluated. At Hanford, the planned facilities use natural gas as the primary utility fuel, and the total requirement for natural gas (13,609,000 cubic meters [m^3]/yr [17,800,000 cubic yds {yd^3}/yr]) would be larger than currently available. Since INEL and SRS use fuel oil as the primary utility fuel, use of natural gas in lieu of fuel oil would require additional infrastructure. Final designs for facilities under the Preferred Alternative at INEL and SRS would be adapted to use fuel oil. At SRS the oil requirement would exceed the site availability by 277,750 liters (l)/yr (73,370 gallons [gal]/yr). Additional oil

and natural gas requirements could be met by increasing procurement at all sites. Locating the Preferred Alternative disposition actions at any of the analyzed sites would require the construction of additional onsite roads and rail spurs.

Air Quality and Noise

Construction and operation of the proposed facilities under the Preferred Alternative would generate criteria and toxic/hazardous air pollutants. To evaluate air quality impacts at Hanford, INEL, Pantex, and SRS, potential concentrations from the facilities have been compared to Federal and State guidelines.

Concentrations of particulate matter less than or equal to 10 microns in diameter (PM_{10}) and total suspended particulates (TSP) are expected to increase during construction of the facilities. Simultaneous construction of the facilities could result in elevated levels of these pollutants. However, appropriate control measures would be implemented to maintain fugitive emissions within applicable Federal and State ambient air quality standards during construction.

The Prevention of Significant Deterioration (PSD) regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on estimated emission rates, PSD permits may be required at all of the sites under consideration for the Preferred Alternative facilities. PSD permits may require inclusion of "offsets" (reductions of existing emissions) for any additional or new emission source.

Noise sources associated with the Preferred Alternative facilities may include construction equipment, increased traffic, ventilation equipment, cooling systems, and emergency diesel generators. The contribution to offsite noise levels would continue to be small at all of the sites because the facilities associated with the Preferred Alternative would be a sufficient distance away from the site boundary and sensitive receptors. Due to the large size of the sites, noise emissions from construction and operation activities would not be expected to cause annoyance to the public.

Water Resources

The construction and operation of the proposed facilities under the Preferred Alternative at Hanford, INEL, Pantex, and SRS would affect water resources. All facilities would be constructed outside of the 100-year, 500-year, and probable maximum flood; although the 500-year floodplain is not completely mapped at SRS, the facilities would likely be located outside the 500-year floodplain. Flooding from dam failures and flooding from a landslide resulting in river blockage would only be potentially possible at Hanford or INEL, but are not expected to occur. Wastewater discharges at all sites are expected to continue to meet National Pollutant Discharge Elimination System (NPDES) limits and reporting requirements at all sites.

Hanford Site. Surface water obtained from the Columbia River would be used as the water source for operation of the proposed facilities. The total water requirement for the Preferred Alternative at Hanford would be less than 1 percent of the Columbia River's average annual flow (3,360 m^3/s [118,700 ft^3/s]). The withdrawals are negligible in comparison with the average flow of the river and would not noticeably affect the local or regional water supply.

The wastewater discharge would account for a 98-percent increase over the No Action Alternative projected discharge. The wastewater would be treated in newly constructed sanitary, utility, and process wastewater treatment systems prior to disposal.

Idaho National Engineering Laboratory. Water requirements for the operation of the Preferred Alternative at INEL would be obtained from groundwater sources. The water requirements for the site over the projected No

Action Alternative water usage would be less than a 0.05-percent increase for construction (approximately 0.24 percent of the groundwater allotment) and a 2-percent increase for operations (approximately 9.6 percent of the groundwater allotment).

The wastewater discharged during operations would represent a 24-percent increase over the projected No Action Alternative discharge. Existing INEL treatment facilities could accommodate all the new Preferred Alternative processes and wastewater streams. If necessary, new sanitary, utility, and process wastewater treatment systems would be constructed to accommodate the increase.

Pantex Plant. Water requirements for the operation of technologies identified in the Preferred Alternative for Pantex would be obtained from groundwater resources or, if feasible, from the City of Amarillo Hollywood Road Wastewater Treatment Plant. Should only groundwater be used, the total annual site groundwater withdrawal, including that required for the Preferred Alternative in the year 2005 (the No Action base year), would be 428 million l/yr (113 million gal/yr). This represents a 72-percent increase in the projected No Action Alternative water usage. Because the projected No Action Alternative water usage reflects reductions in water use due to planned downsizing over the next few years, this quantity (No Action plus the Preferred Alternative) is considerably less than what is currently being withdrawn at Pantex (836 million l/yr [221 million gal/yr]). Pantex's groundwater usage would still contribute to the overall declining water levels of the Ogallala Aquifer.

Total estimated wastewater discharge for the Preferred Alternative (283 million l/yr [74.8 million gal/yr]) at Pantex would result in a 100-percent increase in the projected No Action Alternative discharge. If necessary, new sanitary, utility, and process wastewater treatment systems would be constructed to accommodate the increase.

Savannah River Site. Water requirements during operation of the Preferred Alternative would be obtained from existing or new well fields at SRS. The Preferred Alternative water requirements for the site would be a 3.7-percent increase over projected No Action Alternative groundwater usage. Suitable groundwater from the deep aquifers at the site is abundant, and aquifer depletion is not a problem.

The Preferred Alternative wastewater discharge to the river would be less than 5 percent of the minimum flow of Fourmile Branch (0.16 m^3/s [5.7 ft^3/s]), and less than 0.003 percent of the Savannah River average flow (283 m^3/s [9,990 ft^3/s]). SRS treatment facilities could accommodate all the new processes and wastewater streams if a new facility is built for tritium supply and recycling operations as planned. If necessary, new sanitary, utility, and process wastewater treatment systems would be constructed to accommodate the increase.

Geology and Soils

The construction of the potential facilities under the Preferred Alternative would involve some ground disturbing activities at Hanford, INEL, Pantex, and SRS (see discussion under Land Resources). Ground disturbance increases the potential for soil erosion. The key factors affecting the erosion potential of a site are the amount of disturbed land and the amount of annual precipitation. The potential for soil erosion at Hanford, INEL, and Pantex is slight because of low precipitation. Since SRS receives more precipitation, the potential for erosion is considered moderate. The amount of soil loss would depend on factors such as the frequency and severity of precipitation events; wind velocities; and the area, location, and duration of soil disturbance.

During operation, improvements to buildings, roads, and landscaping would considerably reduce the erosion potential. Erosion from stormwater runoff and wind could occasionally occur during operation of the facilities. Beyond increased erosion potential, no direct or indirect effects on geologic resources are anticipated.

Biological Resources

Hanford Site. Plutonium materials would continue to be stored at the PFP in the 200 West Area. Construction of the pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be located on vacant land in the 200 Area adjacent to 200 East and would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Noise from construction and operation activities would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. Nests and young animals living within the assumed sites may not survive. The sites would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Wetlands or aquatic resources would not be affected since no wetlands or surface water bodies exist near the assumed facilities locations. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure, and wastewater would be discharged to evaporation/infiltration ponds. Wetlands or aquatic resources bordering the river would not be affected because the volume of water required represents a small percentage of the flow of the river.

It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the four disposition facilities, but sagebrush habitat would be disturbed. The sagebrush community is an important nesting/breeding and foraging habitat for several State-listed and candidate species, such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, and sage thrasher. Pre-activity surveys would be conducted as appropriate before construction to determine the occurrence of plant species or animal species and habitat in the area to be disturbed. DOE would also consult with Federal and State agencies pursuant to the *Endangered Species Act* (ESA) and other statutes as appropriate.

Idaho National Engineering Laboratory. Plutonium materials would continue to be stored at the ICPP and at ANL-W in the ZPPR and FMF vaults. Construction of the pit disassembly/conversion and MOX facilities on undeveloped land within or near the ICPP security area would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would be expected not to survive. Noise from construction and operation activities would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. Nests and young animals living with the assumed sites may not survive. The sites would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Wetlands and aquatic resources associated with the nearest surface water body, the Big Lost River, are located 1.6 km (1 mi) from the facility location. Due to the lack of wetlands or aquatic resources at the assumed facility locations, these resources would not be affected by construction or operation of the two facilities.

It is unlikely that federally threatened or endangered species would be affected by construction of the two disposition facilities, but several State-listed species may be affected. Burrows and foraging habitat for the pygmy rabbit would be lost. Bat species such as the Townsend's western big-eared bat may roost in caves and forage through the assumed site. One State-listed sensitive plant species could potentially be affected by construction of the facility. The plant species, tree-like oxytheca, has been collected at eight sites on INEL and at only two other sites in Idaho. If present, individual plants of this species could be destroyed during land clearing activities. Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of these species and habitat in the area to be disturbed. DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes as appropriate. No impacts to threatened and endangered species are expected due to facility operation.

Pantex Plant. Upgrading the existing storage Pu storage facility at Pantex would cause minimal disturbance to biological resources because all activities, including some new construction, would take place within the developed area. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the developed area have already adapted to its presence. Impacts to wetlands and aquatic resources would not occur since these resources do not exist in the upgrade area. Since the upgrade would take place within a developed area, impacts to threatened and endangered species would not be expected.

Both the pit disassembly/conversion facility location in Zone 12 and the MOX fuel fabrication facility location in Zone 11 lack natural vegetation. Disturbance of wildlife would be limited due to the existing disturbed nature of the assumed locations; however, small mammals and some birds and reptiles could be displaced by construction. Since the area around both locations does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the facility. During operation, wastewater would be discharged to site playas through NPDES-regulated outfalls. The additional wastewater could lead to minor increases in open water near the outfalls, as well as changes in plant species composition. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of the facilities. Although the assumed sites have been disturbed, it is possible that the State-listed Texas horned lizard could be present. Before construction, preactivity surveys would be conducted, as appropriate to determine the presence of any special status species and habitat on the proposed site; DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes as appropriate.

Savannah River Site. No additional impacts on biological resources are expected from modifying the APSF in F-Area to accommodate the storage of RFETS non-pit Pu material in addition to SRS non-pit Pu material because the modification would only use previously disturbed land.

For the pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities, impacts to terrestrial resources would be minimal because the F-Area is one of the highly developed industrial areas of the SRS. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since there would be relatively small increases in treated wastewater and storm water that would be discharged via NPDES-permitted outflows. Impacts from construction and operation of the three disposition facilities would not be expected to affect threatened and endangered species due to the developed nature of the assumed facility locations. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the facilities so that this species would not be directly affected by these facilities. Before committing construction resources, DOE would consult with Federal and State agencies pursuant to the ESA and other statutes as appropriate.

Construction of the MOX facility north of the P-Reactor Area on the east side of SRS Route F would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Noise from construction and operation activities would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. Nests and young animals living with the assumed sites may not survive. The sites would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Since the majority of the assumed MOX fuel fabrication facility site is upland, the facility could be located to avoid direct impacts to wetlands. Wastewater discharge from construction and operation would be minimal and would not be expected to affect wetlands associated with the receiving stream. Stormwater runoff during construction could cause temporary water quality changes in local tributaries to Par Pond. During operation,

nonhazardous wastewater flow increases are not expected to impact stream hydrology or aquatic resources. All discharges would be required to meet NPDES permit regulations.

It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of a MOX fuel fabrication facility. Although bald eagles have been sighted in the vicinity of the assumed facility location, it is highly unlikely that construction and operation of the MOX fuel fabrication facility would affect this species. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the facilities so that this species would not be directly affected by the MOX facility. Before construction, preactivity surveys would be conducted as appropriate to determine the presence of any special status species and habitat on the proposed site; DOE would consult with Federal and State agencies pursuant to the ESA and other statutes as appropriate.

Cultural and Paleontological Resources

The impacts to cultural and paleontological resources are closely related to the amount of land disturbed. The land-use impacts associated with construction and operation of the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS are discussed under Land Resources. Because most of the locations proposed have been previously disturbed, it is unlikely that they would contain subsurface prehistoric or historic archaeological deposits. Some paleontological remains may be encountered during construction. Operations would not have additional impacts on historic, prehistoric, or paleontological resources, but there may be visual or auditory intrusions to Native American resources.

Hanford Site. Plutonium materials would continue to be stored at the PFP in the 200 West Area. The pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be located on vacant land in the 200 Area adjacent to 200 East. Although no archeological resources have been identified during surveys conducted in the adjacent 200 Areas, some may exist in the facility locations. Any such sites would be identified through compliance with Sections 106 and 110 of the *National Historic Preservation Act* of 1966 (NHPA). Any identified sites may be affected by facility construction. Operation would not result in additional impacts.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Area. Resources may be identified through facility-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the facility locations, they may exist. These resources may be affected by ground disturbing construction. Operations would not have additional impacts on paleontological resources.

Idaho National Engineering Laboratory. Plutonium materials would continue to be stored at the ICPP and the ZPPR and FMF vaults in ANL-W. The pit disassembly/conversion and MOX facilities would be located on undeveloped land within or near the ICPP security area. The pit disassembly/conversion facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of this area identified no prehistoric or historic sites. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits, due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archeological remains be discovered during construction. Two historic sites exist adjacent to the ICPP, one historic can scatter lies across the Big Lost River to the northeast, and one abandoned homestead is to the east. The can scatter is not considered eligible for National Register of Historic Places (NRHP) listing, and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed facilities. Facility construction and operation may have visual or auditory impacts on traditional use areas or sacred sites. Resources may be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain, which have produced fossilized remains. Operation would not have an effect on paleontological resources.

Pantex Plant. Modifications of Buildings 12-66 and 12-82 in Zone 12 South to accommodate the long-term storage of Pantex pits and RFETS pits are not considered NRHP eligible based on an evaluation of World War II Era structures at Pantex. However determinations of NRHP-eligible Cold War Era structures have not been completed, and some structures in Zone 12 may be determined eligible on that basis. Zone 12 is also the potential location for the pit disassembly/conversion facility. Because Zone 12 South is developed, disturbed, and removed from water sources, it is unlikely to contain subsurface prehistoric or historic archeological deposits, even on lands used for equipment laydown or construction parking. No impacts to prehistoric or historic resources are expected to result from the construction or operation of these facilities.

Areas that would be disturbed in Zone 11 for the MOX fuel fabrication facility have not been systemically surveyed for archaeological or paleontological resources. Before construction, additional survey work may be necessary under Section 106 of the NHPA. Because Zone 11 is disturbed, it is unlikely to contain subsurface prehistoric or historic archeological deposits. Should any subsurface remains be discovered during construction, appropriate mitigation, documentation, and/or preservation measures would be conducted as necessary. Operations would not have additional impacts to archeological resources as it does not result in additional ground disturbance. Facility construction may have an impact on historic structures at Pantex. The original buildings in Zone 11 were constructed between 1942 and 1945 to produce general purpose bombs. Zone 11 contains buildings, ramps, and landscape features that clearly illustrate the historic layout of a World War II bomb manufacturing line. Only two buildings within Zone 11 have been determined ineligible for listing on the NRHP. Construction may obscure the spatial relationship between these buildings, thereby compromising their historic significance. Operation of the facility is not expected to affect historic structures.

The Department has recently initiated consultation with Native American groups that have expressed interest in Pantex lands. To date, no Native American resources have been identified within Zones 11 and 12. Resources may be identified through additional consultation. Although no mortuary remains have been discovered at Pantex to date, it is possible that some exist within land to be disturbed by development. Burials are considered important Native American resources. Construction and operation could affect traditionally used plant and animal species.

The surficial geology of the Pantex area consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the High Plains, this formation has produced Late Pleistocene vertebrate remains including woolly mammoth, bison, and camel, sometimes in context with archaeological remains. The land to be disturbed during construction may contain some fossilized remains. Operation would not have an affect on paleontological resources.

Savannah River Site. The Actinide Packaging and Storage Facility in F-Area would be modified to accommodate the storage of SRS non-pit Pu material and RFETS non-pit Pu material for the storage Preferred Alternative. Vacant land in the F-Area would be used for the pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities. Portions of the F-Area have been surveyed and contain sites potentially eligible for the NRHP. Additional surveys would be conducted in any unsurveyed areas to be disturbed by construction. Site types known to occur at SRS include remains of prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by new facility construction, but not operation.

The MOX fuel fabrication facility would be located on undeveloped land approximately 1.6 km (1 mi) north of the P-Reactor Area on the east side of SRS Route F. To date, seven prehistoric sites have been located within 0.5 km (0.3 mi) of this area, so the potential for archaeological sites is moderate to high, and some NRHP-eligible resources may occur within the acreages that would be disturbed by construction. Prehistoric site types that may occur at SRS include villages, base camps, limited activity sites, quarries, and workshops. Historic site types that may occur at SRS include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farming dikes, cattle pens, dams, towns, churches, cemeteries, trash scatters, and roads.

Some Native American resources may be affected by construction and operation of the facilities. Resources such as prehistoric sites, cemeteries, isolated burials, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to the areas may also result from the proposed facilities. These resources would be identified through consultation with the potentially affected tribes.

Some paleontological remains may occur on this acreage, but impacts during construction would be considered negligible because fossil assemblages known to occur at SRS are of low research value. No additional impacts are expected to paleontological resources during operation since no additional ground disturbance is expected.

Socioeconomics

At Hanford, INEL, Pantex, and SRS the primary impact of the Preferred Alternative would be to increase regional employment and income. There would be some increase in demand for community services and housing at each of the sites as a result of in-migrating population. However, the available housing and existing community infrastructure would be able to accommodate these small population increases. Construction and operation of the proposed facilities would increase traffic flow and cause a potential decline in the level of service on some road segments at all sites except Hanford. At RFETS, phaseout of Pu storage would result in the loss of approximately 2,200 direct jobs. Compared to the total employment in the area, the loss of these jobs and the impacts to the regional economy would not be severe.

Hanford Site. Plutonium materials would continue to be stored at the PFP in the 200 West Area, and there would be no impact on the site workforce. Construction of the pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would continue through the year 2013, and there would be sufficient available labor within the region to fulfill construction workforce requirements. Economic impacts from construction would peak in 2010, during construction of the ceramic immobilization facility. Total regional economic area (REA) employment would increase by 2001 due to construction of the ceramic immobilization facility. However, during this same period, the other three disposition facilities would already be fully operational, generating approximately 7,500 additional jobs in the REA.

In the year 2003, the pit disassembly/conversion and MOX facilities would be the first disposition alternative facilities to become fully operational. Pu conversion would begin in 2006, and the ceramic immobilization operations would begin in 2013. The operational workforce would increase beginning in the year 2003 and peak in the year 2013 when all of the disposition facilities would become fully operational. Total direct employment would reach approximately 3,100 in 2013. Total REA employment would increase by approximately 10,400, and unemployment would decrease from 9.1 to 7.1 percent. The per capita income would increase by 2 percent.

In-migration to fulfill specialized direct job requirements would lead to a population increase of about 1 percent in the ROI. The additional population would increase the demand for community services by approximately 1 percent. Demand for housing would also increase, but the impact on the local markets would be minimal.

Construction and operation workers at Hanford would generate 1,920 and 5,900 additional vehicle trips per day on the local roads, respectively. The level of service would not change due to the additional traffic generated

during construction. Operations would cause a drop in level of service from B to C on Washington State Route 240 from Washington State Route 24 to Washington State Route 224.

Idaho National Engineering Laboratory. Plutonium materials would continue to be stored at ICPP and ZPPR, and in FMF vaults at ANL-W. No additional workforce would be required for continuation of the storage mission at INEL. Construction of the pit disassembly/conversion and MOX facilities would take place concurrently and continue through the year 2003. Some in-migration would take place both during construction and operation to fill specialized job requirements. Direct employment during peak construction would reach 660 in 1999 and total 1,330 during the first year of full operation in 2003. Total REA employment would increase by approximately 1,200 during construction and by approximately 6,000 during operations. Unemployment would decrease from 5.4 percent to 4.8 percent during peak construction and fall further to 2.4 percent during operation. The per capita income would increase by less than 0.4 percent during construction and by about 1.4 percent during operations.

In-migration to fulfill direct job requirements for both construction and operations would lead to a population increase of less than 1 percent in the ROI. The additional population would increase demand for community services by less than 1 percent during both construction and operations. Demand for housing would also increase, but, the impact on the local markets would be minimal.

Construction and operation workers at INEL would generate 1,267 and 2,554 additional vehicle trips per day on local roads, respectively. The level of service would not change due to additional traffic generated during construction. Operations would cause a drop in level of service from D to E on US 20 from US 26/91 at Idaho Falls to US 26 East. Operations would also cause a drop in level of service from B to C on US 20/26 from US 26 East to Idaho State Route 22/33.

Pantex Plant. Buildings 12-66 and 12-82 would be modified to accommodate the long-term storage of Pantex pits and RFETS pits for the storage Preferred Alternative. Additional workers would be required for construction and operation of the modified storage facilities. Construction of the pit disassembly/conversion and MOX fabrication facilities would take place concurrently and continue through 2003, when full operations would commence. Because the construction of the disposition facilities would require a larger workforce than would modification of the storage facilities, peak construction impacts would occur in 1999. Peak operation impacts would occur in 2005, when all three facilities would be fully operational. Total direct construction employment during peak construction would reach 660 in 1999, and direct operation employment would reach 1,420 in 2005, when all three facilities would be fully operational. Total REA employment would increase by 1,192 during peak construction and by 6,404 during operations. Unemployment would decrease from 4.8 percent to 4.3 percent during peak construction and fall further to 3.0 percent during operations. The per capita income would increase about 0.3 percent during construction and by 0.5 percent during operations.

In-migration to fulfill direct job requirements for both construction and operations would lead to a population increase of 0.1 percent during construction and about 2 percent during operation. The increase in demand for community services during construction and operation would be minimal. Demand for housing would also increase, but, the impact on the local markets would be minimal.

Construction and operation workers at Pantex would generate 1,267 and 2,726 additional vehicle trips per day on local roads, respectively. The level of service would not change due to additional traffic generated during construction. Operations would cause a drop in level of service from A to B on Farm-to-Market 683 from US 60 to Farm-to-Market 293 and on Farm-to-Market 2373 from I-40 to US 60.

Savannah River Site. Under the Preferred Alternative, the Actinide Packaging and Storage Facility in the F-area would be modified to accommodate the long-term storage of the SRS non-pit Pu material and RFETS non-pit Pu material. The modification activities would employ workers from the current workforce, while operation of the expanded storage facility would require some additional workers. Construction of the pit

disassembly/conversion, Pu conversion, MOX fuel fabrication, and the ceramic immobilization facilities would continue until 2013, when all of the facilities would become operational. There would be sufficient available labor in the region to fulfill the construction workforce requirements. Economic impacts from construction would peak in 2010, during construction of the ceramic immobilization facility. Total REA employment would increase by 1,793 due to construction of the ceramic immobilization facility. However, during this same period, the other three disposition facilities would already be operating and generating an additional 6,936 jobs in the REA. Peak economic impacts would occur in 2013, when all of the storage and disposition facilities would be fully operational. Total employment in the region would increase by 9,482, and unemployment would decrease to 4.5 percent. Regional per capita income would increase by about 1.6 percent.

Because of the demand for in-migrating workers to fill specialized employment requirements, the ROI population would increase by 0.9 percent. Demand for community services would increase about 1 percent or less. The increase in demand for housing would be too small to affect the market.

Construction and operation workers at SRS would generate 1,920 and 6,150 additional vehicle trips per day on local roads, respectively. Construction would cause a drop in level of service from E to F on South Carolina State Route 19 from US 1/78 at Aiken to US 278. Operations would not significantly impact local roads.

Public and Occupational Health and Safety

Normal Operations. The human health impacts from the radiological and hazardous chemical releases during facility normal operations associated with the storage and disposition Preferred Alternative actions were analyzed at each of the DOE sites. The impact of the Preferred Alternative actions were then combined to obtain the "total impact." Total impact for each receptor/impact parameter is the summation of each facility, action, process, or technology for each of the operational campaigns (the number of years required to complete Pu disposition). Under normal radiological operations, the annual incremental dose to the maximally exposed individual (MEI) ranges from 2.7×10^{-4} millirem (mrem)/yr at INEL to 4.1×10^{-3} mrem/yr at SRS. All doses, when added to No Action, are within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The annual incremental dose to the population within 80 km (50 mi) from the Preferred Alternative ranges from 4.2×10^{-3} person-rem/yr at INEL to 0.22 person-rem/yr at SRS. For DOE activities, proposed 10 CFR 834 (See 58 FR 1628) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an As Low As Reasonably Achievable Program. When the contribution from the Preferred Alternative is combined with the No Action population dose for each of the sites, the total dose is well within the proposed 10 CFR 834. The dose assessments of the involved worker for storage and disposition facilities are within DOE radiological limits and administrative control levels. The incremental latent cancer fatalities to the involved workforce statistically estimated from these doses attributed to the Preferred Alternative range from 0.48 at INEL to 1.32 at SRS for the entire campaign (estimates based on the *1990 Recommendations of the International Commission of Radiological Protection*).

Facility Accidents. A set of potential accidents was postulated for each component of the Preferred Alternative. For each DOE site subject to multiple storage and disposition actions (Hanford, INEL, Pantex, and SRS), this includes a set of accidents for the storage option coupled with the combination of preferred disposition technologies assumed for the analysis. For the Existing LWR Alternative, a Probabilistic Risk Assessment (PRA) approach was applied to determine the effects of operating an existing LWR with a MOX core. The incremental effects are described below.

One measure of impact calculated from modeled accident scenarios is expected risk, the summation of risk (the product of accident occurrence probability and consequence) for the accident spectrum modeled for each component of the Preferred Alternative. These expected risks were aggregated for the Preferred Alternative for the following impact receptors: a worker located 1,000 m (3,280 ft) from the accident release point; the maximum hypothetical offsite individual located at the site boundary; and the population located within 80 km

(50 mi) of the accident release point. Aggregated expected risk estimates of cancer fatality(s) for each assumed campaign under the Preferred Alternative range from: $1.3x10^{-6}$ at INEL to $1.5x10^{-5}$ at Pantex; $1.4x10^{-8}$ at INEL to $6.0x10^{-6}$ at Pantex; and $3.0x10^{-5}$ at INEL to $9.1x10^{-4}$ at Pantex; respectively for these impact receptors. The Y–12 upgrade at ORR under the Preferred Alternative could reduce the expected risk of cancer fatalities for the design basis accidents analyzed in the Y–12 EA to $5.1x10^{-7}$, $7.4x10^{-6}$, and $5.7x10^{-8}$ per year for the 80-km (50-mi) offsite population, MEI, and noninvolved worker, respectively by meeting the performance goal for a moderate hazard facility of Performance Category 3 as prescribed in DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*.

The evaluated accident scenario with the highest risk to the public at the DOE sites under the Preferred Alternative (a fire on the loading dock of the MOX fuel fabrication facility) would result in an estimated risk of $5.2x10^{-5}$, $1.6x10^{-5}$, $1.8x10^{-5}$, and $5.2x10^{-5}$ cancer fatalities over the assumed MOX fuel fabrication campaign at Hanford, INEL, Pantex, and SRS, respectively.

Under the Preferred Alternative, the use of existing LWRs is being pursed for the disposition of surplus plutonium through the use of MOX fuel in place of UO_2. An important question is whether the use of MOX fuel changes the safety envelope of UO_2 fueled reactors documented in Safety Analysis Reports, PRAs, and NUREG-1150 (*Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*). Related reactor safety issues are addressed in a recent report by the National Academy of Sciences (*Management and Disposition of Excess Weapons Plutonium Reactor-Related Options*). The report indicates that the potential influences on safety of the use of MOX fuel in LWRs has been extensively studied in the United States in the 1970s (*Final Generic Environmental Impact Statement on the Use of Recycled Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors*, NUREG-0002). These influences have also been extensively studied in Europe, Japan and Russia. Regarding effects of MOX on accident probabilities, the National Academy of Sciences report states, "... no important overall adverse impact of MOX use on the accident probabilities of the LWRs involved will occur; if there are adequate reactivity and thermal margins in the fuel, as licensing review should ensure, the main remaining determinants of accident probabilities will involve factors not related to fuel composition and hence unaffected by the use of MOX rather than LEU fuel." Regarding the effects of MOX on accident consequences, the report states, "... it seems unlikely that the switch from uranium-based fuel could worsen the consequences of a postulated (and very improbable) severe accident in a LWR by more than 10 to 20 percent. The influence on the consequences of less severe accidents, which probably dominate the spectrum value of population exposure per reactor-year of operation would be even smaller, because less severe accidents are unlikely to mobilize any significant quantity of plutonium at all."

The incremental effects of utilizing MOX fuel in a commercial reactor in place of UO_2 were derived from a quantitative analysis of several typical severe accident scenarios for MOX and UO_2 using the MACCS computer code and generic population and meteorology data. The analysis only considers highly unlikely severe accidents where sufficient damage would occur to cause the release of Pu or uranium. The risks of severe accidents were found to be in the range of plus 8 to minus 7 percent, compared to UO_2 fuel, depending on the accident release scenario. The incremental risk of cancer fatalities to a generic offsite population located within 80 km (50 mi) of the severe accident release point would range from $-2.0x10^{-4}$ to $3.0x10^{-5}$ per year for the accident release scenarios analyzed.[18] These preliminary results would be re-examined for licensing purposes and subsequent NEPA review. More detailed safety analyses would be performed using both up-to-date calculations of radionuclide inventories for different fuel compositions and irradiation histories, and population-exposure models for sensitivity changes in those inventories resulting from the use of weapons-grade Pu in the fuel.

[18] Accidents severe enough to cause a release of Pu or HEU involve combinations of events that are highly unlikely. Estimates and analyses presented in Chapter 4 and summarized in Table 2.5–3 indicate a range of latent cancer fatalities of $5.9x10^{-3}$ to $7.3x10^{-3}$ and risk per year of 0.15 to 0.16.

Natural Phenomena. Under the Preferred Alternative, HEU would continue to be stored at the Y–12 Plant at ORR in existing facilities that would be upgraded. The majority of the HEU would be housed in upgraded facilities currently used for HEU storage. The remaining HEU would be stored in facilities that were formerly used for material processing but are currently being modified and converted into storage areas. Modifications to existing buildings would make the facilities suitable for long-term storage and consist primarily of those upgrades required to meet natural phenomena requirements (including earthquakes and tornadoes) as documented in *Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities* (Y/EN-5080, 1994). The Y–12 storage buildings would be upgraded to meet the performance goal for a moderate hazard facility of Performance Category 3 in DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*. In a Performance Category 3 facility, radioactive or toxic materials are present in significant quantities. Design considerations for this category are to limit facility damage so that hazardous materials can be controlled and confined, occupants can be protected, and functions of the facility can continue without interruption. A performance goal for Performance Category 3 is a hazard exceedance frequency of 1.0×10^{-4} per year (DOE Order 5480.28). Meeting this performance goal would reduce the expected risk for the design basis accidents analyzed in the Y–12 EA (for example, Building 9212) by approximately 80 percent, resulting in a latent cancer fatality risk of 5.1×10^{-7} to the MEI and 5.7×10^{-8} to a noninvolved worker, and potential latent cancer fatalities of 7.4×10^{-6} for the 80-km (50-mi) offsite population.

At SRS, F-Canyon facilities could be used for the immobilization of surplus Pu using the can-in-canister variant under the Preferred Alternative. The earthquake accident analysis in the IMNM EIS determined that the F-Canyon facilities are structurally sound. Since that time, DOE has prepared a *Supplemental Analysis of Seismic Activity on F-Canyon* (August 1996). Based on the evaluation, an earthquake that could occur about once every 8,000 years could cause a level of structural damage to F-Canyon similar to the level of damage attributed to the earthquake considered in the IMNM EIS. Thus, the capability of F-Canyon to survive an earthquake more severe than that evaluated in the EIS, in combination with the fact that the likelihood of this level of damage was less than assumed in the EIS (1 per 8,000 years compared to 1 per 5,000 years), indicates that F-Canyon is seismically safe, or safer, than indicated in the IMNM EIS.

Waste Management

There is no spent nuclear fuel or HLW associated with construction or operation of Preferred Alternative facilities, but the ceramic immobilization facility would generate as its product output a stabilized ceramic form spiked with cesium radionuclides. (For immobilization using vitrification, a stable glass form of Pu and HLW would be generated.) Storage of this immobilized product would be provided until disposal in a geologic repository pursuant to the NWPA.[19] Each of the facilities under the Preferred Alternative have as part of their conceptual design waste management facilities that would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of *Resource Conservation and Recovery Act* (RCRA), and other applicable statutes. Under the Preferred Alternative, the waste management infrastructure of the individual facilities would be integrated into a single waste management infrastructure to include maximum use of existing and planned site waste management facilities. Depending in part on decisions in the waste-type specific RODs for the Waste Management PEIS, wastes could be treated, and (depending on the type of waste) disposed of, onsite or at regionalized or centralized DOE sites. The treatment level and potential disposal of TRU and mixed TRU waste at the Waste Isolation Pilot Plant (WIPP) will depend on decisions in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*. For the purposes of analyses only, this PEIS assumes that transuranic (TRU) and TRU mixed waste would be treated onsite to the current planning-basis Waste Isolation Pilot Plant (WIPP) Waste

[19] Pursuant to the *Nuclear Waste Policy Act*, DOE is currently characterizing the Yucca Mountain Site as a potential repository for spent nuclear fuel and HLW. Legislative clarification, or a determination by the Nuclear Regulatory Commission that the immobilized Pu should be isolated as HLW, may be required before the material could be placed in Yucca Mountain should DOE and the President recommend, and Congress approve, its operation. No radionuclides that are RCRA wastes would be used for immobilization so the immobilized product would be consistent with the repository's waste acceptance criteria.

Acceptance Criteria, and shipped to WIPP for disposal. This PEIS also assumes that hazardous waste, low-level waste (LLW), and mixed LLW would be treated and disposed of in accordance with current site practice.

Construction and operation of the proposed facilities would affect existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Wastes generated during construction would consist of wastewater and hazardous and solid nonhazardous wastes. Wastewater and solid nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be treated onsite or shipped offsite, to a commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of off-site in a commercial RCRA-permitted disposal facility. No radioactive or hazardous soil contamination is expected to be generated during construction. However, if any were generated, it would be managed in accordance with site practice and all applicable Federal and State regulations.

Hanford Site. Under the Preferred Alternative approximately 78.2 m^3 (20,660 gal) of liquid and 750 m^3 (981 yd^3) of solid TRU waste would require treatment, and packaging to meet the current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. An estimated 200 m^3 (262 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the Hanford Tri-Party Agreement to meet the WIPP Waste Acceptance Criteria or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*, 109 additional truck shipments per year or, if applicable, 54 regular train shipments per year, or 18 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 70.4 m^3 (18,590 gal) of liquid and 2,010 m^3 (2,630 yd^3) of solid LLW would require treatment, processing, and packaging to meet the waste acceptance criteria of the 200-Area LLW Burial Grounds. After treatment and volume reduction, 2,010 m^3 (2,630 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 3,400 m^3/ha (1,800 yd^3/acre), this would require 0.6 ha/yr (1.5 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.2 m^3 (320 gal) of liquid and 231 m^3 (302 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the Hanford Tri-Party Agreement. The 46 m^3 (12,150 gal) of liquid and 184 m^3 (241 yd^3) of solid hazardous wastes would be collected, treated on- or off-site, and shipped in Department of Transportation (DOT)-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of off-site in commercial RCRA-permitted disposal facilities.

Approximately 177,000 m^3 (46.8 million gal) of liquid nonhazardous sanitary and industrial wastewater and 170,000 m^3 (45.0 million gal) of steam plant and cooling blowdown and estimated stormwater runoff would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new sanitary, utility, and process wastewater treatment facilities may be required. The 3,240 m^3 (4,240 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the City of Richland landfill per current site practice.

Idaho National Engineering Laboratory. Under the Preferred Alternative approximately 373 m^3 (488 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. An estimated 8 m^3 (11 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the INEL Site Treatment Plan to meet the current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*, 44 additional truck shipments per year or, if applicable, 22 regular train shipments per year, or 7 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 8 m^3 (2,100 gal) of liquid and 255 m^3 (333 yd^3) of solid LLW would require treatment, processing, and packaging to meet the waste acceptance criteria of the Radioactive Waste Management

Complex (RWMC). Assuming a land usage of factor of 6,200 m^3/ha (3,300 yd^3/acre), the disposal of LLW would require 0.04 ha/yr (0.1 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.1 m^3 (290 gal) of liquid and 40 m^3 (52 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the INEL Site Treatment Plan. The 6 m^3 (1,500 gal) of liquid and 154 m^3 (201 yd^3) of solid hazardous wastes would be collected, treated on- or off-site, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of off-site in commercial RCRA-permitted disposal facilities.

Approximately 129,000 m^3 (34.0 million gal) of liquid nonhazardous sanitary, industrial, and other process wastewater would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new sanitary, utility, and process wastewater treatment facilities may be required. The 253 m^3 (331 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the onsite landfill per current site practice.

Pantex Plant. Under the Preferred Alternative approximately 374 m^3 (489 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. An estimated 8 m^3 (11 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the *Pantex Plant Federal Facility Compliance Act Site Treatment Plan/Compliance Plan* to meet the WIPP Waste Acceptance Criteria or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*, 44 additional truck shipments per year or, if applicable, 22 regular train shipments per year, or 7 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 8 m^3 (2,100 gal) of liquid and 392 m^3 (513 yd^3) of solid LLW would require treatment, processing, and packaging to meet the waste acceptance criteria of the NTS Area 5 Radioactive Waste Management Site Waste Acceptance Criteria. After treatment and volume reduction, 324 m^3 (424 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 6,000 m^3/ha (3,200 yd^3/acre), the disposal of LLW would require 0.05 ha/yr (0.13 acres/yr) of LLW disposal area at NTS. Assuming 16.6 m^3 (21.7 yd^3) of LLW per shipment, 20 additional LLW shipments per year from Pantex to NTS would be required. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.3 m^3 (350 gal) of liquid and 48 m^3 (63 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the *Pantex Plant Federal Facility Compliance Act Site Treatment Plan/Compliance Plan*. The 7 m^3 (1,760 gal) of liquid and 155 m^3 (203 yd^3) of solid hazardous wastes would be collected, treated on- or off-site, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of off-site in commercial RCRA-permitted disposal facilities.

Approximately 141,000 m^3 (37.2 million gal) of liquid nonhazardous sanitary, industrial, and other process wastewater would require treatment in accordance with site practice. Depending on site location, expansion of existing or construction of new utility and process wastewater treatment facilities may be required. The existing sanitary wastewater treatment system has adequate excess capacity to treat the additional quantity of sanitary wastewater. The 391 m^3 (511 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the City of Amarillo landfill per current site practice.

Savannah River Site. Under the Preferred Alternative approximately 78.2 m^3 (20,660 gal) of liquid and 750 m^3 (981 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. An estimated 200 m^3 (262 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the SRS Treatment Plan to meet the

current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*, 109 additional truck shipments per year or, if applicable, 54 regular train shipments per year, or 18 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 70.4 m^3 (18,600 gal) of liquid and 2,010 m^3 (2,630 yd^3) of solid LLW would require treatment, processing, and packaging to meet the waste acceptance criteria of the SRS E-Area Low-Level Radioactive Disposal Facility. After treatment and volume reduction, 2,010 m^3 (2,630 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 8,600 m^3/ha (4,600 yd^3/acre), this would require 0.2 ha/yr (0.5 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.2 m^3 (311 gal) of liquid and 231 m^3 (302 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the SRS Site Treatment Plan. The 46 m^3 (12,070 gal) of liquid and 184 m^3 (241 yd^3) of solid hazardous wastes would be collected, treated on- or off-site, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of off-site in commercial RCRA-permitted disposal facilities.

Approximately 179,000 m^3 (47.3 million gal) of liquid nonhazardous sanitary and industrial wastewater and 170,000 m^3 (45 million gal) of steam plant and cooling blowdown and estimated stormwater runoff would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new utility and process wastewater treatment facilities may be required. The centralized sanitary wastewater treatment system is adequate to treat the sanitary portion. The 3,250 m^3 (4,250 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to an offsite landfill per current site practice.

Intersite Transportation

The estimated health effects from transportation of radiological materials for the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS for the life of the project range from 0.193 fatalities for Pantex to 1.87 fatalities for SRS.

In addition to the activities at the DOE sites, there would be transportation of the MOX fuel from the DOE fuel fabrication site to existing LWRs. The location of the LWRs and the destination of the MOX fuel could be either the eastern or western United States. For 4,000 km (2,486 mi) there could be an additional 3.61 potential fatalities. The 3.61 potential fatalities assumes that 100 percent of the surplus Pu would be used in commercial reactors. For analysis purposes, approximately 70 percent of the surplus Pu would be used in commercial reactors under the Preferred Alternative, therefore potential fatalities could be lower.

Environmental Justice

There would be no high and adverse health or environmental impacts to any population around the sites, including low-income and minority populations, from normal operation of the Preferred Alternative actions. The alternatives would confer socioeconomic benefits to each site where storage or disposition activities would occur (except RFETS), and therefore would not lead to any environmental justice concerns.

For environmental justice impacts to occur, there must be high and adverse human health or environmental impacts that disproportionately affect minority populations or low-income populations. The public health and safety analysis shows that air emissions and hazardous chemical and radiological releases from normal operations for all storage and disposition alternatives would be within regulatory limits and that no latent cancer fatalities would result.

The public health and safety analyses also indicate that radiological releases from accidents would not result in significant adverse human health or environmental impacts. Therefore, such accidents would not have disproportionately high and adverse impacts on minority or low-income populations. For the Preferred Alternative, for accidents associated with existing LWRs using MOX fuel, the maximum risk (which includes accident probability) of latent cancer fatalities to the public within 80 km (50 mi) would be 0.10 for the 11-year Pu disposition campaign. Therefore, it is unlikely that there would be disproportionately high and adverse impacts to minority populations or low-income populations surrounding the LWRs. Any potential transportation accidents would be random events that would not disproportionately affect minority or low-income populations.

S.7 CUMULATIVE IMPACTS

Cumulative impacts are those that could result from the incremental impact of the proposed action and alternatives identified above when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. The reference condition is the No Action Alternative, which addresses the impacts of past, present, and ongoing programs. In particular, for alternatives that are proposed for DOE sites, the analysis focuses on the potential for cumulative impacts at each candidate site where other programs are reasonably anticipated.

The reasonably foreseeable future actions that have the potential to be implemented at some of the DOE sites under consideration, in addition to the long-term storage and disposition alternatives considered in the Storage and Disposition PEIS, include the following DOE programs: Waste Management (at Hanford, NTS, INEL, Pantex, ORR, SRS, RFETS, and LANL); Stockpile Stewardship and Management (at NTS, Pantex, ORR, SRS, and LANL); Tritium Supply and Recycling (at SRS); HEU Disposition (at ORR and SRS); Foreign Research Reactor Spent Nuclear Fuel (at INEL and SRS); and Spent Nuclear Fuel Management (at Hanford, INEL, and SRS).

[Text deleted.]

LONG-TERM STORAGE

Long-Term Storage Alternatives

The cumulative impact analysis, including the long-term storage alternatives and the six other reasonably foreseeable DOE programs, identified the following resource areas and issues at each site as having the potential to result in cumulative impacts:

- At Hanford, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources, air quality, biological resources, and waste management.
- At NTS, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources, site infrastructure, air quality, biological resources, cultural and paleontological resources, and waste management.
- At INEL, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources, air quality, biological resources, socioeconomics (local transportation), and waste management.
- At Pantex, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources, site infrastructure, air quality, water resources, and waste management.

- At ORR, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources (visual quality), air quality, biological resources, cultural and paleontological resources, socioeconomics (local transportation), and waste management.

- At SRS, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources, site infrastructure, air quality, biological resources, cultural and paleontological resources, socioeconomics (local transportation), public and occupational health and safety, and waste management.

- At RFETS, potential cumulative impacts from the maximum case alternative (Phaseout) were identified for socioeconomics.

- At LANL, no potential cumulative impacts were identified.

Preferred Alternative

The contribution to long-term storage cumulative impacts from the Preferred Alternative would be lower than the impacts identified above for the maximum case alternative at any one DOE site. Based on the cumulative impact analysis for long-term storage described above, the following resource and issue areas were identified at each site as having the potential to result in cumulative impacts:

- At Pantex, potential cumulative impacts were identified for land resources, site infrastructure, air quality, water resources, and waste management.

- At ORR, potential cumulative impacts were identified for air quality, cultural resources, local transportation, and waste management.

- At SRS, potential cumulative impacts were identified for air quality, public and occupational health and safety, and waste management.

- At RFETS, potential cumulative impacts were identified for socioeconomics.

Because the Preferred Alternative for storage at Hanford, NTS, INEL, and LANL is No Action, the storage program would not contribute to the cumulative impacts at these sites.

DISPOSITION

Disposition Alternatives

A site-specific cumulative impact analysis was not performed for all of the disposition alternatives because many of the facilities (for example, deep borehole complex and existing LWRs) do not allow site-specific cumulative impact analysis. Instead, a generic analysis that is applicable to all DOE sites was developed for these disposition alternatives. This representative scenario includes all of the common activities that would be needed for all of the disposition alternatives (construction and operation of pit disassembly/conversion and Pu conversion facilities), the common activity that would be required for the reactor alternatives (construction and operation of a MOX fuel fabrication facility), and the immobilization alternative that would generally have the largest impacts (ceramic immobilization facility). The scenario assumes that all four of the facilities would be constructed and operated concurrently at the same DOE site. Potential cumulative impacts could result from constructing and operating the pit disassembly/conversion, Pu conversion, MOX fuel fabrication, and immobilization facilities at a single DOE site.

For land resources, the construction of all four of the disposition facilities would disturb up to 191 ha (472 acres) of land during construction, of which up to 133 ha (330 acres) would be used during operations. If all four of the facilities were located at the same site, there would likely be a reduced area of disturbed land due to the sharing of land resources. Construction and operation of the disposition facilities could also result in the direct disturbance of terrestrial resources, wetlands, and threatened and endangered species.

The construction and operation of the disposition facilities could affect cultural and paleontological resources by disturbing Native American and buried paleontological materials. Constructing and operating the disposition facilities would generate employment and income increases in the region.

During normal operations of the disposition facilities, there would be both radiological and chemical releases to the environment and direct in-plant worker exposures. However, exposures are expected to be within regulated limits. To the extent possible, existing treatment systems would be used for the waste streams from the disposition facilities. If the capacity or appropriate treatment technology are not available, new treatment facilities would be built to handle the waste from the new facilities.

Preferred Alternative

Under the Preferred Alternative for disposition, Hanford and SRS are potential sites for four facilities (pit disassembly/conversion, Pu conversion, MOX fuel fabrication, and immobilization), therefore, the maximum contribution to cumulative impacts would result at these sites if all four facilities were constructed. INEL and Pantex are potential sites for two facilities (pit disassembly/conversion and MOX fuel fabrication), therefore, the maximum contribution to cumulative impacts at these sites would result if both of these facilities were constructed. Based on the cumulative impact analysis for the disposition alternatives described above, the following resource areas and issues were identified as having the potential to result in cumulative impacts:

- At Hanford, potential cumulative impacts were identified for land resources, site infrastructure, air quality, biological resources, cultural and paleontological resources, socioeconomics (local transportation), and waste management.

- At INEL, potential cumulative impacts were identified for land resources, site infrastructure, air quality, biological resources, cultural and paleontological resources, socioeconomics (local transportation), and waste management.

- At Pantex, potential cumulative impacts were identified for land resources, site infrastructure, air quality, water resources, cultural and paleontological resources, socioeconomics (local transportation), and waste management.

- At SRS, potential cumulative impacts were identified for land resources, site infrastructure, air quality, biological resources, cultural and paleontological resources, socioeconomics (local transportation), public and occupational health and safety, and waste management.

S.8 COMPARISON OF ALTERNATIVES

The environmental impacts of the storage and disposition alternatives, including the Preferred Alternative, are compared in this section. The emphasis is on those environmental resources and issues that discriminate between the alternatives and are of interest to the public. Detailed comparison tables, including each alternative and each resource and issue, are contained in Chapter 2 of the PEIS. Within this Chapter, Table 2.5–1 provides a summary of environmental impacts for the Preferred Alternative for storage; Table 2.5–2 provides a comparison of environmental impacts for the No Action and long-term storage alternatives; and Table 2.5–3 provides a comparison of environmental impacts for disposition alternatives (including the Preferred Alternative).

LONG-TERM STORAGE

Tables S.8–1 through S.8–6 present a comparison of the key environmental impacts for the long-term storage alternatives and the Preferred Alternative for storage. As discussed in Section S.2, the Preferred Alternative for storage is a combination of No Action and Upgrade Alternatives for the various DOE sites, and phaseout of Pu storage at RFETS.

For all of the storage sites, the No Action Alternative is used as a baseline from which incremental impacts of the storage alternatives are compared. The phaseout associated with these storage alternatives could reduce human health and waste generation impacts and increase the number of lost jobs at some sites.

Site Infrastructure. For the Upgrade Alternatives, all requirements would be within existing site capacities for all sites except for coal at ORR and SRS. Under the Preferred Alternative, coal consumption at ORR and SRS would exceed site storage capacities by less than 1 percent; all other requirements would be within existing site capacities. In those cases where site capacity for fuel storage does not adequately support increased requirements, more frequent deliveries would be scheduled. Increases in resource requirements would be within the following ranges over No Action: electrical energy, 0 to 104 percent (maximum for Pantex); peak electric load, 0 to 90 percent (maximum for Pantex); oil, 0 to 13 percent (maximum for INEL for the Upgrade Alternative); natural gas, 0 to 71 percent (maximum for Pantex); and coal, 0 to 1 percent (maximum for ORR).

For the Consolidation Alteratives, all requirements would be within existing site capacities at all sites except for the following: electrical energy (12 percent over existing capacity), oil (1 percent over existing capacity), and natural gas (no existing capacity) at NTS; coal at INEL (97 percent over existing capacity); and oil (1 percent over existing capacity) and coal (2 percent over existing capacity) at SRS. In these cases where site capacity for fuel storage does not adequately support increased requirements, more frequent deliveries would be scheduled. Increases in resource requirements would be within the following ranges over No Action: electrical energy, 8 to 104 percent (maximum for Pantex); peak electric load, 9 to 90 percent (maximum for Pantex); oil, 1 to 5 percent (maximum for Pantex); natural gas, 0 percent (no existing capacity at NTS); and coal, 0 to 97 percent (maximum for INEL). All infrastructure requirements could be met by increasing procurement or, in the case of NTS, by using a different energy source.

For the Collocation Alternatives, all requirements would be within existing site capacities at all sites except for the following: electrical energy (21 percent over existing capacity), oil (1 percent over existing capacity), and natural gas (no existing capacity) at NTS; coal at INEL (124 percent over existing capacity); oil (3 percent over existing capacity), and coal (35 percent over existing capacity) at ORR; and oil (1 percent over existing capacity) and coal (3 percent over existing capacity) at SRS. In these cases where site capacity for fuel storage does not adequately support increased requirements, more frequent deliveries would be scheduled. Increases in resource requirements would be within the following ranges over No Action: electrical energy, 8 to 126 percent (maximum for Pantex); peak electric load, 9 to 100 percent (maximum for Pantex); oil, 1 to 14 percent (maximum for ORR); natural gas, 0 percent (no existing capacity at NTS); and coal, 0 to 124 percent (maximum for INEL).

Soil, Cultural, and Paleontological. Ground disturbance during construction activities would potentially impact soil; cultural resources (including historic, prehistoric, and Native American); and paleontological resources. The Upgrade Alternatives and the Preferred Alternative would have fewer impacts because they use existing facilities or involve only small areas of ground disturbance. The Consolidation and Collocation Alternatives would have more impacts because they involve more ground disturbance due to the construction of new facilities.

Land Use and Visual Resources. For land use, the larger facilities associated with Consolidation and Collocation Alternatives would use more land (56 to 87 ha [138 to 215 acres]) than the facilities associated with Upgrade and Preferred Alternatives (0 to 0.1 ha [0 to 0.25 acres]). The Collocation Alternative at ORR would

change the current VRM Class 4 designation of the Bear Creek Road/Route 95 intersection to Class 5. Visual resources at the other DOE sites would not be affected by the storage alternatives because the facilities would be located near other similar structures.

Air Quality and Noise. Since the Collocation and Consolidation Alternatives would result in more air emission sources (exhaust from delivery trucks, generators, and boilers), slightly greater air quality impacts would occur than with the Upgrade and Preferred Alternatives. The more extensive ground disturbance during construction associated with the Consolidation and Collocation Alternatives would also result in higher levels of PM_{10} and TSP than for the Upgrade and Preferred Alternatives. Potential air emissions for all of the alternatives are within applicable Federal, State, and local air quality standards and guidelines. Minimal noise impacts would be expected from the storage alternatives because of the remote location of the facilities that would be modified or constructed.

Socioeconomics. Beneficial impacts to regional employment would be expected from all storage alternatives at all storage sites (Table S.8–1) except for the site (or sites depending on the alternative) where storage would be phased out. Collocation would generate the largest employment, followed by the Consolidation, Upgrade, and Preferred Alternatives. However, the phaseout at RFETS associated with the Preferred Alternative would result in the loss of approximately 2,200 direct jobs. Due to the small number of the new jobs created by the alternatives relative to the size of the regional economies at all of the DOE sites, community services would not be affected by the long-term storage alternatives. Short-term local transportation impacts may result at all sites from the construction of the facilities associated with the storage alternatives. The larger construction projects (Collocation and Consolidation Alternatives) would have a greater potential to cause short-term congestion on local roads than the smaller construction projects (the Upgrade and Preferred Alternatives).

Table S.8–1. Maximum Incremental Direct Employment Over No Action Generated During Operations at Each Candidate Site

Site	Total Site Employment in 2005	Upgrade	Consolidation	Collocation	Preferred Alternative
Hanford	14,586	252[a]	443	572	0
NTS	3,800	NA	527[b]	641[b]	0
INEL	6,911	116[a]	432	561	0
Pantex	3,559	90[c]	509[d]	601	90[e]
ORR	18,010	111	[f]	566[g]	111
SRS	16,562	30[h]	485	614	30[h,i]

[a] Upgrade with RFETS and LANL materials.
[b] Modify P-Tunnel.
[c] Upgrade with RFETS and LANL materials. Actual number of employees during operation could be higher.
[d] Construct new and modify existing storage facilities.
[e] Upgrade with pits from RFETS.
[f] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[g] Construct new Pu and HEU facilities.
[h] Workers would be supplied from existing site workforce.
[i] Upgrade with non-pit materials from RFETS.
Note: NA=not applicable.

Water Resources. The water resource impacts for the Consolidation and Collocation Alternatives are greater than for the Upgrade and Preferred Alternatives, both in water requirements and wastewater discharges. Wastewater discharge is dependent on the number of employees, which is greatest for the Consolidation and Collocation Alternatives due to the larger facilities. As shown in Table S.8–2, water resource requirements are the greatest for the Collocation Alternative at all DOE sites because collocation includes the maximum amount of Pu and HEU in the PEIS. Water resource requirements for all the alternatives would impact groundwater

availability at Pantex because the additional groundwater withdrawal would contribute to the existing overall decline in water levels of the Ogallala Aquifer. However, there should be minimal impacts to regional groundwater levels from this additional withdrawal. At all other sites, water requirements would have minimal impact on water resources because of the abundance of surface water or groundwater.

Table S.8–2. Maximum Annual Net Incremental Water Usage Over No Action During Operation at Each Candidate Site

Site	No Action in 2005 (MLY)	Upgrade (MLY)	Consolidation (MLY)	Collocation (MLY)	Preferred Alternative (MLY)
Hanford	195	8.9[a]	110	150	0
NTS	2,400	NA	130[b]	190[b]	0
INEL	7,570	22[a]	66	87	0
Pantex	249	110[a]	110[c]	130	27.5[d]
ORR	14,760	0.24	[e]	360[f]	0.24
SRS	13,247	7.1[a]	360	460	5.7[g]

[a] Upgrade with RFETS and LANL materials.
[b] Modify P-Tunnel.
[c] Construct new and modify existing storage facility.
[d] Upgrade with pits from RFETS.
[e] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[f] Construct new Pu and HEU facilities.
[g] Upgrade with non-pit materials from RFETS.
Note: MLY=million liters per year; NA=not applicable.

Biological Resources. The Preferred Alternative would have no incremental biological resource impacts at INEL and Hanford, and minimal impacts at Pantex and potentially at SRS because of ground disturbance for upgrades. The Consolidation and Collocation Alternatives would have the potential to impact biological resources at all DOE sites because they would involve ground disturbance. At Pantex, previously disturbed land would be used for consolidation and collocation facilities. Threatened and endangered species at NTS and SRS may be affected by the storage alternatives at these sites.

Environmental Justice. All six DOE storage sites have, within an 80-km (50-mi) radius, census tracts with greater than 25 percent minority or low-income populations. However, the public health and safety analyses show that air emissions and hazardous chemical and radiological releases from normal operations for all storage alternatives would be within regulatory limits and that no latent cancer fatalities would result. The public health and safety analyses also indicate that radiological releases from accidents would not result in disproportionate and adverse human health or environmental impacts. Potential transportation accidents would be random events along transportation corridors. Therefore, none of the storage alternatives would have disproportionately high or adverse impacts on minority or low-income populations.

Waste Management. All of the storage alternatives would impact existing waste management practices at the DOE sites by increasing the amount of waste that must be treated, stored, and disposed. Depending on decisions in the waste-type-specific RODs for the Waste Management PEIS, wastes would be treated and disposed of onsite or at regionalized or centralized DOE sites. Generally, the Consolidation and Collocation Alternatives would generate more wastes than the Upgrade and Preferred Alternatives. Tables S.8–3 through S.8–5 show the maximum incremental waste generation rates for solid TRU, solid low-level, and solid hazardous wastes at the six candidate sites.

Public and Occupational Health and Safety. Table S.8–6 shows the differences between the long-term storage alternatives for radiological exposures to the public. The maximum potential latent cancer fatalities over No

Action for the MEI over 50 years from normal operations ranges from 4.5×10^{-13} for the Upgrade and Preferred Alternatives at Pantex to 1.1×10^{-9} for the Collocation Upgrade Alternative at ORR. This means that the chance of a latent cancer fatality occurring ranges from about 1 in 1 billion to 5 in 10 trillion. The risk varies because of site parameters including the distance from the facility to the MEI (small sites vs. large sites); local meteorological conditions (windspeed, direction, and stability); and the type of material being stored (metals and oxides vs. residues).

Table S.8–3. Maximum Annual Net Incremental Volume of Solid Low-Level Waste Over No Action Generated During Operations at Each Candidate Site

Site	Waste Generated in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)	Preferred Alternative (m^3)
Hanford	3,390	89[a]	1,260	1,300	0
NTS	15,000	NA	1,260	1,300	0
INEL	7,200	500[a]	1,260	1,300	0
Pantex	32	1,260[a]	1,260	1,300	138[b]
ORR	7,320	3	[c]	1,300[d]	3
SRS	16,400	0	1,220[e]	1,260[e]	0

[a] Upgrade with RFETS and LANL materials.
[b] Upgrade with pits from RFETS.
[c] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[d] Construct new Pu and HEU facilities.
[e] Net waste from new facility and from phaseout of existing facility.
Note: NA=not applicable.

Table S.8–4. Maximum Annual Net Incremental Volume of Solid Transuranic Waste Over No Action Generated During Operations at Each Candidate Site

Site	Waste Generated in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)	Preferred Alternative (m^3)
Hanford	271	21[a]	10	10	0
NTS	0	NA	10	10	0
INEL	3.5	2[a]	10	10	0
Pantex	0	10[a]	10	10	0.8[b]
ORR	119	0	[c]	10[d]	0
SRS	338	0	2[e]	2[e]	0

[a] Upgrade with RFETS and LANL materials.
[b] Upgrade with pits from RFETS.
[c] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[d] Construct new Pu and HEU facilities.
[e] Net waste from new facility and from phaseout of existing facility.
Note: NA=not applicable.

Table S.8–5. Maximum Annual Net Incremental Volume of Solid Hazardous Waste Over No Action Generated During Operations at Each Candidate Site

Site	Waste Generated in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)	Preferred Alternative (m^3)
Hanford	560	4	2	2	0
NTS	212	NA	2	2	0
INEL	1,200	1	2	2	0
Pantex	31	2[a]	2	2	1.5[b]
ORR	26	0.8[c]	[d]	2[e]	0.8
SRS	15,100	0.8[a]	2	2	0.6[f]

[a] Upgrade with RFETS and LANL materials.
[b] Upgrade with pits from RFETS.
[c] Total of mixed LLW and hazardous waste because hazardous waste is included in mixed LLW.
[d] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[e] Construct new Pu and HEU facilities.
[f] Upgrade with non-pit materials from RFETS.
Note: NA=not applicable.

Table S.8–6. Maximum Latent Cancer Fatalities Over No Action for Maximally Exposed Individual for 50 Years From Normal Operations at Each Candidate Site

Site	No Action in 2005	Upgrade	Consolidation	Collocation	Preferred Alternative
Hanford	1.0×10^{-8}	4.5×10^{-11}	6.2×10^{-11}	6.2×10^{-11}	0
NTS	1.0×10^{-7}	NA	1.4×10^{-10}	1.4×10^{-10}	0
INEL	4.4×10^{-7}	1.3×10^{-11}	4.0×10^{-11}	4.0×10^{-11}	0
Pantex	1.5×10^{-9}	4.5×10^{-13}	2.4×10^{-10}	2.4×10^{-10}	4.5×10^{-13}
ORR	3.5×10^{-8}	5.5×10^{-13}	[a]	1.1×10^{-9}	5.5×10^{-13}
SRS	2.0×10^{-5}	2.1×10^{-10}	3.5×10^{-10}	3.5×10^{-10}	2.1×10^{-10}

[a] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
Note: NA=not applicable.

Potential accidents were postulated for each of the long-term storage alternatives. The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the accident scenario evaluated with the highest risk (PCV penetration by corrosion) for the Upgrade Alternative would be: 4.3×10^{-4} at Hanford; 1.6×10^{-3} at INEL; 8.8×10^{-4} at Pantex (Preferred Alternative); 3.0×10^{-5} at ORR (Preferred Alternative); and 4.6×10^{-4} at SRS. For both the Consolidation and Collocation Alternatives, the highest risk to the population located within 80 km (50 mi) of the accident release point associated with the accident scenarios evaluated (PCV penetration by corrosion) would be: 4.2×10^{-3} at Hanford; $5.1\times10^{-5}/9.4\times10^{-5}$ at NTS (P-Tunnel/New Pu and HEU Facility); 1.2×10^{-3} at INEL; 1.4×10^{-3} at Pantex; and 1.7×10^{-2} at ORR; and 4.6×10^{-3} at SRS. Since Pu accidents dominate the accident spectrum, the risks would be higher for the Consolidation and Collocation Alternatives because these alternatives would require more Pu at a single DOE site than the Upgrade Alternative.

Intersite Transportation. For intersite transportation, the Upgrade and Preferred Alternatives would have lower potential for fatalities. For the Preferred Alternative, the number of potential fatalities ranges from 0 at Hanford and INEL (since there is no transport of material) to 0.06 at SRS. The Consolidation and Collocation Alternatives would have the higher potential for intersite transportation fatalities because they would move the greatest amount of material between sites. The number of potential fatalities ranges from 0.079 (Consolidated Storage Alternative at Pantex) to 1.07 (Collocated Storage Alternative at Hanford). Intersite transportation impacts would primarily result from nonradiological sources, such as fatalities from nonradiological traffic accidents.

DISPOSITION ALTERNATIVES

Table S.8–7 depicts total campaign data for the disposition alternatives including the Preferred Alternative for disposition. A total of approximately 50 t (55.1 tons) of surplus Pu is assumed to be processed over the life of the campaign. In preparation for disposition under any alternative, surplus Pu must be processed through either the pit disassembly/conversion facility or the Pu conversion facility. Approximately 32.5 t (35.8 tons) are assumed to be processed at the pit disassembly/conversion facility, and approximately 17.5 t (19.3 tons) at the Pu conversion facility. Since these two facilities produce the input material for the other disposition facilities, actions at these two facilities would be the first to occur for the campaign. The operating period for these two facilities for each disposition alternative, including the Preferred Alternative, is 10 years.

Table S.8–7. Total Campaign Data (Approximate) for Disposition Alternatives and the Preferred Alternative

	Disposition Alternatives			Preferred Alternative		
Action	Total Pu (t)	Throughput (t/yr)	Years In Operation	Total Pu (t)	Throughput (t/yr)	Years In Operation
Pit disassembly/ conversion	32.5	3.25	10	32.5	3.25	10
Pu conversion	17.5	1.75	10	17.5	1.75	10
Direct to borehole	50	5	10	NA	NA	NA
Immobilized to borehole	50	5	10	NA	NA	NA
Vitrification	50	5	10	17.5[a]	5[a]	3.5[a]
Ceramic immobilization	50	5	10	17.5[a]	5[a]	3.5[a]
Electrometallurgical treatment	50	5	10	NA	NA	NA
MOX fuel fabrication	50	3	17	32.5	3	11
5 Existing LWRs[b]	50	3	17	32.5	3	11
2 Partially completed LWRs[c]	50	3	17	NA	NA	NA
2 Large or 4 small evolutionary LWRs	50	3	17	NA	NA	NA
CANDU reactors[d]	50	3.8	13	NA	NA	NA

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

[b] Three to five existing LWRs would be used depending upon the amount of MOX fuel in the reactor core.

[c] If the partially completed LWRs were to be completed by other parties, they would be considered existing LWRs and could compete for the surplus Pu disposition mission under the Preferred Alternative.

[d] The CANDU reactor is retained in the event a multilateral agreement is made among Russia, Canada, and the United States to use CANDU reactors.

Note: NA=not applicable.

The operation of the disposition facilities for a single disposition alternative would require between 10 and 17 years to accomplish the disposition mission. However, the Preferred Alternative may result in fewer years of operation for the disposition facilities, since the 50 t (55.1 tons) of surplus Pu would be dispositioned under two different technologies. For purposes of analysis, it is assumed that approximately 17.5 t (19.3 tons) of surplus Pu would be immobilized through vitrification or ceramic immobilization, and approximately 32.5 t (35.8 tons) would be converted to MOX fuel for use in reactors,[20] under the Preferred Alternative. The number of years in

[20] The actual amount dispositioned under each disposition technology would depend on subsequent NEPA analysis, costs, test and demonstration results, international agreements, and the procurement process among other things.

operation for each disposition technology may be less than that required to process the full 50 t (55.1 tons) with any single disposition alternative.

Actual years of operation and Pu throughput rates for any of the reactor disposition alternatives would not exceed 17 years and 3.8 t/yr (4.2 tons/yr), respectively, but could be less depending upon the final reactor core design. Variables such as the amount of MOX fuel included in each core have not yet been determined and would affect the years required to complete the mission using the reactor alternatives. Conservative estimates for throughput and years in operation are presented for comparing the Reactor Alternatives with the Preferred Alternative.

Table S.8–8 presents a comparison of the total campaign impacts from the disposition of 50 t (55.1 tons) of surplus Pu for key environmental resources for the individual disposition alternatives and the Preferred Alternative. Since the ceramic immobilization facility generally has greater impacts than the vitrification facility, it was used in the calculation of the total campaign impacts for the Preferred Alternative. A comparison of impacts is not included for community services, environmental justice, and noise since the impacts are highly site-specific.

Biological, Geology and Soil, Land Use, and Cultural and Paleontological Resources. Ground disturbance during construction activities would potentially impact soil; biological; cultural resources (including historic, prehistoric, and Native American); and paleontological resources for all of the disposition alternatives. The immobilization alternatives would disturb the least amount of land while the Evolutionary LWR Alternative would disturb the most land area because it would require the most new construction. However, when considering operational land area, the two Deep Borehole Alternatives would require the most land because of the 1.6-km (1-mi) radius buffer zone. Depending upon location, all of the alternatives could result in visual resource impacts by changing the visual resource management classification of an area. The Deep Borehole Alternatives would impact geologic resources because the borehole operations would render the site perpetually unusable.

Site Infrastructure and Water Resources. The evolutionary LWR would require the largest electrical load during operations. The Evolutionary LWR and the Partially Completed LWR Alternatives would require the most additional water for operations. The rest of the alternatives would require nearly the same amount of water, with the exception of the Electrometallurgical Treatment Alternative, which would require the least amount of water.

Air Quality and Socioeconomics. Potential construction-related impacts on air quality and local transportation would be minor for all of the disposition alternatives and the Preferred Alternative. The Evolutionary LWR and Partially Completed LWR Alternatives would generate the most employment and income among the alternatives. For local transportation, the Evolutionary LWR Alternative would have the greatest potential of reducing the level of service on local roads during construction and/or operations. Some reduction in level of service would also be expected for the Vitrification, Ceramic Immobilization, and the Preferred Alternatives.

Public and Occupational Health and Safety. There would be potential for impacts to public and occupational health and safety from the radiological and hazardous chemical doses during operations of all the disposition alternatives, including the Preferred Alternative; however, the annual radiological doses to onsite workers and the public would be within regulatory limits for all alternatives. For hazardous chemicals, potential impacts to the public and onsite workers would not be expected to cause adverse health affects.

A set of potential accidents was postulated for each of the disposition technology alternatives. The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the front-end disposition process campaign would range from 4.5×10^{-16} to 1.7×10^{-4} for pit disassembly/conversion (for the highest accident risk scenario [fire on loading dock] at the potential disposition sites: 4.6×10^{-5} at Hanford; 1.4×10^{-5} at INEL; 1.6×10^{-5} at Pantex; and 5.0×10^{-5} at SRS) and from 1.5×10^{-16} to 1.3×10^{-4} for Pu conversion

Table S.8–8. Comparison of Resource Use and Impacts From the Total Campaign for the Operation of Disposition Alternatives[a]

Alternatives	Total Number of Worker-Years	Water Usage (million l)	Latent Cancer Fatalities for MEI from Lifetime Accident-Free Operation	Solid TRU Waste Generated (m^3)	Solid Low-Level Waste Generated (m^3)	Solid Hazardous Waste Generated (m^3)
Direct to borehole	20,550	3,405	$1.2x10^{-9}$ to $1.2x10^{-7}$	3,452	18,500	287
Immobilized to borehole	29,550	6,605	$1.2x10^{-9}$ to $1.2x10^{-7}$	4,955	18,740	497
Vitrification	24,810	4,251	$1.2x10^{-9}$ to $1.2x10^{-7}$	4,440	18,590	307
Ceramic immobilization	25,730	4,251	$1.2x10^{-9}$ to $1.2x10^{-7}$	4,440	18,590	307
Electrometallurgical treatment	17,960	1,751	$1.2x10^{-9}$ to $1.3x10^{-7}$	3,510	19,000	125
5 Existing LWRs[b]	29,030	2,717	$1.3x10^{-6}$ to $2.6x10^{-6}$	8,652	21,051	2,718
2 Partially completed LWRs[c]	47,305	2,352,000	$9.8x10^{-6}$ to $9.9x10^{-6}$	8,652	22,955 to 42,709	3,636
2 Evolutionary large LWRs[d]	53,850	2,062,000	$5.8x10^{-7}$ to $8.2x10^{-5}$	8,652	38,051	3,636
4 Evolutionary small LWRs[e]	59,630	1,856,000	$8.4x10^{-7}$ to $9.6x10^{-5}$	8,652	39,411	4,554
CANDU reactors[f]	25,630	2,717	$1.8x10^{-9}$ to $1.2x10^{-7}$	8,652	21,051	2,718
Preferred Alternative[g]	16,140	3,253	$9.0x10^{-7}$ to $1.7x10^{-6}$	7,163	20,182	1,866

[a] Data includes all front-end processes (Pu conversion, pit disassembly/conversion, and MOX fuel fabrication) that would be needed for the individual alternatives. The total campaign impacts were calculated by multiplying the annual impacts times the number of years of operation, as identified in Table S.8–7.

[b] The table reflects the use of 5 existing LWRs. Three to five existing LWRs would be used depending upon the amount of MOX fuel in the reactor core.

[c] The table reflects the use of 2 partially completed LWRs.

[d] The table reflects the use of 2 evolutionary large LWRs.

[e] The table reflects the use of 4 evolutionary small LWRs.

[f] The table reflects impacts from pit disassembly/conversion and MOX fuel fabrication in the United States.

[g] Ceramic immobilization and 5 existing LWRs are the assumed technologies for the Preferred Alternative for comparative purposes only.

(for the highest accident risk scenario [fire on loading dock] at the potential disposition sites: $3.5x10^{-5}$ at Hanford and $3.2x10^{-5}$ at SRS). Within the borehole category, the risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for direct disposition campaign would range from $8.4x10^{-16}$ to $6.3x10^{-8}$. For both the ceramic immobilization front-end process prior to immobilized disposal, and ultimate disposition in the deep borehole complex, the risks would range from $9.3x10^{-18}$ to $6.3x10^{-8}$ and $9.3x10^{-19}$ to $6.3x10^{-9}$, respectively for the disposition campaign. The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the immobilization category would range from $2.8x10^{-14}$ to $1.8x10^{-5}$ for the vitrification alternative and from $7.0x10^{-16}$ to $1.9x10^{-7}$ for the ceramic

immobilization alternative over the disposition campaign (for the highest accident scenario [criticality] at the potential disposition sites and 30 percent immobilization campaign: 1.7×10^{-8} at Hanford and 2.1×10^{-8} at SRS). For the immobilization of Pu through electrometallurgical treatment of spent fuels, the projected campaign risk to the population would be 3.5×10^{-7} for the accident scenario evaluated with the highest risk (a breach in the argon cell initiated by a design basis earthquake).

For the reactor alternative, the risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the MOX fuel fabrication facility would range from 4.6×10^{-16} to 4.3×10^{-4} for the campaign (for the highest accident scenario [fire on loading dock] at the potential disposition sites using for analysis purposes, approximately 70 percent disposition campaign: 5.2×10^{-5} at Hanford; 1.6×10^{-5} at INEL; 1.8×10^{-5} at Pantex; and 5.2×10^{-5} at SRS). The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the MOX-fueled evolutionary LWR would range from 9.6×10^{-11} to 6.9×10^{-6}. Under the Preferred Alternative, DOE would pursue the use of MOX-fueled LWRs. The incremental effects of utilizing MOX fuel in a reactor in place of UO_2 were derived from a quantitative analysis of severe accident release scenarios for MOX and UO_2 using the MACCS computer code and generic population and meteorology data. The analysis only considers severe accidents where sufficient damage would occur to cause the release of Pu or uranium. The risks of severe accidents were found to be in the range of plus 8 to minus 7 percent, compared to UO_2 fuel, depending on the accident release scenario. The incremental risk of cancer fatalities to a generic population located within 80 km (50 mi) of the severe accident release point would range from -2.0×10^{-4} to 3.0×10^{-5} per year.

Waste Management. The reactor alternatives and the Preferred Alternative would be the only alternatives that would generate spent nuclear fuel. The Partially Completed LWR Alternative would generate the largest incremental increase in spent nuclear fuel. The Preferred Alternative would generate the lowest incremental increase of spent nuclear fuel among the reactor alternatives because the combination of disposition technologies would require less Pu to go through reactors. The reactor alternatives and the Preferred Alternative would also generate the most solid TRU, solid low-level, and solid hazardous waste among the alternatives.

Intersite Transportation. The Evolutionary LWR and Partially Completed LWR Alternatives would have the highest potential fatalities over the total campaign because they would require the most material transport. The Preferred Alternative and Electrometallurgical Treatment Alternative would have the lowest potential fatalities from transportation. Intersite transportation impacts would primarily be the result of nonradiological impacts such as fatalities from nonradiological highway accidents.

S.9 SUMMARY OF MAJOR ISSUES IDENTIFIED DURING THE COMMENT PERIOD AND CHANGES TO THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

S.9.1 ISSUES IDENTIFIED AND RESOLVED

The Department initially issued the Storage and Disposition PEIS as a draft for public comment for the period from March 8 through May 7, 1996. In response to public requests, DOE extended the comment period deadline to June 7, 1996. Public meetings on the Draft PEIS were held in March and April 1996 at the following locations:

Denver, CO	March 26, 1996
Las Vegas, NV	March 28–29, 1996
Oak Ridge, TN	April 2, 1996
Richland, WA	April 11, 1996

Idaho Falls, ID	April 15, 1996
Washington, DC	April 17–18, 1996
Amarillo, TX	April 22–23, 1996
North Augusta, SC	April 30, 1996

During the 92-day public comment period on the Storage and Disposition Draft PEIS, DOE received comments on the document by mail, fax, telephone recording, electronic mail, and orally at the public meetings. Altogether, DOE received approximately 8,700 written and recorded comments from individuals and organizations. All comments are presented in Volume IV of the Storage and Disposition Final PEIS, the *Comment Response Document.*

Approximately 80 percent of the comments received consisted of mail-in letter and postcard campaigns which expressed either support of or opposition to the use of various sites or alternatives. Many commentors encouraged DOE and the United States to become the world leader in the safe, secure, and timely disposition of Pu, and favored worldwide nonproliferation efforts for surplus Pu. The following highlights recurring comments, DOE's response, and the PEIS revisions in response to these comments.

A number of commentors expressed the opinion that the surplus Pu should remain in present locations for future energy or weapons use, or until new technologies are available for disposition. In response to these concerns, DOE expanded the discussion on the need for the proposed Pu disposition action in the PEIS. Disposition is necessary to implement the President's *Nonproliferation and Export Control Policy* in a safe, reliable, cost-effective, and timely manner.

Some commentors also stated that DOE should consider additional disposition alternatives, including the use of FFTF, deep burn reactors, and mononitride reactors. The use of advanced reactors such as deep burn reactors and mononitride reactors was considered but eliminated due to the technical immaturity, attendant costs, and lengthy development and demonstration efforts required to bring the technologies to a viable, practical status and enable disposition options to be initiated with certainty. The FFTF would be considered for Pu disposition if first selected for tritium production. The FFTF is not a reasonable, stand-alone alternative because it is in a standby status awaiting shutdown and because it could not satisfy the criterion of completing the disposition mission within 25 years. A discussion of FFTF for this purpose is included in Appendix N. In all, thirty-seven different alternative options were considered by DOE for disposition of Pu. DOE has made revisions to the Summary and Chapter 2 of the PEIS to clarify how the screening process was used for selection of reasonable alternatives.

Commentors noted that transportation of fissile materials is one of their major concerns with the Program. The ground transportation between sites, in the event a consolidation alternative was selected, could increase the potential for traffic accidents. International transportation for specific border crossings for the shipment of MOX fuel to Canada for the CANDU Reactor Alternative was also identified as a concern. DOE acknowledges the public's concern, and in response, the transportation analysis in Section 4.4 and Appendix G of the Draft PEIS was expanded. The revisions address security measures for land and sea transport, emergency preparedness, and clarify the results of analyses performed.

One frequently recurring comment presented by the public relates to the technical, cost, schedule, and nonproliferation analyses to support DOE's ROD. Many of the commentors suggested that DOE should make information available for public review. Since issuance of the Draft PEIS, DOE has prepared both the *Technical Summary Report for Long-Term Storage of Weapons-Usable Fissile Materials* (DOE/MD-0004 Rev. 1) and the *Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition* (DOE/MD-0003 Rev. 1). These two reports summarize representative technical, cost, and schedule data for the reasonable alternatives being

considered for long-term storage and surplus Pu disposition, respectively. In July and August 1996, these documents were initially distributed for public review and comment. After taking the public's comments into consideration, DOE revised and re-issued both reports in November and December 1996. In October 1996, DOE issued the *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives*, which analyzes the nonproliferation and arms reduction implications of the alternatives addressed in the PEIS for Pu and HEU storage and the disposition of surplus Pu. From October through early November 1996, the public was asked to review and comment on the draft nonproliferation document; this process included a series of 10 public meetings held nationwide. Public comments received are being taken into consideration in revising the report, which is scheduled for re-issue in late 1996. This report, in conjunction with the Final PEIS, the technical summary reports previously described, and public input, will form the basis for DOE's decisions, which will be discussed in a ROD to be issued no sooner than 30 days after publication of the Environmental Protection Agency's Notice of Availability of the Final PEIS.

Commentors also stated that the U.S. Nonproliferation Policy does not encourage the civil use of Pu or Pu processing for either nuclear power or nuclear explosive purposes. The commentors requested that the PEIS address the possibility that the MOX option would have an adverse effect on U.S. nonproliferation policy by encouraging its use in civil nuclear power programs and by encouraging Pu reprocessing and recycling. DOE acknowledges the public concern for nonproliferation. As discussed in the PEIS, the reactor option would utilize a once-through fuel cycle. Spent fuel from disposition would be disposed of with other commercial reactor spent fuel. This is consistent with U.S. policy since no Pu in the spent fuel would be recycled. Revisions to the Summary and Chapter 1 of the PEIS were made to expand and clarify this issue.

Commentors indicated that the isotopic composition of the residual Pu in the final waste forms is an inappropriate criterion by which to assess proliferation risks because it perpetuates a myth that reactor-grade Pu cannot be used to make workable weapons. In the opinion of these commentors, isotopic degradation does not constitute a compelling argument in favor of the MOX option. DOE acknowledges that, although it may be possible to make a nuclear weapon from spent commercial reactor fuel, this can only be done with extreme difficulty by individuals with a great deal of experience in handling and processing nuclear materials. DOE believes that the disposition of weapons Pu through the use of MOX fuel in reactors would meet the Spent Fuel Standard in creating a radiological barrier that makes the Pu as difficult to retrieve and reuse in weapons as Pu in spent commercial fuel. The use of this technology would allow for the Pu to be disposed in a geologic repository, the same as for spent commercial fuel. Revisions to Chapter 1 of the PEIS were made to clarify this issue.

S.9.2 CHANGES MADE TO THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

This section identifies changes made since the issuance of the Draft PEIS. The Final PEIS includes the Preferred Alternative, which is a combination of other alternatives and is described in Section S.2 and Section 1.6. Other changes, after considering public comments, are described below.

Appendix N, which in the Draft PEIS summarized the operational aspects of the multipurpose reactor, has been revised for the Final PEIS to provide information on the costs and benefits of conducting separate tritium production and Pu disposition missions versus the costs and benefits of carrying out one multipurpose mission. Included in Appendix N is a cost comparison of using new Advanced LWRs or Modular Helium Reactors, and a discussion of issues regarding the use of the FFTF (a liquid metal reactor at Hanford) for tritium production and Pu disposition.

Appendices O, P, Q, and R were added to the Final PEIS to help clarify alternative issues as they relate to the Preferred Alternative. Appendix O describes two can-in-canister technology concepts at SRS, which are variants of the Vitrification and Ceramic Immobilization Disposition Alternatives described in Chapter 2. This

information was added based on public interest in these concepts during the Draft PEIS comment period, and also because of DOE's reconsideration of this technology as being a viable approach for Pu disposition through immobilization.

Appendix P provides a description of using the Manzano Weapons Storage Area (WSA) near Albuquerque, NM to store Pu pits. This appendix was added because DOE's Preferred Alternative separates the storage of pits from non-pit materials, in which case Manzano WSA no longer appears unreasonable under the Preferred Alternative for pit storage. However, since DOE's preferred site for interim storage of pits is Pantex (as described in the Pantex EIS) and since the majority of pits are already located in storage at Pantex, the Preferred Alternative proposes the long-term storage of Pu pits at Pantex. Weapons assembly/disassembly would continue at Pantex in any case. Construction of a new storage facility at Manzano would create needless expense and transportation risk.

Appendix Q describes the operations and human (radiological) health impacts associated with Pu pits being transferred from RFETS to Pantex, repackaged in Zone 12 South, and placed in storage in Zone 4 West at Pantex, as part of the Preferred Alternative for long-term storage. The information presented in this appendix is based on the Pantex EIS analysis of storing the Pu pits already at Pantex.

Appendix R discusses aircraft crash and radioactive release probabilities for proposed storage and disposition facilities at Pantex.

Section 1.2 of the Final PEIS has been revised to reflect the cooperative effort between the United States and Russia to study different options for managing excess Pu (including secure storage, conversion of Pu weapons components to other forms, and stabilization of unstable forms of Pu), and options for disposition of excess Pu (deep borehole, immobilization, and reactors). The results of this study have been documented in the *Joint United States/Russian Plutonium Disposition Study* report, completed in September 1996. This study and the options considered will provide decisionmakers from both countries with a set of jointly evaluated alternatives for Pu disposition and help build further trust and cooperation in the area of fissile material disposition.

QA: N/A

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Office of
Fissile Materials Disposition

United States Department of Energy

Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Volume I

December 1996

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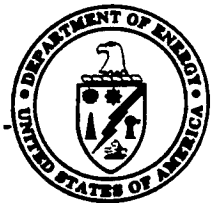

DOE/EIS-0229

Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Volume I

United States Department of Energy
Office of Fissile Materials Disposition

December 1996

FOREWORD

This is the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (PEIS), prepared by the U.S. Department of Energy, Office of Fissile Materials Disposition. The document is composed of four volumes and a separate Summary. Changes made since the Draft PEIS are shown by change bar notation (vertical lines adjacent to the changes) in this Final PEIS for both text and tables. Deletion of one or more sentences is indicated by the phrase "Text deleted." in brackets. This Final PEIS includes the Preferred Alternative, which is a combination of alternatives. The Preferred Alternative is described in Section 1.6 and Chapter 2 of Volume I, and analyzed in Chapter 4 of Volume II. For all the alternatives, including the Preferred Alternative, a comparison of alternatives is presented in Section 2.5 of Volume I and a summary of impacts is presented in Section 4.6 of Volume II (Part B). Information from these sections is also presented in the Summary.

Volume I contains Chapters 1 through 3 of the PEIS. Chapter 1 includes a description of the history and background of the fissile materials disposition program, the purpose of and need for the proposed action, a summary of changes made to the Draft PEIS, and the Preferred Alternative. Chapter 2 gives a description of the proposed long-term storage and disposition alternatives, a description of how the alternatives were selected and why others were eliminated from further consideration, and a comparison of the alternatives in terms of their potential environmental impacts. Chapter 3 describes the affected environment at candidate long-term storage locations, and at sites and environmental settings for the disposition alternatives.

Volume II (Parts A and B) contains Chapters 4 through 10 of the PEIS. Chapter 4 describes the potential environmental impacts resulting from construction and operation of the proposed long-term storage and disposition alternatives, including the Preferred Alternative. Also contained in this chapter are intersite transportation impacts, a discussion of environmental justice issues, cumulative impacts due to the implementation of the proposed alternatives in addition to other actions at a site, avoided environmental impacts, and a summary of impacts. Chapter 5 provides a list of references used in the preparation of this document. Chapter 6 provides an index to the main text of the PEIS. Chapter 7 is a glossary of key terms used in the document. Chapter 8 is a list of preparers. Chapter 9 lists government agencies and organizations contacted during the preparation of this PEIS. Chapter 10 provides a distribution list for the document.

Volume III contains the appendices to this PEIS. Appendix A contains the fact sheet on the President's *Nonproliferation and Export Control Policy*, and the Joint Statement Between the United States and Russia on Nonproliferation. Appendix B provides specifications for key buildings within each facility complex analyzed in this PEIS. Appendix C describes requirements for construction and operation of the various facilities required to accomplish the storage and disposition activities essential to the alternatives described in this PEIS. Appendix D provides information on overall water usage for the storage and disposition facilities discussed in this PEIS. Appendix E gives a general overview of the Department of Energy (DOE) environmental restoration and waste management program, baseline waste management at DOE sites, and project-specific waste management activities associated with the proposed long-term storage and disposition alternatives. Appendix F provides detailed data supporting the air quality and noise analyses. Appendix G describes the methodology used for intersite transportation risk analysis and provides a summary of hazardous materials shipped to and from DOE sites, plus information on shipping containers. Appendix H evaluates various plutonium waste forms for potential disposal in a high-level waste repository. Appendix I describes operations of a Canadian Deuterium Uranium Reactor. Appendix J identifies the compliance requirements associated with the Proposed Action, as specified by the major Federal and State environmental, safety, and health statutes, regulations, and orders. Appendix K lists the scientific names of common nonthreatened and nonendangered animal and plant species identified in Chapters 3 and 4. Appendix L includes the supporting data used for assessing the No Action

Alternative in the socioeconomics sections of this PEIS. Appendix M presents detailed information on the potential health risks associated with releases of radioactivity and hazardous chemicals from the proposed storage and disposition alternatives during normal operations and from postulated accidents. Appendix N describes different concepts for, and provides cost and benefit information on, the multipurpose reactor. Appendix O provides a description of facilities and operations for a can-in-canister approach to plutonium immobilization at the Savannah River Site in South Carolina. Appendix P describes the potential environmental impacts of using the Manzano Weapons Storage Area in New Mexico for the long-term storage of plutonium pits. Appendix Q identifies the potential health impacts from the storage of Rocky Flats Environmental Technology Site plutonium pits at the Pantex Plant in Texas. Appendix R discusses the aircraft crash and radioactive release probabilities for proposed storage and disposition facilities at Pantex Plant in Texas. A separate Classified Appendix was also prepared, which provides detailed analysis results for intersite transportation risks based on classified inventories of materials stored at DOE sites.

Volume IV (Parts A and B) is the Comment Response Document. It contains an overview of the public comment process, the comments received on the Draft PEIS during the public review period, and the DOE responses to those comments, including identifying changes made to the Draft PEIS in response to public comments.

The Summary provides a brief overview of the PEIS. It includes the purpose of and need for the Proposed Action, a description of the storage and disposition alternatives including the Preferred Alternative, and the potential environmental impacts resulting from these alternatives.

COVER SHEET

RESPONSIBLE AGENCY: U.S. Department of Energy (DOE)

TITLE: *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE/EIS-0229)

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ABSTRACT: This document analyzes the potential environmental consequences of alternatives for the long-term storage (up to 50 years), including storage until disposition, and disposition of weapons-usable fissile materials from U.S. nuclear weapon dismantlements under the responsibility of the DOE. Long-term storage of nonsurplus inventories of weapons-usable plutonium (Pu) and highly enriched uranium (HEU) are required for national defense purposes, while the disposition of surplus weapons-usable Pu is necessary in order to implement our national nonproliferation policy. In addition to the No Action Alternative, this PEIS assesses three storage alternatives (that is, upgrade at multiple sites, consolidation of Pu, and collocation of Pu and HEU) at six DOE candidate sites located across the country. These sites are Hanford Site, Nevada Test Site, Idaho National Engineering Laboratory, Pantex Plant, Oak Ridge Reservation, and Savannah River Site. Although they are not candidate sites for storage, Rocky Flats Environmental Technology Site (RFETS) and Los Alamos National Laboratory are assessed for the No Action Alternative. For the disposition of surplus Pu, three alternative categories (that is, deep borehole, immobilization, and reactor) with nine primary alternatives are assessed at several DOE and representative sites for analysis purposes. Evaluations of impacts on site infrastructure, water resources, air quality and noise, socioeconomics, waste management, public and occupational health and safety, and environmental justice are included in the assessment. The intersite transportation of nuclear and hazardous materials is also assessed. DOE's Preferred Alternative is identified in this Final PEIS. The Preferred Alternative for storage is a combination of No Action and Upgrade Alternatives for the various DOE sites, and phaseout of Pu storage at RFETS. The Preferred Alternative for disposition of surplus Pu is to pursue a disposition strategy involving a combination of immobilization and reactor alternatives, including vitrification, ceramic immobilization, and existing reactors.

PUBLIC INVOLVEMENT: The DOE issued a Draft PEIS on March 8, 1996, and held a formal public comment period on the Draft through June 7, 1996. In preparing the Final PEIS, DOE considered comments received via mail, fax, electronic bulletin board (Internet), and transcripts of messages recorded by telephone. In addition, comments and concerns were recorded by notetakers during interactive public meetings held during March and April 1996 in Denver, CO, Las Vegas, NV, Oak Ridge, TN, Richland, WA, Idaho Falls, ID, Washington, DC, Amarillo, TX, and North Augusta, SC. Comments received and DOE's responses to those comments are found in Volume IV of the Final PEIS.

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LIST OF ACRONYMS AND ABBREVIATIONS

AADT	Average Annual Daily Traffic
ACEC	Area of Critical Environmental Concern
ACGIH	American Conference of Governmental Industrial Hygienists
AEA	*Atomic Energy Act*
AEC	Atomic Energy Commission
AGV	automated guided vehicle
ALARA	as low as reasonably achievable
ALE	Arid Lands Ecology Reserve
ANL-W	Argonne National Laboratory-West
APSF	Actinide Packaging and Storage Facility
AQCR	Air Quality Control Region
ARA	Auxiliary Reactor Area
ARIES	Advanced Recovery and Integrated Extraction System
BEA	Bureau of Economic Analysis
BEIR	biological effects of ionizing radiation
BLM	Bureau of Land Management
BOP	balance-of-plant
BPA	Bonneville Power Administration
BWR	boiling water reactor
CAA	*Clean Air Act*
CANDU	Canadian deuterium uranium
CAS	Chemical Abstracts Service
CCDF	complimentary cumulative distribution function
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
CI	confidence interval
CIC	can-in-canister
CLUP	Comprehensive Land-Use Plan
CMR	Chemistry and Metallurgy Research

COE	Corps of Engineers
Complex	Nuclear Weapons Complex
CRD	Comment Response Document
CRT	Cargo Restraint Transporters
CWA	*Clean Water Act*
D&D	decontamination and decommissioning
DAF	Device Assembly Facility
DCG	derived concentration guide
DHLW	defense high-level waste
DNB	departure of nucleate boiling
DNFSB	Defense Nuclear Facilities Safety Board
DNL	day and night average sound levels
DNWR	Desert National Wildlife Range
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DP	Office of Defense Programs
DRCOG	Denver Regional Council of Governments
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EBR	Experimental Breeder Reactor
EDNA	Environmental Design for Noise Abatement
EIA	Energy Information Administration
EIS	environmental impact statement
EM	Office of Environmental Management
EPA	Environmental Protection Agency
ERR	excess relative risk
ES&H	Office of Environment, Safety, and Health
ESA	*Endangered Species Act*
ETF	effluent treatment facility
FAIR	Forest, Agriculture, Industry, and Research
FCF	Fuel Cycle Facility
FEMA	Federal Emergency Management Agency
FFCA	Federal Facility Compliance Agreement
FFTF	Fast Flux Test Facility

FLPMA	*Federal Land Planning Management Act*
FMEF	Fuels and Materials Examination Facility
FMF	Fuel Manufacturing Facility
FONSI	Finding of No Significant Impact
FR	Federal Register
FSAR	Final Safety Analysis Report
GBZ	Glass-bonded zeolite
GESMO	Generic Environmental Statement on Mixed Oxide
GIS	Geographical Information System
GMA	*Growth Management Act*
GMODS	Glass Material Oxidation Dissolution System
HAD	hazard analysis document
Hanford	Hanford Site
HE	high explosives
HEAST	Health Effects Summary Table
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HEU EIS	*Disposition of Surplus Highly Enriched Uranium Environmental Impact Statement*
HFEF	Hot Fuel Examination Facility
HI	Hazard Index
HLW	high-level waste
HQ	Hazard Quotient
HRA EIS	*Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan*
HVAC	Heating Ventilation and Air Conditioning
HWR	Heavy Water Reactor
IAEA	International Atomic Energy Agency
ICPP	Idaho Chemical Processing Plant
ICRP	International Commission of Radiological Protection
INEL	Idaho National Engineering Laboratory
IRIS	Integrated Risk Information System
ISCST2	Industrial Source Complex Short-Term Model Version 2
ISO	International Standards Organization
IWG	Interagency Working Group
K-25	K-25 Site

L/ER	Energy Research Program Office
LA	Limited Area
LAA	Limited Access Area
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Scattering Center
LCF	latent cancer fatalities
LDR	Land Disposal Restriction
LEU	low-enriched uranium
LIGO	Laser Interferometer Gravitational-Wave Observatory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LOB	Laboratory Office Building
LWR	Light Water Reactor
MAA	Material Access Area
MACCS	Melcor Accident Consequence Code System
MC&A	Material Control and Accountability
MD	Office of Fissile Materials Disposition
MEI	maximally exposed individual
MHR	Modular Helium Reactor
MMI	Modified Mercalli Intensity
MOX	mixed oxide
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAGPRA	*Native American Graves Protection and Repatriation Act*
NAS	National Academy of Sciences
NCDC	National Climatic Data Center
NCRP	National Commission of Radiological Protection
NEIC	National Earthquake Information Center
NEPA	*National Environmental Policy Act*
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFS	Nuclear Fuel Services Fuel Fabrication Plant
NHPA	*National Historic Preservation Act*
NIOSH	National Institute of Occupational Safety and Health
NMSF	Nuclear Material Storage Facility

NMSM	Nuclear Materials and Stockpile Management
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NRHP	National Register of Historic Places
NTS	Nevada Test Site
NTS EIS	*Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*
NWI	National Wetlands Inventory
NWPA	*Nuclear Waste Policy Act*
NWS	National Weather Service
OCRWM	Office of Civilian Radioactive Waste Management
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PA	Protected Area
Pantex	Pantex Plant
Pantex EIS	*Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*
PBF	Power Burst Facility
PCV	Primary Containment Vessel
PEIS	programmatic environmental impact statement
PEL	Permissible Exposure Level
PFP	Plutonium Finishing Plant
PFP EIS	*Plutonium Finishing Plant Stabilization Environmental Impact Statement*
PIDAS	Perimeter Intrusion Detection and Alarm System
PNNL	Pacific Northwest National Laboratory
PPA	Property Protection Area
PRA	probabilistic risk assessment
PSAR	Preliminary Safety Analysis Report
PSD	Prevention of Significant Deterioration

PUREX	Plutonium-Uranium Extraction Plant
PWR	pressurized water reactor
R&D	Research and Development
RCRA	*Resource Conservation and Recovery Act*
REA	regional economic area
RIA	reactivity insertion accident
RFETS	Rocky Flats Environmental Technology Site
RIMS II	Regional Input-Output Modeling System
RL	Richland Operations Office
ROD	Record of Decision
ROI	region of influence
RSWF	Radioactive Scrap and Waste Facility
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SAR	Safety Analysis Report
SARA	*Superfund Amendments and Reauthorization Act*
sd	standard deviation
SDWA	*Safe Drinking Water Act*
SEB	Security Equipment Building
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SISMP	Site Integrated Stabilization and Management Plan
SMR	Standardized Mortality Ratio
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SRR	standardize rate ratio
SRS	Savannah River Site
Stockpile Stewardship and Management PEIS	*Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*
Storage and Disposition PEIS	*Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement*
SST	safe secure trailer
START	Strategic Arms Reduction Talks

TA	Technical Area
TAN	Test Area North
TCLP	toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environmental Conservation
TDS	total dissolved solids
TI	transport index
TLV	Threshold Limit Values
TNRCC	Texas Natural Resources Conservation Commission
TRA	Test Reactor Area
TRU	transuranic
TSCA	*Toxic Substance Control Act*
TSD	Transportation Safeguards Division
TSP	total suspended particulates
TSR PEIS	*Tritium Supply and Recycling Programmatic Environmental Impact Statement*
TVA	Tennessee Valley Authority
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Survey
VOC	volatile organic compound
VRM	Visual Resource Management
WAC	Waste Acceptance Criteria
Waste Management PEIS	*Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*
WIPP	Waste Isolation Pilot Plant
WMIS	Waste Management Information System
WNP	Washington Nuclear Power
WPPSS	Washington Public Power Supply System
WSA	Weapons Storage Area
WSCC	Western Systems Coordinating Council
WSCF	Waste Sampling and Characterization Facility
Y–12	Y–12 Plant
Y–12 EA	*Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Level at the Y–12 Plant, Oak Ridge, Tennessee*
YMSCO	Yucca Mountain Site Characterization Office
ZPPR	Zero Power Physics Reactor

CHEMICALS AND UNITS OF MEASURE

°C	degrees Celsius
Ci	curie
cm	centimeter
CO	carbon monoxide
CO_2	carbon dioxide
Co-60	cobalt-60
Cs	cesium
Cs-137	cesium-137
CsCl	cesium chloride
Cu	copper
dB	decibel
dBA	decibel A-weighted
°F	degrees Fahrenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
g	gram
G	gravitational acceleration
gal	gallon
Gd	gadolinium
GWd	gigawatt-days
ha	hectare
H_2	hydrogen
HF	hydrogen fluoride
HNO_3	nitric acid
hr	hour
I-129	iodine-129
in	inch
k_{eff}	effective neutron multiplication factor
kg	kilogram
km	kilometer
km^2	square kilometer

Kr	krypton
kV	kilovolt
l	liter
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
mCi	millicurie
mg	milligram
mi	mile
mi^2	square miles
min	minute
mph	miles per hour
mrem	millirem (one thousandth of a rem)
MW	megawatt
MWe	megawatt electric
N_2	nitrogen
nCi	nanocurie (one-billionth of a Curie)
Ni	nickel
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
oz	ounce
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocurie (one-trillionth of a Curie)
PM_{10}	particulate matter less than or equal to 10 microns
ppm	parts per million
Pu	plutonium
PuCl	plutonium chloride
PuO_2	plutonium dioxide
rad	radiation absorbed dose
rem	roentgen equivalent man
RfC	Reference Concentration
RfD	Reference Dose

s	second
SO_2	sulfur dioxide
Sr-90	strontium-90
t	metric ton
Tc-99	technetium-99
ton	short ton
U	uranium
U-233	uranium-233
U-234	uranium-234
U-235	uranium-235
U-236	uranium-236
U-238	uranium-238
UF_6	uranium hexafluoride
UNH	uranyl nitrate hexahydrate
UO_2	uranium dioxide
U_3O_8	triuranium octaoxide
VOC	volatile organic compound
yd	yard
yr	year
µg	microgram (one-millionth of a gram)

METRIC CONVERSION CHART

To Convert Into Metric			To Convert Out of Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor
exa-	E	$1\,000\,000\,000\,000\,000\,000 = 10^{18}$
peta-	P	$1\,000\,000\,000\,000\,000 = 10^{15}$
tera-	T	$1\,000\,000\,000\,000 = 10^{12}$
giga-	G	$1\,000\,000\,000 = 10^{9}$
mega-	M	$1\,000\,000 = 10^{6}$
kilo-	k	$1\,000 = 10^{3}$
hecto-	h	$100 = 10^{2}$
deka-	da	$10 = 10^{1}$
deci-	d	$0.1 = 10^{-1}$
centi-	c	$0.01 = 10^{-2}$
milli-	m	$0.001 = 10^{-3}$
micro-	μ	$0.000\,001 = 10^{-6}$
nano-	n	$0.000\,000\,001 = 10^{-9}$
pico-	p	$0.000\,000\,000\,001 = 10^{-12}$
femto-	f	$0.000\,000\,000\,000\,001 = 10^{-15}$
atto-	a	$0.000\,000\,000\,000\,000\,001 = 10^{-18}$

Chapter 1
Background, Purpose of, and Need for the Proposed Action

1.1 INTRODUCTION

At the end of the Cold War, the need for nuclear materials used in weapons in the United States was significantly reduced. Substantial quantities of weapons-usable fissile materials that had previously been intended for use in warheads remain in Department of Energy (DOE) facilities. The President has declared that some quantities of fissile materials are surplus to national defense and defense-related program needs. Other materials are being retained for defense and defense-related program needs. Additional fissile materials may be declared surplus in the future. As a result, DOE is developing an integrated strategy for storage and disposition of weapons-usable fissile materials.

As the number of weapons in the stockpile is reduced, DOE is faced with the challenge of effectively managing weapons-usable fissile materials in existing inventories and those resulting from the dismantlement of nuclear weapons and weapon components. Declaration of fissile materials as surplus by the President is resulting in an inventory of fissile materials that includes all isotopes of plutonium (Pu) except Pu-238 (used in space and industrial applications), uranium-233 (U-233), and highly enriched uranium (HEU), which is uranium with a U-235 isotopic content of 20 percent or more. If not properly managed, these fissile materials could pose a danger to national and international security. DOE must manage the storage and disposition of these materials to prevent the potential for proliferation of nuclear weapons and adverse environmental, safety, and health consequences.

This *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (Storage and Disposition PEIS) analyzes the potential direct, indirect, and cumulative environmental effects of reasonable alternatives for the long-term storage of nonsurplus Pu and HEU, storage of surplus Pu and HEU pending disposition, and disposition of surplus weapons-usable Pu. [Text deleted.] A separate document, *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE/EIS-0240 [HEU EIS]), addresses the disposition of surplus HEU. The HEU EIS Record of Decision (ROD) was published on August 5, 1996 (61 FR 40619).

A key element of DOE's decisionmaking is a thorough understanding of the environmental impacts that may occur during the implementation of the proposed action. The *National Environmental Policy Act* of 1969 (NEPA), as amended, provides Federal agency decisionmakers with a process to consider potential environmental consequences (both positive and negative) of proposed actions before making decisions. In following this process, DOE has prepared this Storage and Disposition Final PEIS to analyze various long-term storage and disposition alternatives and to provide the necessary background, data, and analyses to help decisionmakers and the public understand the potential environmental impacts of each alternative. The results of the environmental analyses, together with information from technical and economic studies, the nonproliferation analysis, and public input, will form the basis for DOE's decisions, which will be discussed in an ROD to be issued no sooner than 30 days after publication of this Storage and Disposition Final PEIS.

1.1.1 WEAPONS-USABLE FISSILE MATERIALS

Locations in the United States. The Department's inventories of Pu and HEU are located at a number of DOE sites, including the Hanford Site (Hanford), Idaho National Engineering Laboratory (INEL), Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), Oak Ridge Reservation (ORR), the Pantex Plant (Pantex), Rocky Flats Environmental Technology Site (RFETS), and Savannah River

Site (SRS). [Text deleted.] The weapons-usable Pu materials are those that can be readily converted for use in nuclear weapons, including weapons-grade, fuel-grade, and power reactor-grade Pu. Inventories and locations of currently declared surplus weapon-grade Pu and surplus HEU, as stated in DOE's Openness Initiative of February 6, 1996, are presented in Figures 1.1.1–1 and 1.1.1–2, respectively. These materials, currently declared excess to national security needs, total approximately 38.2 metric tons (t) (42.1 short tons [tons]) of weapons-grade Pu and 174.3 t (192.1 tons) of HEU. As of September 1994, the total U.S. inventory of Pu is composed of 85 t (93.7 tons) of weapons-grade material,[1] 13.2 t (14.6 tons) of fuel grade, and 1.3 t (1.4 tons) of power reactor grade (DOE 1996p:17). [Text deleted.]

Materials Covered in This Programmatic Environmental Impact Statement. All Pu (except for Pu-238 and Department of Defense [DoD] weapons program materials in use) and nonsurplus HEU (except DoD weapons program materials in use) are being considered for the various long-term storage alternatives. The Pu materials being considered for disposition in this PEIS are those the President has declared surplus or may declare surplus to national defense needs in the future in response to recommendations from the Nuclear Weapons Council (made up of representatives from DOE, DoD, and the Joint Chiefs of Staff). For the purposes of analysis, this PEIS analyzes the disposition of a nominal 50 t (55.1 tons) of Pu. The Pu materials covered in this PEIS are primarily in the form of pits (Pu-bearing weapons components), metals, and oxides.

The Department is currently in the process of stabilizing and repackaging weapons-usable fissile materials and placing them in safe, secure interim storage awaiting decisions on long-term storage and disposition. For Pu, this is being accomplished in accordance with the corrective actions identified in DOE's *Plutonium Vulnerability Management Plan* (DOE/EM-0199). This plan was developed in response to an assessment in DOE's *Plutonium Working Group Report* (DOE/EH-0415) and recommendations by the Defense Nuclear Facilities Safety Board (DNFSB) to improve the schedule for interim safe storage at those sites where Pu is currently stored (DNFSB 94-1). These corrective actions include material packaging upgrades and standardized packaging to facilitate cost-effective management of materials well into the future. This will be the base condition and storage configuration from which decisions will be made on future storage. In addition, the Pu materials will also meet the *Criteria for Safe Storage of Plutonium Metals and Oxides* (DOE-STD-3013-94), a DOE standard for long-term storage (at least 50 years) of these materials. Fissile materials present in spent nuclear fuel or irradiated targets[2] from reactors are not covered in this PEIS; they are not considered weapons-usable because separation of the relevant isotopes from these highly radioactive materials requires significant remote chemical processing. Any subsequent reprocessing and extraction of Pu from spent fuel is beyond the scope and the fundamental nonproliferation purpose of the program covered by this PEIS.

Following the discontinuance of nuclear weapons material production, large quantities of residues remained as a result of the chemical and thermal processes applied to separate and purify Pu. Examples of residue forms include some impure oxides and metals, halide salts, combustibles, ash, sludges, and contaminated glass. To meet requirements of DOE's *Plutonium Vulnerability Management Plan*, as well as various compliance agreements with State and local regulatory agencies, some Pu residues must be stabilized. As a result of the stabilization process, portions of the residues will potentially be concentrated and stored. These concentrates may be in a form and concentration (greater than 50 percent Pu by weight) that is weapons-usable and are therefore included in this PEIS.[3]

The stabilization, concentration, and storage of Pu residues, as well as disposal of non-weapons-usable waste, is covered in other existing and future environmental documents as appropriate, including the *Final Environmental Impact Statement, Interim Management of Nuclear Materials* (at SRS) and ROD; the *Plutonium*

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[1] Weapons-grade Pu contains less than 7 percent Pu-240, fuel grade Pu contains from 7 to less than 19 percent Pu-240, and power reactor grade Pu contains 19 percent and greater Pu-240.

[2] These materials are not directly subject to disposition pursuant to this PEIS unless the irradiated fuel or targets were first processed to separate the Pu under another program. Currently, DOE is not proposing such an action.

[3] As a result of the stabilization process, there will also be nonweapons-usable Pu or HEU contaminated wastes or residues (less than 50 percent Pu by weight) that would not be within the scope of this PEIS.

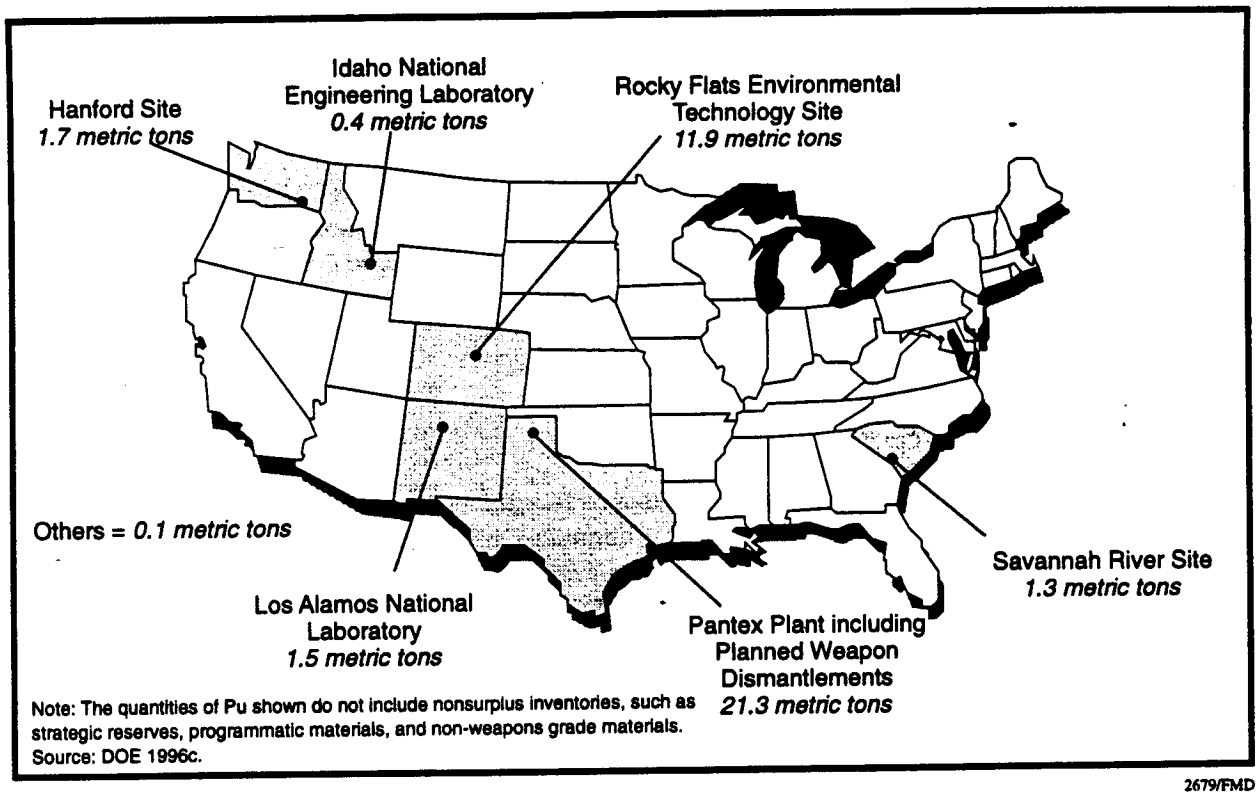


Figure 1.1.1–1. Department of Energy Locations With Surplus Weapons-Grade Plutonium Inventories in September 1994.

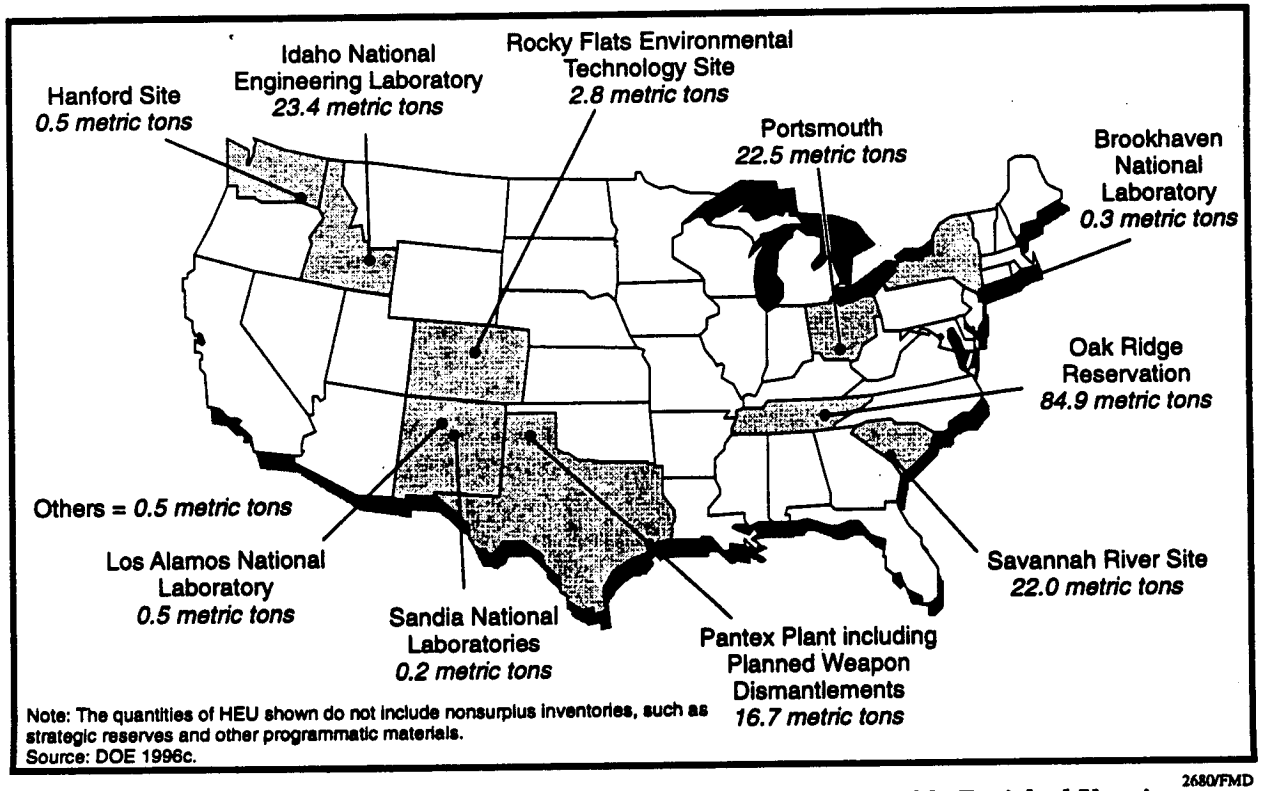


Figure 1.1.1–2. Department of Energy Locations With Surplus Highly Enriched Uranium Inventories on February 6, 1996.

Finishing Plant Stabilization Final Environmental Impact Statement (at Hanford) and ROD; the *Environmental Assessment for Solid Residue Treatment, Repackaging, and Storage (at RFETS)* and Finding of No Significant Impact (FONSI); and an EIS on the *Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* (in preparation), as discussed in Section 1.4. [Text deleted.]

The nonsurplus HEU materials covered in this PEIS are primarily in the form of metals and oxides. These materials include naval nuclear fuel feed stock, strategic reserves, and programmatic materials. Storage of surplus HEU, pending disposition under the HEU EIS and ROD, is also analyzed.[4] The HEU materials for long-term storage will meet long-term storage criteria for safe storage of HEU metals and oxides, which are under development at this time. Appropriate environmental review will be prepared for stabilizing and repackaging the HEU materials to meet respective long-term storage criteria.

1.2 BACKGROUND

The arms race between the superpowers was brought to a close at the end of the Cold War, causing increases in stockpiles of surplus weapons-usable fissile materials. Continued implementation of arms reduction agreements may lead to additional quantities being declared surplus in the future. With the collapse of the Soviet Union and the economic and social challenges faced by newly formed states; there is a serious risk of nuclear proliferation from those growing stockpiles. The United States has taken steps to address this risk of nuclear proliferation. In September 1993, President Clinton announced the *Nonproliferation and Export Control Policy* (see Appendix A), which included the commitment that the United States will do the following:

- Seek to eliminate, where possible, the accumulation of stockpiles of HEU or Pu, and to ensure that, where these materials already exist, they are subject to the highest standards of safety, security, and international accountability.

- Initiate a comprehensive review of long-term options for Pu disposition, taking into account technical, nonproliferation, environmental, budgetary, and economic considerations. Russia and other nations with relevant interests and experience will be invited to participate in the study.

Following the President's policy announcement, the National Security Council, together with the White House Office of Science & Technology Policy, established an Interagency Working Group (IWG) to initiate a comprehensive review of the options for disposition of surplus Pu from nuclear weapons activities. Members of the IWG include the Arms Control and Disarmament Agency, Environmental Protection Agency (EPA), DNFSB, Nuclear Regulatory Commission (NRC), Office of Management and Budget, DOE, Department of State, and DoD. DOE has the lead role within the IWG for evaluating technical options and conducting economic, schedule, and environmental analyses.

At the Moscow Summit in January 1994, President Clinton and President Yeltsin issued the *Joint Statement by the President of the Russian Federation and the President of the United States of America on Non-Proliferation of Weapons of Mass Destruction and the Means of Their Delivery* (see Appendix A). The two Presidents agreed to task their technical experts to study options for the disposition of weapons-usable fissile materials, including Pu, taking into account the issues of nonproliferation, environmental protection, safety, and technical and economic factors. Under the leadership of the IWG, an initial meeting was held in Moscow in May 1994 to establish the framework for this effort. DOE and its national laboratories have assumed the lead technical role in supporting this joint effort.

[4] This Storage and Disposition PEIS covers long-term storage of nonsurplus HEU and storage of surplus HEU pending disposition. Until storage decisions are implemented, surplus HEU that has not gone to disposition will continue to be stored pursuant to, and not to exceed the 10-year interim storage time period evaluated in the *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y-12 Plant, Oak Ridge, Tennessee* (DOE/EA-0929, September 1994) and Finding of No Significant Impact. [Text deleted.]

At the end of January 1995, specialists from the United States and Russia met at LANL for a 2-day exchange of technical presentations on scientific research that had been conducted on potential Pu disposition alternatives and on promising prospective investigations. During this meeting, the United States and Russia reviewed various long-term storage and disposition options. Both sides agreed to conduct consistent comparisons of alternatives for the disposition of Pu, taking into account the factors noted in the Summit statement of the two Presidents.

In addition, DOE sponsored a National Academy of Sciences (NAS) study on the management and disposition of surplus weapons Pu. In its report, *Management and Disposition of Excess Weapons Plutonium* of March 1994, the NAS stated that the existence of surplus weapons-usable fissile materials was a "clear and present danger to national and international security" and then identified proposed standards for managing the risks associated with surplus weapons-usable fissile materials (NAS 1994a:vii,31-34). The following standards, although not regulatory requirements, were identified by the NAS and modified by DOE:

- *The Stored Weapons Standard.* The high standards of security and accounting for the storage of intact nuclear weapons should be maintained, to the extent practical, for weapons-usable fissile materials throughout dismantlement, storage, and disposition. [Text deleted.]

- *The Spent Fuel Standard.* The surplus weapons-usable Pu should be made as inaccessible and unattractive for weapons use as the much larger and growing quantity of Pu that exists in spent nuclear fuel from commercial power reactors.

The NAS also identified several disposition options that meet these standards, including immobilization of Pu for disposal and the use of Pu in mixed oxide (MOX) fuel for commercial (non-defense) nuclear reactors. Material forms resulting from the immobilization and reactor options would be disposed of in a high-level waste (HLW) repository. The NAS also identified the deep borehole as a possible disposition option, where ultimate disposal is accomplished by emplacing the Pu material several kilometers below the water table into ancient, geologically stable rock formations. DOE used the NAS report as the starting point for developing the proposed action for disposition of surplus Pu.

More recently, through the ongoing efforts of the joint U.S./Russia study, the *Joint United States/Russian Plutonium Disposition Study* on technical options for the disposition of surplus Pu was issued in late September 1996. This study was undertaken to provide a consistent comparison of deep borehole, immobilization, and reactor alternatives by the two countries using criteria related to nuclear nonproliferation, safety, environmental protection, and technical and economic factors. Joint technical demonstrations are planned by the United States and Russia to support implementation of disposition decisions. The study and options will provide decisionmakers from both countries with a set of jointly evaluated alternatives for Pu disposition and help build further trust and cooperation in the area of fissile materials disposition.

1.3 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The Department proposes to take the following actions for U.S. weapons-usable fissile materials:

- Storage—provide a long-term storage system (for up to 50 years) for nonsurplus Pu and HEU that meets the Stored Weapons Standard and applicable environmental, safety, and health standards while reducing storage and infrastructure[5] costs

- Storage Pending Disposition—provide storage that meets the Stored Weapons Standard for inventories of weapons-usable Pu and HEU that have been or may be declared surplus

[5] Includes electrical power, fuel, transportation network requirements, and safeguards/security.

- Disposition—convert surplus Pu and Pu that may be declared surplus in the future to forms that meet the Spent Fuel Standard, thereby providing evidence of irreversible disarmament and setting a model for proliferation resistance

[Text deleted.]

The purpose of the proposed action is to implement the President's *Nonproliferation and Export Control Policy* in a safe, reliable, cost-effective, and timely manner. DOE is proposing a comprehensive program to accomplish this purpose by providing an exemplary long-term storage system for weapons-usable fissile materials, eliminating the stockpile of surplus weapons-usable Pu, and establishing the technical and program infrastructure that will enable the United States to dispose of surplus weapons-usable Pu.

A portion of the materials covered in this Storage and Disposition Final PEIS may be subject to international and/or bilateral inspection. Consistent with the President's *Nonproliferation and Export Control Policy*, surplus fissile materials will be subject to international inspections, including inspections by the International Atomic Energy Agency (IAEA), with the imperative that there would be no disclosure of sensitive/classified information to unauthorized parties. Furthermore, in an effort to increase transparency between the United States and Russia on nuclear disarmament, some nonsurplus materials may be made available for bilateral inspections with the Russians, once an agreement is reached between the two countries. Facilities for long-term storage and disposition would be designed or modified, as needed, to accommodate inspection requirements. Other modifications to those facility designs might be needed should new treaties come into effect.

In March 1995, the President declared 200 t (220 tons) of fissile materials to be surplus to national defense needs. These materials are in various compositions and forms. A long-term storage plan is needed to provide continued and adequate control of these surplus materials and any that may be declared surplus in the future, from now through disposition. Disposition of surplus Pu is needed to reduce the reliance on institutional controls and to provide visible evidence of irreversible disarmament. A comprehensive long-term storage and disposition action is needed to ensure that weapons-usable fissile materials are properly managed and to prevent the increase of potential environmental, health, and safety risks. This includes achieving nonproliferation goals through the disposition of surplus Pu, providing long-term storage for nonsurplus Pu and HEU, and providing storage for surplus Pu and HEU that cannot go directly from current storage to disposition. DOE also recognizes the need to strengthen national and international arms control efforts by providing a storage and disposition model for the international community. This action will enhance U.S. credibility and flexibility in negotiations on bilateral or multilateral reductions of surplus weapons-usable fissile materials inventories.

1.4 RELATED *NATIONAL ENVIRONMENTAL POLICY ACT* REVIEWS

Weapons-usable fissile materials are divided into two categories—surplus and nonsurplus. The nonsurplus category includes naval nuclear fuel, strategic reserves, programmatic materials (non-weapons research and development [R&D], weapons R&D, and other programmatic materials), and weapons program materials in use (as shown in Figure 1.4–1). Weapons program materials in use will not go into long-term storage. These materials are primarily located in weapons and operational storage vaults at current DoD weapons complex sites. For this reason, these materials are not analyzed for long-term storage. The ongoing and completed environmental reviews related to the storage and disposition of weapons-usable fissile materials, both Pu and HEU, are summarized in Table 1.4–1. A description of these and other related environmental reviews is given below.

Current or Interim Storage. The *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (Pantex EIS, DOE/EIS-0225, November 1996), is a sitewide EIS that covers current and proposed facilities and activities at Pantex in Amarillo, Texas, where Pu pits are currently stored. The Pantex EIS analyzes the alternatives and environmental impacts associated with conducting nuclear weapons operations at Pantex for approximately 10 years. Included in the

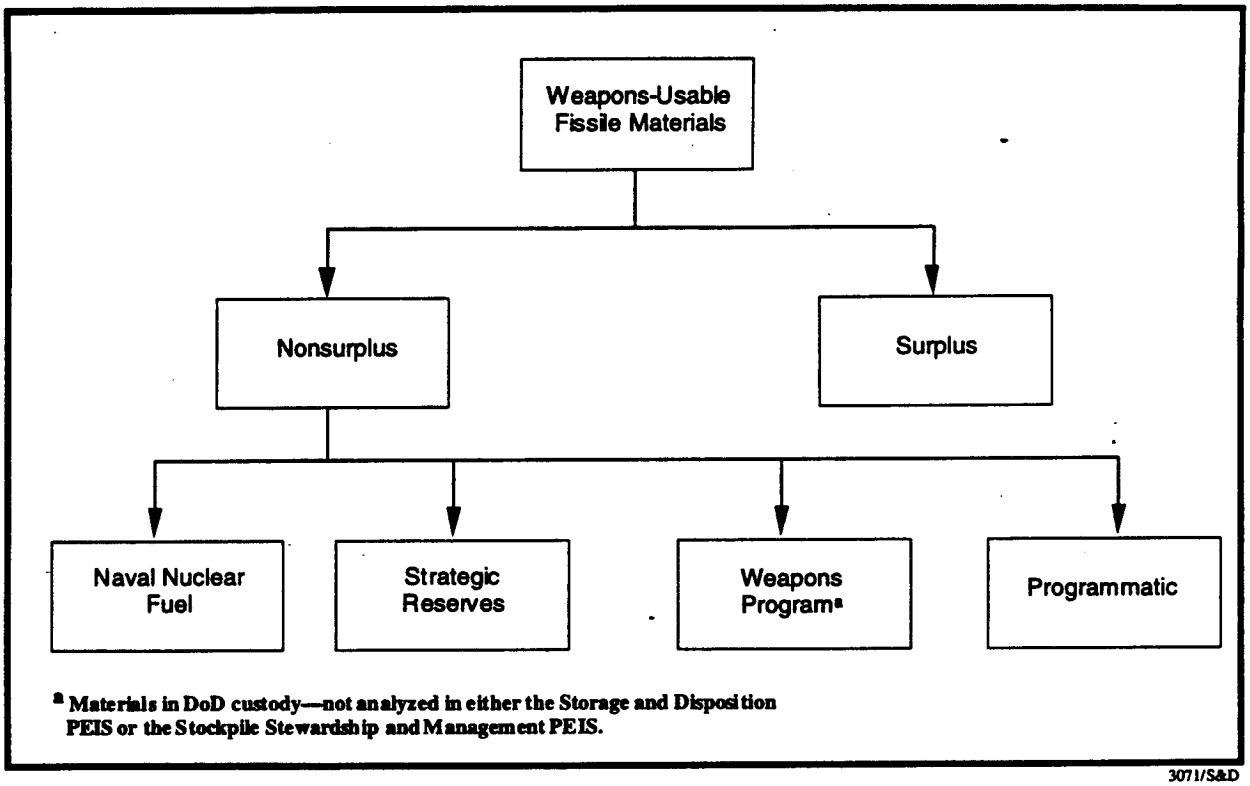


Figure 1.4–1. Weapons-Usable Fissile Material Categories.

Pantex EIS is an analysis to increase the interim storage of Pu pits from 12,000 pits to 20,000 pits. The Pantex EIS also analyzes alternate locations to Pantex for interim pit storage operations.

In May 1994, when DOE announced its intention to prepare the Pantex EIS, DOE believed that the Pantex EIS ROD would precede decisionmaking on the long-term storage of pits. Accordingly, the Pantex EIS was scoped to address alternate locations for interim pit storage (that is, until the long-term decisions are made and implemented).

The *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y–12 Plant, Oak Ridge, Tennessee* (Y–12 EA) (DOE/EA-0929) evaluates the continued receipt, prestorage processing, and interim storage of enriched uranium for up to 10 years in quantities that would exceed the historical maximum storage level. The Y–12 EA was issued in September 1994 and was followed by a FONSI in September 1995. In the FONSI, DOE determined that the Y–12 Plant (Y–12) would store no more than 500 t (550 tons) of HEU and no more than 6 t (6.6 tons) of low-enriched uranium (LEU).

The *Interim Storage of Plutonium at the Rocky Flats Environmental Technology Site Environmental Impact Statement*, announced for preparation by DOE on July 17, 1996 (61 FR 37247), will evaluate reasonable alternatives for the safe interim storage of Pu at RFETS, including current and additional inventory from future processing of Pu residues into more stable forms, pending implementation of upcoming long-term storage and disposition decisions, and waste management decisions.

The *Environmental Assessment for Solid Residue Treatment, Repackaging, and Storage* (DOE/EA-1120, April 1996) describes and analyzes the environmental effects of the proposed action to treat, repackage, and provide interim storage of solid residues at RFETS. It also analyzes the alternatives of taking no action, shipping the

Table 1.4–1. Environmental Reviews for Storage and Disposition of Weapons-Usable Fissile Materials

Action	Pu	HEU
Current/Interim Storage	Pantex EIS[a] and other site-specific NEPA documents (see Table 1.4–2)	Y–12 EA[b]
Long-Term Storage	Storage and Disposition PEIS	Storage and Disposition PEIS
	Stockpile Stewardship and Management PEIS[c]	Stockpile Stewardship and Management PEIS[c]
Disposition	Storage and Disposition PEIS	HEU EIS[d]
[Text deleted.]		

[a] *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE/EIS-0225, November 1996).

[b] *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y–12 Plant, Oak Ridge, Tennessee* (DOE/EA-0929, September 1994).

[c] *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE/EIS-0236, September 1996).

[Text deleted.]

[d] *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE/EIS-0240, June 1996).

residues offsite for treatment, and shipping the residues offsite for storage. A FONSI to the environmental assessment (EA) was signed by DOE in April 1996.

On November 19, 1996, DOE announced its intention to prepare an EIS on the *Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* (61 FR 58866). This EIS will evaluate the potential environmental impacts associated with reasonable management alternatives for certain Pu residues and all scrub alloy currently being stored at RFETS. The management alternatives include treatment of these materials to enable them to be disposed of as waste or, in the case of separated surplus weapons-usable Pu, stored and dispositioned in accordance to the decisions to be made in the Storage and Disposition PEIS ROD. Activities analyzed in this EIS would be in addition to certain activities evaluated in the *Environmental Assessment for Solid Residue Treatment, Repackaging, and Storage*, previously described, in which a portion of the residues would undergo further treatment prior to waste disposal or other disposition.

Long-Term Storage. With the exception of those materials in weapons programs, the Storage and Disposition PEIS analyzes the environmental impacts of reasonable alternatives for long-term storage of various materials in all categories shown in Figure 1.4–1, including the long-term storage of all Pu pits (strategic reserves and surplus) and the approach for dispositioning pits that are surplus to national security requirements.

Another DOE NEPA document that addresses the storage of pits is the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (Stockpile Stewardship and Management PEIS, DOE/EIS-0236, September 1996). The Stockpile Stewardship and Management PEIS supports decisions on the long-term storage of pits that will be needed for national security requirements (strategic reserve pits). The Preferred Alternative for strategic reserve storage is as follows: (1) HEU strategic reserve storage at Y–12 and (2) Pu pits strategic reserve storage in Zone 12 at Pantex. It also calls for the weapons R&D material (Pu-242), to be stabilized at SRS as a result of the ROD for the *Final Environmental Impact Statement, Interim Management of Nuclear Materials* (DOE/EIS-0220, October 1995), to be transported to LANL for storage.

Table 1.4–2. Additional Environmental Reviews Related to the Storage and Disposition Programmatic Environmental Impact Statement

Site	Document	Status
Argonne National Laboratory-West, Idaho Falls, ID	Electrometallurgical Treatment Research and Demonstration Project in the Fuel Conditioning Facility at ANL-West EA	Final 5/96
Hanford Site, Richland, WA	Plutonium Finishing Plant Stabilization EIS	Final 5/96
Los Alamos National Laboratory, Los Alamos, NM	Los Alamos National Laboratory Site-Wide EIS	In preparation
Multiple DOE sites	Waste Management PEIS	Draft 8/95 Final in preparation
Nevada Test Site, Mercury, NV	Nevada Test Site and Off-Site Locations in the State of Nevada EIS	Final 8/96
Rocky Flats Environmental Technology Site, Golden, CO	Interim Storage of Plutonium at the Rocky Flats Environmental Technology Site EIS	In Preparation
Rocky Flats Environmental Technology Site, Golden, CO	Solid Residue Treatment, Repackaging, and Storage EA	Final 4/96
Rocky Flats Environmental Technology Site, Golden, CO	Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site EIS	In preparation
Savannah River Site, Aiken, SC	Defense Waste Processing Facility, Supplemental EIS	Final 11/94
Savannah River Site, Aiken, SC	F-Canyon Plutonium Solutions EIS	Final 12/94
Savannah River Site, Aiken, SC	Savannah River Site Waste Management EIS	Final 7/95
Savannah River Site, Aiken, SC	Interim Management of Nuclear Materials EIS	Final 10/95
Savannah River Site, Aiken, SC	Tritium Supply and Recycling PEIS	Final 10/95

Since the Stockpile Stewardship and Management Program may store strategic materials and weapons R&D material, this Storage and Disposition Final PEIS separately analyzes, as a subpart of each alternative, the long-term storage of weapons-usable fissile materials without strategic reserves and weapons R&D material (under the programmatic category in Figure 1.4–1). Preparation of this Storage and Disposition Final PEIS and the Stockpile Stewardship and Management PEIS has been closely coordinated to ensure that all necessary information is available to the decisionmaker. Both of these PEISs have progressed to the point where they are scheduled to have their RODs issued in late 1996 or early 1997. Decisions on the long-term storage of pits would be made in the RODs of the PEISs. A decision relating to the interim storage of pits at Pantex would be made in the ROD of the Pantex EIS pending implementation of the selected long-term storage alternative(s).[6]

Disposition. The Storage and Disposition PEIS addresses the disposition of surplus Pu. In the *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (TSR PEIS, DOE/EIS-0161, October 1995), there is an option for a multipurpose reactor that could produce tritium, use Pu in reactor fuel, and generate revenue through the production of electricity. Environmental analysis of the multipurpose reactor

[6] If there is a delay in implementing the RODs for either of the PEISs (for example, delay due to availability and construction of upgrades for long-term storage facilities), then there would be a need to make a decision on the location of interim storage of pits. The Pantex EIS has been completed with the analysis of interim storage alternatives, including the issues and comments received from the public on that EIS, to support a decision relating to the storage of pits until a long-term storage decision is made and implemented.

is included in the TSR PEIS. On December 6, 1995, the Secretary of Energy made the decision that the future source of tritium would either be from a purchased reactor, from irradiation in a commercial reactor, or from the accelerator production of tritium. The multipurpose reactor was preserved as an option for future consideration. Therefore, the multipurpose reactor, as well as the Fast Flux Test Facility (FFTF) at Hanford, are discussed in Appendix N of this Storage and Disposition Final PEIS.

For the disposition of surplus HEU, DOE's decision, as identified in the HEU EIS ROD, is to gradually blend down a nominal 200 t (220 tons) of HEU[7] to LEU, containing less than 20 percent of the U-235 isotope, with the potential use of up to 85 percent of the resulting LEU as non-defense reactor fuel feed. The remaining LEU produced by blend-down would be disposed of as low-level waste (LLW). The blending down of the HEU will occur over an estimated 15- to 20-year period, with continued storage of the HEU until blend-down. The proposed action was analyzed separately in the HEU EIS from that of the Storage and Disposition PEIS because the disposition of surplus HEU can be accomplished at existing facilities and with existing technologies, and would involve different alternatives, timeframes, technologies, facilities, and personnel than those required for Pu disposition. The surplus HEU is part of the larger HEU inventory that was analyzed for interim storage in the Y–12 EA. [Text deleted.]

Other Related Environmental Reviews. The *Draft Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (Waste Management PEIS, DOE/EIS-0200D, August 1995) addresses management of the current and 20-year projected inventories of five types of waste (high-level, transuranic, low-level, low-level mixed, and hazardous waste) on a national basis. Among other things, it identifies impacts of consolidating or not consolidating waste management operations across sites where DOE manages wastes. [Text deleted.]

Waste management assumptions in this Storage and Disposition PEIS are based on current practice. These practices may be changed by the waste-type specific RODs from the Waste Management PEIS. However, none of the alternatives analyzed in this PEIS are expected to result in waste forms or produce "end product" materials that are not covered in the Waste Management PEIS.

Additional site-specific environmental reviews are currently being prepared by DOE. A listing of these reviews is included in Table 1.4–2. In particular, the site-specific, sitewide EISs being prepared cover continued operations for some of the sites evaluated in this Storage and Disposition PEIS. Some of the existing activities covered by these EISs are also similar to those of the No Action Alternative analyzed in this Storage and Disposition PEIS. Although the near-term analytical periods for these sitewide EIS analyses may be different from that of this Storage and Disposition PEIS, which is focused on longer-term activities, the preparation of these documents has been closely reviewed and coordinated within DOE.

As work on these and other potentially related NEPA documents proceeds, information from such future NEPA documents will be incorporated, as appropriate, in any supplements to, or documents tiered from, this Storage and Disposition Final PEIS.[8]

1.5 DECISIONS TO BE MADE

From March 8 through June 7, 1996, the Storage and Disposition Draft PEIS was circulated for written and oral comments from other Federal government agencies, State and local governments, Native American tribes,

[7] The nominal 200 t (220 tons) of HEU addressed in the HEU EIS consists of HEU already declared surplus, plus HEU that may be declared surplus in the future. This is different from and should not be confused with the 200 t (220 tons) of fissile material currently declared surplus by the President, which includes both HEU and Pu.

[8] The other ongoing or completed NEPA reviews referenced in Section 1.4 of this PEIS involve different purposes, needs, and alternative actions. They also involve, in whole or in part, different workers, locations, affected environments, and timing. As such, this PEIS is independently justified, and can and should proceed regardless of actions taken pursuant to other NEPA reviews. Except for tiered NEPA reviews, the decisions pursuant to this PEIS will not automatically trigger other actions requiring NEPA review.

special interest groups, and the public. Public meetings in the vicinity of the sites under consideration for the proposed action and in Washington, DC were held during the comment period. The comments received, along with DOE's responses, became a part of this Storage and Disposition Final PEIS. The Department also made available the results of the technical, cost, and schedule analyses[9,10] in July and November 1996, (DOE 1996o:ES-1–ES-14; DOE 1996r: ES-1–ES-8) and the nonproliferation analysis[11] in October 1996. Taken together, these analyses will support a formal ROD regarding Pu and HEU storage and Pu disposition. [Text deleted.] These decisions are as follows:

For storage:

- The strategy for long-term storage of nonsurplus weapons-usable Pu and nonsurplus HEU
- The strategy for storage of surplus Pu and surplus HEU until disposition
- The storage site(s) and (if appropriate) facilities

For disposition:

- The strategy and technologies for disposition of surplus weapons-usable Pu

The Department, with interagency coordination, will then issue the ROD. Following the ROD, subsequent tiered and project-specific NEPA documents will be prepared. The tiered NEPA reviews will analyze alternative locations for disposition activities.

1.6 PREFERRED ALTERNATIVE

STORAGE

The Department's Preferred Alternative for storage is to reduce, over time, the number of locations where the various forms of Pu are stored, through a combination of storage alternatives in conjunction with a combination of disposition alternatives. DOE would begin implementing this Preferred Alternative by moving surplus Pu from RFETS as soon as possible, transporting the pits to Pantex as early as 1997, and the non-pit Pu materials to SRS beginning in 2002. Over time, DOE would store Pu in upgraded facilities at Pantex and in an expanded, planned new facility at SRS, and store nonsurplus HEU and surplus HEU pending disposition in upgraded and consolidated facilities at ORR. Storage facilities would also be modified, as needed, to accommodate international inspection requirements consistent with the President's *Nonproliferation and Export Control Policy.* Accordingly, DOE's Preferred Alternative for storage would call for the following actions:

- **Phase out storage of all weapons-usable Pu at RFETS beginning in 1997; move pits to Pantex, and non-pit materials to SRS.** At Pantex, DOE would repackage pits from RFETS in Zone 12, then place them in existing storage facilities in Zone 4, pending completion of facility upgrades in Zone 12. At SRS, DOE would expand the planned new Actinide Packaging and Storage Facility (APSF), and move non-pit Pu materials from RFETS, after stabilization at RFETS, to the expanded APSF upon completion. The small number of pits currently at RFETS that are not in shippable form would be placed in a shippable condition in accordance with existing procedures prior to shipment to Pantex. Additionally, some pits and non-pit Pu materials from RFETS could be used at SRS, LANL, and LLNL for tests and demonstrations of aspects of disposition technologies (see Preferred

[9] *Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition* (DOE/MD-0003, Rev. 1, October 31, 1996).
[10] *Technical Summary Report for Long-Term Storage of Weapons-Usable Fissile Materials* (DOE/MD-0004, Rev. 1, November 1996).
[11] *Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives* (Draft, October 1996).

Alternative for disposition as discussed later in this section). All non-pit weapons-usable Pu materials currently stored at RFETS are surplus.

- **Upgrade storage facilities at Zone 12 South (to be completed by 2004) at Pantex to store those pits currently stored at Pantex, and pits from RFETS, pending disposition. Storage facilities at Zone 4 would continue to be used for these pits prior to completion of the upgrade.** This action would place pits at a central location where most pits already reside and where expertise and infrastructure exist to accommodate pit storage.

- **In accordance with the Preferred Alternative in the Stockpile Stewardship and Management PEIS, store Strategic Reserve pits at Pantex in the facilities discussed above. To the extent not reflected above, store Strategic Reserve materials in accordance with the Preferred Alternative in the Stockpile Stewardship and Management PEIS.**

- **Expand the APSF (Upgrade Alternative) at SRS to store those surplus, non-pit Pu materials currently at SRS and surplus non-pit Pu materials from RFETS, pending disposition** (see Preferred Alternative for disposition as discussed later in this section). The APSF would be built by 2001 pursuant to the *Final Environmental Impact Statement, Interim Management of Nuclear Materials* (DOE/EIS-0220) and ROD, and the expansion to accommodate RFETS material would be completed by 2002. The RFETS surplus non-pit Pu materials would be moved to SRS after stabilization is performed at RFETS under corrective actions in response to recommendation 94-1 by the DNFSB, and after completion of the APSF expansion. This action would place non-pit Pu materials in a new storage facility, in a location with existing expertise and Pu handling capabilities, and where potential disposition activities could occur (see Preferred Alternative for disposition as discussed later in this section). Strategic Reserve pits currently located at SRS would be stored in accordance with the Preferred Alternative in the Stockpile Stewardship and Management PEIS. There are no Strategic Reserve non-pit materials currently located at SRS.

- **Continue current storage (No Action) of surplus Pu at Hanford and INEL, pending disposition** (or movement to lag storage[12] at the disposition facilities). This action would allow surplus Pu to remain at the sites with existing expertise and Pu handling capabilities, and where potential disposition activities could occur (see Preferred Alternative for disposition as discussed later in this section). There are no nonsurplus weapons-usable Pu materials currently stored at either site.

- **Continue current storage (No Action) of surplus Pu at LANL, pending disposition** (or movement to lag storage at the disposition facilities). This Pu would be stored in stabilized form with the nonsurplus Pu in the upgraded Nuclear Material Storage Facility pursuant to the No Action Alternative for the site.

- **Take No Action at the Nevada Test Site (NTS).** DOE would not add Pu to sites that do not currently have Pu in storage.

- **Upgrade storage facilities at Y–12 (to be completed by 2004 or earlier) at ORR to store nonsurplus HEU and surplus HEU pending disposition.** Existing storage facilities at Y–12 would be modified to meet natural phenomena requirements, as documented in *Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities* (Y/EN-5080, 1994). Storage facilities would be consolidated and the storage footprint would be reduced as surplus HEU is dispositioned and blended to LEU, pursuant to the HEU EIS. Consistent with the Preferred Alternative in the Stockpile Stewardship and Management PEIS, HEU strategic reserves would be stored at Y–12.

[12] Lag storage is temporary storage at the applicable disposition facility.

DISPOSITION

The Department's Preferred Alternative for the disposition of surplus Pu is to pursue a disposition strategy that allows for immobilization of surplus weapons Pu in glass or ceramic forms and burning of the surplus Pu as MOX fuel in existing reactors. The disposition of the surplus Pu using these technological approaches would depend on the results of future technology development and demonstrations, site-specific environmental analyses, and detailed cost proposals as well as nonproliferation considerations. The results of these efforts and negotiations with Russia and other nations will ultimately determine the timing and extent to which either or both technologies are deployed.[13]

Under this Preferred Alternative, the U.S. policy not to encourage the civil use of Pu and, accordingly, not to itself engage in Pu reprocessing for either nuclear power or nuclear explosive purposes will not change. Although under the Preferred Alternative some Pu may ultimately be burned in existing reactors, every possible means will be pursued to ensure that Federal support for this unique disposition mission does not encourage other civil uses of Pu or Pu reprocessing. The United States, however, will maintain its commitments regarding the use of Pu in civil nuclear programs in Western Europe and Japan.

Proceeding with this strategy would provide increased flexibility to initiate Pu disposition promptly, and help assure disposition efforts could be accomplished in a timely manner. Establishing the means for expeditious Pu disposition would also help provide the basis for an international cooperative effort that can result in reciprocal, irreversible Pu disposition actions by Russia. DOE's preferred disposition strategy signals a strong U.S. commitment to reducing its stockpile of surplus Pu, thereby effectively meeting the purpose of and need for the Proposed Action.

To accomplish the Pu disposition mission, DOE would consider, to the extent practical, new as well as modified existing buildings and facilities for portions of the disposition activities. The PEIS analyzes new facilities for most disposition alternatives to obtain bounding environmental impacts. DOE would analyze and compare existing and new buildings and facilities for the technologies chosen as part of this strategy in subsequent, tiered NEPA review. In addition, all disposition facilities would be designed or modified, as needed, to accommodate international inspection requirements consistent with the President's *Nonproliferation and Export Control Policy*. Accordingly, DOE's Preferred Alternative for Pu disposition involves the following strategy and supporting actions:

- **Immobilize Pu materials using vitrification or ceramic immobilization.** The immobilization technology could be used for processing pure or impure forms of Pu. Vitrification or ceramic immobilization could include the can-in-canister variant, which could utilize the existing HLW and the Defense Waste Processing Facility (DWPF) at SRS, or new facilities at Hanford or SRS. DOE would continue the R&D leading to the demonstration of the can-in-canister variant at the DWPF using surplus Pu.

- **Convert Pu materials into MOX fuel for use in existing reactors.** Pure materials including pits, pure metal, and oxides could be converted without extensive processing into MOX fuel for use in existing commercial reactors. Other, already separated forms of surplus Pu would require additional cleanup (not reprocessing of spent nuclear fuel). The MOX fuel would be used in existing light water reactors (LWRs) with a once-through fuel cycle, with no reprocessing and subsequent reuse of the spent fuel. If partially completed LWRs were to be completed by other parties, they would be considered for this mission. The MOX fuel would be fabricated in a domestic, government-owned facility at a DOE site.

[13] Through these efforts, the President would be provided the basis and flexibility to initiate disposition efforts either multilaterally or bilaterally through negotiations or unilaterally as an example to Russia and other nations.

The Department would retain using MOX fuel in Canadian Deuterium Uranium (CANDU) reactors in Canada in the event that a multilateral agreement to use CANDU reactors is negotiated among Russia, Canada, and the United States. The DOE would engage in a test and demonstration for CANDU MOX fuel as appropriate and consistent with future cooperative efforts with Russia and Canada.

With regard to the above, for purposes of analysis of an approach involving a combination of both technologies, approximately 70 percent of the surplus Pu was identified to be in forms (metals and other pure forms) suitable for MOX fuel. The actual percentage and timing for disposition of the surplus Pu using either or a combination of both of the technological approaches would depend on the results of international agreements, future technology development and demonstrations, site-specific environmental assessments, and detailed cost proposals to be completed within the next 2 years. The results of these efforts, as well as nonproliferation considerations and negotiations with Russia and other nations, will ultimately determine the timing and extent to which either or both technologies are deployed for disposition of surplus Pu. In the event both technologies are deployed, and because the time required for Pu disposition using reactors would be longer than that for immobilization, it is probable that some surplus Pu would be immobilized initially, prior to completion of reactor irradiation for other surplus Pu. Deployment of this strategy would involve the following supporting actions:

- **Constructing and operating a Pu vitrification or ceramic immobilization facility at either Hanford or SRS.** DOE would analyze alternative locations at these two sites for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review. SRS has existing facilities and infrastructure to support an immobilization mission, and Hanford has existing plans for constructing and operating immobilization facilities for the wastes in Hanford tanks. DOE would not create new infrastructure for immobilizing Pu with HLW or cesium (Cs) at INEL, NTS, ORR, or Pantex.

- **Constructing and operating a Pu conversion facility[14] at either Hanford or SRS.** DOE would collocate the Pu conversion facility with the vitrification or ceramic immobilization facility discussed above. In subsequent, tiered NEPA reviews, DOE would analyze alternative locations at Hanford and SRS, for constructing new or potentially using modified existing buildings.

- **Constructing and operating a pit disassembly/conversion facility[15] at Hanford, INEL, Pantex, or SRS.** DOE would not add Pu to sites that do not currently have Pu in storage. Therefore, two sites analyzed in the PEIS, NTS and ORR, would not be considered further for Pu disposition activities. DOE would analyze alternative locations at Hanford, INEL, Pantex, and SRS for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review. DOE would demonstrate the Advanced Recovery and Integrated Extraction System (ARIES) concept at LANL for pit disassembly/conversion beginning in fiscal year 1997.

- **Constructing and operating a domestic, Government-owned, MOX fuel fabrication facility at Hanford, INEL, Pantex, or SRS.** DOE would not add Pu to sites that do not currently have Pu in storage. Therefore, two sites analyzed in the PEIS, NTS and ORR, would not be considered further for Pu disposition activities. The MOX fuel fabrication facility would serve only the finite mission of fabricating MOX fuel using surplus Pu for the purpose of Pu disposition. DOE would analyze alternative locations at Hanford, INEL, Pantex, and SRS, for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review.

[14] The Pu conversion facility would convert surplus non-pit Pu material (using a wet chemical process) into a metal or oxide form suitable for use at the next facility in the disposition process.

[15] The pit disassembly/conversion facility would disassemble, reshape, and convert surplus Pu pits (using a dry chemical process) into an unclassified metal or oxide form suitable for use at the next facility in the disposition process. In addition, some non-pit Pu material may also be processed in this facility.

Depending upon decisions in the ROD and pursuant to appropriate NEPA review(s), DOE would continue R&D and engage in further testing and demonstrations of Pu disposition technologies which may include: dissolution of small quantities of Pu in both glass and ceramic formulation; experiments with immobilization equipment and systems; fabrication of MOX fuel pellets for demonstrations of reactor irradiation at INEL; mechanical milling and mixing of Pu and feed forms; and testing of shipping and storage containers for certification, in addition to the testing and demonstrations previously described for the can-in-canister immobilization variant and the ARIES. These tests and demonstrations would slightly reduce the quantity of RFETS pit and non-pit materials to be stored at Pantex and SRS, respectively.

The storage and disposition actions proposed for various DOE sites by the Preferred Alternative are summarized in Table 1.6–1.

Table 1.6–1. Storage and Disposition Actions Proposed by the Preferred Alternative

Action	Hanford	NTS	INEL	Pantex	ORR	SRS	RFETS	LANL
Storage								
No Action	X[a]	X[b]	X[a]					X[a]
Upgrade				X[c]	X[d]	X[e]		
Phaseout							X	
Disposition[f]								
Pit Disassembly/Conversion	X		X	X		X		
MOX Fuel Fabrication	X		X	X		X		
Pu Conversion	X					X		
Immobilization	X					X		

[a] Pending subsequent tiered NEPA decisions for disposition of surplus Pu.

[b] NTS does not currently store either Pu or HEU.

[c] For storage of those pits currently at Pantex and pits from RFETS.

[d] For storage of HEU only.

[e] For storage of only those Pu materials currently at SRS and non-pit Pu materials from RFETS.

[f] "X" denotes potential sites for locating the disposition facilities pending subsequent tiered NEPA decisions. Only one of each facility is needed for accomplishing the disposition mission.

1.7 SCOPE OF THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Public Scoping Process. During 1994, DOE conducted a phased scoping process to solicit comments on long-term storage and disposition of weapons-usable fissile materials. The initial phase of the scoping process consisted of a series of planning meetings attended by technical experts from DOE's National Laboratories, industry, and academia. These planning meetings helped introduce the objectives of the Fissile Materials Disposition Program to the public and to identify DOE and IWG's roles in implementing the President's *Nonproliferation and Export Control Policy.*

On May 4 and 5, 1994, DOE conducted the first public meeting in Washington, DC. Using the 1994 NAS study as a starting point, the public meeting served as a forum to solicit input on the scope of the Notice of Intent (NOI), which was published on June 21, 1994, in the *Federal Register* (59 FR 31985) to inform the public of the preparation of the Storage and Disposition PEIS.

During August, September, and October 1994, 12 workshops were held to solicit public comment on the scope of the program. Figure 1.7–1 shows the locations and dates of these public scoping workshops. Written comments on the scope of the Storage and Disposition PEIS were also requested from the public. The objective of the workshops was four-fold: comply with NEPA requirements; ensure that the PEIS addresses a range of

reasonable alternatives; solicit relevant, focused input from the public; and continue the ongoing public participation efforts of DOE with the goal of reaching all interested parties.

In addition to the 12 workshops, DOE conducted 2 other meetings in November and December 1994 to obtain public input on the NEPA review strategy and reasonable alternatives for disposition of surplus weapons-usable HEU and Pu. The meeting on November 10, 1994, in Oak Ridge, Tennessee, led to DOE's decision to proceed with a separate EIS to evaluate reasonable disposition alternatives for surplus HEU. A meeting on December 13 and 14, 1994, in Herndon, Virginia, provided preliminary feedback on Pu disposition alternatives from the scoping process and public input on additional concerns relative to the alternatives being considered.

Incorporating Input in the Screening Process. As part of the overall scoping process, a screening committee consisting of five DOE technical experts was formed to identify the reasonable alternatives to be evaluated in the Storage and Disposition PEIS. Using a screening evaluation process to compare potential alternatives against a set of screening criteria, the committee considered input from the general public and used technical reports and analyses from the national laboratories and industry to develop the final list of reasonable alternatives. The initial screening process and results were reviewed by the IWG and a senior technical review group of outside experts.

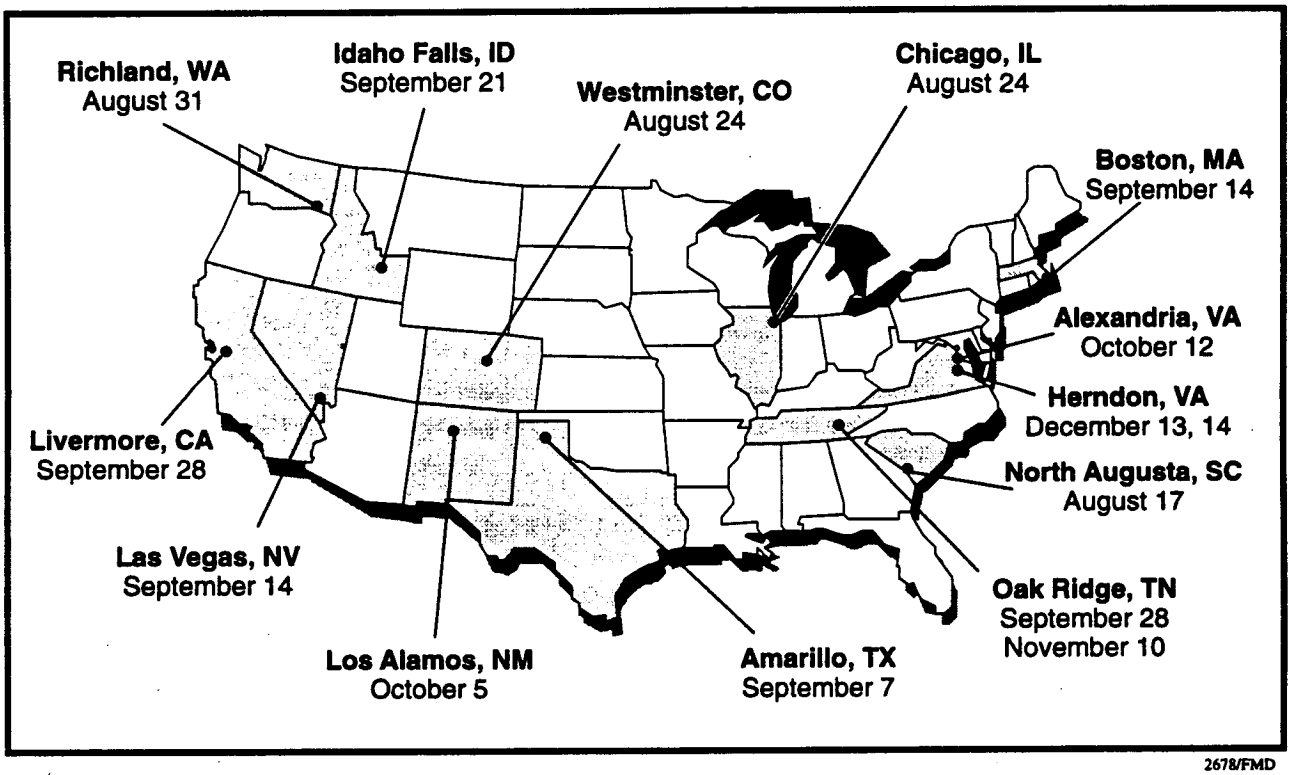


Figure 1.7–1. Public Scoping Workshop Locations, 1994.

The Department proposed criteria for screening reasonable Storage and Disposition PEIS alternatives and submitted them for public review and comment as part of the formal scoping process for the PEIS. During the scoping workshops, participants were given questionnaires to evaluate DOE's proposed screening criteria. The responses to these questionnaires, together with comments submitted by the public regarding the screening criteria, were reviewed by the screening committee. The input from the questionnaires resulted in several changes and clarifications of the criteria. The final criteria used for selecting alternatives are described in Chapter 2 of this PEIS.

Defining the Significant Issues. In the comment analysis process, written and oral public comments were reviewed and considered on their merits equally, regardless of the manner in which they were submitted. Each public comment was entered into a comment tracking system. A database was created with more than 3,000 individual records documented, and an analysis of similar comments was conducted to identify specific issues that the public felt DOE should address as part of the Storage and Disposition PEIS. The analysis of comments resulted in the identification of approximately 50 issues organized under the following 12 major issue categories:

- Overall scope of the proposed action and alternatives
- Storage alternatives
- Pu disposition
- HEU disposition
- Nonproliferation
- Surplus fissile materials declaration
- Spent Fuel Standard
- Environmental impacts
- Nonenvironmental impacts
- Relationship of the PEIS to other DOE actions
- Screening criteria
- Public participation

The resolution of many comments was described in the *Long-Term Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement Implementation Plan* (DOE/EIS-0229-IP, March 1995) for the Storage and Disposition PEIS. Issues regarding environmental impacts are addressed in this PEIS.

Organizing the Programmatic Environmental Impact Statement to Address Significant Issues. As mentioned in Section 1.3, DOE's proposed action involves evaluation of reasonable alternatives for long-term storage and disposition of weapons-usable Pu and HEU. These alternatives are as follows:

Storage:

- Storage Alternatives
  - Preferred Alternative (Combination)
  - Upgrade at Multiple Sites Alternative
  - Consolidation of Pu Alternative
  - Collocation of Pu and HEU Alternative
  - No Action Alternative
- Candidate Storage Sites

- Hanford
- NTS
- INEL
- Pantex
- ORR
- SRS

Environmental impacts of each long-term storage alternative and the No Action Alternative are analyzed for each of the six candidate storage sites to allow (1) the comparison of impacts by site for each alternative and (2) the comparison of impacts by alternative for each site. As a result, decisions can be made to select a single storage alternative for all sites or a combination of different alternatives for different sites.

Disposition:

- Preferred Alternative (Combination)
- Deep Borehole Category
  - Direct Disposition Alternative
  - Immobilized Disposition Alternative
- Immobilization Category
  - Vitrification Alternative
  - Ceramic Immobilization Alternative
  - Electrometallurgical Treatment Alternative
- Reactor Category
  - Existing LWR Alternative
  - Partially Completed LWR Alternative
  - Evolutionary LWR Alternative
  - CANDU Reactor Alternative
- No Disposition Action

Facilities under each alternative within the Immobilization and Deep Borehole Categories could be designed such that they could process all the surplus Pu over their operating lives. Each disposition alternative under the Reactor Category would consist of reactors that would use the MOX fuel produced from surplus; however, existing surplus Pu comes in various forms, and some of these forms may not be suitable for conversion to MOX fuel without specialized chemical processing.

[Text deleted.] In addition to the proposed storage and disposition alternatives, a No Action Alternative is analyzed. This alternative has two parts: (1) no change in current storage of Pu and HEU and (2) no disposition of surplus Pu. DOE may choose part one, part two, or both parts of this alternative. If only part one were chosen, no change in long-term storage would take place. Therefore, the current DOE storage sites would be used for continued storage of HEU and nonsurplus Pu (the No Action Alternative for these materials), while decisions

would be made for surplus Pu disposition. If only part two were chosen, disposition of surplus Pu would not occur, and this material would remain in storage. Therefore, decisions on long-term storage would become the "No Disposition Action" for surplus Pu. If both parts were chosen, no Pu disposition and no change in current storage of Pu and HEU would occur. This case is analyzed in the Storage and Disposition PEIS as the baseline case for the No Action Alternative. Disposition of surplus HEU is addressed in the HEU EIS.

Each of these alternatives, along with the screening process that led to the selection of these alternatives, is described in detail in Chapter 2. Definitions of the environmental resources and issue areas, and descriptions of the affected environments at each site, are presented in Chapter 3. The general approach and specific methods for assessing environmental consequences, along with estimated results and potential cumulative impacts, are presented in Chapter 4. The information and environmental analyses provided in this PEIS, together with separate cost, schedule, technical, and policy analyses, are intended to address all significant issues raised during the scoping process.

Changes in Scope. The original NOI to prepare the Storage and Disposition PEIS included the disposition of surplus HEU, long-term storage and disposition of surplus U-233, and long-term storage and disposition of minor actinides.

In the course of the public scoping process, it was deemed more appropriate to analyze the impact of surplus HEU disposition in a separate EIS. The decision to analyze HEU separately from the Storage and Disposition PEIS was made for a number of reasons, including the following:

- The disposition of surplus HEU could use existing technologies and facilities in the United States, in contrast to the disposition of surplus Pu.
- The disposition of surplus HEU would involve different alternatives, timeframes, technologies, facilities, and personnel than those required for the disposition of surplus Pu.
- Decisions on surplus HEU disposition are independently justified; would not affect, trigger, or preclude other decisions that may be made regarding the disposition of surplus Pu; and would not depend on actions taken or decisions made pursuant to the Storage and Disposition PEIS.
- Disposition is the most rapid path for neutralizing the proliferation threat of surplus HEU, is consistent with the President's *Nonproliferation and Export Control Policy*, would demonstrate U.S. nonproliferation commitment to other nations, and is consistent with the course of action now underway in Russia to reduce Russian HEU stockpiles.

Accordingly, DOE concluded that surplus HEU disposition should be treated separately, and published a notice in the *Federal Register* (60 FR 17344) in April 1995 to inform the public of its conclusion. The HEU Draft EIS was issued for public review in October 1995 (60 FR 54867), the HEU Final EIS was issued in June 1996 (61 FR 33719), and the resulting ROD was published on August 5, 1996 (61 FR 40619).

The long-term storage and disposition of surplus U-233 were also included in the original scope of the Storage and Disposition PEIS. Existing surplus U-233 is stored at two DOE sites in small quantities. Results of preliminary studies indicate that the only reasonable alternative for U-233 is to blend it down and dispose of it as waste. However, in contrast to Pu and HEU, U-233 is a high-energy radiation source, must be remotely handled, and involves additional worker and public radiation health and safety concerns that would need to be accommodated. In addition, if the U-233 is to be disposed of as waste, the requirements for its waste form must be established for existing or planned waste repositories or disposal sites. Further research on waste form requirements and the feasibility of blending the U-233 to meet these requirements is needed to assess the final disposition of this material. Finally, because U-233 emits high-energy radiation, it is inherently more proliferation-resistent than Pu.

Since U-233 disposition is not ready for decision, DOE is not currently proposing to take action on the disposition of surplus U-233, which will continue to be stored at current locations. Upon identification of disposition requirements and verification of the feasibility of accommodations to meet these requirements, DOE may propose disposition of surplus U-233 and would conduct appropriate environmental analyses under NEPA at that time. Any such disposition of surplus U-233, if proposed, would involve different alternatives, wastes, personnel, worker safety concerns, technologies, and proliferation concerns than disposition of Pu. Any disposition of surplus U-233, if proposed, would be independent of surplus Pu disposition, would be independently justified, would not trigger or affect Pu disposition, and could proceed regardless of any subsequent or prior Pu disposition actions.

The long-term storage and disposition of minor actinides, radioisotopes having atomic numbers of 95 and above, were included in the original scope of the Storage and Disposition PEIS. An assessment of these materials showed that they exist in small quantities, are in active program use, or are planned to be declared wastes. Consequently, there is no need to include minor actinides in the scope of this PEIS.

1.8 SUMMARY OF MAJOR ISSUES IDENTIFIED DURING THE COMMENT PERIOD AND CHANGES TO THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

1.8.1 ISSUES IDENTIFIED AND RESOLVED

The Department initially issued the Storage and Disposition PEIS as a draft for public comment for the period from March 8 through May 7, 1996 (61 FR 9443). In response to public requests, DOE extended the comment period deadline to June 7, 1996 (61 FR 22038). Public meetings on the Draft PEIS were held in March and April 1996 at the following locations:

Denver, CO	March 26, 1996
Las Vegas, NV	March 28–29, 1996
Oak Ridge, TN	April 2, 1996
Richland, WA	April 11, 1996
Idaho Falls, ID	April 15, 1996
Washington, DC	April 17–18, 1996
Amarillo, TX	April 22–23, 1996
North Augusta, SC	April 30, 1996

During the 92-day public comment period on the Storage and Disposition Draft PEIS, DOE received comments on the document by mail, fax, telephone recording, electronic mail, and orally at the public meetings. Altogether, DOE received approximately 8,700 written and recorded comments from individuals and organizations. All comments are presented in Volume IV of the Storage and Disposition Final PEIS, the *Comment Response Document* (CRD).

Approximately 80 percent of the comments received consisted of mail-in letter and postcard campaigns which expressed either support of or opposition to the use of various sites or alternatives. Many commentors encouraged DOE and the United States to become the world leader in the safe, secure, and timely disposition of

Pu, and favored worldwide nonproliferation efforts for surplus Pu. The following highlights some of the recurring comments, DOE's response, and the PEIS revisions in response to these comments.

A number of commentors expressed the opinion that the surplus Pu should remain in present locations for future energy or weapons use, or until new technologies are available for disposition. In response to these concerns, DOE expanded the discussion on the need for the proposed Pu disposition action in the PEIS. Disposition is necessary to implement the President's *Nonproliferation and Export Control Policy* in a safe, reliable, cost-effective, and timely manner.

Some commentors also stated that DOE should consider additional disposition alternatives, including the use of FFTF, deep burn reactors, and mononitride reactors. The use of advanced reactors such as deep burn reactors and mononitride reactors was considered but eliminated due to the technical immaturity, attendant costs, and lengthy development and demonstration efforts required to bring the technologies to a viable, practical status and enable disposition options to be initiated with certainty. The FFTF would be considered for Pu disposition if first selected for tritium production. The FFTF is not a reasonable, stand alone alternative because it is in a standby status awaiting shutdown and because it could not satisfy the criterion of completing the disposition mission within 25 years. A discussion of FFTF for this purpose is included in Appendix N. In all, 37 different alternative options were considered by DOE for disposition of Pu. DOE has made revisions to the Summary and Chapter 2 of the PEIS to clarify how the screening process was used for selection of reasonable alternatives.

Commentors noted that transportation of fissile materials is one of their major concerns with the Program. The ground transportation between sites, in the event a consolidation alternative was selected, could increase the potential for traffic accidents. International transportation for specific border crossings for the shipment of MOX fuel to Canada for the CANDU Reactor Alternative was also identified as a concern. DOE acknowledges the public's concern, and in response, the transportation analysis in Section 4.4 and Appendix G of the Draft PEIS was expanded. The revisions address security measures for land and sea transport, emergency preparedness, and clarify the results of analyses performed.

One frequently recurring comment presented by the public relates to the technical, cost, schedule, and nonproliferation analyses to support DOE's ROD. Many of the commentors suggested that DOE should make information available for public review. Since issuance of the Draft PEIS, DOE has prepared both the *Technical Summary Report for Long-Term Storage of Weapons-Usable Fissile Materials* (DOE/MD-0004 Rev. 1) and the *Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition* (DOE/MD-0003 Rev. 1). These two reports summarize representative technical, cost, and schedule data for the reasonable alternatives being considered for long-term storage and surplus Pu disposition, respectively. In July and August 1996, these documents were initially distributed for public review and comment. After taking the public's comments into consideration, DOE revised and re-issued both reports in November and December 1996. In October 1996, DOE issued the *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives*, which analyzes the nonproliferation and arms reduction implications of the alternatives addressed in the PEIS for Pu and HEU storage and the disposition of surplus Pu. From October through early November 1996, the public was asked to review and comment on the draft nonproliferation document; this process included a series of 10 public meetings held nationwide. Public comments received are being taken into consideration in revising the report, which is scheduled for re-issue in late 1996. This report, in conjunction with the Final PEIS, the technical summary reports previously described, and public input, will form the basis for DOE's decisions, which will be discussed in a ROD to be issued no sooner than 30 days after publication of the Environmental Protection Agency's Notice of Availability of the Storage and Disposition Final PEIS.

Commentors also stated that the U.S. Nonproliferation Policy does not encourage the civil use of Pu or Pu processing for either nuclear power or nuclear explosive purposes. The commentors requested that the PEIS address the possibility that the MOX option would have an adverse effect on U.S. nonproliferation policy by encouraging its use in civil nuclear power programs and by encouraging Pu reprocessing and recycling. DOE

acknowledges the public concern for nonproliferation. As discussed in the PEIS, the reactor option would utilize a once-through fuel cycle. Spent fuel from disposition would be disposed of with other commercial reactor spent fuel. This is consistent with U.S. policy since no Pu in the spent fuel would be recycled. Revisions to Chapter 1 of the PEIS were made to expand and clarify this issue.

Commentors indicated that the isotopic composition of the residual Pu in the final waste forms is an inappropriate criterion by which to assess proliferation risks because it perpetuates a myth that reactor-grade Pu cannot be used to make workable weapons. In the opinion of these commentors, isotopic degradation does not constitute a compelling argument in favor of the MOX option. DOE acknowledges that, although it may be possible to make a nuclear weapon from spent commercial reactor fuel, this can only be done with extreme difficulty by individuals with a great deal of experience in handling and processing nuclear materials. DOE believes that the disposition of weapons Pu through the use of MOX fuel in reactors would meet the Spent Fuel Standard in creating a radiological barrier that makes the Pu as difficult to retrieve and reuse in weapons as Pu in spent commercial fuel. The use of this technology would allow for the Pu to be disposed in a geologic repository pursuant to the *Nuclear Waste Policy Act,*[16] the same as for spent commercial fuel. Revisions to Chapter 1 of the PEIS were made to clarify this issue.

1.8.2 CHANGES MADE TO THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

This section identifies changes made since the issuance of the Draft PEIS. The Final PEIS includes the Preferred Alternative, which is a combination of other alternatives and is described in Section 1.6. Other changes, after considering public comments, are described below.

Appendix N, which in the Draft PEIS summarized the operational aspects of the multipurpose reactor, has been revised for the Final PEIS to provide information on the costs and benefits of conducting separate tritium production and Pu disposition missions versus the costs and benefits of carrying out one multipurpose mission. Included in Appendix N is a cost comparison of using new Advanced LWRs or Modular Helium Reactors (MHR), and a discussion of issues regarding the use of the FFTF (a liquid metal reactor at Hanford) for tritium production and Pu disposition.

Appendices O, P, Q, and R were added to the Final PEIS to help clarify alternative issues as they relate to the Preferred Alternative. Appendix O describes two can-in-canister technology concepts at SRS, which are variants of the Vitrification and Ceramic Immobilization Disposition Alternatives described in Chapter 2. This information was added based on public interest in these concepts during the Draft PEIS comment period, and also because of DOE's reconsideration of this technology as being a viable approach for Pu disposition through immobilization.

Appendix P provides a description of using the Manzano Weapons Storage Area (WSA) near Albuquerque, NM to store Pu pits. This appendix was added because DOE's Preferred Alternative separates the storage of pits from non-pit materials, in which case Manzano WSA no longer appears unreasonable under the Preferred Alternative for pit storage. However, since DOE's preferred site for interim storage of pits is Pantex (as described in the Pantex EIS) and since the majority of pits are already located in storage at Pantex, the Preferred Alternative proposes the long-term storage of Pu pits at Pantex. Weapons assembly/disassembly would continue at Pantex in any case. Construction of a new storage facility at Manzano would create needless expense and transportation risk.

Appendix Q describes the operations and human (radiological) health impacts associated with Pu pits being transferred from RFETS to Pantex, repackaged in Zone 12 South, and placed in storage in Zone 4 West at Pantex, as part of the Preferred Alternative for storage. The information presented in this appendix is based on the Pantex EIS analysis of storing the Pu pits already at Pantex.

[16] Also referred in the PEIS as a geologic, permanent, or HLW repository.

Appendix R discusses aircraft crash and radioactive release probabilities for proposed storage and disposition facilities at Pantex.

Section 1.2 of the Final PEIS has been revised to reflect the cooperative effort between the United States and Russia to study different options for managing excess Pu (including secure storage, conversion of Pu weapons components to other forms, and stabilization of unstable forms of Pu), and options for disposition of excess Pu (deep borehole, immobilization, and reactors). The results of this study have been documented in the *Joint United States/Russian Plutonium Disposition Study* report, completed in September 1996. This study and the options considered will provide decisionmakers from both countries with a set of jointly evaluated alternatives for Pu disposition and help build further trust and cooperation in the area of fissile material disposition.

Chapter 2
Weapons-Usable Fissile Materials Long-Term Storage and Disposition Alternatives

2.1 DEVELOPMENT OF ALTERNATIVES

Alternatives analyzed in this PEIS were determined through a screening evaluation process in which a comprehensive set of screening criteria were used. From this process, reasonable alternatives for the following were identified:

- The strategy for long-term storage of weapons-usable Pu and HEU, including nonsurplus Pu and HEU, and surplus Pu and HEU pending disposition
- The strategy and technology for disposition of surplus weapons-usable Pu

In addition, a list of candidate sites for long-term storage of weapons-usable Pu and HEU was developed based on site-selection criteria established previously. The site selection process is described in Section 2.1.3. These reasonable alternatives and candidate sites are analyzed in this PEIS as part of the input for DOE's decisionmaking on the storage and disposition of weapons-usable fissile materials.

2.1.1 SCREENING CRITERIA

To determine reasonable alternatives for evaluation in this PEIS, DOE developed, for both long-term storage and disposition, screening criteria based on the policy objectives articulated in the President's *Nonproliferation and Export Control Policy* of September 1993 and the January 1994 *Joint Statement by the President of the Russian Federation and the President of the United States of America on Nonproliferation of Weapons of Mass Destruction and the Means of Their Delivery* (see Appendix A), as well as the analytical framework established by NAS in its 1994 report, *Management and Disposition of Excess Weapons Plutonium* study. Based on input from the public during the scoping process, the screening criteria were expanded and used for selecting reasonable alternatives. Descriptions of the screening criteria used for long-term storage and disposition alternatives are given in Sections 2.1.3 and 2.1.4, respectively.

2.1.2 SCREENING EVALUATION PROCESS

The screening evaluation was conducted by a committee of five DOE technical experts, DOE officials assisted by advisors from the National Laboratories, and other support staff. Based on a review of the NAS report, prior DOE-sponsored work on HLW disposal, and input from the public obtained during the scoping process, the screening committee identified an extensive set of options and developed potential disqualifiers for both long-term storage and disposition options. Each option represented a storage or disposition strategy that might be implemented in a systematic, cradle-to-grave manner. There were 5 long-term storage options, 37 Pu disposition options, 9 HEU disposition options, and 8 U-233 disposition options. As previously identified in Chapter 1, the disposition of surplus HEU and disposition of U-233 are not within the scope of this Storage and Disposition PEIS; disposition of surplus HEU is addressed in the HEU Final EIS and U-233 disposition will be addressed at the time it is proposed by DOE and found to be ready for decision.

The screening committee evaluated each option against potential disqualifiers to determine if any options had a "fatal flaw" in one or more of the screening criteria. For example, inability to meet the Stored Weapons Standard or the Spent Fuel Standard was considered a fatal flaw that resulted in the disqualification of an option. Options that survived this process were then ranked. Each option was rated high, medium, or low against each screening

criterion, relative to other options. This ranking process eliminated options that were rated low for multiple criteria or were clearly dominated by similar, more attractive options in the same category. Options that survived the ranking process emerged as reasonable alternatives for detailed evaluation in the Storage and Disposition PEIS. Details of the screening evaluation process can be found in the *Summary Report of the Screening Process* (DOE/MD-0002). After considering public comment on the Draft PEIS, as well as other public comments and internal DOE review following the Draft PEIS, DOE has for some of the disposition alternatives clarified and expanded explanations of the screening rationale and has added DoD's Manzano WSA Facility as a storage facility under consideration. A description of alternatives considered but eliminated for further analysis, along with reasons for elimination, is given in Section 2.1.3 for long-term storage and Section 2.1.4 for Pu disposition.

2.1.3 Reasonable Alternatives for Long-Term Storage of Weapons-Usable Fissile Materials

Screening Criteria for Long-Term Storage Options

Resistance to Theft and Diversion by Unauthorized Parties. The site and facility must be capable of providing comprehensive protection and control of weapons-usable fissile materials (that is, meet the Stored Weapons Standard).

Technical Viability. There should be a high degree of confidence that the facility and site infrastructure can provide storage of nuclear components and materials for up to 50 years.

Environment, Safety and Health (ES&H) Compliance. High standards of public and worker health and safety and environmental protection must be met, and significant additional ES&H burdens should not be created.

Cost-Effectiveness. Long-term storage should be accomplished in a cost-effective manner and should be compatible with reasonable disposition alternatives.

Timeliness. Long-term storage should be implemented in a timely manner.

Fosters Progress and Cooperation With Russia and Other Countries. A facility must accommodate international inspections for surplus material in unclassified forms and must establish appropriate standards for storage and protection of international nuclear material inventories.

Public and Institutional Acceptance. An alternative should be able to muster a broad and sustainable consensus on the manner in which long-term storage is accomplished.

Results of the Screening Process: Reasonable Alternatives for Long-Term Storage

Options that were not disqualified or eliminated through the use of the screening criteria emerged from the screening process as reasonable options for further evaluation. As a result of the screening process, two options were identified as reasonable:

- Upgrade of storage facilities to make them suitable for long-term storage (upgrade existing storage capability at more than one site)
- Consolidation of the weapons-usable fissile materials at DOE sites (consolidate or collocate storage at one or two DOE sites)

Both options assumed that all nonsurplus HEU and surplus HEU pending disposition were located at ORR before initiating any action under this PEIS. The scope of the first option, upgrade existing storage capability

(referred to in the PEIS as Upgrade at Multiple Sites Alternative or Upgrade Alternative), has been expanded to include the possibility of upgrading through new construction where existing facilities cannot be economically modified to meet requirements and to account for the relocation of RFETS and/or LANL Pu to one or more Pu storage sites. The second option, consolidate storage at DOE sites, has been modified to separately address two alternative approaches: the Consolidation of Pu Alternative, and the Collocation of Pu and HEU Alternative. For each alternative (Upgrade at Multiple Sites Alternative, Consolidation of Pu Alternative, and the Collocation of Pu and HEU Alternative), a subalternative has also been added that would exclude the strategic reserve and weapons R&D material covered by the Stockpile Stewardship and Management PEIS. Finally, a Preferred Alternative was developed, representing a combination of alternatives. The PEIS alternatives are further described.

Upgrade at Multiple Sites Alternative: Modify Existing *and/or* Construct New Facilities at More Than One Site for Continued Storage of Plutonium and Highly Enriched Uranium; Relocate Rocky Flats Environmental Technology Site and Los Alamos National Laboratory Plutonium to Another Plutonium Storage Site. Under this alternative, DOE would modify certain existing facilities and/or build new facilities, depending on individual site requirements for meeting updated DOE standards for nuclear material storage facilities. The facilities would be designed to operate for up to 50 years. Pu material currently stored at Hanford, INEL, Pantex, and SRS would remain at those sites. Pu currently in storage at RFETS and LANL would be moved to a single long-term storage site or distributed for long-term storage at more than one site. HEU material stored at ORR would remain at that site in modified facilities.

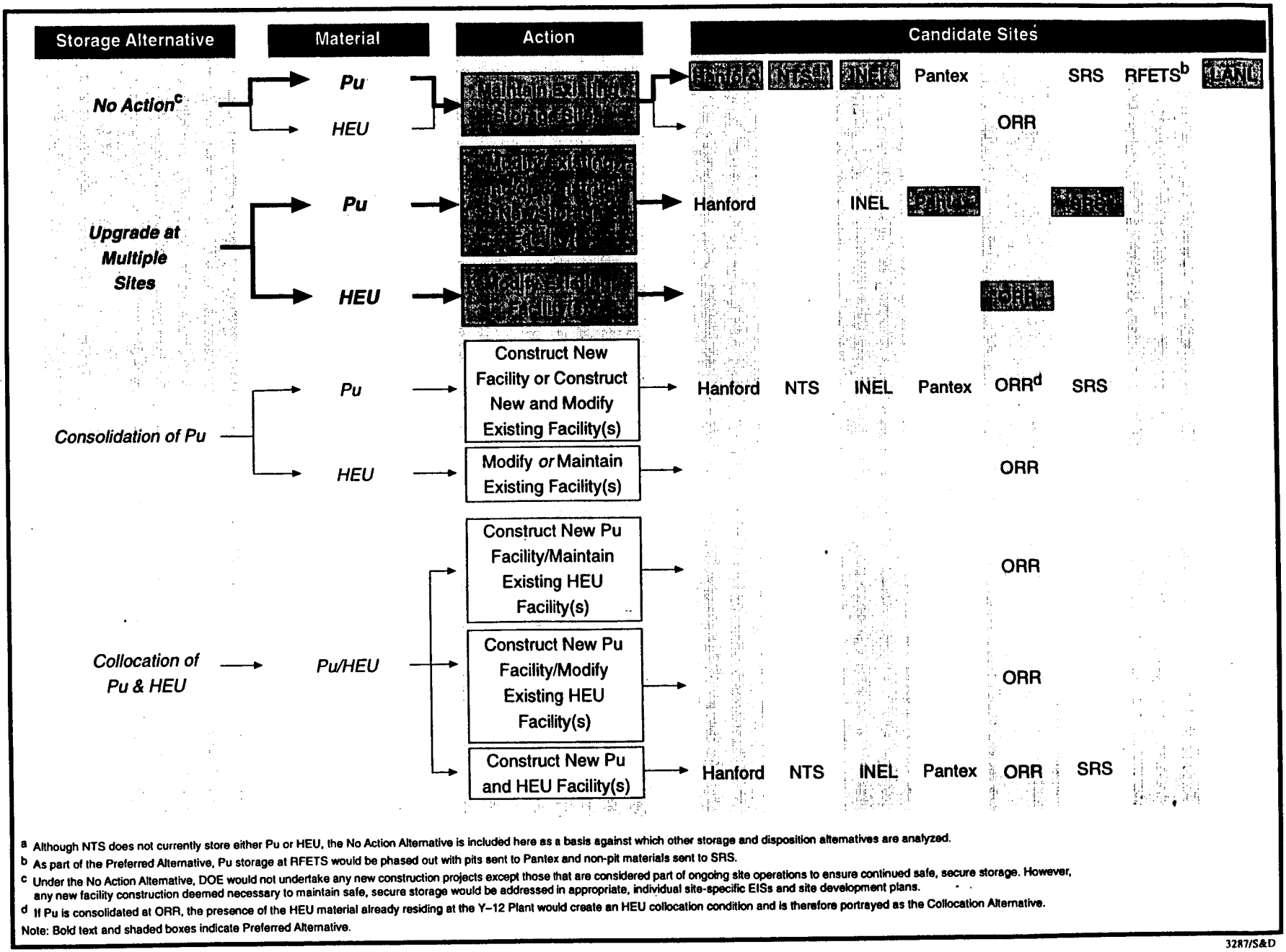
Consolidation of Plutonium Alternative: Construct New Facility *or* Construct New and Modify Existing Facilities at One Site for all Plutonium Materials; Maintain (and Modify as Necessary) Existing Highly Enriched Uranium Facilities at Oak Ridge Reservation. Under this alternative, a new consolidated Pu storage facility would be constructed alone or with modified existing facilities to store current and future DOE weapons-usable Pu inventories. Pu would be removed from existing storage facilities at Hanford, INEL, Pantex, SRS, RFETS, and LANL and transported to the consolidated storage facility. The facility would be designed to provide safe, secure, long-term storage of both nonsurplus Pu and surplus Pu (pending disposition) for up to 50 years. HEU material stored at ORR would remain at that site. DOE would maintain and, as necessary, modify and upgrade the ORR facilities to ensure continued safe, secure storage.

Collocation of Plutonium and Highly Enriched Uranium Alternative: Construct New Facility *or* Construct New and Modify or Maintain Existing Facilities at One Site for all Plutonium and Highly Enriched Uranium Materials. Under this alternative, a new consolidated Pu storage facility would be collocated with new or existing HEU facilities to store current and future DOE weapons-usable fissile material inventories. The facilities would be responsible for storing Pu as well as HEU. Pu would be moved from existing storage facilities at Hanford, INEL, Pantex, SRS, RFETS, and LANL. HEU would either stay at ORR, should ORR be selected, or be moved to the collocated storage facility. The facility would be designed to provide safe, secure, long-term storage for up to 50 years.

Preferred Alternative. Under the Preferred Alternative, existing facilities would be upgraded at Pantex, ORR,[1] and SRS. RFETS Pu pits would be relocated to Pantex, and RFETS surplus non-pit Pu materials would be relocated to SRS. Current storage would continue (No Action) at Hanford, INEL, and LANL for surplus Pu, pending disposition. Strategic Reserve pits would be stored at Pantex in accordance with the Preferred Alternative in the Stockpile Stewardship and Management PEIS. No Action would be taken at NTS; Pu storage would not be added to NTS, consistent with the site's current mission.

Figure 2.1.3–1 depicts the conceptual structure of the long-term storage alternatives and the Preferred Alternative for storage analyzed in this PEIS. Under each long-term storage alternative and the No Action

[1] DOE may subsequently propose to construct new HEU storage facilities at ORR; any such proposal would be assessed in subsequent site-specific NEPA documentation.



[a] Although NTS does not currently store either Pu or HEU, the No Action Alternative is included here as a basis against which other storage and disposition alternatives are analyzed.

[b] As part of the Preferred Alternative, Pu storage at RFETS would be phased out with pits sent to Pantex and non-pit materials sent to SRS.

[c] Under the No Action Alternative, DOE would not undertake any new construction projects except those that are considered part of ongoing site operations to ensure continued safe, secure storage. However, any new facility construction deemed necessary to maintain safe, secure storage would be addressed in appropriate, individual site-specific EISs and site development plans.

[d] If Pu is consolidated at ORR, the presence of the HEU material already residing at the Y-12 Plant would create an HEU collocation condition and is therefore portrayed as the Collocation Alternative.

Note: Bold text and shaded boxes indicate Preferred Alternative.

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Figure 2.1.3–1. Long-Term Storage Alternatives, Including the Preferred Alternative for Storage.

Alternative, Figure 2.1.3–1 describes the action that would be taken at the various candidate sites and locations for these materials.[2] For the No Action Alternative and upgrade, consolidation and collocation long-term storage alternatives, this PEIS analyzes the impact of storing all weapons-usable fissile materials. Under these alternatives, this PEIS also analyzes the impacts of storing weapons-usable fissile materials excluding those covered under the Stockpile Stewardship and Management PEIS (strategic reserves and some weapons R&D materials). [Text deleted.]

Candidate Sites for Long-Term Storage Alternatives

Six locations (Hanford, NTS, INEL, Pantex, ORR, and SRS) are being considered as candidate sites for the long-term storage of weapons-usable fissile materials. Each site is being considered for the location of upgraded, consolidated, or collocated storage facilities.

Site Screening Process

Concurrent with the publication of the NOI to prepare a PEIS for Reconfiguration of the Nuclear Weapons Complex in the *Federal Register* (56 FR 5590) on February 11, 1991, a *Notice of Availability of an Invitation for Site Proposals for the Nuclear Weapons Complex Reconfiguration Site* was also published (56 FR 5595). The invitation solicited proposals for consideration of non-DOE sites and listed five DOE sites that met the initial screening criteria (Hanford, INEL, Pantex, ORR, and SRS). No additional locations were identified as a result of this invitation.

The five initial sites were evaluated against the following siting criteria: (1) density and distribution of population, (2) ES&H, (3) socioeconomics, (4) site availability, (5) transportation, and (6) site flexibility. All sites were found by the Site Evaluation Panel to be fully qualified.

There have been significant changes in the world since publication of the *Nuclear Weapons Complex Reconfiguration Study* in January 1991, especially with regard to projected future requirements of the United States' nuclear weapons stockpile. As a result, the study no longer provides a suitable framework for determining the appropriate configuration of the future Nuclear Weapons Complex. Therefore, DOE decided to separate the Reconfiguration PEIS into two PEISs: a TSR PEIS and a Stockpile Stewardship and Management PEIS.

A Revised NOI to prepare a Reconfiguration PEIS was published in the *Federal Register* (58 FR 39528) on July 23, 1993. In this notice, DOE eliminated Hanford from further consideration as a candidate site, because all nuclear weapons production functions at that location had been terminated and the site was dedicated to environmental and waste management activities. NTS was evaluated using the siting criteria described above and was determined to be a reasonable site alternative for new tritium supply and recycling facilities. The resulting five sites—NTS, INEL, Pantex, ORR, and SRS—were evaluated in the TSR PEIS.

The long-term storage mission is a portion of the proposed action considered under the original reconfiguration proposal. Thus, sites meeting criteria for reconfiguration are considered reasonable for the long-term storage mission. Since the five TSR sites meet these criteria, they are being considered for long-term storage of weapons-usable fissile materials. In addition, Hanford is considered a reasonable site for the following reasons:

- It satisfies the original reconfiguration criteria
- Long-term storage is consistent with its current mission

[2] As of September 1994, LLNL stored 0.3 t (0.3 tons) of Pu, which are primarily R&D and operational feedstock materials not surplus to government needs. Adequate storage facilities for this material currently exist at LLNL; consequently, none of the Pu stored at LLNL falls within the scope of this Storage and Disposition PEIS.

- It has the infrastructure to support a long-term storage mission

The resulting sites—Hanford, NTS, INEL, Pantex, ORR, and SRS—are analyzed in the PEIS.

Long-Term Storage Alternatives Considered But Eliminated from Further Analysis

As a result of the screening process, two long-term storage options were eliminated: the utilization of existing facilities at non-DOE domestic sites for storage of non-pit Pu forms, and the utilization of non-domestic sites. The utilization of existing facilities at non-DOE sites for long-term storage as an option was rated but eliminated from further consideration. The Pantex EIS analyzes DoD's Manzano WSA near Albuquerque, NM, as a candidate non-DOE domestic site for temporary storage of Pu pits (58 FR 39528). [Text deleted.]

As in the case of temporary pit storage, the materials to be placed in long-term storage include Pu pits. However, they also include oxides and other dispersible material forms that may require treatment and repackaging not needed for pits. There are ES&H concerns associated with locating these operations in proximity to the metropolitan Albuquerque area. Furthermore, there is insufficient land area available to construct the necessary direct support facilities needed for analysis, repackaging, accounting, and waste management. Therefore, the Manzano WSA was considered in the Draft PEIS but eliminated as a reasonable alternative primarily because Manzano WSA could not accommodate storage of both pit and non-pit materials.

Since the issuance of the Draft PEIS, DOE has developed a Preferred Alternative for storage that would separate storage of most Pu pits from storage of non-pit Pu material. Specifically, the Preferred Alternative would store Pu pits from Pantex and RFETS at Pantex, and would store non-pit Pu at SRS, Hanford, and INEL. Since DOE's Preferred Alternative would separately locate storage of pits and non-pit Pu from RFETS, the option to store pits at Manzano WSA no longer appears unreasonable. Therefore, DOE has added Appendix P to the Final PEIS, which discusses potential storage of Pantex and RFETS pits at Manzano WSA.

For a number of reasons, the Preferred Alternative would store the pits from Pantex and RFETS at Pantex, rather than Manzano WSA. Pantex is the proposed site for interim storage of pits under the Preferred Alternative in the Pantex EIS.[3] The majority of the pits that require storage are surplus to U.S. defense needs and are already located at Pantex. The number of pits that would be relocated from RFETS would be small by comparison. Since the majority of pits are already in storage at Pantex, it would be prudent for DOE to consolidate all pits there for storage. Assembly and disassembly operations would continue at Pantex even if pit storage did not occur there. Selecting Manzano WSA would require DOE to create another site where Pu would be located with the risk of contamination and the associated costs for site infrastructure and security. In addition, other missions that could be added to Pantex (for example, pit disassembly/conversion or MOX fuel fabrication) could not be added to Manzano.

Storage at Manzano WSA would involve the transportation risk of moving these materials from Pantex to Manzano WSA. Furthermore, two shipment campaigns would be required for disposition for most of the pits (those already at Pantex) if Manzano WSA were chosen, whereas only one shipment campaign of those same pits would be required if the pits were stored at Pantex. For the Manzano case, pits at Pantex would require relocation to Manzano and then a second shipment campaign to a disposition site. Leaving the pits in storage at Pantex would result in only one shipment campaign from Pantex to the disposition site.[4]

The utilization of non-domestic sites for long-term storage was proposed, but was eliminated from further consideration because it was not able to address all of the long-term storage requirements. These requirements

[3] The disposition of these surplus pits would begin within the next 10 years and would be completed within the next 25 years. The time period required for the storage of the pits is therefore close to that considered in the Pantex EIS for pit storage and the reasons for not using Manzano WSA are the same.

[4] Two shipment campaigns of pits would be required for those pits currently stored at RFETS for both Pantex and Manzano.

include the storage of the materials set aside as strategic reserve for defense purposes, which are not appropriate to locate outside the United States. This option was disqualified in the screening process for non-strategic reserve material as well, because the risk of theft or diversion by unauthorized parties would be greater than those involved in the utilization of domestic sites. Safeguard and security of nuclear materials are also enhanced by the domestic law enforcement infrastructure, which would not be easily coordinated outside the United States. Figure 2.1.3–2 shows the long-term storage options that were considered and rated based on the seven screening criteria and the principal reasons for disqualification or elimination. The Preferred Alternative for storage at each DOE site was selected from among these storage options.

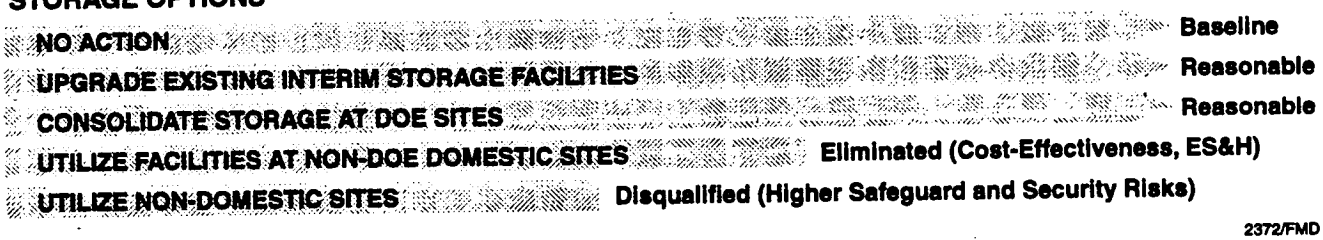


Figure 2.1.3–2. Results of the Screening Process—Long-Term Storage Options.

2.1.4 Reasonable Alternatives for the Disposition of Surplus Plutonium

Screening Criteria for Disposition Options

Resistance to Theft and Diversion by Unauthorized Parties. Each step in the disposition process must be capable of providing for comprehensive protection and control of weapons-usable fissile materials.

Resistance to Retrieval, Extraction, and Reuse by Host Nation. The surplus material must be made highly resistant to potential use in weapons to reduce reliance on institutional controls and demonstrate that the arms reductions will not be easily reversed.

Technical Viability. There should be a high degree of confidence that the alternative will be technically successful.

Environmental, Safety and Health Compliance. High standards of public and worker health and safety, and environmental protection must be met, and significant additional ES&H burdens should not be created.

Cost-Effectiveness. Disposition should be accomplished in a cost-effective manner and be compatible with reasonable long-term storage alternatives.

Timeliness. There is an urgent need to begin Pu disposition and to minimize the time period that surplus fissile materials remain in weapons-usable form.

Fosters Progress and Cooperation With Russia and Other Countries. The alternative must establish appropriate standards for the disposition of surplus weapons-usable fissile material inventories and support negotiations for bilateral or multilateral reductions in these materials, and each step in the disposition process must allow international inspections.

Public and Institutional Acceptance. An alternative should be able to muster a broad and sustainable consensus on the manner in which disposition is accomplished.

Additional Benefits. The ability to leverage government investments for disposition of surplus materials to contribute to other national or international initiatives should be considered.

Results of the Screening Process: Reasonable Alternatives for Surplus Plutonium Disposition

As a result of the screening process for surplus Pu disposition, three alternative categories consisting of nine alternatives are considered reasonable. The alternative categories for further evaluation are the deep borehole category, the immobilization category, and the reactor category.

Deep Borehole Category. Within this category, surplus weapons-usable Pu would be emplaced in deep boreholes drilled several kilometers below the water table into ancient, geologically stable rock formations. The deep boreholes would be sealed to isolate the Pu from the environment.

Two Deep Borehole Alternatives were analyzed for this PEIS:

- Direct Disposition Alternative—direct emplacement of canisters containing Pu forms that have not been immobilized
- Immobilized Disposition Alternative—Pu immobilized in ceramic pellets (without the addition of high-energy, gamma-emitting radionuclides) would be emplaced in a borehole as part of a grout-pellet mixture

In the first borehole alternative, surplus weapons-usable Pu would be encapsulated directly in suitable canisters without any immobilization processing of Pu material and the canisters would be placed in a deep borehole. The deep borehole would then be plugged after completion of the emplacement. In the second deep borehole alternative, surplus weapons-usable Pu would be converted to an immobilized ceramic form. The immobilized Pu form then would be directly emplaced in a deep borehole without encapsulation in canisters, and the deep borehole would be plugged after completion of the emplacement. Under both alternatives, emplacement in a deep borehole would provide a geologic barrier to proliferation and Pu could not be recovered by the host nation undetected. Therefore, the Pu would not need to be mixed with HLW or other radioactive materials to provide a radiation barrier to recovery.

Immobilization Category. Within this category, surplus Pu would be immobilized in an acceptable matrix to create a chemically stable form for disposal. The immobilized material would be placed in lag storage prior to transfer to a repository constructed pursuant to the *Nuclear Waste Policy Act* (NWPA), as amended (see discussion in Section 2.4). The immobilized Pu would contain HLW or a radioactive isotope to create a radiation field that enhances proliferation resistance to meet the Spent Fuel Standard.

Three Immobilization Alternatives were included in this PEIS:

- **Vitrification Alternative.** This alternative would consist of building a new facility or modifying existing facilities to produce a glass waste form that embeds Pu and radioisotopes within the glass form. This PEIS analyzes the impacts associated with building and operating a new facility at any of six DOE sites (Hanford, NTS, INEL, Pantex, ORR, and SRS). As an example of a technology variant at existing facilities, Appendix O of this PEIS describes the can-in-canister variant at the DWPF at SRS.
- **Ceramic Immobilization Alternative.** This alternative would consist of building a new facility or modifying existing facilities to produce a ceramic waste form that embeds Pu and radioisotopes within the ceramic form. This PEIS analyzes the impacts associated with building a new facility at any of six DOE sites (Hanford, NTS, INEL, Pantex, ORR, and SRS). As an example of a technology

variant at existing facilities (with appropriate modifications), Appendix O of this PEIS describes the can-in-canister variant at the DWPF at SRS.

- **Electrometallurgical Treatment Alternative.** This alternative would utilize electrometallurgical treatment to produce a glass-bonded zeolite (GBZ) waste form that embeds Pu and radioisotopes within the GBZ form. Although this alternative could be conducted at other sites, the Argonne National Laboratory-West (ANL-W) site at INEL was used as an example site for evaluating potential environmental effects.

In all three alternatives, surplus weapons-usable Pu would be converted to an immobilized form (glass, ceramic, or GBZ). A radiation barrier for the immobilized surplus Pu would be required for nonproliferation purposes; the radioisotopes available to produce the barrier include radioactive Cs-137 (in storage at Hanford as cesium-chloride [CsCl] capsules in shippable form) or HLW (which would only be used if an immobilization facility were located at a site with quantities of this material). HLW would not be shipped between sites, thus avoiding additional risk in transportation.[5]

Reactor Category. Under this category, surplus Pu would be converted to MOX fuel for use in domestic or Canadian reactors. Using the MOX fuel would consume a portion of the Pu content of the fuel while embedding the rest in highly radioactive spent fuel similar to that now produced by uranium-fueled commercial power reactors. The resultant spent fuel then would be stored pending disposal in accordance with the applicable spent fuel program (U.S. or Canadian).

Analyses were conducted in this PEIS on four separate MOX fuel alternatives:

- Existing LWR Alternative—utilizing existing U.S. commercial reactors that would use MOX fuel instead of traditional LEU fuel
- Partially Completed LWR Alternative—completing construction of U.S. commercial reactors that are presently maintained in an extended interim state and utilize MOX fuel in these reactors
- Evolutionary LWR Alternative—building new reactors in the United States to use MOX fuel
- CANDU Reactor Alternative—utilizing existing Canadian reactors that would use MOX fuel instead of traditional natural uranium fuel

Because the United States does not have a MOX fuel fabrication facility or capability, a dedicated facility would likely have to be constructed or an existing facility be modified at a U.S. Government or existing commercial fuel fabricator's site. In the event MOX fuel is needed before a domestic fuel fabrication plant is available, existing facilities in Europe could be used on a short-term basis to provide initial lead test assemblies and other MOX fuel.

Preferred Alternative for Pu Disposition: A combination of Reactor and Immobilization Alternatives. The Preferred Alternative calls for (1) immobilizing at least those Pu materials not readily suitable for MOX fuel using vitrification or ceramic immobilization and (2) converting pure Pu metal, including pits and oxides into MOX fuel for use in existing reactors. Use of Canadian CANDU reactors would be retained in the event a multilateral agreement is made among Russia, Canada, and the United States to implement this.

The deployment of two disposition technologies would provide increased flexibility and assurance of mission accomplishment should technical problems develop with one technology as well as greater flexibility to deal

[5] Under the Immobilization Alternatives, DOE would not use CsCl or HLW that is a RCRA waste unless immobilization constituted sufficient RCRA treatment, or unless the CsCl or HLW first underwent RCRA treatment before immobilization with the surplus Pu.

with a wide range of Pu forms. The deployment of two technologies would signal a strong U.S. commitment to reducing the stockpiles of Pu and encourage Russia to reduce its stockpiles. The two disposition technologies that would allow an early start of Pu disposition have been determined to be the reactor and immobilization alternatives. The Preferred Alternative is a combination of reactor and immobilization alternatives.

Figure 2.1.4–1 depicts the alternative strategies and technologies for disposition of surplus Pu including the Preferred Alternative for disposition and how the material flows from the front-end process to the disposition categories.

Front-End Processes Common to Surplus Plutonium Disposition Alternatives

For the disposition of surplus Pu, a conversion process would be required to transform the various Pu forms into one suitable for further use in each of the disposition alternatives. Either pit disassembly/conversion (Section 2.4.1) or a Pu conversion process would be used (Section 2.4.2), depending on the current form of the surplus material.

Sites for the Analysis of Plutonium Disposition Alternatives

Six DOE sites and other generic and specific sites were used for assessing environmental impacts of various disposition techniques and strategies. The sites include Hanford, NTS, INEL, Pantex, ORR, and SRS. Additionally, some disposition facilities (specifically those involving the deep borehole complex, MOX fuel fabrication at a commercial facility [combination of five reactor fuel fabrication sites], and use of existing LWRs [combination of 12 existing LWRs at five sites]) have no representative sites, and so do not lend themselves to site-specific analysis at this time. Therefore, as explained more fully in Section 3.10 for the deep borehole, Section 3.11 for the MOX fuel fabrication site, and Section 3.12 for the existing LWR site, generic site characteristics have been developed for environmental evaluations of these facilities. Depending on programmatic decisions from this PEIS, DOE will conduct site-specific tiered NEPA analyses in the future. For the CANDU Reactor Alternative, a representative site (Bruce-A Nuclear Generating Station, Province of Ontario, Canada) is being considered for analysis. For the Partially Completed LWR Alternative, a representative site (Bellefonte Nuclear Plant, Alabama) is analyzed. The immobilization alternatives could be performed in new or existing, modified facilities, using technology variants identified in Table 2.4–1. For the Electrometallurgical Treatment Alternative, ANL-W at INEL is the representative site for analysis. If the Electrometallurgical Treatment Alternative is selected in the ROD, additional construction and operational impacts would result if this alternative were implemented at other sites, and additional tiered NEPA analyses and documentation would be developed. For the vitrification and ceramic immobilization alternatives, impacts of new facilities are analyzed for six DOE sites. As an example of a technology variant at an existing facility, the can-in-canister technology variant at the DWPF at SRS is described in Appendix O.

Disposition Alternatives Considered But Eliminated From Further Analysis

Twenty-seven Pu disposition options were eliminated as follows:

Radiation Barrier Alloy for Indefinite Storage. This option was eliminated because it did not have an endpoint destination comparable to options such as direct disposal, immobilization, or reactor burning. The Screening Committee noted the material (a Pu-beryllium compound) would be in a form unsuitable for a civilian HLW repository unless reconverted to remove the Pu and process it into a repository-compatible waste form.

Injection Into Continental Magma. This technology was eliminated because it is very immature. A licensing and regulatory regime for the technology is undefined and uncertain, and its use would present several ES&H concerns.

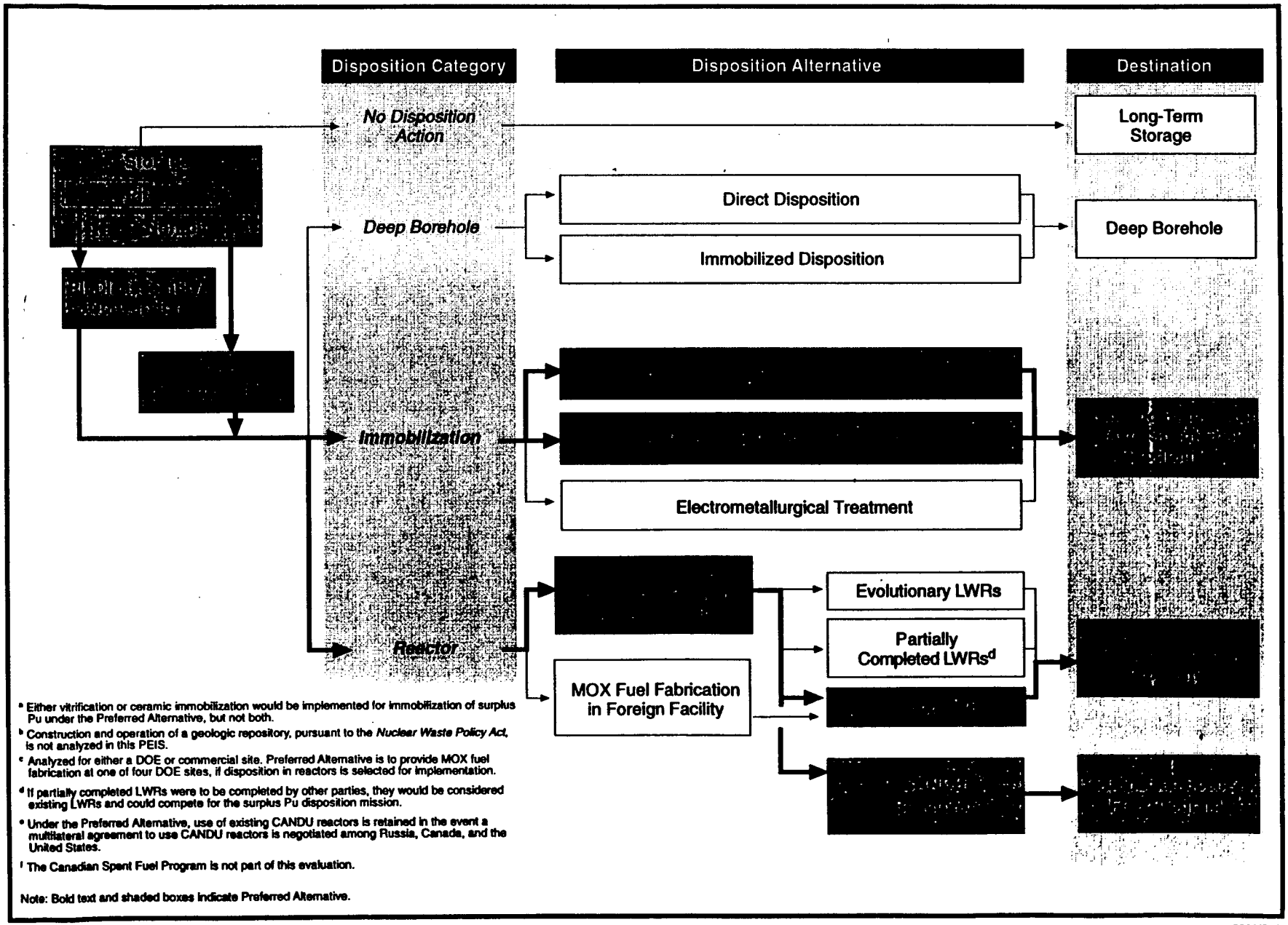


Figure 2.1.4–1. Surplus Plutonium Disposition Alternatives, Including the Preferred Alternative for Disposition.

Emplacement in the Sub-Seabed. This option was eliminated because the technical approach is immature and because a licensing and regulatory regime is undefined and uncertain, which also makes the schedule uncertain. Extended operations at sea would enhance the opportunities for a transportation vessel accident in which material lost at sea could be available for retrieval. Public and international perceptions are also uncertain due to similar concerns as other ocean disposal options.

Launching to Deep Outer Space. This option was eliminated for a number of reasons. First, based on the U.S. experience to date, the risk of an explosion during launch and offsite dispersal of radioactive material would be much higher than the risks of accidents and dispersal of radioactive materials for other options. Second, if the space vehicle with its surplus fissile material payload failed to achieve orbit and reentered the atmosphere, the chances of other nations recovering the material would be enhanced and the chances of U.S. retrieval would be reduced. Also, this option would be more expensive and more time consuming to complete than many others.

Direct Immobilization With Radionuclides in Borosilicate Glass, Use of Retrofitted Defense Waste Processing Facility. This option was eliminated as unreasonable for reasons stated in the Screening Report.[6] Installing a specially designed melter for Pu immobilization remains unreasonable. However, it is reasonable to modify the DWPF for other variants of the vitrification and ceramic immobilization alternatives.

Reactor and Accelerator Options. Five new reactor and accelerator options requiring significant technology development, including three concepts with accelerators coupled to reactors, were eliminated primarily due to their technical immaturity and the attendant costly and lengthy development and demonstration effort that would be required to bring them to viable, practical status and enable disposition options to be initiated with certainty. Although these options hold promise of higher levels of Pu destruction than other reactor burning options, these alternatives involve significant time delay, increased cost, technical uncertainties, and are not as reasonable as the mature reactor burning options to achieve the Spent Fuel Standard. However, if some of these advanced concepts are developed and successfully demonstrated or operated (for commercial nuclear power) they may be considered for Pu disposition in supplemental NEPA documents.

These five options were as follows:

- Accelerator Conversion: Molten Salt Target
- Accelerator Conversion: Particle Bed Target
- Accelerator-Driven MHR
- Particle Bed Reactor
- Molten Salt Reactor

Consuming in Modular Helium Reactors. A reactor concept was evaluated that involves MHR coupled to closed cycle power conversion systems. This option is less technically mature than other available options using MOX fuel in operating water-cooled reactor plants. The MHR would use tested, but not fully demonstrated or proved, ceramic-coated plutonium dioxide (PuO_2) fuel particles in a graphite matrix. The power conversion system would use components that have neither been tested as a "system" themselves nor integrated with a

[6] In this option, the present DWPF at SRS would have a new, specially designed melter installed. Much of the supporting equipment would require major retrofitting for this application because DWPF was not designed for criticality control. Retrofitting the DWPF would create additional total personnel radiation exposure and would significantly interfere with its mission to stabilize and treat HLW, resulting in delays and cost escalation. Note that eliminating this "DWPF Upgrade" variant does not preclude other DWPF-related variants of the Vitrification and Ceramic Immobilization Alternatives (such as adding an adjunct melter adjacent to the DWPF, or the can-in-canister approach in the DWPF) if these other variants do not introduce increased radiation or Pu criticality concerns into the DWPF.

gas-cooled reactor system. The concept could achieve higher levels of Pu destruction than water-cooled reactors if this concept were developed and successfully operated. However, the technical uncertainty, cost, and time to develop, license, and successfully demonstrate or operate this new integrated reactor plant and power conversion system is not as reasonable as other reactor alternatives because Pu disposition can be accomplished using existing technologies. If this concept is developed and successfully demonstrated or operated for other missions, it may be considered for Pu disposition as well.

Advanced Liquid Metal Reactors with Pyroprocessing. Another reactor burning concept was evaluated that involves a variation of the integral fast reactor concept whereby an advanced liquid metal cooled reactor with a Pu alloy metal fuel would operate on a once-through cycle and then utilize pyroprocessing techniques to make a Pu-rich HLW form for potential disposal in a repository. This concept, which would use a reactor fuel cycle design still under development in a manner different from its intended purpose, would be more costly and more time-consuming than other reactor options. The development program was recently terminated by Executive and Congressional action. Since the Pu disposition can be accomplished using existing technologies, there is no justification for developing this advanced technology for the purpose of Pu disposition. However, if it is developed and successfully operated for other missions, it will be considered for Pu disposition.

Direct Emplacement (Without Immobilization) in a High-Level Waste Repository. It is highly unlikely that a determination of acceptability could be reached in a timely manner for this nonreference waste form for disposal in a HLW repository, should DOE decide to operate a HLW repository. Such a form would also require the safeguards and security requirements for weapons-usable material until the repository, currently planned to allow retrieval of spent fuel for about 100 years, is sealed.

Discard Surplus Plutonium in the Waste Isolation Pilot Plant. This option for surplus Pu would exceed capacity after meeting the needs for disposal of defense-related transuranic (TRU) waste, should DOE decide to proceed with the disposal phase of the Waste Isolation Pilot Plant (WIPP). This option would likely require amendment of the *Waste Isolation Pilot Plant Land Withdrawal Act*, associated regulations, and draft or pending regulatory compliance documents, and the planning-basis for WIPP Waste Acceptance Criteria (WAC), among other things.

Hydraulic Fracturing. This option (high-pressure injection of slurried materials into fractured shale formations) was previously tested and evaluated for civilian HLW disposal. The screening committee concluded that there was no assurance that the technical feasibility of this unproven option would be demonstrated in time for the option to be considered in the decision process. No engineered barrier would exist to prevent leakage into subsurface aquifers.

Injection of Slurry Into Deep Wells. This option, similar to the hydraulic fracturing, would not have an engineered barrier to prevent leakage into subsurface aquifers, would therefore pose unacceptable ES&H risks, and would be prohibited under current law.

Melting Into Crystalline Rock. Information previously developed in initially evaluating this approach for disposal of civilian HLW, which uses the heat from the fuel to melt into rock formations, was reviewed. It was concluded that the option is not technically viable for this disposition application because of major uncertainties. These include criticality concerns and difficulty in assuring that enough heat would be available from spent fuel (to be commingled with the surplus fissile materials) to melt the host rock.

Disposal Under Ice Caps. This option is not considered technically viable and poses unacceptable ES&H risks because ice caps in Greenland and Antarctica are not necessarily stable beyond a few hundred years. Reaching an agreement with Denmark to dispose of our nuclear materials on Greenland is not likely; a current treaty already prohibits leaving nuclear wastes in Antarctica.

Seabed Disposal and Controlled Dilution in Oceans. These options are unreasonable and were disqualified because they present ES&H concerns and are contrary to domestic and international laws, treaties, and policies. Because of increasing concerns about the pollution of marine environments with radioactive materials (ocean dumping of radioactive materials is prohibited), EPA has not issued any permits for ocean dumping or dispersal of radioactive materials in recent years. These options are inconsistent with the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, generally known as the London Dumping Convention, enacted in 1975 and amended in 1980 and 1993.

Underground Nuclear Detonation. This option is unreasonable and was disqualified because compliance with regulatory and licensing requirements is regarded as very uncertain, and compliance with ES&H regulations is unlikely for a new process of this type. In addition, the United States has a moratorium on underground nuclear testing and the President recently signed a Comprehensive Test Ban Treaty. The Screening Committee judges it unlikely that detonations for this application would be approved since such actions might undermine this national policy.

Naval Nuclear Fuel; Using Plutonium Fuel in Naval Reactor Plants. There is no design, testing, or demonstration experience with MOX fuel in naval reactors. Even if technical feasibility had been demonstrated, new classified fuel and reactor core fabrication plants would be required. Since these processes and facilities cannot be declassified, transparent confirmation of the process or final condition by international inspections would not be possible. Additionally, the number of new fuelings of naval reactor plants is so small that disposition of surplus Pu could not be accomplished in a reasonable timeframe.

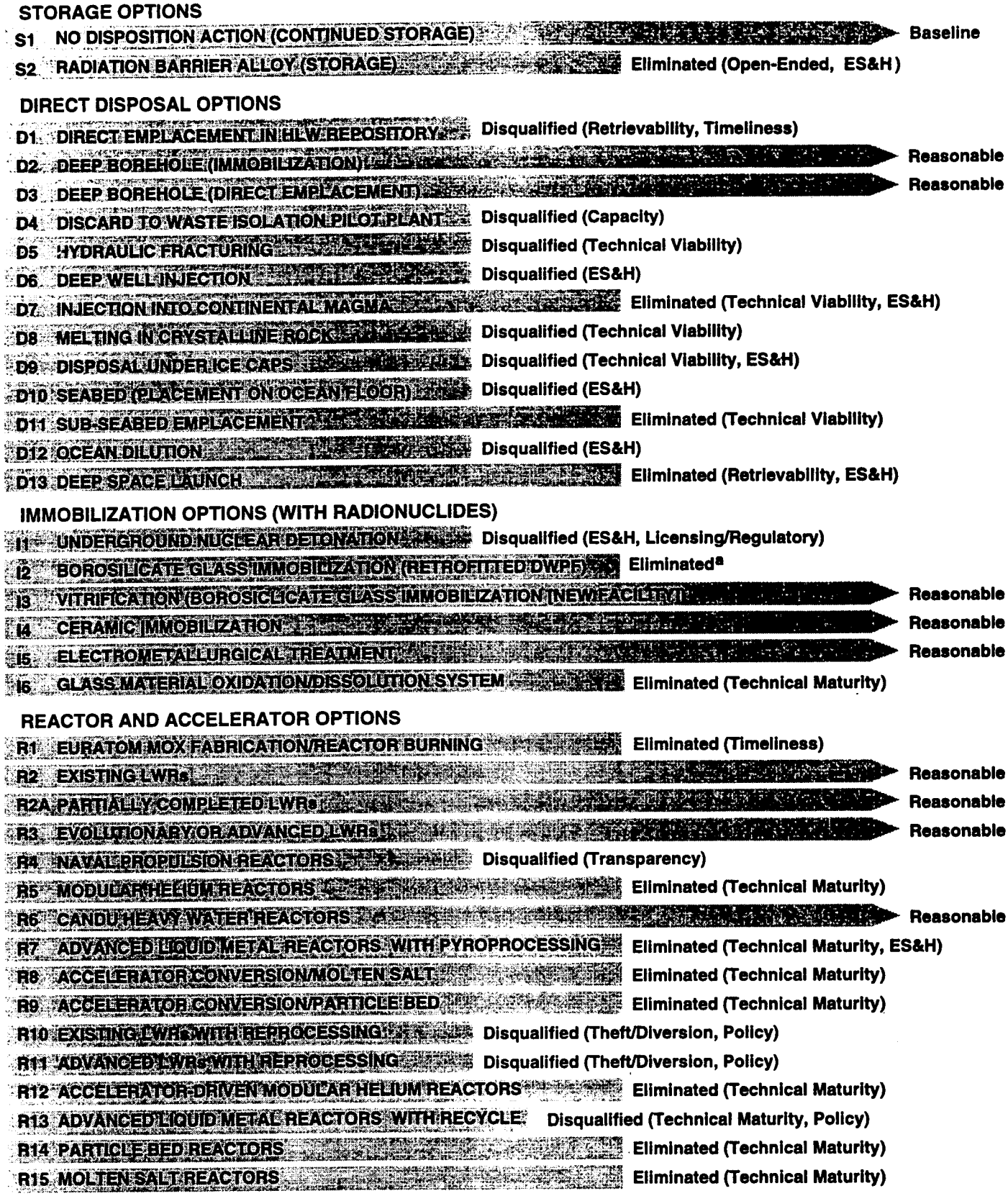
Reprocessing: Using Plutonium Fuel in Existing or New Evolutionary/Advanced Light Water Reactors With Chemical Reprocessing of Spent Fuel. During reprocessing to separate Pu from spent fuel to fabricate more fuel, there are stages in the processing and handling when weapons-usable materials are more vulnerable to theft or diversion than the Stored Weapons Standard. Additionally, the time and cost required to design and construct reprocessing plants for this application are much greater than those for available, adequate options that meet the Spent Fuel Standard.

Advanced Liquid Metal Reactor With Recycle and Reuse of Metallic Alloy Fuel Elements. Based on recent DOE and Congressional action, development of the advanced liquid metal reactor/integral fast reactor concept is no longer being pursued due to a U.S. nonproliferation policy to not develop technologies that rely on Pu recycling. Since this is a relatively immature reactor concept that has not been demonstrated, and since Pu disposition can be accomplished using existing technologies, there is no justification for developing this advanced technology solely for the purpose of Pu disposition. [Text deleted.]

Glass Material Oxidation/Dissolution System. This option was eliminated due to timeliness and technical immaturity. The time required to complete the necessary R&D for this process is much longer than that for other alternatives and options.

Euratom Mixed Oxide Fuel Reactor Use. This option would involve the preparation of PuO_2 at a processing facility to be built in the United States, and transportation of the oxide to Europe where it would be fabricated into MOX reactor fuel assemblies and utilized as full-core MOX fuel loading in existing reactor facilities in one or more European countries. Final disposal of the spent fuel assemblies would be in Europe. Due to lack of capacity to complete the disposition mission, the institutional complexities such as transportation, security, and other geopolitical factors, this option was warranted unreasonable in light of the other alternatives considered.

Figure 2.1.4–2 shows the disposition options that were considered and rated based on the nine screening criteria and the principal reasons for disqualification or elimination.



[a] In this option, the present DWPF at SRS would have a new, specially designed melter installed. Much of the supporting equipment would require major retrofitting for this application because DWPF was not designed for criticality control. Retrofitting the DWPF would create additional total personnel radiation exposure and would significantly interfere with its mission to stabilize and treat HLW, resulting in delays and cost escalation. Note that eliminating this "DWPF Upgrade" variant does not preclude other DWPF-related variants of the Vitrification and Ceramic Immobilization Alternatives (such as adding an adjunct melter adjacent to the DWPF or the can-in-canister approach in the DWPF) if these other variants do not introduce increased radiation or Pu criticality concerns into the DWPF. Can-in-canister at a retrofitted DWPF is discussed in Appendix O and would be examined along with other site-specific alternatives in subsequent NEPA review tiered from this PEIS.

Note: ES&H=Environmental Safety and Health.

Source: DOE 1995m.

2373/S&D

Figure 2.1.4–2 Results of the Screening Process—Surplus Plutonium Disposition Options.

2.2 NO ACTION ALTERNATIVE

The definition of the No Action Alternative as it relates to both surplus and nonsurplus Pu and HEU was discussed in Section 1.7. The baseline case for the No Action Alternative involves no disposition of surplus Pu and no change in the current storage sites for Pu and HEU. This case is analyzed and referred to as the No Action Alternative in this section. The Preferred Alternative for storage calls for continuing current storage (No Action) of surplus non-pit Pu materials at Hanford, INEL, and LANL, pending disposition.

The No Action Alternative for long-term storage would maintain storage of all weapons-usable fissile materials at existing storage sites using proven nuclear material safeguards and security procedures. This alternative assumes that the corrective actions necessary to ensure compliance with high-priority ES&H requirements identified in the *Plutonium Working Group Report on Environmental, Safety and Health Vulnerabilities Associated with the Department's Plutonium Storage* would be completed. Maintenance at these existing storage sites would be done as required to ensure safe facility operation for the balance of the facility's useful life. DOE would not undertake any new construction projects except those that are considered part of ongoing site operations as portrayed in individual site-specific EISs and site development plans.

Under the No Action Alternative, surplus and nonsurplus Pu materials would remain in place at LANL, RFETS, Hanford, INEL, Pantex, and SRS. HEU would continue to be stored in existing buildings at Y–12 at ORR. Under No Action, it is assumed that HEU from other sites in the DOE Complex would be relocated to Y–12. The Y–12 EA addresses the transportation of this material and the storage of the material for up to 10 years. Nonsurplus HEU would remain in storage at Y–12 under No Action. Nonsurplus HEU materials represent nuclear weapons, secondary components, naval nuclear fuel, and working material. Surplus HEU would be stored at Y–12 until the material is removed for disposition, as is described in the HEU Final EIS. As a result of the ROD from the HEU EIS, storage of some of this surplus HEU may extend past the 10 years specified in the Y–12 EA. Under No Action, the storage facilities would be maintained to ensure safe facility operation. Subsequent NEPA analysis would be performed for continued storage beyond the 10-year period analyzed in the Y–12 EA.

2.2.1 HANFORD SITE

Hanford Site, located in the State of Washington (Figure 2.2.1–1), had 11 t (12.1 tons) of Pu material in September 1994. Of this, approximately 4.0 t (4.4 tons) falls within the scope of this PEIS. This material is stored within the protected vaults and gloveboxes of the Plutonium Finishing Plant (PFP) complex located in the 200 West Area (Figure 2.2.1–2). The remaining Pu materials currently within the PFP consist of solutions and numerous solid compounds such as metals, oxides, fluorides, mixed (Pu and uranium) oxide residues containing less than 50 percent Pu such as ash, and other Pu-containing materials such as plastics and combustibles. Pu inventories associated with irradiated fuel, buried or retrievably stored solid waste, liquid tank and waste residues containing less than 50 percent Pu, are outside the scope of this PEIS.

Preferred Alternative: No Action. Under the No Action Alternative, Hanford would continue to store Pu-bearing materials in the storage vaults and approved vault-type rooms of the PFP that have been assessed in the *Plutonium Finishing Plant Stabilization Final Environmental Impact Statement* (PFP EIS) (DOE/ EIS-0244D).[7] The *DNFSB Recommendation 94-1 Hanford Site Integrated Stabilization Management Plan* (VHC-EP-0853) calls for transforming the Pu-bearing materials to a stable form that meets the DOE standard *Criteria for Safe Storage of Pu Metals and Oxides* (DOE-STD-3013-94) by 2002 for materials with greater than 50-percent Pu. Some PFP plant systems that provide basic facility services (such as power,

[7] All Pu materials (both greater than and less than 50-percent Pu) would be stabilized and repackaged, as necessary, to ensure safe storage. The cleanout, stabilization, and storage of readily retrievable Pu materials in the PFP have been assessed in the *Plutonium Finishing Plant Stabilization Final Environmental Impact Statement* (PFP-EIS) (DOE/EIS-0244D). Hanford would continue to store residues containing less than 50 percent, which are not within the scope of this PEIS.

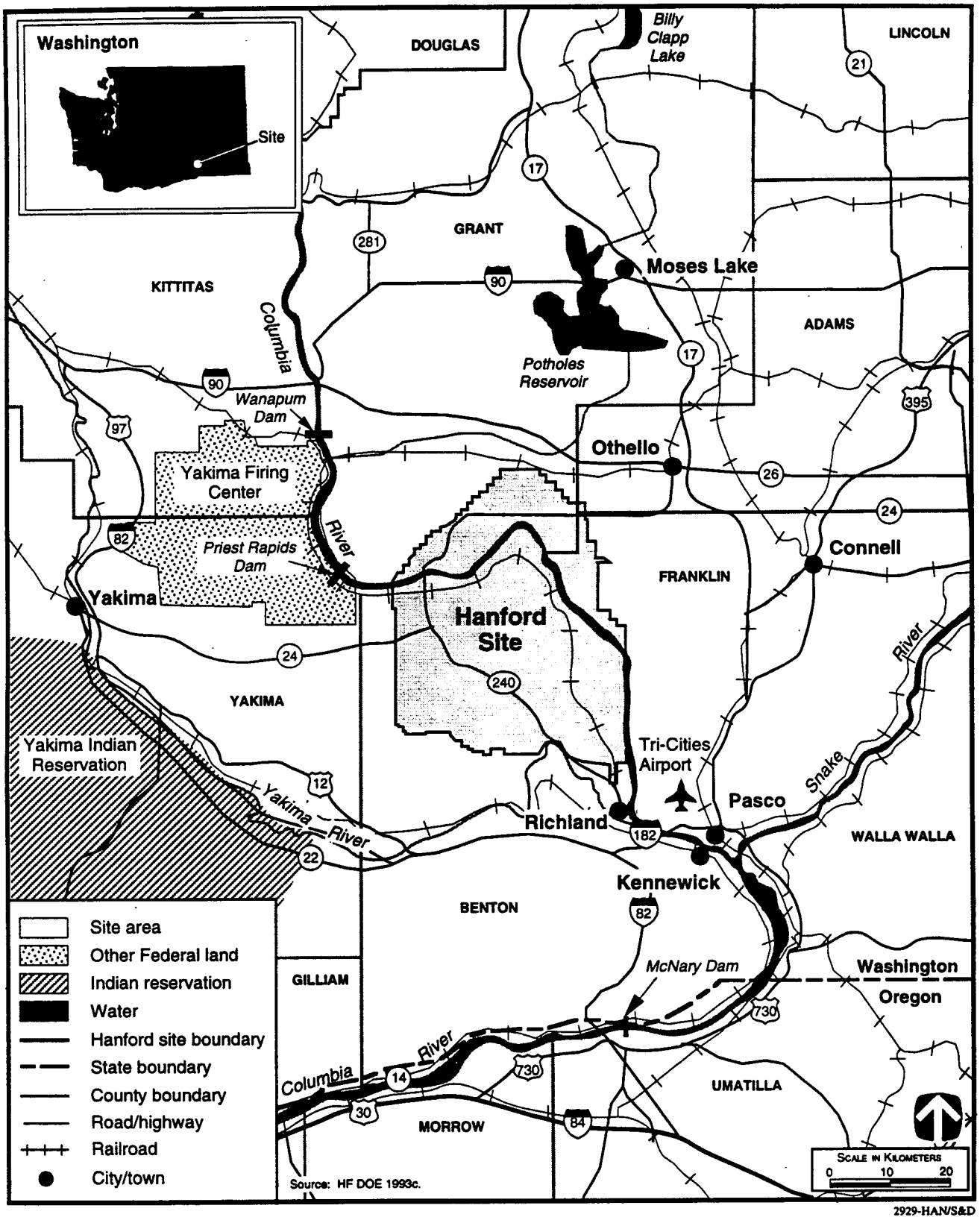


Figure 2.2.1–1. Hanford Site, Washington, and Region.

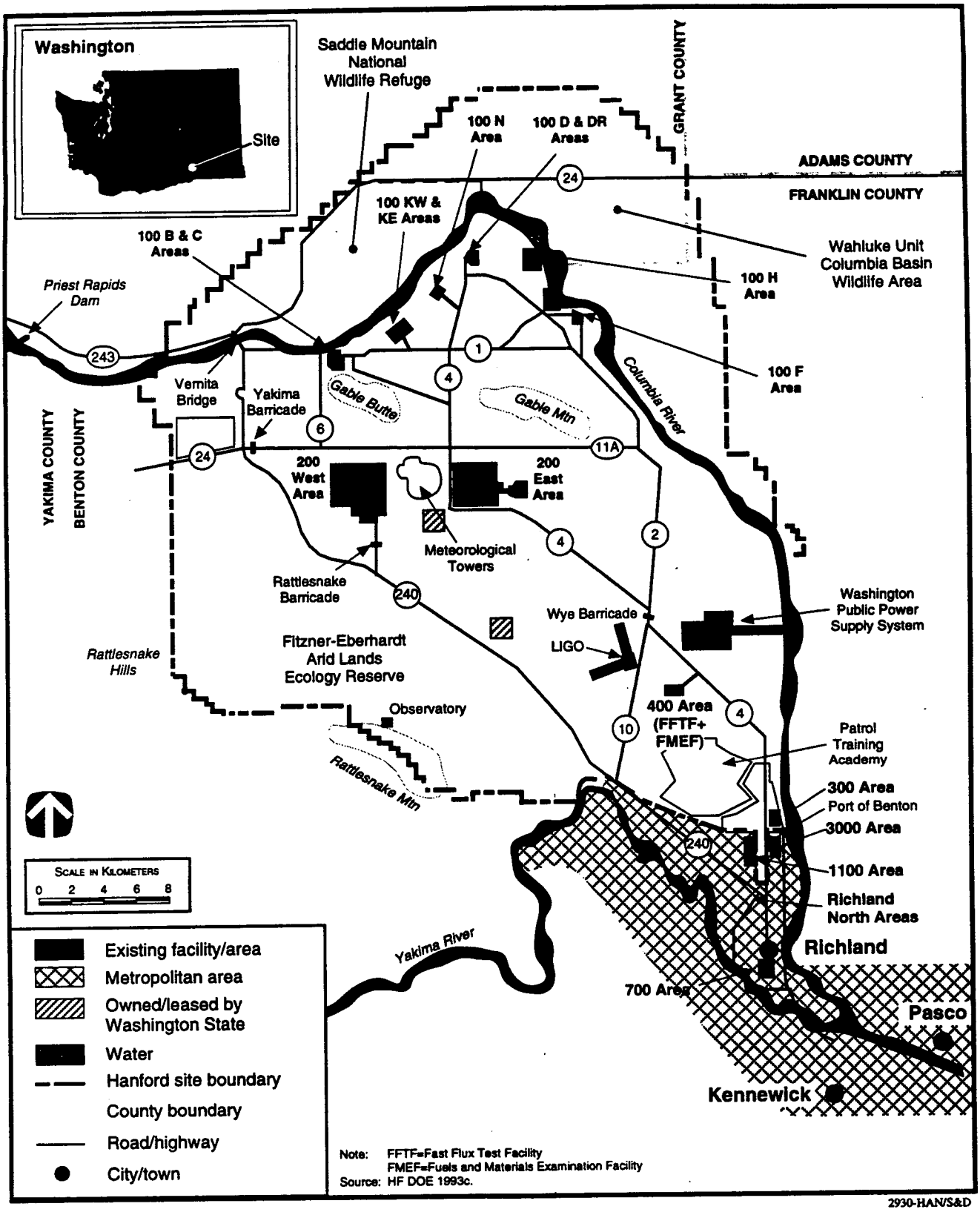


Figure 2.2.1–2. Site Designations and Principal Facilities at Hanford Site.

ventilation, and heat) would be upgraded for storage operations under the No Action Alternative. [Text deleted.] Hanford would continue to store residues containing less than 50 percent Pu. The unirradiated FFTF fuel pins and assemblies are acceptable "as is" for long-term storage. No further actions are envisioned for these unirradiated materials under the No Action Alternative.

[Text deleted.]

2.2.2 NEVADA TEST SITE

Nevada Test Site, located in the southern part of Nye County in southern Nevada (Figure 2.2.2–1), does not currently store any Pu or HEU within the scope of this PEIS. [Text deleted.] Due to existing available storage space within the P-Tunnel Facility, NTS is being considered for the long-term storage alternatives involving the consolidation of Pu and the collocation of Pu and HEU. These alternatives are described in Sections 2.3.2 and 2.3.3. Site designations and principal facilities at NTS are shown in Figure 2.2.2–2.

Preferred Alternative: No Action. DOE would not add Pu to sites that do not currently have Pu in storage. NTS does not store any Pu within the scope of this PEIS. Therefore, NTS would continue to carry out projected missions described in Chapter 3.

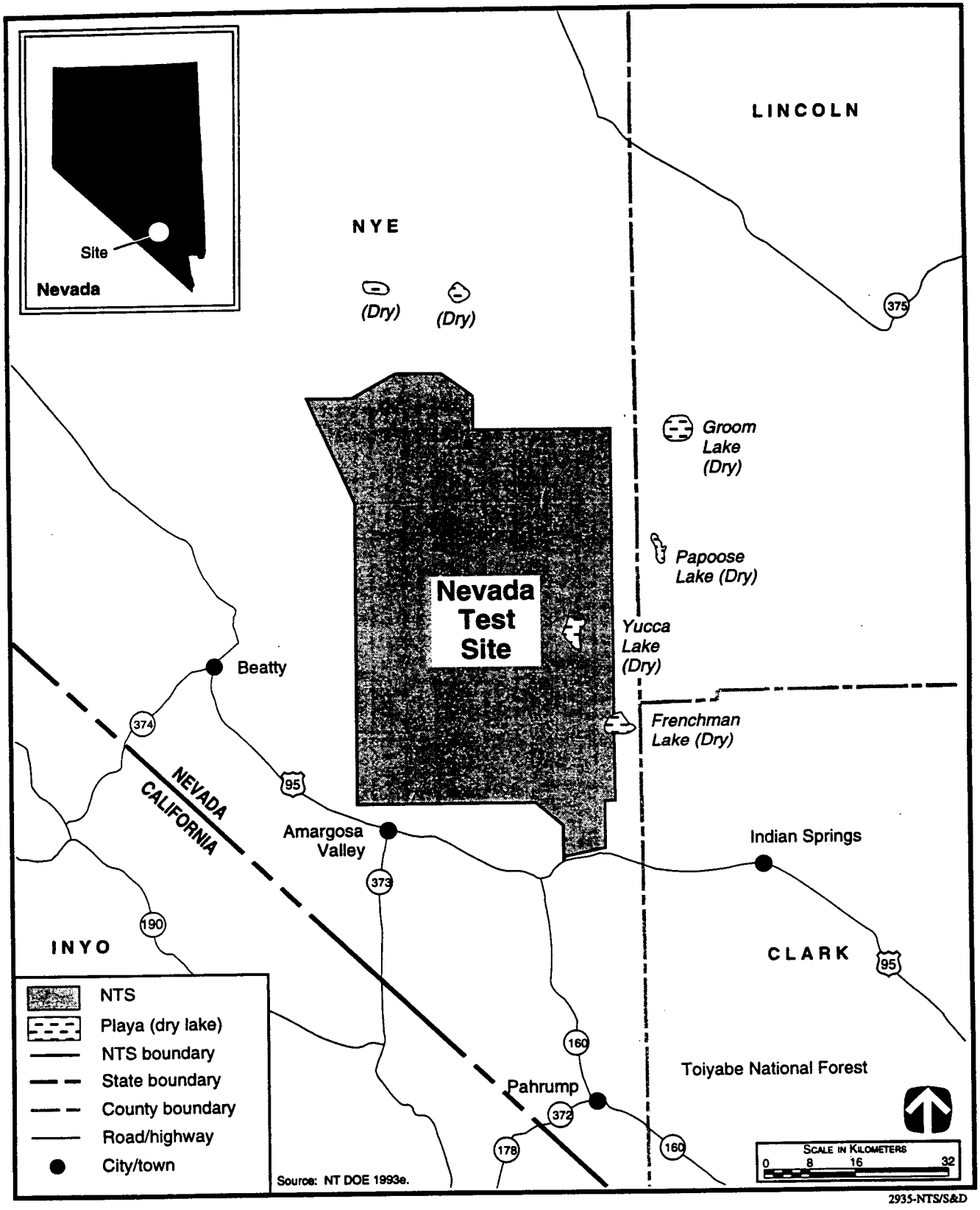


Figure 2.2.2–1. Nevada Test Site, Nevada, and Region.

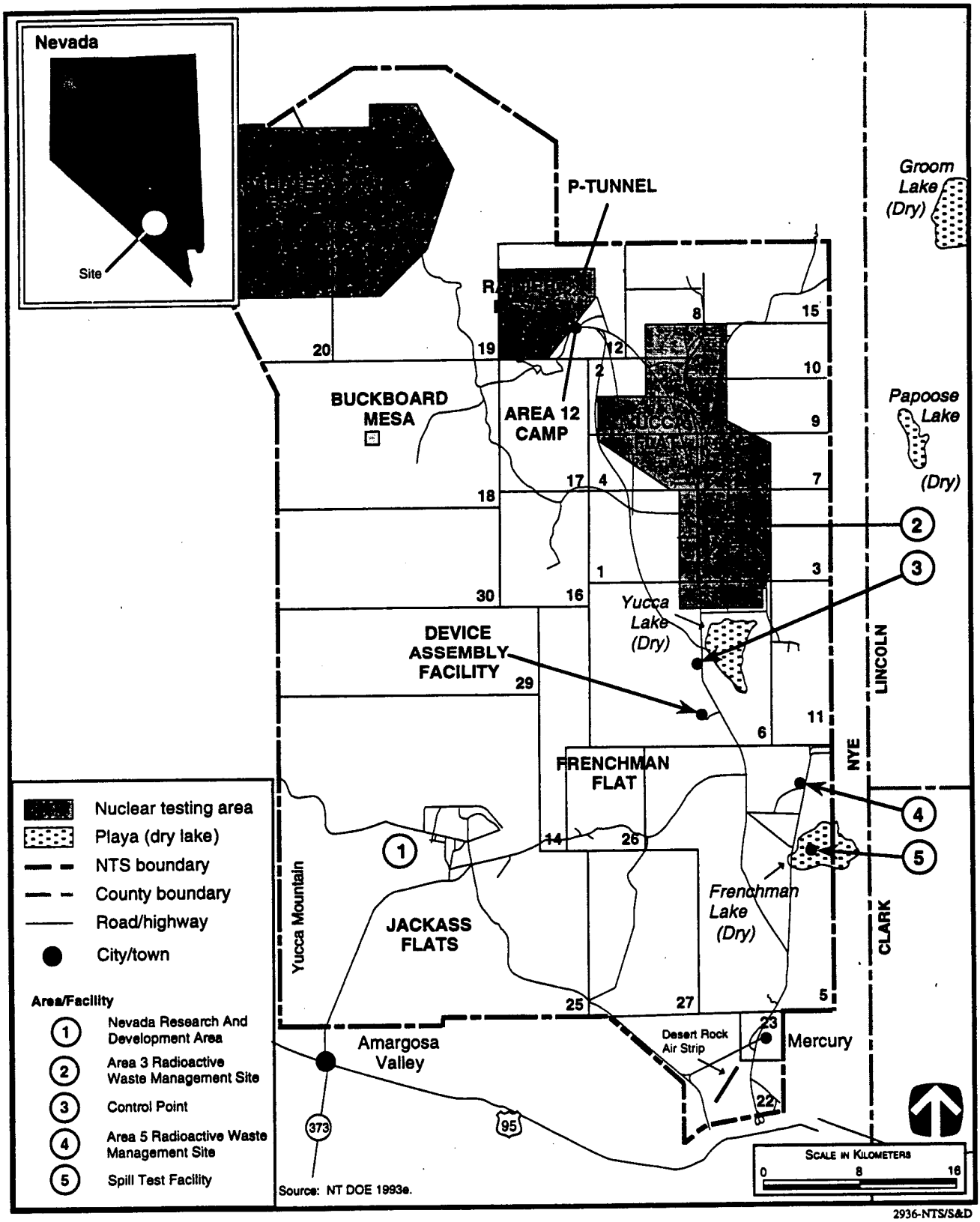


Figure 2.2.2–2. Site Designations and Principal Facilities at Nevada Test Site.

2.2.3 IDAHO NATIONAL ENGINEERING LABORATORY

Idaho National Engineering Laboratory is located near Idaho Falls in southern Idaho (Figure 2.2.3–1). As of February 6, 1996, there were approximately 4.0 t (4.4 tons) of Pu stored in the Zero Power Physics Reactor (ZPPR) and Fuel Manufacturing Facility (FMF) vaults at ANL-W and 0.5 t (0.55 tons) of Pu located in the Idaho Chemical Processing Plant (ICPP). All of this material falls within the scope of this PEIS. Site designations and principal facilities at INEL are shown in Figure 2.2.3–2.

Preferred Alternative: No Action. Under the No Action Alternative, weapons-usable Pu material at ANL-W would continue to be stored in the material forms deemed most stable according to the *ANL-W Plutonium ES&H Vulnerability Assessment Plan* (October 31,1994). The proposed *Corrective Action Plan* for vulnerability (ANL-W-I-4), involving almost all Pu onsite, calls for the site to store the material in the ZPPR and FMF vaults and maintain accountability pending disposal direction from DOE. Other site corrective action plans deal with the remaining INEL Pu which is in considerably smaller amounts, such as 13 kilograms (kg) (29 pounds [lbs]) requiring repackaging, 70 grams (g) (2.45 ounces [oz]) of surface oxides removed from stored Pu metal and alloys, and 2.7 g (0.095 oz) in sodium test loops.

2.2.4 PANTEX PLANT

Pantex is located in the Texas Panhandle in Carson County along U.S. Highway 60, as shown in Figure 2.2.4–1. Almost all Pu at Pantex is in the form of pits from disassembled nuclear weapons. The Pu inventory of 66.1 t (72.8 tons) at Pantex in September 1994 was the total amount actually at Pantex plus the amount in DoD custody. Currently, Pantex has the physical capacity to store up to 20,000 pits, but DOE has agreed to store no more than 12,000, pending completion of the Pantex EIS. Site designations and principal facilities at Pantex are shown in Figure 2.2.4–2.

Under the No Action Alternative, all site Pu holdings specific to the Storage and Disposition Program would continue to be stored in the Zone 4 facilities. However, if the Stockpile Stewardship and Management Final PEIS preferred alternative for downsizing assembly/disassembly actions is selected and implemented, the Pu pit strategic reserve storage would be moved to Zone 12 by 2005. Pu-bearing materials at Pantex would continue to reside in the material forms and facilities deemed most stable according to the DNFSB *Recommendation 94-1 Pantex Corrective Action Plan*. In accordance with this plan, Pantex will correct ES&H vulnerabilities by improving management and training within the plant and improving some operating structures to reduce the probability of dispersing hazardous material. In order to avoid or greatly reduce the possibility that Pu would be dispersed outside an assembly cell in case of an explosion, facility utility penetrations have been sealed and door seals have been improved. [Text deleted.] To mitigate the consequences of the possible collapse of the roof over Bay 27 in Building 12-26 due to natural phenomena, updated procedures and processes and modification of equipment and facilities would be accomplished.

In concert with its corrective action plan, Pantex is taking to reduce the probability of an operational accident, human error, or equipment failure that could cause failure of pit cladding, and to mitigate the effects of pit cladding failure due to these or other causes, such as aging. Pits would be repackaged in the more robust AT-400A containment vessel, and storage is being converted to a configuration that allows for remote handling and surveillance. To reduce the probability of accident or human error, a more robust weapons operations safety process has been instituted for B61, W56, and W69 weapons dismantlements and will be implemented for others in the near future.

2.2.5 OAK RIDGE RESERVATION

Oak Ridge Reservation is located near Knoxville, Tennessee, as shown in Figure 2.2.5–1. There are two ORR sites that currently store fissile materials within ORR. These sites are Oak Ridge National Laboratory (ORNL) and Y–12. The positions of these sites on ORR are shown in Figure 2.2.5–2.

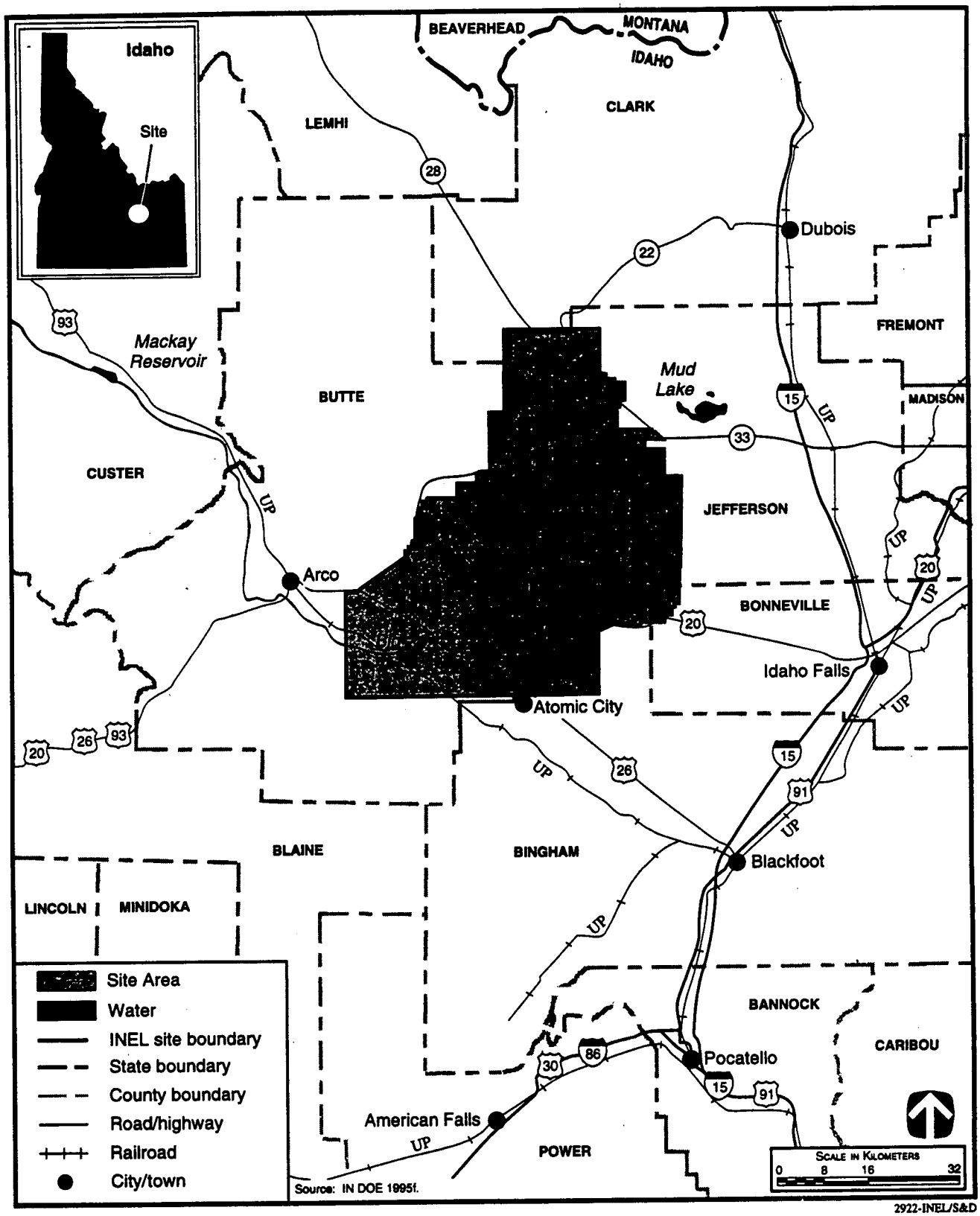


Figure 2.2.3–1. Idaho National Engineering Laboratory, Idaho, and Region.

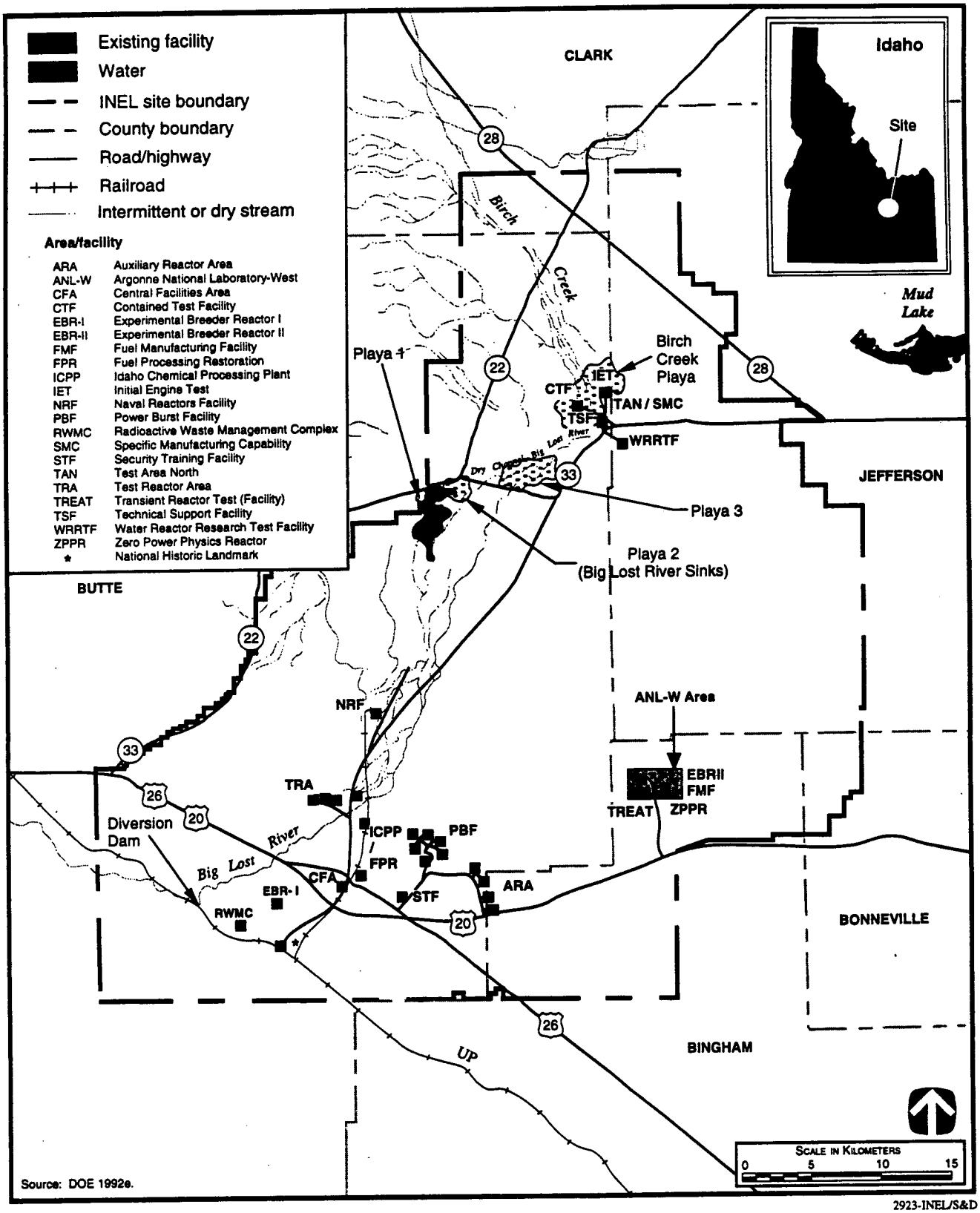


Figure 2.2.3–2. Site Designations and Principal Facilities at Idaho National Engineering Laboratory.

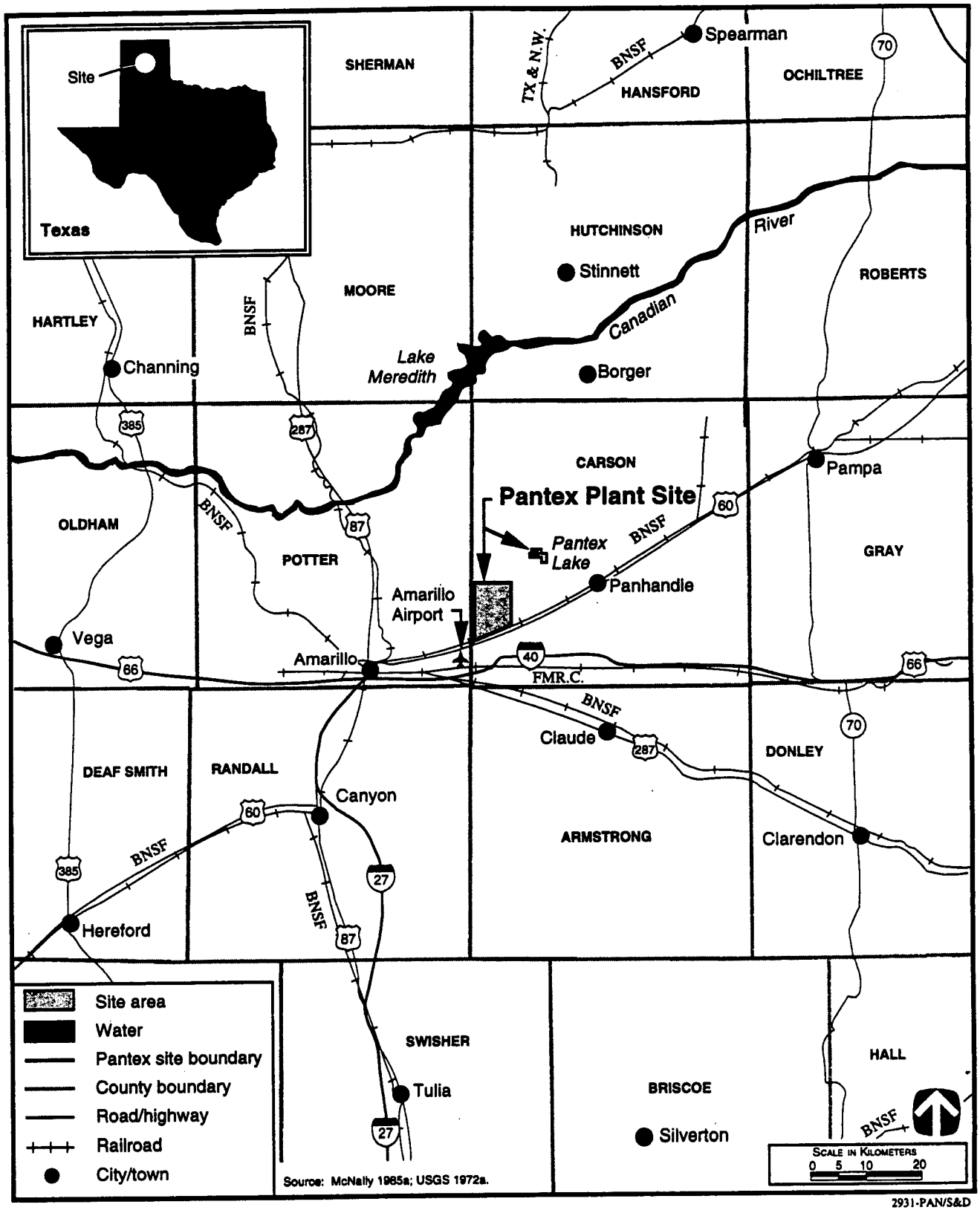


Figure 2.2.4–1. Pantex Plant, Texas, and Region.

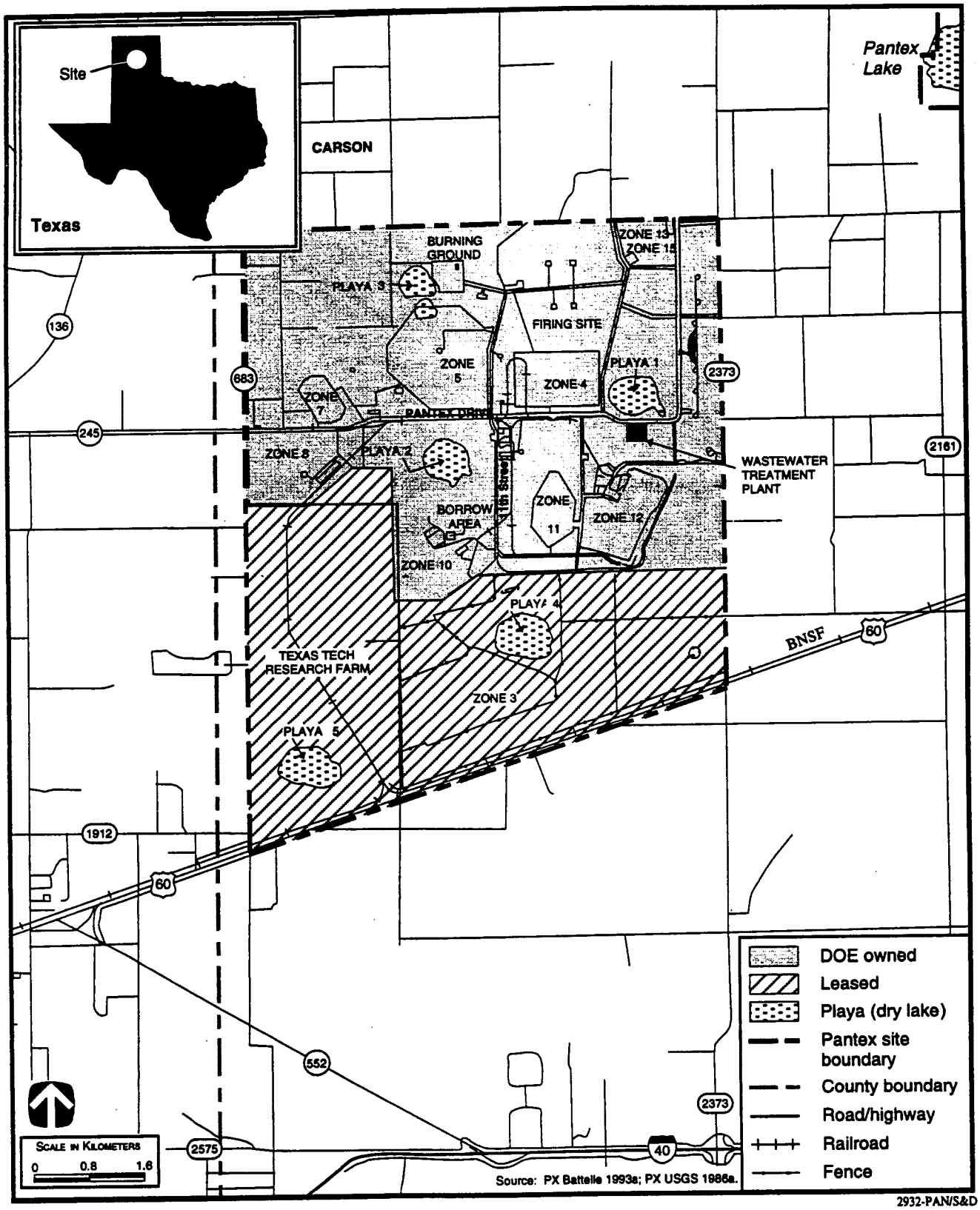


Figure 2.2.4–2. Site Designations and Principal Facilities at Pantex Plant.

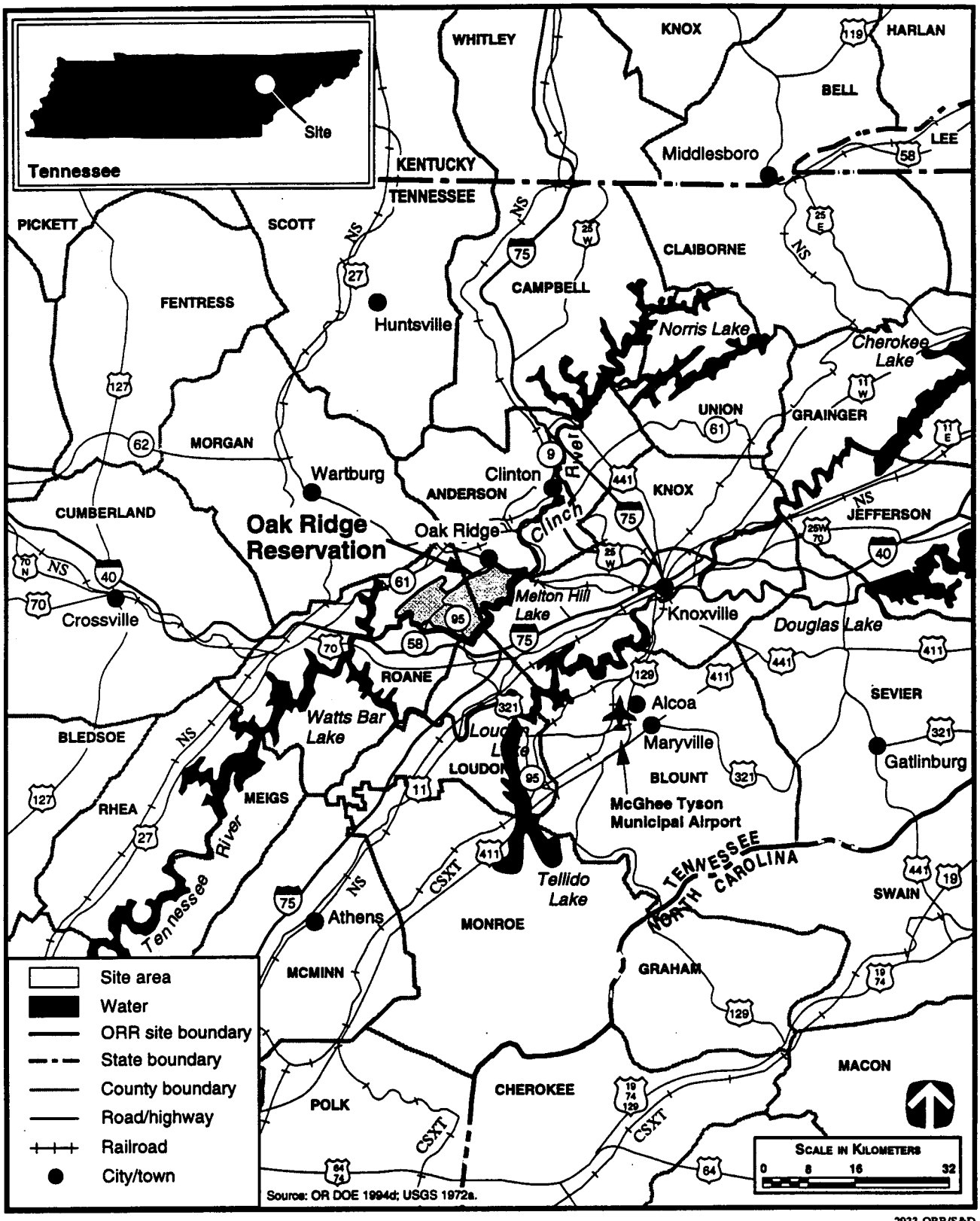


Figure 2.2.5–1.—Oak Ridge Reservation, Tennessee, and Region.

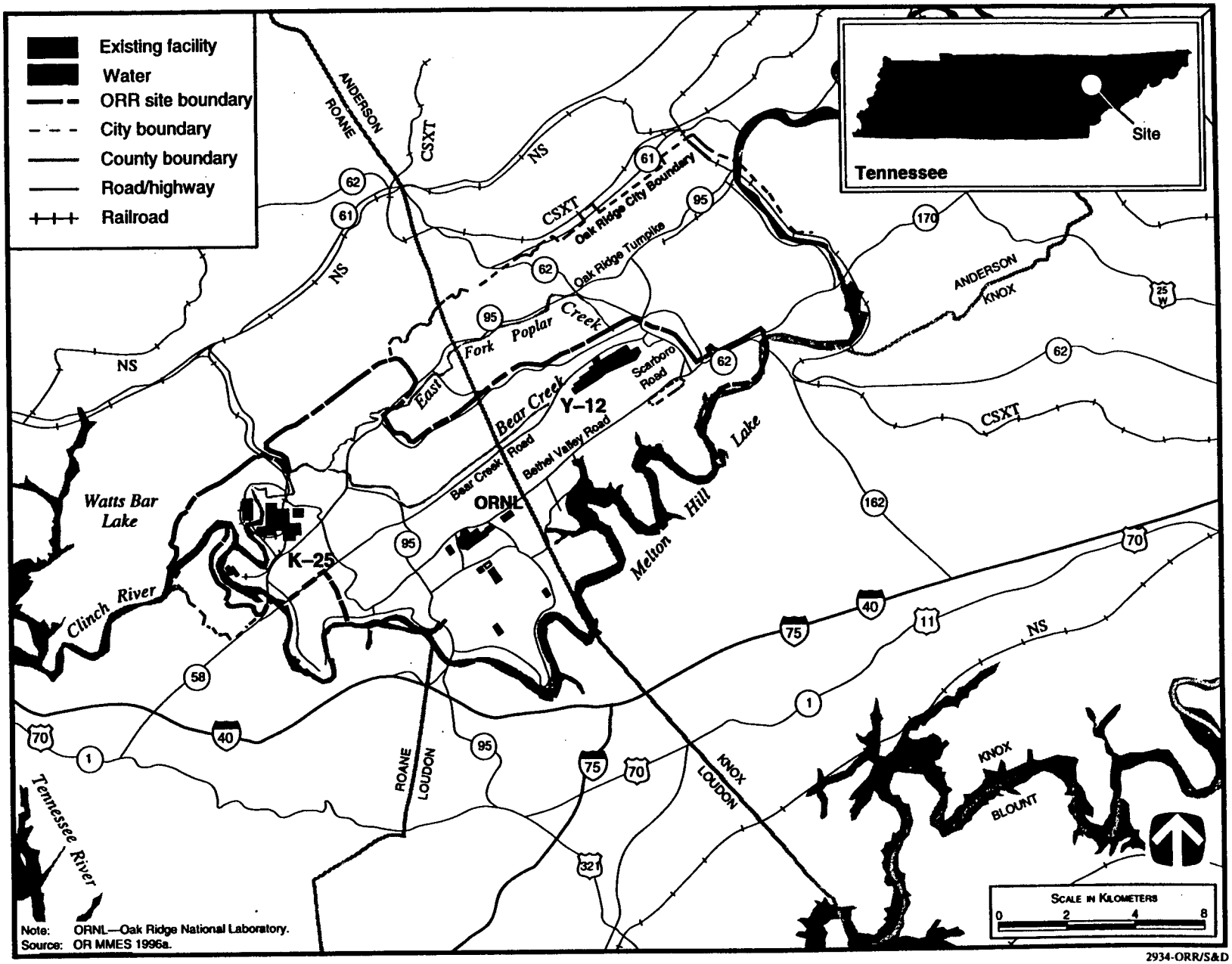


Figure 2.2.5–2. Site Designations and Principal Facilities at Oak Ridge Reservation.

As of September 1994, approximately 4.1 kg (9.0 lb) of Pu and 1 kg (2.2 lb) of collocated TRU waste was distributed among 19 facilities at ORNL and Y–12. This 5.1 kg (11.2 lb) is in various forms, including sealed sources, oxide, metal, solutions, and scrap/residues. Since the quantity of Pu stored at ORR is relatively insignificant compared to that located at other storage sites, and because it is in the form of waste, none of this material is within the scope of this PEIS.

All nonsurplus HEU currently stored at ORR is within the scope of this PEIS. Under the No Action Alternative, HEU would continue to be stored in existing buildings at Y–12. As of September 1994 the inventory at Y–12 consisted of 168.9 t (186.2 tons) of HEU. The bounding quantity (expected upper limit) of HEU that could be shipped to Y–12 from sites other than Pantex (whose quantity is classified) is an additional 98.4 t (108.5 tons).

Nonsurplus HEU would remain in storage at Y–12 under No Action. Nonsurplus HEU materials represent nuclear weapons, secondary components, naval nuclear fuel, and working material. Surplus HEU would be stored at Y–12 until the material is removed for disposition, as is described in the HEU Final EIS. As a result of the ROD from the HEU EIS, storage of some of this surplus HEU may extend past the 10 years specified in the Y–12 EA. Under No Action, the storage facilities would be maintained to ensure safe facility operation. Subsequent NEPA analysis would be performed for continued storage beyond the 10-year period analyzed in the Y–12 EA.[8]

2.2.6 SAVANNAH RIVER SITE

Savannah River Site, located south of Aiken, SC (Figure 2.2.6–1), had as of September 1994, 2.0 t (2.2 tons) of Pu material that falls within the scope of this PEIS, as well as other fissile materials in various forms which are outside the scope of this PEIS. The materials are in various forms, including Pu solutions, metal and oxides (more than 50-percent Pu), residues and oxides (less than 50-percent Pu), special isotopes, uranium, and spent nuclear fuel. Site designations and principal facilities are shown in Figure 2.2.6–2.

Under the No Action Alternative, SRS would continue to store Pu-bearing materials in the forms and facilities deemed most stable according to the *DNFSB Recommendation 94-1 Savannah River Site Integrated Stabilization Management Plan* (NMPP-PPLS95-0058) and in accordance with the *Spent Fuel Working Group Report on Inventory and Storage of the Department's Spent Nuclear Fuel and other Reactor Irradiated Nuclear Materials and Their Environmental Safety, and Health Vulnerabilities*, Volumes I, II, III, the *F-Canyon Plutonium Solutions Environmental Impact Statement* (DOE/EIS-0219, December 1994), the *Final Environmental Impact Statement, Interim Management of Nuclear Materials* (DOE/EIS-0220, October 1995), and the DOE standard *Criteria for Safe Storage of Plutonium Metals and Oxides* (DOE-STD-3013-94).

Under the No Action alternative, SRS would stabilize and store its various forms of Pu in accordance with the above listed plans for Pu materials as follows:

- *Pu-239 Solutions, F-Area.* The plan, supported by the *F-Canyon Plutonium Solutions Environmental Impact Statement* (DOE/EIS-0219) and the ROD dated February 1, 1995, was to convert this material to Pu metal. The conversion process in F-Canyon was completed in April 1996. The metal product will be stored temporarily in one of the F-Area vaults.

- *Pu-239 Solutions, H-Area.* In the *Final Environmental Impact Statement, Interim Management of Nuclear Materials* (DOE/EIS-0220) and the ROD dated December 12, 1995 (60 FR 65300), and supplemental ROD dated July 1996 (61 FR 6633), DOE determined procedures and processes for stabilizing stored nuclear materials, previously identified through independent reviews conducted by DOE and the DNFSB, that posed environmental, safety, or health vulnerabilities. A second

[8] Under No Action, DOE may, pursuant to appropriate NEPA review, propose to modify the Y–12 facilities or to build new facilities as necessary to ensure safe storage.

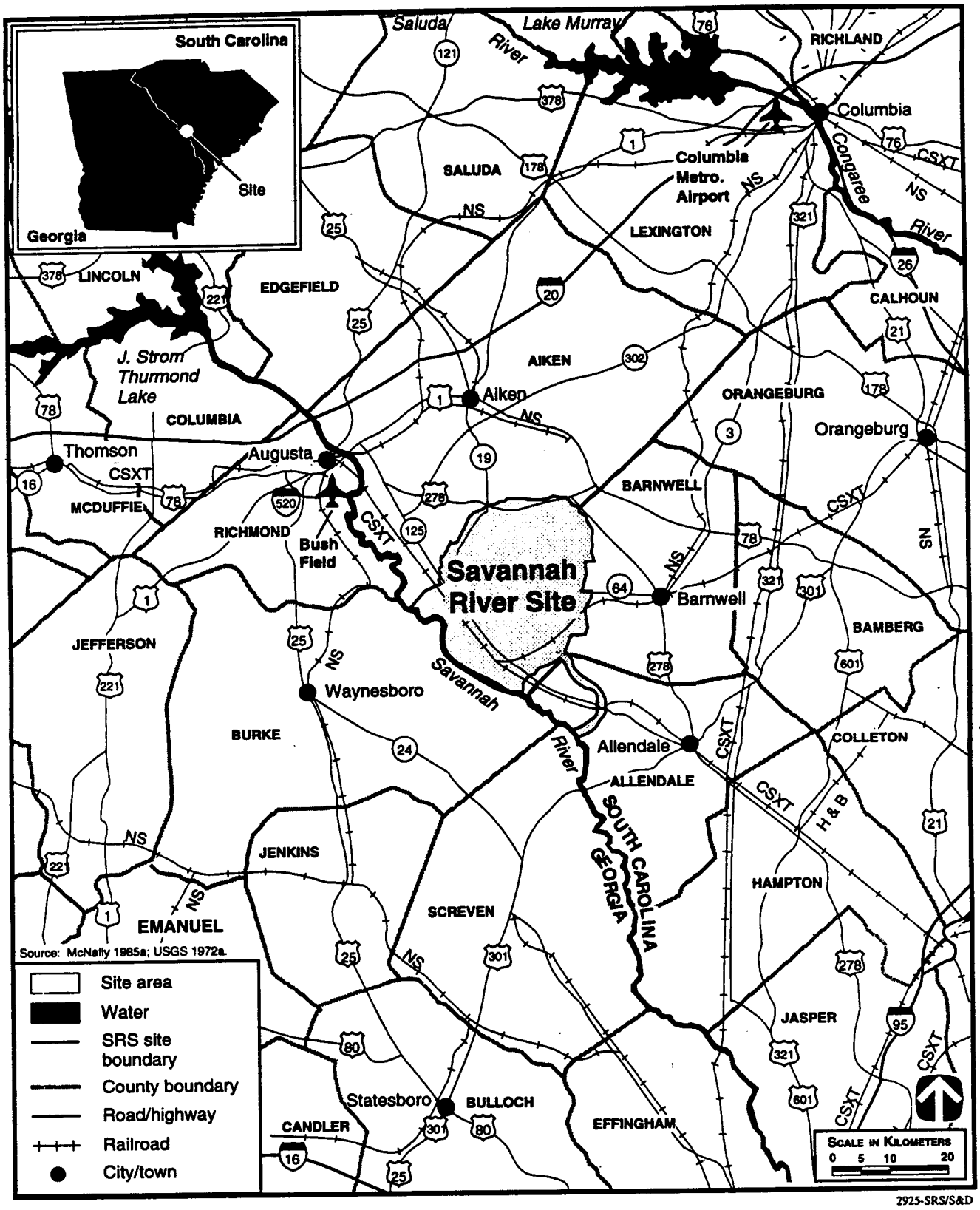


Figure 2.2.6–1. Savannah River Site, South Carolina, and Region.

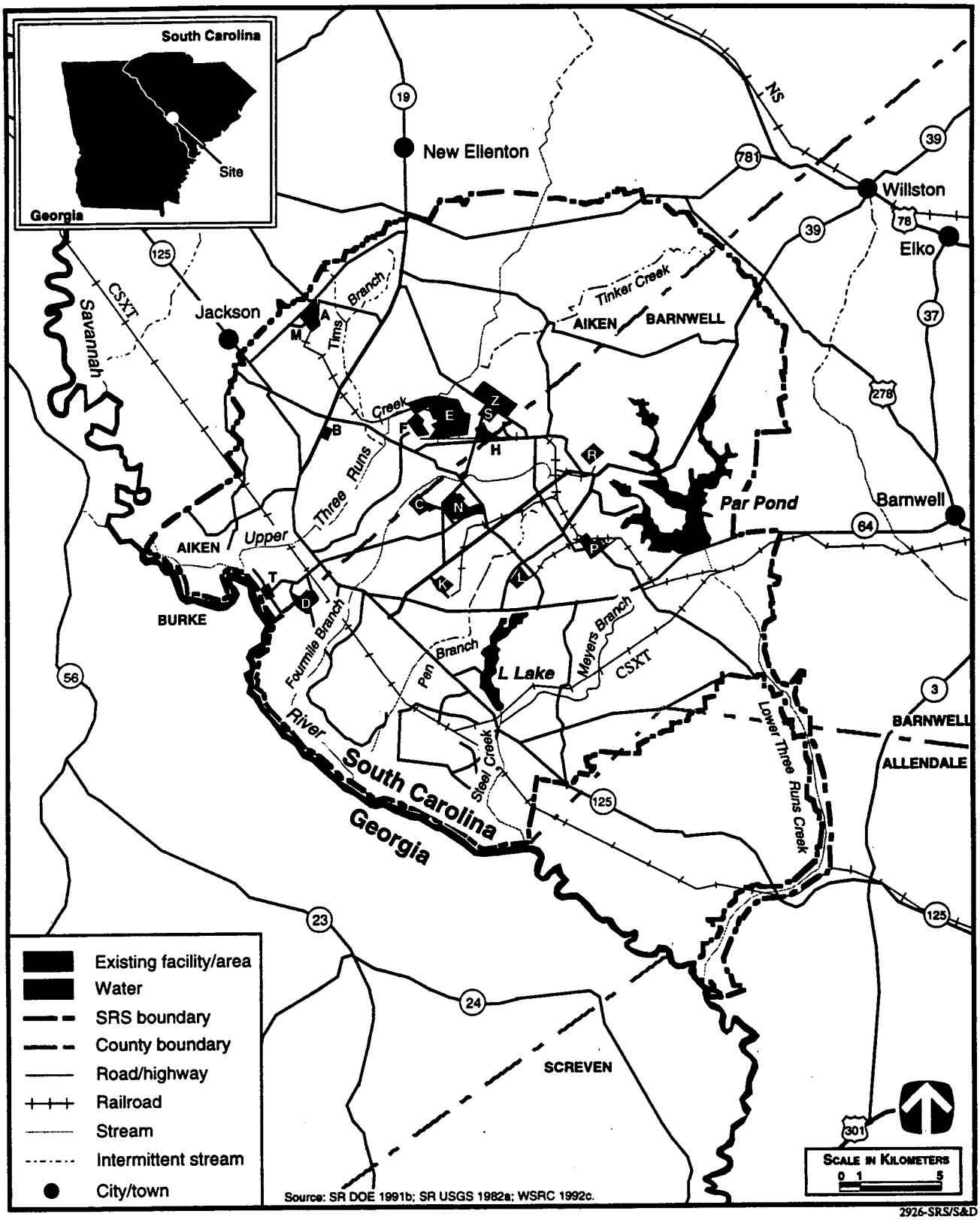


Figure 2.2.6–2. Site Designations and Principal Facilities at Savannah River Site.

supplemental ROD announcing DOE's decision for the stabilization of Pu-239 solutions by conversion to metal at F-Canyon and the FB-Line was published September 13, 1996 (61 FR 48474 through 61 FR 48479).

- *Pu-242. The Final Environmental Impact Statement, Interim Management of Nuclear Materials* (DOE/EIS-0220) and the ROD dated December 12, 1995, categorized certain isotopes of Pu, neptunium, americium, and curium as programmatic. DOE has determined that the Pu-242 from SRS would be useful for future research and development activities.

- *Plutonium metal and oxide resulting from the stabilization actions at SRS.* This material would be stored in accordance with the DOE storage standard (DOE-STD-3013-94). In the ROD dated December 12, 1995, for the *Final Environmental Impact Statement, Interim Management of Nuclear Materials*, DOE decided to construct a new APSF in F-Area. This facility would enable SRS to stabilize and package Pu metals and oxides to meet storage criteria and also provide space for storage of all Pu and special actinide materials. The new facility is expected to be completed by 2001. In the interim, the Pu metals and oxides would be stored temporarily in one of the F-Area vaults.

[Text deleted.]

2.2.7 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Rocky Flats Environmental Technology Site, located in northern Jefferson County, Colorado (Figure 2.2.7–1), stored 12.9 t (14.2 tons) of Pu as of September 1994.[9] The Pu is in three basic forms: metals, oxides, and scrap/residues. The storage of the total Pu inventory at RFETS is within the scope of the storage portion of this PEIS. There are a small number of pits at RFETS that are surplus to national security needs but are still needed for ongoing, non-weapons-related R&D projects at LANL and LLNL. Therefore, these pits will not come within the scope of this PEIS until the R&D projects are completed. It is expected that this work will result in the transportation of these materials to LANL or LLNL, the conversion of the Pu into metal or oxide, and the return of the material to RFETS.[10] At that point, the materials will come within the scope of this PEIS and be stored and dispositioned in accordance with the decisions reached on the storage and disposition of surplus Pu in metal or oxide form. All Pu materials are stored in seven principal facilities: Buildings 371, 559, 707, 771, 776/777, 779, and 991. Site designations and principal facilities are shown in Figure 2.2.7–2.

In response to the DNFSB's Recommendation 94-1, and as addressed in the DOE *Plutonium Working Group Report on Environmental, Safety and Health Vulnerabilities Associated with the Department's Plutonium Storage*, the Pu metal and oxide at RFETS will be placed in a stable long-term (50-year) storage configuration. This storage configuration is in accordance with the DOE storage standard (DOE-STD-3013-94). DOE-STD-3013-94 does not apply to pits. In addition to the stabilization of this material, actions for resolving the Pu vulnerabilities have been identified as part of the RFETS *Site Integrated Stabilization and Management Plan*, and are being implemented.

Of the total amount of Pu in storage at RFETS, 11.9 t (13.1 tons) has been declared surplus to national security needs.[11] The amount of surplus in each of the basic forms is: metal 5.7 t (6.3 tons); oxides 1.6 t (1.8 tons); and scrap/residues 4.6 t (5.1 tons). Only a portion of the Pu is currently within the scope of this PEIS because the residues[12] are not in a weapons-usable form. Under proposed stabilization activities, all or portions of the non-weapons-usable material could be converted to a weapons-usable form.

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[9] Secretary of Energy's Openness Initiative, December 7, 1993.
[10] Under the Preferred Alternative, the RFETS material could be shipped directly from LANL or LLNL to Pantex.
[11] Secretary of Energy's Openness Initiative, February 6, 1996.
[12] Scrub alloy, ash, salts, dry residues, wet residues, and classified shapes.

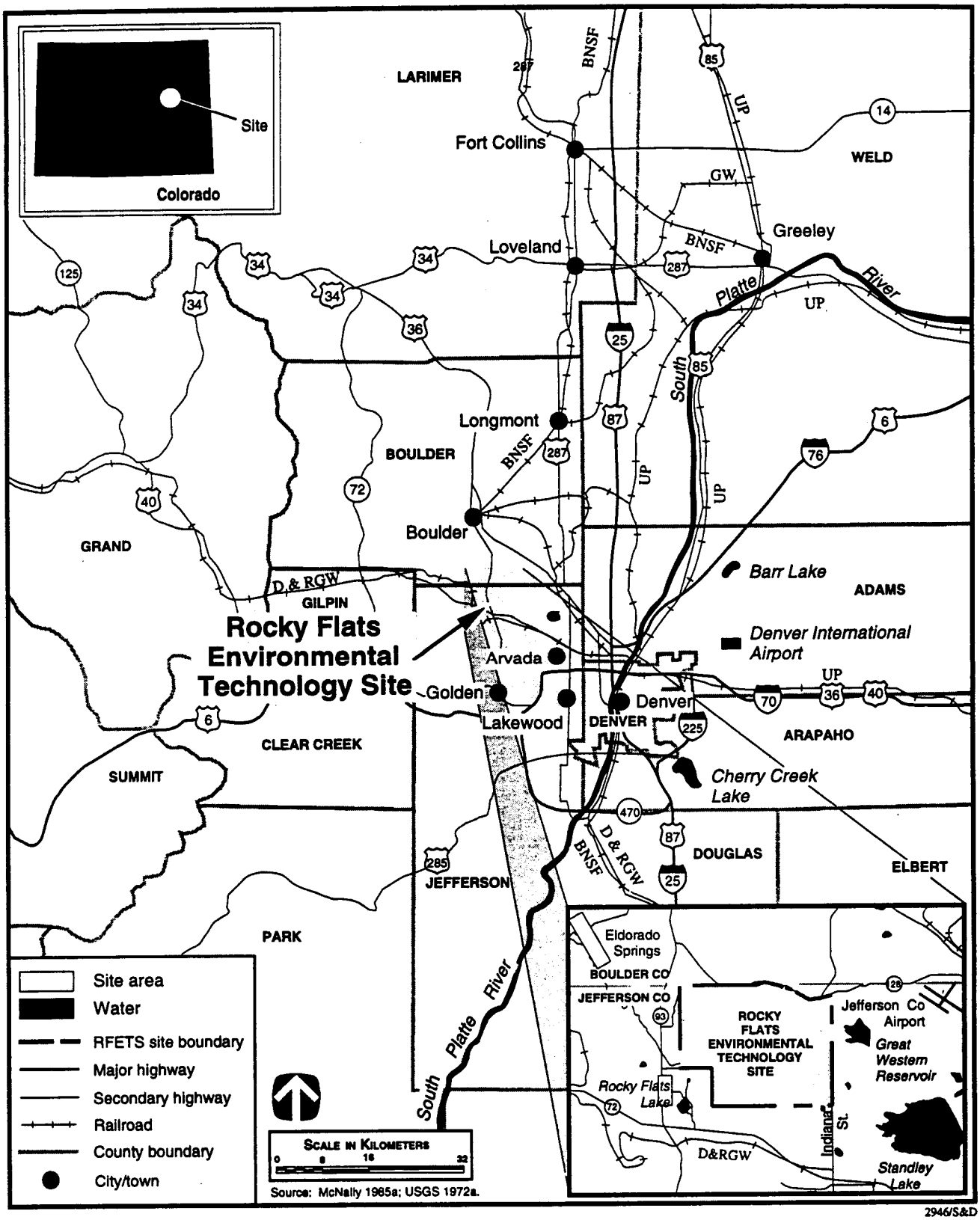


Figure 2.2.7–1. Rocky Flats Environmental Technology Site, Colorado, and Region.

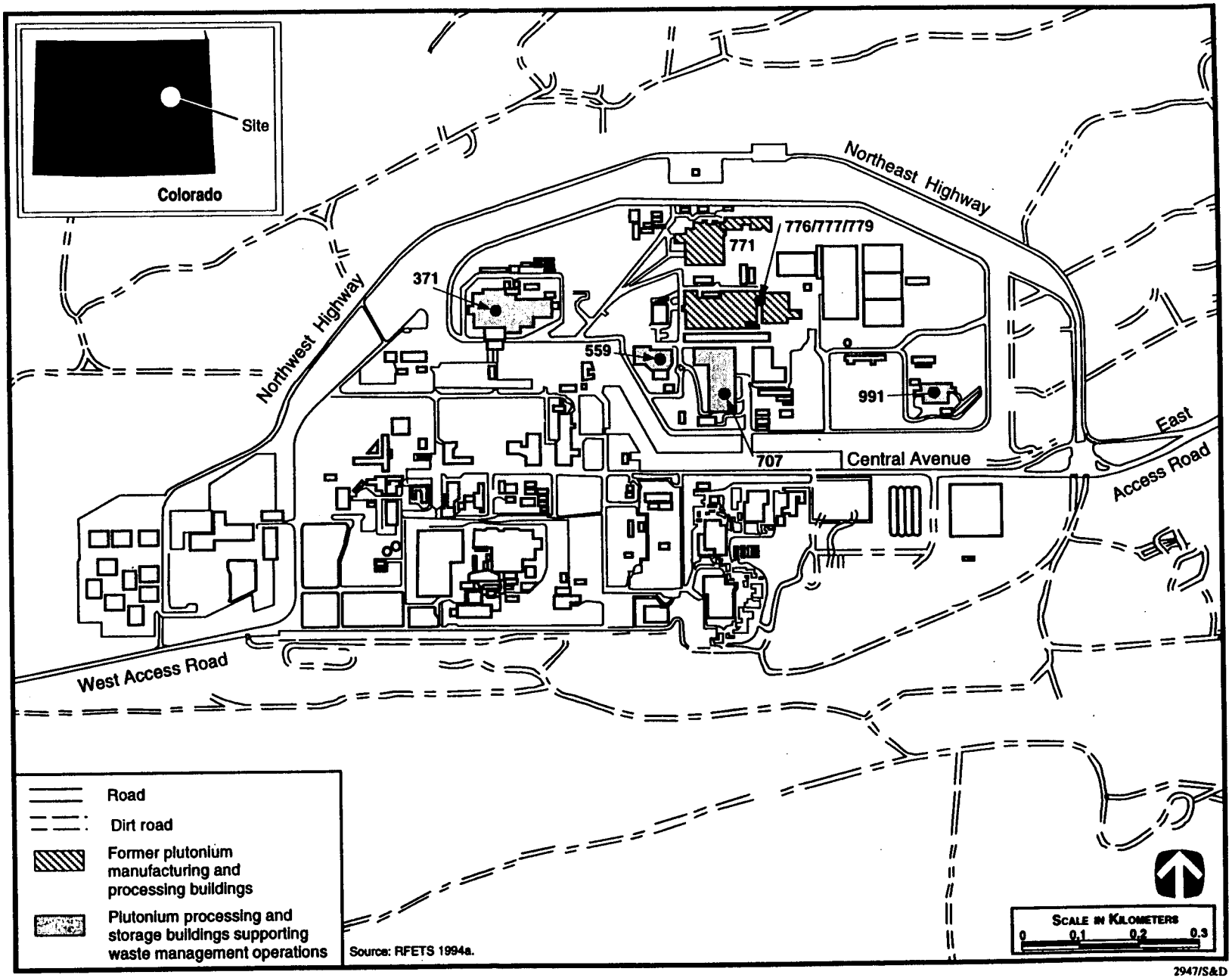


Figure 2.2.7–2. Site Designations and Principal Facilities at Rocky Flats Environmental Technology Site.

Under the No Action Alternative, Pu-bearing materials at RFETS would be stabilized and converted to metal and/or oxide form and stored in existing, upgraded existing, or new facilities. Some Pu materials would be stabilized by conversion into a weapons-usable form and/or a waste form.

2.2.8 LOS ALAMOS NATIONAL LABORATORY

Los Alamos National Laboratory is located in north-central New Mexico adjacent to the town of Los Alamos, as shown in Figure 2.2.8–1. The Technical Areas (TAs) at LANL are shown in Figure 2.2.8–2. The inventory of Pu materials in storage at LANL as of September 1994, was 2.7 t (3.0 tons). This material is stored at 24 facilities and is in various physical and chemical forms, including metal, pits, fabricated weapons shapes, Pu compounds and alloys, and a broad range of scraps/residues (mostly solids). There are a number of sealed sources used for radiation instrument calibrations, neutron sources, and targets for experiments. In addition, small quantities of Pu exist in process equipment and at a few facilities within controlled access areas. Approximately 90 percent of the Pu at LANL is stored in packages located in TA-55. Of the total LANL Pu inventory, approximately 1.5 t (1.7 tons) falls within the scope of this PEIS.

Research at the TA-55 facility includes Pu recovery processes, Pu metal fabrication, Pu-238 general purpose heat source and radioisotope thermoelectric generation production, and advance fuel fabrication. Pu analytical operations are also conducted in the Chemistry and Metallurgy Research building, which has laboratories, hot cells, a waste assay facility, and a vault. The Los Alamos Critical Experiments Facility, remotely located in TA-18, uses Pu in nuclear criticality experiments.

Preferred Alternative: No Action. Under the No Action Alternative, weapons-usable Pu materials would continue to be stored in the upgraded Nuclear Material Storage Facility, in stabilized form pursuant to DNFSB Recommendation 94-1, within TA-55. Storage would be in accordance with LANL's proposed *Corrective Action Plan* for addressing ES&H vulnerabilities associated with Pu storage.

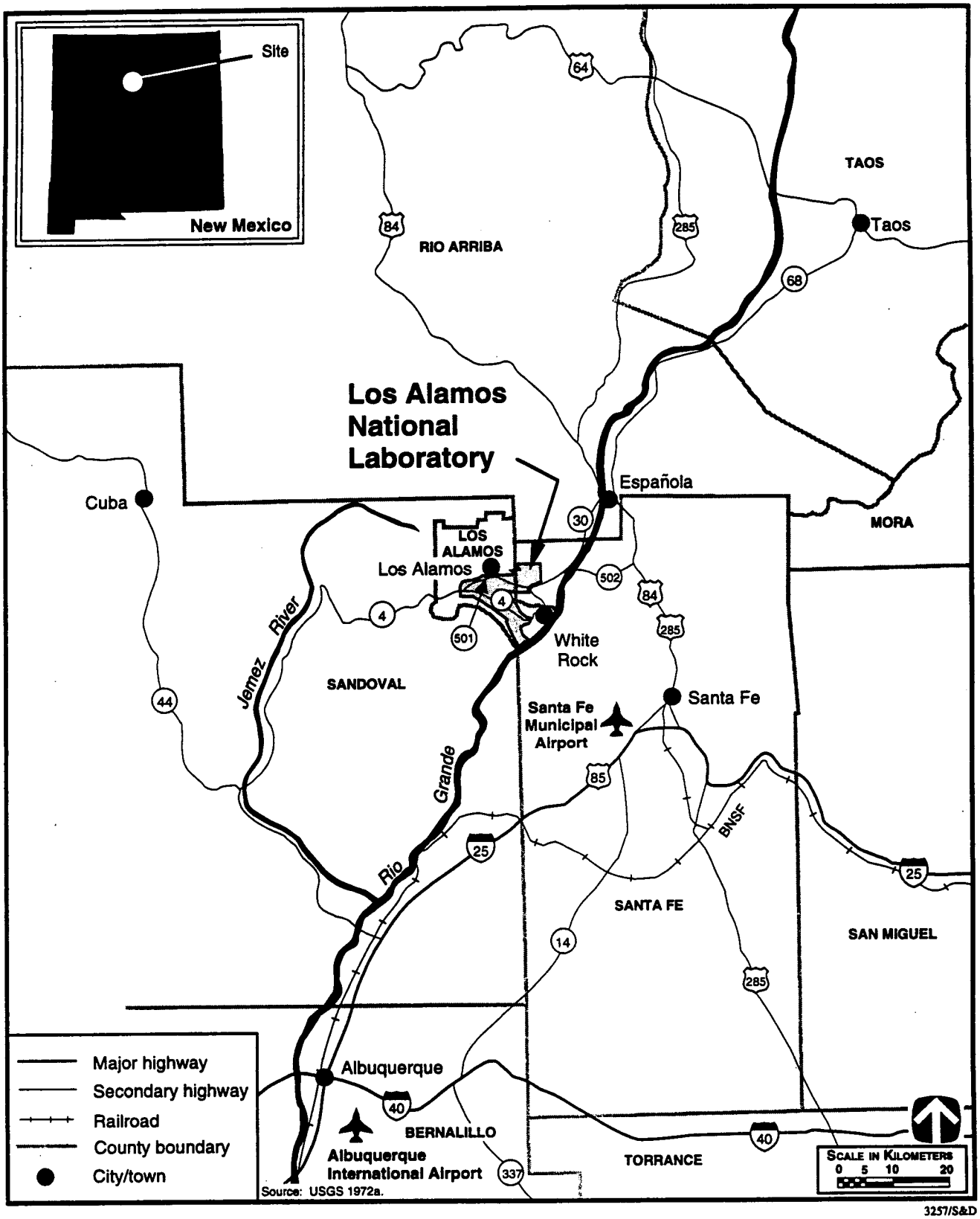


Figure 2.2.8–1. Los Alamos National Laboratory, New Mexico, and Region.

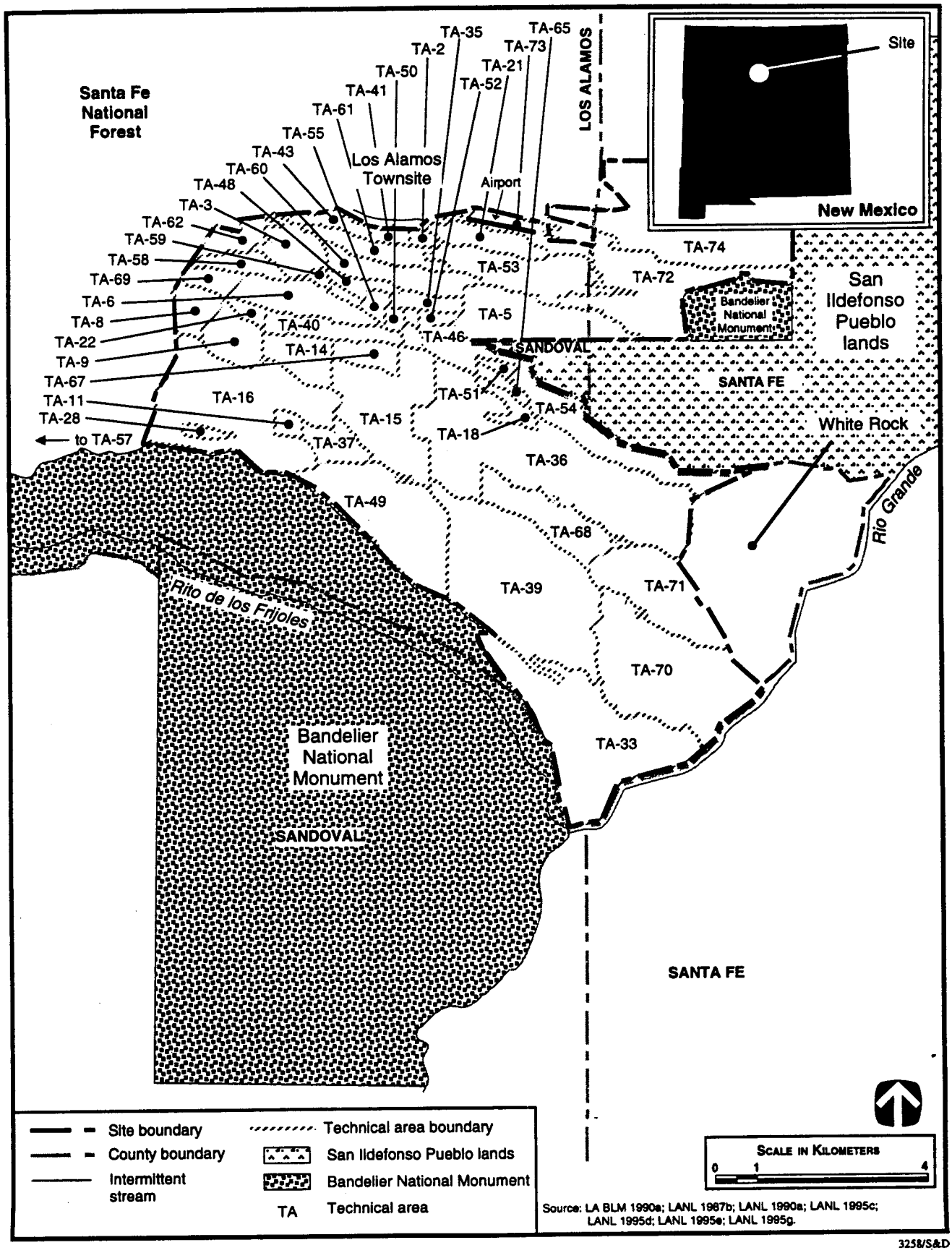


Figure 2.2.8–2. Site Designations and Principal Facilities at Los Alamos National Laboratory.

2.3 LONG-TERM STORAGE ALTERNATIVES AND RELATED ACTIVITIES

The long-term storage alternatives evaluated and discussed in this Storage and Disposition PEIS include the following:

- *Upgrade at Multiple Sites Alternative*—modify existing and/or construct new facilities at several DOE sites for continued storage of Pu and HEU; relocate all or some RFETS and LANL Pu to one or more of the Pu storage sites
- *Consolidation of Pu Alternative*—construct new facility, *or* construct new and modify existing facilities at one site for all Pu materials; modify or maintain existing HEU facilities at ORR
- *Collocation of Pu and HEU Alternative*—construct new facility, *or* construct new and modify or maintain existing facilities at one site for all Pu and HEU materials

Preferred Alternative for Storage: The Preferred Alternative for storage calls for (1) the upgrade of Zone 12 South facilities (to be completed by 2004) at Pantex to store strategic reserve pits, those surplus pits currently stored at Pantex, and pits from RFETS pending disposition; (2) the upgrade (expansion) of the APSF (planned to be built by 2001) at SRS to store those Pu materials currently at SRS, and surplus non-pit Pu materials from RFETS after stabilization is performed at RFETS; and (3) the upgrade of existing Y–12 facilities to store non-surplus HEU, and surplus HEU pending disposition.

Environmental impacts of each long-term storage alternative and the No Action Alternative are analyzed for each of the six candidate storage sites to allow the comparison of impacts by sites for each alternative and the comparison of impacts by alternatives for each site. As a result, decisions can be made to select a single storage alternative for all sites or a combination of different alternatives for different sites. In addition to the environmental analysis for storing all weapons-usable fissile materials under the scope of this PEIS under the No Action Alternative and the various long-term storage alternatives, an analysis of Pu storage without the nonsurplus materials covered under the Stockpile Stewardship and Management PEIS (strategic reserve and weapons R&D materials) is also presented. The impacts would generally be lower if these materials are not included.[13]

Conceptual facility locations for the long-term storage alternatives at Hanford, NTS, INEL, Pantex, ORR, and SRS are shown in Figures 2.3–1 through 2.3–6. [Text deleted.] Detailed descriptions of each long-term storage alternative are provided in the following sections. The descriptions, to the extent they describe new (not yet built) facilities or modifications, are based on conceptual designs and, depending on the strategy selected in the ROD, may be refined when more detailed designs become available.

2.3.1 UPGRADE AT MULTIPLE SITES ALTERNATIVE

The Upgrade at Multiple Sites Alternative includes four subalternatives. Under the first subalternative, Pu and HEU materials currently stored at five candidate DOE sites would remain in long-term storage at those sites in modified and/or new facilities. In addition, Pu material currently at RFETS and LANL, which are not candidate sites, would remain at those sites until decisions on the disposition alternatives are implemented.

The second subalternative includes relocating all or some of the Pu materials from RFETS and LANL to one or more of the upgraded long-term storage sites. For this second subalternative, all or some of the approximately 12.9 t (14.2 tons) of the Pu from RFETS Pu and 1.5 t (1.7 tons) of LANL surplus Pu material in storage would

[13] For the subalternatives that would not include strategic reserve and weapons R&D materials, a qualitative analysis for resources is presented.

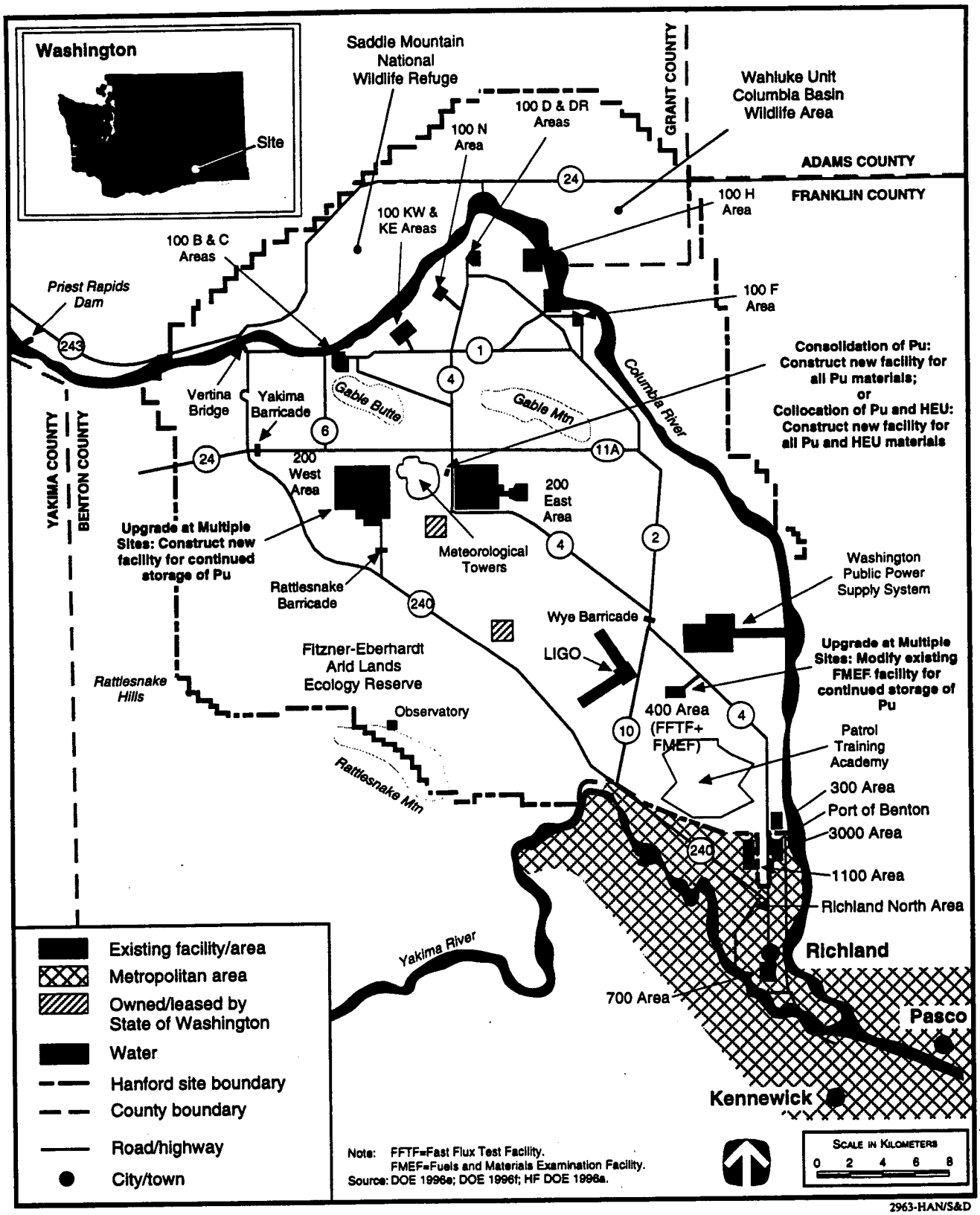


Figure 2.3–1. Conceptual Facility Locations for the Long-Term Storage Alternatives at Hanford Site.

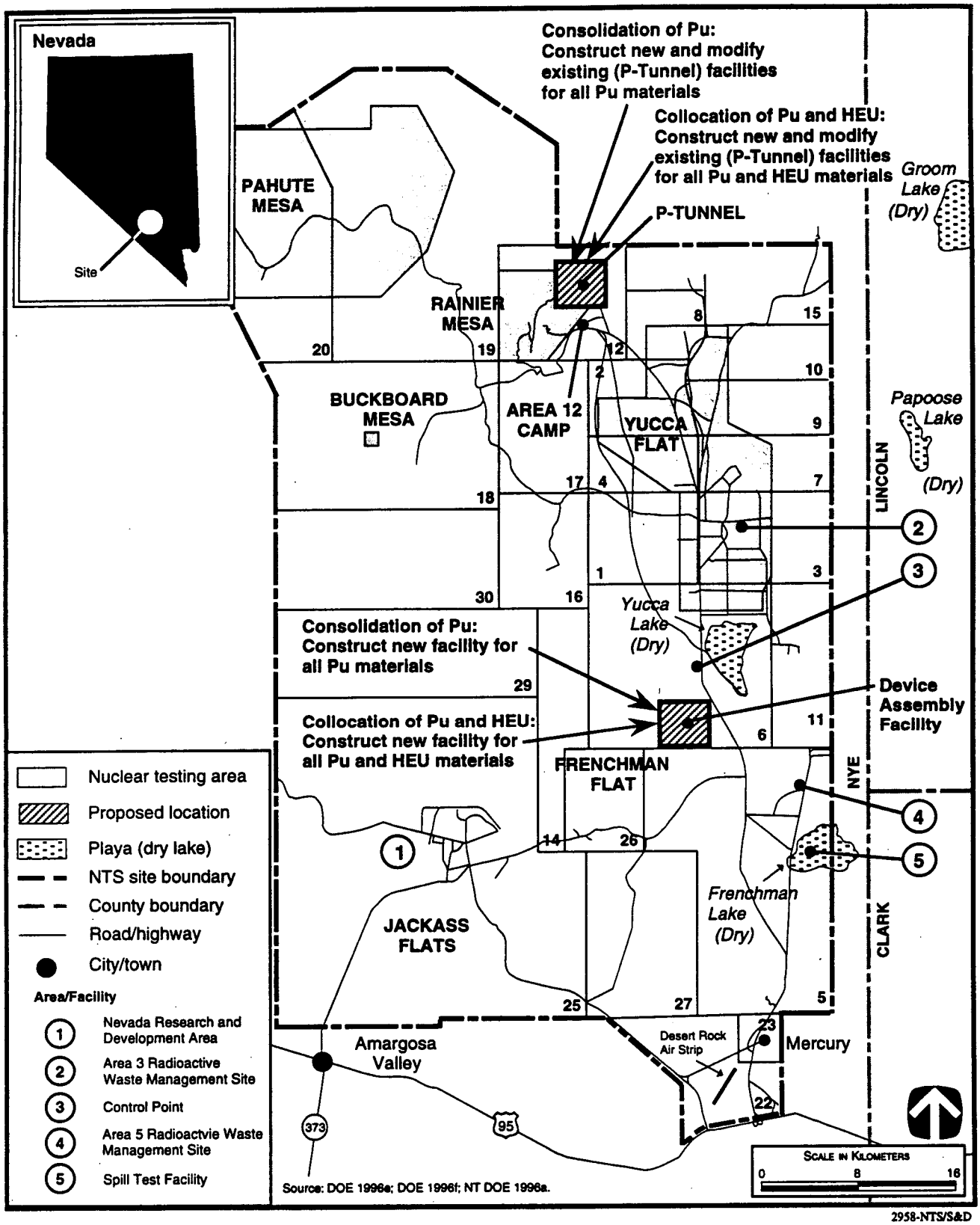


Figure 2.3–2. Conceptual Facility Locations for the Long-Term Storage Alternatives at Nevada Test Site.

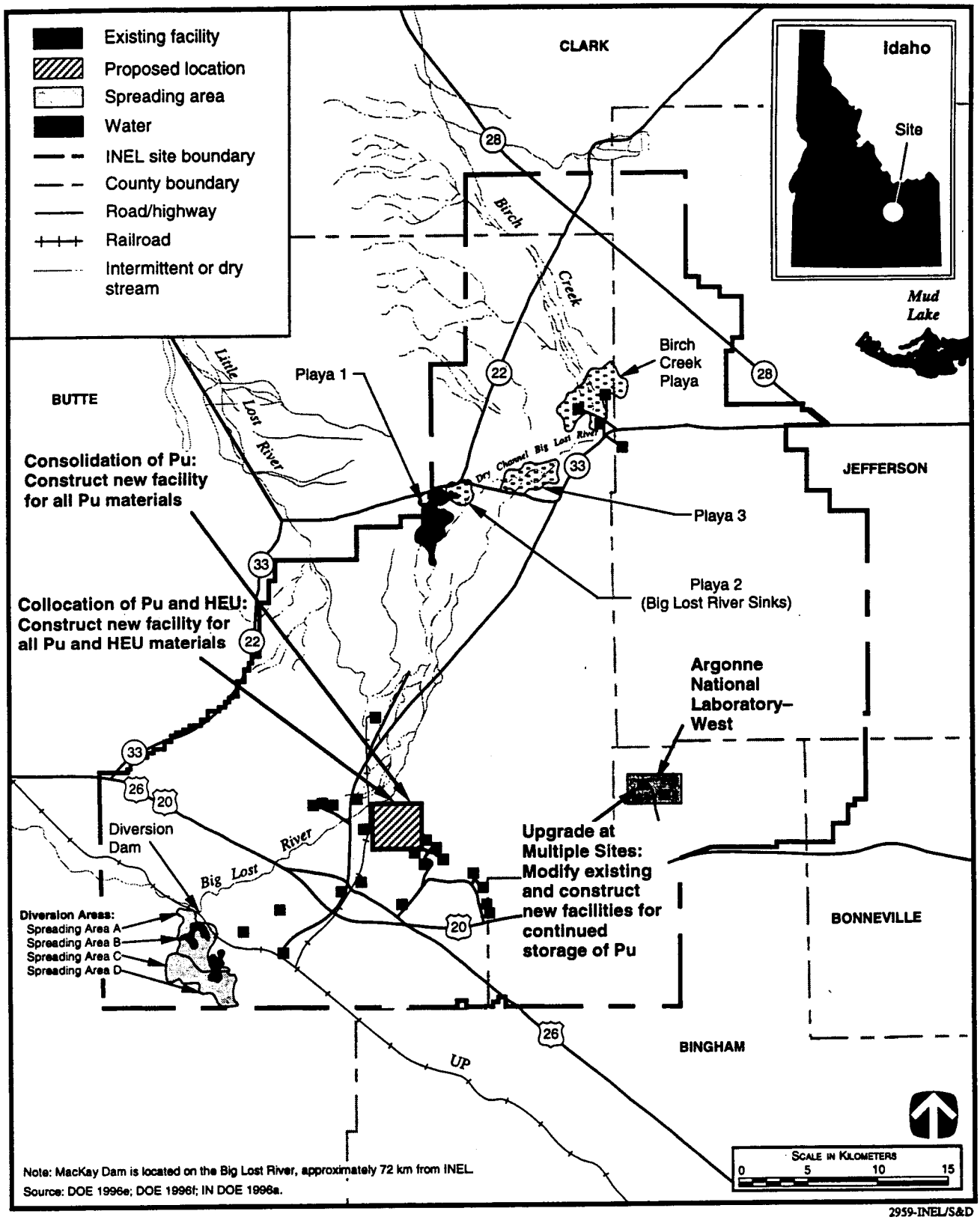


Figure 2.3–3. Conceptual Facility Locations for the Long-Term Storage Alternatives at Idaho National Engineering Laboratory.

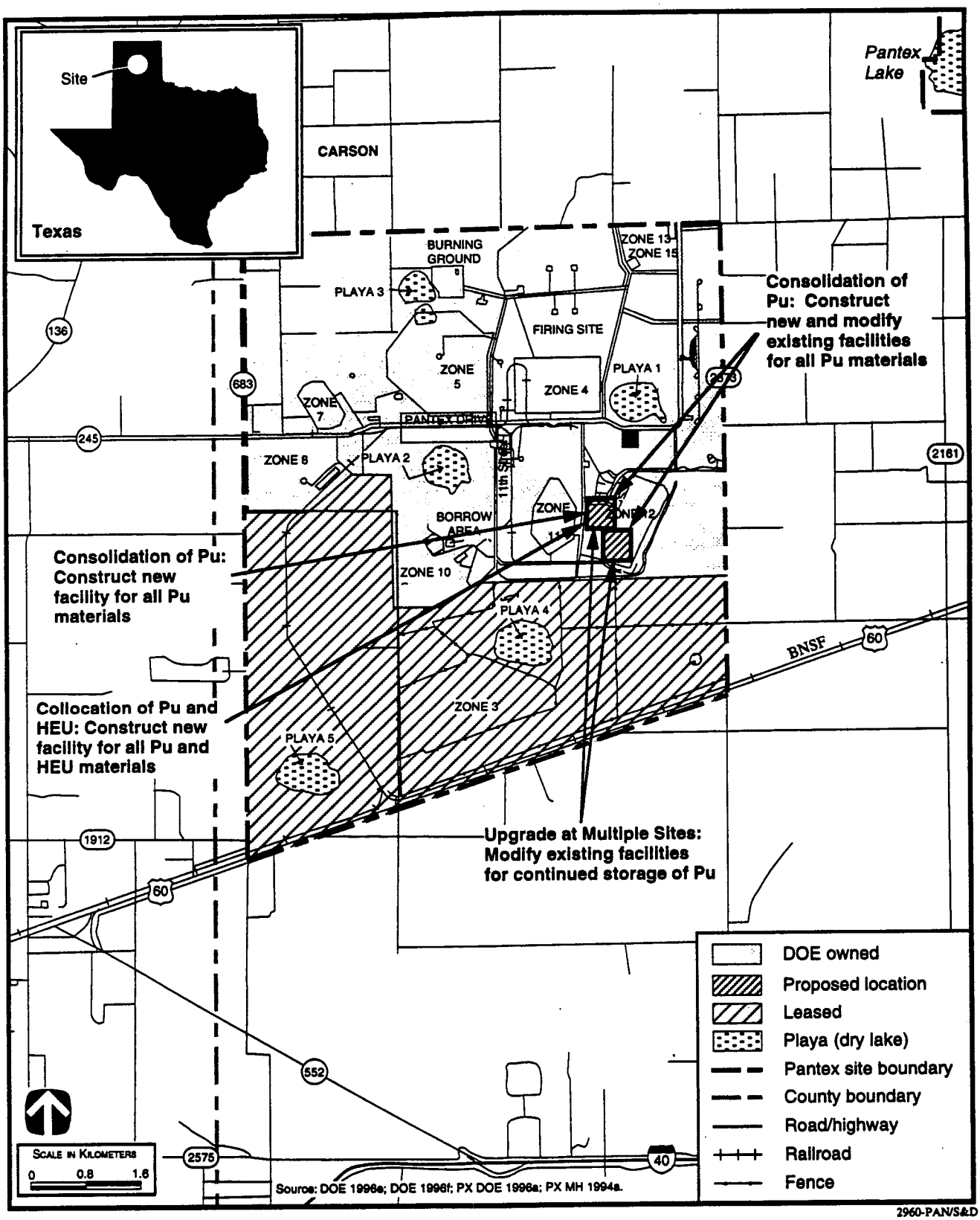


Figure 2.3–4. Conceptual Facility Locations for the Long-Term Storage Alternatives at Pantex Plant.

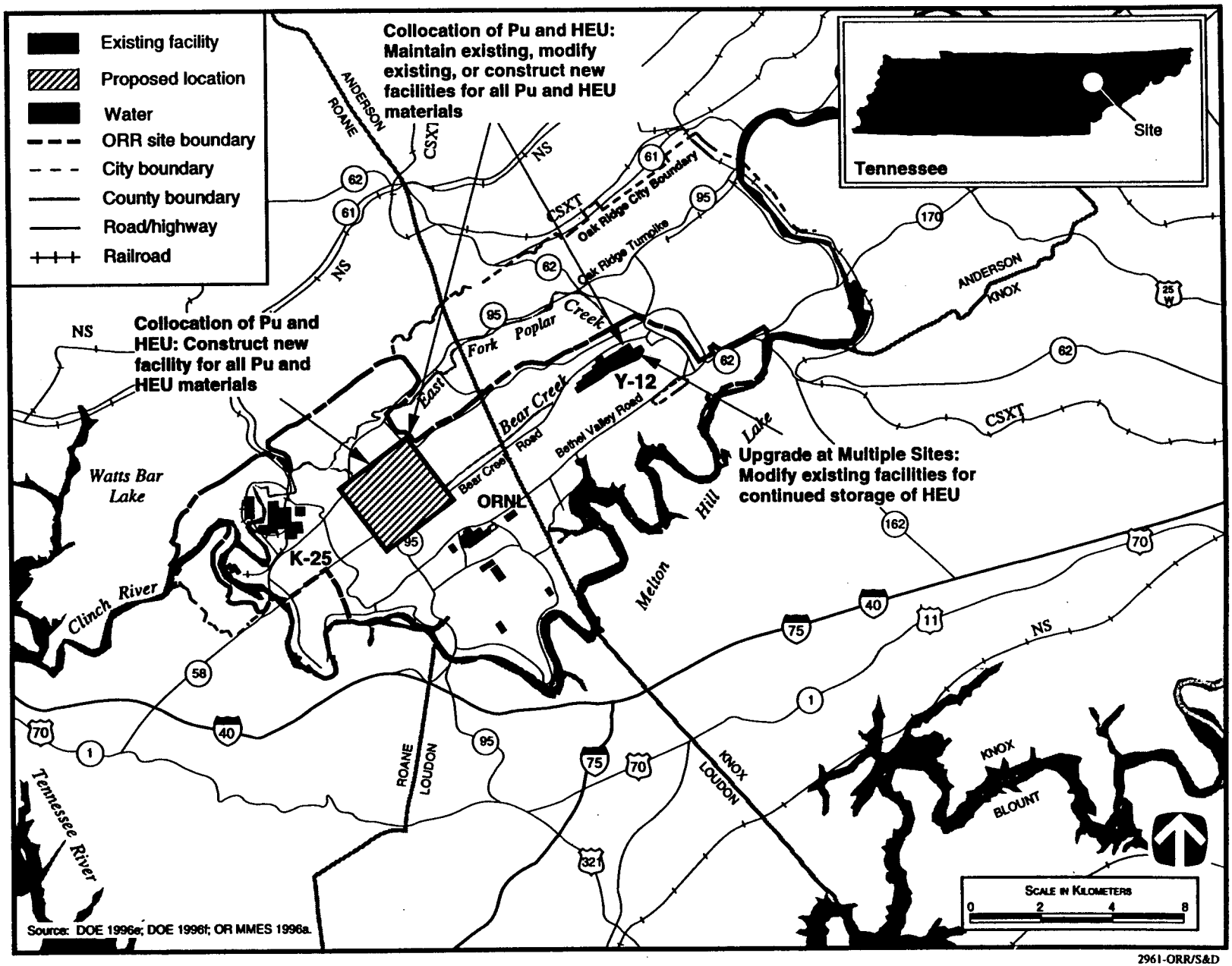


Figure 2.3–5. Conceptual Facility Locations for the Long-Term Storage Alternatives at Oak Ridge Reservation.

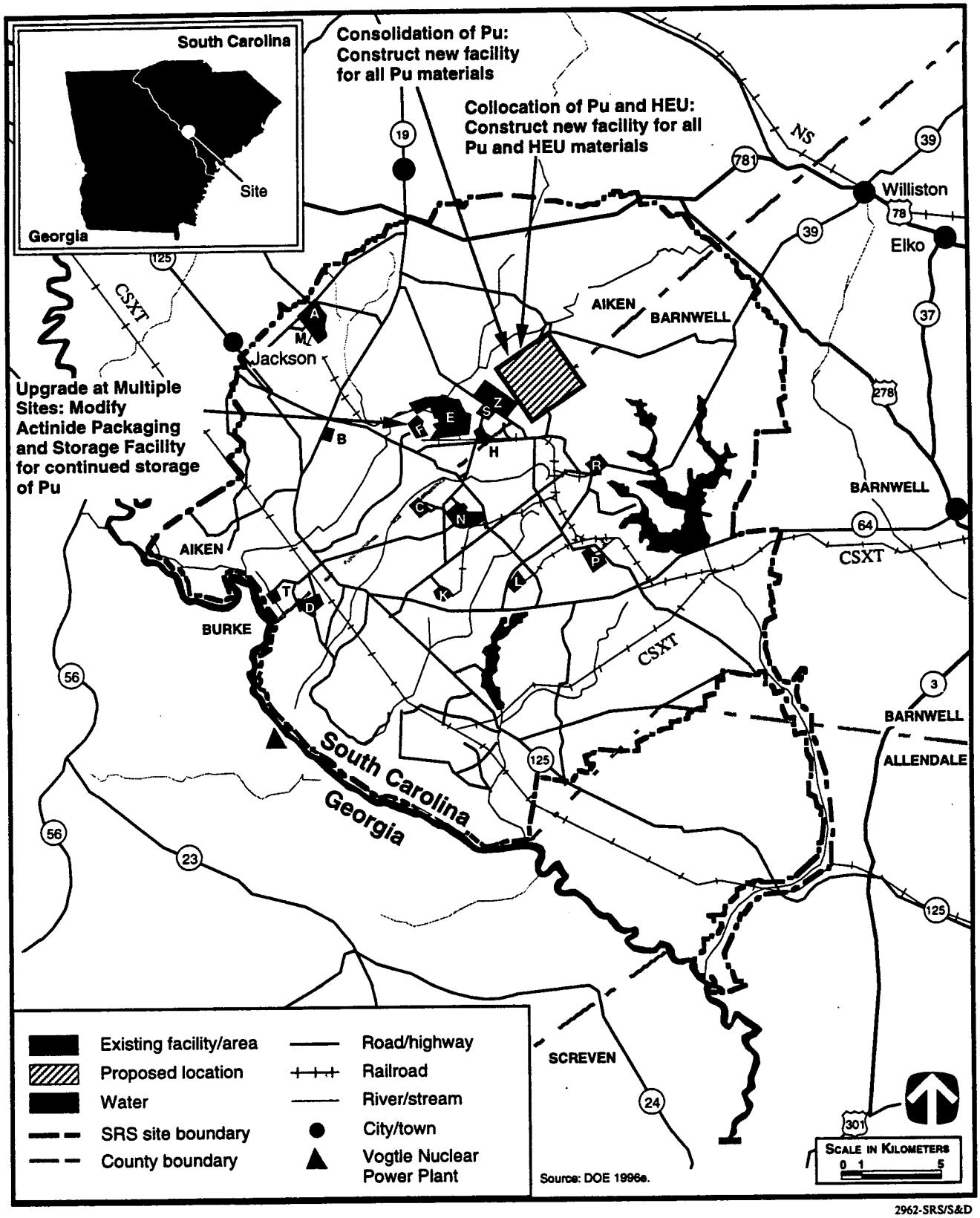


Figure 2.3–6. Conceptual Facility Locations for the Long-Term Storage Alternatives at Savannah River Site.

be relocated to one or more of the upgraded candidate sites. A summary of the long-term storage options (facility requirements) by candidate site is presented in Table 2.3.1–1 [Text deleted.]

The third subalternative includes relocating Pu pits from RFETS to Pantex with storage of surplus pits pending disposition. Transfer of pits from RFETS would begin in 1997. Pits from Pantex and RFETS would be stored in Zone 4 until the facilities in Zone 12 South have been upgraded. The fourth subalternative would include relocating non-pit Pu materials from RFETS to SRS. Facilities in the F-Area at SRS would be modified to accommodate non-pit Pu from RFETS. This subalternative involves a similar but smaller expansion of facilities in F-Area compared to the second subalternative, which includes all or some of the Pu materials from RFETS and LANL. Requirements presented in Appendices B, C, D, E, and F reflect the various Upgrade at Multiple Sites subalternatives.

Table 2.3.1–1. Long-Term Storage Options for the Upgrade at Multiple Sites Alternative[a]

Candidate Site	Storage Option
Hanford	Modify Existing Fuels and Materials Examination Facility, or Construct New 200 West Area Facility for Continued Pu Storage
INEL	Modify Existing and Construct New ANL-W Facilities for Continued Pu Storage
Pantex (Preferred Alternative)	Modify Existing Zone 12 South Facilities for Continued Pu Storage
ORR (Preferred Alternative)	Modify Existing Y–12 Plant for Continued HEU Storage
SRS (Preferred Alternative)	Modify New Actinide Packaging and Storage Facility for Continued Pu Storage

[a] Proposed storage facility locations were primarily based on optimal use of existing facilities and are in accordance with current site development and utilization plans and proposals.

In addition to the environmental analysis performed for storing all weapons-usable fissile materials within the scope of this PEIS under this alternative, an analysis of the long-term storage of Pu and HEU without those nonsurplus materials covered under the Stockpile Stewardship and Management Final PEIS (strategic reserve and weapons R&D materials) is also presented as a subalternative to the Upgrade at Multiple Sites Alternative.

[Text deleted.]

Facility construction and operations data for the Upgrade at Multiple Sites Alternative at Hanford, INEL, Pantex, ORR, and SRS are listed in Appendix B, *Building and Facility Specifications*; Appendix C, *Materials, Resources, and Employment Requirements for Construction and Operations*; Appendix D, *Water Usage*; Appendix E, *Waste Management*; and Appendix F, *Air Quality and Noise*.

Hanford Site

Three options for onsite long-term storage of approximately 4 t (4.4 tons) of Pu materials were identified for the Hanford Site Upgrade Alternative. These include modifying current facilities at the PFP, modifying the as yet unused Fuels and Materials Examination Facility (FMEF), and constructing a new Pu storage facility. All three options appear realistically feasible and similar in total lifecycle cost. However, since lifecycle costs are similar, the PFP modification option was not specifically analyzed because of the potential difficulties associated with construction work within the PFP facility area and the risk of uncovering unexpected contamination during the modification activities. This leaves two options for consideration in this PEIS. The first option is to modify the existing FMEF. The second option is to upgrade Hanford's storage capability through new construction. The operational flow diagram is shown in Figure 2.3.1–1.

Modify Fuels and Materials Examination Facility. This option would utilize certain areas within the existing but as yet unused six-level, 18,600-square meter (m^2) (200,000-square foot [ft^2]) FMEF located in the 400 Area at Hanford (Figure 2.3–1). Figure 2.3.1–2 shows the plan view of the FMEF and surrounding buildings in the 400 Area. This location has a protected area with all required security features and necessary support utility

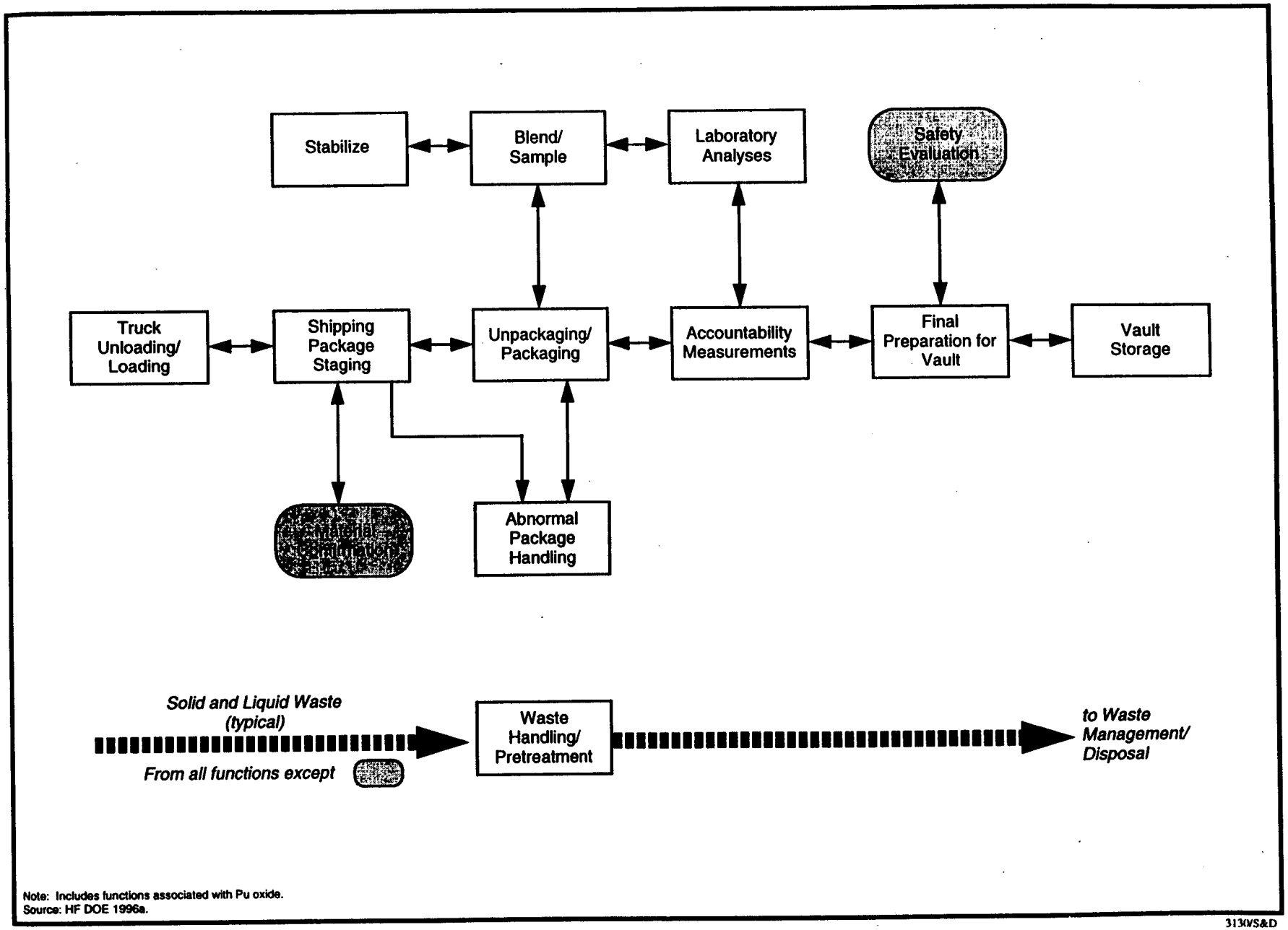


Figure 2.3.1–1. Operational Flow Diagram for the Upgrade Alternative at Hanford Site.

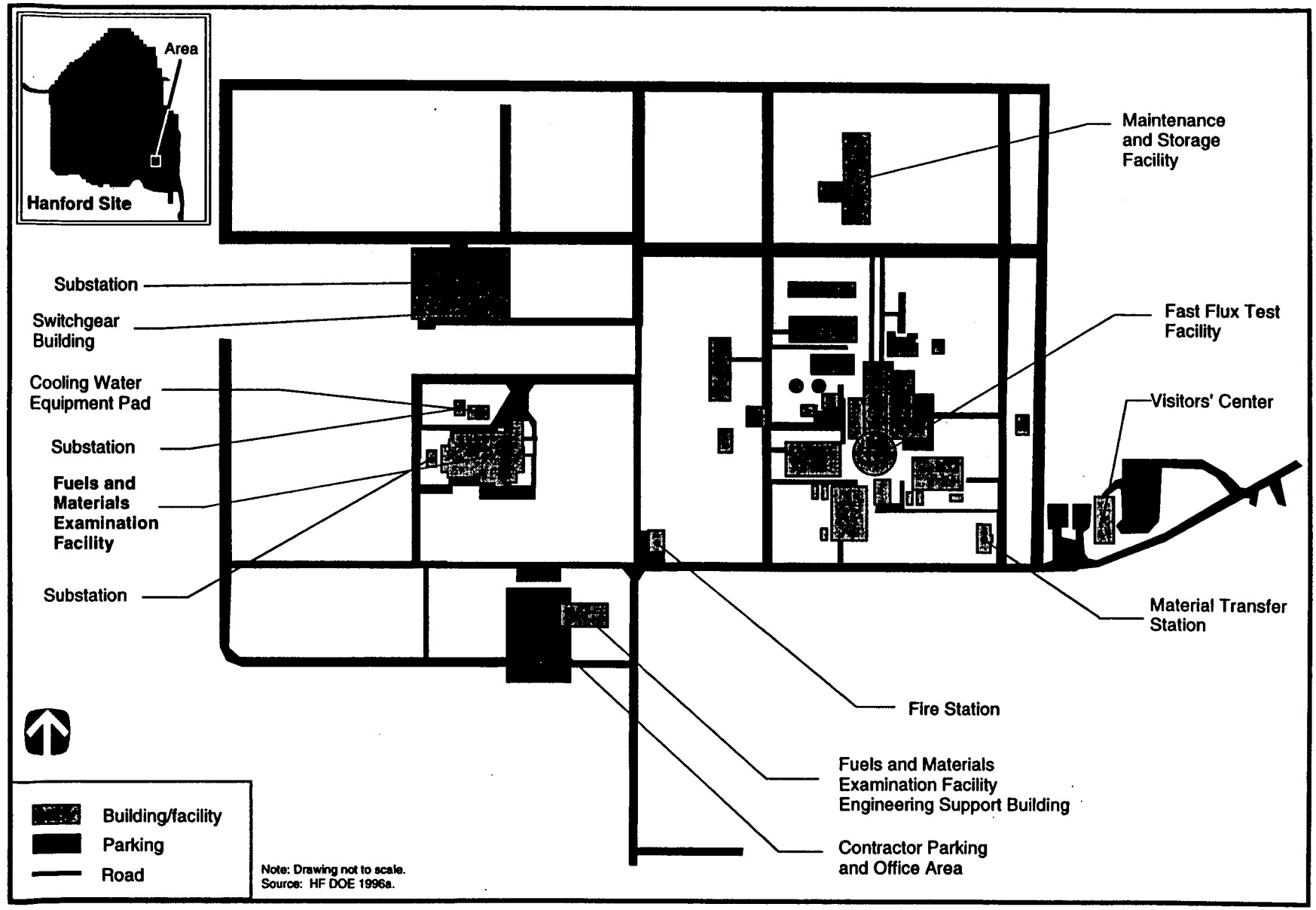


Figure 2.3.1–2. Location of Fuels and Materials Examination Facility in 400 Area at Hanford Site (Plan View).

services.The hardened outside walls of this facility are made of reinforced concrete and are designed to resist the forces of tornadoes and seismic events considered possible at Hanford. Modifying the FMEF would require minor demolition and stripping of some existing structures and utilities, and the possible addition of more radiation shielding. General renovation of laboratory areas would occur along with the addition of new equipment. Supporting office facilities would be provided in Buildings 4862 and 4706. A crane maintenance loft would be added, along with shielding and security hardening.

Secured storage vault space would utilize the FMEF main and decontamination cells within the 427 Building. The main cell would be modified to provide a vertical rack storage area. Shipping and receiving and other primary support functions would be housed in areas within the facility's hardened boundary. Utilization of the FMEF for the Upgrade Storage Alternative would not preclude its use to also support Pu disposition activities for either reactor or immobilization alternatives. This structure would meet all requirements of DOE O 430.1, *Life-Cycle Asset Management*, for Pu storage and handling. Pu handling capability would be accommodated by about 12 to 15 new gloveboxes in the hardened portion of the structure. These gloveboxes could also be used to directly support the Pu disposition operations. Modifications to the FMEF for storage would not preclude use of the FMEF for MOX fuel fabrication for the disposition alternatives.

Construct New Facility. Under this option, DOE would construct and operate a new two-story, stand-alone facility that would provide secured long-term vault storage as well as hardened and nonhardened long-term storage support space in a single building. The hardened portion of the facility walls and the vault walls would be made of reinforced concrete. Maintenance, utilities, process support, and access to the secured vault would be on the first floor. The second floor would house exhaust fans, filters, and the space for laboratory support.

The new long-term storage facility would be located adjacent to the current PFP protected area (PA) boundary in the 200 West Area at Hanford. Figure 2.3.1–3 shows the plan view of the proposed location for the new Hanford Pu storage facility in relation to surrounding buildings at the 200 West Area. This location has the advantage of allowing utilization of the existing secured PA, fences, and guards. In addition, movement of material from the present vaults into the facility would be more secure because of the collocation of vault facilities.

Support activities would be housed in the nonhardened portion of the new structure. These would include nonhardened utilities, offices for operations staff, and change areas. Existing Hanford facilities would be utilized for all required waste storage, handling, and disposal operations.

Nevada Test Site

This alternative does not apply at this site because neither Pu nor HEU is stored at existing facilities at NTS. Therefore, no facility is identified to be modified for continued storage of either material.

Idaho National Engineering Laboratory

The upgrade alternative at INEL would modify existing and construct new facilities for long-term storage of Pu located within the existing ANL-W facility at INEL as shown in Figure 2.3–3. The upgrade would be accomplished by constructing a new 2,650-m^2 (28,500-ft^2) material-handling building to augment existing buildings that would be modified for long-term storage and storage support. In addition, existing balance-of-plant (BOP) facilities at INEL would be used for support functions. The material handling, long-term storage, and storage support functions for the ANL-W upgrade would be provided by modifying Building 704 for long-term material storage, modifying Buildings 774 and 775 for storage support, and providing a new material handling building. The buildings would be interconnected by a new material transfer access corridor, with material handling lines and flow paths contained within one Materials Access Area (MAA). Figures 2.3.1–4 and 2.3.1–5 show the plan views of the ANL-W storage buildings in relation to the ZPPR building and other support buildings. The operational flow diagram is shown in Figure 2.3.1–6.

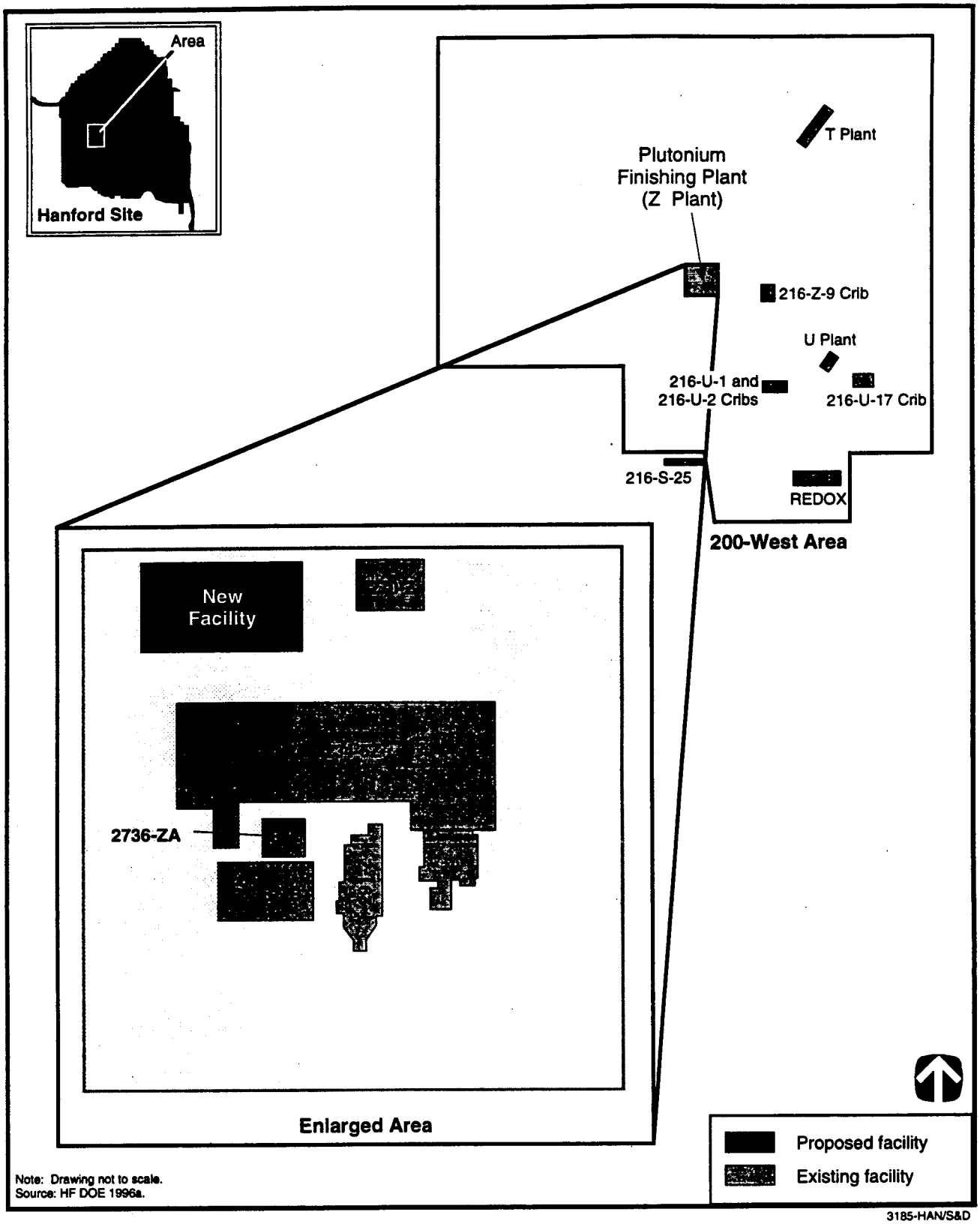


Figure 2.3.1–3. Proposed New Plutonium Storage Facility at Hanford Site (Plan View).

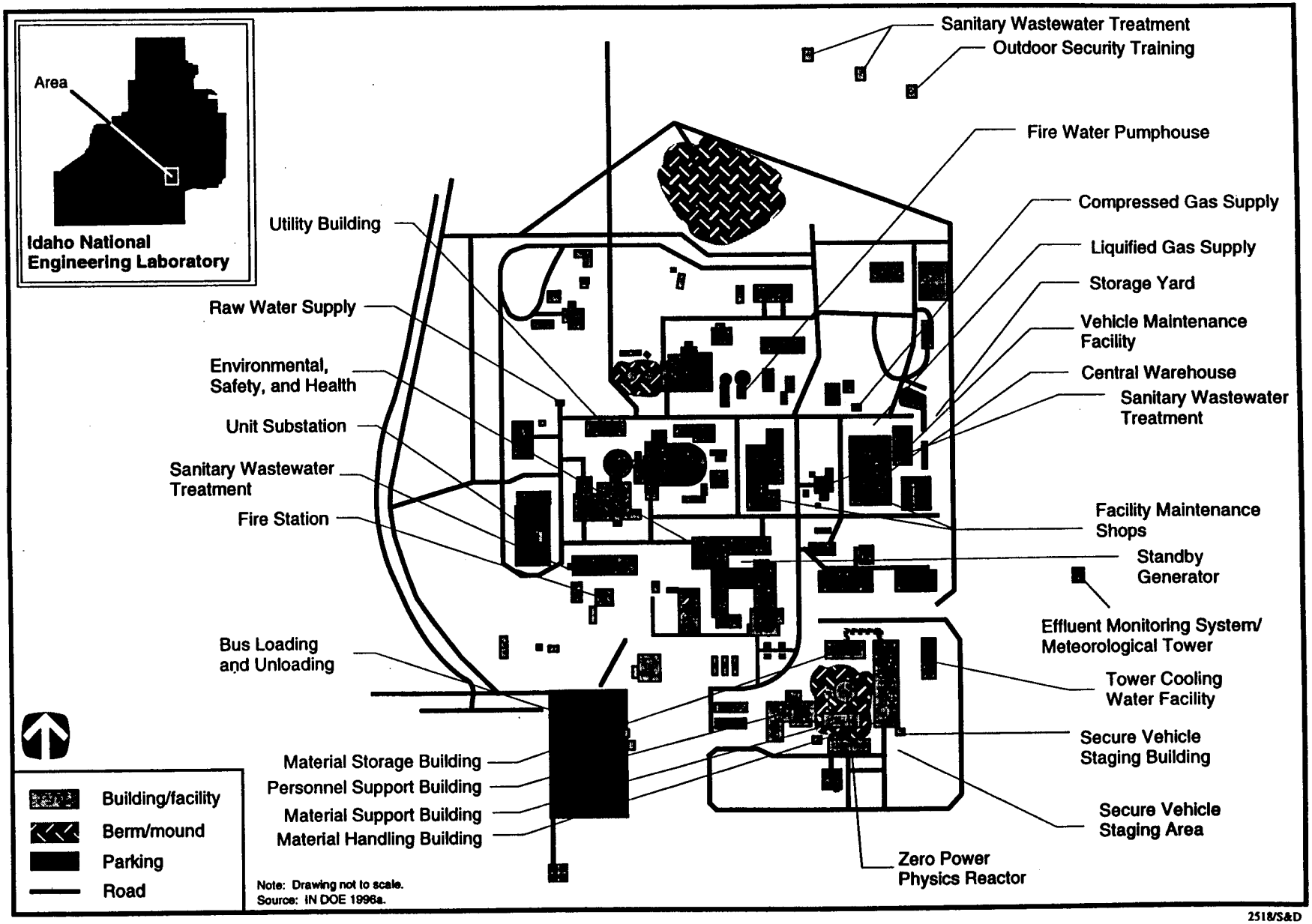


Figure 2.3.1–4. Proposed Plutonium Storage Upgrade at Idaho National Engineering Laboratory, Argonne National Laboratory-West (Plan View).

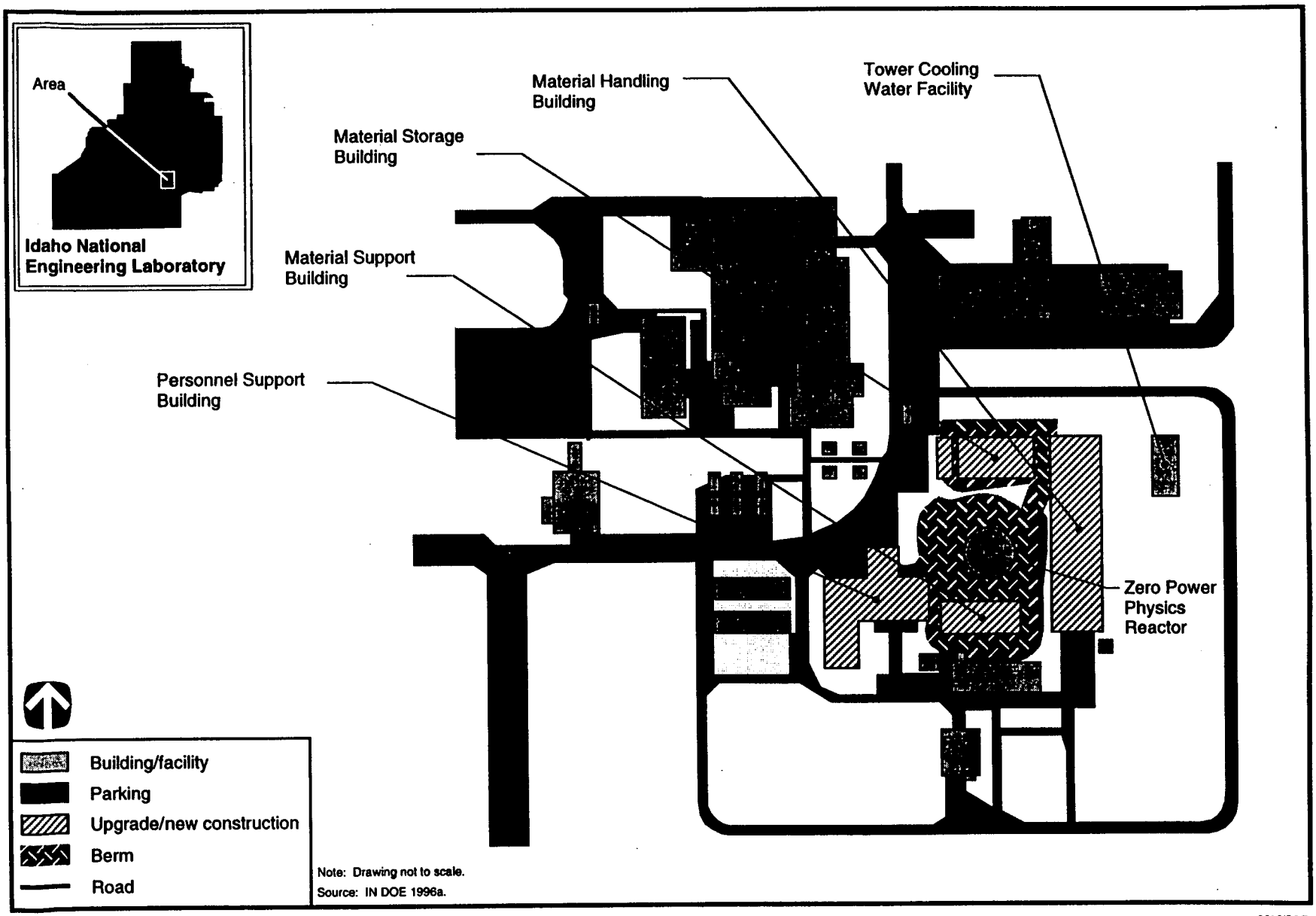


Figure 2.3.1–5. Large Scale View of the Proposed Plutonium Storage Upgrade at Idaho National Engineering Laboratory, Argonne National Laboratory-West (Plan View).

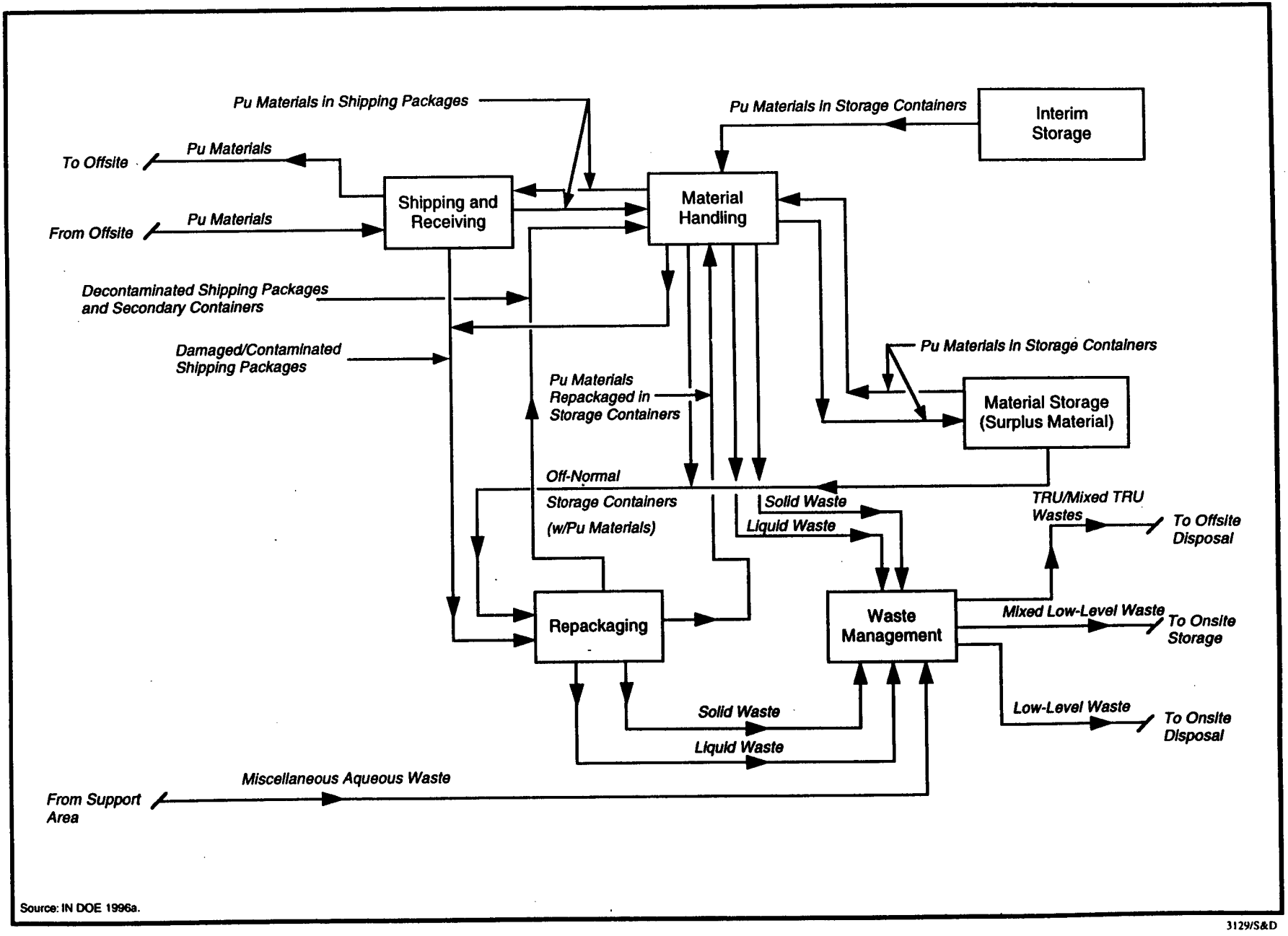


Figure 2.3.1–6. Operational Flow Diagram for the Upgrade Alternative at Idaho National Engineering Laboratory, Argonne National Laboratory-West.

Pantex Plant

The upgrade alternative at Pantex would modify existing facilities in Zone 12 South. This alternative takes advantage of projected upgrade to support, security, and infrastructure systems for the assembly/disassembly operations at Pantex. The proposed location for this long-term storage option is shown in Figure 2.3–4. The modifications for long-term storage would be integrated into the Pantex infrastructure, security, waste, and assembly/disassembly operations systems. Upgrades of the Pantex assembly/disassembly operations include the upgrade of all support, security, and infrastructure systems needed for Pu storage operations. Therefore, the Pu storage upgrade is incremental to other planned upgrades at Pantex, and no additional upgrades of support systems beyond those identified for Pantex assembly/disassembly operations upgrade would be required. Figure 2.3.1–7 shows the plan view of the existing buildings in Zone 12 South (12-66 and 12-82 primarily) that would be modified for the Upgrade Alternative. The operational flow diagram is shown in Figure 2.3.1–8.

The modified facilities would provide staging capabilities to receive and ship approximately 3,000 shipping packages per year. The staging facility would include automated handling equipment to reduce radiation exposure. The long-term storage vault would be a modular design. It would incorporate remote operations to reduce the radiation exposure to personnel and enhance safeguards for the material. The vault would have a storage capacity of approximately 20,000 surplus material positions and approximately 5,000 nonsurplus material positions.[14]

In keeping with the primary objective to provide safe, secure, environmentally sound, and long-term storage of Pu pits from nuclear weapons, the upgrade would divide operations into three primary systems: a shipping/receiving and packaging system, a long-term storage vault system, and an abnormal package handling system. Currently, Pantex possesses the capability to overpack failed pit containers for offsite remediation. Under the preferred alternative, pits from RFETS would be stored similar to those currently stored at Pantex. No additional capability would be required to overpack failed pit containers since this capability already exists at Pantex. No capability exists for onsite remediation or overpacking of metal and oxide containers.

The majority of the pits at RFETS are already in a shippable form. For the small number of pits that are not currently in shippable condition, DOE would place these pits in a shippable condition prior to shipment to Pantex, in accordance with existing procedures. All of these pits are types which are currently stored at Pantex or have been stored there in the past. No capability exists for onsite remediation or overpacking of metal and oxide containers. If RFETS and/or LANL metal and oxide materials were moved to Pantex, processing equipment and space would be provided at Pantex to add the capability to either remediate or overpack any failed metal and oxide containers.

Preferred Alternative: Upgrade with RFETS Pu Pits Subalternative. The Upgrade with RFETS Pu Pits Subalternative would transfer Pu pits from RFETS to Pantex with storage of surplus pits continuing until disposition. Pits to be transferred would be packaged in FL (Type B) containers at RFETS before shipment and, upon receipt at Pantex, would be repackaged into AL-R8 containers in Zone 12 South and placed into storage in Zone 4 West pending availability of AT-400A containers and relocation to upgraded storage facilities in Zone 12 South. Storage of Pantex pits at Zone 4 West is analyzed in the Pantex EIS and storage and intrasite transportation of RFETS pits at Zone 4 West are described in Appendix Q. The intersite transportation analysis for shipment of the RFETS Pu to Pantex is given in Section 4.4 of this PEIS for both workers and the public. The transportation of existing Pantex pits between Zone 4 and Zone 12 and the repackaging of the pits from AL-R8 to AT-400A containers is analyzed in the Pantex EIS.

[14] A storage position is a volume defined by the dimensions 45.7 centimeters (cm) x 45.7 cm x 61 cm (18 inches [in] x 18 in x 24 in).

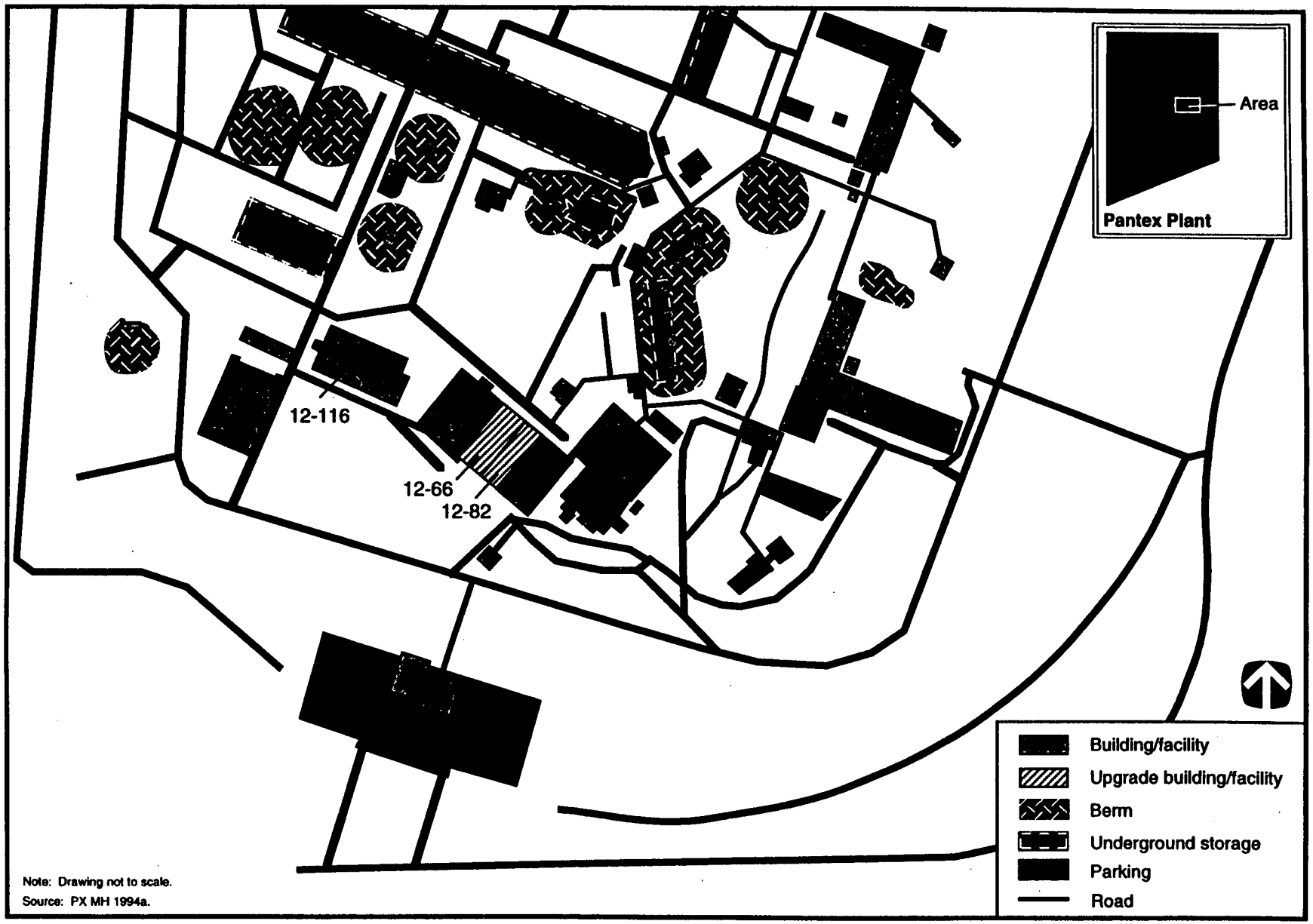


Figure 2.3.1–7. Proposed Plutonium Storage Upgrade at Pantex Plant, Zone 12 South (Plan View).

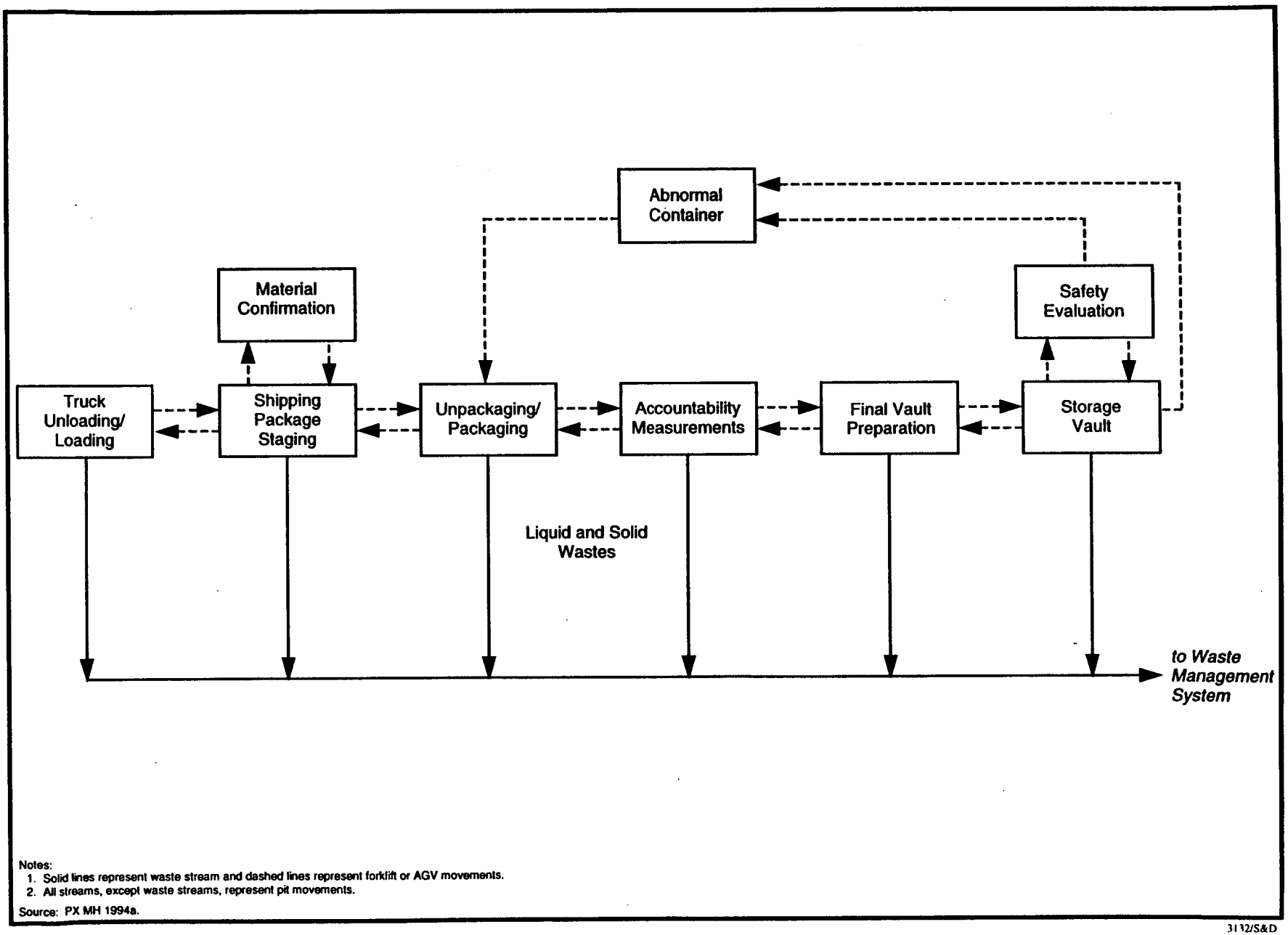


Figure 2.3.1–8. Operational Flow Diagram for the Upgrade Alternative at Pantex Plant.

Oak Ridge Reservation

Preferred Alternative: Upgrade. Under the Upgrade Alternative, the entire HEU inventory requiring long-term storage would be stored at Y–12 in modified existing facilities as shown in Figure 2.3–5; no new facilities would be built. The majority of the HEU would be housed in facilities currently used for HEU storage. The remaining HEU would be stored in facilities that were formerly used for material processing, but are currently being modified and converted into storage areas. Modifications to existing buildings that would be required to make the facilities suitable for long-term storage consist primarily of those upgrades required to meet natural phenomena requirements as documented in *Natural Phenomena Upgrade of the Downsized/ Consolidated Oak Ridge Uranium/Lithium Plant Facilities* (Y/EN-5080, 1994) and the Y–12 EA as follows:

- Building 9204-2: Seventeen concrete beams supporting the second floor need strengthening by the addition of steel beams. The steel beams would be placed directly below the existing columns, and grout packed between the concrete and the steel beams. All of the crane bay columns located on column lines J and K would be strengthened by adding concrete to the outside face of the columns. Shear walls to brace eight large columns between the first and second floors would also be provided.

- Building 9204-2E: The metal roof deck needs to be tack welded to existing purlins, and additional roof scuppers added.

- Building Complex 9212/9995: Modifications would be made to numerous columns, knee braces, and cross braces to provide proper stiffness and load distribution. Building 9995 in this Complex is structurally unique, and the structural frame needs to be strengthened with additional vertical braces; struts need to be welded to the roof beams and then bolted to the walls to provide out-of-plane support.

- Building Complex 9215/9998: Roof bracing would be added to the penthouse and columns and beams strengthened by adding steel plates to them. Also, the roof deck would be tack welded to existing purlins, and additional corners and scuppers provided.

Figure 2.3.1–9 shows existing buildings at Y–12 that are proposed to be converted to long-term storage space for HEU.[15]

The material arriving at Y–12 (pursuant to the Y–12 EA) includes both surplus and nonsurplus HEU. Under the Upgrade Alternative, nonsurplus HEU would be retained in long-term storage. Surplus HEU would remain in interim storage at Y–12 until removed for disposition, as addressed in the HEU Final EIS. As the surplus HEU material is dispositioned over time, the total amount remaining in interim storage at Y–12 would decrease. As a result, environmental impacts associated with storing HEU materials at ORR would decrease as well.

Savannah River Site

Under the Upgrade With All or Some RFETS Pu and LANL Pu Material Subalternative, SRS would expand the APSF, which will be located north of the 235-F Building and east of the 247-F Building in F-Area as shown in Figure 2.3–6. The APSF will be a new building planned for completion by 2001. Thus, the Draft PEIS described this Upgrade Alternative as "construct a new long-term storage facility." DOE decided to construct the APSF in the ROD associated with the *Interim Management of Nuclear Materials Final Environmental Impact Statement* (DOE/EIS-0220). Therefore, the Upgrade Alternative is more correctly described in this Final PEIS as an expansion of the APSF. The expansion would provide up to approximately 4,100 additional long-term storage

[15] The Department is pursuing the Stockpile Management Restructuring Initiative, which includes, among other things, the preparation of a Conceptual Design Report for these structural modifications. Approval of the Conceptual Design Report would result in budget funding request(s) for line item project(s) for some or all the structural upgrades described above.

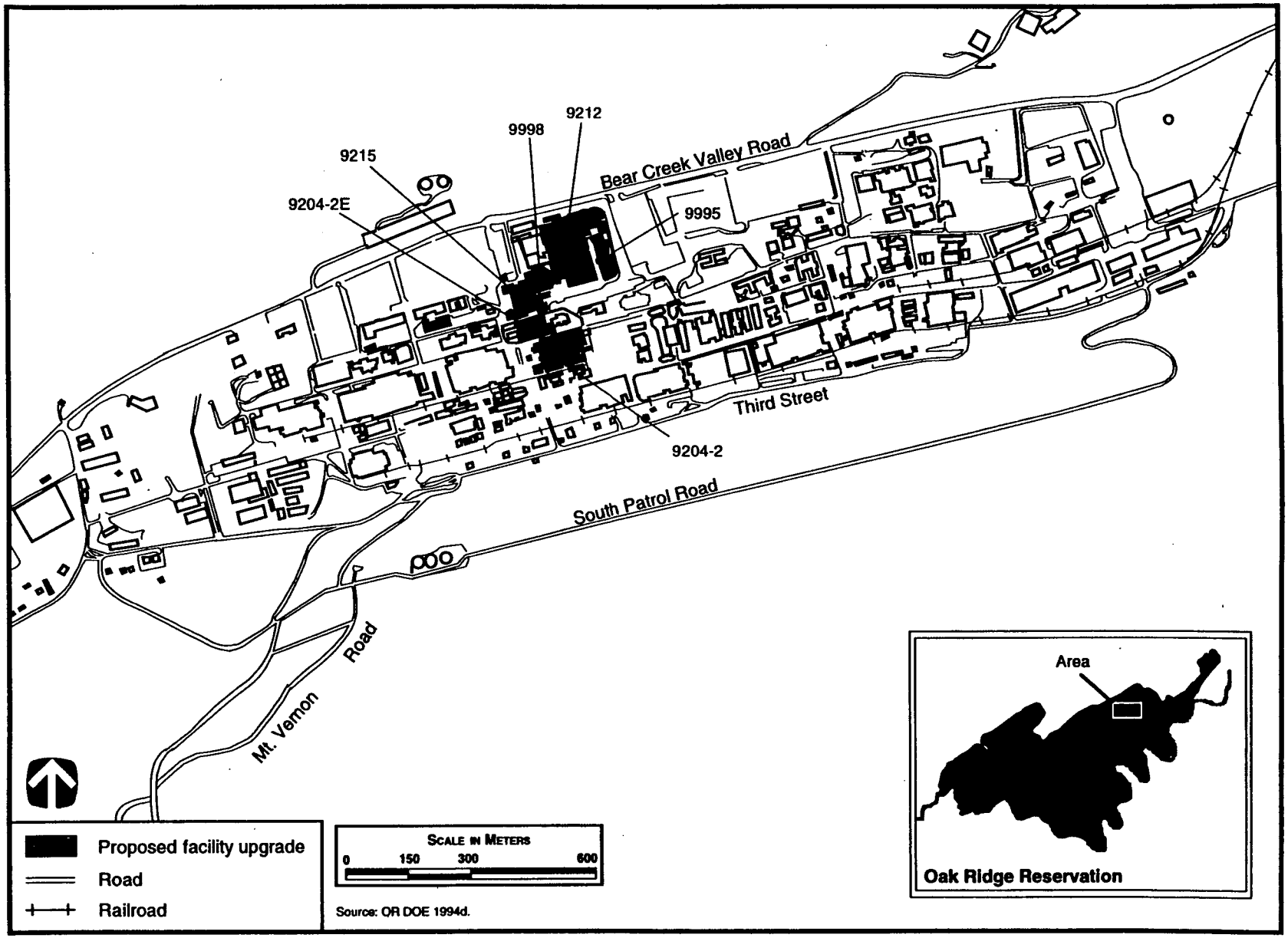


Figure 2.3.1–9. Proposed Highly Enriched Uranium Storage Upgrade at Oak Ridge Reservation, Y–12 Plant (Plan View).

positions for Pu material potentially relocated from RFETS and LANL. Figure 2.3.1–10 shows the plan view of the proposed location for the APSF expansion in relation to the surrounding buildings at the F-Area. The expansion site covers approximately 1,100 m^2 (11,900 ft^2), and would be protected by an appropriate security system with an entrance control facility and a central alarm station. The MAA portion of the Pu storage facility expansion would be a reinforced concrete structure. The staging operation would include confirmation measurement, packaging/unpackaging, abnormal package handling, and accountability measurement. Area would also be provided for safety evaluation systems and IAEA inspection. The operational flow diagram is shown in Figure 2.3.1–11.

Preferred Alternative: Upgrade with RFETS Non-Pit Pu Material Subalternative. The Preferred Alternative, a subalternative of the Upgrade Alternative, would involve a similar but smaller expansion of the APSF. The facility construction and operational data used for this subalternative is based on an APSF expansion sized to accommodate approximately 3,000 storage positions for the non-pit Pu to be relocated from RFETS.

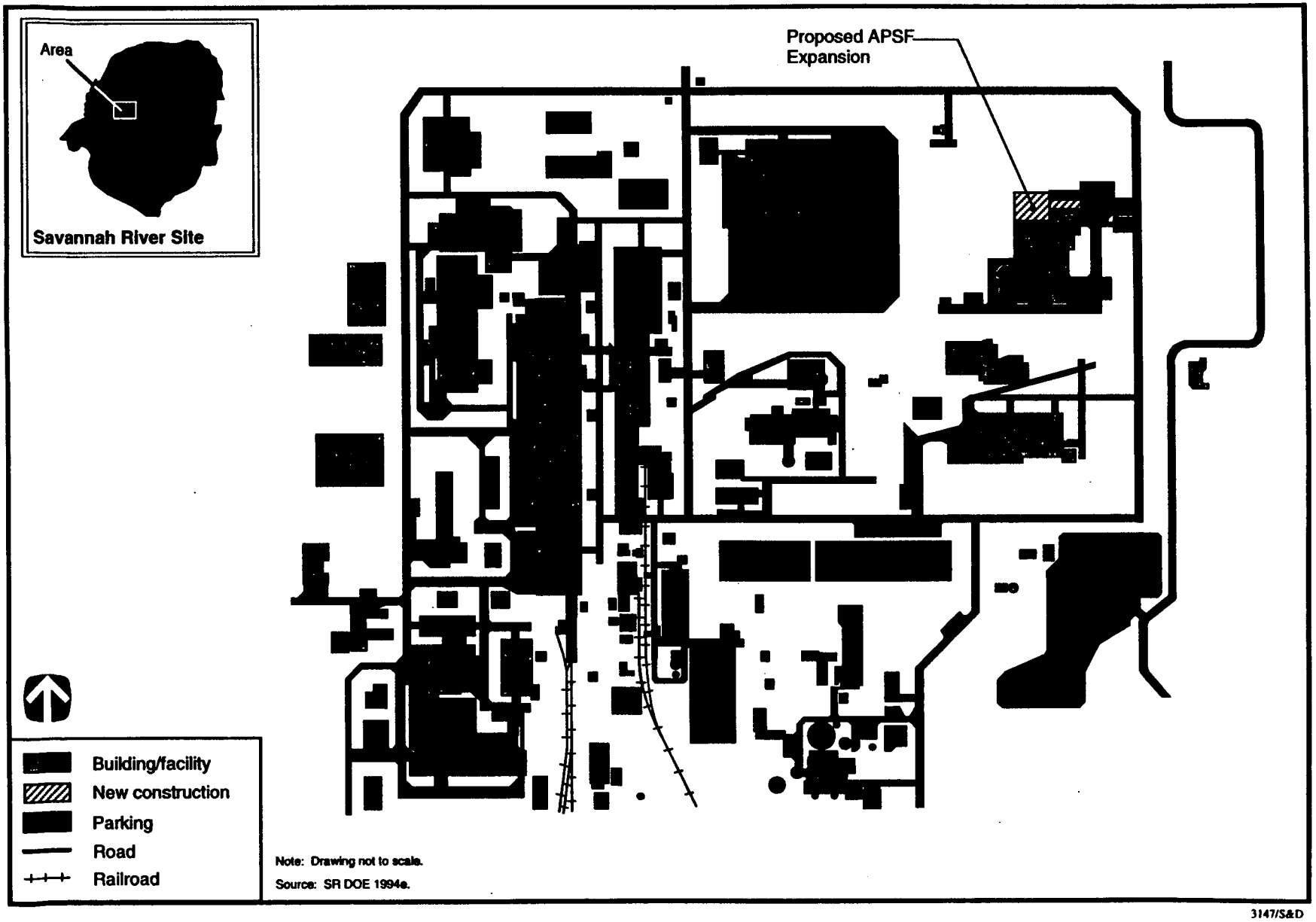


Figure 2.3.1–10. Proposed Plutonium Storage Upgrade at Savannah River Site F-Area (Plan View).

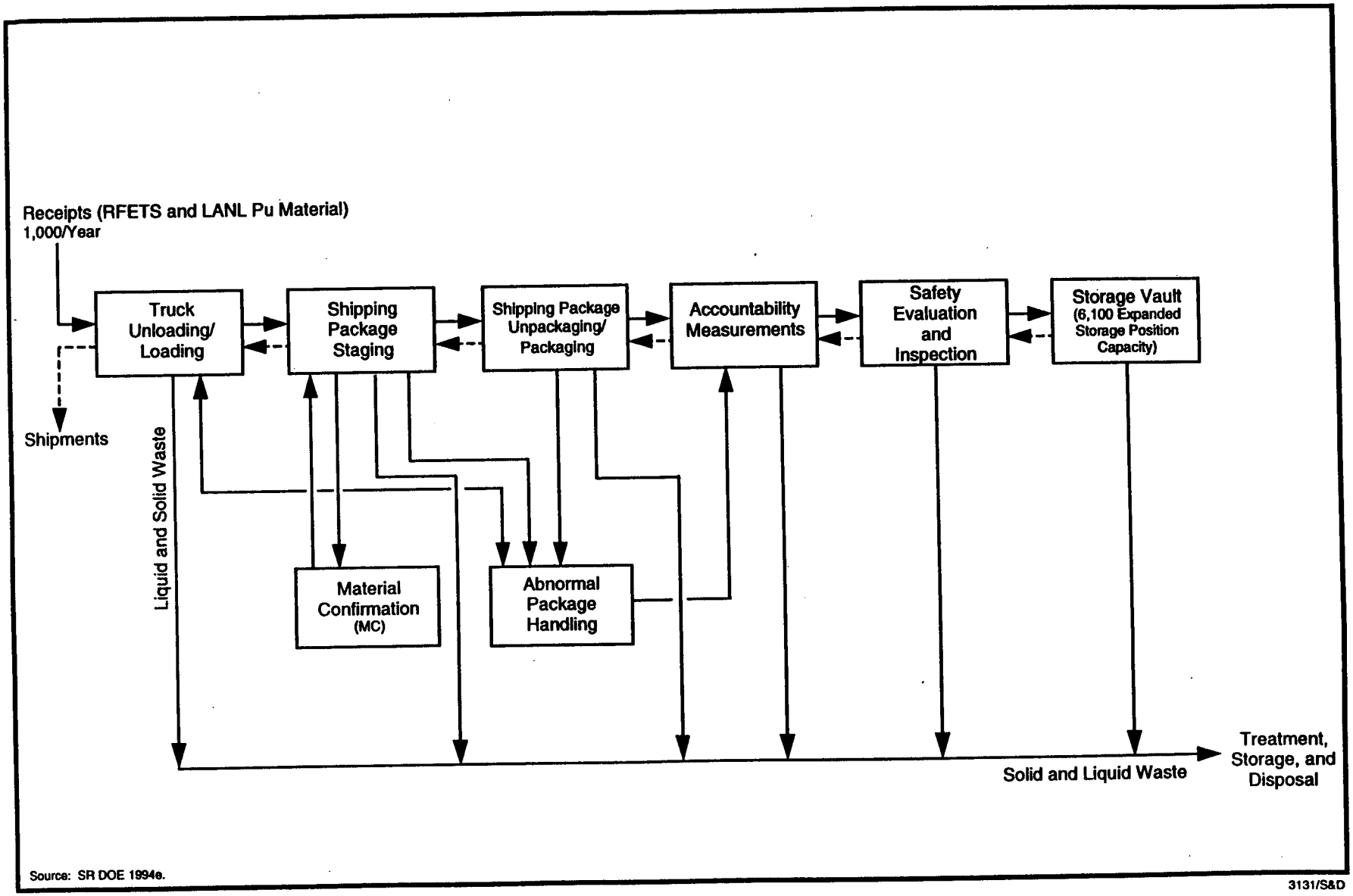


Figure 2.3.1–11. Operational Flow Diagram for the Upgrade Alternative at Savannah River Site F-Area.

2.3.2 CONSOLIDATION OF PLUTONIUM ALTERNATIVE

2.3.2.1 Common Activities and Facility Requirements

If a new consolidated Pu storage facility were chosen to store the entire DOE inventory of Pu within the scope of this PEIS, surplus and nonsurplus Pu would be removed from existing storage facilities and relocated to the new facility at one of six candidate DOE sites.

The consolidated Pu storage facility would provide safe, secure, long-term storage of DOE surplus and nonsurplus Pu materials. These materials would be either in the form of pits (from disassembled nuclear weapons) or nonweapon forms such as metals or oxides. The stand-alone facility would perform a number of major functions to accomplish the storage mission, including the following:

- Material handling operations consisting of shipping/receiving, truck unloading/loading, cargo restraint transporter handling, unpackaging/packaging, material confirmation, staging of nuclear materials, material control and accountability (MC&A) verification, stabilization, and repackaging of Primary Containment Vessel (PCV) contents
- Material storage operations consisting of long-term storage of Pu materials in a safe, secure vault, material long-term safety evaluations, and international inspection of surplus material
- Analytical laboratory operations to support long-term storage of Pu materials
- Waste management operations, as required, to prepare wastes generated at the storage facility for shipment to disposal facilities
- Storage support functions necessary to meet DOE requirements for ES&H, waste management, maintenance, and safeguards and security

The consolidated Pu storage facility would also satisfy a variety of functional and administrative requirements:

- The consolidated Pu storage facility would have a design life of 50 years.
- Shipping sites would be responsible for initially meeting all long-term storage acceptance criteria, including processing, packaging, and certification before shipment. Materials received at the consolidated Pu storage facility would not require reprocessing, repackaging, or recertification before transfer to long-term storage vaults unless an abnormal condition is detected.
- The consolidated Pu storage facility would have the capability to offer surplus materials for international inspection. Inspection of nonsurplus materials would not be provided.
- The total capacity of the consolidated Pu storage facility would be 40,000 positions. [Text deleted.] Of the 40,000 positions, 35,000 would be allocated to surplus material, and 5,000 to nonsurplus materials.
- The maximum receipt rate would be 6,000 shipping packages per year, ranging from 6,000 pits to 5,000 pits plus 1,000 non-pits. The consolidated Pu storage facility would have the capability to simultaneously ship and receive PCVs and shipping packages.
- Storage capacity of the consolidated Pu storage facility would be expanded incrementally. The minimum capacity required upon initial operation would be 15,000 positions for surplus material and 5,000 positions for nonsurplus materials.

- The consolidated Pu storage facility would include the minimum capabilities necessary for onsite stabilization and repackaging of PCVs damaged in storage during the life of the facility. The consolidated storage facility would be able to package damaged pit PCVs to the Department of Transportation (DOT) requirements for shipment. It would also have the capability to repackage the contents of damaged PCVs into new PCVs. The consolidated Pu storage facility would not rely on existing Nuclear Weapons Complex Pu processing capabilities for the stabilization and packaging of metals and oxides from damaged PCVs. The stabilization and packaging of metals and oxides from damaged PCVs would generate TRU, low-level, mixed TRU, mixed low-level, hazardous, and nonhazardous wastes as outlined in Appendix E

- LLW would be immobilized and disposed of at an existing, onsite LLW facility or shipped offsite to a DOE-approved LLW disposal facility, depending on each site-specific practice and on decisions made pursuant to the Waste Management PEIS and any site-specific NEPA documents

- TRU waste and mixed TRU waste would be treated, packaged, and shipped offsite for disposal depending on decisions pursuant to the WIPP PEIS and the Waste Management PEIS

- Mixed LLW would be treated and disposed of offsite in accordance with site-specific treatment plans that were developed pursuant to the *Federal Facility Compliance Act* of 1992 in coordination with the EPA and State regulatory agencies and in accordance with decisions pursuant to the Waste Management PEIS

- Hazardous waste would be treated and disposed of through the use of *Resource Conservation and Recovery Act* (RCRA)-permitted facilities in accordance with site-specific practice. Temporary storage for up to 90 days would be provided as part of the facility design

- Sanitary solid and industrial solid wastes would be either disposed of at an existing, onsite, sanitary waste landfill or shipped to an offsite landfill, depending on each site-specific practice

To accomplish its mission, the consolidated Pu storage facility would require a main storage building and service support buildings and functional areas to support the storage function. The consolidated Pu storage facility would share security force, fire department, domestic water treatment, wastewater treatment, and utility distribution system services with other facilities onsite, as appropriate.

The storage facility conceptual design consists of a multilevel Pu storage building that would provide all required storage and support functions. This building would have three primary functions: material storage, material handling, and support. Three secondary functions would include repackaging, analytical laboratories, and waste management. Each of these six functions would be, in turn, supported by several service facilities, including fire protection, ES&H, safeguards and security, utilities, maintenance, and waste management. The MAA would house the nonsurplus material vault, the surplus material storage vault, and areas dedicated to providing safety evaluation, international inspection, automated guided vehicle (AGV) aisles, and personnel corridors. The material handling area would contain areas for shipping/receiving, staging, packaging/unpackaging, temporary storage, processing/recanning, AGV maintenance, and various support functions required for the primary storage operations and functions within the MAA. The material handling portion of the Pu storage building would also contain the Safe Secure Trailers (SST) loading/unloading, commodity shipping/receiving, waste shipping, and electrical and equipment maintenance shops. The support area would include the main MAA portal, control rooms, change rooms, showers, waste management, offices, kitchen, and cafeteria.

There would be three general zones within the consolidated Pu storage facility: the Property Protection Area (PPA), the Limited Area (LA), and the PA. The Pu Storage Building, which would contain the stored Pu, the Pu handling function, and support function, would be located in the PA, a higher security area. The general BOP support functions would be located in the PPA. This area contains administration offices; health, safety, and

environmental support laboratories and offices; fire protection; vehicle maintenance garage; water and sewage treatment facilities; warehousing; and other service facilities. An LA encloses the security center, with chainlink fencing and a guard station for both pedestrians and vehicles.

2.3.2.2 Site-Specific Requirements

Under this alternative, all surplus and nonsurplus Pu within the scope of this PEIS would be phased out of existing storage facilities and moved to a new long-term storage facility located at a DOE site. Hanford, NTS, INEL, Pantex, and SRS are candidate sites for the consolidated Pu storage facility. ORR is also a candidate site for the consolidated Pu storage facility. However, if Pu were consolidated at ORR, the presence of the HEU material already residing at Y–12 would create an HEU collocation condition. Since this alternative makes no provision to move the HEU material out of ORR, the Consolidation of Pu Alternative at ORR is described with the Collocation of Pu and HEU Alternative presented in Section 2.3.3.

Figure 2.3.2.2–1 shows the plan view of the conceptual design and layout for the new consolidated Pu facility. This layout is nearly identical for each candidate site. Slight variations are attributable to the BOP support buildings required at each site. The operational flow diagram is shown in Figure 2.3.2.2–2. A summary of the long-term storage options by candidate site is presented in Table 2.3.2.2–1.

Table 2.3.2.2–1. Long-Term Storage Options for the Consolidation of Plutonium Alternative

Candidate Site[a]	Storage Option
Hanford	Construct New Pu Storage Facility
NTS	Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel, or
	Construct New Pu Storage Facility
INEL	Construct New Pu Storage Facility
Pantex	Construct New and Modify Existing Zone 12 South Facilities, or
	Construct New Pu Storage Facility
	[Text deleted.]
SRS	Construct New Pu Storage Facility

[a] Consolidation of Pu at ORR results in a HEU collocation condition. This is described with other HEU collocation subalternatives presented in Section 2.3.3.

Note: NA=not applicable.

At NTS, two options could be pursued. The first option is to modify and make use of the P-Tunnel. Figure 2.3.2.2–3 and Figure 2.3.2.2–4 show the plan views of the proposed locations and modifications at P-Tunnel and Area 12, respectively, for the storage vault and BOP support buildings that combine to form this consolidation alternative. Modified existing tunnel drifts could be used for storing surplus and nonsurplus Pu materials. The second option would be to construct a new consolidated Pu storage facility near the Device Assembly Facility (DAF) in Area 6.

At Pantex, two options could also be pursued. The first option uses modified existing facilities for nonsurplus materials in combination with a new vault to be built for surplus materials, all in Zone 12 South. Figure 2.3.2.2–5 shows the plan view of the proposed location in Zone 12 South for the new surplus Pu storage building, and Figure 2.3.2.2–6 shows the proposed modification in Zone 12 South for the existing building to be used for nonsurplus storage. Construction and modification of these buildings combine to form this Consolidation Alternative. The overall operational flow diagram for this option is shown in Figure 2.3.2.2–7. The second option would be to construct a new consolidated Pu Storage facility in Zone 12.

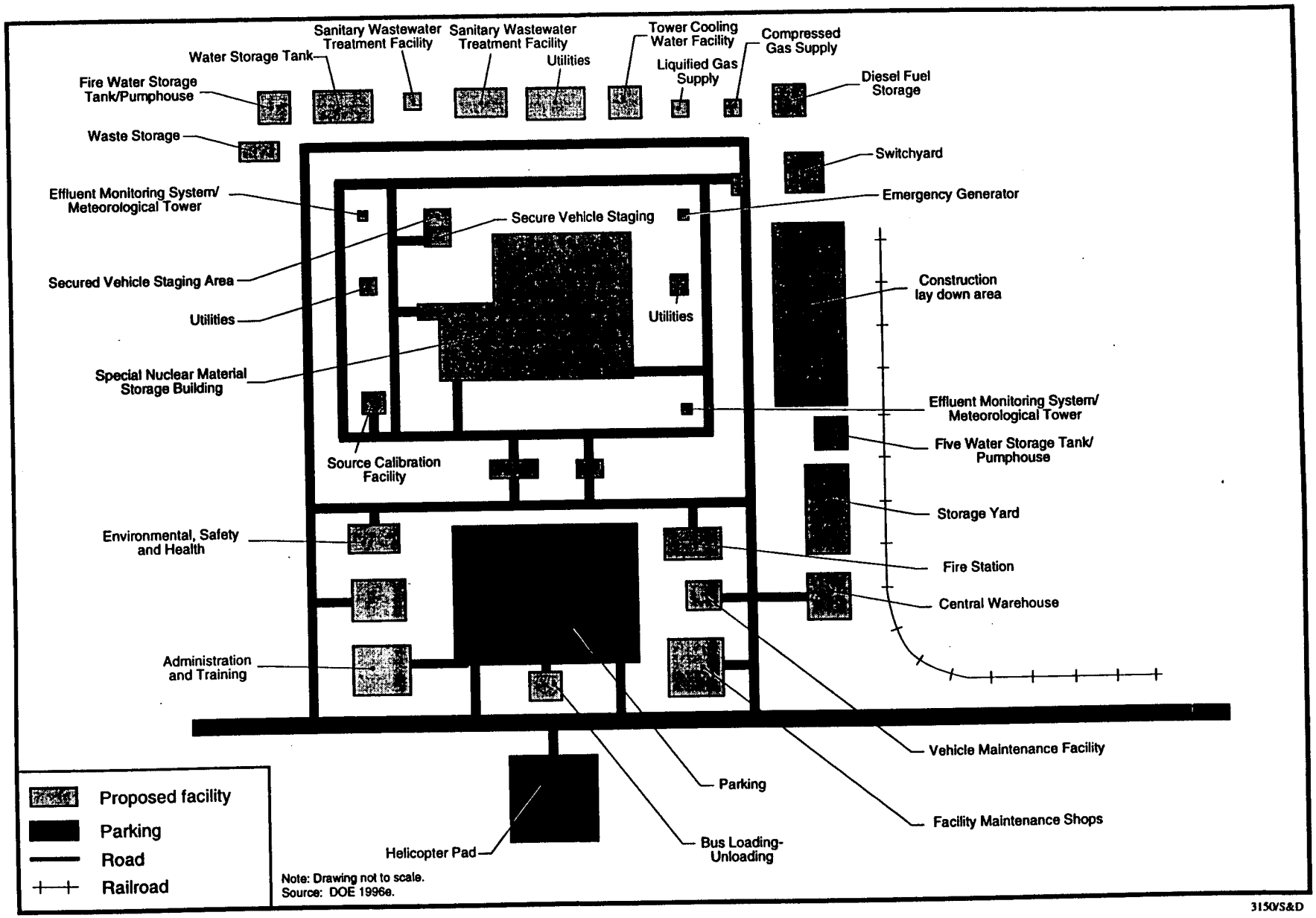


Figure 2.3.2.2–1. Conceptual Consolidated Plutonium Storage Facility (Plan View).

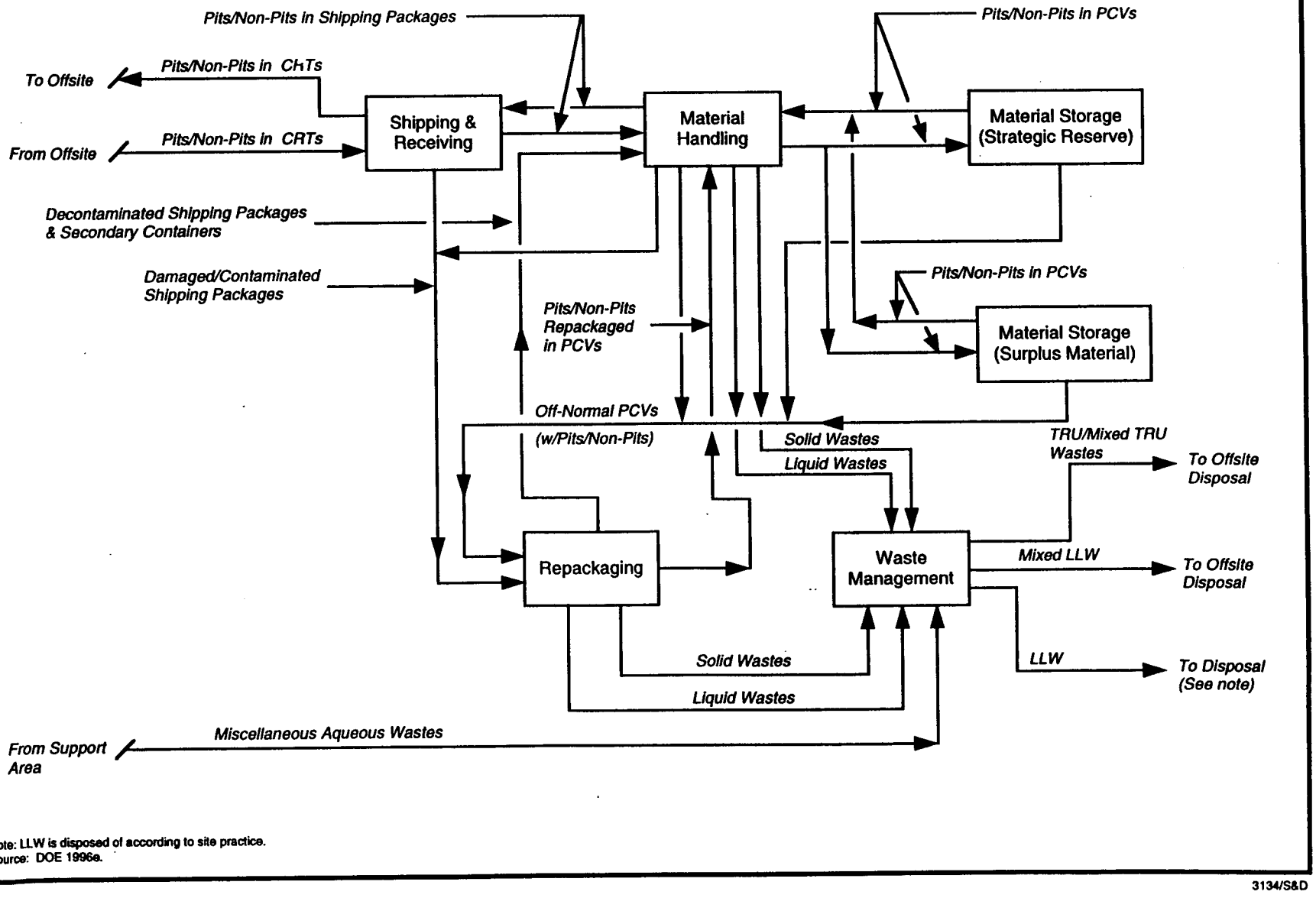


Figure 2.3.2.2–2. Operational Flow Diagram for the Consolidation Alternative.

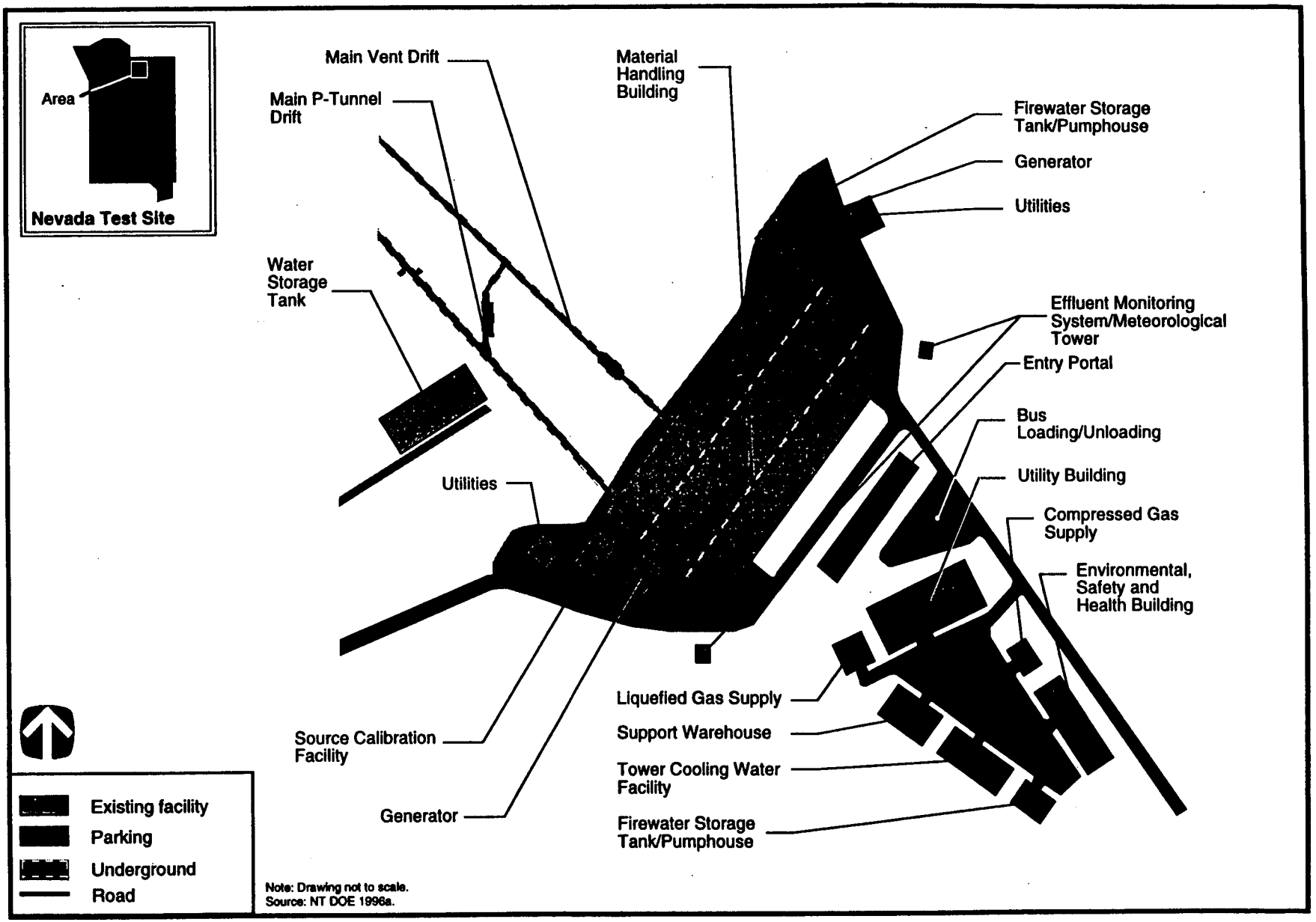


Figure 2.3.2.2–3. P-Tunnel Modifications for the Consolidated Plutonium Storage Facility at Nevada Test Site (Plan View).

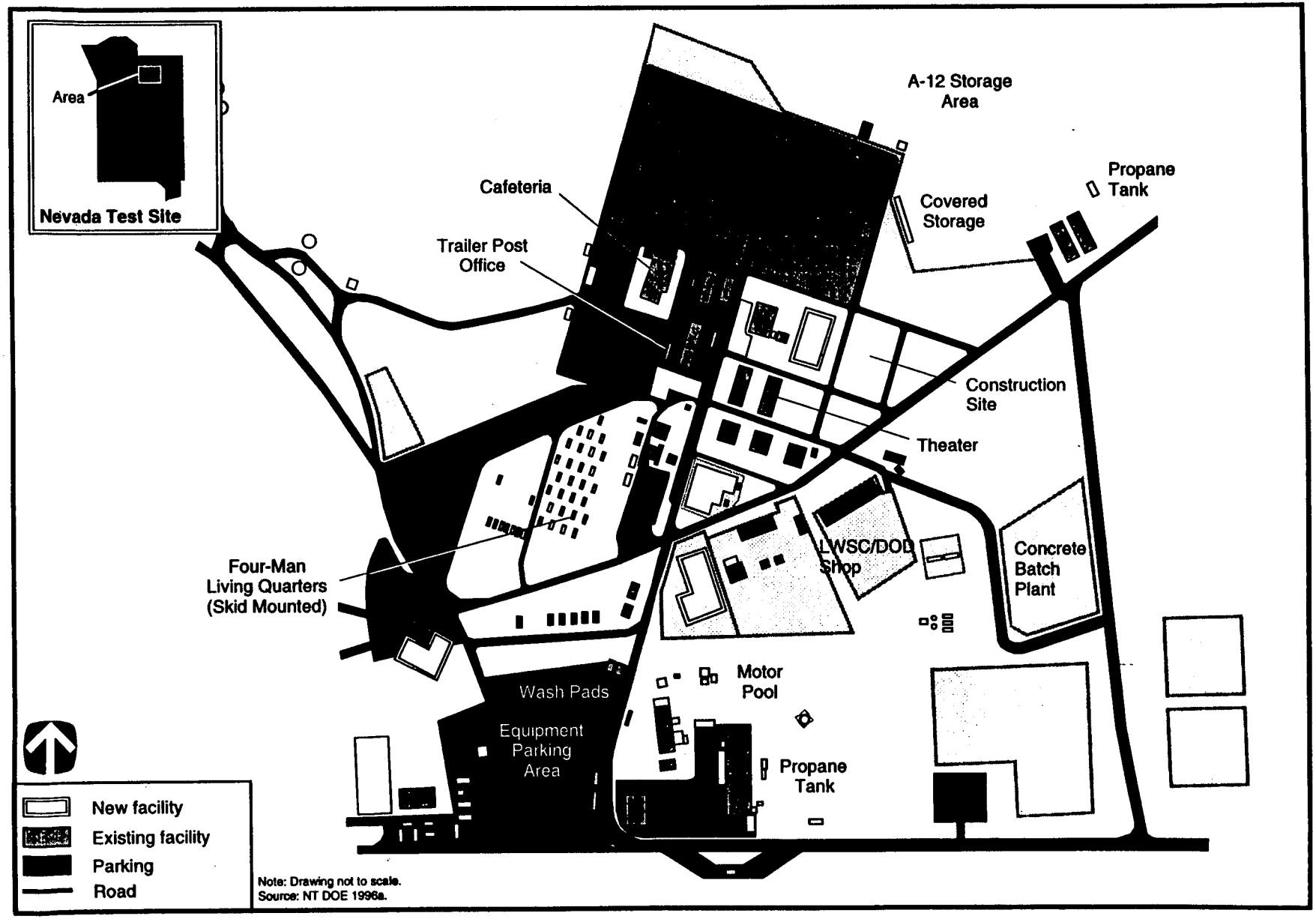


Figure 2.3.2.2–4. Proposed Area 12 Modifications for the Consolidated Plutonium Storage Facility at Nevada Test Site (Plan View).

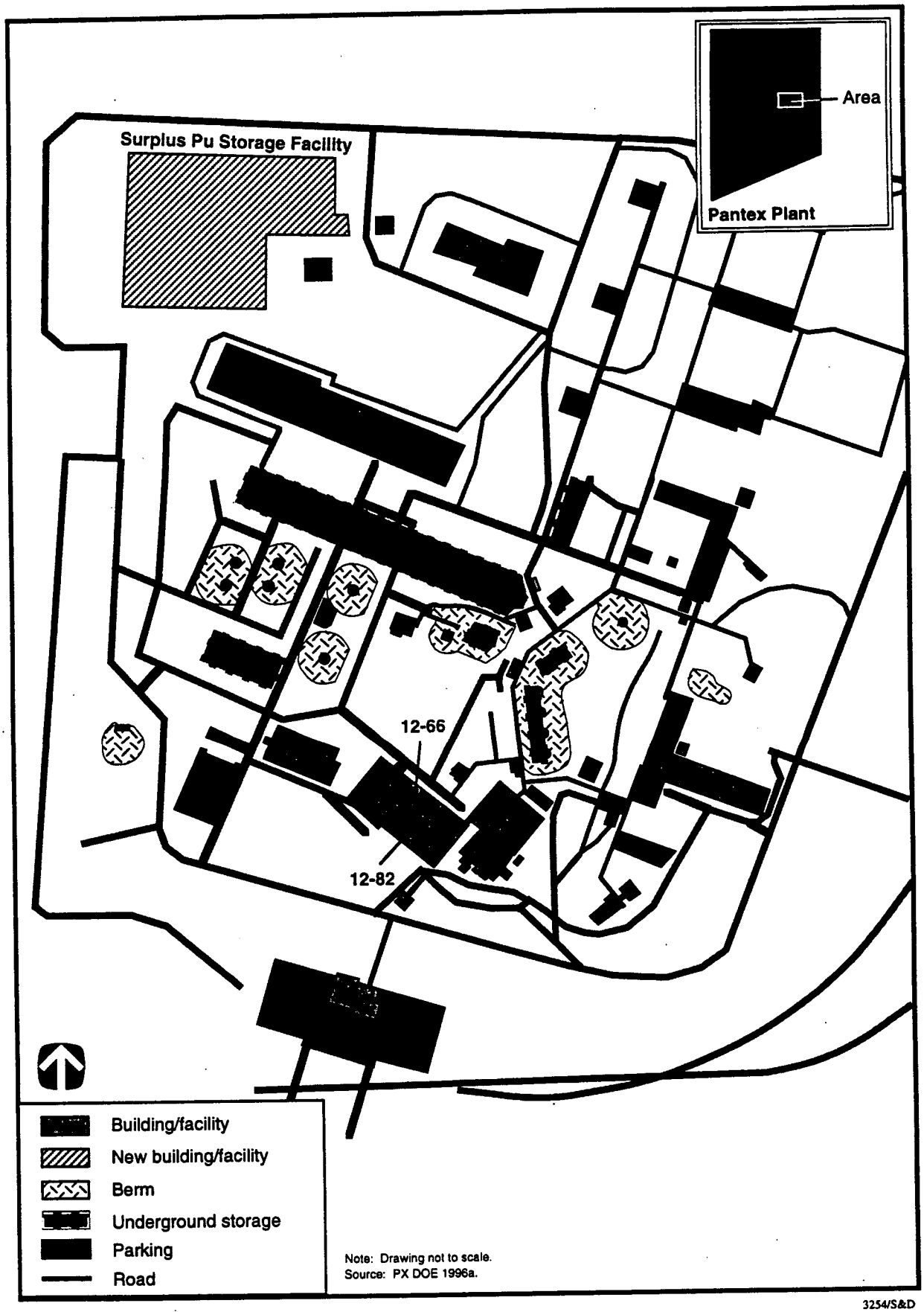


Figure 2.3.2.2–5. Proposed Zone 12 South New Facility for the Consolidated Plutonium Storage Facility at Pantex Plant (Plan View).

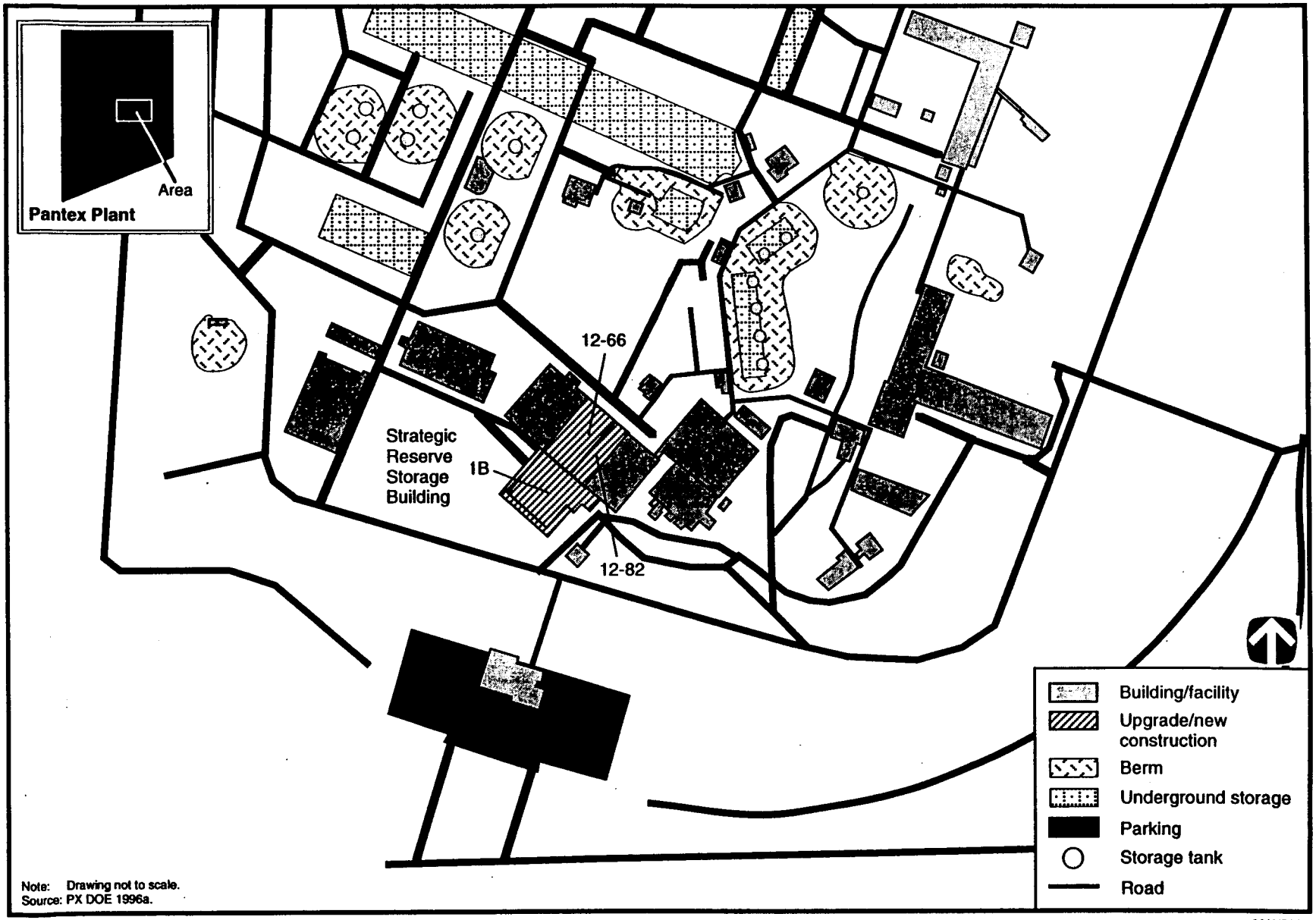


Figure 2.3.2.2–6. Proposed Zone 12 South Modifications for the Consolidated Plutonium Storage Facility at Pantex Plant (Plan View).

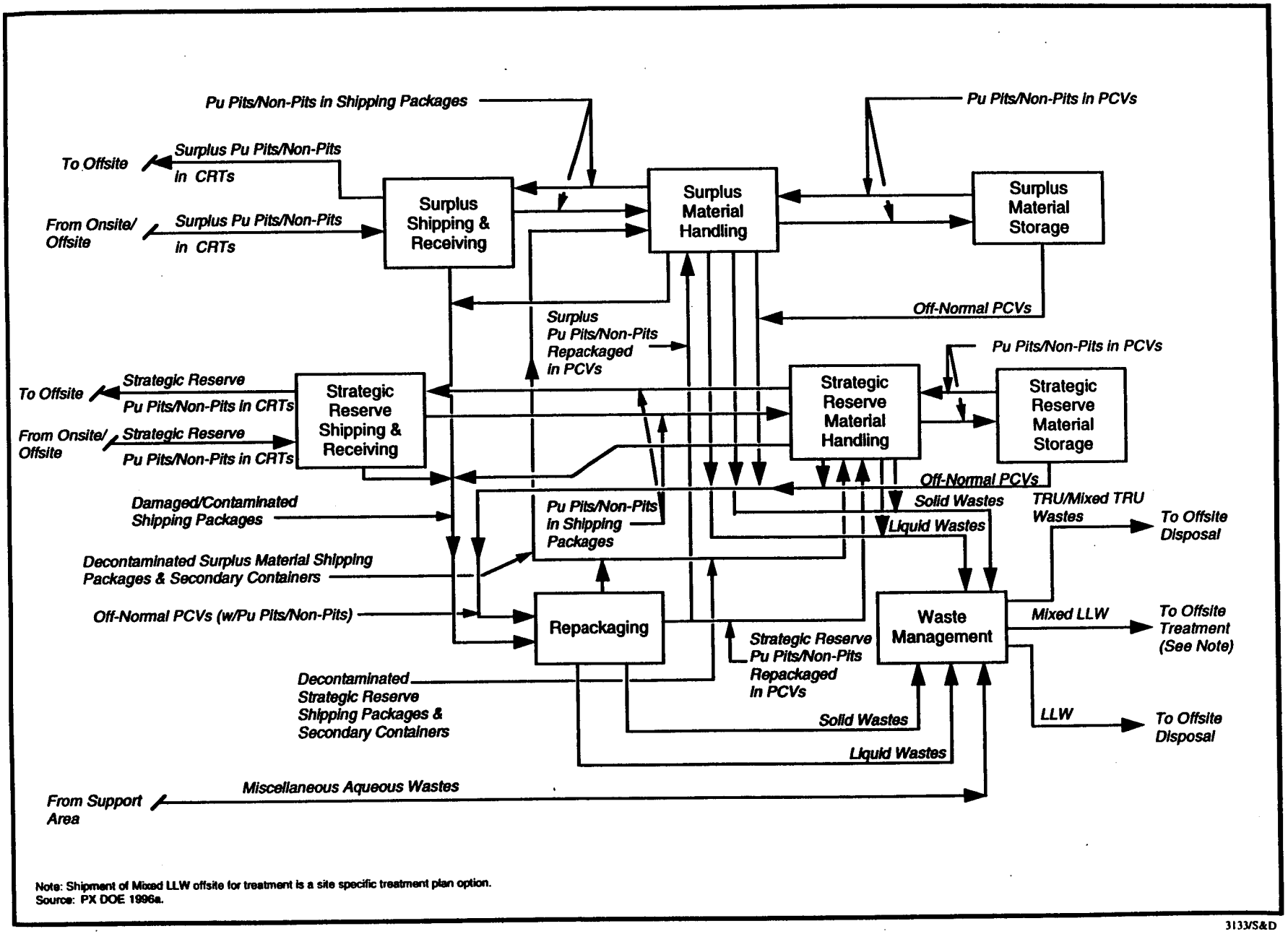


Figure 2.3.2.2–7. Operational Flow Diagram for the Consolidation Alternative Modifying Existing Buildings and Constructing a New Facility in Zone 12 South at Pantex Plant.

In addition to the environmental analysis for the long-term storage of all weapons-usable fissile materials within the scope of this PEIS at a consolidated Pu storage facility, an analysis of consolidated Pu storage without those nonsurplus materials covered under the Stockpile Stewardship and Management Final PEIS (strategic reserves and weapons R&D materials) is also presented as a subalternative to this alternative. Location options for all sites for the consolidation of Pu are also shown in Figures 2.3–1 through 2.3–6.

Construction and operations data for the consolidated Pu storage facility at Hanford, NTS, INEL, Pantex, ORR, and SRS are listed in Appendices B, C, D, E, and F.

2.3.3 COLLOCATION OF PLUTONIUM AND HIGHLY ENRICHED URANIUM ALTERNATIVE

2.3.3.1 Common Activities and Facility Requirements

If new consolidated Pu and new collocated HEU storage facilities are chosen to store the entire DOE inventory of Pu and nonsurplus HEU within the scope of this PEIS, all Pu and nonsurplus HEU would be removed from existing storage facilities and relocated to the new consolidated Pu and collocated HEU storage facilities at one of the six candidate sites. Surplus HEU would continue to be stored at Y–12. It is assumed that most surplus HEU from other sites in the DOE complex would already have been relocated to Y–12. Missions and functions resulting from construction and operation of a new collocated HEU storage facility are presented below.

The stand-alone facility would perform a number of major functions to accomplish the HEU storage mission in addition to those presented earlier for Pu storage in Section 2.3.2.1. These include the following:

- Material handling functions consisting of shipping/receiving, unpackaging/packaging, material confirmation, and preparation of nonsurplus HEU materials for long-term storage
- Material storage functions consisting of long-term storage of HEU materials in a safe, secure vault; material inventory evaluations; and MC&A verifications
- Storage support functions required to meet DOE requirements for ES&H, waste management, maintenance, safeguards and security, and BOP services

In order to fulfill its prescribed mission, the collocated HEU storage facility would also satisfy a variety of functional and administrative requirements:

- The collocated HEU storage facility would store HEU materials. HEU metal castings or loose HEU oxide powder would be contained in cans. Assembled components containing HEU would be contained in drums. There would be no uranium liquids or gases and no irradiated materials stored at the facility.
- The collocated HEU storage facility would have a design life of 50 years.
- The total capacity of the collocated HEU storage facility would be 6,000 positions for HEU cans and 8,500 positions for HEU drums. The number of cans and drums that would be placed in a single storage position would vary depending on the contents of individual cans and drums.
- The maximum receipt rate would be 2,900 shipping packages per year, ranging from 2,900 HEU cans to 2,900 HEU drums, or any mixture thereof. The facility would have the capability to prepare and ship packages.
- The collocated HEU storage facility would include capabilities necessary for repackaging and waste management.

To accommodate its mission, the collocated HEU storage facility would include a main storage building and all of the service support buildings and functional areas that support the storage function. These facilities are in addition to the consolidated Pu storage facility. The collocated HEU storage facility would share security force, fire department, domestic water treatment, sewage treatment, and utility distribution system services with other onsite facilities, as appropriate.

There would be three zones within the combined Pu and HEU storage facility: the PPA, the LA, and the PA. The consolidated Pu storage facility, the collocated HEU storage facility, and the material handling and storage support functions would be located in the PA, a higher security area. The general BOP support functions of the collocated HEU storage facility are shared and located in the PPA.

2.3.3.2 Site-Specific Requirements

Under this alternative, all nonsurplus HEU within the scope of this PEIS would be located on the same DOE site as the consolidated Pu storage facility described in Section 2.3.2. Hanford, NTS, INEL, Pantex, ORR, and SRS are candidate sites for the Collocation of Pu and HEU Alternative. Figure 2.3.3.2–1 shows the plan view of the conceptual design and layout for the new collocated Pu and HEU facilities. This layout is nearly identical for each candidate site. Slight variations are attributable to the BOP support buildings required at each site. The operational flow diagram is shown in Figure 2.3.3.2–2. A summary of these long-term storage options by candidate site is presented in Table 2.3.3.2–1.

Table 2.3.3.2–1. Long-Term Storage Options for the Collocation of Plutonium and Highly Enriched Uranium Alternative

Candidate Site	Storage Option
Hanford	Construct New Pu and HEU Storage Facilities
NTS	Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel, or
	Construct New Pu and HEU Storage Facilities
INEL	Construct New Pu and HEU Storage Facilities
Pantex	Construct New Pu and HEU Storage Facilities
ORR	Construct New Pu Storage Facility; Maintain Existing (No Action) HEU Storage Facilities at Y–12 Plant, or
	Construct New Pu Storage Facility and Modify Existing (Upgrade) HEU Storage Facilities at Y–12 Plant, or
	Construct New Pu and HEU Storage Facilities
SRS	Construct New Pu and HEU Storage Facilities

At NTS, two options could be pursued. The first option would be to construct a new consolidated Pu storage facility and construct a new collocated HEU storage facility near the DAF in Area 6. The second option would be to make use of the P-Tunnel. Figures 2.3.3.2–3 and 2.3.3.2–4 show the plan view of the proposed locations and modifications at P-Tunnel and Area 12, respectively, for the storage vaults and BOP support buildings that combine to form this collocation of Pu and HEU option. Modified existing tunnel drifts could be used for storing surplus and nonsurplus Pu materials along with nonsurplus HEU materials. The operational flow diagram is shown in Figure 2.3.3.2–5.

If ORR were selected as the collocated Pu and HEU storage site, any one of three options could be pursued. These include constructing the consolidated Pu storage facility and continuing storage of HEU in existing (No Action) storage facilities at Y–12 (under the No Action Alternative, DOE would not undertake any new construction projects except those that are considered part of ongoing site operations to ensure continued safe, secure storage; however, any new facility construction deemed necessary to maintain safe, secure storage would be addressed in appropriate, individual, site-specific EISs and site development plans); constructing the

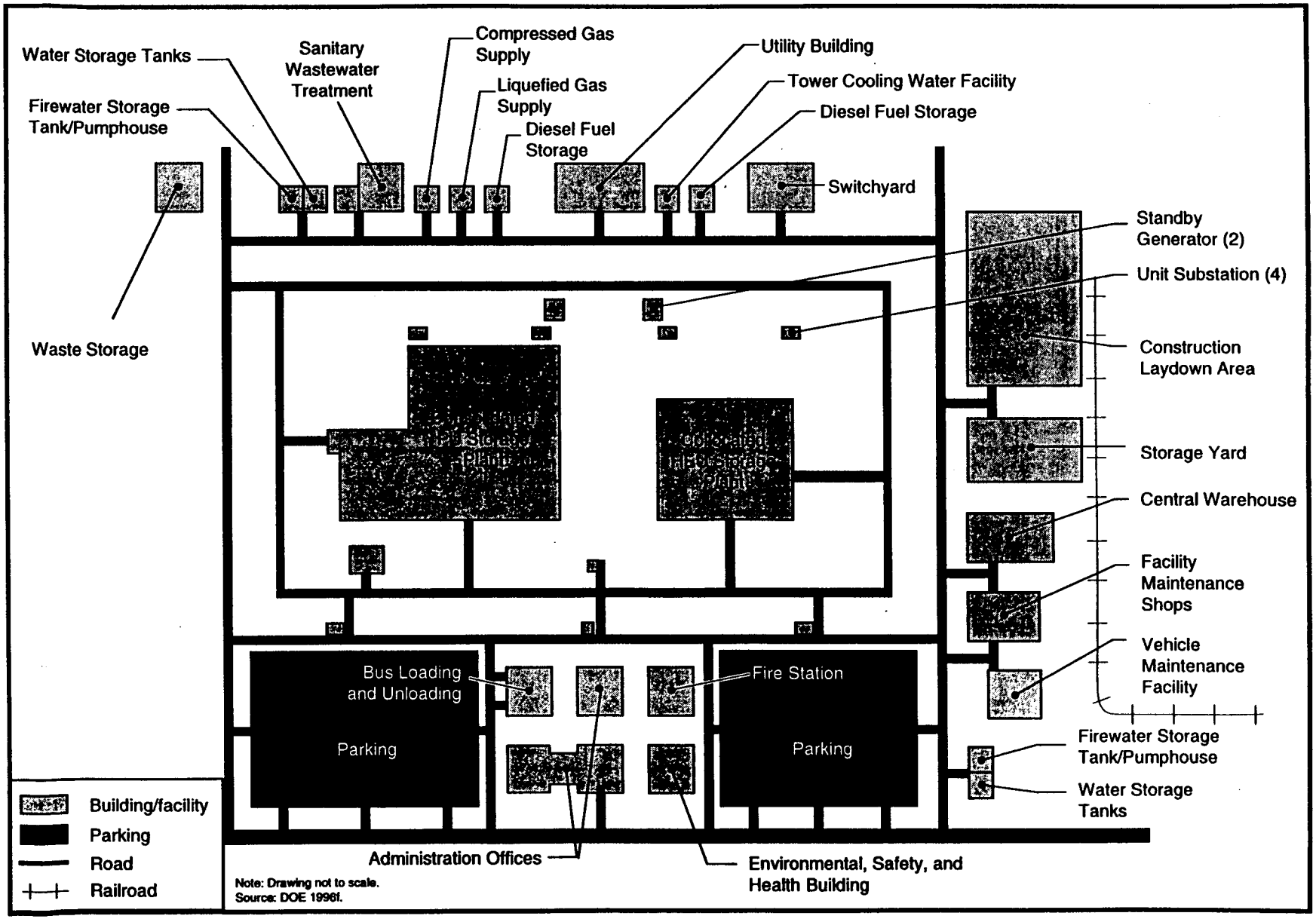


Figure 2.3.3.2–1. Conceptual Collocated Plutonium and Highly Enriched Uranium Storage Facility (Plan View).

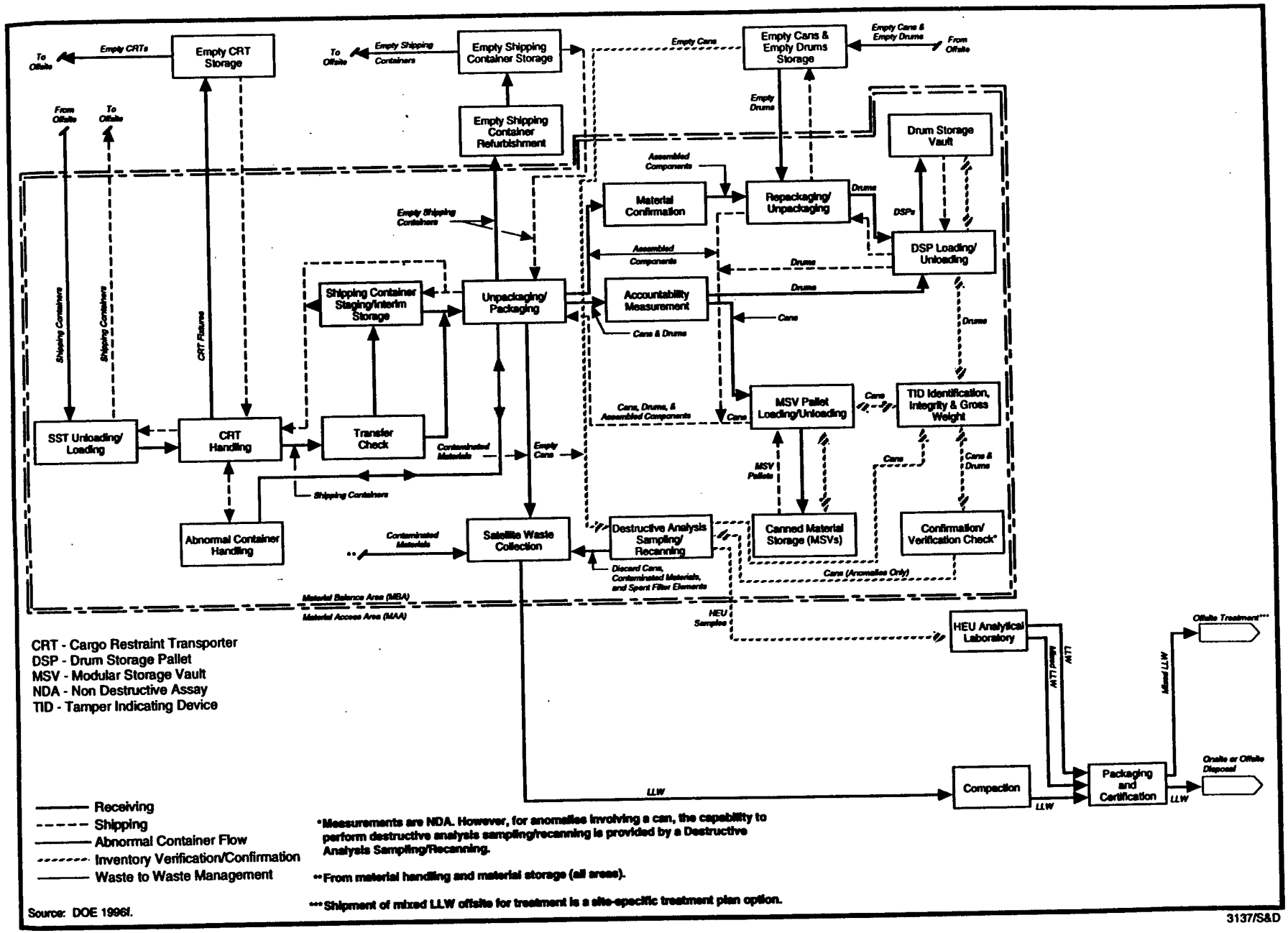


Figure 2.3.3.2–2. Operational Flow Diagram for the Collocation Alternative.

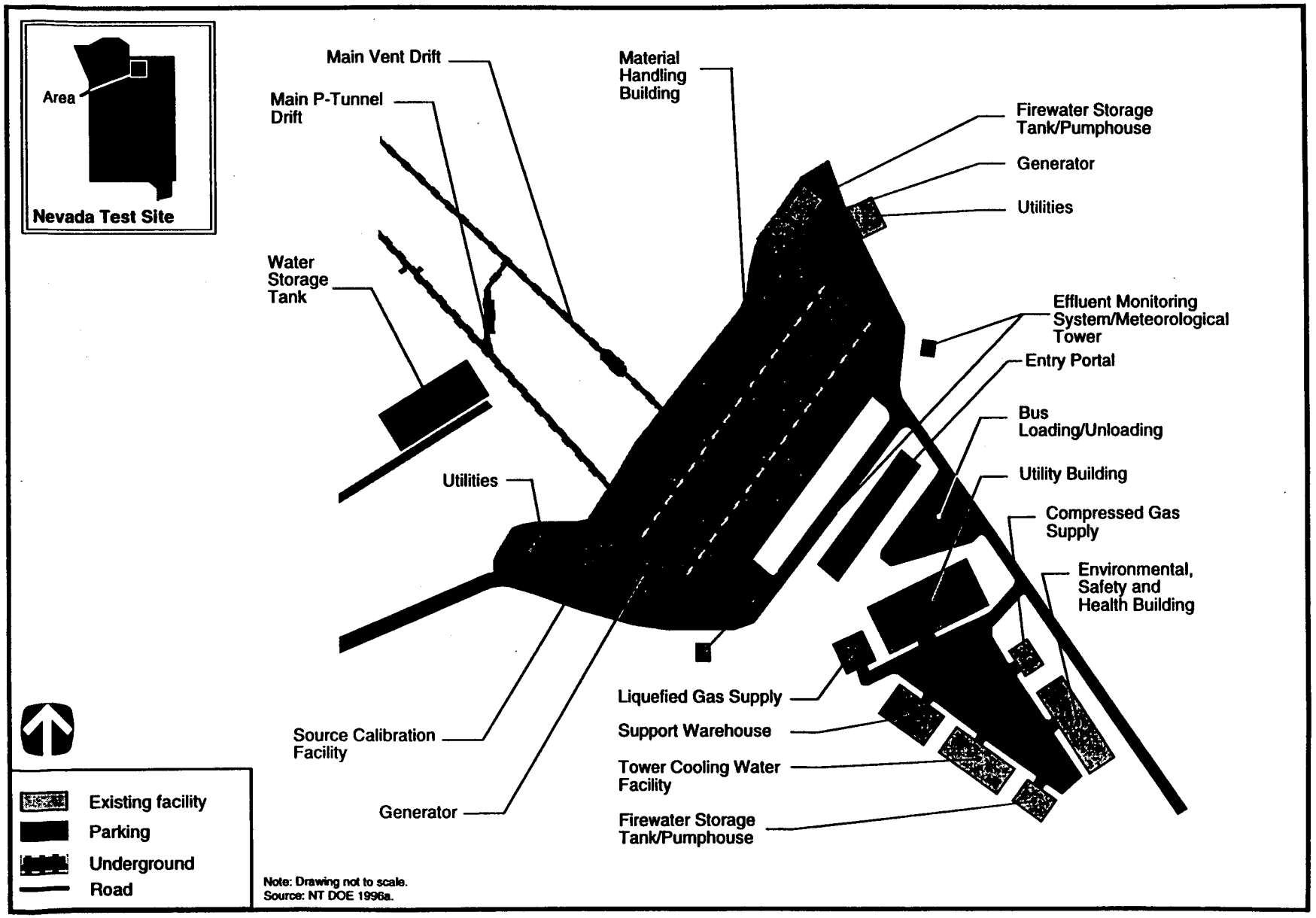


Figure 2.3.3.2–3. P-Tunnel Modifications for the Collocated Plutonium and Highly Enriched Uranium Storage Facility at Nevada Test Site (Plan View).

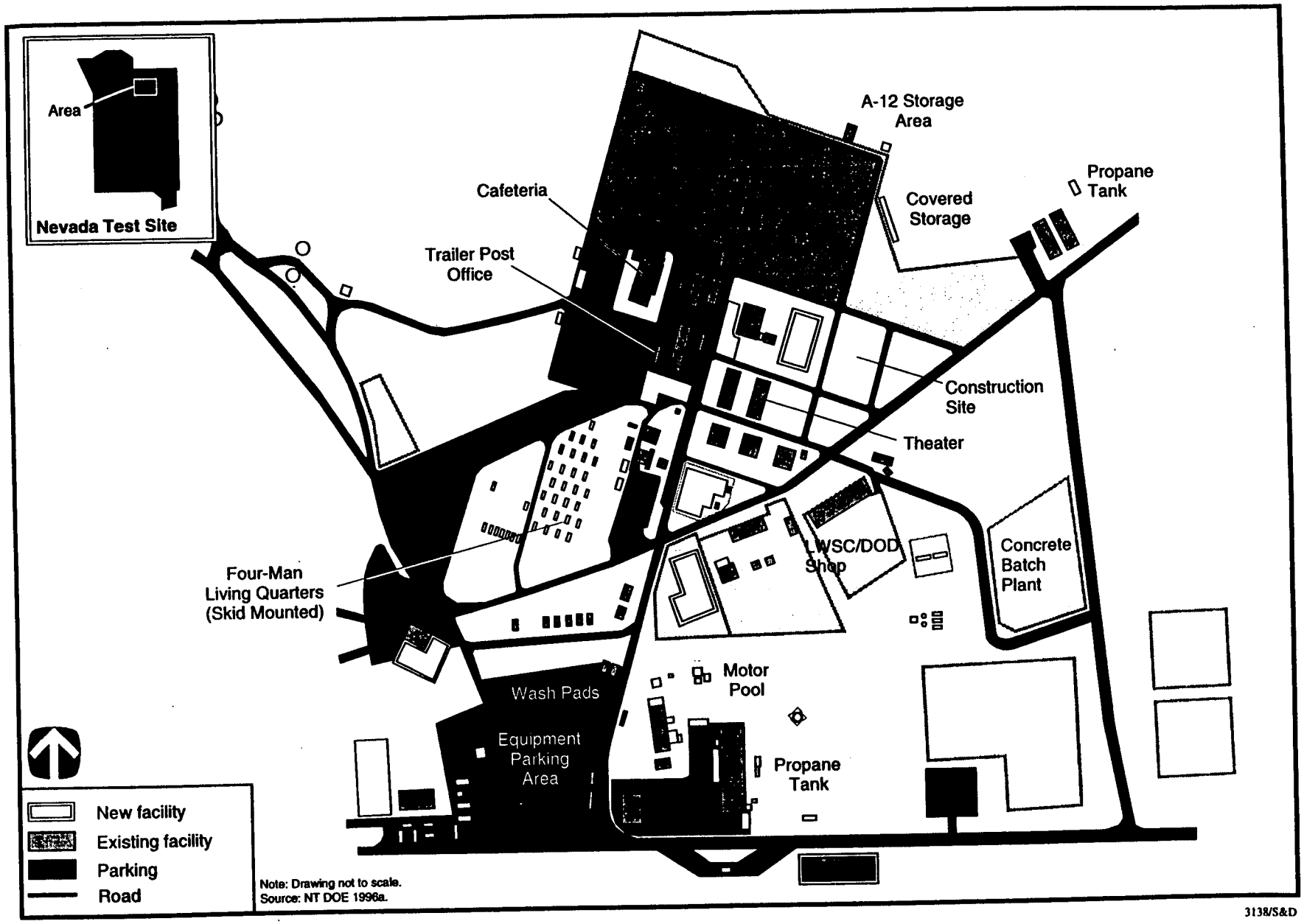


Figure 2.3.3.2–4. Proposed Area 12 Modifications for the Collocated Plutonium and Highly Enriched Uranium Storage Facility at Nevada Test Site (Plan View).

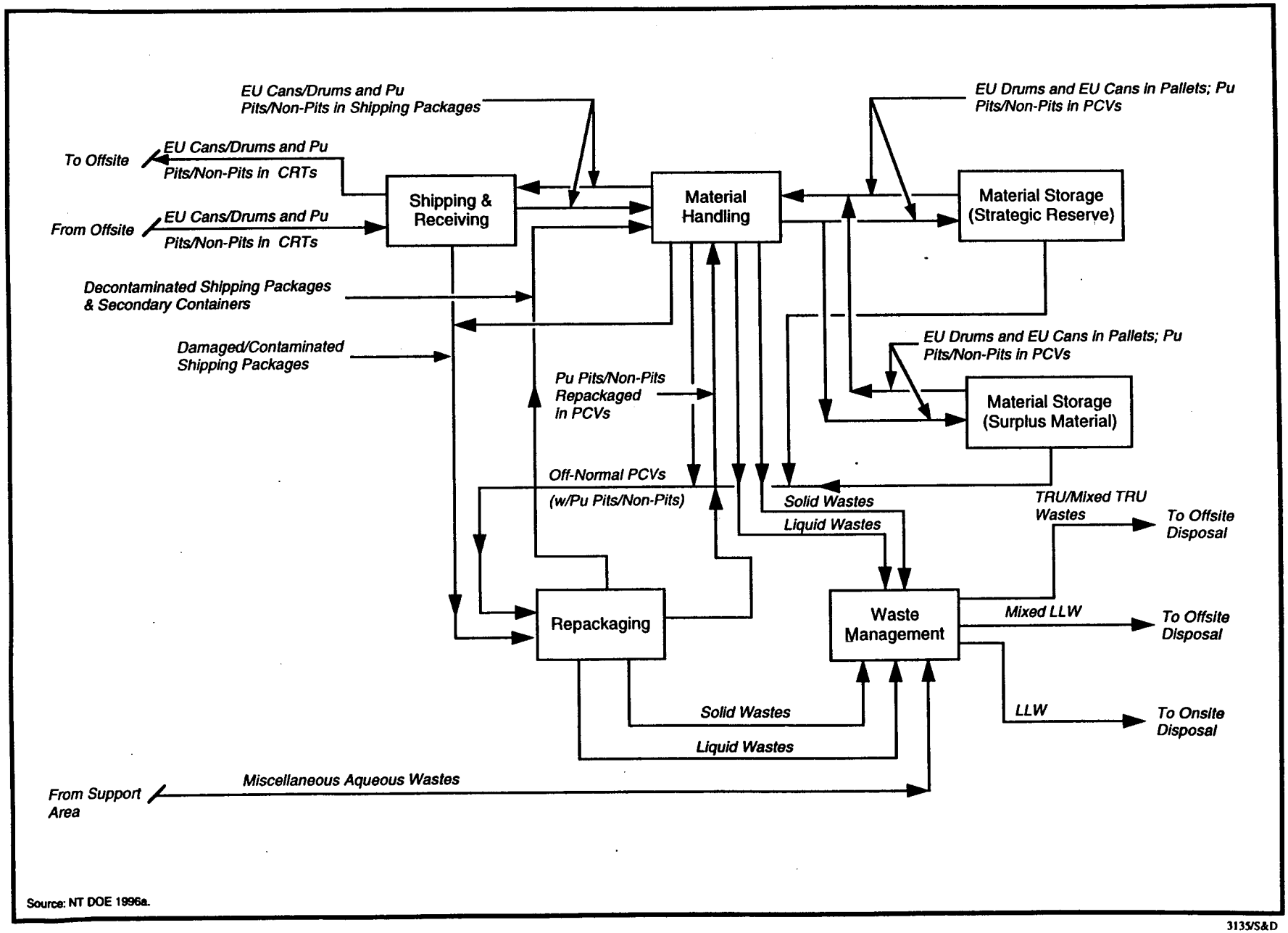


Figure 2.3.3.2–5. Operational Flow Diagram for the Collocation Alternative Modifying P-Tunnel at Nevada Test Site.

consolidated Pu storage facility and upgrading HEU storage facilities at Y–12; and constructing the consolidated Pu storage facility and constructing a new collocated HEU storage facility at a location on ORR other than Y–12. Under all three of these ORR options, it is assumed that HEU from other sites in the DOE complex would already be relocated to Y–12.

If ORR were not selected as the collocated HEU storage site, all nonsurplus HEU within the scope of this PEIS would be phased out of Y–12 and moved to a new facility collocated with the consolidated Pu storage facility located at another DOE site. Surplus HEU would continue to be stored at Y–12 as described above.

At all other sites a new consolidated Pu storage facility and new collocated HEU storage facility would be constructed to satisfy requirements under this alternative. Locations of facilities under the Collocation of Pu and HEU Alternative are shown in Figures 2.3–1 through 2.3–6. In addition to the environmental analysis performed for the long-term storage of all weapons-usable fissile materials under the scope of this PEIS at a consolidated Pu storage facility and collocated HEU storage facility, an analysis of consolidated Pu storage without those nonsurplus materials covered under the Stockpile Stewardship and Management Final PEIS (strategic reserve and weapons R&D materials) is also presented.

Construction and operations data for the Collocation of Pu and HEU Alternative are listed in Appendices B, C, D, E, and F.

2.3.4 STORAGE PHASEOUT

For alternatives described in Sections 2.3.1, 2.3.2, and 2.3.3, storage of existing Pu and HEU materials at various sites may be partly or entirely phased out. For Pu, under the phaseout process, material within the scope of this PEIS would be removed from one or more of the current storage sites and dispositioned (surplus materials only), partially consolidated at more than one storage site (all materials), or fully consolidated at a single storage site (all materials). Phaseout could occur at more than one of these sites because surplus and/or nonsurplus Pu materials currently exist at Hanford, INEL (ANL-W), Pantex, SRS, RFETS, and LANL. For HEU, nonsurplus HEU, which consists of strategic reserves (nuclear weapon secondary components and working material), and naval nuclear fuel, would be removed from its current storage site (assumed to be Y–12 for all HEU by the time actions under this PEIS are begun) and transported to the storage site chosen for collocation of Pu and HEU.

Although Pu and HEU may be transferred from a shipping site to a receiving site, the shipping site may still store material outside the scope of this PEIS (for example, residues with less than 50 percent Pu, and irradiated fuel). In addition to the environmental analysis performed for storing all weapons-usable fissile materials within the scope of this PEIS under the various long-term storage alternatives, an analysis of Pu storage without those materials covered under the Stockpile Stewardship and Management Final PEIS (strategic reserve and weapons R&D materials) is also presented.

2.4 PLUTONIUM DISPOSITION ALTERNATIVES AND RELATED ACTIVITIES

As described in Section 2.1.4, nine alternatives, which can be grouped into three categories, were identified as reasonable for disposition of Pu. The three categories and the alternatives within them are as follows:

Deep Borehole Category

- *Direct Disposition Alternative*—direct emplacement to deep boreholes without immobilizing Pu forms
- *Immobilized Disposition Alternative*—immobilization of Pu forms without adding radionuclides and then emplacement into deep boreholes

Immobilization Category

- *Vitrification Alternative*—immobilization of Pu in a glass matrix with processing in a vitrification facility and then dispose in a HLW repository[16]
- *Ceramic Immobilization Alternative*—immobilization of Pu in a ceramic matrix with processing in a ceramic immobilization facility and then dispose in a HLW repository[16]
- *Electrometallurgical Treatment Alternative*—immobilization of Pu in a GBZ form in an electrometallurgical treatment facility and then dispose in a HLW repository[16]

Reactor Category

- *Existing LWR Alternative*—convert Pu into MOX fuel, use MOX fuel in existing LWRs, and then dispose of spent fuel in an HLW repository[16]
- *Partially Completed LWR Alternative*—convert Pu into MOX fuel, use MOX fuel in partially completed LWRs, which are completed under this program, and then dispose of spent fuel in a HLW repository[16]
- *Evolutionary LWR Alternative*—convert Pu into MOX fuel, use MOX fuel in evolutionary LWRs, and then dispose of spent fuel in a HLW repository[16]
- *CANDU Reactor Alternative*—convert Pu into MOX fuel, use MOX fuel in Canadian CANDU reactors, and then dispose of spent fuel in the Canadian spent fuel program

Preferred Alternative for Pu Disposition: A combination of reactor and immobilization alternatives. The Preferred Alternative calls for (1) immobilizing at least those Pu materials not readily suitable for MOX fuel using vitrification or ceramic immobilization and (2) converting pure Pu metal, including pits, and oxides into MOX fuel for use in existing reactors. Use of Canadian CANDU reactors would be retained in the event that a multilateral agreement is made among Russia, Canada, and the United States to implement this.

The number of years a specific facility is expected to operate is based on facility sizing and throughput capacities. Preconstruction activities would require about 5 years for all the alternatives.[17] Preconstruction activities for the deep borehole category may take longer and may require additional legislation and associated

[16] See Appendix H (appropriate regulatory section) for a discussion of how the NWPA, as amended, might apply for disposal in a HLW repository.

[17] Preconstruction activities include tests, demonstrations, licenses, and tiered NEPA activities.

regulations. About another 5 years would be required for construction, startup, preoperational testing, and operational readiness review for all the alternatives. Construction of completely new reactors or deep boreholes could take longer. The time required for operations of all alternatives will vary depending on the amount of Pu material remaining after stabilization activities and the size, number, and throughput capacities of disposition facilities. If one of the domestic Reactor Alternatives were chosen, the MOX-based spent nuclear fuel is assumed to remain in the spent fuel pool for up to 10 years before relocation to a HLW repository. If either of the Deep Borehole Alternatives were chosen, the time to emplace the surplus Pu would depend on the number of deep boreholes being drilled. For each alternative, if decontamination and decommissioning (D&D) is proposed in the future, such activities are estimated to require up to 5 years for all but MOX fuel fabrication and reactors, which could take up to 10 years. D&D would not be proposed for the borehole sites, but for long-term institutional control (for future deterrence), the Deep Borehole Alternatives would likely take longer. D&D, if proposed, would be preceded by appropriate NEPA analysis.

As the various disposition technologies evolve and are refined through further study, development, and design, processes and facility arrangements would be optimized. This optimization would include specific operational relationships of facilities common to the selected alternatives, such as pit disassembly/conversion and Pu conversion facilities. Because this refinement process is ongoing, information and data presented in the technical documents for some of the alternatives are updated from that which was initially presented in the data reports supporting this PEIS. However, this PEIS considers the updated information as well. [Text deleted.]

Each of the nine disposition alternatives can be implemented in a number of ways because each alternative merely defines the generic technology approach used to achieve the Spent Fuel Standard. For example, using different numbers of existing reactors to accomplish the mission or utilizing different Pu concentrations within a borosilicate glass formulation represent variations for the existing reactor and vitrification alternatives, respectively. Determining which of the many possible variants to analyze within the PEIS is a matter of engineering judgment. A list of possible variants to the nine disposition alternatives is shown in Table 2.4–1.

[Text deleted.]

Representative facility locations for analyzing Pu disposition alternatives at Hanford, NTS, INEL, Pantex, ORR, and SRS are shown in Figures 2.4–1 through 2.4–6. These locations include those for the pit disassembly/conversion, Pu conversion, vitrification, ceramic immobilization, MOX fuel fabrication, and evolutionary LWR facilities. Locations for the deep borehole complex, commercial MOX fuel fabrication facility, and existing LWRs, are generic. At ORR, the representative site for the evolutionary LWR is on undeveloped land (see Figure 2.4–5). This site is not within the ORR boundary, but is owned by the Tennessee Valley Authority (TVA). A previous agreement between DOE and TVA has reserved the site for a nuclear application, and it is anticipated that the land area would be transferred from TVA to DOE. The Bellefonte Nuclear Plant, approximately halfway between Huntsville, Alabama, and Chattanooga, Tennessee, is the representative analysis site for the partially completed reactor alternative. INEL is the representative site for the Electrometallurgical Treatment Alternative. For the CANDU Reactor Alternative, the Bruce-A Nuclear Generating Station is the representative site for the analysis. The following sections describe the requirements for each disposition technology listed above.

[Text deleted.] Three Immobilization Alternatives and three reactor alternatives produce a waste form that could be suitable for disposal in a domestic HLW repository. Such a repository, if approved under the provisions of the NWPA and its amendments, would serve as the disposal site for commercial and DOE-owned spent nuclear fuel and HLW. DOE is currently characterizing the Yucca Mountain site for the repository. If the Secretary of Energy recommended the Yucca Mountain site for the repository, the recommendation would be accompanied by an EIS (the repository EIS), the NOI for which was published on August 7, 1995 (60 FR 40164). DOE completed scoping in Fiscal Year 1996 and will continue working the EIS given sufficient appropriations. The Yucca Mountain site has not yet been recommended by the President and approved by Congress; therefore, this Storage and Disposition PEIS does not analyze impacts to a repository. No waste forms are currently licensed for disposal

Table 2.4–1. Descriptions of Variants to Analyzed Disposition Alternatives

Alternatives	Possible Variants
• Deep borehole direct disposition	• Arrangement of Pu in different types of emplacement canisters.
• Deep borehole immobilized disposition	• Bucket emplacement of pellet-grout mix. • Pumped emplacement of pellet-grout mix. • Pu concentration loading, size and shape of ceramic pellets.
• New vitrification facilities	• Collocated pit disassembly, Pu conversion, and immobilization facilities. • Use of either Cs-137 from capsules or HLW as a radiation barrier. • Wet or dry feed preparation technologies. • An adjunct melter adjacent to the DWPF at SRS, in which borosilicate glass frit with Pu (without highly radioactive radionuclides) is added to borosilicate glass containing HLW from the DWPF. • A can-in-canister approach at SRS in which cans of Pu glass (without highly radioactive radionuclides) are placed in DWPF canisters which are then filled with borosilicate glass containing HLW in the DWPF (See Appendix O). • A can-in-canister approach similar to above but using new facilities.
• New ceramic immobilization facilities	• Collocated pit disassembly, Pu conversion, and immobilization facilities. • Use of either Cs-137 from capsules or HLW as a radiation barrier. • Wet or dry feed preparation technologies. • A can-in-canister approach at SRS in which the Pu is immobilized without highly radioactive radionuclides in a ceramic matrix and placed in which are then placed in the DWPF canisters that are then filled with borosilicate glass containing HLW (see Appendix O). • A can-in-canister approach similar to above but using new facilities.
• Electrometallurgical treatment (glass-bonded zeolite form)	• Immobilize Pu into metal ingot form. • Locate at DOE sites other than ANL-W at INEL.
• Existing LWR with new MOX facilities	• Pressurized or Boiling Water Reactors. • A different number of reactors. • European MOX fuel fabrication. • Modification/completion of existing facilities for MOX fuel fabrication. • Collocated pit disassembly/conversion, Pu conversion, and MOX fuel facilities. • Reactors with different core management schemes (Pu loadings, refueling intervals).
• Partially completed LWR with new MOX facilities	• Same as for existing LWR (except that MOX fuel would not be fabricated in Europe).
• Evolutionary LWR with new MOX facilities	• Same as for partially completed LWR.
• CANDU reactor with new MOX facilities	• A different number of reactors. • Modification/completion of existing facilities for MOX fabrication. • Collocated pit disassembly/conversion, Pu conversion, and MOX facilities. • Reactors with different core management schemes (Pu loadings, refueling intervals).

in a HLW repository. For the Immobilization Alternatives, legislative clarification or NRC determination by rule may be required before the immobilized Pu can be placed in an NWPA repository. Data to estimate waste forms under consideration in this PEIS for disposal in a repository are compared to data currently being evaluated for disposal in a NWPA-licensed repository. The results of this analysis are in Appendix H.

The fourth Reactor Alternative would use surplus U.S. Pu in MOX fuel for Canadian reactors, with the spent nuclear fuel managed by Canada. The MOX-based spent nuclear fuel from the alternative would be comparable to spent fuel from ongoing power producing operations in that country. This PEIS presents an analysis of domestic activities within the continental United States. A brief impact assessment of activities in Canada is included in Appendix I.

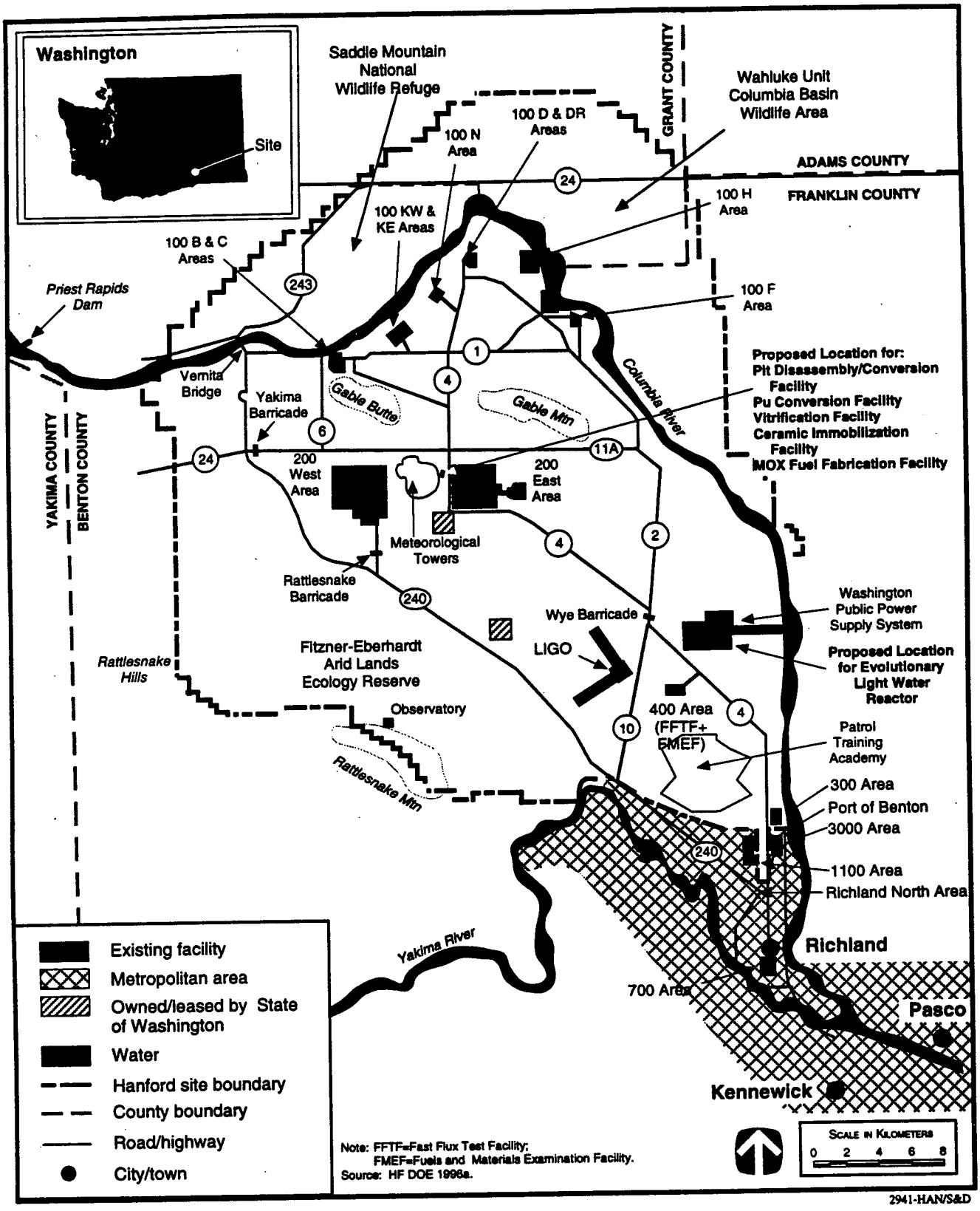


Figure 2.4–1. Representative Facility Locations for the Disposition of Plutonium at Hanford Site.

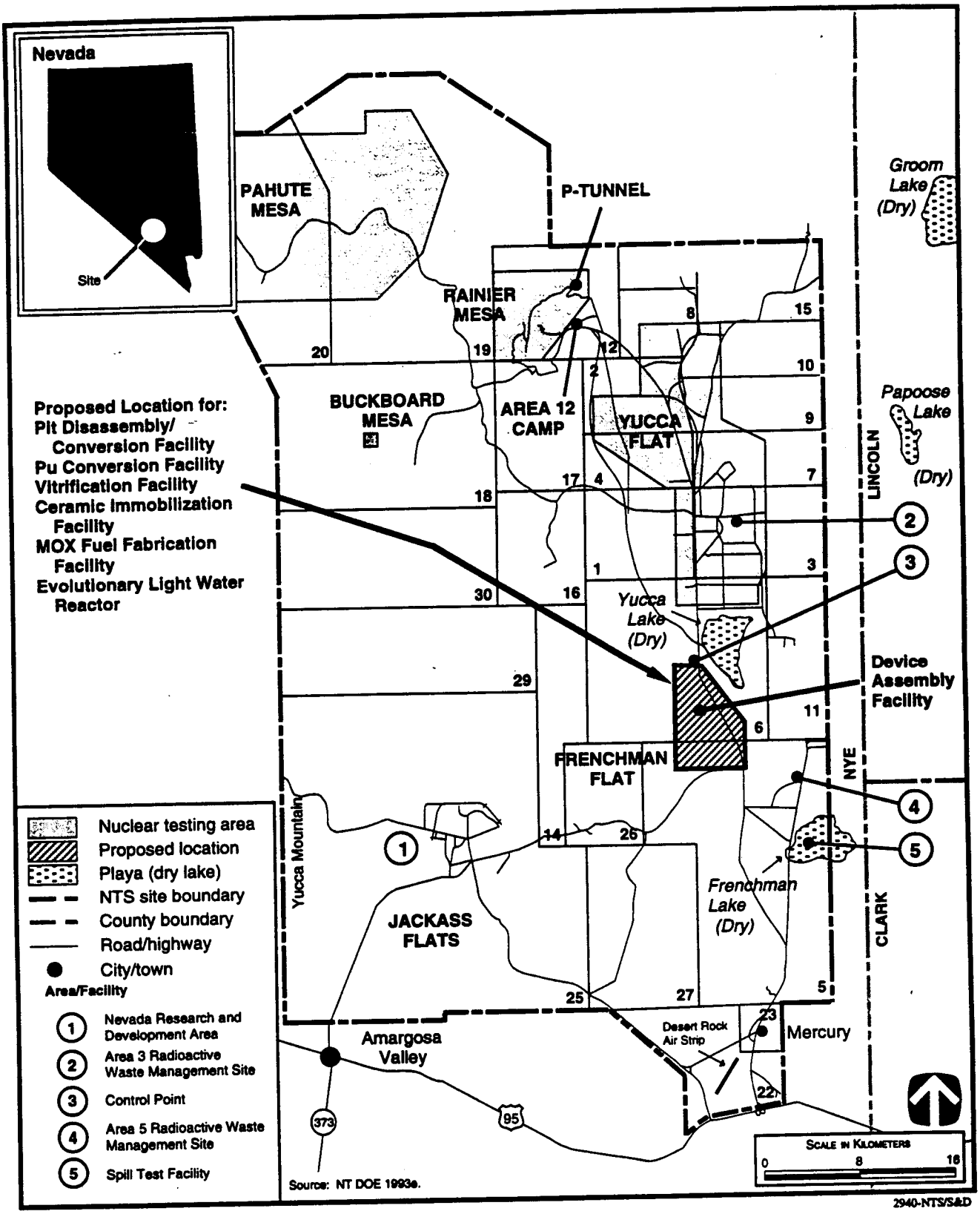


Figure 2.4–2. Representative Facility Locations for the Disposition of Plutonium at Nevada Test Site.

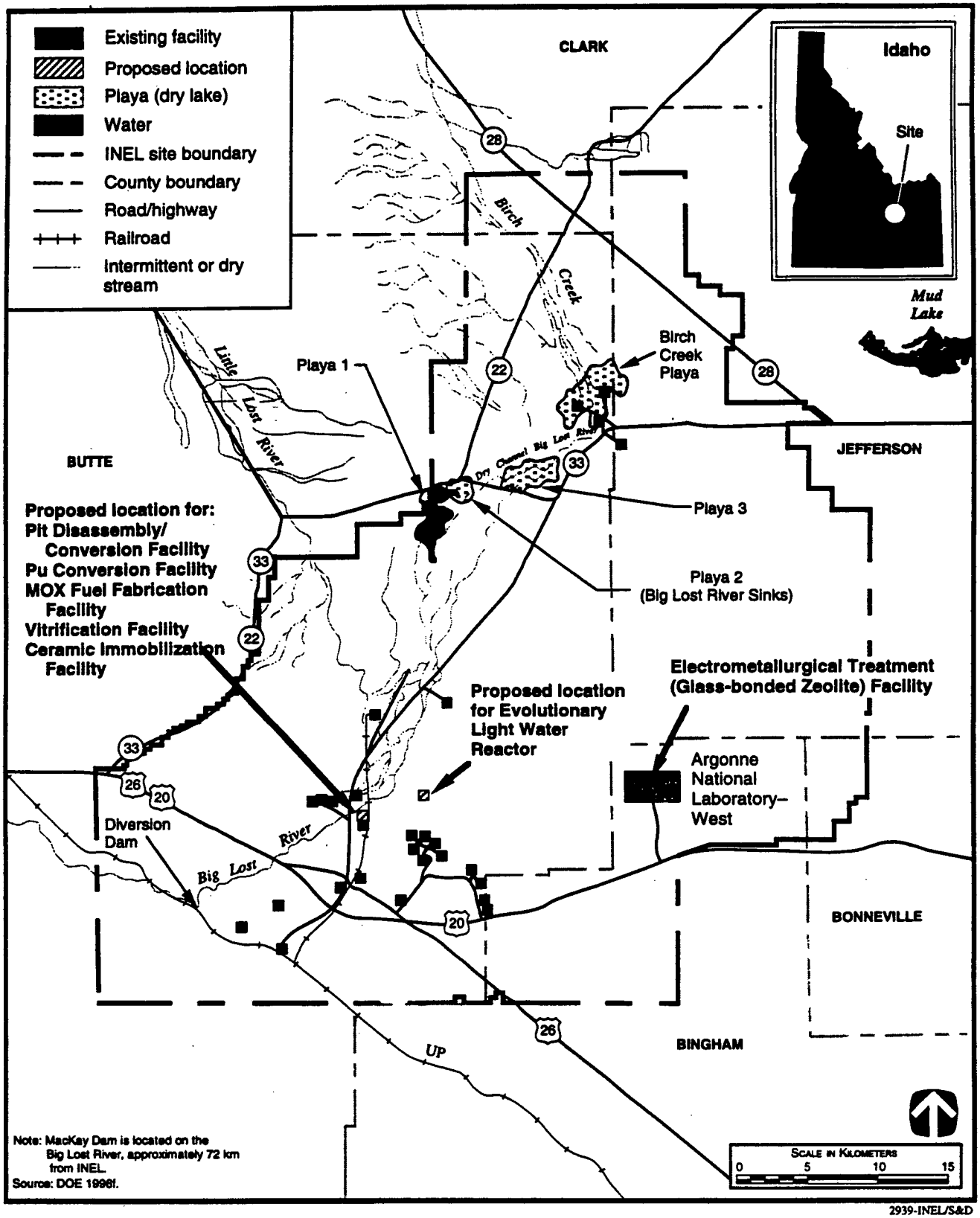


Figure 2.4–3. Representative Facility Locations for the Disposition of Plutonium at Idaho National Engineering Laboratory.

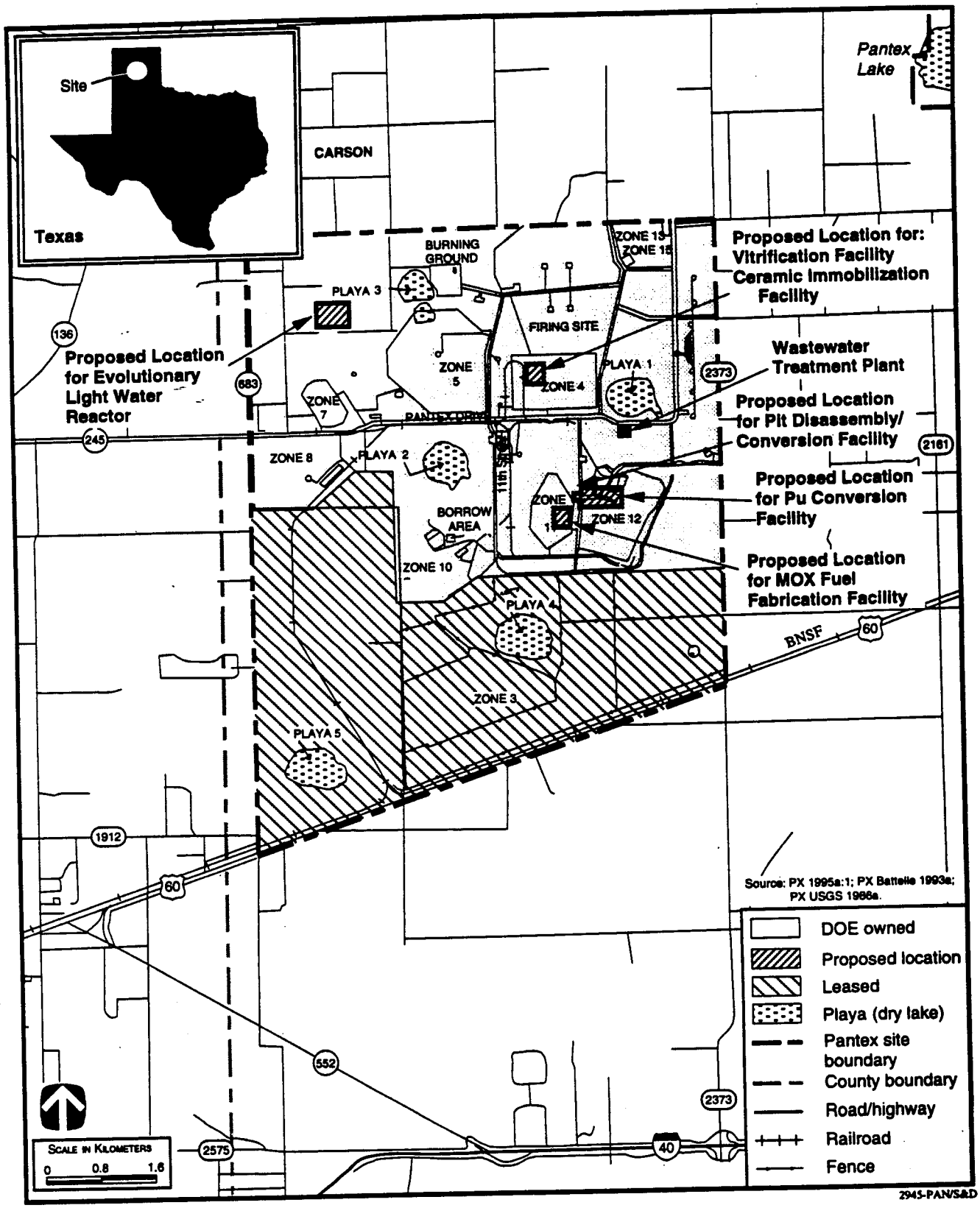


Figure 2.4–4. Representative Facility Locations for the Disposition of Plutonium at Pantex Plant.

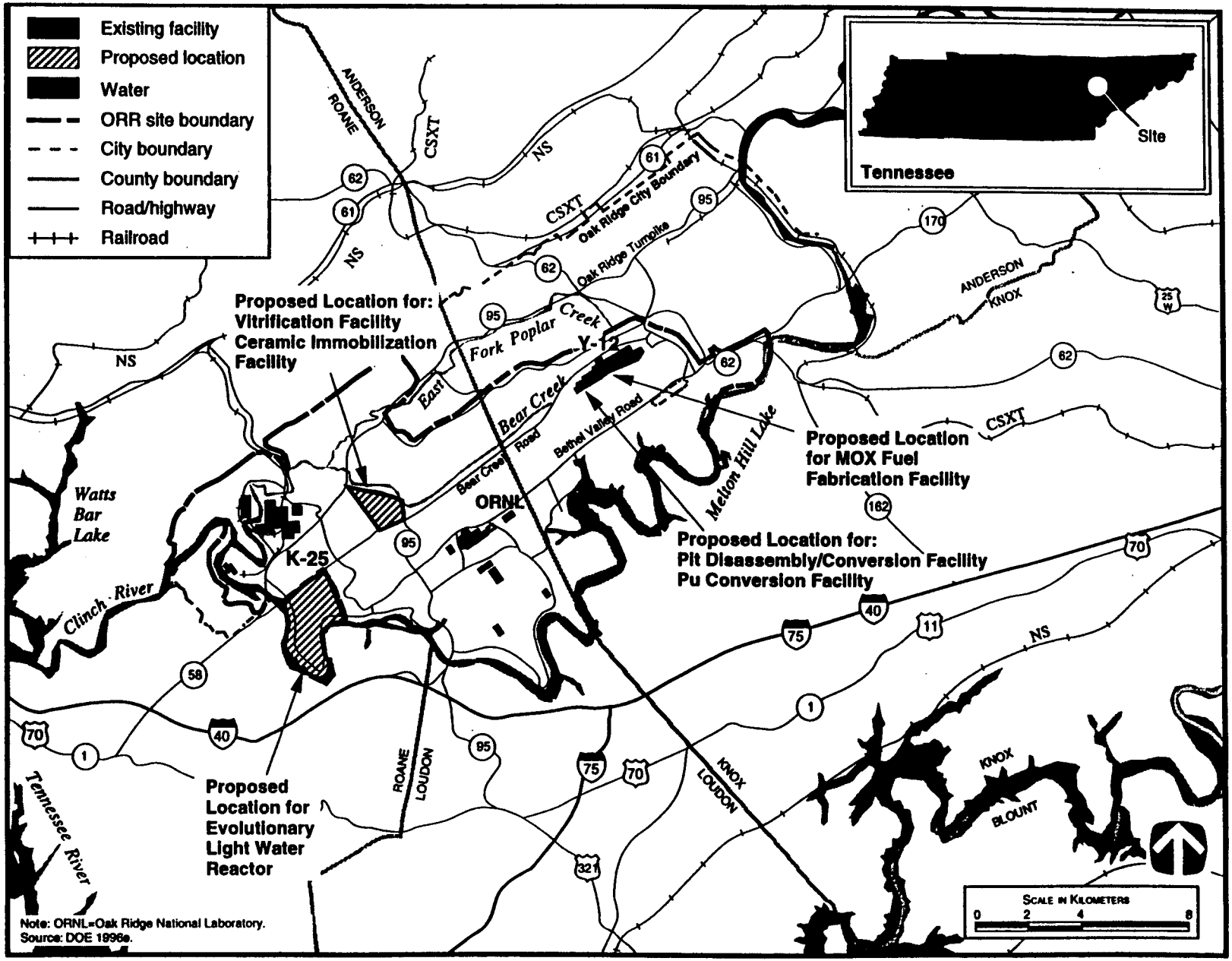


Figure 2.4–5. Representative Facility Locations for the Disposition of Plutonium at Oak Ridge Reservation.

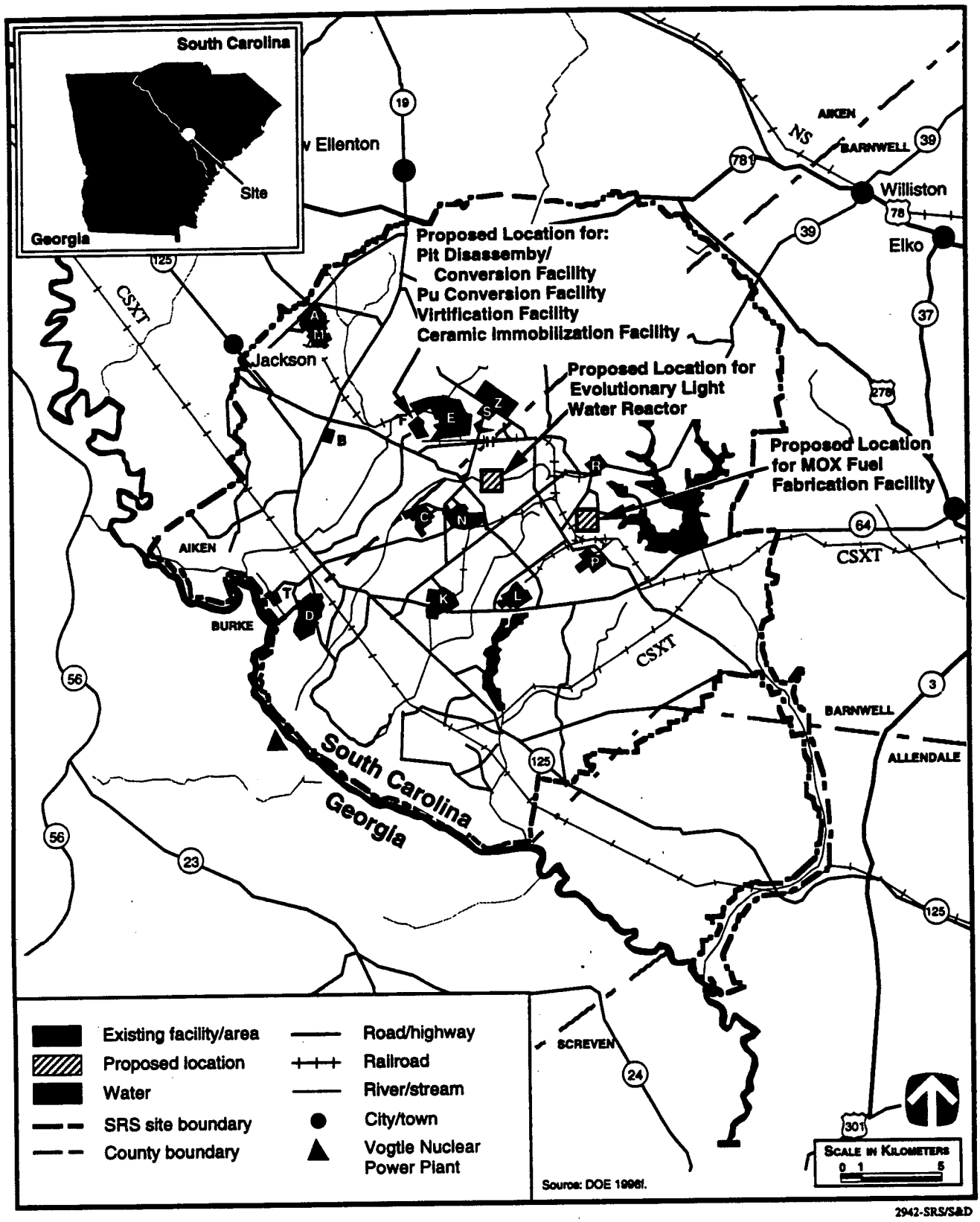


Figure 2.4–6. Representative Facility Locations for the Disposition of Plutonium at Savannah River Site.

DOE would analyze the impacts of continued storage of immobilized Pu waste forms or MOX-based spent nuclear fuel in a tiered NEPA document under any of the following conditions: (1) if the DOE HLW Program changes its approach for disposal of commercial spent nuclear fuel, (2) if the timeframe for acceptance of waste by the program is significantly delayed beyond current projections, or (3) if the Pu immobilized waste forms or MOX-based spent nuclear fuel resulting from Pu disposition alternatives are not acceptable to a licensed repository.

Six DOE sites and other generic and specific sites were used for assessing the environmental impacts of various disposition technologies and strategies. The locations of the new facilities considered for the various disposition technologies are representative and for analysis purposes only. Until tiered NEPA documentation has been completed, no specific location within any specific site (or sites) will be selected for any disposition alternative action.

This Storage and Disposition PEIS assumes all surplus Pu could be processed through each of the various disposition technology alternatives. However, some surplus Pu material may not be suitable for processing under every disposition technology. As a result, the strategy for disposition of surplus Pu could involve a combination of disposition alternatives. In addition, if any of the LWR alternatives are selected, there is also a multipurpose reactor variant (see Section 1.4 and Appendix N) that could produce tritium, use Pu as fuel, and in some designs generate revenue through the sale of electricity.

No Plutonium Disposition Action

As discussed in Section 1.6, a "No Pu Disposition" action means disposition would not occur, and surplus Pu-bearing weapon components (pits) and other forms, such as metal and oxide, would remain in long-term storage in accordance with decisions on the long-term storage of Pu.

Activities Common to Multiple Plutonium Disposition Alternatives

As previously described, the disposition alternatives for surplus Pu involve a variety of technologies. However, two activities are common to all the disposition alternatives, including the Preferred Alternative:

- Pit disassembly/conversion
- Pu conversion

Since these common activities involve the conversion of surplus Pu from current forms to one suitable for disposition, they are essential components of each disposition alternative. Pit disassembly and Pu conversion facilities could be collocated. Multiple facilities located at the same site are analyzed in Section 4.7.3, and more specific analysis will be performed in tiered NEPA documents, as appropriate.

Upon completion of the pit disassembly/conversion and/or Pu conversion processes, the Pu materials would be ready for further actions under one or more of the disposition technology alternatives.

2.4.1 PIT DISASSEMBLY/CONVERSION FACILITY

The pit disassembly/conversion facility would be common to all disposition alternatives, including the Preferred Alternative. The facility would disassemble, reshape, and convert the pits into an unclassified metal or oxide form usable by the next facility in the disposition process. In addition, some non-pit material (such as pure Pu metal) may be processed at the pit disassembly/conversion facility. The material contained in the pit disassembly/conversion facility, would require the highest levels of protection.

In accordance with the Preferred Alternative for surplus Pu disposition, the pit disassembly/conversion facility could be located at either Hanford, INEL, Pantex, or SRS. Further tiered NEPA review will be conducted to examine alternative locations, including new and existing facilities, at these four sites should the Preferred Alternative be selected at the ROD.

Facility Description. The surplus Pu would be removed from the pits by separating them in half with a cutting wheel and subjecting each half to a dry chemical process that converts the metal to a hydride powder, then either back to metal or to an oxide powder. Figure 2.4.1–1 depicts the material flow through the facility.

The total disturbed land area for the operating facility would be approximately 12 hectares (ha) (30 acres), plus a 1.6-kilometer (km) (1-mile [mi]) buffer zone around the operating facility. Provisions would be included to accommodate future international treaty requirements for inspection. Figure 2.4.1–2 shows a conceptual site layout perspective.

[Text deleted.] Appendix B provides a more detailed breakdown of the key buildings required at the pit disassembly/conversion facility. These buildings and their missions include the following:

Plutonium Processing Building. Pits would be disassembled, and the Pu and other components would be separated in this building. All wastes would be processed here for disposal. In addition, the building would contain maintenance facilities, laboratories, utility systems, heating ventilation and air conditioning (HVAC) equipment, and other support functions.

Administration Building. Management offices, meeting and conference rooms, a visitor control office, and the cafeteria would be contained here.

Plutonium Operations Support Building. Change rooms, decontamination facilities, offices, maintenance shops, operator training rooms, process demonstration laboratories, and general storage areas would be located in this building.

Warehouse. This building would provide miscellaneous storage and general delivery areas.

Utilities Building. Steam and water treatment facilities, the plant air system, and the chilled water system would be located in this building.

Generator Building. Emergency generators would be located in this building.

Guard and Vehicle Monitoring Station. This building would serve as the pedestrian and vehicle entrance to the facility. A hardened guard booth and a vehicle entrance lane next to the pedestrian entrance would be provided.

Facility Operations. Wherever possible, operations would be conducted by automated and robotic systems to reduce personnel exposure. The facility would be designed for a throughput of 3.25 t (3.58 tons) of Pu per year, using two shifts per day, 5 days per week. Surge capability would be provided by increasing plant personnel and adding weekend work shifts.

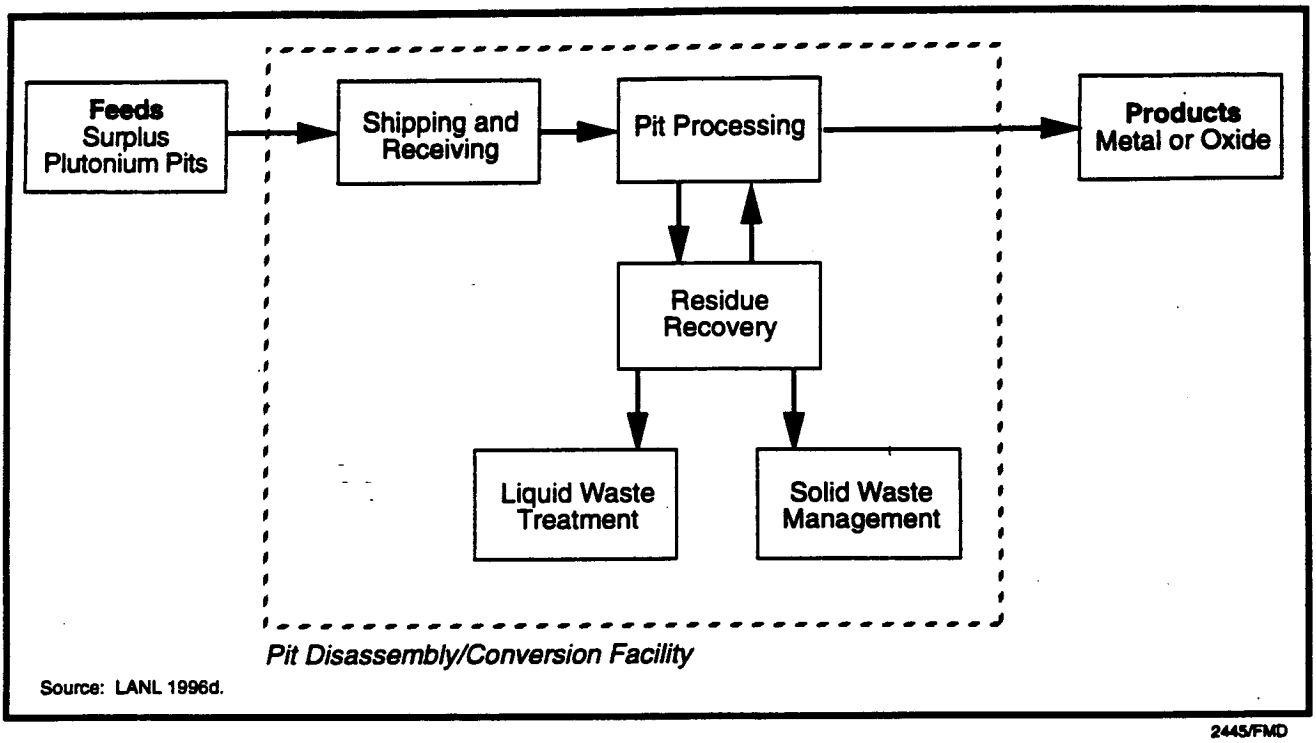


Figure 2.4.1–1. Pit Disassembly/Conversion Facility Material Process Flow.

The pit disassembly/conversion facility would contain all required systems to remove Pu from weapons components and to package the material into an unclassified form suitable for shipment to the next facility in the disposition process. Operational flow within the facility would be through several main processing areas. Shipping and receiving would handle the incoming pit inspection, decontamination, storage, and initial processing and the outgoing shipping functions for the Pu metal or oxide produced by the facility. Pit disassembly and conversion operations[18] would process the pit mechanically and chemically within gloveboxes into either Pu metal or oxide (depending upon the selected disposition process) and would package it for removal. Another output of the process would be waste, both liquid and solid, consisting of low-level, TRU, hazardous, and mixed waste. An analytical laboratory would be required to perform Pu assays on product and waste streams as well as to certify waste streams. A lag storage vault would be used to store product metal or oxide, uranium forms, and other components before packaging for shipment to the next disposition facility. Utilities and manpower resources needed during operation are presented in Appendix C. Chemicals required during operations can be found in the classified appendix. The water balance is depicted in Appendix D.

Construction. Construction of the facility would take approximately 6 years and have a peak annual employment of 125 construction workers. Construction of the pit disassembly/conversion facility would require an additional 2 ha (5 acres) of land for construction laydown, warehousing, and construction parking. Resources consumed during construction are shown in Appendix C.

Waste Management. The solid and liquid nonhazardous wastes generated during construction would include concrete and steel construction waste materials and sanitary wastewater. The steel construction waste would be recycled as scrap metal before construction was completed. The remaining nonhazardous wastes generated during construction would be disposed of by the contractor as part of the construction project. Uncontaminated

[18] The Department is developing ARIES to remove Pu from weapons pits and convert it into either an oxide or metal. This prototype program is intended to demonstrate a completely integrated process to disassemble and convert pits into an unclassified metal or oxide form that would be usable in the next disposition process facility.

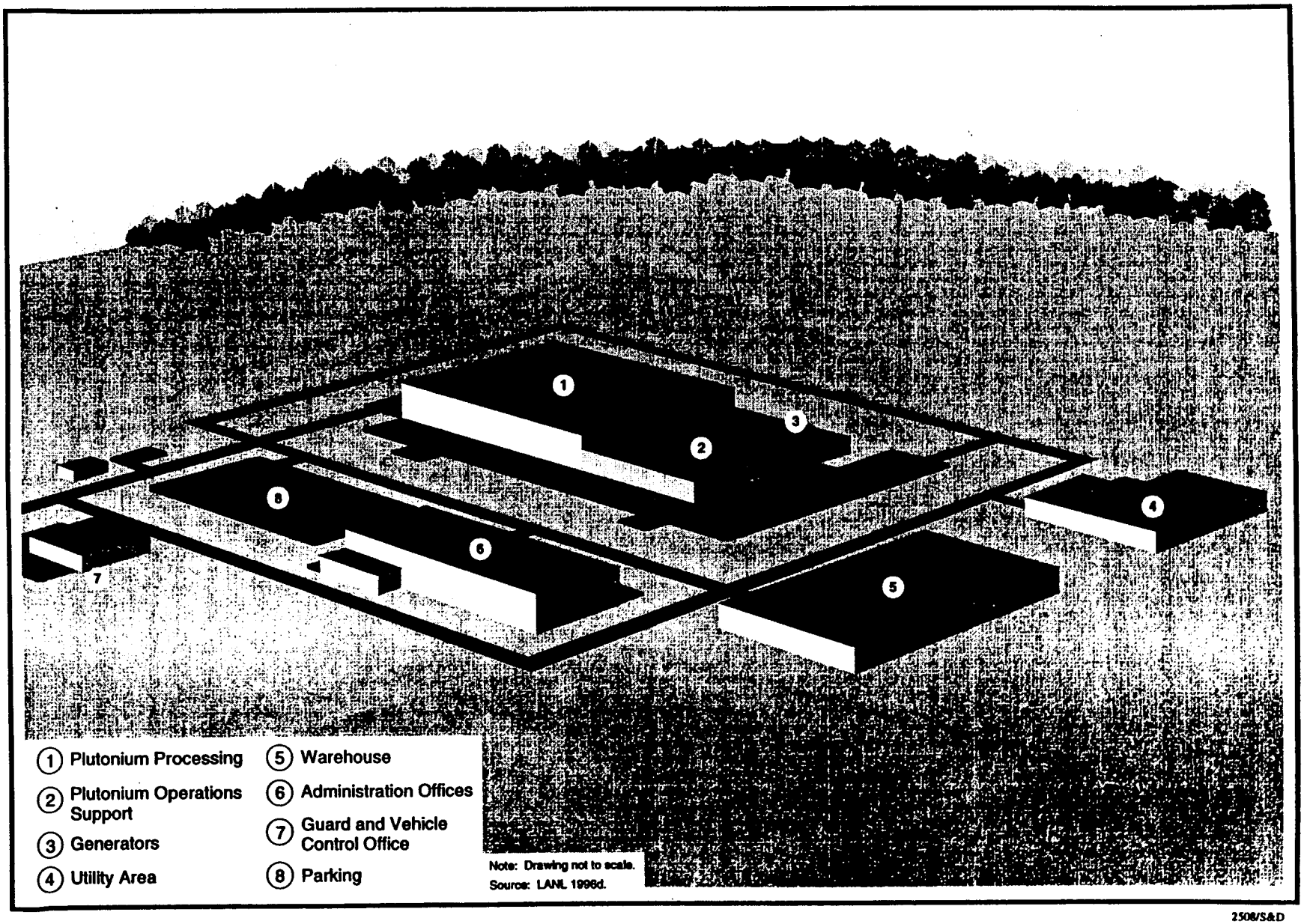


Figure 2.4.1–2. Conceptual Pit Disassembly/Conversion Facility Site Layout (Perspective).

wastewater would be used for soil compaction and dust control, and excavated soil would be used for grading and site preparation. Wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling. Hazardous wastes such as adhesives, oils, and solvent rags would be packaged in DOT-approved containers and shipped to offsite commercial RCRA-permitted treatment, storage, and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any was generated, it would be managed in accordance with site practice and all Federal and State standards.

Operation of the pit disassembly and conversion facility would generate TRU, low-level, hazardous, mixed, and nonhazardous wastes. The conceptual design includes waste management facilities that would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with RCRA and other applicable statutes. TRU and mixed TRU waste would be treated and packaged to meet the WIPP WAC. These wastes would be stored awaiting shipment to a Federal repository (assumed to be WIPP, depending on decisions resulting from the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste). LLW would be treated and packaged to meet the waste acceptance criteria of an onsite or offsite DOE LLW disposal facility. The DOE LLW disposal facility that would be used would be consistent with decisions resulting from the Waste Management PEIS and tiered NEPA documents. Mixed LLW would be treated and disposed in accordance with the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act*. Hazardous wastes would be packaged in DOT-approved containers and shipped to RCRA-permitted treatment and disposal facilities. Liquid nonhazardous wastes such as sanitary, utility, and process wastewater would be treated and discharged in accordance with the site practice. Treated wastewater would be reclaimed to use as makeup water when economically and/or environmentally desirable. Solid nonhazardous waste would be disposed of in permitted landfills and recycled, as appropriate. [Text deleted.]

Transportation. Intrasite transportation of all the receiving, storage, and processing activities would be contained within the facility. Transfers within the processing building would be through tunnels or secure transfer hallways. Material would be moved between process areas by carts, forklifts, or a conveyer system. Upon receipt, material would go either directly into the process lines or into lag storage, depending on the amount of material received and the status of the processing areas. After processing is complete, the material would be placed in lag storage before being sent to the next facility in the disposition process.

For offsite transfers, the organization initiating action for the material would have the ultimate responsibility for its safe transfer from the time the material is offered for transportation until it is received at the final destination. Shippers, transporters, and receivers are responsible for compliance with applicable transportation requirements. Destination of the products would depend on the disposition alternatives that are chosen. Transportation data can be found in Appendix G.

2.4.2 PLUTONIUM CONVERSION

For all the surplus Pu disposition alternatives, including the Preferred Alternative, Pu not processed at the pit disassembly/conversion facility would be processed at the Pu conversion facility. This facility would convert non-pit, surplus Pu into metal or oxide suitable for use at the next disposition facility in the process. Most, if not all, of the Pu material in the scope of the Storage and Disposition program is assumed to be in the *Criteria for Safe Storage of Plutonium Metal and Oxides* (DOE-STD-3013-94) stabilized form prior to disposition activities. However, a small amount of material consisting of metals, oxides, and alloys may need additional processing. Such materials would be converted in this facility for subsequent disposition. The facility would also provide lag storage for some materials to be converted. Figure 2.4.2–1 depicts the material flow through the facility.

In accordance with the Preferred Alternative for surplus Pu disposition, the Pu conversion facility could be located at either Hanford or SRS. Further tiered NEPA review will be conducted to examine alternative

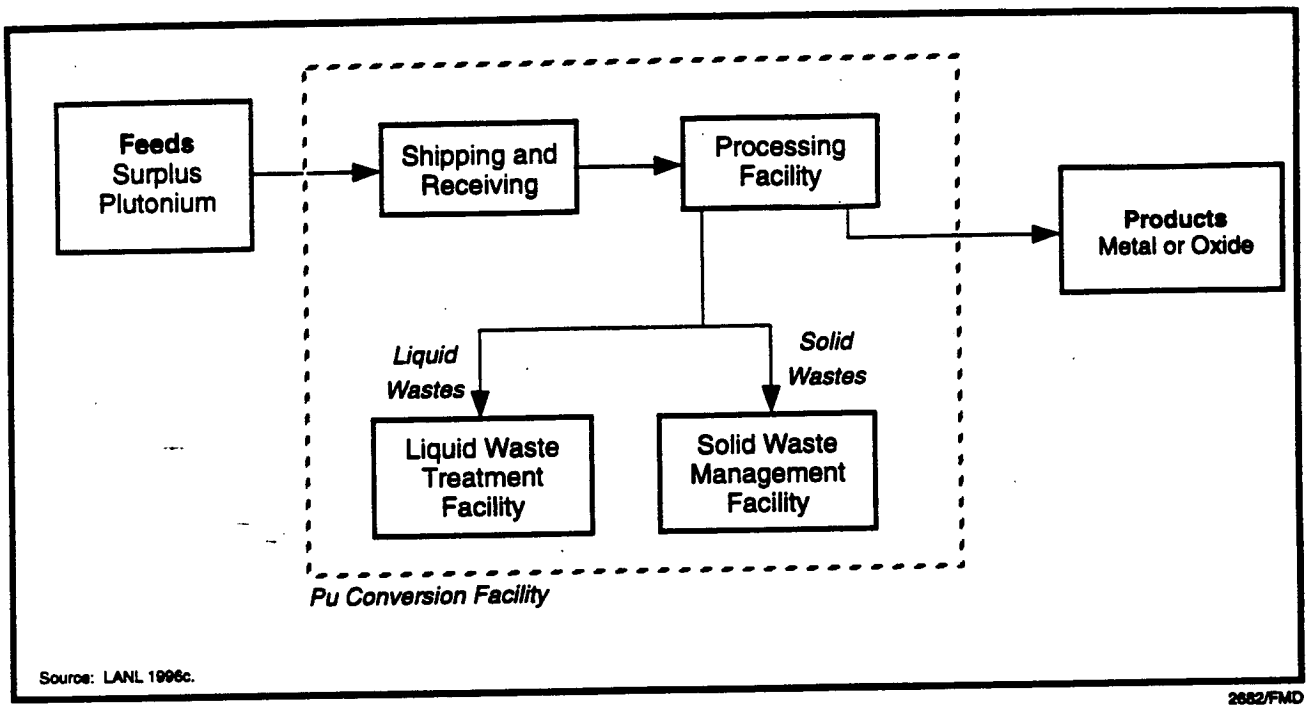


Figure 2.4.2–1. Plutonium Conversion Facility Material Flow Diagram.

locations, including new and existing facilities, at these two sites should the Preferred Alternative be selected at the ROD.

Facility Description. The material contained in the Pu conversion facility would require the highest levels of protection, including a 1.6-km (1-mi) buffer zone around the operating facility. Personnel security programs would require badging and access control of all personnel. For a new facility, the total disturbed land area would be approximately 28 ha (70 acres). Figure 2.4.2–2 depicts the conceptual site layout. Appendix B provides a more detailed description of key Pu conversion facility buildings. The mission of these buildings is as follows:

Central Warehouse, Shipping and Receiving Building. Packaging, safety confirmation of containers from the lag storage vault, and truck loading functions would be provided here. Services include unloading feed from transports, removing items from the shipping containers, confirming the contents, and handling abnormally sized packages.

Staging/Storage Facility. The interface between receiving and processing, and repackaging and storage functions would be provided in this building. These functions characterize, verify, and prepare the feeds and products for lag storage and control the flow and quality of material into and out of the glovebox operations.

Processing Building. Handling and processing Pu into a form acceptable for the next facility in the disposition process would occur here. This building would also provide utility support functions, MC&A, safety systems, waste management, repackaging, and assay and analysis.

Facility Operations. The Pu conversion facility conceptual design assumes that scrap and surplus Pu materials are pretreated to meet DOE interim storage and DOT shipping regulations. [Text deleted.] The facility design is flexible and provides for additional or reduced processing with minor process changes, such as increasing metal dissolution capacity for conversion to oxide, adding americium extraction, oxidation furnaces, or nitrate processing to meet additional alternative feed pretreatment requirements as feed forms and quantities are better

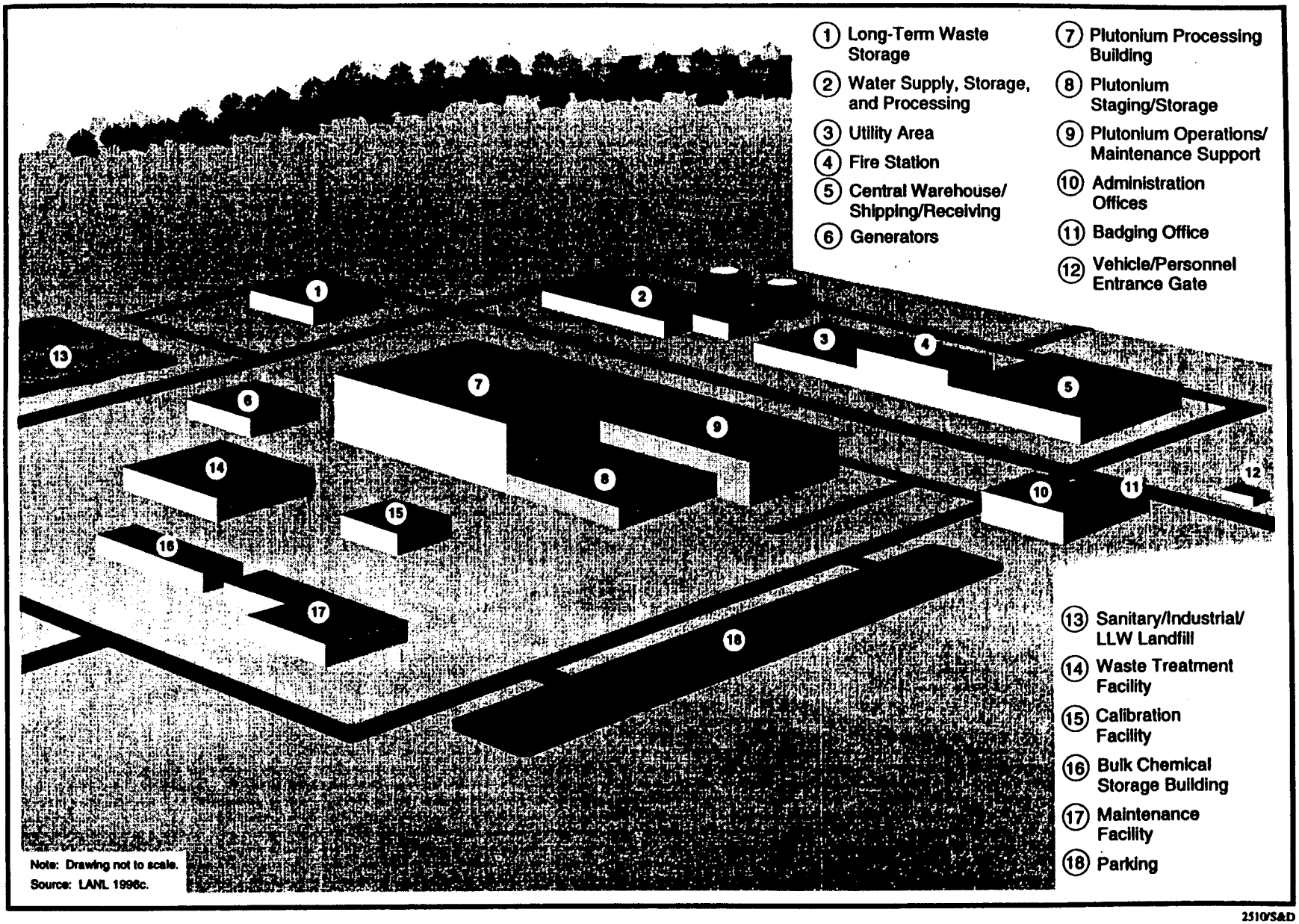


Figure 2.4.2–2. Conceptual Plutonium Conversion Facility Site Layout (Perspective).

defined. The Pu conversion facility would process Pu to a form that meets nuclear fuels feed or immobilization feed criteria. The facility design would be based on an annual throughput rate of 0.4 t (0.44 tons) of Pu, using one 10-hour shift, 200 days per year. Surge capability would be provided by increasing personnel and adding work shifts. Utilities and manpower resources needed during operations are presented in Appendix C. The water balance is depicted in Appendix D. Chemicals required during operations can be found in the Classified Appendix.

Construction. The construction of the Pu conversion facility would take approximately 6 years and have a peak annual employment of 358 construction workers. For a new facility, additional land area required temporarily for construction is projected to be approximately 8 ha (20 acres). This provides for construction material laydown, warehousing, and parking. Other resources consumed during construction are shown in Appendix C.

Waste Management. The solid and liquid nonhazardous wastes generated during construction would include concrete and steel construction waste materials and sanitary wastewater. The steel construction waste would be recycled as scrap metal before construction was completed. The remaining nonhazardous wastes generated during construction would be disposed of by the contractor as part of the construction project. Uncontaminated wastewater would be used for soil compaction and dust control, and excavated soil would be used for grading and site preparation. Wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling. Hazardous wastes such as adhesives, oils, and solvent rags would be packaged in DOT-approved containers and shipped to offsite commercial RCRA-permitted treatment, storage, and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any were generated, it would be managed in accordance with site practice and all Federal and State standards.

Operation of the Pu conversion facility would generate TRU, low-level, hazardous, mixed, and nonhazardous wastes. The conceptual design includes waste management facilities that would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with the RCRA and other applicable statutes. TRU and mixed TRU waste would be treated and packaged to meet the WIPP WAC. These wastes would be stored awaiting shipment to a Federal repository (assumed to be WIPP, depending on decisions resulting from the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste). LLW would be treated and packaged to meet the WAC of an onsite or offsite DOE LLW disposal facility. The DOE LLW disposal facility that would be used would be consistent with decisions resulting from the Waste Management PEIS and tiered NEPA documents. Mixed LLW would be treated and disposed in accordance with the respective site treatment plan which was developed to comply with the *Federal Facility Compliance Act*. Hazardous wastes would be packaged in DOT-approved containers and shipped to RCRA-permitted treatment and disposal facilities. Liquid nonhazardous wastes such as sanitary, utility, and process wastewater would be treated and discharged in accordance with the site practice. Treated wastewater would be reclaimed to use as makeup water when economically and/or environmentally desirable. Solid nonhazardous waste would be disposed of in permitted landfills and recycled, as appropriate.

Transportation. Intrasite transportation of radiological and hazardous materials would be between the Pu processing and manufacturing building and the Pu storage building. The storage container packages would be transported between vault storage and staging buildings via a hardened transfer corridor. Primary containers that have failed in storage or require intensive testing would be transported to Pu processing and manufacturing.

For offsite transfers, the organization initiating action for the material would have the ultimate responsibility for its safe transfer from the time the material is offered for transportation until it is received at the final destination. Shippers, transporters, and receivers would be responsible for compliance with applicable transportation requirements. Destination of the products would depend on the disposition alternatives that are chosen. Transportation data can be found in Appendix G.

2.4.3 DEEP BOREHOLE CATEGORY

Under this category of alternatives, surplus weapons-usable Pu would be emplaced into one or more deep boreholes drilled below the water table into ancient, geologically stable rock formations. The Pu disposal form is emplaced and sealed in the emplacement zone, typically 2-km (1.25-mi) long. The isolation zone, also typically about 2-km (1.25-mi) long extends from the top of the emplacement zone to the ground surface, and would be filled and sealed with appropriate materials. At emplacement depths, which would be several kilometers greater than those of mined geologic repositories, the groundwater is expected to be stagnant. Because the barrier to transport posed by the isolation zone and the siting of the facility at a carefully selected stable location with stagnant groundwater at depth, the Pu is expected to remain, for all practical purposes, permanently isolated from the biosphere.

This PEIS analyzes two alternatives for emplacing Pu into a deep borehole: direct disposition and immobilized disposition. These are discussed in Sections 2.4.3.1 and 2.4.3.2, respectively. Under both alternatives, emplacement in a deep borehole would provide a geologic barrier to proliferation that would be difficult, costly, and time-consuming to overcome for recovering the material. According to the NAS, Pu in deep boreholes would be inaccessible to potential proliferators, but would be accessible to the state in control of the deep borehole site. Since the deep borehole is accessible to the nation in control of the deep borehole site, redrilling the hole could technically be accomplished within a few months. However, such activity would be detected well before the Pu was retrieved. As a result, it is doubtful that potential proliferators could recover the Pu or the host nation could recover the Pu without being detected. Therefore, under both alternatives, the Pu would not need to be mixed with HLW or other highly radioactive material to increase proliferation resistance. Under the first alternative, surplus Pu would be encapsulated directly in suitable canisters and emplaced into the deep borehole. Under the second alternative, surplus Pu would be converted into a ceramic pellet immobilized form. The ceramic pellets would then be mixed with grout and an equal volume of Pu-free ceramic pellets and emplaced into the deep borehole without canisters. Under either alternative, the deep borehole would be sealed after completion of the emplacement.

The environmental impacts of emplacement in a deep borehole are evaluated at a generic site that would be characteristic of a deep borehole complex. The identification of a suitable location for a deep borehole requires detailed site-specific studies and is beyond the programmatic scope of the Storage and Disposition PEIS. [Text deleted.] In addition, the regulatory requirements that the deep borehole must satisfy for site characterization and licensing for long-term disposal would have to be developed by the appropriate regulatory bodies.

2.4.3.1 Direct Disposition Alternative

Under this alternative, surplus Pu would be removed from storage, processed as necessary through the pit disassembly/conversion facility and/or the Pu conversion facility, packaged, and placed into a deep borehole. The deep borehole would be sealed to isolate the Pu from the accessible environment. The Direct Disposition Alternative does not require direct handling of dispersable Pu at the deep borehole site. Long-term performance of the deep borehole would depend on the stability of the geologic system to ensure isolation of Pu until rendered stable. No specific deep borehole locations have been identified but a generic assessment of site availability has been performed and site selection criteria have been developed (LANL 1996m:7-8, 27-38). This study has shown that suitable sites can be found in many regions of the continental United States. All requirements shown in this section are in addition to those previously stated for the pit disassembly/conversion and Pu conversion facilities.

Facility Description. Under the Direct Disposition Alternative, a deep borehole complex would be sited and constructed to dispose of surplus Pu material (Pu in various forms). Pu from the pit disassembly/conversion and Pu conversion facilities would be packaged to preclude criticality as determined by deep borehole disposal requirements. Two 2.25-kg (5-lb) product cans, a total of 4.5 kg (10 lb) of Pu, could be appropriately spaced inside each PCV. The PCV would be placed inside a shipping container (like a 6M) and shipped by SST to the

deep borehole complex. The sealed PCVs would be removed from the shipping containers at the deep borehole complex and placed directly into metal emplacement canisters and sealed with kaolinite sealant, without any handling of dispersable Pu material. Emplacement canisters would be 0.4-m (16 in) in diameter, 6.1-m (20-ft) long, and contain 9 PCVs, which collectively contain 40.5 kg (89 lb) of Pu. Twenty-five emplacement canisters would be connected end-to-end in an emplacement string approximately 150-m (500-ft) long to facilitate faster canister insertion. A material flow diagram can be found in Figure 2.4.3.1–1.

The deep borehole subsurface facilities analyzed in this PEIS would consist of an array of four separate deep boreholes, with each deep borehole separated approximately 500 m (1,640 ft) from the nearest hole. Each deep borehole could be up to 4 km (2.5 mi) in depth. Figure 2.4.3.1–2 shows a typical deep borehole in which the upper 2 km (1.25 mi) or more of depth (the isolation zone) would pass completely through the water table and sedimentary and/or fractured crystalline rocks. The isolation portion of each borehole would be cased with steel pipe and filled and sealed with appropriate sealing materials to prevent influx and contamination of near surface waters. The lower 2 km (1.25 mi) would be drilled into crystalline basement rock that is isolated from the accessible environment. The emplacement zone of each borehole would contain 12 individual 150-m (500-ft) emplacement canister strings that would be grouted or cemented into place. Undercut seals would be installed between the canister strings in the emplacement zone for additional protection.

The deep borehole complex would occupy a land area of approximately 2,041 ha (5,043 acres), of which 57 ha (141 acres) would be occupied by the main facility and the assumed four-hole borehole array, with the remaining approximately 2,000 ha (4,940 acres) being buffer zone. Operations involving the Pu disposal form in the Surface Processing Facility are performed in an MAA that is hardened for security purposes. However, no direct contact with Pu is required. The MAA and facilities supporting MAA operations are located in a PA. The emplacement and borehole sealing facility to which the emplacement canisters are brought is also within a PA. Each PA is a secure, fenced area. The PA and operations involving any classified materials are contained within the LA. The PPA surrounds the LA and includes the buffer zone around the facility. The passenger vehicle parking and personnel services facilities are located outside the LA but within the PPA. A deep borehole facility site layout perspective is shown in Figure 2.4.3.1–3, and a list of deep borehole site buildings can be found in Appendix B.

The deep borehole complex would be designed to ensure that surface facilities could withstand earthquakes, high winds, or floods. The fire protection systems of the facility would be in accordance with DOE Orders and National Fire Protection Association Codes and Standards. The physical security, MC&A, IAEA safeguards, and physical security system facilities would be consistent with protecting Pu materials in the deep borehole complex surface facilities. In addition, the material would be emplaced to ensure post-emplacement downhole nuclear criticality safety.

The deep borehole complex would be a stand-alone site containing five types of facilities grouped by function. These five are described in the following:

Surface Processing Facilities. Surface processing facilities would receive the Pu metal and oxide disposal forms, provide lag storage of the received Pu materials, load emplacement canisters with the Pu metal and oxide disposal forms, and seal the canisters.

Drilling Facilities. Drilling rigs (either portable or constructed in place) would drill boreholes, seal natural and drilling-induced hydraulically conductive pathways in the host rock, install the casing in the isolation zone, and cement behind the casing to ensure a good hydraulic seal. Drilling facilities would mix various additives into the drilling mud and bring up brine from the bottom of the borehole as it is drilled. For this reason, each drilling facility would be provided with a wastewater treatment subsystem.

Emplacing-Borehole Sealing Facilities. One or more emplacing-borehole sealing facilities would emplace the Pu-bearing canisters, seal around the canister, and plug the upper 2-km (1.25-mi) isolation zone of the deep

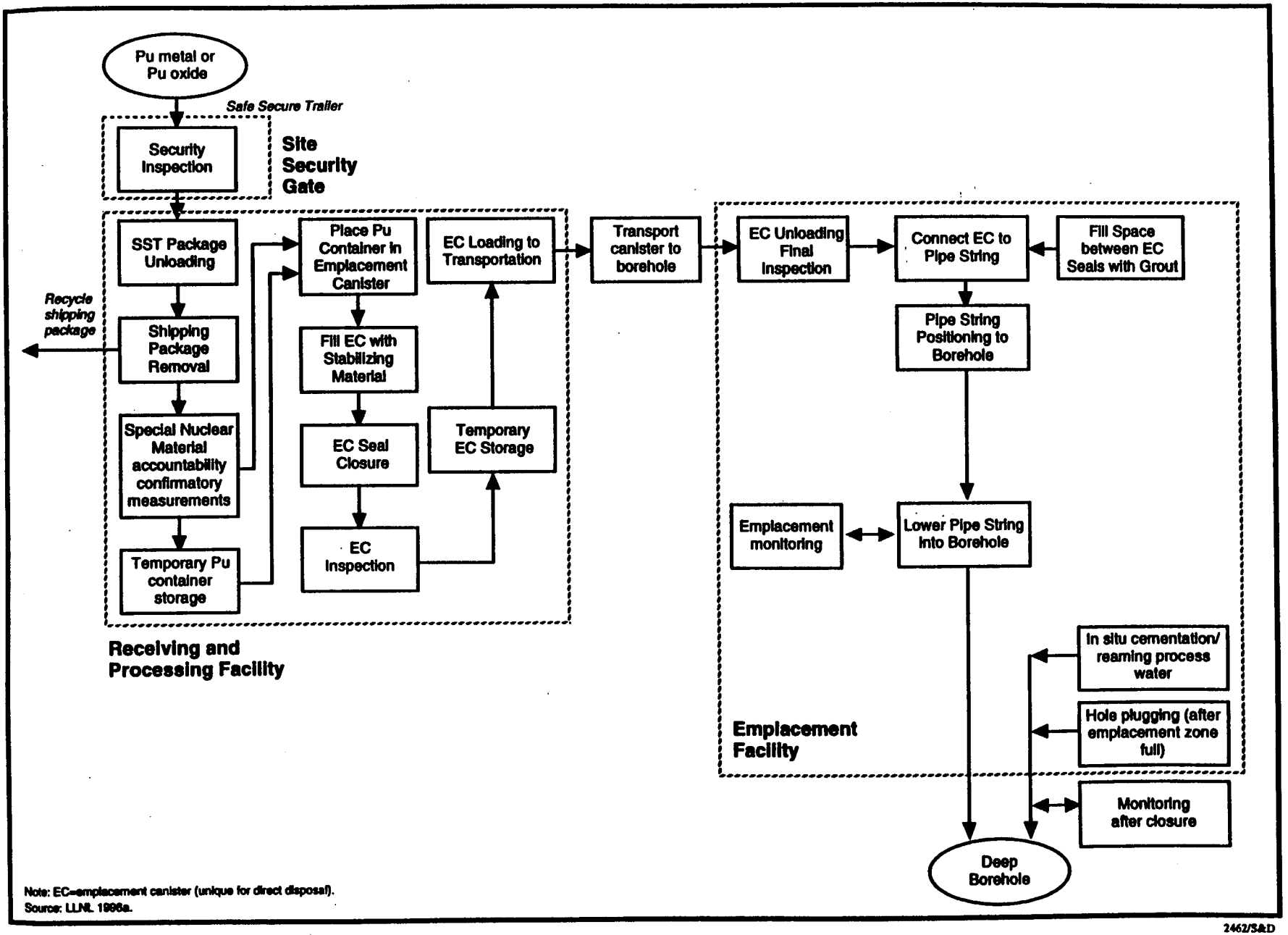


Figure 2.4.3.1–1. Deep Borehole Facility Material Flow Diagram —Emplaced Canisters—Direct Disposition Alternative.

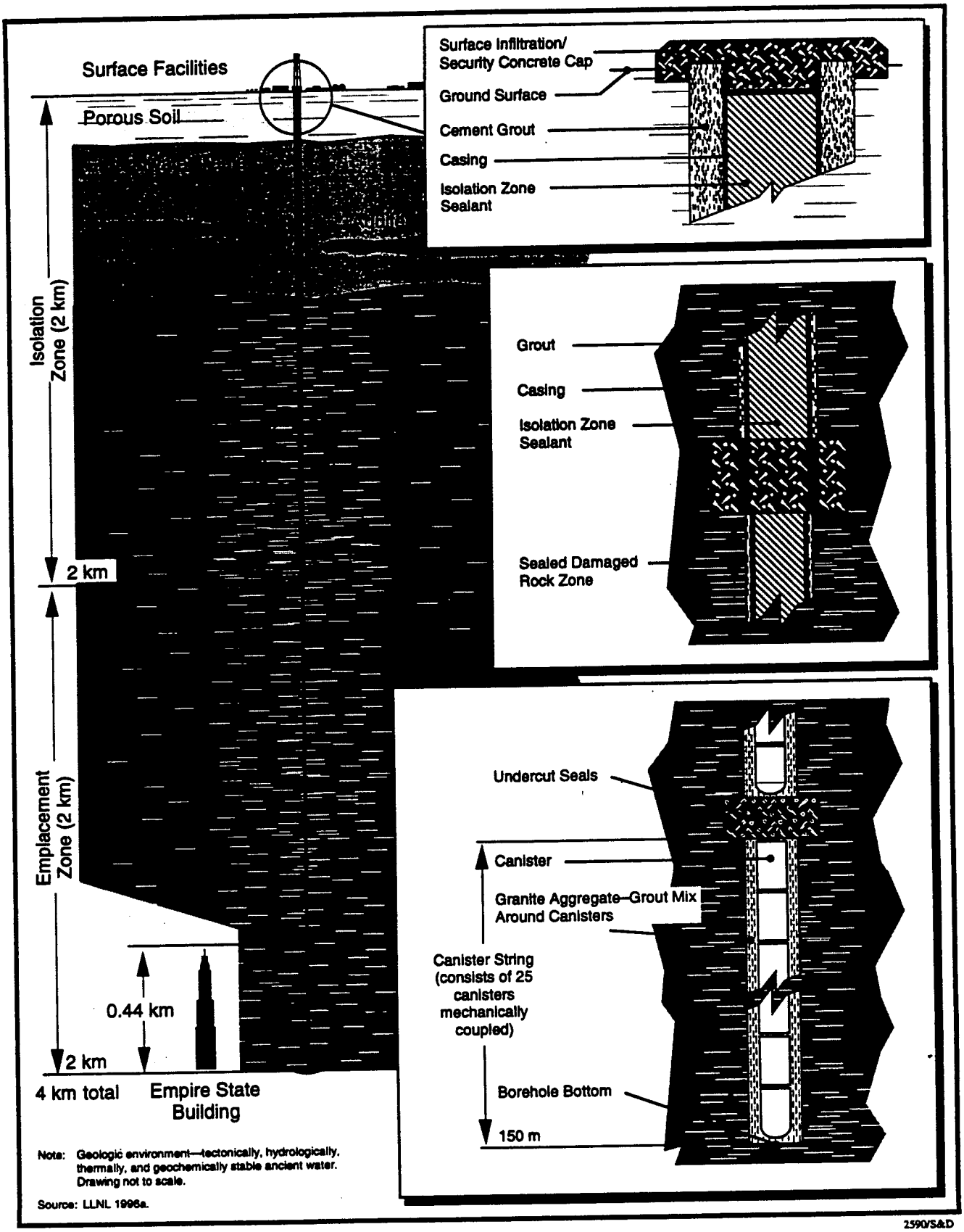


Figure 2.4.3.1–2. Cross-Section—Deep Borehole Typical Arrangement With Emplaced Canisters—Direct Disposition Alternative.

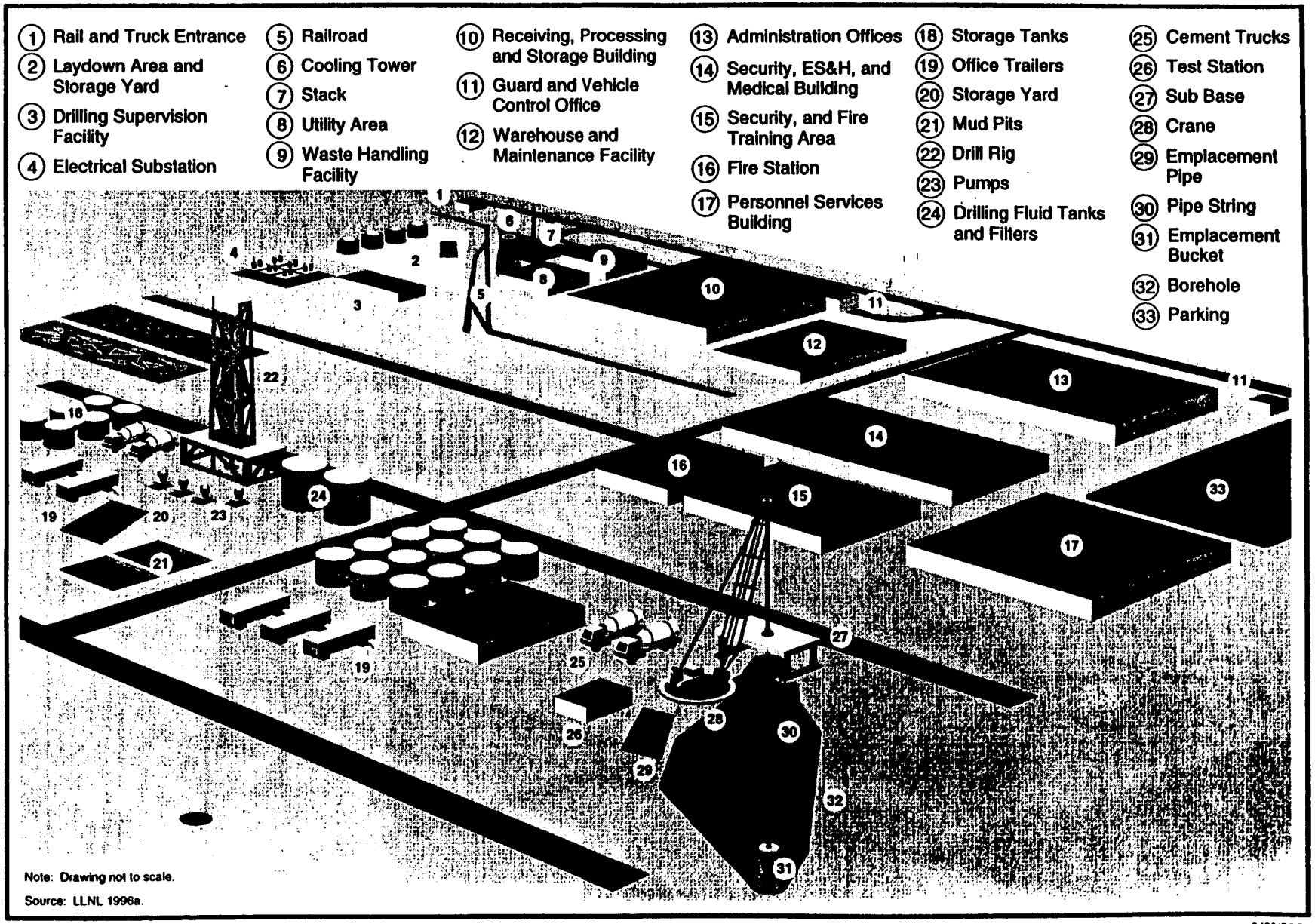


Figure 2.4.3.1–3. Conceptual Deep Borehole Facility Site Layout—Direct Disposition Alternative (Perspective).

borehole. Workers would assemble canister modules into canister strings for emplacement at this subfacility. Under normal conditions, the water pumped from the borehole during emplacement operations would not be contaminated with radioactivity, and the wastewater would be treated as in any drilling operation. However, the water must continually be tested for radioactive contamination, and if contaminated, the water would be redirected to the main facility process wastewater treatment system. A containment structure covers the borehole entrance and emplacing equipment to contain any Pu that could be released in the event of an accident or canister breakage during emplacement.

Waste Management Facility. A waste management facility would treat the process wastes, process wastewater, utility wastewater, and sanitary wastewater generated by borehole disposal operations.

Support and Balance-of-Plant Facilities. A support facility would consist of administration, plant operations, and BOP. The BOP facilities would include security, plant alarm, safety and decontamination systems, shipping and receiving, central warehouse, maintenance, and utilities to provide general operational support.

Facility Operations. The borehole facility could process and dispose of 5 t (5.5 tons) of Pu, in all forms, each year. Operations would be based on continuous operations 7 days a week, 24 hours a day, in two 12-hour shifts with three drilling crews. A surge capacity of 10 t/year (yr) (11 tons/yr) could be achieved by introducing a second 8-hr shift in the surface processing and emplacing-borehole sealing facilities and by adding a second drilling rig and extra crews, as needed, in the drilling facility. Utility consumptions, chemicals consumed, and the number of personnel required during operations are listed in Appendix C.

The raw water requirement for the deep borehole disposal facility would be approximately 166 million liters (l) yr (44 million gallons [gal]/yr), of which 91 million l/yr (24 million gal/yr) would be consumed by the main facility area and the remainder consumed by the drilling and emplacing-borehole sealing facilities in the borehole array area. A raw water subsystem could be provided from production wells, supply pumps, and transfer piping to the facility water subsystem. The annual water balance for the borehole facility is shown in Appendix D.

Construction. Additional land area requirements during construction would be approximately 6 ha (15 acres) for construction laydown, warehousing, and temporary parking. The construction of the borehole complex would require 3 years and have a peak annual employment of 870 construction workers. Materials and resources consumed and employment needs during construction are listed in Appendix C.

Construction of the deep borehole array requires drilling several boreholes up to 4-km (2.5-mi) deep into geologically stable rock formations. This would be accomplished using drilling techniques based on technology developed for and used extensively in the petroleum, mining, and scientific drilling industries, and for deep boreholes drilled in crystalline rocks for disposal of HLW. The drill system would include a derrick to lower and raise the drillstring and bit and to route the slurry and cuttings. A slurry of water, compressed air, and bentonite additives would be pumped into the borehole to bring up cuttings. The used slurry then would be sent to a holding area to allow cutting solids to settle. The slurry would be filtered to remove coarser particles before it is recycled. When drilling holes down, two pipes, one inside the other, would be used. The fresh mud slurry would flow in the area between pipes (the annulus), and the cuttings would flow to the surface through the center pipe.

Boreholes would be drilled with their diameter decreasing with depth in a stepwise fashion, as dictated by site drilling conditions. A metal casing, smaller in outside diameter than the hole, would be inserted, and a cement slurry would be pumped at high pressure into the annulus between the casing and rock or soil in the isolation zone. Casing is not used in the emplacement zone. At specific locations in the borehole, the hole would be widened (undercut) to a larger diameter to provide a seat for seals and plugs. These seals and plugs, required to prevent vertical migration of fluids, would be installed during canister emplacement to achieve borehole closure.

A 3-year construction schedule is assumed for the deep borehole facility. The estimated total quantity of generated solid and liquid wastes associated with construction of the deep borehole disposal facility is shown in Appendix E. The waste generation data are based on factors from historic data on construction area size and construction labor force. Solid wastes would be hauled offsite for disposal during the construction period.

Waste Management. Waste management for the deep borehole complex would handle the treatment of criteria air pollutants, toxic and hazardous air emissions, and other gases emitted during operation and construction. Facility waste management would also include handling and treatment operations for processing TRU, low-level, and mixed waste, as well as industrial waste in aqueous, organic liquid, or solid forms generated from the onsite deep borehole disposition operations or from other site activities. Waste management would be in accordance with DOE Order 5820.2A and RCRA. TRU waste generated from deep borehole operations would be treated and packaged for disposal to WIPP (should DOE decide to operate WIPP for TRU disposal) in accordance with WIPP WAC (WIPP-DOE-069) and in accordance with decisions to be made as a result of the *Waste Isolation Pilot Plant Disposal Phase Supplemental Environmental Impact Statement*. A waste management process flow diagram is shown in Appendix E.

Estimated annual quantities of air pollutant emissions due to operation of the deep borehole disposal facility are shown in Appendix F. These emissions would result from minor borehole gases and fuel and gas consumption necessary to drill and, later, close the deep boreholes. Chemical processes that may lead to the release of contamination over time are unlikely in the abbreviated times associated with the canister emplacement, backfill, and closing processes. More likely are releases resulting from mechanical accidents where the containment canisters are breached.

Transportation. Intrasite transport of radiological materials will be limited to Pu metal and oxide container transport. There is no handling or processing of Pu on the site under normal operations. Intersite transportation of Pu material coming into the deep borehole facility from offsite would be in SSTs.

2.4.3.2 Immobilized Disposition Alternative

The second disposition alternative based on the deep borehole concept would immobilize surplus Pu in a ceramic spherical pellet form. Under this alternative, the output material from the pit disassembly/conversion and Pu conversion facilities would be sent to a ceramic immobilization facility. The ceramic immobilization facility would receive Pu feed in both oxide and metal forms. The output from the ceramic immobilization facility would be 2.54-centimeter (cm) (1-inch [in]) diameter coated ceramic pellets containing 1 percent by weight Pu. The ceramic pellets of Pu would be shipped by SST to the deep borehole facility. At the deep borehole facility the Pu-loaded ceramic pellets would be mixed with an equal volume of Pu-free commercially produced ceramic pellets and kaolinite clay grout and the mix would be directly emplaced in the borehole without any canisters. The drilling operations at the borehole facility would be similar to those described in the previous section. The emplacement of ceramic pellet-grout mix would be done either by bucket delivery or by pneumatically pumping slugs of the ceramic pellet-grout mix down a drill pipe. The sealing of the boreholes to isolate the emplaced Pu from the accessible environment would be as described in the previous section. Although representative locations for the ceramic immobilization facility are analyzed, no specific deep borehole locations have been considered. All requirements shown in this section, both for the ceramic immobilization facility and the deep borehole, are additive and are in addition to those requirements previously described for the pit disassembly/conversion and the Pu conversion facilities.

Facility description and operations, construction, waste management, and transportation descriptions for the ceramic immobilization facility are in the next section. They are followed by facility description and operations, construction, waste management, and transportation descriptions for the deep borehole complex.

2.4.3.2.1 *Ceramic Immobilization Facility—Immobilized Disposition Alternative*

Facility Description. A ceramic immobilization facility site of 18 ha (45 acres) would be required. The ceramic immobilization facility site layout is shown in Figure 2.4.3.2.1–1. The facility would be centered around a Pu processing facility and would contain waste processing and support facilities. The list of facilities is found in Appendix B. Support processes required at the immobilization facility would include radioactive liquid waste treatment, process offgas treatment, and waste solidification. Scrap recovery and Pu recycle, MC&A, cold chemical storage and makeup, process gas supply, material handling, equipment decontamination, and maintenance systems would also be required.

The ceramic immobilization facility would be designed to ensure that surface facilities could withstand earthquakes, high winds, and floods. The fire protection systems of the plant would be in accordance with DOE orders and National Fire Protection Association Codes and Standards. The material would be handled to ensure criticality safety. The physical security, materials control and accountability, IAEA safeguards, and physical security system facilities would be consistent with protecting DOE-defined Category I and II type special nuclear materials.

Facility Operations. Operations at the ceramic immobilization facility would process both Pu metal and oxide. The Pu metal would be oxidized, added to the material received as Pu oxide, and the oxides dissolved in an electrochemical solution consisting of nitric acid and silver nitrates. Plutonyl nitrate solution formed from the dissolution process would be mixed with ceramic additives called precursors. After sampling and feed adjustment, the solution would be calcined in a rotary calciner and converted to oxide powder. The powder would be fed into an anvil powder compacting press, which would compact the oxide powder to form green ceramic pellets. The pellets would be sintered at 1,200 degrees Celsius (°C) (2,200 degrees Fahrenheit [°F]) for about 8 hours. The resultant pellets would be spheres, about 2.54 cm (1 in) in diameter, and would contain about 1 percent Pu by weight. The pellets would contain Pu dispersed throughout the sphere, with an exterior coating of durable non-Pu-bearing ceramic material, and would be shipped to the deep borehole site via SST. The material flow through the ceramic immobilization process is shown in Figure 2.4.3.2.1–2.

The ceramic immobilization facility could process Pu metal and PuO_2 feed in the amount of 25 kg/day (55 lb day). Operations would be based on 3 shifts per day, 7 days per week, 24 hours per day. Normal plant availability is considered to be 200 days per year. The oxide dissolution rate is about 1.1 kg/hour (h) (2.4 lb/h). About 126 l (33 gal) of 200 g Pu/l (1.6 lb/gal) plutonyl nitrate solution is produced each day. Annual utility consumptions for the ceramic immobilization facility are listed in Appendix C, along with the chemicals consumed during ceramic immobilization operations and the number of personnel required during ceramic immobilization operations.

The raw water requirement for the ceramic immobilization facility would be approximately 322 million l/yr (85 million gal/yr). The annual water balance diagram for the ceramic immobilization facility is shown in Appendix D.

Construction. Additional land area requirements during construction of the ceramic immobilization facility would be approximately 28 ha (70 acres) of land for construction activities, laydown, and temporary parking. The construction of the ceramic immobilization facility would require 5 years and have a peak annual employment of 1,000 construction workers. Materials and resources consumed and employment needs during facility construction are listed in Appendix C. The peak construction year is based on the construction schedule. Estimated total quantities of solid and liquid wastes generated from activities associated with construction of new facilities are shown in Appendix E. [Text deleted.] Solid wastes would be hauled offsite for disposal during the construction period.

Waste Management. The ceramic immobilization facility would have its own facilities to control emissions of criteria pollutants, toxic and hazardous air pollutants, and other gases emitted during operation and construction.

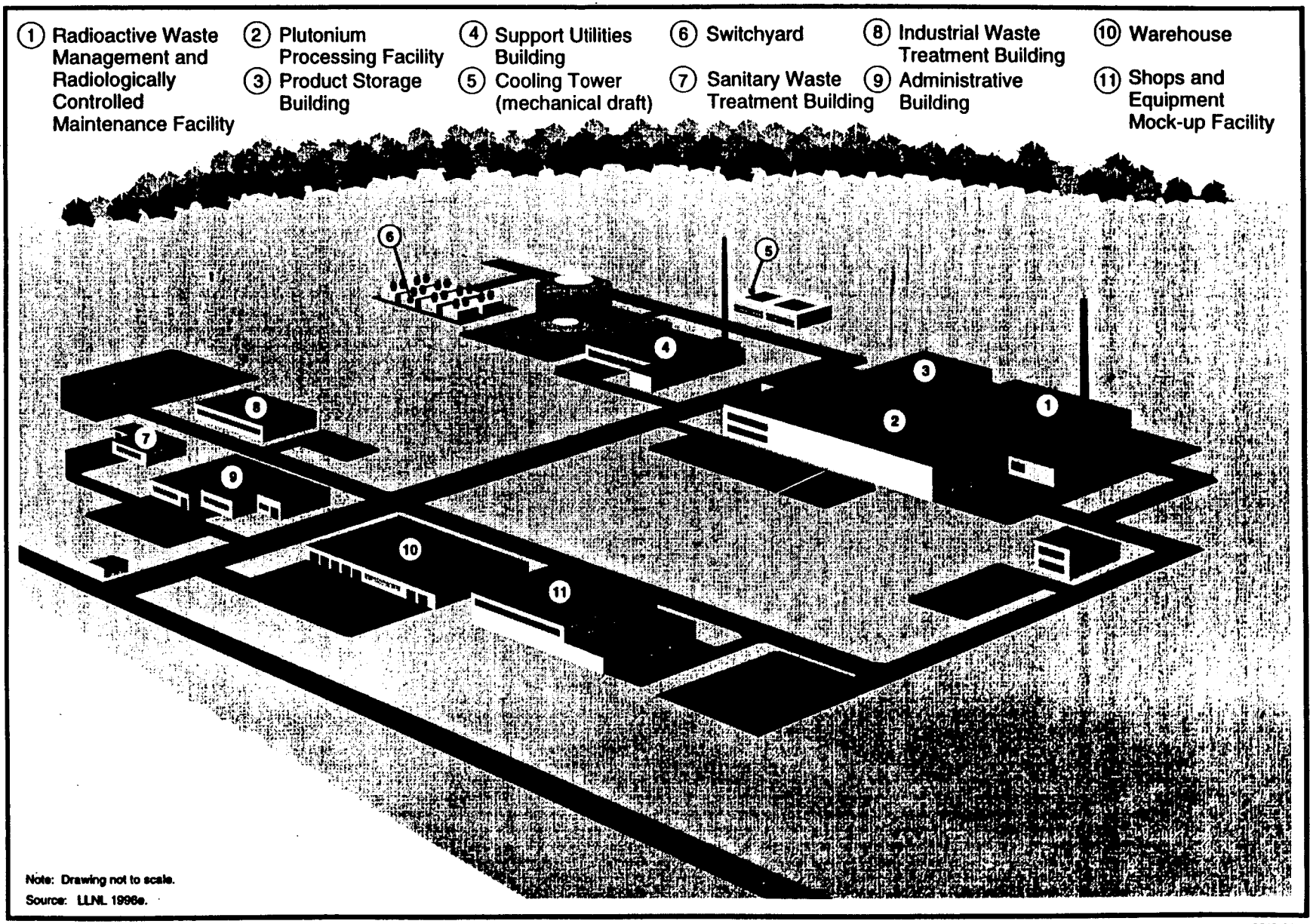


Figure 2.4.3.2.1–1. Conceptual Ceramic Immobilization Facility Site Layout—Immobilized Disposition Alternative (Perspective).

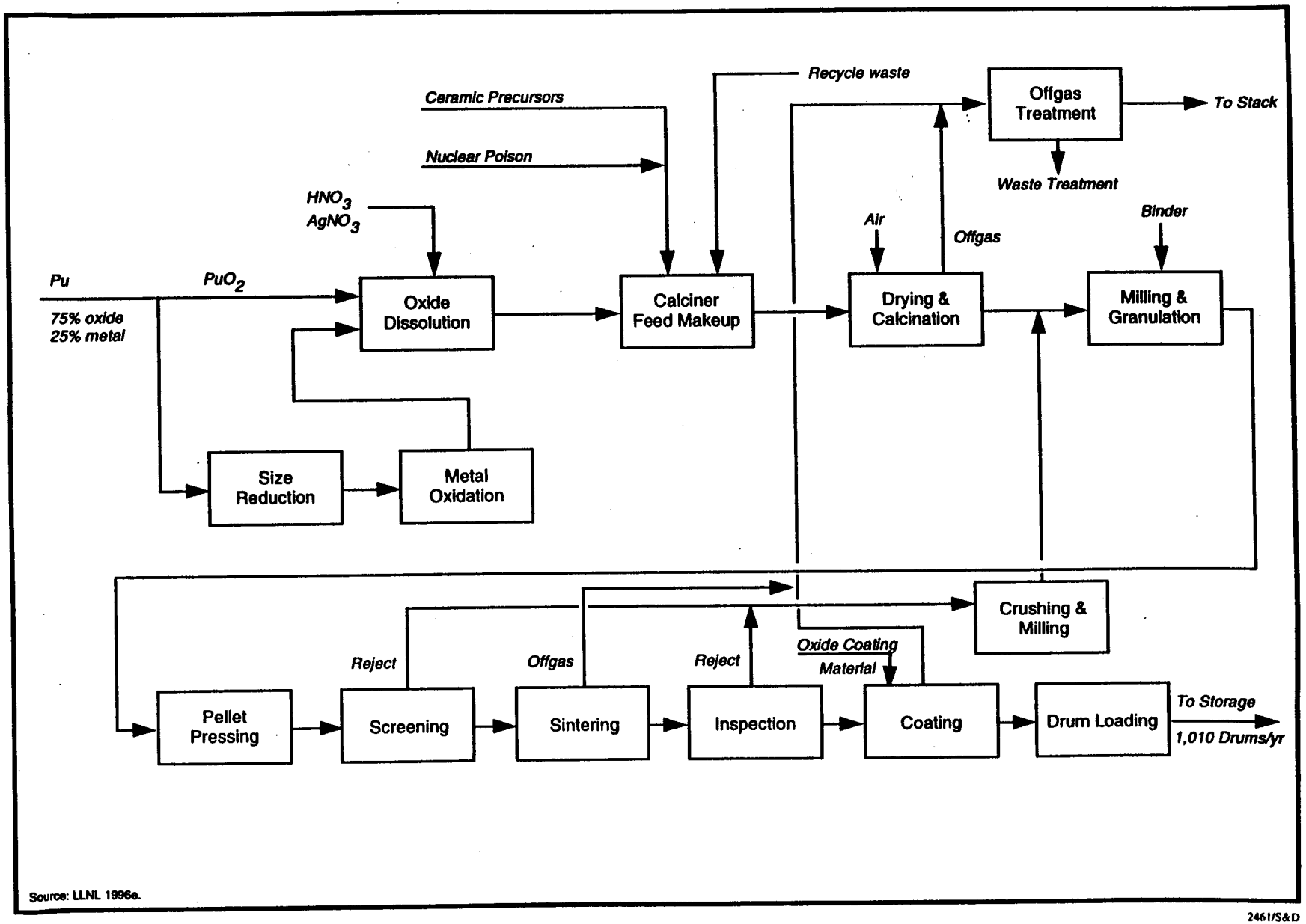


Figure 2.4.3.2.1–2. Ceramic Immobilization Facility Material Flow Diagram—Immobilized Disposition Alternative.

Facility waste management would also include handling and treatment operations for processing TRU, low-level, and mixed wastes, as well as industrial waste in aqueous, organic liquid, or solid forms generated from onsite operations. Waste management would be in accordance with DOE Order 5820.2A and RCRA. TRU waste generated from operations would be disposed of at WIPP (should DOE decide to operate WIPP for TRU disposal) in accordance with WIPP WAC (WIPP-DOE 069) and in accordance with decisions to be made as a result of the *Waste Isolation Pilot Plant Disposal Phase Supplemental EIS*. The waste management process flow diagram and annual quantities of wastes expected to be generated during ceramic immobilization operations are shown in Appendix E. The estimated air emissions from the ceramic immobilization processes are shown in Appendix F.

Transportation. Intrasite transport of radiological materials at the ceramic immobilization facility would be limited to the transport of shipping containers of Pu metal and oxide into the processing facility and the shipping and handling of ceramic pellets containing Pu. Intersite transportation requirements exist for material coming into the ceramic immobilization facility from offsite and material being shipped from the ceramic immobilization facility to the deep borehole complex.

2.4.3.2.2 *Deep Borehole Complex—Immobilized Disposition Alternative*

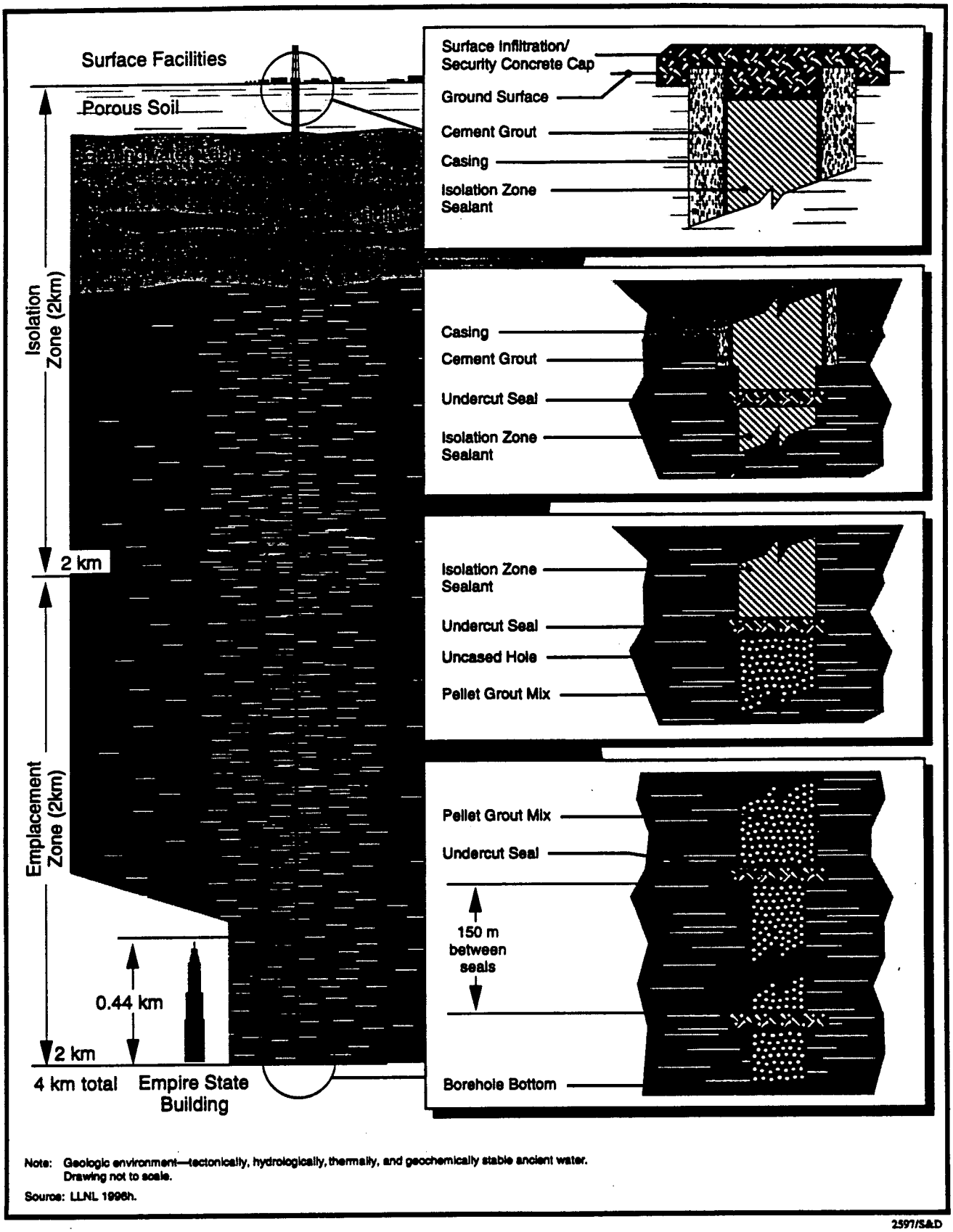
Facility Description. The facilities required for disposal after immobilization are similar to those for direct disposition (Section 2.4.3.1), with minor exceptions in the receiving and storage facilities and an additional pellet-grout mixing facility and process waste management in the emplacing facilities. As explained in Section 2.4.3.1, subsurface facilities would consist of an array of four separate boreholes, with each deep borehole separated approximately 500 m (1,640 ft) from the next nearest hole. Each deep borehole would be about 4 km (2.5 mi) in depth. Figure 2.4.3.2.2–1 shows the cross-section of a typical deep borehole, in which the upper 2 km (1.25 mi) or more of depth would pass completely through the water table. The deepest 2 km (1.25 mi) would be drilled into crystalline basement rock that is isolated from the accessible environment.

The deep borehole complex would require approximately 2,041 ha (5,043 acres) and would include the same five groups of surface facilities with the subsurface borehole array as discussed in Section 2.4.3.1. The deep borehole site layout is shown in Figure 2.4.3.2.2–2.

The deep borehole facilities would be designed to ensure that surface facilities could withstand earthquakes, high winds, and floods. The fire protection systems of the site would be in accordance with DOE orders and National Fire Protection Association Codes and Standards. The physical security, materials control and accountability, IAEA safeguards, and physical security system facilities would be consistent with protecting DOE-defined Category I and II type special nuclear materials in the deep borehole complex above ground facilities. In addition, the material would be emplaced to ensure post-emplacement downhole criticality safety.

Facility Operations. The deep borehole complex would receive ceramic pellets of immobilized Pu from the ceramic immobilization facility. Material handling of the pellets would be accomplished at the borehole site, mixing ceramic pellets with grout before emplacement. No canisters would be required to emplace the ceramic pellets into the boreholes. This operation would be done without contamination risk or radiation hazard at the deep borehole site during normal operations. As in direct disposition, the containment structure located above the deep borehole entrance would contain any Pu releases if there were accidental breakage. The material flow through the deep borehole facility is shown in Figure 2.4.3.2.2–3.

The surface processing and emplacement/sealing facilities of the deep borehole complex would operate 5 days per week, 8 hours per day, 250 days per year. The drilling facility would operate 7 days per week, 24 hours per day in two 12-hour shifts with three drilling crews. The surge rate would be handled by introducing a second 8-hour shift in the surface processing and emplacement/sealing facilities and adding a second drilling rig and additional crew, if needed, in the drilling facility. Annual utility consumptions for the deep borehole operations are listed in Appendix C, along with the chemicals consumed and the number of personnel required during deep



Note: Geologic environment—tectonically, hydrologically, thermally, and geochemically stable ancient water. Drawing not to scale.

Source: LLNL 1996h.

2597/S&D

Figure 2.4.3.2.2–1. Cross-Section—Deep Borehole With Typical Arrangement With Coated Ceramic Pellets in Grout—Immobilized Disposition Alternative.

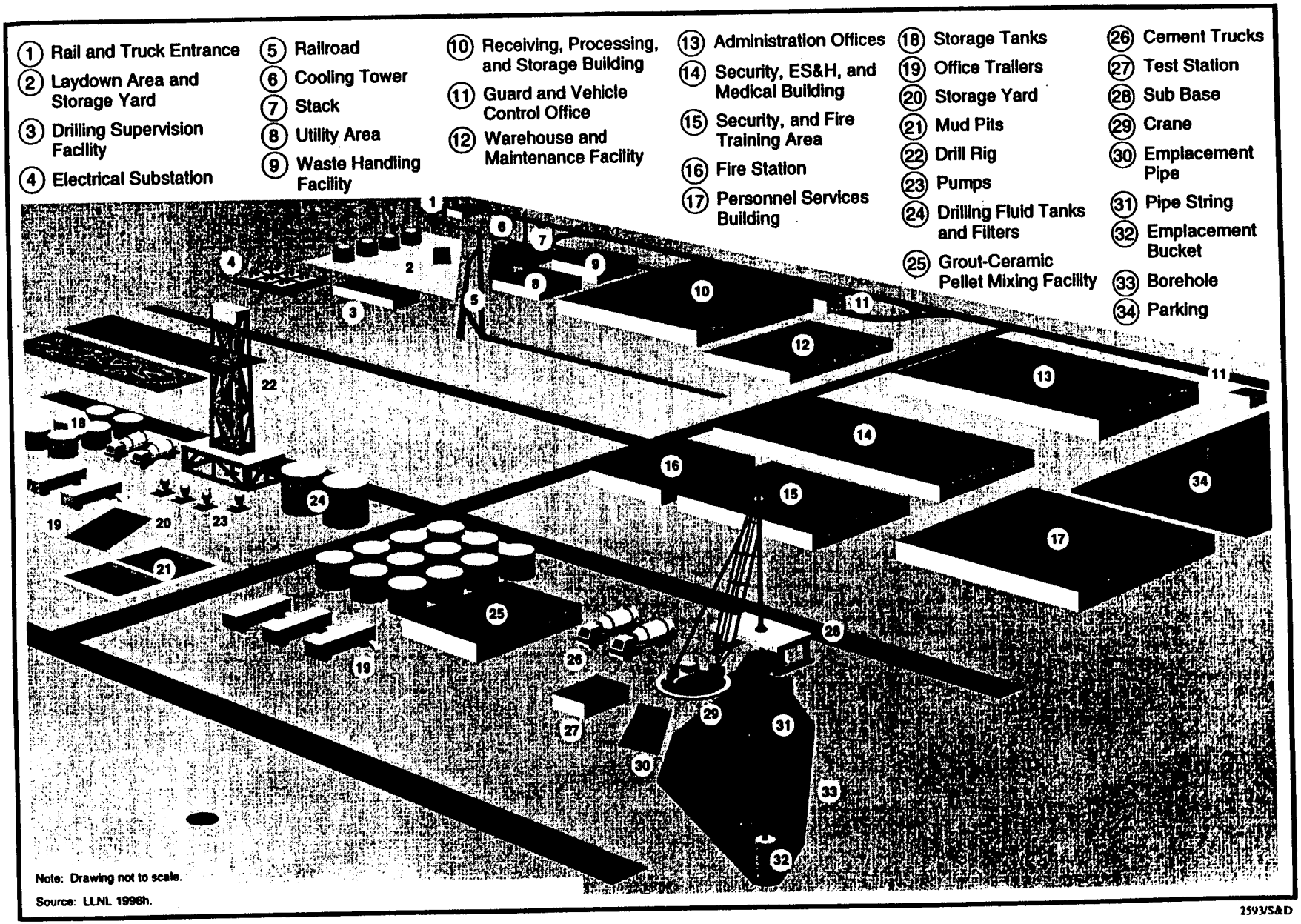


Figure 2.4.3.2.2–2. Conceptual Deep Borehole Facility Site Layout (Perspective).

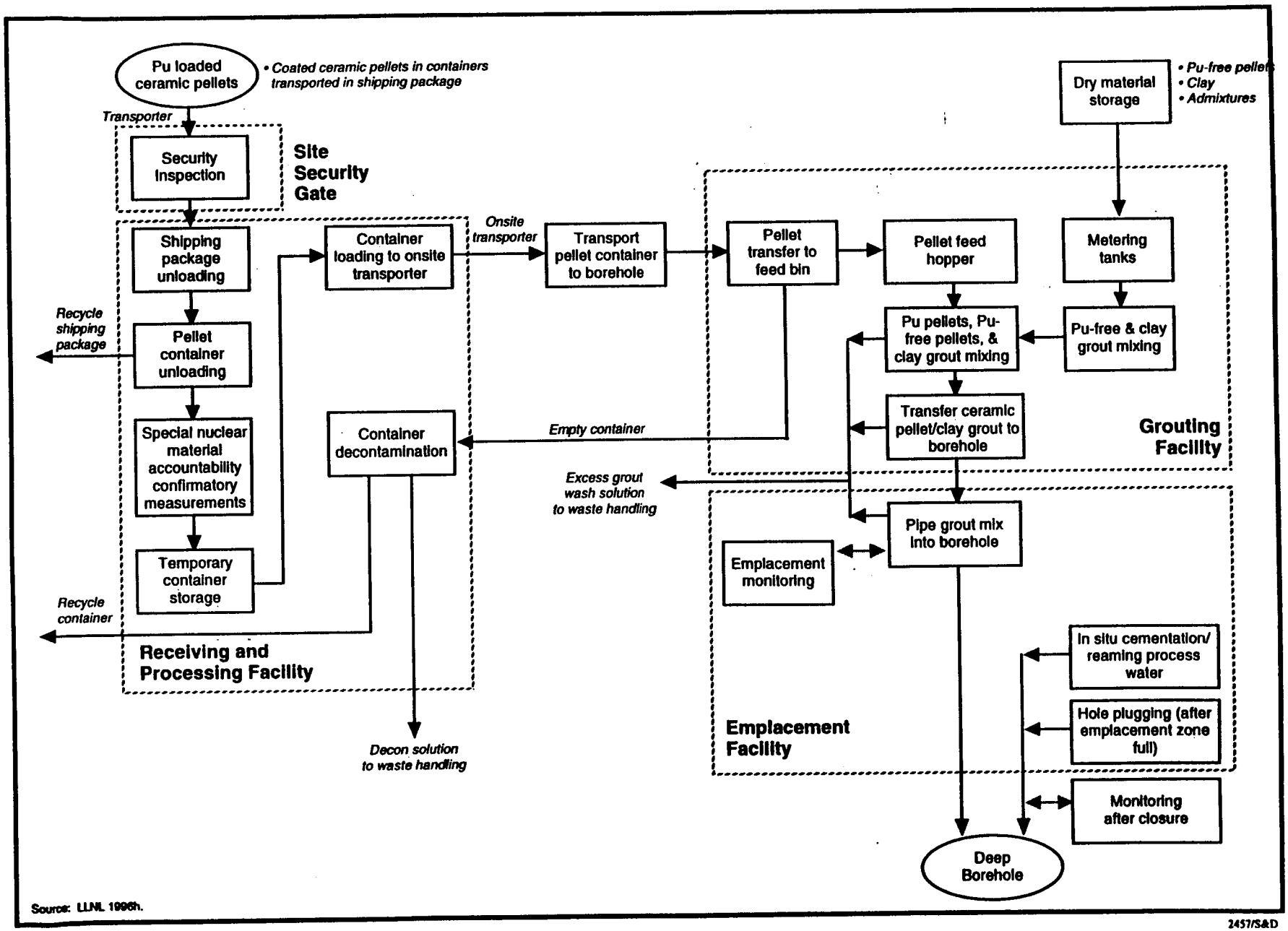


Figure 2.4.3.2.2–3. Deep Borehole Facility Material Flow Diagram—Immobilized Forms.

borehole operations. The annual water balance diagram for the deep borehole facility is shown in Appendix D. The raw water requirement for the deep borehole facility would be 138 million l/yr (36 million gal/yr).

Construction. Additional land area requirements during construction of the deep borehole complex would be 6 ha (15 acres) for construction laydown, warehousing, and temporary parking. The construction of the deep borehole facility would require 3 years and have a peak annual employment of 810 construction workers. Materials and resources consumed and employment needs during facility construction are listed in Appendix C. The peak construction year is based on the construction schedule. Estimated total quantities of solid and liquid wastes generated from activities associated with construction of new facilities are shown in Appendix E. [Text deleted.] Solid wastes would be hauled offsite for disposal during the construction period.

Waste Management. The deep borehole complex would have its own facilities to control emissions of criteria pollutants, toxic and hazardous air pollutants, and other gases emitted during operation and construction. Facility waste management would also include handling and treatment operations for processing industrial waste in aqueous, organic liquid, or solid forms generated from the onsite deep borehole operations or from other site activities. Waste management would be in accordance with DOE Order 5820.2A and RCRA. The waste management process flow diagram is shown in Appendix E as are the annual quantities of wastes expected to be generated during deep borehole operations. The estimated air emissions from the deep borehole operations are shown in Appendix F.

Transportation. Intrasite transport of radiological materials at the deep borehole would be limited to transport and handling of ceramic pellets. Intersite transportation requirements for radioactive material being shipped from the offsite ceramic immobilization facility to the deep borehole complex are shown in Section 4.4 (Table 4.4.2.2–1).

2.4.4 IMMOBILIZATION CATEGORY

Under this category of alternatives, surplus Pu would be immobilized in a subcritical matrix to create a chemically stable form for disposal in a HLW repository. The fissile material would be immobilized after mixing with radioactive isotopes from HLW or CsCl capsules to create a radiation field that could serve as a proliferation deterrent comparable to commercial spent nuclear fuel.

This PEIS analyzes the following three immobilization alternatives:

- Vitrification
- Ceramic immobilization
- Electrometallurgical treatment (GBZ form)

In addition, based upon comments from the public on the Draft PEIS there is substantial interest in the can-in-canister concept for the disposition of surplus Pu, and requests for DOE to consider its use. Accordingly, additional information on this concept is presented in Appendix O. The can-in-canister concept includes variations to the two Pu disposition alternatives for vitrification and ceramic immobilization. The can-in-canister concept could use modified existing facilities at SRS to perform the functions of the various pit disassembly/conversion, Pu conversion, and vitrification or ceramic immobilization facilities. For the vitrification can-in-canister approach, Pu would be immobilized in a glass matrix in small cans and the cans placed in stainless steel canisters which are then filled with molten HLW to serve as the radiation barrier. For the ceramic can-in-canister approach, Pu would be immobilized in a ceramic matrix in lieu of the borosilicate glass. In both cases, canisters would be filled at the DWPF and placed in lag storage at SRS until shipment to a HLW repository is possible.

2.4.4.1 Vitrification Alternative

Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, packaged, and transported to the vitrification facility. The vitrification facility would be constructed or an existing facility would be modified, and the facility operated to accept surplus Pu in the form of metal and oxides. The Pu would be vitrified in borosilicate glass (or other types of glass) logs encased in stainless steel canisters. Also, HLW or the highly radioactive isotope Cs-137 would be mixed into the borosilicate glass to serve as a radiation barrier to theft and diversion. The Cs-137 isotope could be separated from CsCl capsules currently stored at Hanford. Gadolinium, hafnium, or another neutron absorber would be included along with the boron in the glass logs to prevent criticality. The borosilicate glass logs would be emplaced in a HLW repository (or alternative) for disposal. The absence of any RCRA-regulated hazardous materials in the final glass form would need to be demonstrated prior to acceptance into a HLW repository. The vitrified forms would remain in onsite vault-type lag storage, and would not be transported to a disposal site until such site is operational pursuant to separate appropriate NEPA documentation. A material flow diagram is presented in Figure 2.4.4.1–1. All requirements described in this section are in addition to those requirements previously described for the pit disassembly/conversion and the Pu conversion facilities.

Facility Description. The vitrification facility site layout for a new facility is shown in Figure 2.4.4.1–2. The facility data are found in Appendix B. The overall site would occupy approximately 12 ha (30 acres). All buildings would be located within a fenced area, with the Pu processing, radioactive waste management, and storage buildings contained within a PA. The mission of the key buildings in the vitrification facility follows.

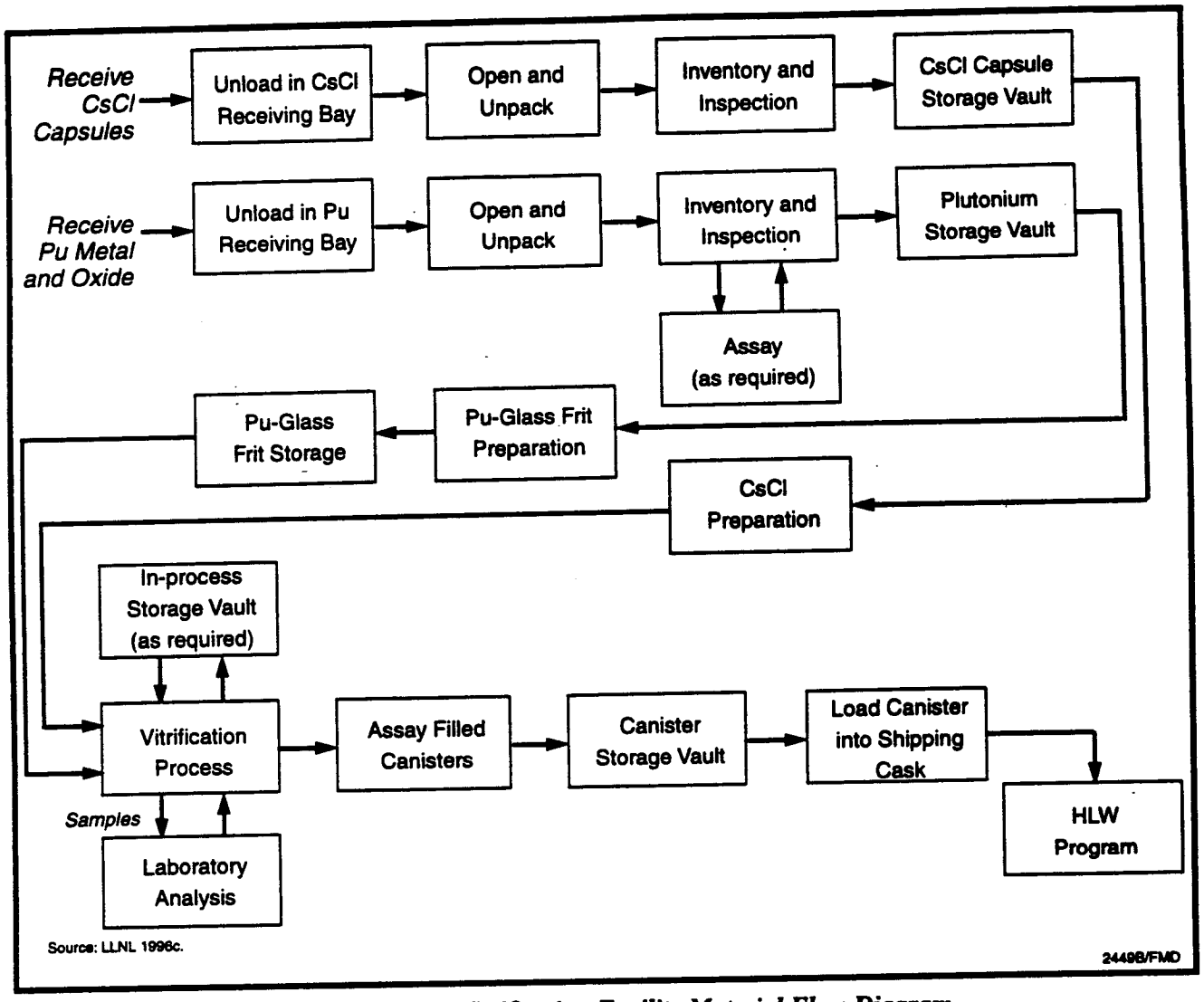


Figure 2.4.4.1–1. Vitrification Facility Material Flow Diagram.

Vitrification Building. The vitrification building would provide the following functions:

- Shipping, receipt, assay, and storage of all incoming radioactive process feed materials
- Accountability, repackaging, control, and temporary in-process remote storage of Pu, Cs, and other radioactive materials, and cold storage of chemical feed materials and borosilicate glass frit
- Conversion of incoming Pu metal and oxide to a borosilicate glass containing PuO_2 for subsequent inclusion within the vitrification process
- CsCl capsule and/or HLW processing and preparation for inclusion within the Pu-bearing borosilicate glass melt
- Processing of combined Cs-137/PuO_2 borosilicate glass melt
- Encapsulation, decontamination, and shipment of the combined Cs-137/PuO_2 borosilicate glass melt in a stainless steel cask to a repository (or alternative) for disposition

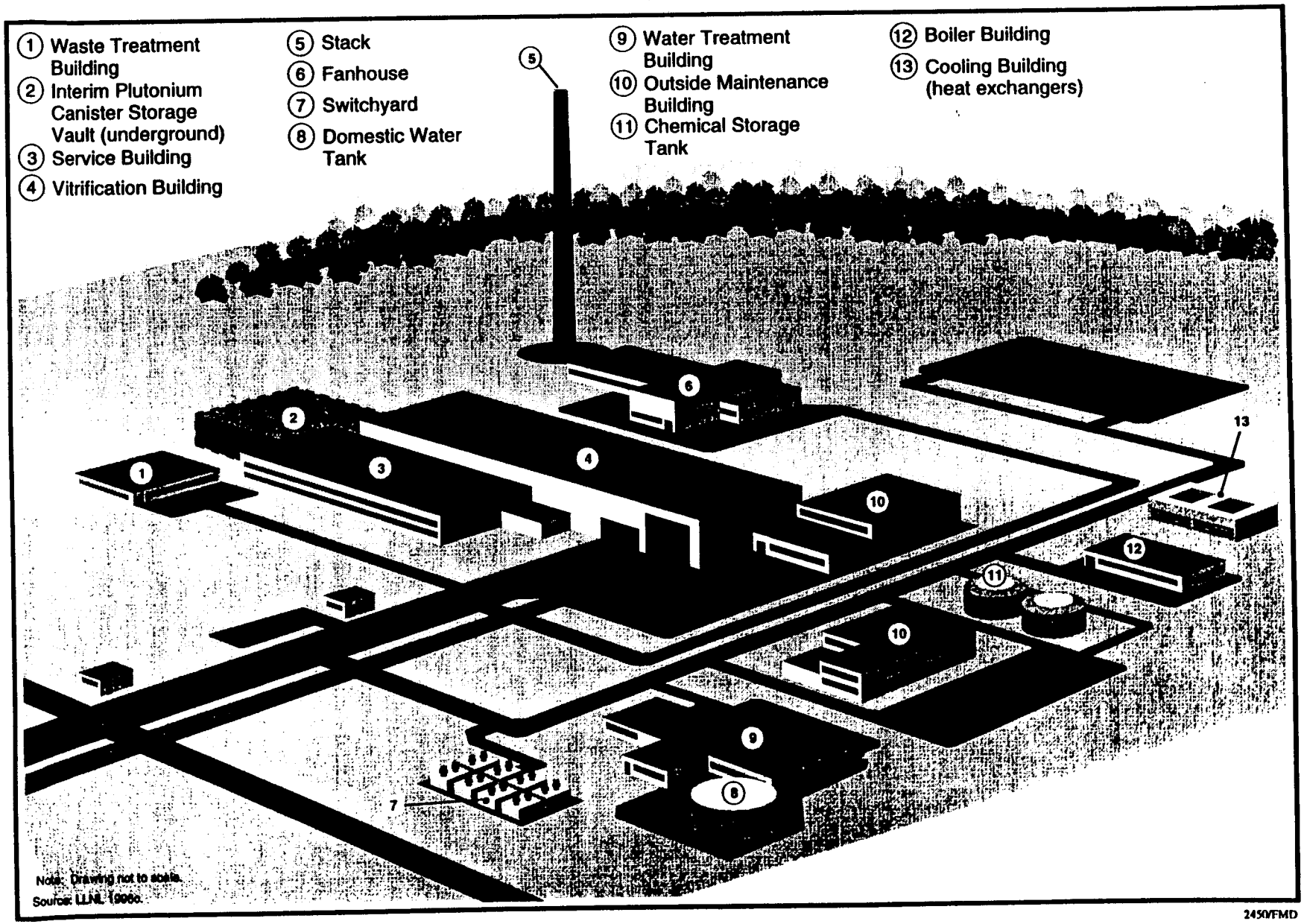


Figure 2.4.4.1–2. Conceptual Vitrification Facility Site Layout (Perspective).

- Material accountability and temporary remote safe storage of completed and loaded casks awaiting transport to the repository or alternative
- Scrap treatment and recycle of recovered Pu and Cs for inclusion within the immobilization process
- Area access control, health physics, and personnel support

Service Building. The service building would provide the following functions:

- Central control for the main process and the crane
- Administrative support and office space, an analytical laboratory, training rooms, mock-up rooms, a lunchroom, change rooms, shops, an electrical equipment room, a utility equipment area, and warehousing
- Serve as the security access control point for the facility, providing regulated and nonregulated sections for radiation monitoring, decontamination, and access control

Interim Plutonium Canister Storage Vault. This building provides interim or lag storage after initial thermal cooling until shipment to a HLW repository.

Maintenance Building. This building would provide space for work on service vehicles and equipment that are too large for the service building.

Radwaste Building. This building would provide waste management for monitoring, treating, and handling liquid and solid radioactive wastes, industrial and chemical wastes, and sanitary/stormwater waste.

Chemical Storage Tank. This building would contain the nitric acid supply for washdown solution for decontaminating some of the process cells and equipment.

Cooling System. This building would provide cooling for water used in the immobilization process, air compressors, HVAC, and other process equipment.

Facility Operations. The vitrification facility would process surplus Pu into glass logs. A normal operating year would be 200 days. Nominal throughput in the vitrification facility would be 25 kg (55 lb) of Pu per operating day. The operating schedule assumes 3 shifts per day, 7 days per week. Time is allowed for remote maintenance, accountability, criticality control, and other functions that would shut down vitrification operations during the 165 days per year that the plant would not be expected to operate. Expected annual utility consumption, chemicals consumed, and the number of personnel required during operation are listed in Appendix C.

The raw water requirement for the vitrification facility would be approximately 250 million l/yr (66 million gal/yr). The annual water balance for the vitrification facility is provided in Appendix D.

The vitrification facility would be designed to ensure that facilities could withstand earthquakes, high winds, and floods. The fire protection systems of the plant would be in accordance with DOE Orders and National Fire Protection Association Codes and Standards. The physical security, materials control and accountability, IAEA safeguards, and physical security system facilities would be consistent with protecting DOE-defined Category I and II type special nuclear materials.

Construction. Additional land area requirements during construction would be approximately 12 ha (30 acres) for laydown areas, erosion control facilities, temporary utilities, and non-radioactive storage areas. The construction of the vitrification facility would require 5 years and have a peak annual employment of 382

construction workers. Materials and resources consumed and employment needs during construction are listed in Appendix C.

Estimated total quantities of solid and liquid wastes generated from activities associated with construction of the vitrification facility are shown in Appendix E. [Text deleted.] Solid wastes would be hauled offsite for disposal during the construction period. Waste management would be in accordance with DOE Order 5820.2A and RCRA.

Waste Management. The soil and liquid nonhazardous wastes generated during construction would include concrete and steel construction waste materials and sanitary wastewater. The steel construction waste would be recycled as scrap metal before construction was completed. The remaining nonhazardous wastes generated during construction would be disposed of by the construction contractor as part of the construction project. Uncontaminated wastewater could be used for soil compaction and dust control, and excavated soil would be used for grading and site preparation. Wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling. Hazardous wastes such as adhesives, oils, and solvent rags would be packaged in DOT-approved containers and shipped to offsite commercial RCRA-permitted treatment, storage, and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any were generated, it would be managed in accordance with site practice and all Federal and State standards.

Operation of the vitrification facility would generate TRU, low-level, hazardous, mixed, and nonhazardous wastes. The conceptual design includes waste management facilities that would treat and package all waste generated into forms that would enable staging and disposal in accordance with RCRA and other applicable statutes. TRU and mixed TRU waste would be treated and packaged to meet the WIPP WAC. These wastes would be stored awaiting shipment to a Federal repository (assumed to be WIPP, depending on decisions resulting from the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste). LLW would be treated and packaged to meet the WAC of an onsite or offsite DOE LLW disposal facility. DOE LLW treatment, storage and disposal sites that would be used would be consistent with decisions resulting from the Waste Management PEIS and NEPA reviews tiered from that PEIS. Mixed LLW would be treated and disposed of in accordance with the respective site treatment plan developed to comply with the *Federal Facility Compliance Act* of 1992 and would be in accordance with decisions made pursuant to the Waste Management PEIS and tiered NEPA documents. Hazardous wastes would be packaged in DOT-approved containers and shipped offsite to RCRA-permitted treatment and disposal facilities. Liquid nonhazardous wastes such as sanitary, utility, and process wastewater would be treated, and either discharged in accordance with site practice or reclaimed to use as makeup water when economically and/or environmentally desirable. Solid nonhazardous waste would be disposed of in permitted landfills and recycled as appropriate. The vitrified Pu (with Cs or HLW) would be stored in the lag storage facility until shipment to and disposal in a HLW repository under the NWPA. Additional details can be found in Section E.3.2.4.

Transportation. Intrasite transport of radiological materials that are not vitrified would be limited to the secure transportation of shipping containers of Pu metal and oxide, and either CsCl capsules or HLW (via pipeline). Pu metal or oxide would be delivered from offsite by SST and transported to the Pu processing complex. Vitrified borosilicate glass logs encased in stainless steel canisters would be shipped from the vitrification building to onsite lag storage. The canisters would remain in lag storage until they are shipped by rail or truck from the vitrification facility to a HLW repository for disposal.

Modified Existing Facilities. As an example of a technology variant using modified existing facilities, the can-in-canister vitrification variant using the F canyon and DWPF at SRS is described in Appendix O.

2.4.4.2 Ceramic Immobilization Alternative

Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, packaged, and transported to the ceramic immobilization facility. The ceramic immobilization facility would be constructed, or an existing facility would be modified, and the facility would be operated to accept surplus Pu in the form of metal and oxides. The Pu would be immobilized within a titanate-based ceramic matrix, formed into disks, and the disks would be encased in stainless steel canisters. Also, the highly radioactive isotope Cs-137, would be included into the ceramic matrix to serve as a radiation barrier to theft and diversion. The Cs-137 could be provided from CsCl capsules currently stored at Hanford or from HLW. Gadolinium, hafnium, or another neutron absorber also would be included in the ceramic matrix to prevent criticality. Canisters with the ceramic immobilized disks would be emplaced in a HLW repository (or alternative) for disposal. The absence of any RCRA-regulated hazardous materials in the final ceramic form would need to be demonstrated prior to acceptance into a HLW repository. The canisters would remain in onsite vault-type lag storage and would not be transported to a disposal site until the site is operational pursuant to separate appropriate NEPA documentation. A material flow diagram can be found in Figure 2.4.4.2–1. All requirements shown in this section are in addition to those requirements previously described for the pit disassembly/conversion and the Pu conversion facilities.

Facility Description. The ceramic immobilization facility site layout for a new facility is shown in Figure 2.4.4.2–2. The facility data is found in Appendix B. The overall site would occupy approximately 12 ha (30 acres). The primary Pu handling buildings would be located within a double security fenced area. The mission of key facilities follows.

Plutonium Processing Building. The Pu processing building would provide the following functions:

- Shipping, receiving, accountability, repackaging, control, and temporary in-process storage of Pu, Cs-137, and other radioactive materials, cold chemical feed materials, ceramic precursor, titanium metal, and bellows
- Processing, process control, decontamination, mechanical and electrical support, equipment maintenance, analytical laboratory analysis, and clean equipment maintenance
- Remotely operated ceramic immobilization processing and in-process storage of Pu and Cs
- Scrap treatment and recycling of Pu from contaminated process materials
- Area access control, health physics, and personnel support

Radwaste Management Building. This building would monitor, process, treat, and handle radioactive wastes, including low-level, TRU, and mixed wastes, in gaseous, liquid, and solid form.

Hot Maintenance Shop. This building would provide facilities for the maintenance and repair of process equipment from the Pu processing facility, the radiation waste management building, and the canister storage building. Shop areas are provided for receiving and decontaminating equipment, disassembly and repair of equipment, machining, repair of electrical equipment and controls, and equipment testing.

Canister Storage Building. This building would provide canister storage for 1 year of canister production and space for an additional 9 years capacity.

Facility Operations. The ceramic immobilization facility would process surplus Pu and Cs-137 into compressed ceramic bellows shaped like flat disks. Twenty ceramic bellows would be stacked inside stainless steel canisters which then would be sealed. A normal operating year would be 200 days. Nominal throughput in

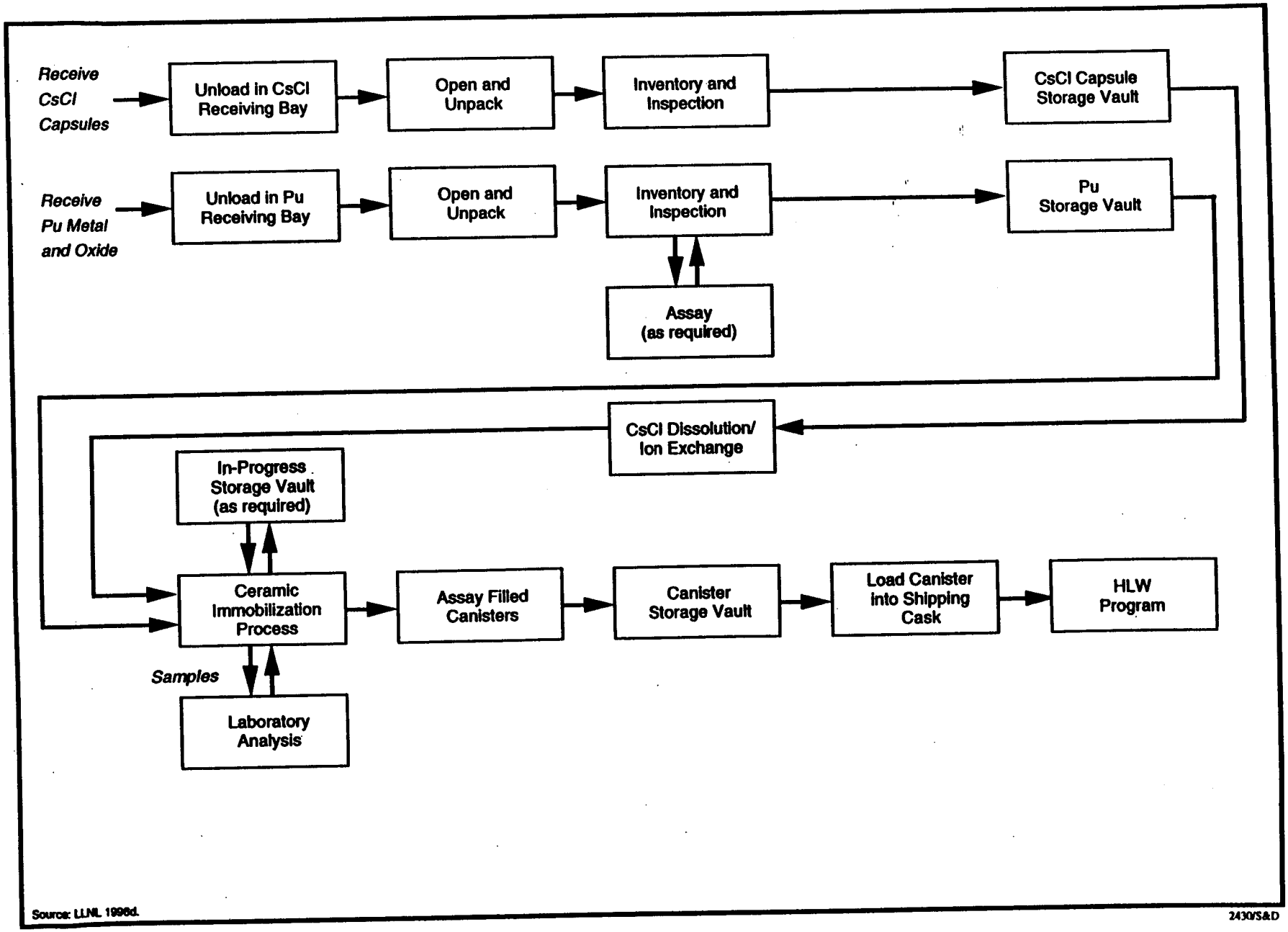


Figure 2.4.4.2–1. Ceramic Immobilization Facility Material Flow Diagram.

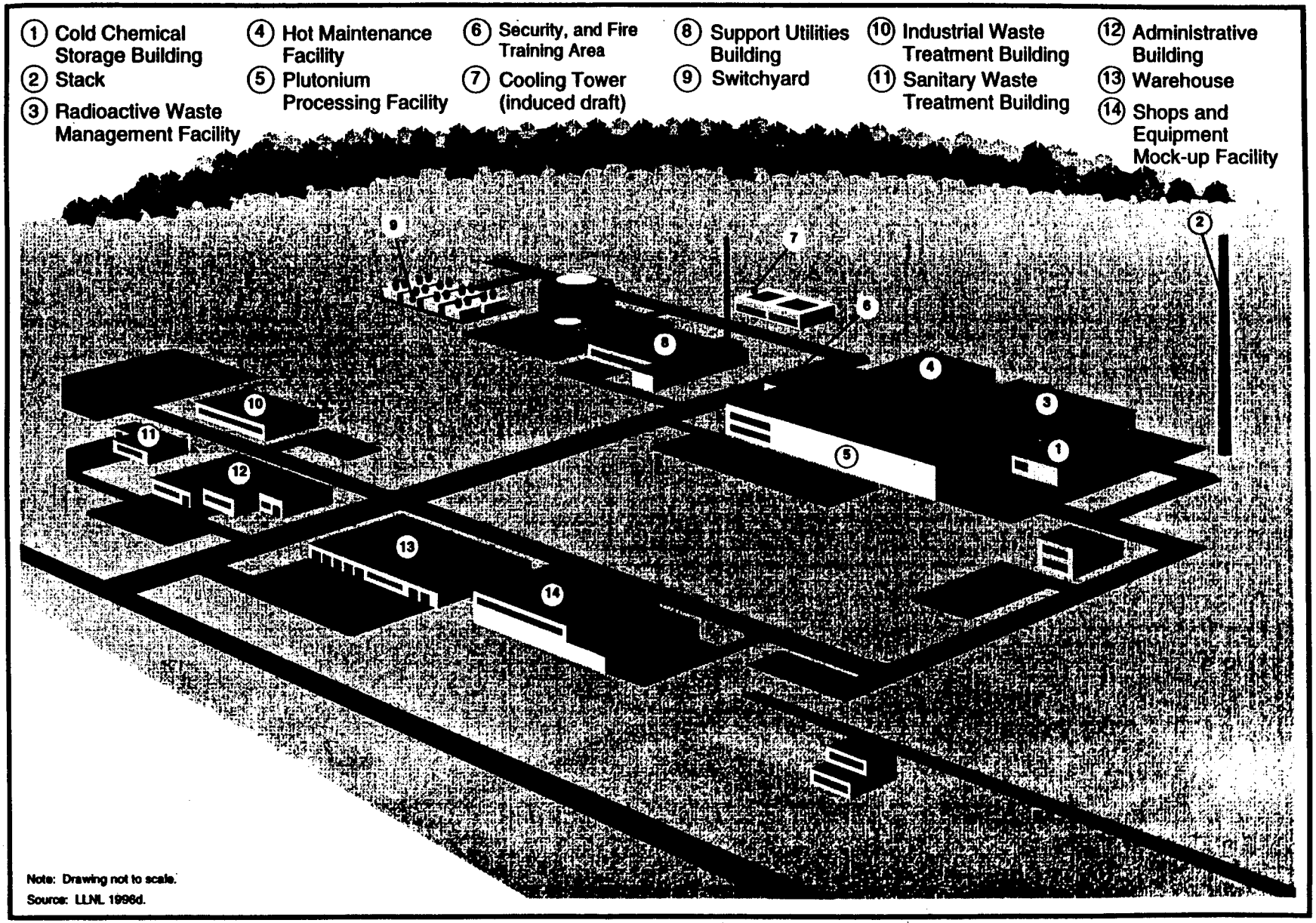


Figure 2.4.4.2–2. Conceptual Ceramic Immobilization Facility Site Layout (Perspective).

the ceramic immobilization facility would be 25 kg (55 lb) of Pu per operating day. The operating schedule assumes 3 shifts per day, 7 days per week. Time is allowed for remote maintenance, accountability, criticality control, and other functions that would shut down immobilization operations during the 165 days per year that the plant would not be expected to operate.

Expected annual utility consumption, chemical consumption, and personnel requirements during operation are listed in Appendix C. The raw water requirement for the ceramic immobilization facility would be approximately 250 million l/yr (66 million gal/yr). The annual water balance for the ceramic immobilization facility is shown in Appendix D.

The ceramic immobilization facility would be designed with features to prevent, control, and mitigate the consequences of potential accidents. The facility design uses a defense-in-depth approach to protect workers, the public, and the environment from release of radioactive or hazardous materials. Facilities would be designed to ensure that they would withstand earthquakes, high winds, or floods. The fire protection systems of the plant would be in accordance with DOE Orders and National Fire Protection Association Codes and Standards. The physical security, materials control and accountability, IAEA safeguards, and physical security system facilities would be consistent with protecting DOE-defined Category I and II type special nuclear materials.

Construction. Additional land area requirements during construction would be approximately 8 ha (20 acres) required for laydown areas, temporary utilities, and storage areas. The construction of the ceramic immobilization facility would require 5 years and have a peak annual employment of 1,000 construction workers. Projected material and resource consumption and employment needs during construction are listed in Appendix C.

Estimated total quantity of solid and liquid wastes generated during construction of the ceramic immobilization facility is shown in Appendix E. The waste generation data are based on factors from historic data on construction area size and construction labor force estimates. Solid wastes would be hauled offsite for disposal during the construction period. Waste management would be in accordance with DOE Order 5820.2A and RCRA.

Waste Management. The solid and liquid nonhazardous wastes generated during construction would include concrete and steel construction waste materials and sanitary wastewater. The steel construction waste would be recycled as scrap metal. The remaining nonhazardous wastes generated during construction would be disposed of by the contractor as part of the construction project. Uncontaminated wastewater could be used for soil compaction and dust control, and excavated soil would be used for grading and site preparation. Nonhazardous wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling. Hazardous wastes such as adhesives, oils, and solvent rags would be packaged in DOT-approved containers and shipped to RCRA-permitted treatment, storage, and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any were generated, it would be managed in accordance with site practice and all Federal and State standards.

Operation of the ceramic immobilization facility would generate TRU, low-level, hazardous, mixed, and nonhazardous wastes. The conceptual design includes waste management facilities that would treat and package all waste generated into forms that would enable staging and disposal in accordance with RCRA and other applicable statutes. TRU and mixed TRU waste would be treated and packaged to meet the WIPP WAC. These wastes would be stored awaiting shipment to a Federal repository (assumed to be WIPP, depending on decisions resulting from the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste). LLW would be treated and packaged to meet the WAC of an onsite or offsite DOE LLW treatment, storage and disposal sites. DOE LLW treatment, storage and disposal sites that would be used would be consistent with decisions resulting from the Waste Management PEIS and NEPA reviews tiered from that PEIS. Mixed LLW would be treated and disposed of in accordance with the respective site treatment plan which was

developed to comply with the *Federal Facility Compliance Act* and with decisions made pursuant to the Waste Management PEIS. Hazardous wastes would be packaged in DOT-approved containers and shipped to RCRA-permitted treatment and disposal facilities. Liquid nonhazardous wastes such as sanitary, utility, and process wastewater would be reclaimed to use as makeup water when economically and/or environmentally desirable. Solid nonhazardous waste would be disposed of in permitted landfills and recycled as appropriate. The immobilized Pu (with Cs or HLW) would be stored in the lag storage facility until shipment to and disposal in a HLW repository under the NWPA. Additional details can be found in Section E.3.2.5.

Transportation. Intrasite transport of radiological materials that are not immobilized would be limited to the secure transportation of shipping containers of Pu metal and oxide, and either CsCl capsules or HLW (via pipeline). Pu metal or oxide would be delivered from offsite by SST and transported to the Pu processing complex. Canisters, with immobilized Pu, would be transported intrasite to lag storage. The canisters would remain in lag storage until they are shipped by rail of truck from the ceramic immobilization facility to a HLW repository for disposal.

Modified Existing Facilities. As an example of a technology variant using modified existing facilities, the can-in-canister ceramic immobilization variant using the F canyon and DWPF at SRS is described in Appendix O.

2.4.4.3 Electrometallurgical Treatment Alternative

Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or Pu conversion facility, packaged and transported to new or modified facilities for electrometallurgical treatment. The electrometallurgical treatment process could immobilize surplus fissile materials into two waste forms: a GBZ and/or a metal ingot. With the GBZ material, the Pu is in the form of a stable, leach-resistant mineral that is incorporated in durable glass materials. The processes to produce the metal waste form result in the larger accident impacts and are used as the basis for assessing potential accident consequences and risks. Although this alternative could be conducted at other DOE sites, the ANL-W site is described as being representative for analysis. If this alternative is selected at ROD, additional construction impacts could occur if implemented at a site other than ANL-W.[19]

With the electometallurgical treatment to immobilize the material into a GBZ form, Pu oxide or Pu would be converted to chlorides, dissolved in a molten salt solution, sorbed on zeolites, and then immobilized in a GBZ waste form. The Cs-137 isotope and HLW would be used to provide a radiation barrier. The Cs-137 isotope could come from processed CsCl capsules currently stored at Hanford. A material flow diagram is presented in Figure 2.4.4.3–1. The absence of any RCRA-regulated hazardous material in the final GBZ form would need to be demonstrated prior to acceptance into a HLW repository.

Facility Description. A facility site layout, using ANL-W as a representative site, showing the locations of the most relevant buildings is provided in Figure 2.4.4.3–2. The pertinent parameters for the major structures and other support buildings and areas, relevant to the immobilization activities, are detailed in Appendix B. A brief description of the primary facilities for this immobilization process (using ANL-W as a representative site) are as follows:

Fuel Cycle Facility (FCF) (Building No. 765). This area would house some of the major equipment that could be used in producing the GBZ waste form. This equipment would include an electrorefiner, a casting furnace,

[19] DOE has recently issued a FONSI (61FR25647) and decision to proceed with the demonstration of the electrometallurgical treatment process at ANL-W at INEL for processing up to 125 spent fuel assemblies from Experimental Breeder Reactor II (EBR-II) (100 driver and 25 blanket assemblies). The National Research Council performed *An Evaluation of the Electrometallurgical Approach for Treatment of Excess Weapons Plutonium,* (National Academy Press, Washington, D.C., 1996). The results of this evaluation will be considered in DOE's decisionmaking process for Pu disposition.

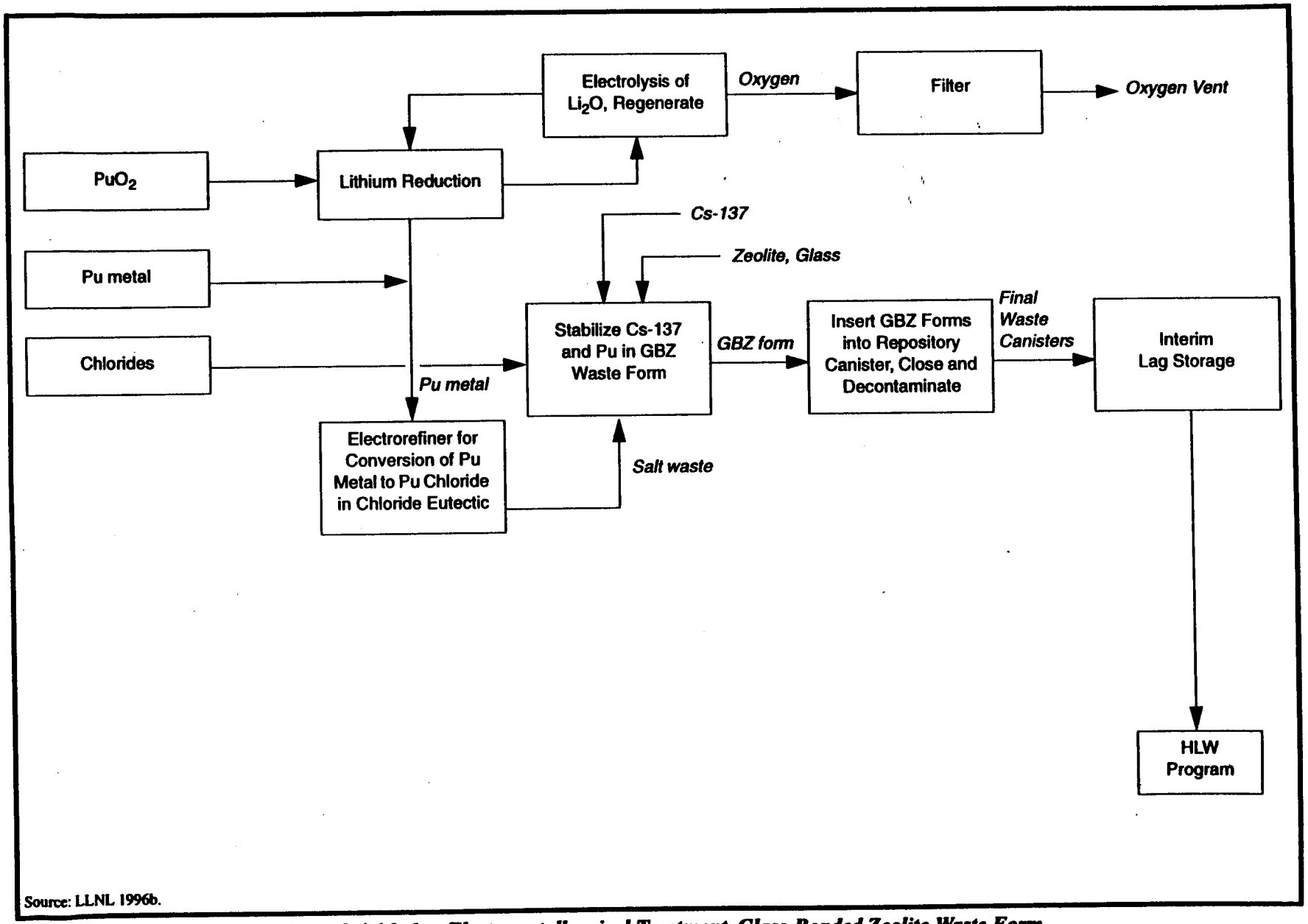


Figure 2.4.4.3–1. Electrometallurgical Treatment, Glass-Bonded Zeolite Waste Form.

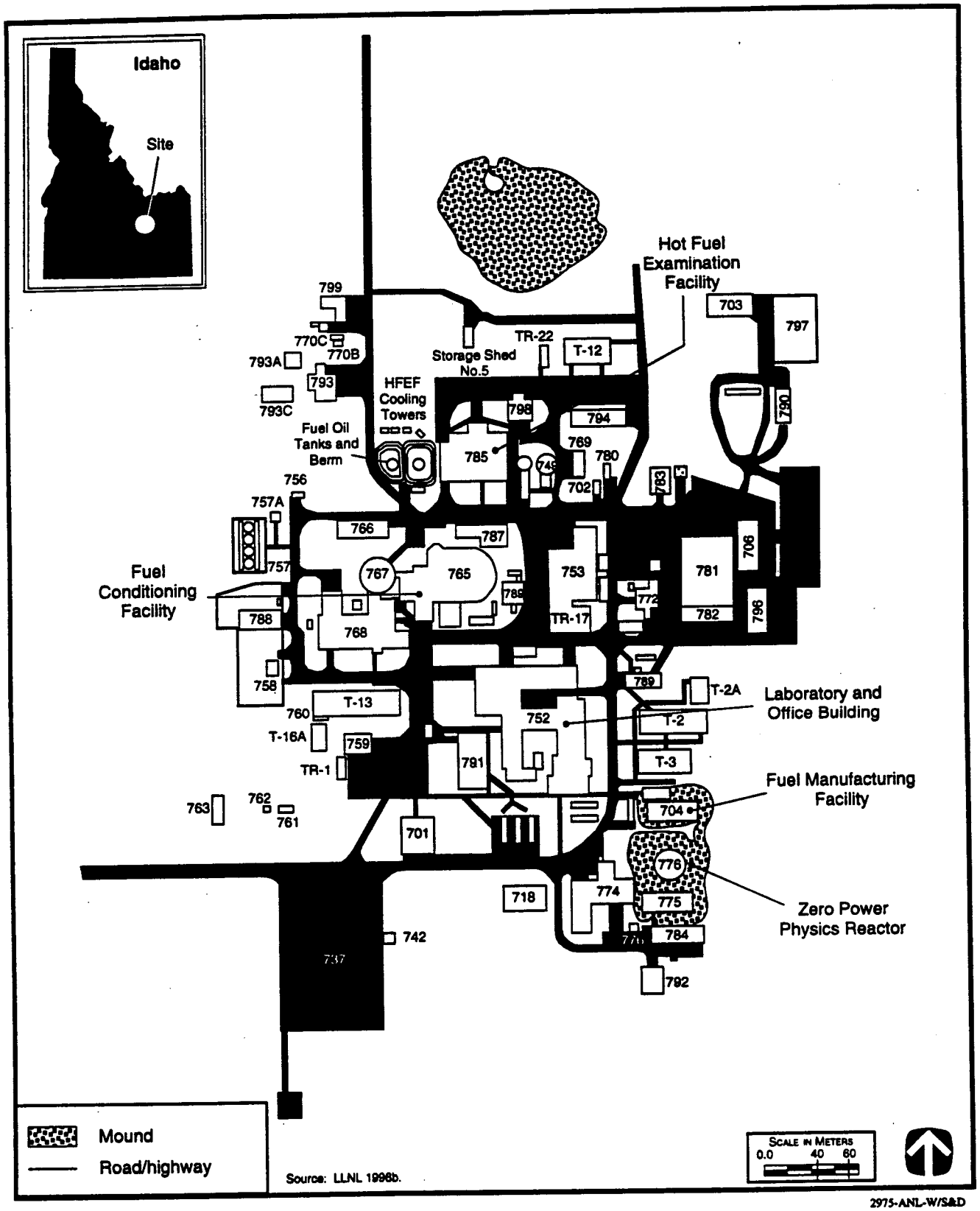


Figure 2.4.4.3–2. Detailed Layout of the Argonne National Laboratory-West Site.

and a cathode processing system. The facility is composed of the FCF process building, the Safety Equipment Building, the interconnecting tunnel, the safety equipment pit, and exhaust gas stack.

Safety Equipment Building (No. 709). This building houses the safety-grade diesel generating and emergency exhaust systems.

Hot Fuel Examination Facility (HFEF) (No. 785). This facility contains hot cells for the remote handling of materials and may be used for the temporary storage of the product waste forms. The HFEF is capable of handling large, highly radioactive objects such as spent fuel elements from commercial light water reactors.

Zero Power Physics Reactor (No. 776) The cell and fuel storage vault would be used for temporary storage of incoming fissile materials. The facility is divided into an area under an earthen mound where all fissile materials would be stored and a support wing that contains rooms with monitoring and control instruments, offices and other support systems.

The reactor cell, which currently houses the ZPPR, is a 15.25-m (50-ft) diameter circular room with floor and walls of reinforced concrete. An air system that once provided cooling for the critical facility and maintained a negative pressure relative to the surroundings would be used to maintain a negative pressure in the two storage areas and provide cooling for product ingots with high gamma or neutron emissions. The analytical laboratory in this facility is fully equipped to support the immobilization activities.

Laboratory and Office Building (No. 752). This building contains analytical facilities and offices for the supporting technical and administrative personnel.

Fuel Manufacturing Facility (No. 704). This is a secure facility where glovebox facilities are located.

Radioactive Scrap and Waste Facility (No. 771). This facility provides temporary storage for radioactive and hazardous wastes. It is an RCRA Class B facility. The Radioactive Waste Management Complex (RWMC) at INEL is also available for interim waste storage.

ANL-W has in place, approved safeguard and security systems for the quantities of weapons-usable Pu materials to be located onsite. The site is equipped with a vehicle control station for positive control of all vehicular traffic to and from the ANL-W facilities that would be used for operations with surplus Pu-bearing materials.

Facility Operations. The Pu feed would consist of a combination of metal, oxides, and chloride salts. Immobilization operations would be performed 18 hours per day for 200 days per year. Nominal throughput in the electrometallurgical treatment facility would be 25 kg (55 lbs) Pu per operating day. The fissile materials would be shipped in and placed in lag storage at rates adequate to maintain the processing rate. Two to three months of inventories of feed materials would be stored onsite. The Pu loading in the GBZ waste form would be identified during the R&D program, but is estimated at 5 percent by weight of Pu. The package size is assumed to be up to 400 kg (880 lbs). Actual size would depend largely on criticality considerations. Neutron absorbers would be added to the waste form to decrease the probability of a criticality event.

During operation of the facility, only a minor increase in resources would be required to implement the Pu disposition mission since existing facilities, equipment, and personnel would be used. Additional personnel would be required to take care of operating the added equipment and to satisfy the increased security and safeguards requirements. The only additional utilities required would be electricity for the new process furnaces and a small increase in water consumption due to the increased number of employees and cooling requirements. The chemicals that would be consumed during operation include some process salt required for the material processed and some added zeolite and glass. Appendix C provides summary listings of the annual utilities, chemical resources, and employment operational requirements for this alternative.

No process water would be required. A modest increase in water would be required for a nominal 20-percent increase in the site population and cooling tower makeup water. A simplified water balance diagram is presented in Appendix D.

Construction. No new construction would be required to perform the immobilization operations with this alternative at ANL-W. The FCF was completely refurbished and upgraded in 1994 to modern standards appropriate for the immobilization project. Minor modifications would be expected to be required for the HFEF and ZPPR. The Pu immobilization effort would require additional equipment not currently in place in these facilities. Existing mock-up areas would be adequate for pre-installation checkout and qualification of this equipment, with the principal mock-up area located in the northeast corner of the FCF outside the MAA. The additional process equipment would be shipped in from offsite and installed in existing space. The materials and resources consumed and employment required during the modification period are given in Appendix C.

Waste Management. [Text deleted.] The Pu disposition mission would not significantly increase the quantity of liquid and solid wastes. The mass of the product HLW would be increased by the amount of Pu, zeolite, and Cs added. For the Pu disposition mission, the TRU, low-level, and other nonhazardous waste quantities would be in proportion to the processing rate. Due to operational controls to minimize the amount of hazardous materials used in conducting facility operations, the amount of mixed and hazardous wastes generated would be minimized. The amount of nonhazardous (sanitary) wastes would be based upon a water usage factor and the number of additional employees needed for the Pu disposition operations. An estimate of the annual waste volumes produced as a result of the disposition operations is presented in Appendix E. The radioactive emissions are conservatively based on the estimated releases from the FCF. Estimates of annual emissions during operations are provided in Appendix F. Waste facility modifications/construction would not be required to support the Pu disposition mission. Estimates of construction-related wastes and incremental operations emissions associated with this alternative are presented in Appendices E and F. Modifications to existing permits may be required to implement the Pu disposition mission.

Transportation. The periodic shipment of radioactive process feed materials and packaged waste products would be required to support the Pu disposition mission. Pu metal or oxide would be delivered by SST and stored in the ZPPR vault upon arrival at the site. Cesium feed would be shipped from Hanford as CsCl capsules and received and stored onsite in the HFEF.

When needed for processing, containers with the Pu feed would be transported to the FCF or HFEF process cell. Since the CsCl capsules would be stored at the HFEF, no intrasite transport of this material would be necessary. Following processing, the GBZ waste forms with the immobilized Pu would be placed in canisters for onsite lag storage until shipment to a HLW repository (or alternative) is possible.

2.4.5 REACTOR CATEGORY AND COMMON ACTIVITIES

The alternatives under the Reactor Category considered in this PEIS would convert surplus Pu to MOX fuel for use in reactors. The irradiated MOX fuel would reduce the proliferation risks of the Pu material, and the reactors would generate electricity. The spent nuclear fuel generated from using the MOX fuel would be sent to an HLW repository or, if a foreign reactor is used, disposed of in a foreign spent fuel program.

These reactor alternatives include the following:

- Existing LWRs
- Partially Completed LWRs
- Evolutionary LWRs
- CANDU Reactors

Before surplus Pu can be used as reactor fuel, a conversion process is required to transform the Pu, in its various forms, into MOX fuel. The following common supporting facilities are required to process Pu, in its current forms, into MOX fuel:

- Pit disassembly/conversion facility
- Pu conversion facility
- MOX fuel fabrication facility

Under the various Reactor Alternatives, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or Pu conversion facility, transported to the MOX fuel fabrication facility, converted into a MOX fuel, transported to the reactor site, and used as fuel for the reactor.

The Storage and Disposition PEIS addresses the disposition of surplus Pu. In the TSR PEIS (final version issued October 1995), there is an option for a multipurpose reactor that could produce tritium, use Pu in reactor fuel, and generate revenue through the production of electricity. Environmental analysis of the multipurpose reactor is included in the TSR PEIS. On December 6, 1995, the Secretary of Energy made the decision (60 FR 63878) that the future source of tritium would either be from a purchased reactor or irradiation in a commercial reactor or the accelerator production of tritium. The multipurpose reactor was preserved as an option for future consideration. DOE is also evaluating the operation of the FFTF at Hanford for its possible role as a multipurpose reactor in meeting future tritium requirements. Additional information can be found in Appendix N.

2.4.5.1 Mixed Oxide Fuel Fabrication

Mixed oxide fuel fabrication is common to all four reactor alternatives because each reactor would use Pu in the form of MOX fuel. In the 1970s, MOX fuel fabrication was conducted in a number of U.S. and foreign facilities on a laboratory or pilot line scale. However, today only the foreign MOX fuel fabrication programs continue. Proliferation concerns and unfavorable economics of Pu use resulted in a U.S. decision, in late 1970s, to defer indefinitely commercial reprocessing and recycling of the Pu produced in U.S. nuclear power programs. Consequently, MOX fuel fabrication facilities do not currently exist in the United States.

Converting surplus Pu into MOX fuel for use in a reactor would be consistent with U.S. nonproliferation policy since while the Pu is in the MOX fuel form it would be subject to high standards of safeguards and security and

would be available for inspection by the IAEA. After use in a reactor, the Pu would meet the Spent Fuel Standard for proliferation resistance.

Because the United States does not have a MOX fuel fabrication facility or capability, a dedicated facility would likely have to be constructed or modified at a U.S. Government or existing commercial fuel fabricator's site. To provide MOX fuel until a domestic fuel fabrication plant is available, fuel for initial lead test assemblies and other MOX fuel may be produced by existing facilities in Europe on a short-term basis.

In accordance with the Preferred Alternative for surplus Pu disposition, the MOX fuel fabrication facility could be located at either Hanford, INEL, Pantex, or SRS. Further tiered NEPA review will be conducted to examine alternative locations, including new and existing facilities at these four sites, should the Preferred Alternative be selected at the ROD.

Facility Description. The MOX fuel fabrication facility would accept surplus Pu material in oxide form from the pit disassembly/conversion facility and the Pu conversion facility and fabricate mixed PuO_2-uranium dioxide (UO_2) fuel. The fabrication process would take PuO_2, purify it to meet MOX PuO_2 feed specifications, and blend it with UO_2 (this UO_2 may contain natural or depleted uranium) and any required burnable neutron absorbers. The MOX would be formed into pellets, loaded into fuel rods,[20] and assembled into fuel bundles. The facility would have storage capacity for approximately a 1-year supply of fuel bundles awaiting shipment to any of the various disposition reactors. Figure 2.4.5.1–1 presents a process flow diagram.

The total disturbed land area for the MOX fuel fabrication facility would be approximately 81 ha (200 acres), plus a 1.6-km (1-mi) wide buffer zone around the facility. All facility buildings would be located within a fenced area. A PA containing the fuel fabrication, waste management, receiving and storage, chemical storage, and cold support and utilities buildings would be surrounded by an appropriate perimeter security system. Within the PA, an MAA would connect the receiving and storage, fuel fabrication, and waste management buildings.

Figure 2.4.5.1–2 provides a facility site layout. The type of construction and the footprint area required for each building can be found in Appendix B. The mission description of these buildings follows.

Receiving and Storage Building. Process materials and supplies would be received and stored here. This building would house the Pu lag storage vault.

Fuel Fabrication Building. The MOX fuel fabrication processes would be housed here.

Waste Management Building. This building would process, temporarily store, ship, and provide control and accountability for all solid, liquid, contaminated, or uncontaminated generated wastes. The waste processes and handling areas would be segregated by waste form.

Cold Support and Utilities Building. This building would house HVAC, electrical, water, and natural gas distribution for the facility. It would also provide a machine shop and storage facilities for nonradioactive or uncontaminated materials.

General Administration and Security Building. This building would provide office and support space for the site.

Fire Station. This building would provide augmented support to the site (in addition to local services) for immediate response to fire and medical emergencies.

Chemical Storage Area. This area would provide space for chemical storage tanks that supply the buildings and processes in the PA.

[20] The term "rods" used herein means LWR rods or CANDU elements.

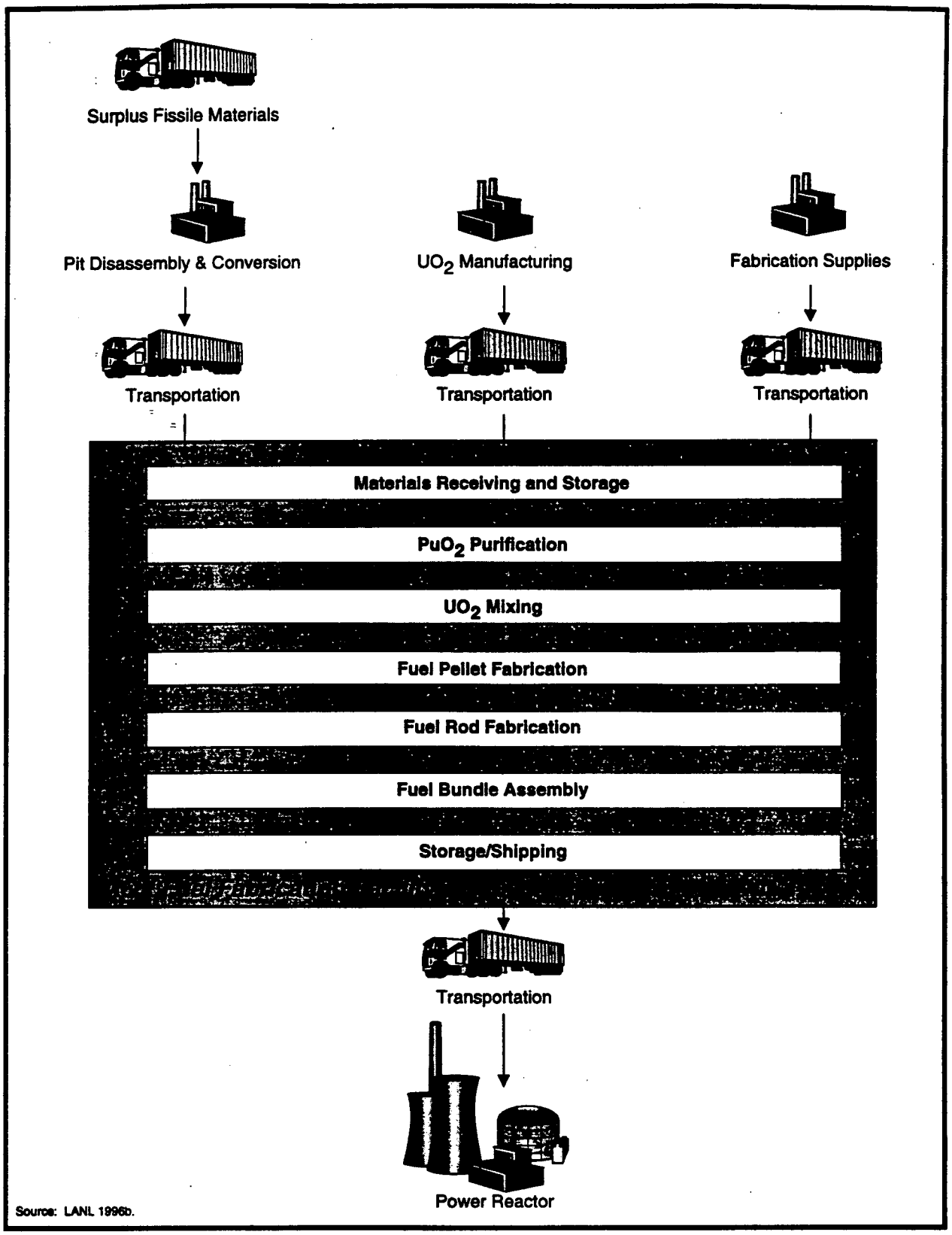


Figure 2.4.5.1–1. Mixed Oxide Fuel Fabrication Facility Material Flow Diagram.

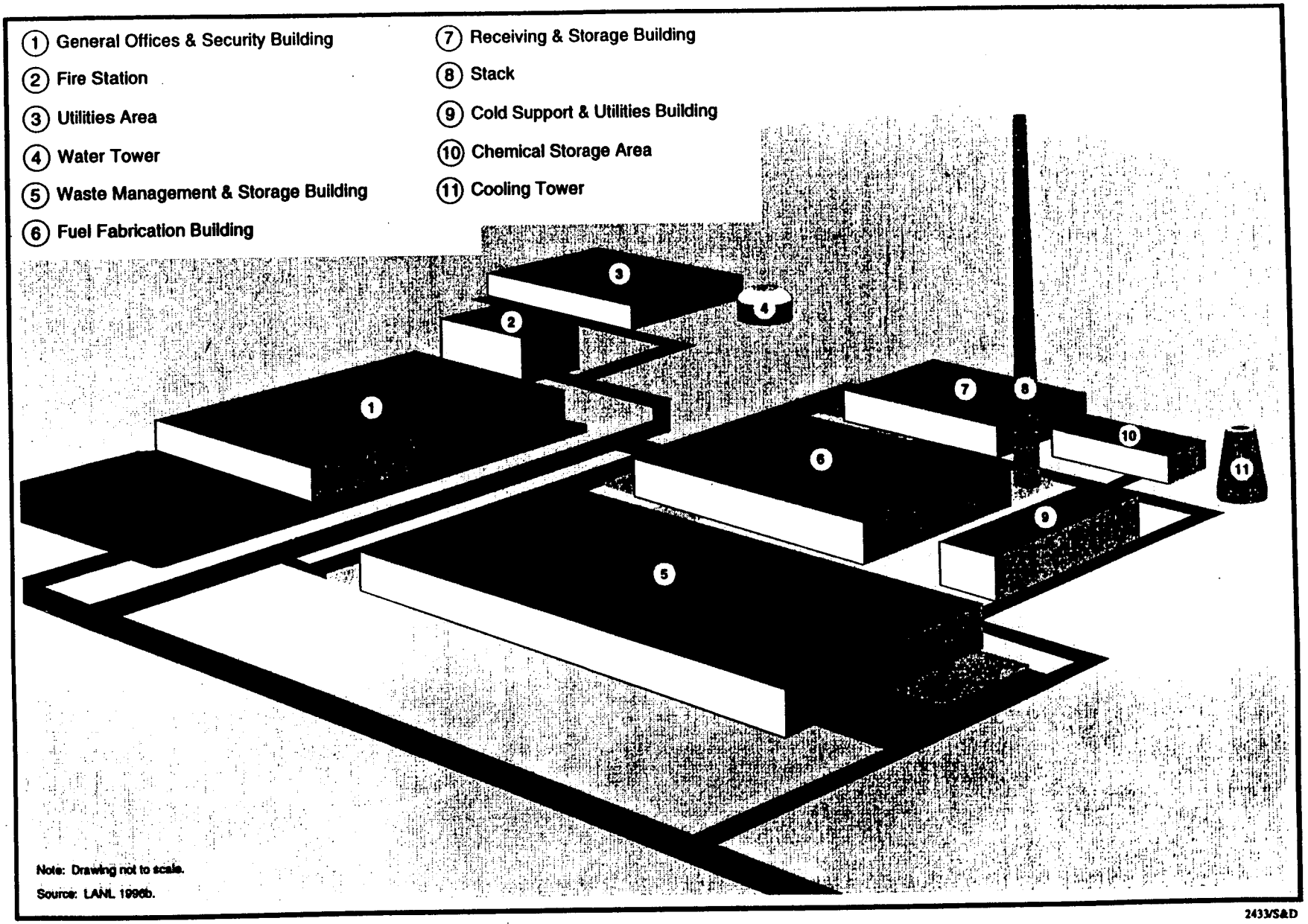


Figure 2.4.5.1–2. Conceptual Mixed Oxide Fuel Fabrication Facility Site Layout (Perspective).

Utilities Area. This area would be the entrance and metering point for electrical, natural gas, and water supplies. The electrical substation, emergency generator(s), and associated switching equipment would be located in this area.

Facility Operations. Initial operations would begin 1 year before associated reactor operations using the MOX fuel. Based on these data, a campaign for the disposition of surplus Pu can be examined. As shown in Table 2.4.5.1–1, a Pu throughput of between 2.9 t/yr (3.2 tons/yr) and 5.0 t/yr (5.5 tons/yr) would be achievable. The average fraction of input weapons-grade Pu would determine the throughput required of the fuel fabrication facility and, consequently, facility size and environmental impact. The MOX fuel Pu fraction would range, depending on reactor type, between 2.2 and 6.8 percent of the heavy metal (uranium and Pu). Required throughput, depending on reactor type, would range between 52 t/yr (57 tons/yr) and 150 t/yr (165 tons/yr) heavy metal. Therefore, nominal MOX throughput would be 50 t/yr (55 tons/yr) heavy metal, and the bounding MOX throughput would be 150 t/yr (165 tons/yr) heavy metal. Expected annual utility consumption for facility operation, annual chemicals consumed during operation, and the number of personnel required during operation are provided in Appendix C.

Protection of special nuclear material requires an integrated program involving both material control and accountability. Safeguards and security systems would be designed to meet DOE, NRC, and, as applicable, IAEA requirements.

Estimated annual emissions released from the MOX fuel fabrication facility during operations are listed in Appendix F. These emissions would be made up of various gases used or otherwise generated as a result of activities involved in MOX fuel fabrication. All gaseous effluent streams coming from the facility would be thoroughly scrubbed or filtered to remove or reduce the amount of undesirable particulates before release. Estimates of annual wastes resulting from the MOX fuel fabrication facility are shown in Appendix E. No HLW would be generated during normal operations. A diagram of the water balance for the new MOX fuel fabrication facility is presented in Appendix D.

Construction. The construction of the MOX facility would require 6 years and have a peak annual employment of 475 construction workers. The primary constraint on this schedule is the coincident operation of the MOX fuel fabrication facility with that of the two to five dispositioning reactors and the availability of the PuO_2 stock. Additional land area required for construction is projected to be approximately 40 ha (99 acres). This provides

Table 2.4.5.1–1. Mixed Oxide Fuel Reactors Operations Assumptions

Reactor Type (3 to 5 LWRs required)	Average MOX Enrichment of Pu in Heavy Metal (percent)	Pu Throughput (t/yr)	MOX Throughput (t/yr of heavy metal)
Existing			
BWR-full MOX	3.0	3.0	98.8
PWR-full MOX	4.2	5.0	118.2
CANDU-reference MOX[a]	2.2	2.9	136.1
CANDU-CANFLEX MOX[a]	3.4	5.0	149.9
Evolutionary			
Large	6.8	3.5	52.2
Small	6.6	4.1	61.4

[a] CANDU-reference MOX utilizes a standard fuel bundle, whereas the CANFLEX-MOX option uses an alternate fuel design that would permit the use of higher Pu concentrations and result in a higher burn-up of the MOX fuel.

Source: DOE 1996o; LANL 1996b.

for construction material laydown, warehousing, and temporary parking. Materials and resources consumed during construction of a new facility, and the number of construction personnel required, are presented in Appendix C. Total amounts of solid and liquid wastes generated during construction are given in Appendix E.

Waste Management. The solid and liquid nonhazardous wastes generated during construction would include concrete and steel construction waste materials and sanitary wastewater. The steel construction waste would be recycled as scrap metal before construction was completed. The remaining nonhazardous wastes generated during construction would be disposed of by the contractor as part of the construction project. Uncontaminated wastewater would be used for soil compaction and dust control, and excavated soil would be used for grading and site preparation. Non-hazardous wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling. Hazardous wastes such as adhesives, oils, and solvent rags would be packaged in DOT-approved containers and shipped to offsite commercial RCRA-permitted treatment, storage, and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any were generated, it would be managed in accordance with site practice and all Federal and State standards.

Operation of a new MOX fuel fabrication facility would generate TRU, low-level, hazardous, mixed, and nonhazardous wastes. The conceptual design includes waste management facilities that would treat and package all waste generated into forms that would enable staging and disposal in accordance with RCRA and other applicable statutes. TRU and mixed TRU waste would be treated and packaged to meet the WIPP WAC. These wastes would be stored awaiting shipment to a Federal repository (assumed to be WIPP, depending on decisions resulting from the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste). LLW would be treated and packaged to meet the WAC of an onsite or offsite LLW disposal facility. The LLW treatment/disposal facilities that would be used would be consistent with decisions resulting from the Waste Management PEIS and NEPA reviews tiered from that PEIS. Mixed LLW would be treated and disposed of in accordance with the respective site treatment plan which was developed to comply with the *Federal Facility Compliance Act* of 1992, if applicable, and with decisions made pursuant to the Waste Management PEIS and tiered NEPA reviews, if applicable. Hazardous wastes would be packaged in DOT-approved containers and shipped to RCRA-permitted treatment and disposal facilities. Liquid nonhazardous wastes, such as sanitary, utility, and process wastewater, would be treated and discharged in accordance with the site practice or reclaimed to use as makeup water when economically and/or environmentally desirable. Solid nonhazardous waste would be disposed of in permitted landfills and recycled as appropriate. Additional details can found in Section E.3.2.3.

Transportation. Transportation of Pu and associated wastes would be subject to government regulations and DOE Orders regarding safety and security. The facility would receive PuO_2 and send out completed MOX fuel bundles. Intersite shipment of Pu-bearing material would be by SST to minimize potential for diversion. For domestic MOX fuel fabrication, UO_2 feed stock would come from existing domestic commercial sources and would be shipped by approved commercial carriers. UO_2 feed stock for European MOX fuel fabrication would come from existing European sources. Appendix G presents intersite transportation data for input and output materials.

European Mixed Oxide Fuel Fabrication Facility. MOX fuel could be produced in existing European MOX fuel fabrication facilities. However, studies have shown that the Europeans are driving their MOX fuel fabrication capacity and projected MOX fuel demand towards a balance (DOE 1995c:1-7). In the near-term, European MOX fuel fabricators have excess capacity that could be applied to support weapons-Pu disposition. This excess capacity could support fabrication of lead test assemblies and possibly partial reloads or a few reload full cores. While the Europeans may be willing to expand their capacity to support surplus weapons-Pu disposition, the United States would likely have to pay a premium for such MOX fuel. In addition, because European MOX capacities and demand could unexpectedly change, resulting in the loss or gain of excess capacity, until contracts are signed for the fabrication of fuel from U.S. surplus-weapons Pu, the United States should not rely on excess European MOX fabrication capacity in the long term. Transportation risks associated

with moving the Pu feed materials and the finished MOX fuel across the global commons are presented in Appendix G.

2.4.5.2 Existing Light Water Reactor Alternative

Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, packaged, transported to a MOX fuel fabrication facility, and converted to MOX fuel. The finished MOX fuel would be transported to three to five existing LWRs for use in lieu of conventional uranium reactor fuel. The reactors employed for domestic electric power generation are conventional LWRs that use water as a moderator and coolant. The two types of LWRs used are pressurized water reactors (PWRs) and boiling water reactors (BWRs). Approximately two-thirds of the operating power reactors in the United States are PWRs.

In accordance with the Preferred Alternative for surplus Pu disposition, three to five existing LWRs could be selected. This would occur only after negotiations between DOE and interested parties, and through a competitive procurement process. Further tiered NEPA review will be conducted to examine locations (as many as five sites or as few as one site) should the Preferred Alternative be selected at the ROD.

Facility Description. A sample of reactors from across the United States was compiled in order to generate generic operating characteristics for a commercial LWR, since no specific site or reactor has been selected. The sample was studied to determine valid, applicable characteristics that could be used to describe a generic reactor using MOX fuel. The sample includes eight operating high power (greater than 1,200 megawatt electric [MWe]) PWRs and four BWRs built after 1975. Characteristics of these 12 were felt to be representative of both reactor types, since none of the 12 experienced any unusual operating conditions over the operating period reviewed. Where possible, data was averaged for the 5-year period to smooth out unusually low or high values due to shutdowns for reasons other than normal refueling or maintenance activities.

Data for each reactor characteristic were taken for calendar years 1988 to 1992 (ORNL 1995b:A-5). Entries for all 12 plants were used to determine an average for each listed characteristic.

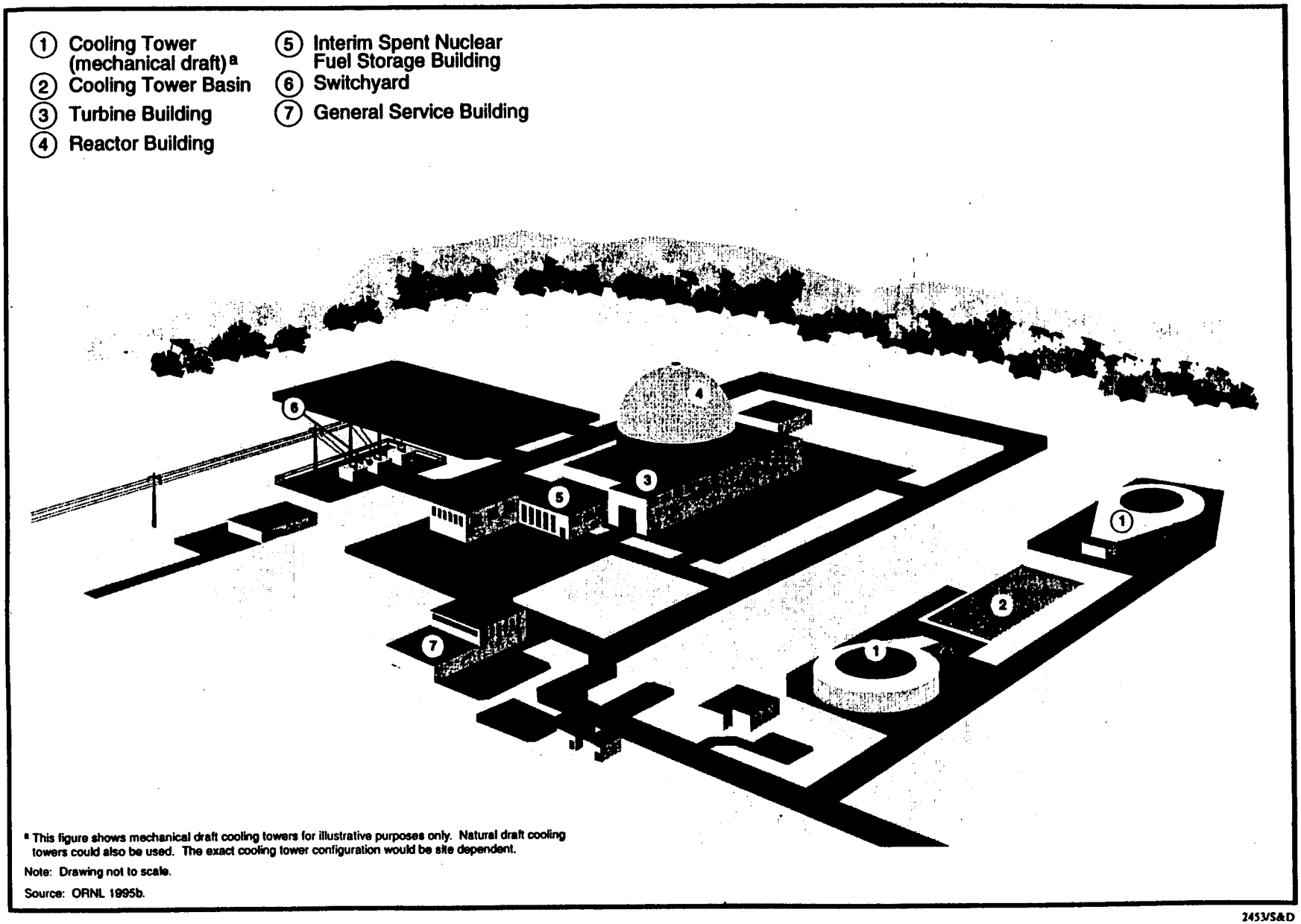
Nuclear power plants generally contain the four major components described below. Figure 2.4.5.2–1 depicts a typical LWR facility.

Reactor Building. This building houses the reactor vessel, the suppression pool (BWRs only), steam generators and pressurizers (PWRs only), pumps, and associated piping. BWRs generate steam directly within the reactor core and pass it through internal moisture separators and steam dryers before sending it to the turbine. In contrast, PWR reactor heat is transferred from the primary coolant to a secondary coolant loop that is at a lower pressure. Generated steam from the secondary loop then flows to the turbine.

All domestic nuclear power plants have containment structures as a major safety feature to prevent release of radionuclides in the event of an accident. BWR containments are composed of a suppression pool and dry well. PWRs have one of three types of containments structured: large, dry; subatmospheric; or ice condenser. Large, dry containments comprise approximately 80 percent of the PWR containment structures.

Turbine Building. This building houses the steam turbine and generator, condenser, waste heat rejection system, pumps, and equipment that support these systems.

Auxiliary Buildings. These buildings house support systems such as the ventilation system, emergency core cooling system, water treatment system, waste treatment system, fuel storage facilities, and plant control room. Also, the plant site contains a large switchyard.



[a] This figure shows mechanical draft cooling towers for illustrative purposes only. Natural draft cooling towers could also be used. The exact cooling tower configuration would be site dependent.

Note: Drawing not to scale.

Source: ORNL 1995b.

2453/S&D

Figure 2.4.5.2–1. Representative Existing Light Water Reactor Facility (Perspective).

Cooling Towers and Ponds. Water is used predominantly for cooling in nuclear power plants, and accordingly these facilities are designed to remove excess heat without dumping this heat directly into adjacent water bodies. The quantity of water used is a function of several factors, including the capacity rating of the plant and the increase in cooling water temperature from intake to discharge. Therefore, the larger the plant, the greater the quantity of waste heat to be dissipated and the greater the quantity of cooling water required. In addition, the quantity of water used is a function of the type of cooling system.

Approximately half of the operating power reactors use "closed-cycle" cooling systems as opposed to "once-through" cooling systems. In closed-cycle systems, waste heat is removed by dissipation to the atmosphere, usually through cooling towers. Several types of closed-cycle cooling systems are currently in use. These systems consist of either natural or mechanical draft cooling towers, cooling ponds, cooling lakes, or cooling canals. Most of the water used for cooling is not returned to a water source because the predominant cooling mechanism associated with closed-cycle systems is evaporation.

In addition to removing waste heat, closed-cycle systems provide cooling for service water and auxiliary cooling water systems. At closed-cycle cooling sites, the additional water needed for source water and auxiliary cooling water systems is usually less than 5 percent per year of that needed for waste heat cooling.

In a once-through cooling system, circulating water is drawn from an adjacent body of water (such as a lake), passed through cooling tubes, and returned to the same body of water at a higher temperature. The volume of water required for service and auxiliary systems is usually less than 15 percent of the volume required for waste heat cooling at once-through cooling sites. Some systems are augmented with helper cooling towers that reduce the temperature of the water released. Waste heat is then dissipated in the receiving water body.

The water intake and discharge structures accommodate the source water body and minimize impacts to the aquatic ecosystem in both cooling systems. The intake structures are generally located along the shoreline of the body of water and equipped with fish protection devices. The discharge structures are generally of the jet or diffuser outfall type and are designed to promote rapid mixing of the effluent stream with the receiving body of water. Chemicals used for corrosion control and other water treatment purposes are also mixed with the cooling water and then discharged from the system.

Some nuclear power plants use groundwater as a source of makeup or potable water in addition to surface water sources. Other existing LWR sites operate dewatering systems that intentionally lower the groundwater table in the vicinity of building foundations either through pumping or a system of drains.

Facility Operations. Three to five existing LWRs would be operated to achieve 3 to 5 t/yr (3.3 to 5.5 tons/yr) throughput for disposition of surplus Pu and simultaneous production of electric power. No attempt was made to characterize the optimum reactor deployment approach. The data presented and analyzed in this PEIS is representative of reactor operations using full MOX fuel cores. The actual core loading for individual reactors will be determined as part of business decisions that follow the ROD. The MOX fuel Pu fraction would range, with reactor type, between 3 and 4.2 percent. MOX throughput depends on reactor type and ranges between 99 t/yr (109 tons/yr) and 118 t/yr (130 tons/yr) heavy metal (uranium and Pu). After discharge from the reactor, the spent MOX fuel assemblies would be stored at the reactor site for up to 10 years before further disposition. A typical LWR facility fuel cycle is depicted in Figure 2.4.5.2–2.

Construction. Major construction activities associated with the existing domestic LWRs that could be selected for this alternative have been completed. The use of MOX fuel in these reactors may require an internal modification to reactor site fuel receiving and storage buildings to properly secure the MOX fuel prior to its use. No significant additional land would be required for this construction.

Waste Management. During the fission process, radioactive products build up within the fuel. Virtually all of these products are contained within the fuel. However, a small fraction of the fission products can escape the

fuel and contaminate the reactor coolant. The primary system coolant also contains radioactive contaminants as a result of neutron activation. The radioactivity found in the LWR coolant is the source of gaseous effluent, liquid effluent, and solid radioactive wastes. The following describes the basic design and operation of PWR and BWR radioactive waste treatment systems.

Gaseous Radioactive Effluents. For BWRs, an air ejector is the primary source of routine radioactive gaseous effluents released to the atmosphere. Air ejectors are used to remove noncondensable gases from the coolant to improve power conversion efficiency and reduce gaseous and vapor leakages to the atmosphere. After monitoring and filtering, the leakages are discharged to the atmosphere by the building ventilation system. The offgas treatment systems collect noncondensable gases and vapors exhausted from the condenser by the air ejectors. These offgases are then processed through a series of delay systems and filters to remove airborne radioactive particulates and halogens, thereby minimizing the quantities of radionuclides that might be released to the atmosphere. Building ventilation system exhausts are another source of gaseous radioactive emissions for BWRs.

The PWRs have three primary sources of gaseous radioactive effluents: discharges from the gaseous effluent management system, discharges associated with the exhaust of noncondensable gases from the main condenser (if a primary-to-secondary system leak exists), and radioactive gaseous discharges from the building ventilation exhaust. This includes discharges from the reactor building, the reactor auxiliary building, and the fuel-handling building.

The gaseous effluent management system collects fission products. These fission products consist mainly of inert gases that migrate to the primary coolant. A small portion of the primary coolant flow is continually diverted to the primary coolant purification, volume, and chemical control system to remove contaminants and adjust the coolant chemical makeup and volume. During this process, noncondensable gases are stripped and routed to the gaseous effluent management system, which consists of a series of gas storage tanks. The storage

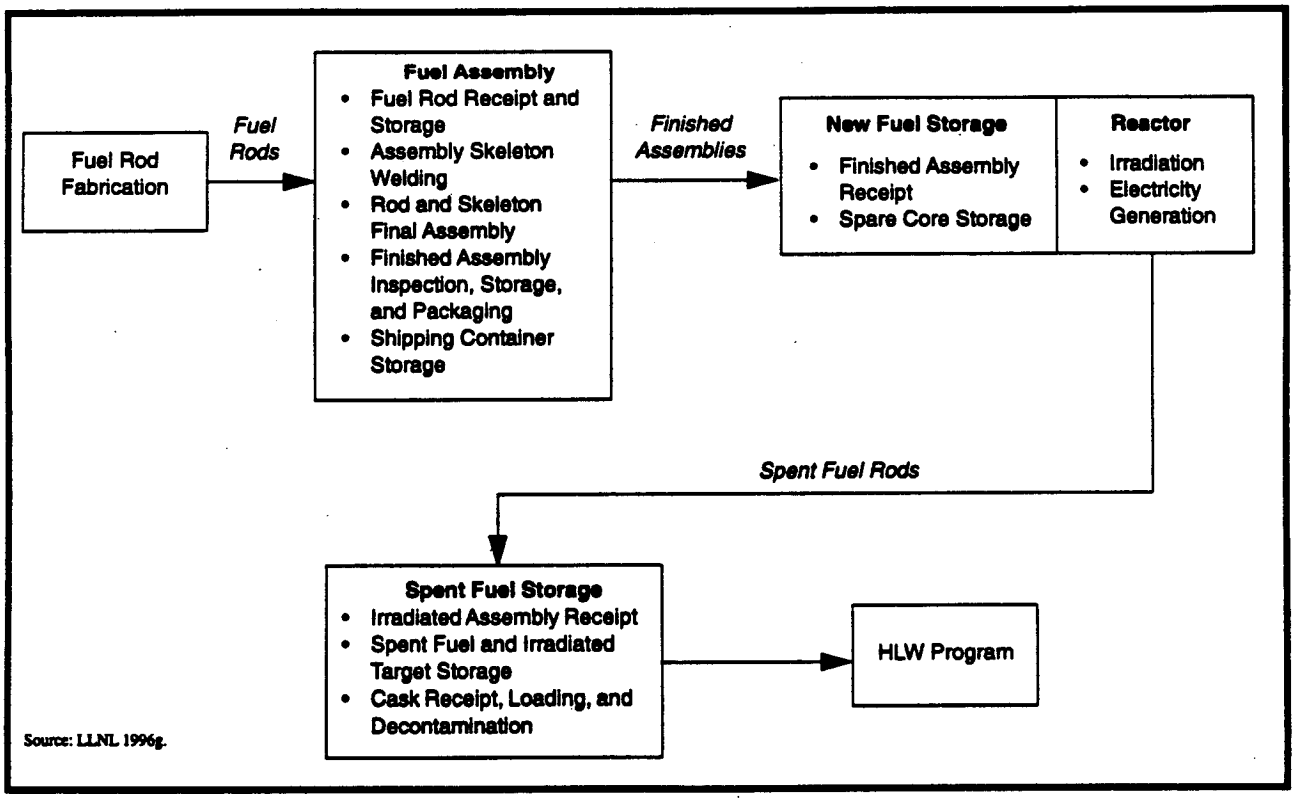


Figure 2.4.5.2–2. Representative Existing Light Water Reactor Fuel Cycle.

tanks allow the short half-life radioactive gases to decay, releasing only relatively small quantities of long half-life radionuclides to the atmosphere. In addition, some PWRs use charcoal delay systems rather than gas holdup tanks. Expected gaseous radioactive effluent is shown in Appendix F.

Liquid Radioactive Effluents. The source of liquid radioactive effluents in LWRs is radionuclide contaminants in the primary coolant. The specific sources, their mode of collection and treatment, and the types and quantities of liquid radioactive effluents released to the environment are similar in BWRs and PWRs. The following discussion applies to both BWRs and PWRs, with distinctions made only when important differences exist.

Liquid effluents from LWRs may be classified in the following categories: clean wastes, dirty wastes, detergent wastes, turbine building floor drain water (BWRs only), and steam generator blowdown (PWRs only). Clean wastes include all liquid effluents with normally low conductivity and variable radioactivity content. These wastes are collected from equipment leaks and drains, valve and pump seal leakoffs not collected in the reactor coolant drain tank, and other leakage sources.

Dirty wastes include all liquid effluents with moderate conductivity and variable radioactivity content that, after processing, may be used as reactor coolant makeup water. Dirty wastes consist of liquid effluents collected in the containment building sump, auxiliary building sumps and drains, laboratory drains, sample station drains, and other miscellaneous floor drains. Detergent wastes consist primarily of laundry wastes and personnel and equipment decontamination wastes. These wastes normally have a low radioactivity content. Water from the turbine building floor drain usually has high-conductivity and low-radionuclide content. In PWRs, steam generator blowdown can contain relatively high concentrations of radionuclides, depending on the amount of primary-to-secondary leakage present. Following treatment, the water may be reused or discharged.

Each of these liquid effluent sources receives varying degrees of and different types of treatment before storage for reuse. Some treated effluents can also be discharged by a site to the environment under the National Pollutant Discharge Elimination System (NPDES) permit. The extent and types of treatment depend on the chemical and radionuclide content of the effluent. To increase the efficiency of processing, effluents of similar characteristics are batched before treatment.

Operating plants have steadily increased the degree of treatment and storage of liquid radioactive effluents. In addition, extensive recycling of steam generator blowdown in PWRs is now common, and secondary side wastewater is routinely treated. Also, the systems used to treat effluents may be augmented with the use of commercial mobile treatment systems. As a result, radionuclide releases in liquid effluent from LWRs have generally declined. Expected liquid radioactive effluent is shown in Appendix E.

Solid Radioactive Waste. Nuclear power plants generate solid LLW through the removal of radionuclides from liquid waste streams, filtration of airborne gaseous emissions, and removal of contaminated material from various reactor areas. Concentrated liquids, filter sludges, waste oils, and other liquid sources are segregated by type and then flushed to storage tanks. They are stabilized for packaging in a solid form by dewatering, then slurried into 208-l (55-gal) steel drums and stored onsite in shielded buildings or other facilities until suitable for offsite disposal. These buildings usually contain volume reduction facilities to reduce LLW for offsite disposal.

High-efficiency particulate air (HEPA) filters are used to remove radioactive material from gaseous plant effluents. These filters are compacted in volume reduction facilities. The material is then disposed of as solid radioactive waste.

Solid LLW consists of contaminated protective clothing, paper, rags, glassware, compactible and noncompactible trash, and non-fuel-irradiated reactor components and equipment. Most of this waste comes from plant modifications and routine maintenance activities. Additional sources include tools and other materials contaminated from use in the reactor environment. Compacted dry radioactive waste is the largest single form of

LLW generated by nuclear plants, and it comprises one-half the total average annual volumes from PWRs and one-third of total average annual volumes from BWRs. Expected waste generated is shown in Appendix E.

Spent Nuclear Fuel. The formation of fission products and actinides when nuclear fuel is irradiated in reactors produces spent fuel. After it is removed from reactors, spent fuel is stored in racks in storage pools to isolate it and to allow the fuel to cool (that is, lose some radioactivity due to decay of the short-lived radioisotopes). Delays in siting a permanent repository, as well as the continual filling of spent fuel pools, have led utilities to seek other storage solutions. These solutions include high-density storage within the existing storage pools, aboveground dry storage, longer fuel burnup, and shipment of spent fuel to other plants.

Efforts are underway to develop dry storage technologies. These technologies include casks, silos, dry wells, and vaults. The NRC has already licensed a number of casks for utilization by public utilities. Dry storage is used by about 5 percent of the operating sites. These facilities are simpler and more readily maintained than fuel pools. They offer a more stable means of storage, occupy relatively little land area (less than 0.2 ha [0.5 acres] in most cases), and offer important economic advantages. Spent fuel is required to be maintained in the spent fuel storage pool for up to 10 years to allow for sufficient cooling. The increased number of MOX spent fuel assemblies shown in Table 2.4.5.2–1 would therefore need to be held in an existing pool for this same amount of time. All the plants studied have sufficient pool capacity to accommodate additional assemblies resulting from use of MOX fuel.

Table 2.4.5.2–1. Existing Light Water Reactor Facility Additional Spent Fuel Generation/Storage Requirements

	Spent Fuel Assemblies	
	PWR	**BWR**
Typical LEU-fueled plant	48	127
Additional for MOX-fueled plant (average)	32	15

Source: ORNL 1995b.

Transportation. There are five types of radioactive material shipments: LLW transported from plants to disposal facilities, LLW shipped to offsite facilities for volume reduction, nuclear fuel shipments from fuel fabrication facilities to plants for loading into reactors (which occurs on a 12- to 18-month cycle), spent fuel shipments from the storage pool at the reactor site to a repository (would only occur after a repository is recommended, approved, and licensed pursuant to the NWPA, and the particular fuel is accepted by the repository), and spent fuel shipments to other nuclear power plants with available storage space (an infrequent occurrence usually limited to plants owned by the same utility).

Waste packaging protects workers and the public from exposure during radioactive material transport. Operation restrictions on transport vehicles, ambient radiation monitoring, imposition of licensing standards (which ensure proper waste certification by testing and analysis of packages), waste solidification, and training of emergency personnel are also used.

A typical PWR creates approximately 44 shipments of LLW per year, while an average BWR makes 104 shipments per year. The majority of the LLW is shipped to disposal facilities by flatbed truck. These shipments are typically packaged in 208-l drums or other Type A containers. These containers must maintain sufficient shielding to limit radiation exposure to handling personnel and do not allow for release of radioactive material under normal transportation conditions.

Fresh MOX fuel is substantially more radioactive than fresh LEU fuel and would be shipped in Type B packages designed and certified for the shipment of unirradiated MOX fuel. One such package is Model No. MO-1 (Certificate No. 9069). Because the quantity of Pu in the fuel is greater than 6 kg (13.2 lbs), the unirradiated

MOX fuel package would be transported within an SST. A variant for this alternative is to use an existing European MOX fuel fabrication facility on a short-term basis. Pu feed material for the European facility would be transported across the global commons to the fabrication site. Similarly, the finished MOX fuel would be transported back to the United States across the global commons. An analysis of the transportation risks associated with this variant are presented in Appendix G.

After discharge from the reactor, spent fuel is placed in the spent fuel storage pool and allowed to cool until it can be sent to permanent disposal. Because of the limited size of spent fuel pools, some utilities have resorted to shipment of spent fuel between different reactors (usually within the same utility). For shipment, spent fuel is placed in Type B packages (called casks), and shipped by either truck or rail. Spent fuel shipping casks are very robust, and are designed to retain the highly radioactive contents under both normal and accident conditions.

A number of truck and rail casks are available for shipment of LEU spent fuel. Shipment of MOX spent fuel may require that each cask design be re-evaluated, and the NRC certificate may need to be amended to address the MOX spent fuel characteristics. Among the many casks designed for spent fuel, truck casks in the 23-t (25-tons) to 36-t (40-tons) range, such as (1) NAC-LWT (for one PWR or two BWR assemblies), (2) GA-4 (for four PWR assemblies), and (3) the GA-9 (for nine BWR assemblies), could be utilized.

2.4.5.3 Partially Completed Light Water Reactor Alternative

Under this alternative, commercial domestic LWRs on which construction has been halted would be completed and operated for disposition. The completed reactors would use MOX fuel in lieu of conventional LEU fuel. The characteristics of these units would essentially be the same as those of contemporary operating commercial LWRs discussed in Section 2.4.5.2. There are seven partially completed commercial LWRs located at four sites in the continental United States. The Bellefonte Nuclear Plant has been selected for study as a representative site for this alternative. As was stated for the Existing LWR Alternative, before the surplus Pu can be used as reactor fuel, a conversion process would be required to transform the Pu, in its various forms, into a usable form. Pit disassembly/conversion, Pu conversion, and MOX fuel fabrication facilities would be required to process the Pu into MOX fuel. All requirements shown in this section are in addition to those previously described for the pit disassembly/conversion, Pu conversion, and MOX fuel fabrication facilities. Since the reactors that would use the MOX fuel are in addition to existing commercial reactors, these partially completed reactors would create an additional amount of spent fuel to be added to the existing disposal requirements for uranium-based fuels.

In accordance with the Preferred Alternative for surplus Pu disposition, two partially completed LWRs could be selected. This would occur only after negotiations between DOE and interested parties, and through a competitive procurement process. Further tiered NEPA review will be conducted to examine locations should this option of the Preferred Alternative be selected at the ROD.

Facility Description. The partially completed LWRs contain the same four major components described in Section 2.4.5.2: the reactor building, the turbine building, auxiliary buildings, and cooling towers or ponds. A representative partially completed reactor site layout is depicted in Figure 2.4.5.3–1.

Facility Operations. Partially completed reactor facility operations would be generally the same as those described in Section 2.4.5.2. In this alternative, two partially completed reactors would be operated with an average MOX throughput of 68 t/yr (75 tons/yr) heavy metal.

Construction. Construction of two partially completed reactors would have to be completed to satisfy requirements under this alternative. Appendix C contains resources and personnel requirements necessary to complete construction of the typical pair of reactors. The construction of the partially completed LWR facility would require 7 years and have a peak annual employment of approximately 2,300 construction workers.

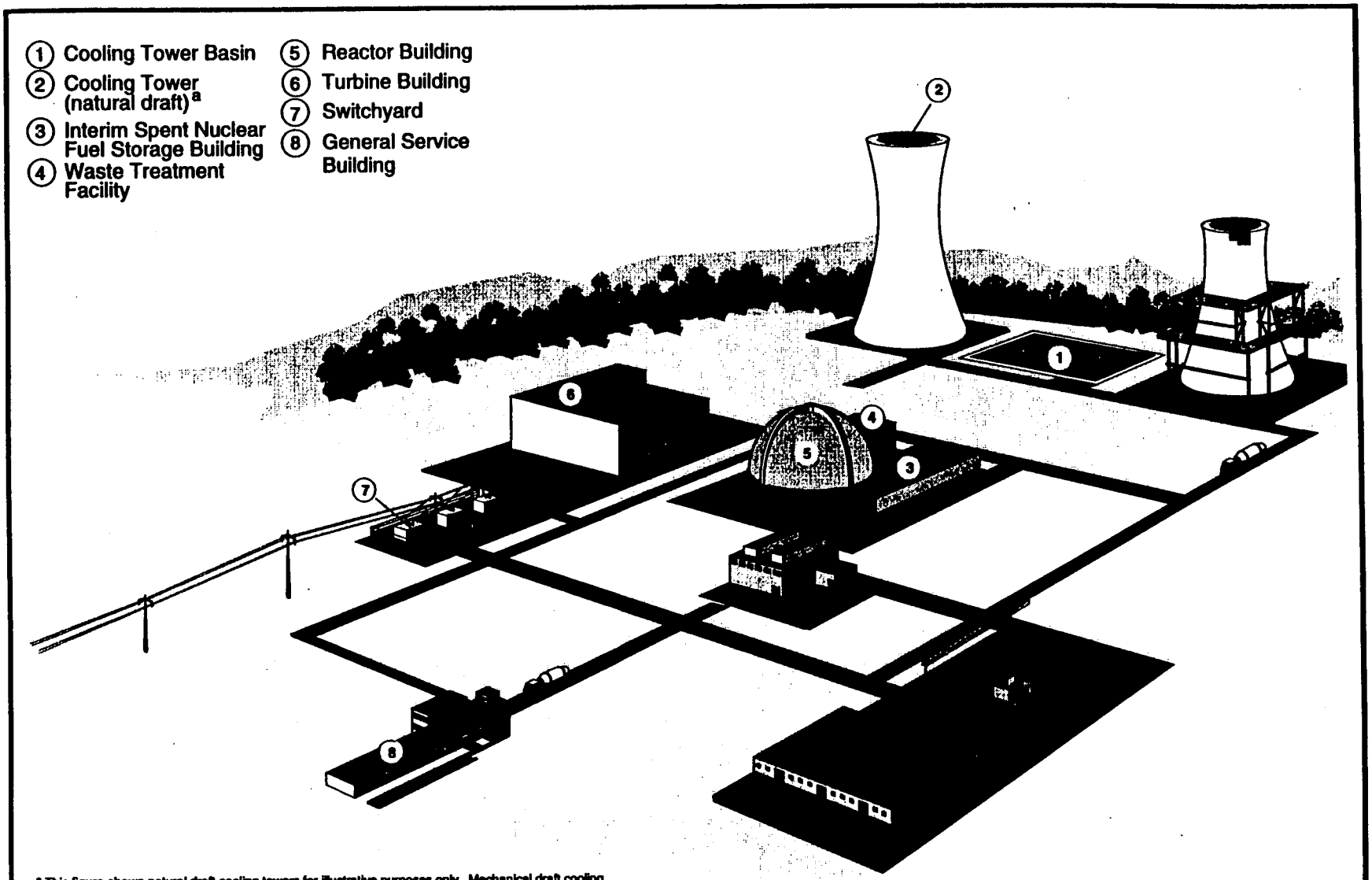


Figure 2.4.5.3–1. Representative Partially Completed Light Water Reactor Facility (Perspective).

Waste Management. The solid and liquid nonhazardous wastes generated during construction would include concrete and steel construction waste materials and sanitary wastewater. The remaining nonhazardous wastes generated during construction would be disposed of as part of the construction project by the contractor. Uncontaminated wastewater could be used for soil compaction and dust control, and excavated soil would be used for grading and site preparation. Wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling. Hazardous wastes generated during construction would consist of materials such as waste adhesives, oils, cleaning fluids, solvents, and coatings. Hazardous waste would be packaged in DOT-approved containers and shipped offsite to commercial RCRA-permitted treatment, storage, and disposal facilities. No radioactive waste would be generated during construction. Waste management requirements for operation are the same as those discussed in Section 2.4.5.2. Appendix F shows reactor average annual emissions during the peak construction year, respectively.

Transportation. Transportation requirements for the partially completed LWRs are the same as those discussed in Section 2.4.5.2.

2.4.5.4 Evolutionary Light Water Reactor Alternative

Evolutionary LWRs would be designed for the purposes of surplus Pu disposition and simultaneous production of electric power. As for the Existing LWR and Partially Completed LWR Alternatives, before the surplus Pu can be used as reactor fuel, a conversion process is required to transform the Pu, in its various forms, into a usable form. Pit disassembly/conversion, Pu conversion, and MOX fuel fabrication facilities would be required to convert the Pu into MOX fuel. Each fuel assembly loaded into a reactor would reside in the reactor between 4 and 5.4 years, during which time the reactor would be at power 75 percent of the time. After discharge from the reactor, the spent fuel assemblies would be stored at the reactor site for up to 10 years before further disposition. All requirements in this section are in addition to those previously described for the pit disassembly/conversion, Pu conversion, and MOX fuel fabrication facilities. Since the MOX-burning evolutionary reactors would be in addition to existing commercial reactors, these evolutionary reactors would create an additional amount of spent fuel to be added to the existing disposal requirement for uranium-based fuels.

Facility Description. Two evolutionary LWR design approaches, based on rated power (large and small reactor, designated large evolutionary LWR and small evolutionary LWR in the following discussion), are under consideration. There are three large evolutionary LWR designs: an approximately 1,400-MWe PWR, an approximately 1,250-MWe PWR, and an approximately 1,300-MWe BWR. A small, evolutionary LWR, approximately 600-MWe PWR, is also under consideration. For any design, an evolutionary LWR facility would consist of the following major components: the reactor, interim spent fuel storage, power conversion facility, and waste treatment facility. The planned Pu disposition campaign would require a minimum of two large evolutionary LWRs or four small evolutionary LWRs. The total disturbed land area for the evolutionary LWR operating facility would be approximately 138 ha (340 acres). In addition, a 1.6-km (1-mi) wide buffer zone around the facility may be required, depending on NRC licensing requirements. Figure 2.4.5.4–1 depicts a typical evolutionary LWR facility site plan. The major components of an evolutionary LWR facility are described below.

Reactor. The individual reactors would be an improved version of existing commercial electric power generating reactors using ordinary (light) water as both the moderator and coolant. The core, contained within a steel pressure vessel, would be composed of bundles of fuel rods. The fuel rods would consist of MOX fuel. The evolutionary LWR facility fuel cycle is depicted in Figure 2.4.5.4–2.

The cooling system selected, wet or dry, would depend on site characteristics. Both wet and dry cooling systems would use water as the heat exchange medium. Wet systems would use water towers and the evaporation process to carry off heat. Dry systems, designed for cold or high-humidity climates, would use water in closed nonevaporative cooling towers to remove heat by conduction to the atmosphere through heat exchangers. In moderate climates, fans would be added to the dry cooling towers to move air over the vanes of the heat

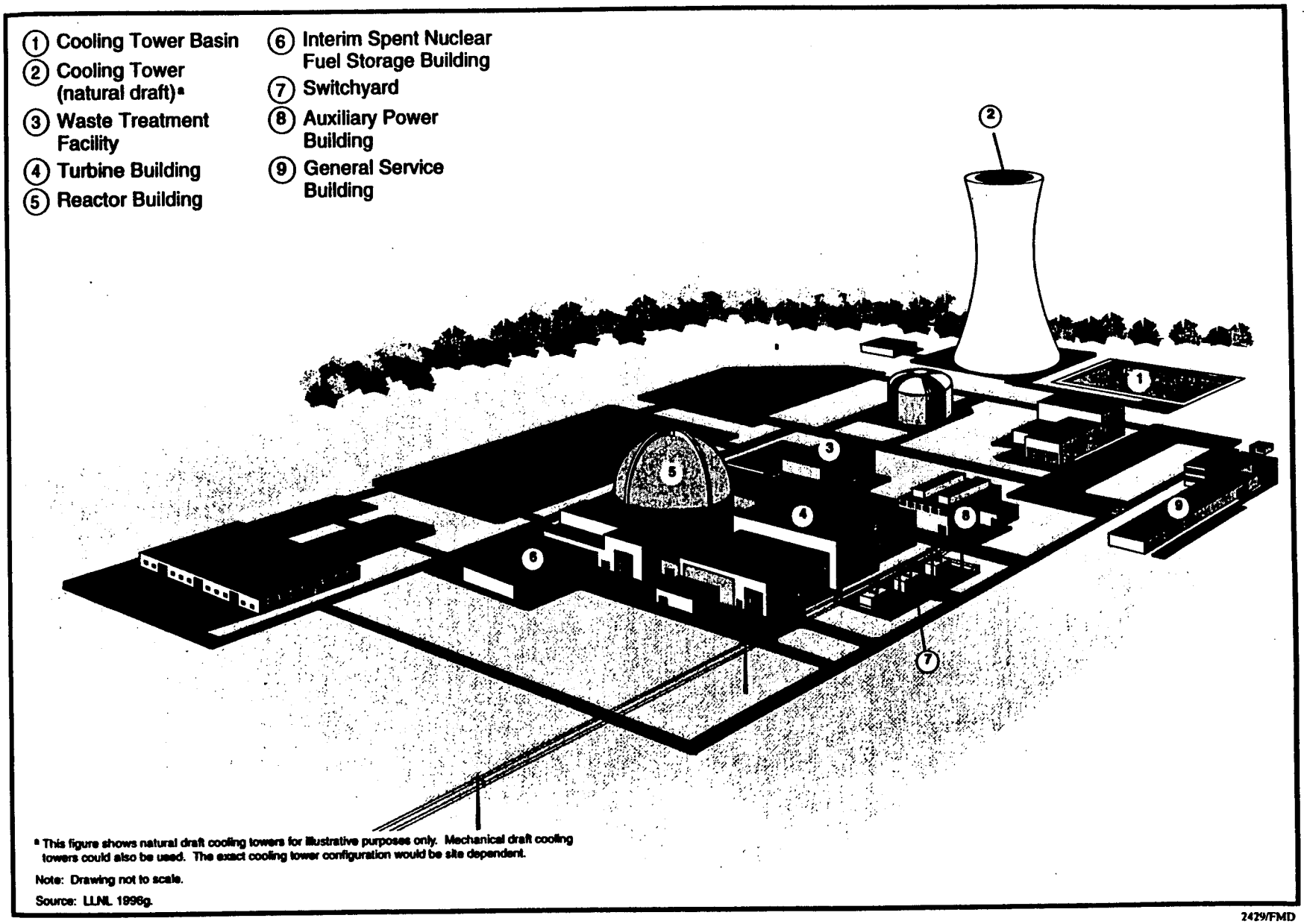


Figure 2.4.5.4–1. Representative Evolutionary Light Water Reactor Facility (Perspective).

exchangers. There would be some water loss through evaporation in a dry system, but significantly less than with a wet tower. Dry cooling towers would be used for the reactors at all dry sites. The use of wet cooling towers would be an option only for the power conversion facility and only when the facility would be located at a wet site.

Interim Spent Fuel Storage Facility. Spent fuel would be stored onsite in an underwater spent fuel storage pool.

Power Conversion Facility. This facility would contain a turbine generator, electrical equipment, control equipment, auxiliary systems, plant support systems, and other equipment.

Waste Treatment Facility. This facility would receive all solid, liquid, and gaseous radioactive waste for storage, treatment, and packaging for either release or disposal at an appropriate permanent waste disposal facility.

Facility Operations. As a minimum, two large reactors or four small reactors would be operated to achieve 3.5 t to 4.1 t/yr (3.6 to 4.5 tons/yr) throughput for the disposition of surplus Pu and the simultaneous production of electric power.

Construction. The construction of the evolutionary LWR would require 6 years and have a peak annual employment of 3,500 construction workers. Additional land area required for construction is projected to be approximately 146 ha (360 acres). This provides for construction material laydown, warehousing, and temporary parking. Appendix C contains resources and personnel requirements required for the construction phase.

Waste Management. The solid and liquid nonhazardous wastes generated during construction would include concrete and steel construction waste materials and sanitary wastewater. The remaining nonhazardous wastes generated during construction could be disposed of as part of the construction project by the contractor.

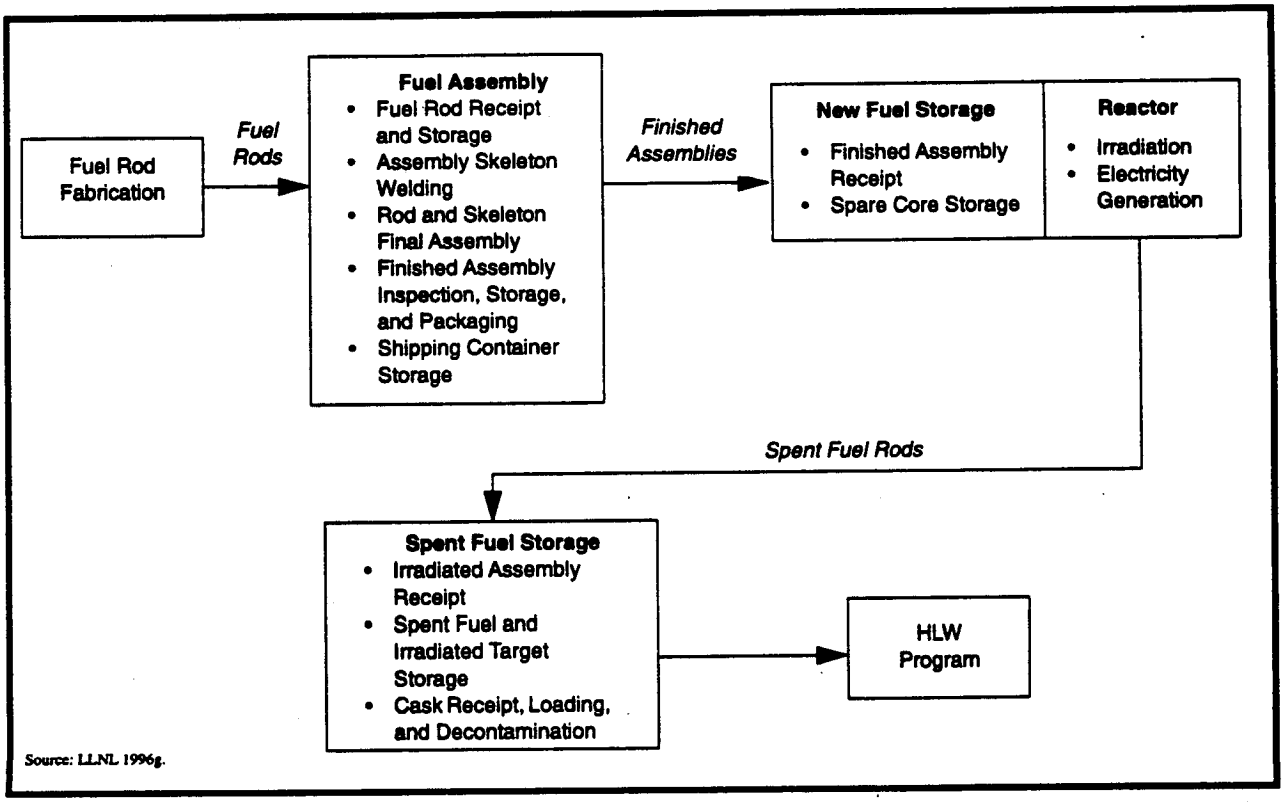


Figure 2.4.5.4–2. Representative Evolutionary Light Water Reactor Fuel Cycle.

Uncontaminated wastewater would be used for soil compaction and dust control, and excavated soil would be used for grading and site preparation. Wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling. Hazardous wastes generated during construction would consist of materials such as waste adhesives, oils, cleaning fluids, solvents, and coatings. Hazardous waste would be packaged in DOT-approved containers and shipped offsite to commercial RCRA-permitted treatment, storage, and disposal facilities. No radioactive waste would be generated during construction.

The evolutionary reactor design considers and incorporates waste minimization and pollution prevention. Segregation of activities that generate radioactive and hazardous wastes would be employed, where possible, to avoid the generation of mixed wastes. Where applicable, treatment to separate radioactive and nonradioactive components would be performed to reduce the volume of mixed wastes and provide for cost-effective disposal or recycling. To facilitate waste minimization where possible, nonhazardous materials would be substituted for those materials that contribute to the generation of hazardous or mixed waste. Production processes would be configured with high priority given to minimization of waste production. Where possible, material from the waste streams would be treated to facilitate disposal as nonhazardous wastes. [Text deleted.]

Solid and liquid waste streams would be routed to the waste management system. Solid waste would be characterized and segregated into low-level, mixed, and hazardous wastes, then treated to forms suitable for disposal or storage within the facility. Liquid waste would be treated onsite to reduce hazardous/toxic and radioactive elements before discharge or transport. All fire sprinkler water discharged in process areas would be contained and treated as process wastewater.

Spent Nuclear Fuel. Fuel elements containing spent fuel would be stored for up to 3 years in water-cooled storage basins and up to 7 additional years in dry storage. The spent fuel pool would be equipped with an underwater canister loading system. Twelve spent fuel assemblies would be placed in fixed positions in a borated aluminum or stainless-steel basket for criticality safety. The basket would be contained in a canister whose lids are seal-welded in place. After the 3-year cooling period, the canisters would be drained, vacuum dried, and backfilled with helium through lid penetrations in preparation for dry storage. The canisters would be transferred in a cask to the interim spent fuel storage facility. At the storage facility, the canisters would be transferred into the final storage cask, which would be made of precast concrete and would hold one canister each. Casks would be placed on a concrete basemat. Periodic visual inspections of the canisters and the cask vents would be required. Periodic testing for helium leaks might also be required. Although the spent nuclear fuel is assumed to be stored at the reactor site for 3 to 10 years before further disposition, the facility design would have sufficient capacity to store the spent nuclear fuel for the life of the facility.

Transuranic Waste. The evolutionary LWRs would not generate any TRU waste.

Low-Level Waste. LLW would be generated by the operation of the reactor and support facilities. Process effluents would be temporarily stored in storage tanks before conversion into solid LLW that is suitable for disposal. The liquid effluent, after treatment, would be discharged through a permitted NPDES outfall. The bulk of the solid LLW would be generated in the reactor. Solid LLW would consist of contaminated equipment pieces, plastic sheeting, and protective clothing. This solid LLW would be compacted if appropriate and then disposed in a permitted onsite/offsite disposal facility.

Mixed Low-Level Waste. No liquid mixed LLW would be generated from operating the evolutionary LWR. Solid mixed LLW may originate from wipes laden with contaminated oils and hydraulic fluids. Mixed LLW would be stored in an onsite RCRA-permitted storage facility until treatment.

Hazardous Waste. Liquid hazardous waste would be generated from cleaning solvents, cutting oils, vacuum pump oils, film processing fluids, hydraulic fluids from mechanical equipment, antifreeze solutions, and paint. The cleaning solvent selected would be from a list of non-halogenated solvents. Liquid hazardous waste would be collected in DOT-approved containers and sent to an onsite hazardous waste accumulation area. The

hazardous waste accumulation area would provide a 90-day staging capacity prior to shipment to an offsite commercial RCRA-permitted treatment, storage, and disposal facility. Solid hazardous waste would be generated from nonradioactive materials such as wipes contaminated with oils, lubricants, and cleaning solvents that are used for equipment outside the main processing units. After compaction, if appropriate, the solid hazardous waste would be packaged in DOT-approved containers and sent to a hazardous waste accumulation area for staging before shipment to an offsite commercial RCRA-permitted treatment, storage, and disposal facility.

Nonhazardous (Sanitary) Waste. Sewage wastewater would be treated in the sanitary wastewater treatment plant. Sewage wastewater would be kept separate from all industrial and process wastewaters and normally would contain no radioactive wastes from the reactor. The sewage wastewater would be routinely monitored for radioactive contaminants. The sludge would be disposed of in a permitted landfill. The treated effluent would be discharged through a permitted NPDES outfall (wet site) or recycled for cooling water makeup and other services (dry site). The treated effluent from the process wastewater treatment would be discharged to the river through an NPDES outfall. Other nonrecyclable, nonhazardous, solid sanitary, and industrial wastes would be compacted and disposed of in a permitted landfill.

Nonhazardous (Other) Waste. The evolutionary reactor design includes stormwater retention facilities with the necessary NPDES monitoring equipment. Rainfall within the LA and PA would be collected separately and routed to the stormwater collection ponds and then sampled and analyzed before discharge. If the runoff were contaminated, it would be treated in the radioactive waste treatment system. Runoff from the PPA may be discharged directly through an NPDES outfall into the natural drainage channels. Cooling tower blowdown would be treated and discharged to the outfall (wet site) or recycled for reuse (dry site). The treated effluent from the utility wastewater treatment would be discharged to the river through an NPDES outfall (wet site) or a natural drainage channel (dry site). All sludges would be disposed of in a permitted landfill.

Transportation. Transportation requirements for the evolutionary LWRs are the same as those discussed in Section 2.4.5.2.

2.4.5.5 Canadian Deuterium Uranium Reactor Alternative

Ontario Hydro operates 20 CANDU reactor units capable of using MOX fuel at five nuclear generating stations in the Province of Ontario. In addition, there is one CANDU reactor in the Province of Quebec and another CANDU reactor in New Brunswick. Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion or Pu conversion facility, packaged, transported to the MOX fuel fabrication facility, and converted into MOX fuel. The MOX fuel would be transported to and used in one or more CANDU reactors. The use of Canadian reactors would be subject to the approval, policies, and regulations of the Canadian Federal and Provincial governments.

Ontario Hydro Nuclear Bruce-A Generating Station has been identified as a reference facility by the Government of Canada and is used as a representative site for evaluation of the CANDU Reactor Alternative and the CANFLEX fuel bundle. The Ontario Hydro Nuclear Bruce-A Generating Station, containing four 769-MWe generating stations along with its four-unit sister station, Bruce-B, is located on Lake Huron about 300 km (186 mi) northeast of Detroit, Michigan.

Facility Description. The major components of a CANDU reactor are described below.

Reactor. An individual CANDU reactor has a horizontal, cylindrical, heavy-water filled, calandria tank containing 480 high-pressure fuel channel assemblies (also referred to as tubes) and reactivity control units. Heavy water, deuterium oxide (deuterium is a form of hydrogen with a neutron in its nucleus in addition to the proton of the hydrogen nucleus), is the neutron moderator and reflector. This entire assembly is contained in a light water-filled shield tank to form an integral structure that provides operational and shutdown shielding.

Power Conversion Facility. The turbine hall contains turbo-generators, electrical equipment, control equipment, auxiliary systems, plant support systems, and other equipment.

Vacuum Building. This facility is the focal point of the Negative Pressure Containment System.

Auxiliary Services Building. This facility houses supporting services for the Nuclear Generating Station.

Waste Treatment Facility. This facility would receive all spent fuel, solid, liquid, and gaseous radioactive waste for storage, treatment, and packaging for either release or disposal at an appropriate permanent waste disposal facility.

Facility Operations. The CANDU reactor MOX fuel cycle for CANDU fuel bundles in two CANDU reactors at the representative generating station would dispose of approximately 2.9 t/yr (3 tons/yr) of Pu based on a MOX throughput of 136 t/yr (150 tons/yr) heavy metal. Using the CANFLEX fuel design, four reactors would dispose of 5 t/yr Pu (5.5 tons/yr) based on a MOX throughput of 150 t/yr (165 tons/yr) heavy metal. The fuel cycle is depicted in Figure 2.4.5.5–1.

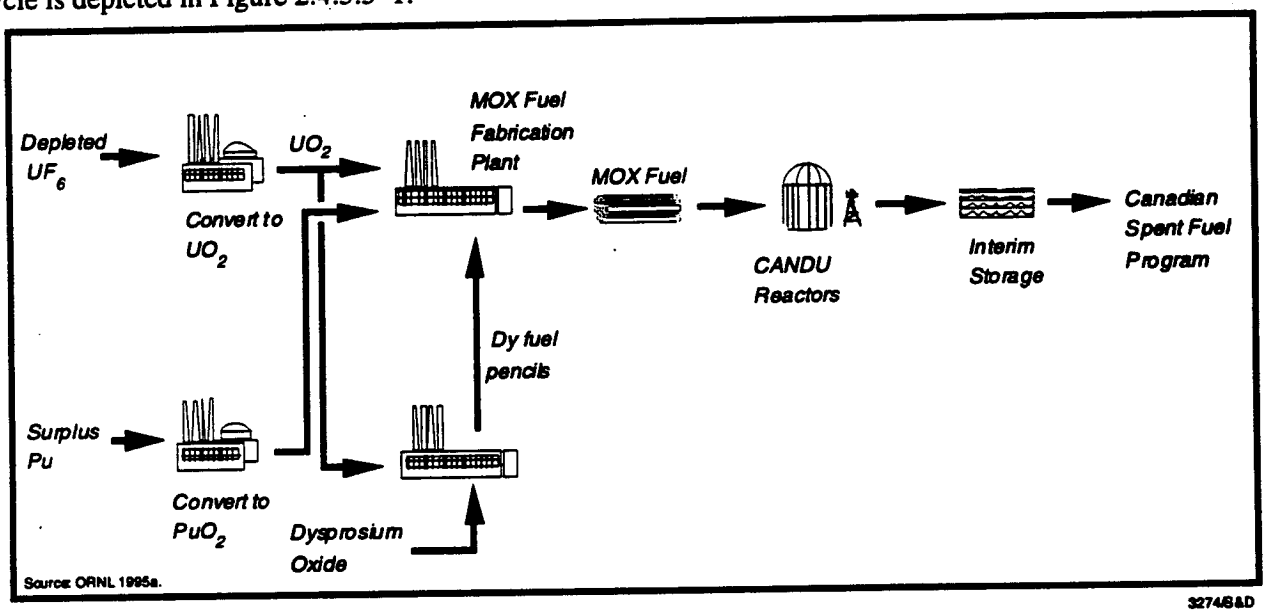


Figure 2.4.5.5–1. Canadian Deuterium Uranium Reactor Mixed Oxide Fuel Cycle.

Construction. The use of MOX fuel in the existing CANDU reactors may require a small addition to reactor site fuel receiving and storage buildings to properly secure the MOX fuel prior to its use. No significant additional land would be required for this construction.

Waste Management. Externally, MOX fuel and natural uranium fuel bundles are identical. The only difference, beside their fuel content, is the higher external radiation level of the MOX fuel bundle. The difference would not result in any increase in the quantity or hazard level of waste produced, processes employed, or facilities required for interim waste storage or disposal.

The Bruce Nuclear Generating Station has facilities for the storage of low-, medium-, and high-level radioactive MOX wastes. Spent MOX fuel bundles would be stored in CANDU wet storage spent fuel modules, equivalent to LWR spent fuel storage racks. Spent MOX fuel decay heat generation and fission product concentration would be similar to current CANDU fuel. The spent fuel resulting from using MOX fuel in the CANDU reactors

would be the responsibility of Ontario Hydro and will be stored and disposed of in accordance with procedures established by the Canadian Atomic Energy Control Board.

Transportation. DOE would coordinate the transport of MOX fuel with the Canadian Federal and Provincial Governments. Transportation would be by commercial truck with appropriate security protection, or by SST, in accordance with applicable Federal regulation (49 CFR) and trucking industry practice to ensure safe, secure transport. Fresh MOX fuel bundles would be packaged in a standard stainless steel 208-l (55-gal) container. The packaging would be capable of holding seven CANDU MOX fuel bundles and would have to be certified as Type B packaging and approved for use within both Canada and the United States. The packaging would have to undergo certification by DOE, NRC, and DOT, as well as the Canadian Atomic Energy Control Board and Canadian Ministry of Transport. Although a packaging system has been approved in the United States for shipments of Category 1 materials, it has not yet been approved for the transport of CANDU MOX fuel bundles to Canada.

Based on the annual fuel requirement of 9,052 bundles (ORNL 1995a:26), approximately 54 truckloads per year would be required (slightly more than 1 per week). A brief technical description of MOX fuel use in a CANDU reactor is included in Appendix I.

2.5 COMPARISON OF ALTERNATIVES

The environmental impacts of the storage and disposition alternatives, including the Preferred Alternative, are compared in this section. The emphasis is on those environmental resources and issues that discriminate between the alternatives and are of interest to the public. At the end of this section, Table 2.5–1 provides a summary of environmental impacts for the Preferred Alternative for storage; Table 2.5–2 provides a comparison of environmental impacts for the No Action and long-term storage alternatives; and Table 2.5–3 provides a comparison of environmental impacts for disposition alternatives (including the Preferred Alternative).

2.5.1 LONG-TERM STORAGE ALTERNATIVES

Tables 2.5.1–1 through 2.5.1–6 present a comparison of the key environmental impacts for the long-term storage alternatives and the Preferred Alternative for storage. As discussed in Section 1.6, the Preferred Alternative for storage is a combination of No Action and Upgrade Alternatives for the various DOE sites, and phaseout of Pu storage at RFETS.

For all of the storage sites, the No Action Alternative is used as a baseline from which incremental impacts of the storage alternatives are compared. The phaseout associated with these storage alternatives could reduce human health and waste generation impacts and increase the number of lost jobs at some sites.

Site Infrastructure. For the Upgrade Alternative, all requirements would be within existing site capacities for all sites except for coal at ORR and SRS. Under the Preferred Alternative, coal consumption at ORR and SRS would exceed site storage capacities by less than 1 percent; all other requirements would be within existing site capacities. In those cases where site capacity for fuel storage does not adequately support increased requirements, more frequent deliveries would be scheduled. Increases in resource requirements would be within the following ranges over No Action: electrical energy, 0 to 104 percent (maximum for Pantex); peak electric load, 0 to 90 percent (maximum for Pantex); oil, 0 to 13 percent (maximum for INEL for the Upgrade Alternative); natural gas, 0 to 71 percent (maximum for Pantex); and coal, 0 to 1 percent (maximum for ORR).

For the Consolidation Alterative, all requirements would be within existing site capacities at all sites except for the following: electrical energy (12 percent over existing capacity), oil (1 percent over existing capacity), and natural gas (no existing capacity) at NTS; coal at INEL (97 percent over existing capacity); and oil (1 percent over existing capacity) and coal (2 percent over existing capacity) at SRS. In these cases where site capacity for fuel storage does not adequately support increased requirements, more frequent deliveries would be scheduled. Increases in resource requirements would be within the following ranges over No Action: electrical energy, 8 to 104 percent (maximum for Pantex); peak electric load, 9 to 90 percent (maximum for Pantex); oil, 1 to 5 percent (maximum for Pantex); natural gas, 0 percent (no existing capacity at NTS); and coal, 0 to 97 percent (maximum for INEL). All infrastructure requirements could be met by increasing procurement or, in the case of NTS, by using a different energy source.

For the Collocation Alternative, all requirements would be within existing site capacities at all sites except for the following: electrical energy (21 percent over existing capacity), oil (1 percent over existing capacity), and natural gas (no existing capacity) at NTS; coal at INEL (124 percent over existing capacity); oil (3 percent over existing capacity), and coal (35 percent over existing capacity) at ORR; and oil (1 percent over existing capacity) and coal (3 percent over existing capacity) at SRS. In these cases where site capacity for fuel storage does not adequately support increased requirements, more frequent deliveries would be scheduled. Increases in resource requirements would be within the following ranges over No Action: electrical energy, 8 to 126 percent (maximum for Pantex); peak electric load, 9 to 100 percent (maximum for Pantex); oil, 1 to 14 percent (maximum for ORR); natural gas, 0 percent (no existing capacity at NTS); and coal, 0 to 124 percent (maximum for INEL).

Soil, Cultural, and Paleontological. Ground disturbance during construction activities would potentially affect soil; cultural resources (including historic, prehistoric, and Native American); and paleontological resources. The Upgrade Alternatives and the Preferred Alternative would have fewer impacts because they use existing facilities or involve only small areas of ground disturbance. The Consolidation and Collocation Alternatives would have more impacts because they involve more ground disturbance due to the construction of new facilities.

Land Use and Visual Resources. For land use, the larger facilities associated with Consolidation and Collocation Alternatives would use more land (56 to 87 ha [138 to 215 acres]) than the facilities associated with Upgrade and Preferred Alternatives (0 to 0.1 ha [0 to 0.25 acres]). The Collocation Alternative at ORR would change the current Visual Resource Management (VRM) Class 4 designation of the Bear Creek Road/Route 95 intersection to Class 5. Visual resources at the other DOE sites would not be affected by the storage alternatives because the facilities would be located near other similar structures.

Air Quality and Noise. Since the Collocation and Consolidation Alternatives would result in more air emission sources (exhaust from delivery trucks, generators, and boilers), slightly greater air quality impacts would occur than with the Upgrade and Preferred Alternatives. The more extensive ground disturbance during construction associated with the Consolidation and Collocation Alternatives would also result in higher levels) of particulate matter less than or equal to 10 microns (PM_{10}) and Total Suspended Particulates (TSP) than for the Upgrade and Preferred Alternatives. Potential air emissions for all of the alternatives would be within applicable Federal, State, and local air quality standards and guidelines. Minimal noise impacts are expected from the storage alternatives because of the remote location of the facilities that would be modified or constructed.

Socioeconomics. Beneficial impacts to regional employment would be expected from all storage alternatives at all storage sites (Table 2.5.1–1) except for the site (or sites depending on the alternative) where storage would be phased out. Collocation would generate the largest employment, followed by the Consolidation, Upgrade, and Preferred Alternatives. However, the phaseout at RFETS associated with the Preferred Alternative would result in the loss of approximately 2,200 direct jobs. Due to the small number of the new jobs created by the alternatives relative to the size of the regional economies at all of the DOE sites, community services would not be affected by the long-term storage alternatives. Short-term local transportation impacts may result at all sites from the construction of the facilities associated with the storage alternatives. The larger construction projects (Collocation and Consolidation Alternatives) would have a greater potential to cause short-term congestion on local roads than the smaller construction projects (the Upgrade and Preferred Alternatives).

Water Resources. The water resource impacts for the Consolidation and Collocation Alternatives are greater than for the Upgrade and Preferred Alternatives, both in water requirements and wastewater discharges. Wastewater discharge is dependent on the number of employees, which is greatest for the Consolidation and Collocation Alternatives due to the larger facilities. As shown in Table 2.5.1–2, water resource requirements are the greatest for the Collocation Alternative at all DOE sites because collocation includes the maximum amount of Pu and HEU in the PEIS. Water resource requirements for all the alternatives would impact groundwater availability at Pantex because the additional groundwater withdrawal would contribute to the existing overall decline in water levels of the Ogallala Aquifer. However, there should be minimal impacts to regional groundwater levels from this additional withdrawal. At all other sites, water requirements would have minimal impact on water resources because of the abundance of surface water or groundwater.

Biological Resources. The Preferred Alternative would have no incremental biological resource impacts at INEL and Hanford, and minimal impacts at Pantex and potentially at SRS because of ground disturbance for upgrades. The Consolidation and Collocation Alternatives would have the potential to impact biological resources at all DOE sites because they would involve ground disturbance. At Pantex, previously disturbed land would be used for consolidation and collocation facilities. Threatened and endangered species at NTS and SRS may be affected by the storage alternatives at these sites.

Table 2.5.1–1. Maximum Incremental Direct Employment Over No Action Generated During Operation at Each Candidate Site

Site	Total Site Employment in 2005	Upgrade	Consolidation	Collocation	Preferred Alternative
Hanford	14,586	252[a]	443	572	0
NTS	3,800	NA	527[b]	641[b]	0
INEL	6,911	116[a]	432	561	0
Pantex	3,559	90[c]	509[d]	601	90[e]
ORR	18,010	111	[f]	566[g]	111
SRS	16,562	30[h]	485	614	30[h,i]

[a] Upgrade with RFETS and LANL materials.
[b] Modify P-Tunnel.
[c] Upgrade with RFETS and LANL materials. Actual number of employees during operation could be higher.
[d] Construct new and modify existing storage facilities.
[e] Upgrade with pits from RFETS.
[f] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[g] Construct new Pu and HEU facilities.
[h] Workers would be supplied from existing site workforce.
[i] Upgrade with non-pit materials from RFETS.
Note: NA=not applicable.

Table 2.5.1–2. Maximum Annual Net Incremental Water Usage Over No Action During Operation at Each Candidate Site

Site	No Action in 2005 (million l/yr)	Upgrade (million l/yr)	Consolidation (million l/yr)	Collocation (million l/yr)	Preferred Alternative (million l/yr)
Hanford	195	8.9[a]	110	150	0
NTS	2,400	NA	130[b]	190[b]	0
INEL	7,570	22[a]	66	87	0
Pantex	249	110[a]	110[c]	130	27.5[d]
ORR	14,760	0.24	[e]	360[f]	0.24
SRS	13,247	7.1[a]	360	460	5.7[g]

[a] Upgrade with RFETS and LANL materials.
[b] Modify P-Tunnel.
[c] Construct new and modify existing storage facility.
[d] Upgrade with pits from RFETS.
[e] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[f] Construct new Pu and HEU facilities.
[g] Upgrade with non-pit materials from RFETS.
Note: MLY=million liters per year; NA=not applicable.

Environmental Justice. All six DOE storage sites have, within an 80-km (50-mi) radius, census tracts with greater than 25 percent minority or low-income populations. However, the public health and safety analyses show that air emissions and hazardous chemical and radiological releases from normal operations for all storage alternatives would be within regulatory limits and that no latent cancer fatalities would result. The public health and safety analyses also indicate that radiological releases from accidents would not result in adverse human health or environmental impacts. Potential transportation accidents would be random events along transportation corridors. Therefore, none of the storage alternatives would have disproportionately high or adverse impacts on minority or low-income populations.

Waste Management. All of the storage alternatives would impact existing waste management practices at the DOE sites by increasing the amount of waste that must be treated, stored, and disposed. Depending on decisions in the waste-type-specific RODs for the Waste Management PEIS, wastes would be treated and disposed of onsite or at regionalized or centralized DOE sites. Generally, the Consolidation and Collocation Alternatives would generate more wastes than the Upgrade and Preferred Alternatives. Tables 2.5.1–3 through 2.5.1–5 show the maximum incremental waste generation rates for solid low-level, solid TRU, and solid hazardous wastes at the six candidate sites.

Table 2.5.1–3. Maximum Annual Net Incremental Volume of Solid Low-Level Waste Over No Action Generated During Operation at Each Candidate Site

Site	Waste Generated in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)	Preferred Alternative (m^3)
Hanford	3,390	89[a]	1,260	1,300	0
NTS	15,000	NA	1,260	1,300	0
INEL	7,200	500[a]	1,260	1,300	0
Pantex	32	1,260[a]	1,260	1,300	138[b]
ORR	7,320	3	[c]	1,300[d]	3
SRS	16,400	0	1,220[e]	1,260[e]	0

[a] Upgrade with RFETS and LANL materials.
[b] Upgrade with pits from RFETS.
[c] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[d] Construct new Pu and HEU facilities.
[e] Net waste from new facility and from phaseout of existing facility.
Note: NA=not applicable.

Table 2.5.1–4. Maximum Annual Net Incremental Volume of Solid Transuranic Waste Over No Action Generated During Operation at Each Candidate Site

Site	Waste Generated in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)	Preferred Alternative (m^3)
Hanford	271	21[a]	10	10	0
NTS	0	NA	10	10	0
INEL	3.5	2[a]	10	10	0
Pantex	0	10[a]	10	10	0.8[b]
ORR	119	0	[c]	10[d]	0
SRS	338	0	2[e]	2[e]	0

[a] Upgrade with RFETS and LANL materials.
[b] Upgrade with pits from RFETS.
[c] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[d] Construct new Pu and HEU facilities.
[e] Net waste from new facility and from phaseout of existing facility.
Note: NA=not applicable.

Table 2.5.1–5. Maximum Annual Net Incremental Volume of Solid Hazardous Waste Over No Action Generated During Operation at Each Candidate Site

Site	Waste Generated in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)	Preferred Alternative (m^3)
Hanford	560	4	2	2	0
NTS	212	NA	2	2	0
INEL	1,200	1	2	2	0
Pantex	31	2[a]	2	2	1.5[b]
ORR	26	0.8[c]	[d]	2[e]	0.8
SRS	15,100	0.8[a]	2	2	0.6[f]

[a] Upgrade with RFETS and LANL materials.
[b] Upgrade with pits from RFETS.
[c] Total of mixed LLW and hazardous waste because hazardous waste is included in mixed LLW.
[d] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[e] Construct new Pu and HEU facilities.
[f] Upgrade with non-pit materials from RFETS.
Note: NA=not applicable.

Public and Occupational Health and Safety. Table 2.5.1–6 shows the differences between the long-term storage alternatives for radiological exposures to the public. The maximum potential latent cancer fatalities over No Action for the maximally exposed individual (MEI) over 50 years from normal operations ranges from $4.5x10^{-13}$ for the Upgrade and Preferred Alternatives at Pantex to $1.1x10^{-9}$ for the Collocation Upgrade Alternative at ORR. This means that the chance of a latent cancer fatality occurring ranges from about 1 in 1 billion to 5 in 10 trillion. The risk varies because of site parameters including the distance from the facility to the MEI (small sites vs. large sites); local meteorological conditions (windspeed, direction, and stability); and the type of material being stored (metals and oxides vs. residues).

Table 2.5.1–6. Maximum Latent Cancer Fatalities Over No Action for Maximally Exposed Individual for 50 Years From Normal Operation at Each Candidate Site

Site	No Action in 2005	Upgrade	Consolidation	Collocation	Preferred Alternative
Hanford	$1.0x10^{-8}$	$4.5x10^{-11}$	$6.2x10^{-11}$	$6.2x10^{-11}$	0
NTS	$1.0x10^{-7}$	NA	$1.4x10^{-10}$	$1.4x10^{-10}$	0
INEL	$4.4x10^{-7}$	$1.3x10^{-11}$	$4.0x10^{-11}$	$4.0x10^{-11}$	0
Pantex	$1.5x10^{-9}$	$4.5x10^{-13}$	$2.4x10^{-10}$	$2.4x10^{-10}$	$4.5x10^{-13}$
ORR	$3.5x10^{-8}$	$5.5x10^{-13}$	[a]	$1.1x10^{-9}$	$5.5x10^{-13}$
SRS	$2.0x10^{-5}$	$2.1x10^{-10}$	$3.5x10^{-10}$	$3.5x10^{-10}$	$2.1x10^{-10}$

[a] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
Note: NA=not applicable.

Potential accidents were postulated for each of the long-term storage alternatives. The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the accident scenario evaluated with the highest risk (PCV penetration by corrosion) for the Upgrade Alternative would be: $4.3x10^{-4}$ at Hanford; $1.6x10^{-3}$ at INEL; $8.8x10^{-4}$ at Pantex (Preferred Alternative); $3.0x10^{-5}$ at ORR (Preferred Alternative); and $4.6x10^{-4}$ at SRS. For both the Consolidation and Collocation Alternatives, the highest risk to the population located within 80 km (50 mi) of the accident release point associated with the accident scenarios evaluated (PCV penetration by corrosion) would be: $4.2x10^{-3}$ at Hanford; $5.1x10^{-5}/9.4x10^{-5}$ at NTS (P-Tunnel/New Pu and HEU Facility); $1.2x10^{-3}$ at INEL; $1.4x10^{-3}$ at Pantex; and $1.7x10^{-2}$ at ORR; and $4.6x10^{-3}$ at SRS. Since Pu accidents dominate the accident spectrum, the risks would be higher for the Consolidation and Collocation Alternatives then for the Upgrade Alternatives.

Intersite Transportation. For intersite transportation, the Upgrade and Preferred Alternatives would have lower potential for fatalities. For the Preferred Alternative, the number of potential fatalities ranges from 0 at Hanford and INEL (since there is no transport of material) to 0.06 at SRS. The Consolidation and Collocation Alternatives would have the higher potential for intersite transportation fatalities because they would move the greatest amount of material between sites. The number of potential fatalities ranges from 0.079 (Consolidated Storage Alternative at Pantex) to 1.07 (Collocated Storage Alternative at Hanford). Intersite transportation impacts would primarily result from nonradiological sources, such as fatalities from nonradiological traffic accidents.

2.5.2 DISPOSITION ALTERNATIVES

Table 2.5.2–1 depicts total campaign data for the disposition alternatives including the Preferred Alternative for disposition. A total of approximately 50 t (55.1 tons) of surplus Pu is assumed to be processed over the life of the campaign. In preparation for disposition under any alternative, surplus Pu must be processed through either the pit disassembly/conversion facility or the Pu conversion facility. Approximately 32.5 t (35.8 tons) are assumed to be processed at the pit disassembly/conversion facility, and approximately 17.5 t (19.3 tons) at the Pu conversion facility. Since these two facilities produce the input material for the other disposition facilities, actions at these two facilities would be the first to occur for the campaign. The operating period for these two facilities for each disposition alternative, including the Preferred Alternative, is 10 years.

Table 2.5.2–1. Total Campaign Data (Approximate) for Disposition Alternatives and the Preferred Alternative

	Disposition Alternatives			Preferred Alternative		
Action	Total Pu (t)	Throughput (t/yr)	Years In Operation	Total Pu (t)	Throughput (t/yr)	Years In Operation
Pit disassembly/ conversion	32.5	3.25	10	32.5	3.25	10
Pu conversion	17.5	1.75	10	17.5	1.75	10
Direct to borehole	50	5	10	NA	NA	NA
Immobilized to borehole	50	5	10	NA	NA	NA
Vitrification	50	5	10	17.5[a]	5[a]	3.5[a]
Ceramic immobilization	50	5	10	17.5[a]	5[a]	3.5[a]
Electrometallurgical treatment	50	5	10	NA	NA	NA
MOX fuel fabrication	50	3	17	32.5	3	11
5 existing LWRs[b]	50	3	17	32.5	3	11
2 partially completed LWRs[c]	50	3	17	NA	NA	NA
2 large or 4 small evolutionary LWRs	50	3	17	NA	NA	NA
CANDU reactors[d]	50	3.8	13	NA	NA	NA

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

[b] Three to five existing LWRs would be used depending upon the amount of MOX fuel in the reactor core.

[c] If the partially completed LWRs were to be completed by other parties, they would be considered existing LWRs and could compete for the surplus Pu disposition mission under the Preferred Alternative.

[d] The CANDU reactor is retained in the event a multilateral agreement is made among Russia, Canada, and the United States to use CANDU reactors.

Note: NA=not applicable.

The operation of the disposition facilities for a single disposition alternative would require between 10 and 17 years to accomplish the disposition mission. However, the Preferred Alternative may result in fewer years of operation for the disposition facilities, since the 50 t (55.1 tons) of surplus Pu would be dispositioned under two different technologies. For purposes of analysis, it is assumed that approximately 17.5 t (19.3 tons) of surplus Pu would be immobilized through vitrification or ceramic immobilization, and approximately 32.5 t (35.8 tons) would be converted to MOX fuel for use in reactors,[21] under the Preferred Alternative. The number of years in operation for each disposition technology may be less than that required to process the full 50 t (55.1 tons) with any single disposition alternative.

Actual years of operation and Pu throughput rates for any of the reactor disposition alternatives would not exceed 17 years and 3.8 t/yr (4.2 tons/yr), respectively, but could be less depending upon the final reactor core design. Variables such as the amount of MOX fuel included in each core have not yet been determined and would affect the years required to complete the mission using the reactor alternatives. Conservative estimates for throughput and years in operation are presented for comparing the Reactor Alternatives with the Preferred Alternative.

Table 2.5.2–2 presents a comparison of the total campaign impacts from the disposition of 50 t (55.1 tons) of surplus Pu for key environmental resources for the individual disposition alternatives and the Preferred Alternative. Since the ceramic immobilization facility generally has greater impacts than the vitrification facility, it was used in the calculation of the total campaign impacts for the Preferred Alternative. A comparison of impacts is not included for community services, environmental justice, and noise since the impacts are highly site-specific.

Biological, Geology and Soil, Land Use, and Cultural and Paleontological Resources. Ground disturbance during construction activities would potentially impact soil; biological; cultural resources (including historic, prehistoric, and Native American); and paleontological resources for all of the disposition alternatives. The immobilization alternatives would disturb the least amount of land while the Evolutionary LWR Alternative would disturb the most land area because it would require the most new construction. However, when considering operational land area, the two Deep Borehole Alternatives would require the most land because of the 1.6-km (1-mi) radius buffer zone. Depending upon location, all of the alternatives could result in visual resource impacts by changing the visual resource management classification of an area. The Deep Borehole Alternatives would impact geologic resources because the borehole operations would render the site perpetually unusable.

Site Infrastructure and Water Resources. The evolutionary LWR would require the largest electrical load during operations. The Evolutionary LWR and the Partially Completed LWR Alternatives would require the most additional water for operations. The rest of the alternatives would require nearly the same amount of water, with the exception of the Electrometallurgical Treatment Alternative, which would require the least amount of water.

Air Quality and Socioeconomics. Potential construction-related impacts on air quality and local transportation would be minor for all of the disposition alternatives and the Preferred Alternative. The Evolutionary LWR and Partially Completed LWR Alternatives would generate the most employment and income among the alternatives. For local transportation, the Evolutionary LWR would have the greatest potential of reducing the level of service on local roads during construction and/or operations. Some reduction in level of service would also be expected for the Vitrification, Ceramic Immobilization, and the Preferred Alternatives.

Public and Occupational Health and Safety. There would be potential for impacts to public and occupational health and safety from the radiological and hazardous chemical doses during operations of all the disposition

[21] The actual amount dispositioned under each disposition technology would depend on subsequent NEPA analysis, costs, test and demonstration results, international agreements, and the procurement process, among other things.

Table 2.5.2–2. Comparison of Resource Use and Impacts From the Total Campaign for the Operation of Disposition Alternatives[a]

Alternatives	Total Number of Worker-Years	Water Usage (million l)	Latent Cancer Fatalities for MEI from Lifetime Accident-Free Operation	Solid TRU Waste Generated (m^3)	Solid Low-Level Waste Generated (m^3)	Solid Hazardous Waste Generated (m^3)
Direct to borehole	20,550	3,405	$1.2x10^{-9}$ to $1.2x10^{-7}$	3,452	18,500	287
Immobilized to borehole	29,550	6,605	$1.2x10^{-9}$ to $1.2x10^{-7}$	4,955	18,740	497
Vitrification	24,810	4,251	$1.2x10^{-9}$ to $1.2x10^{-7}$	4,440	18,590	307
Ceramic immobilization	25,730	4,251	$1.2x10^{-9}$ to $1.2x10^{-7}$	4,440	18,590	307
Electrometallurgical treatment	17,960	1,751	$1.2x10^{-9}$ to $1.3x10^{-7}$	3,510	19,000	125
5 existing LWRs[b]	29,030	2,717	$1.3x10^{-6}$ to $2.6x10^{-6}$	8,652	21,051	2,718
2 partially completed LWRs[c]	47,305	2,352,000	$9.8x10^{-6}$ to $9.9x10^{-6}$	8,652	22,955 to 42,709	3,636
2 evolutionary large LWRs[d]	53,850	2,062,000	$5.8x10^{-7}$ to $8.2x10^{-5}$	8,652	38,051	3,636
4 evolutionary small LWRs[e]	59,630	1,856,000	$8.4x10^{-7}$ to $9.6x10^{-5}$	8,652	39,411	4,554
CANDU reactors[f]	25,630	2,717	$1.8x10^{-9}$ to $1.2x10^{-7}$	8,652	21,051	2,718
Preferred Alternative[g]	16,140	3,253	$9.0x10^{-7}$ to $1.7x10^{-6}$	7,163	20,182	1,866

[a] Data includes all front-end processes (Pu conversion, pit disassembly/conversion, and MOX fuel fabrication) that would be needed for the individual alternatives. The total campaign impacts were calculated by multiplying the annual impacts times the number of years of operation, as identified in Table S.8–7.

[b] The table reflects the use of 5 existing LWRs. Three to five existing LWRs would be used depending upon the amount of MOX fuel in the reactor core.

[c] The table reflects the use of 2 partially completed LWRs.

[d] The table reflects the use of 2 evolutionary large LWRs.

[e] The table reflects the use of 4 evolutionary small LWRs.

[f] The table reflects impacts from pit disassembly/conversion and MOX fuel fabrication in the United States.

[g] Ceramic immobilization and five existing LWRs are the assumed technologies for the Preferred Alternative for comparative purposes only.

alternatives, including the Preferred Alternative; however, the annual radiological doses to onsite workers and the public would be within regulatory limits for all alternatives. For hazardous chemicals, potential impacts to the public and onsite workers would not be expected to cause adverse health affects.

A set of potential accidents was postulated for each of the disposition technology alternatives. The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the front-end disposition process campaign would range from $4.5x10^{-16}$ to $1.7x10^{-4}$ for pit disassembly/conversion (for the highest accident risk scenario [fire on loading dock] at the potential disposition sites: $4.6x10^{-5}$ at Hanford;

$1.4x10^{-5}$ at INEL; $1.6x10^{-5}$ at Pantex; and $5.0x10^{-5}$ at SRS) and from $1.5x10^{-16}$ to $1.3x10^{-4}$ for Pu conversion (for the highest accident risk scenario [fire on loading dock] at the potential disposition sites: $3.5x10^{-5}$ at Hanford and $3.2x10^{-5}$ at SRS). Within the borehole category, the risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for direct disposition campaign would range from $8.4x10^{-16}$ to $6.3x10^{-8}$. For both the ceramic immobilization front-end process prior to immobilized disposal, and ultimate disposition in the deep borehole complex, the risks would range from $9.3x10^{-18}$ to $6.3x10^{-8}$ and $9.3x10^{-19}$ to $6.3x10^{-9}$, respectively for the disposition campaign. The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the immobilization category would range from $2.8x10^{-14}$ to $1.8x10^{-5}$ for the vitrification alternative and from $7.0x10^{-16}$ to $1.9x10^{-7}$ for the ceramic immobilization alternative over the disposition campaign (for the highest accident scenario [criticality] at the potential disposition sites and 30 percent immobilization campaign: $1.7x10^{-8}$ at Hanford and $2.1x10^{-8}$ at SRS). For the immobilization of Pu through electrometallurgical treatment of spent fuels, the projected campaign risk to the population would be $3.5x10^{-7}$ for the accident scenario evaluated with the highest risk (a breach in the argon cell initiated by a design basis earthquake).

For the reactor alternative, the risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the MOX fuel fabrication facility would range from $4.6x10^{-16}$ to $4.3x10^{-4}$ for the campaign (for the highest accident scenario [fire on loading dock] at the potential disposition sites using for analysis purposes, approximately 70 percent disposition campaign: $5.2x10^{-5}$ at Hanford; $1.6x10^{-5}$ at INEL; $1.8x10^{-5}$ at Pantex; and $5.2x10^{-5}$ at SRS). The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the MOX-fueled evolutionary LWR would range from $9.6x10^{-11}$ to $6.9x10^{-6}$. Under the Preferred Alternative, DOE would pursue the use of MOX-fueled LWRs. The incremental effects of utilizing MOX fuel in a reactor in place of UO_2 were derived from a quantitative analysis of severe accident release scenarios for MOX and UO_2 using the MACCS computer code and generic population and meteorology data. The analysis only considers severe accidents where sufficient damage would occur to cause the release of Pu or uranium. The risks of severe accidents were found to be in the range of plus 8 to minus 7 percent, compared to UO_2 fuel, depending on the accident release scenario. The incremental risk of cancer fatalities to a generic population located within 80 km (50 mi) of the severe accident release point would range from $-2.0x10^{-4}$ to $3.0x10^{-5}$ per year.

Waste Management. The reactor alternatives and the Preferred Alternative would be the only alternatives that would generate spent nuclear fuel. The Partially Completed LWR Alternative would generate the largest incremental increase in spent nuclear fuel. The Preferred Alternative would generate the lowest incremental increase of spent nuclear fuel among the reactor alternatives because the combination of disposition technologies would require less Pu to go through reactors. The reactor alternatives and the Preferred Alternative would also generate the most solid TRU, solid low-level, and solid hazardous waste among the alternatives.

Intersite Transportation. The Evolutionary LWR and Partially Completed LWR Alternatives would have the highest potential fatalities over the total campaign because they would require the most material transport. The Preferred Alternative and Electrometallurgical Treatment Alternative would have the lowest potential fatalities from transportation. Intersite transportation impacts would primarily be the result of nonradiological impacts such as fatalities from nonradiological highway accidents.

Table 2.5–1

Summary of Environmental Impacts for the Preferred Alternative for Storage

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Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Land Resources							
Refer to No Action.	Refer to No Action.	Refer to No Action.	Land area requirements for *Modify Existing Zone 12* would be 0.18 ha during construction, of which 0.1 ha would be used during operation. However, the facility would be situated on previously disturbed land. A buffer zone would be established between the facility and the site boundary.	*Modify Existing Y–12 Plant* would utilize existing facilities with no modifications of the exterior of the facility. Land area would not be disturbed nor would additional land be required. A buffer zone would be provided between the facility and the site boundary.	*Modify Actinide Packaging and Storage Facility* within an existing previously disturbed protected area. The entire protected area would be required during operation. A buffer zone is provided between the facility and the site boundary.	No new construction or modification of existing facilities would occur under phaseout of the storage mission.	Refer to No Action.

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Site Infrastructure							
Refer to No Action.	Refer to No Action.	Refer to No Action.	Construction and operation of the *Modify Existing Zone 12* would not affect site infrastructure. Only electrical energy usage would increase over no action. Operation would increase site infrastructure needs above current site availability as follows:	There would be no affect on site infrastructure for *Modify Existing Y–12 Plant* during construction. Operational impact for *Modify Existing Y–12 Plant* would increase site infrastructure above current site availability needs as follows:	Construction of the *Modify Actinide Packaging and Storage Facility* would not affect site infrastructure. Operation effects would be minimal and would increase site infrastructure needs above current site availability as follows:	Phaseout would not affect site infrastructure.	Refer to No Action.
			Electrical Energy (EE): 0 MWh/yr	EE: 0 MWh/yr	EE: 0 MWh/yr		
			Peak Electric Load (PEL): 0 MWe	PEL: 0 MWe	PEL: 0 MWe		
			Oil: 0 l/yr	Oil: 0 l/yr	Oil: 0 l/yr		
			Gas: 0 m^3/yr	Gas: 0 m^3/yr	Gas: 0 m^3/yr		
			Coal: 0 t/yr.	Coal: 160 t/yr.	Coal: 290 t/yr.		

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Air Quality and Noise							
For this resource, there are no discriminatory impacts for the eight sites under consideration.							

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Water Resources							
Refer to No Action.	Refer to No Action.	Refer to No Action.	The total percent increase in surface water use/discharge for *Modify Existing Zone 12* during construction would be 0/0.	The total percent increase in surface water use/discharge for *Modify Existing Y–12 Plant* during construction would be 0.02/0.1.	The total percent increase in surface water use/discharge for *Modify Actinide Packaging and Storage Facility* during construction would be 0/0.	There would be no impact to surface water flow or water quality. Phaseout would not result in an incremental change in the total wastewater volume handled.	Refer to No Action.
			The total percent increase in groundwater use/ discharge for *Modify Existing Zone 12* during construction would be 2.6/2.2.	The total percent increase in groundwater use/ discharge for *Modify Existing Y–12 Plant* during construction would be 0/0.	The total percent increase in groundwater use/ discharge for *Modify Actinide Packaging and Storage Facility* during construction would be 0.02/0.2.	There would be no impact on groundwater availability, since RFETS does not withdraw groundwater. There would be no impact to groundwater quality associated with the phaseout.	
			The total percent increase in surface water use/discharge for *Modify Existing Zone 12* during operation would be 0/0.	The total percent increase in surface water use/discharge for *Modify Existing Y–12 Plant* during operation would be $2.0 \times 10^{-3}/9.0 \times 10^{-5}$.	The total percent increase in surface water use/discharge for *Modify Actinide Packaging and Storage Facility* during operation would be 0/0.		

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Water Resources (continued)							
Refer to No Action.	Refer to No Action.	Refer to No Action.	The total percent increase in groundwater use/ discharge for *Modify Existing Zone 12* during operation would be 11/9.1.	The total percent increase in groundwater use/ discharge for *Modify Existing Y–12 Plant* during operation would be 0/0.	The total percent increase in groundwater use/ discharge for *Modify Actinide Packaging and Storage Facility* during operation would be 0.04/0.2.		Refer to No Action.

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Geology and Soils							
For this resource, there are no discriminatory impacts for the eight sites under consideration.							

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Biological Resources							
Refer to No Action.	Refer to No Action.	Refer to No Action.	Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Existing Zone 12 Facility.*	Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Existing Y–12 Plant.*	Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Actinide Packaging and Storage Facility.*	Phaseout is not expected to affect biological resources.	Refer to No Action.

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Cultural and Paleontological Resources							
Refer to No Action.	Refer to No Action.	Refer to No Action.	It is unlikely that NRHP-eligible prehistoric and historic resources exist within the previously disturbed 0.18 ha of land area for the *Modify Existing Zone 12*. Operation would not result in additional impact.	Building modifications are proposed for four NRHP-eligible resources for *Modify Existing Y–12 Plant*.	Some NRHP-eligible prehistoric and historic resources may exist within the construction area for *Modify Actinide Packaging and Storage Facility*. Operation would not result in additional impact.	There are no impacts anticipated for prehistoric resources; some of the historic sites at RFETS, may be affected through alteration if subsequently proposed.	Refer to No Action.
			Some Native American resources would be affected by construction and operation of the *Modify Existing Zone 12*.	It is unlikely that Native American resources would be affected by construction or operation for *Modify Existing Y–12 Plant*.	Some Native American resources may be affected by construction and operation of the *Modify Actinide Packaging and Storage Facility*.	Native American resources would not be affected by phaseout of Pu storage.	
			Some paleontological resources would be affected by the construction and operation of the *Modify Existing Zone 12*.	No activity is planned that would affect paleontological resources for *Modify Existing Y–12 Plant*.	SRS does not contain scientifically valuable paleontological remains.	Paleontological resources would not be affected by phaseout of Pu storage.	

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Socioeconomics							
Refer to No Action.	Refer to No Action.	Refer to No Action.	During peak construction/ operation total employment would increase by much less than 1 percent/ less than 1 percent over No Action.	During peak construction/ operation total employment would increase by much less than 1 percent/ much less than 1 percent over No Action.	During peak construction/ operation total employment would increase by much less than 1 percent/ much less than 1 percent over No Action.	Should all personnel be phased out at the same time, unemployment would increase to 4.6 percent.	Refer to No Action.
			Local transportation would change from free flow to a restricted condition during construction. Local transportation would not change appreciably during operation.	Local transportation would not change appreciably.	Local transportation would change from a restricted condition to a further restricted condition during construction. Local transportation would not be affected during operation.		

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Public and Occupational Health and Safety							
Normal Radiological Impacts							
Refer to No Action.	Refer to No Action.	Refer to No Action.	The annual dose from the *Modify Existing Zone 12 Storage Facility* to the MEI of the public would be $<1.8 \times 10^{-8}$ mrem. The estimated fatal cancer risk for the MEI of the public would be $<4.5 \times 10^{-13}$ from 50 years of operation.	The annual dose from the *Modify Existing Y–12 Plant Storage Facility* to the MEI of the public would be 2.2×10^{-7} mrem. The estimated fatal cancer risk for the MEI of the public would be 5.5×10^{-12} from 50 years of operation.	The annual dose from the *Modify Actinide Packaging and Storage Facility* to the MEI of the public would be 6.8×10^{-6} mrem. The estimated fatal cancer risk for the MEI of the public would be 1.7×10^{-10} from 50 years of operation.	Phaseout would reduce the impacts from radiological releases and exposures to levels below the No Action levels.	Refer to No Action.
			The annual dose from the *Modify Existing Zone 12 Storage Facility* to the public within 80 km would be $<6.3 \times 10^{-6}$ person-rem. The estimated number of fatal cancers to the public is $<1.6 \times 10^{-7}$ from 50 years of operation.	The annual dose from the *Modify Existing Y–12 Plant Storage Facility* to the public within 80 km would be 3.4×10^{-6} person-rem. The estimated number of fatal cancers to the public is 8.5×10^{-8} from 50 years of operation.	The annual dose from the *Modify Actinide Packaging and Storage Facility* to the public within 80 km would be 2.9×10^{-4} person-rem. The estimated number of fatal cancers to the public is 7.2×10^{-6} from 50 years of operation.		
			The average annual dose from the *Modify Existing Zone 12 Storage Facility* to the involved worker would be 116 mrem. The estimated fatal cancer risk for the average involved worker would be 2.3×10^{-3} from 50 years of operation.	The average annual dose from the *Modify Existing Y–12 Plant Storage Facility* to the involved worker would be 28 mrem. The estimated fatal cancer risk for the average involved worker would be 5.6×10^{-4} from 50 years of operation.	The average annual dose from the *Modify Actinide Packaging and Storage Facility* to the involved worker would be 250 mrem. The estimated fatal cancer risk for the average involved worker would be 5.0×10^{-3} from 50 years of operation.		

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Public and Occupational Health and Safety (continued)							
Normal Radiological Impacts (continued)							
Refer to No Action.	Refer to No Action.	Refer to No Action.	The annual total dose from the *Modify Existing Zone 12 Storage Facility* to the involved workforce would be 3 person-rem, which would result in an estimated 0.060 fatal cancer from 50 years of operation.	The annual total dose from the *Modify Existing Y–12 Plant Storage Facility* to the involved workforce would be 3 person-rem, which would result in an estimated 0.060 fatal cancer from 50 years of operation.	The annual dose from the *Modify Actinide Packaging and Storage Facility* to the total involved workforce would be 7.5 person-rem, which would result in an estimated 0.15 fatal cancer from 50 years of operation.	Phaseout would reduce the impacts from radiological releases and exposure to levels below the No Action level.	Refer to No Action.

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Public and Occupational Health and Safety (continued)							
Hazardous Chemical Impacts							
Refer to No Action.	Refer to No Action.	Refer to No Action.	The Hazard Index (HI) and cancer risk for the public for *Modify Existing Zone 12* would be 0 and 0, respectively.	The HI and cancer risk for the public for *Modify Existing Y–12 Plant* would be 8.6×10^{-5} and 0, respectively.	The HI and cancer risk for the public for *Modify Actinide Packaging and Storage Facility* would be 1.5×10^{-6} and 0, respectively.	Phaseout would reduce the impacts from chemical releases and exposures to levels below the No Action levels.	Refer to No Action.
			The HI and cancer risk for the worker for *Modify Existing Zone 12* would be 0 and 0, respectively.	The HI and cancer risk for the worker for *Modify Existing Y–12 Plant* would be 5.7×10^{-4} and 0, respectively.	The HI and cancer risk for the worker for *Modify Actinide Packaging and Storage Facility* would be 2.1×10^{-4} and 0, respectively.		

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Public and Occupational Health and Safety (continued)							
Facility Accidents							
Refer to No Action.	Refer to No Action.	Refer to No Action.	Based on the estimated maximum impacts from a set of accidents that propagate radioactive exposure to a worker 1,000 m from the release point for *Modify Existing Zone 12*, the probability of cancer/risk to worker would be $7.2x10^{-6}/1.4x10^{-5}$.	Based on the estimated maximum impacts from a set of accidents analyzed for environmental assessment analyses, the maximum impacts and annual facility lifetime risks for *Modify Existing Y–12 Plant*, would be reduced approximately 80 percent for the expected risk, resulting in a latent cancer fatality risk of $5.7x10^{-8}$ to worker.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point for *Modify Actinide Packaging and Storage Facility*, the probability of cancer/risk to worker would be $1.2x10^{-5}/2.9x10^{-6}$.	The phaseout operation will be conducted in accordance with DOE safety orders to ensure that the risk to the public of prompt fatalities due to accidents or of cancer fatalities due to operations will be minimized.	Refer to No Action.
			Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary for *Modify Existing Zone 12*, the probability of the cancer/risk to the MEI would be $2.9x10^{-6}/5.8x10^{-6}$.	Based on the estimated maximum impacts from a set of potential accidents analyzed for environmental assessment analyses, the maximum impacts and annual facility lifetime risks for *Modify Existing Y–12 Plant*, would be reduced approximately 80 percent for the expected risk, resulting in a latent cancer fatality risk of $5.1x10^{-7}$ to the	Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary for *Modify Actinide Packaging and Storage Facility*, the probability the of cancer/risk to the MEI would be $2.9x10^{-7}/7.0x10^{-8}$.		

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Public and Occupational Health and Safety (continued)							
Facility Accidents (continued)							
Refer to No Action.	Refer to No Action.	Refer to No Action.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for *Modify Existing Zone 12* would be: Population: Cancer fatalities: 4.4×10^{-4} Cancer fatalities risk: 8.8×10^{-4}.	Based on the estimated maximum impacts from a set of potential accidents analyzed for environmental assessment analyses, the maximum impacts and annual facility lifetime risks for *Modify Existing Y–12 Plant* would be reduced approximately 80 percent for the expected risk, resulting in a latent cancer fatality risk of 7.4×10^{-6} to population.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for *Modify Actinide Packaging and Storage Facility* would be: Population: Cancer fatalities: 1.4×10^{-3} Cancer fatalities risk: 3.4×10^{-4}.	The phaseout operation will be conducted in accordance with DOE safety orders to ensure that the risk to the public of prompt fatalities due to accidents or of cancer fatalities due to accidents.	Refer to No Action.

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Waste Management							
Refer to No Action.	Refer to No Action.	Refer to No Action.	The annual net increase in generation due to *Modify Existing Zone 12 South* for liquid/solid would be as follows:	The annual net increase in generation due to *Modify Existing Y–12 Plant* for liquid/solid would be as follows:	The net annual increase or decrease in generation due to *Modify Actinide Packaging and Storage Facility* for liquid/solid would be as follows:	The waste associated with Pu storage would no longer be generated, but the total wastes generated at RFETS could increase due to cleanup activities at formerly used Pu storage facilities.	Refer to No Action.
			TRU: 0 m^3/0.8 m^3	TRU: 0 m^3/0 m^3	TRU: 0 m^3/0 m^3		
			Mixed TRU: 0 m^3/ 0 m^3	Mixed TRU: 0 m^3/ 0 m^3	Mixed TRU: 0 m^3/ 0 m^3		
			LLW: 0.08 m^3/ 138 m^3	LLW: 0.04 m^3/ 3 m^3	LLW: 0 m^3/ 0 m^3		
			Mixed LLW: 0.2 m^3/ 8 m^3	Mixed LLW: 0.02 m^3/0.8 m^3	Mixed LLW: 0 m^3/ 0 m^3		
			HAZ: 1 m^3/1.5 m^3	HAZ: Included in Mixed LLW/ Included in Mixed LLW	HAZ: 0 m^3/ 0.56 m^3		
			Nonhaz (sanitary): 12,900 m^3/275 m^3	Nonhaz (sanitary): 0.8 m^3/31 m^3	Nonhaz (sanitary): 1,490 m^3/13 m^3		
			Nonhaz (other): Included in sanitary/344 m^3.	Nonhaz (other): 0.8 m^3/0.8 m^3.	Nonhaz (other): Included in sanitary/13 m^3.		

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Intersite Transportation of Fissile Materials[a]							
Refer to No Action.	Refer to No Action.	Refer to No Action.	Transport of RFETS Pu pits to Pantex would have maximum potential fatalities of 6.4×10^{-3}.	This resource does not apply at ORR.	Transport of all non-pit materials to SRS would have maximum potential fatalities of 0.06.	The risk associated with transport of RFETS materials would be 0.067.	Refer to No Action.

[a]Detailed information is provided in the classified Appendix.

Table 2.5–1. Summary of Environmental Impacts for the Preferred Alternative for Storage—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Preferred Alternative							
Environmental Justice							
Refer to No Action.	Refer to No Action.	Refer to No Action.	No high or adverse impacts from normal operations or accidents that would disproportionately impact minority or low-income populations.	No high or adverse impacts from normal operations or accidents that would disproportionately impact minority or low-income populations.	No high or adverse impacts from normal operations or accidents that would disproportionately impact minority or low-income populations.	Impacts would not disproportionately affect minority or low-income populations.	Refer to No Action.

Table 2.5–2

Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives

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Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Land Resources							
Land use would be in conformance with existing land-use plans, policies, and controls, and the visual landscape would remain compatible.	Land use would be in conformance with existing land-use plans, policies, and controls, and the visual landscape would remain compatible.	Land use would be in conformance with existing land-use plans, policies, and controls, and the visual landscape would remain compatible.	Land use would be in conformance with existing land-use plans, policies, and controls, and the visual landscape would remain compatible.	Land use would be in conformance with existing land-use plans, policies, and controls, and the visual landscape would remain compatible.	Land use would be in conformance with existing land-use plans, policies, and controls, and the visual landscape would remain compatible.	Land use would be in conformance with existing land-use plans, policies, and controls, and the visual landscape would remain compatible.	Land use would be in conformance with existing land-use plans, policies, and controls, and the visual landscape would remain compatible.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Site Infrastructure							
The infrastructure can accommodate all missions and functions.	The infrastructure can accommodate all missions and functions.	The infrastructure can accommodate all missions and functions.	A considerable reduction in site infrastructure requirements would occur.	Some additional coal would be needed. All other resources are greater than projected usage.	The infrastructure can accommodate all missions and functions.	The infrastructure can accommodate all missions and functions.	The infrastructure can accommodate all missions and functions.
During operation projected use would be as follows: EE: 345,500 MWh/yr PEL: 58 MWe Oil: 9,334,800 l/yr Gas: 21,039,531 m^3/yr Coal: 0 t/yr.	During operation projected use would be as follows: EE: 124,940 MWh/yr PEL: 25 MWe Oil: 5,716,000 l/yr Gas: 0 m^3/yr Coal: 0 t/yr.	During operation projected use would be as follows: EE: 232,500 MWh/yr PEL: 42 MWe Oil: 5,820,000 l/yr Gas: 0 m^3/yr Coal: 11,340 t/yr.	During operation projected use would be as follows: EE: 46,266 MWh/yr PEL: 10 MWe Oil: 795,166 l/yr Gas: 7,200,000 m^3/yr Coal: 0 t/yr.	During operation projected use would be as follows: EE: 726,000 MWh/yr PEL: 110 MWe Oil: 379,000 l/yr Gas: 95,000,000 m^3/yr Coal: 16,300 t/yr.	During operation projected use would be as follows: EE: 794,000 MWh/yr PEL: 116 MWe Oil: 28,390,500 l/yr Gas: 0 m^3/yr Coal: 221,352 t/yr.	During operation projected use would be as follows: EE: 184,000 MWh/yr PEL: 26 MWe Oil: 8,140,000 l/yr Gas: 18,600,000 m^3/yr Coal: 0 t/yr.	During operation projected use would be as follows: EE: 381,425 MWh/yr PEL: 87 MWe Oil: 0 l/yr Gas: 43,414,560 m^3/yr Coal: 0 t/yr.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Air Quality and Noise							
Concentrations of criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable ambient air quality standards. Increased PM_{10} and TSP concentrations occur due to ongoing construction associated with other activities (that are outside the scope of this PEIS) under the no action alternative.	Concentrations of criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable ambient air quality standards. Increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside the scope of this PEIS) under the no action alternative.	Concentrations of criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable ambient air quality standards. Increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside the scope of this PEIS) under the no action alternative.	Concentrations of criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable ambient air quality standards. Increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside the scope of this PEIS) under the no action alternative.	Concentrations of criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable ambient air quality standards. Increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside the scope of this PEIS) under the no action alternative.	Concentrations of criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable ambient air quality standards. Increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside the scope of this PEIS) under the no action alternative.	Concentrations of criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable ambient air quality standards. Increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside the scope of this PEIS) under the no action alternative.	Concentrations of criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable ambient air quality standards. Increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside the scope of this PEIS) under the no action alternative.
No appreciable change in traffic noise and onsite operational noise sources from current levels would occur. Some noise sources may impact onsite sensitive areas, such as disturbance of wildlife.	No appreciable change in traffic noise and onsite operational noise sources from current levels would occur. Some noise sources may impact onsite sensitive areas, such as disturbance of wildlife.	No appreciable change in traffic noise and onsite operational noise sources from current levels would occur. Some noise sources may impact onsite sensitive areas, such as disturbance of wildlife.	No appreciable change in traffic noise and onsite operational noise sources from current levels would occur. Some noise sources may impact onsite sensitive areas, such as disturbance of wildlife.	No appreciable change in traffic noise and onsite operational noise sources from current levels would occur. Some noise sources may impact onsite sensitive areas, such as disturbance of wildlife.	No appreciable change in traffic noise and onsite operational noise sources from current levels would occur. Some noise sources may impact onsite sensitive areas, such as disturbance of wildlife.	No appreciable change in traffic noise and onsite operational noise sources from current levels would occur. Some noise sources may impact onsite sensitive areas, such as disturbance of wildlife.	No appreciable change in traffic noise and onsite operational noise sources from current levels would occur. Some noise sources may impact onsite sensitive areas, such as disturbance of wildlife.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Water Resources							
Withdrawal of 13,511 MLY of surface water and 195 MLY of ground water would occur during operations.	No surface water would be used at NTS. Withdrawal of 2,400 MLY of groundwater would occur during operations.	No surface water would be used at INEL. Withdrawal of 7,570 MLY of groundwater would occur during operations.	No surface water would be used at Pantex. Withdrawal of 249 MLY of groundwater would occur during operations.	Withdrawal of 14,760 MLY of water would continue from surface water. No groundwater would be used at ORR for this mission.	Withdrawal of 127,000 MLY of surface water and 13,247 MLY of groundwater would occur during operations.	Withdrawal of 439 MLY from municipal water supplies would occur during operations. No additional impacts to groundwater are anticipated.	Withdrawal of 5,760 MLY from groundwater would occur during operations.
Quantities of wastewater (246 MLY) would be generated and discharged to evaporation/ infiltration ponds.	Quantities of wastewater (82 MLY) would be generated and discharged to evaporation/ infiltration ponds.	Quantities of wastewater (540 MLY) would be generated and discharged to evaporation/ infiltration ponds.	Quantities of wastewater (141 MLY) would be generated and discharged to the playas.	Quantities of wastewater (2,277 MLY) would be generated, treated, and discharged to nearby streams.	Quantities of wastewater (700 MLY) would be generated, treated, and discharged to nearby streams.	Quantities of wastewater (130 MLY) would be generated, treated, and discharged to nearby streams. Groundwater remediation removals decrease from 10.6 MLY to 7.8 MLY.	Quantities of wastewater (693 MLY) would be generated, treated, and discharged to nearby canyons.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Geology and Soils							
There would be no impact to geologic or soil resources because no construction activities would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to geologic or soil resources because no construction activities would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to geologic or soil resources because no construction activities would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to geologic or soil resources because no construction activities would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to geologic or soil resources because no construction activities would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to geologic or soil resources because no construction activities would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to geologic or soil resources because no construction activities would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to geologic or soil resources because no construction activities would occur for No Action beyond those associated with existing and future site improvements.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Biological Resources							
There would be no impact to biotic resources.	There would be no impact to biotic resources.	There would be no impact to biotic resources.	There would be no impact to biotic resources.	There would be no impact to biotic resources.	There would be no impact to biotic resources.	There would be no impact to biotic resources.	There would be no impact to biotic resources.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Cultural and Paleontological Resources							
There would be no impact to cultural and paleontological resources because no construction would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to cultural and paleontological resources because no construction would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to cultural and paleontological resources because no construction would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to cultural and paleontological resources because no construction would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to cultural and paleontological resources because no construction would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to cultural and paleontological resources because no construction would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to cultural and paleontological resources because no construction would occur for No Action beyond those associated with existing and future site improvements.	There would be no impact to cultural and paleontological resources because no construction would occur for No Action beyond those associated with existing and future site improvements.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Socioeconomics							
Employment in the economic study area is expected to grow less than 1 percent annually to the year 2040.	Employment in the economic study area is expected to grow 2 percent annually to the year 2040.	Employment in the economic study area is expected to grow about 1 percent annually to the year 2040.	Employment in the economic study area is expected to grow less than 1 percent annually to the year 2040.	Employment in the economic study area is expected to grow less than 1 percent annually to the year 2040.	Employment in the economic study area is expected to grow less than 1 percent annually to the year 2040.	Employment in the economic study area is expected to grow about 1 percent annually to the year 2040.	Employment in the economic study area is expected to increase over 1 percent annually to the year 2040.
Local transportation would not be affected.	Local transportation would not be affected.	Local transportation would not be affected.	Local transportation would not be affected.	Local transportation would not be affected.	Local transportation would not be affected.	Local transportation would not be affected.	Local transportation would not be affected.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Public and Occupational Health and Safety							
Normal Radiological Impacts							
The annual dose to the MEI of the public from total site operation would be 5.3×10^{-3} mrem. The estimated risk of fatal cancer for the MEI from 50 years of operations would be 1.3×10^{-7}.	The annual dose to the MEI of the public from total site operation would be 4.2×10^{-3} mrem. The estimated risk of fatal cancer for the MEI from 50 years of operations would be 1.0×10^{-7}.	The annual dose to the MEI of the public from total site operation would be 0.018 mrem. The estimated risk of fatal cancer for the MEI from 50 years of operations would be 4.4×10^{-7}.	The annual dose to the MEI of the public from total site operation would be 6.1×10^{-5} mrem. The estimated risk of fatal cancer for the MEI from 50 years of operations would be 1.5×10^{-9}.	The annual dose to the MEI of the public from total site operation would be 3.2 mrem. The estimated risk of fatal cancer for the MEI from 50 years of operations would be 8.0×10^{-5}.	The annual dose to the MEI of the public from total site operation would be 0.79 mrem. The estimated risk of fatal cancer for the MEI from 50 years of operations would be 2.0×10^{-5}.	The annual dose to the MEI of the public from total site operation would be 0.48 mrem. The estimated risk of fatal cancer for the MEI from 50 years of operations would be 1.2×10^{-5}.	The annual dose to the MEI of the public from total site operation would be 6.5 mrem. The estimated risk of fatal cancer for the MEI from 50 years of operations would be 1.6×10^{-4}.
The annual total dose to the public within 80 km from total site operation would be 1.6 person-rem. The estimated number of fatal cancers to the public is 0.039 as the result of 50 years of operation.	The annual total dose to the public within 80 km from total site operation would be 3.7×10^{-3} person-rem. The estimated number of fatal cancers to the public is 9.3×10^{-5} as the result of 50 years of operation.	The annual total dose to the public within 80 km from total site operation would be 2.4 person-rem. The estimated number of fatal cancers to the public is 0.061 as the result of 50 years of operation.	The annual total dose to the public within 80 km from total site operation would be 2.8×10^{-4} person-rem. The estimated number of fatal cancers to the public is 7.0×10^{-6} as the result of 50 years of operation.	The annual total dose to the public within 80 km from total site operation would be 34 person-rem. The estimated number of fatal cancers to the public is 0.85 as the result of 50 years of operation.	The annual total dose to the public within 80 km from total site operation would be 44 person-rem. The estimated number of fatal cancers to the public is 1.1 as the result of 50 years of operation.	The annual total dose to the public within 80 km from total site operation would be 0.10 person-rem. The estimated number of fatal cancers to the public is 2.5×10^{-3} as the result of 50 years of operation.	The annual total dose to the public within 80 km from total site operation would be 2.7 person-rem. The estimated number of fatal cancers to the public is 0.068 as the result of 50 years of operation.
The average annual dose to the site worker from total site operation would be 31 mrem. The fatal cancer risk for this worker from 50 years of operation is estimated to be 6.0×10^{-4}.	The average annual dose to the site worker from total site operation would be 5.0 mrem. The fatal cancer risk for this worker from 50 years of operation is estimated to be 1.0×10^{-4}.	The average annual dose to the site worker from total site operation would be 30 mrem. The fatal cancer risk for this worker from 50 years of operation is estimated to be 6.0×10^{-4}.	The average annual dose to the site worker from total site operation would be 24 mrem. The fatal cancer risk for this worker from 50 years of operation is estimated to be 4.8×10^{-4}.	The average annual dose to the site worker from total site operation would be 2.6 mrem. The fatal cancer risk for this worker from 50 years of operation is estimated to be 5.2×10^{-5}.	The average annual dose to the site worker from total site operation would be 36 mrem. The fatal cancer risk for this worker from 50 years of operation is estimated to be 7.2×10^{-4}.	The average annual dose to the site worker from total site operation would be 122 mrem. The fatal cancer risk for this worker from 50 years of operation is estimated to be 2.4×10^{-3}.	The average annual dose to the site worker from total site operation would be 32 mrem. The fatal cancer risk for this worker from 50 years of operation is estimated to be 6.4×10^{-4}.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Public and Occupational Health and Safety (continued)							
Normal Radiological Impacts (continued)							
The annual total dose to the site workforce would be 250 person-rem, which would cause an estimated 5.1 fatal cancers from 50 years of operation.	The annual total dose to the site workforce would be 3.0 person-rem, which would cause an estimated 0.060 fatal cancers from 50 years of operation.	The annual total dose to the site workforce would be 219 person-rem, which would cause an estimated 4.4 fatal cancers from 50 years of operation.	The annual total dose to the site workforce would be 34 person-rem, which would cause an estimated 0.68 fatal cancers from 50 years of operation.	The annual total dose to the site workforce would be 44 person-rem, which would cause an estimated 0.88 fatal cancers from 50 years of operation.	The annual total dose to the site workforce would be 259 person-rem, which would cause an estimated 5.2 fatal cancers from 50 years of operation.	The annual total dose to the site workforce would be 775 person-rem, which would cause an estimated 15 fatal cancers from 50 years of operation.	The annual total dose to the site workforce would be 183 person-rem, which would cause an estimated 3.7 fatal cancers from 50 years of operation.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Public and Occupational Health and Safety (continued)							
Hazardous Chemical Impacts							
The HI and cancer risk for the public are $6.2x10^{-5}$ and 0, respectively.	The HI and cancer risk for the public are 0 and 0, respectively.	The HI and cancer risk for the public are $1.5x10^{-2}$ and $3.6x10^{-6}$, respectively.	The HI and cancer risk for the public are $5.7x10^{-3}$ and $1.1x10^{-8}$, respectively.	The HI and cancer risk for the public are $4.0x10^{-2}$ and 0, respectively.	The HI and cancer risk for the public are $5.2x10^{-3}$ and $1.3x10^{-7}$, respectively.	The HI and cancer risk for the public are $1.2x10^{-3}$ and $2.1x10^{-8}$, respectively.	The HI and cancer risk for the public are $3.0x10^{-2}$ and $5.2x10^{-6}$, respectively.
The HI and cancer risk for the worker are $4.0x10^{-3}$ and 0, respectively.	The HI and cancer risk for the worker are 0 and 0, respectively.	The HI and cancer risk for the worker are 0.22 and $7.7x10^{-4}$, respectively.	The HI and cancer risk for the worker are $6.1x10^{-3}$ and $4.5x10^{-7}$, respectively.	The HI and cancer risk for the worker are 0.15 and 0, respectively.	The HI and cancer risk for the worker are 1.2 and $1.9x10^{-4}$, respectively.	The HI and cancer risk for the worker are $1.3x10^{-2}$ and $2.3x10^{-6}$, respectively.	The HI and cancer risk for the worker are $4.7x10^{-2}$ and $1.5x10^{-4}$, respectively.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Public and Occupational Health and Safety (continued)							
Facility Accidents							
Pu storage would continue to be performed at the site with no change to facilities or operations.	No change to non-storage facilities and operations would occur. Under existing conditions, potential accidents and their consequences have previously been addressed and documented according to requirements in DOE Orders.	Pu storage would continue to be performed at the site with no change to facilities or operations.	Pu storage would continue to be performed at the site with no change to facilities or operations. Under existing conditions, potential accidents and their consequences have previously been addressed and documented according to requirements in DOE Orders.	Uranium storage would continue to be performed at the site with no change to facilities or operations. Under existing conditions, potential accidents and their consequences have previously been addressed and documented according to requirements in DOE Orders.	Pu storage would continue to be performed at the site with no change to facilities or operations. Under existing conditions, potential accidents and their consequences have previously been addressed and documented according to requirements in DOE Orders.	Pu storage would continue to be performed at the site with no change to facilities or operations. Under existing conditions, potential accidents and their consequences have previously been addressed and documented according to requirements in DOE Orders.	Pu storage would continue to be performed at the site with no change to facilities or operations. Under existing conditions, potential accidents and their consequences have previously been addressed and documented according to requirements in DOE Orders.
Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point, for the No Action probability of cancer/risk to worker would be: $2.2 \times 10^{-3}/2.2 \times 10^{-10}$.		Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point, for the No Action probability of cancer/risk to worker would be: $0.02/2.0 \times 10^{-9}$.					

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Public and Occupational Health and Safety (continued)							
Facility Accidents (continued)							
Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary, for the No Action probability of cancer/risk to worker for would be: $1.7x10^{-5}/1.7x10^{-12}$.		Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary, for the No Action probability of cancer/risk to worker for would be: $9.8x10^{-4}/9.8x10^{-11}$.					
Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, for the No Action Alternative maximum impacts and 50-year facility lifetime risks would be:		Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, for the No Action Alternative maximum impacts and 50-year facility lifetime risks would be:					
Population: Cancer fatalities: 0.12 Cancer fatalities risk: $1.2x10^{-8}$.		Population: Cancer fatalities: 0.33 Cancer fatalities risk: $3.3x10^{-8}$.					

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Waste Management							
TRU, low-level, mixed, hazardous, and nonhazardous wastes would continue to be managed. No impact to current waste management activities would occur.	Low-level, mixed, hazardous, and nonhazardous wastes would continue to be managed. No impact to current waste management activities would occur.	TRU, low-level, mixed, hazardous, and nonhazardous wastes would continue to be managed. No impact to current waste management activities would occur.	Low-level, mixed, hazardous, and nonhazardous wastes would continue to be managed. No impact to current waste management activities would occur.	TRU, low-level, mixed, hazardous, and nonhazardous wastes would continue to be managed. No impact to current waste management activities would occur.	TRU, low-level, mixed, hazardous, and nonhazardous wastes would continue to be managed. No impact to current waste management activities would occur.	TRU, low-level, mixed, hazardous, nonhazardous wastes would continue to be managed. No impact to current waste management activities would occur.	TRU, low-level, mixed, hazardous, nonhazardous wastes would continue to me managed. No impact to current waste management activities would occur.
Annual total site generation rates for liquid/solid would be as follows:`	Annual total site generation rates for liquid/solid would be as follows:	Annual total site generation rates for liquid/solid would be as follows:	Annual total site generation rates for liquid/solid would be as follows:	Annual total site generation rates for liquid/solid would be as follows:	Annual total site generation rates for liquid/solid would be as follows:	Annual total site generation rates for liquid/solid would be as follows:	Annual total site generation rates for liquid/solid would be as follows:
SNF: 0 m^3/0 m^3	SNF: Not generated	SNF: 0 m^3/0 m^3	SNF: Not generated	SNF: Not generated	SNF: 0 m^3/0 m^3	SNF: Not generated	SNF: Not generated
HLW: 0 m^3/0 m^3	HLW: Not generated	HLW: 538 m^3/192 m^3	HLW: Not generated	HLW: Not generated	HLW: 126 m^3/ 127 m^3	HLW: Not generated	HLW: Not generated
TRU: 0 m^3/271 m^3	TRU: 0 m^3/0 m^3	TRU: 0 m^3/3.5 m^3	TRU: 0 m^3/0 m^3	TRU: 0 m^3/119 m^3	TRU: 0 m^3/338 m^3	TRU:<1 m^3/ 1,583 m^3	TRU: 0.1 m^3/54 m^3
Mixed TRU: 0 m^3/ 98 m^3	Mixed TRU: 0 m^3/ 0 m^3	Mixed TRU: 0 m^3/ Included in TRU	Mixed TRU: 0 m^3/ 0 m^3	Mixed TRU: 0 m^3/ 0 m^3	Mixed TRU: 0 m^3/ Included in TRU	Mixed TRU: <1 m^3/ 1,505 m^3	Mixed TRU: 0 m^3/ 255 m^3
LLW: 0 m^3/3,390 m^3	LLW: Dependent on restoration activities/ 15,000 m^3	LLW: 0 m^3/7,200 m^3	LLW: 8 m^3/32 m^3	LLW: 2,970 m^3/ 7,320 m^3	LLW: 74,000 m^3/ 16,400 m^3	LLW: <1 m^3/701 m^3	LLW: 21,400 m^3/ 2,690 m^3
Mixed LLW: 3,760 m^3/ 1,505 m^3	Mixed LLW: 0 m^3/ 50 m^3	Mixed LLW: 4 m^3/ 170 m^3	Mixed LLW: 4 m^3/ 46 m^3	Mixed LLW: 87,600 m^3/ 432 m^3	Mixed LLW: 1,330 m^3/ 7,700 m^3	Mixed LLW: 0 m^3/ 6,019 m^3	Mixed LLW: 0 m^3/ 45 m^3
HAZ: Included in solid/560 m^3	HAZ: Included in solid/212 m^3	HAZ: Included in solid/1,200 m^3	HAZ: 2 m^3/31 m^3	HAZ: 6,460 m^3/ 26 m^3	HAZ: 1,260 m^3/ 15,100 m^3	HAZ: <1 m^3/25 m^3	HAZ: 273 m^3/ 669 m^3
Nonhaz (sanitary): 414,000 m^3/ 5,107 m^3	Nonhaz (sanitary): Included in solid/2,120 m^3	Nonhaz (sanitary): Included in solid/52,000 m^3	Nonhaz (sanitary): 141,000 m^3/339 m^3	Nonhaz (sanitary): 550,000 m^3/ 53,100 m^3	Nonhaz (sanitary): 703,000 m^3/ 61,200 m^3	Nonhaz (sanitary): 457,600 m^3/ 11,400 m^3	Nonhaz (sanitary): 692,827 m^3/ 5,453 m^3
Nonhaz (other): Included in sanitary/Included in sanitary.	Nonhaz (other): Included in sanitary/76,500 m^3.	Nonhaz (other): 0 m^3/Included in sanitary.	Nonhaz (other): Included in liquid sanitary/Included in solid sanitary.	Nonhaz (other): 650,000 m^3/ 321 m^3.	Nonhaz (other): Included in sanitary/Included in sanitary.	Nonhaz (other): Included in liquid sanitary/73 m^3.	Nonhaz (other): Included in sanitary/Included in sanitary.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Intersite Transportation of Fissile Materials							
No material would be transported, so no transportation risks would be incurred.	No material would be transported, so no transportation risks would be incurred.	No material would be transported, so no transportation risks would be incurred.	No material would be transported, so no transportation risks would be incurred.	No material would be transported, so no transportation risks would be incurred.	No material would be transported, so no transportation risks would be incurred.	No material would be transported, so no transportation risks would be incurred.	No material would be transported, so no transportation risks would be incurred.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
No Action							
Environmental Justice							
No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	Impacts would not disproportionately affect minority or low-income populations.	Only under unusual conditions would low-income and minority population have the potential to be disproportionately affected by an accidental release.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Land Resources - Upgrade With RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	Land area requirements for *Modify Existing Zone 12* would be 0.18 ha during construction, of which 0.1 ha would be used during operation. However, the facility would be situated on previously disturbed land. A buffer zone is established between the facility and the site boundary.	*This subalternative does not apply to ORR.*	Land area requirements for *Modify Actinide Packaging and Storage Facility* would be within an existing previously disturbed protected area. The entire protected area would be required during operation. A buffer zone is provided between the facility and the site boundary.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
Land Resources - Upgrade Without RFETS Pu or LANL Pu Subalternative							
Modify Existing FMEF and *Construct New 200 West Area* would be constructed in a previously disturbed protected area with no new land disturbance. During operation the protected area of 6.25 ha/10.5 ha, respectively, would be required. A buffer zone is provided between the facility and the site boundary.	*This subalternative does not apply to NTS.*	*Modify Existing and Construct New ANL-W* would be situated on previously disturbed land and would not create any newly disturbed land area outside the protected area during construction. The protected area of approximately 9 ha would be required during operation. A buffer zone is provided between the facility and the site boundary.	Land area requirements for *Modify Existing Zone 12* would be 0.18 ha during construction, of which 0.1 ha would be used during operation. However, the facility would be situated on previously disturbed land. A buffer zone is established between the facility and the site boundary.	*Modify Existing Y–12 Plant* would utilize existing facilities with no modifications of the exterior of the facility. Land area would not be disturbed nor would additional land be required. A buffer zone is provided between the facility and the site boundary.	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Land Resources - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative							
Modify Existing FMEF and *Construct New 200 West Area* would be constructed in a previously disturbed protected area with no new land disturbance. During operation the protected area of 6.25 ha and 10.5 ha, respectively, would be required. A buffer zone is provided between the facility and the site boundary.	*This subalternative does not apply to NTS.*	*Modify Existing and Construct New ANL-W* would be situated on previously disturbed land and would not create any newly disturbed land area outside the protected area during construction. The protected area of approximately 9 ha would be required during operation. A buffer zone is provided between the facility and the site boundary.	Land area requirements for *Modify Existing Zone 12* would be 0.18 ha during construction, of which 0.1 ha would be used during operation. However, the facility would be situated on previously disturbed land. A buffer zone is established between the facility and the site boundary.	*This subalternative does not apply to ORR.*	Land area requirements for *Modify Actinide Packaging and Storage Facility* would be within an existing previously disturbed protected area. The entire protected area would be required during operation. A buffer zone is provided between the facility and the site boundary.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
Land Resources - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Impacts would be the same as all the previous subalternatives, except less land area would be required because the size of the facilities would be smaller.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Site Infrastructure - Upgrade With RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	Construction and operation of the *Modify Existing Zone 12* would not affect site infrastructure. Only electrical energy usage would increase over no action. Operation would increase site infrastructure needs above current site availability as follows: EE: 0 MWh/yr PEL: 0 MWe Oil: 0 l/yr Gas: 0 m^3/yr Coal: 0 t/yr.	*This subalternative does not apply to ORR.*	Construction of the *Modify Actinide Packaging and Storage Facility* would not affect site infrastructure. Operation effects would be minimal and would increase site infrastructure needs above current site availability as follows: EE: 0 MWh/yr PEL: 0 MWe Oil: 0 l/yr Gas: 0 m^3/yr Coal: 290 t/yr.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Site Infrastructure - Upgrade Without RFETS or LANL Pu Subalternative							
Modify Existing FMEF/Construct New 200 West Area would not affect site infrastructure. Operations impacts for *Modify Existing FMEF/Construct New 200 West Area* would be minimal and within site availability. Site infrastructure needs would increase above current site availability as follows: EE: 0/0 MWh/yr PEL: 0/0 MWe Oil: 0/0 l/yr Gas: 0/0 m^3/yr Coal: 0/0 t/yr.	*This subalternative does not apply to NTS.*	Construction of *Modify Existing and Construct New ANL-W* would not affect site infrastructure. Operation would increase site infrastructure needs above current site availability as follows: EE: 0 MWh/yr PEL: 0 MWe Oil: 0 l/yr Gas: 0 m^3/yr Coal: 0 t/yr.	Construction and operation of the *Modify Existing Zone 12* would not affect site infrastructure. Only electrical energy usage would increase over no action. Operation would increase site infrastructure needs above current site availability as follows: EE: 0 MWh/yr PEL: 0 MWe Oil: 0 l/yr Gas: 0 m^3/yr. Coal: 0 t/yr.	There would be no affect on site infrastructure for *Modify Existing Y–12 Plant* during construction. Operational impact for *Modify Existing Y–12 Plant* would increase site infrastructure needs above current site availability as follows: EE: 0 MWh/yr PEL: 0 MWe Oil: 0 l/yr Gas: 0 m^3/yr Coal: 160 t/yr.	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Site Infrastructure - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative							
Modify Existing FMEF/Construct New 200 West Area would not impact site infrastructure. Operations impacts for *Modify Existing FMEF/Construct New 200 West Area* would be minimal and within site availability. Site infrastructure needs would increase above current site availability as follows:	*This subalternative does not apply to NTS.*	During construction of the *Modify Existing and Construct New ANL-W* no affect to site infrastructure would occur. Operation would increase site infrastructure needs above current site availability as follows:	During construction of the *Modify Existing Zone 12* no impacts to site infrastructure would occur. Operation would increase site infrastructure needs above current site availability as follows:	*This subalternative does not apply to ORR.*	Construction of the *Modify Actinide Packaging and Storage Facility* would not affect site infrastructure. Operation effects would be minimal and would increase site infrastructure needs above current site availability as follows:	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
EE: 0/0 MWh/yr		EE: 0 MWh/yr	EE: 0 MWh/y		EE: 0 MWh/yr		
PEL: 0/0 MWe		PEL: 0 MWe	PEL: 0 MWe		PEL: 0 MWe		
Oil: 0/0 l/yr		Oil: 0 l/yr	Oil: 0 l/yr		Oil: 0 l/yr		
Gas: 0/0 m^3/yr		Gas: 0 m^3/yr	Gas: 0 m^3/yr		Gas: 0 m^3/yr		
Coal: 0/0 t/yr.		Coal: 0 t/yr.	Coal: 0 t/yr.		Coal: 400 t/yr.		
Site Infrastructure - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Site infrastructure would be able to accommodate this subalternative. There would be a reduction in the use of electrical energy because electric usage is dependent on the amount of material used.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Water Resources - Upgrade With RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	The total percent increase in surface water use/discharge for *Modify Existing Zone 12* during construction would be 0/0.	*This subalternative does not apply to ORR.*	The total percent increase in surface water use/discharge for *Modify Actinide Packaging and Storage Facility* during construction would be 0/0.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
			The total percent increase in groundwater use/discharge for *Modify Existing Zone 12* during construction would be 2.6/2.2.		The total percent increase in groundwater use/discharge for *Modify Actinide Packaging and Storage Facility* during construction would be 0.02/0.2.		
			The total percent increase in surface water use/discharge for *Modify Existing Zone 12* during operation would be 0/0.		The total percent increase in surface water use/discharge for *Modify Actinide Packaging and Storage Facility* during operation would be 0/0.		
			The total percent increase in groundwater use/discharge for *Modify Existing Zone 12* during operation would be 11/9.1.		The total percent increase in groundwater use/discharge for *Modify Actinide Packaging and Storage Facility* during operation would be 0.04/0.2.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Water Resources - Upgrade Without RFETS Pu or LANL Pu Subalternative							
The total percent increase in surface water use/discharge for *Modify Existing FMEF* and *Construct New 200 West Area* during construction would be 0/0 and 0.04/1.6, respectively.	*This subalternative does not apply to NTS.*	The total percent increase in surface water use/discharge for *Modify Existing and Construct New ANL-W* during construction would be 0/0.	The total percent increase in surface water use/discharge for *Modify Existing Zone 12* during construction would be 0/0.	The total percent increase in surface water use/discharge for *Modify Existing Y–12 Plant* during construction would be 0.02/0.1.	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
The total percent increase in groundwater use/discharge for *Modify Existing FMEF* and *Construct New 200 West Area* during construction would be 2.6/1.6 and 0/0, respectively.		The total percent increase in groundwater use/discharge for *Modify Existing and Construct New ANL-W* during construction would be 0.1/0.7.	The total percent increase in groundwater use/discharge for *Modify Existing Zone 12* during construction would be 2.6/2.2.	The total percent increase in groundwater use/discharge for *Modify Existing Y–12 Plant* during construction would be 0/0.			
The total percent increase in surface water use/discharge for *Modify Existing FMEF* and *Construct New 200 West Area* during operation would be 0/0 and 0.06/0, respectively.		The total percent increase in surface water use/discharge for *Modify Existing and Construct New ANL-W* during operation would be 0/0.	The total percent increase in surface water use/discharge for *Modify Existing Zone 12* during operation would be 0/0.	The total percent increase in surface water use/discharge for *Modify Existing Y–12 Plant* during operation would be $2.0 \times 10^{-3}/9.0 \times 10^{-5}$.			
The total percent increase in groundwater use/discharge for *Modify Existing FMEF* and *Construct New 200 West Area* during operation would be 4.3/0 and 0/0.		The total percent increase in groundwater use/discharge for *Modify Existing and Construct New ANL-W* during operation would be 0.2/0.	The total percent increase in groundwater use/discharge for *Modify Existing Zone 12* during operation would be 11/9.1.	The total percent increase in groundwater use/discharge for *Modify Existing Y–12 Plant* during operation would be 0/0.			

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Water Resources - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative							
The total percent increase in surface water use/discharge for *Modify Existing FMEF* and *Construct New 200 West Area* during construction would be 0/0 and 0.06/0.04, respectively.	*This subalternative does not apply to NTS.*	The total percent increase in surface water use/discharge for *Modify Existing and Construct New ANL-W* during construction would be 0/0.	The total percent increase in surface water use/discharge for *Modify Existing Zone 12* during construction would be 0/0.	*This subalternative does not apply to ORR.*	The total percent increase in surface water use/discharge for *Modify Actinide Packaging and Storage Facility* during construction would be 0/0.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
The total percent increase in groundwater use/discharge for *Modify Existing FMEF* and *Construct New 200 West Area* during construction would be 4.0/3.0 and 0/0, respectively.		The total percent increase in groundwater use/discharge for *Modify Existing and Construct New ANL-W* during construction would be 0.2/1.1.	The total percent increase in groundwater use/discharge for *Modify Existing Zone 12* during construction would be 32.1/5.7.		The total percent increase in groundwater use/discharge for *Modify Actinide Packaging and Storage Facility* during construction would be 0.02/0.3.		
The total percent increase in surface water use/discharge for *Modify Existing FMEF* and *Construct New 200 West Area* during operation would be 0/0 and 0.07/0, respectively.		The total percent increase in surface water use/discharge for *Modify Existing and Construct New ANL-W* during operation would be 0/0.	The total percent increase in surface water use/discharge for *Modify Existing Zone 12* during operation would be 0/0.		The total percent increase in surface water use/discharge for *Modify Actinide Packaging and Storage Facility* during operation would be 0/0.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Water Resources - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative (continued)							
The total percent increase in groundwater use/discharge for *Modify Existing FMEF* and *Construct New 200 West Area* during operation would be 4.6/0 and 0/0, respectively.	*This subalternative does not apply to NTS.*	The total percent increase in groundwater use/discharge for *Modify Existing and Construct New ANL-W* during operation would be 0.3/0.	The total percent increase in groundwater use/discharge for *Modify Existing Zone 12* during operation would be 44.2/0.	*This subalternative does not apply to ORR.*	The total percent increase in groundwater use/discharge for *Modify Actinide Packaging and Storage Facility* during operation would be 0.05/0.3.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
Water Resources - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Impacts for construction and operation would be slightly less than the other subalternatives.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Biological Resources - Upgrade With RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Existing Zone 12 Facility.*	*This subalternative does not apply to ORR.*	Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Actinide Packaging and Storage Facility.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
Biological Resources - Upgrade Without RFETS Pu or LANL Pu Subalternative							
Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Existing FMEF* and *Construct New 200 West Area.*	*This subalternative does not apply to NTS.*	Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Existing and Construct New ANL-W.*	Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Existing Zone 12 Facility.*	Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Existing Y–12 Plant.*	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
Biological Resources - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative							
Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Existing FMEF* and *Construct New 200 West Area.*	*This subalternative does not apply to NTS.*	Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Existing and Construct New ANL-W.*	Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Existing Zone 12 Facility.*	*This subalternative does not apply to ORR.*	Construction and operation would have minimal impact on biological resources due to use of disturbed areas of the site for *Modify Actinide Packaging and Storage Facility.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
Biological Resources - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Impacts would have same effects as the other subalternative because the size of the facilities would be similar.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Cultural and Paleontological Resources - Upgrade With RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	It is unlikely that NRHP-eligible prehistoric and historic resources exist within the previously disturbed 0.18 ha of land area for the *Modify Existing Zone 12*. Operation would not result in additional impact. Some Native American resources would be affected by construction and operation of the *Modify Existing Zone 12.* Some Paleontological resources would be affected by the construction and operation of the *Modify Existing Zone 12.*	*This subalternative does not apply to ORR.*	Some NRHP-eligible prehistoric and historic resources may exist within the construction area for *Modify Actinide Packaging and Storage Facility.* Operation would not result in additional impact. Some Native American resources may be affected by construction and operation of the *Modify Actinide Packaging and Storage Facility.* SRS does not contain scientifically valuable paleontological remains.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Cultural and Paleontological Resources - Upgrade Without RFETS Pu or LANL Pu Subalternative							
No impact would occur as a result of *Modify Existing FMEF.* Some NRHP-eligible prehistoric and historic resources may exist within the previously disturbed construction area (10.5 ha) for the *New 200 West Area Facility.* Operation would not result in additional impact.	*This subalternative does not apply to NTS.*	It is unlikely that NRHP-eligible prehistoric and historic resources exist within the construction area for the *Modify Existing and Construct New ANL-W.* Operation would not result in additional impact.	It is unlikely that NRHP-eligible prehistoric and historic resources exist within the previously disturbed 0.18 ha of land area for the *Modify Existing Zone 12.* Operation would not result in additional impact.	Building modifications are proposed for four NRHP-eligible resources for *Modify Existing Y–12 Plant.*	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
No impact would occur as a result of *Modify Existing FMEF.* Some Native American resources may be affected by construction and operation of the *New 200 West Area Facility.*		Some Native American resources may be affected by construction and operation for *Modify Existing and Construct New ANL-W.*	Some Native American resources would be affected by construction and operation of the *Modify Existing Zone 12.*	It is unlikely that Native American resources would be affected by construction or operation for *Modify Existing Y–12 Plant.*			
No impact would occur as a result of *Modify Existing FMEF.* Some paleontological resources may be affected by construction of the *New 200 West Area Facility.*		Paleontological resources may be affected by construction of the *Modify Existing and Construct New ANL-W.*	Some Paleontological resources would be affected by the construction and operation of the *Modify Existing Zone 12.*	No activity is planned that would affect paleontological resources for *Modify Existing Y–12 Plant.*			

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Cultural and Paleontological Resources - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative							
No impact would occur as a result of *Modify Existing FMEF.* Some NRHP-eligible prehistoric and historic resources may exist within the previously disturbed construction area (10.5 ha) for construction of the *New 200 West Area Facility.* Operation would not result in additional impact.	*This subalternative does not apply to NTS.*	It is unlikely that NRHP-eligible prehistoric and historic resources exist within the construction area for the *Modify Existing and Construct New ANL-W.* Operation would not result in additional impact.	It is unlikely that NRHP-eligible prehistoric and historic resources exist within the previously disturbed 0.18 ha of land area for the *Modify Existing Zone 12.* Operation would not result in additional impact.	*This subalternative does not apply to ORR.*	Some NRHP-eligible prehistoric and historic resources may exist within the construction area for *Modify Actinide Packaging and Storage Facility.* Operation would not result in additional impact.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
No impact would occur as a result of *Modify Existing FMEF.* Some Native American resources may be affected by construction and operation of the *New 200 West Area Facility.*		Some Native American resources may be affected by construction and operation for *Modify Existing and Construct New ANL-W.*	Some Native American resources would be affected by construction and operation of the *Modify Existing Zone 12.*		Some Native American resources may be affected by construction and operation of the *Modify Actinide Packaging and Storage Facility.*		
No impact would occur as a result of *Modify Existing FMEF.* Some paleontological resources may be affected by construction of the *New 200 West Area Facility.*		Paleontological resources may be affected by construction for the *Modify Existing and Construct New ANL-W.*	Some Paleontological resources would be affected by the construction and operation of the *Modify Existing Zone 12.*		SRS does not contain scientifically valuable paleontological remains.		
Cultural and Paleontological Resources - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Impacts would be similar to those for the other subalternatives because the amount of land disturbed would be the same.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Socioeconomics - Upgrade With RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	During peak construction/operation total employment would increase by much less than 1 percent/less than 1 percent over No Action. Local transportation would change from free flow to a restricted condition during construction. Local transportation would not change appreciably during operation.	*This subalternative does not apply to ORR.*	During peak construction/operation total employment would increase by much less than 1 percent/much less than 1 percent over No Action. Local transportation would change from a restricted condition to a further restricted condition during construction. Local transportation would not be affected during operation.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
Socioeconomics - Upgrade Without RFETS Pu or LANL Pu Subalternative							
During peak construction/operation total employment would increase by much less than 1 percent/much less than 1 percent over No Action. Local transportation would not change appreciably.	*This subalternative does not apply to NTS.*	During peak construction/operation total employment would increase by much less than 1 percent/much less than 1 percent over No Action. Local transportation would change from free flow to a restricted condition during construction. Operation would not have an effect.	During peak construction/operation total employment would increase by much less than 1 percent/less than 1 percent over No Action. Local transportation would change from free flow to a restricted condition during construction. Local transportation would not change appreciably during operation.	During peak construction/operation total employment would increase by much less than 1 percent/much less than 1 percent over No Action. Local transportation would not change appreciably.	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Socioeconomics - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative							
During peak construction/operation total employment would increase by much less than 1 percent/much less than 1 percent over No Action.	*This subalternative does not apply to NTS.*	During peak construction/operation total employment would increase by much less than 1 percent/much less than 1 percent over No Action.	During peak construction/operation total employment would increase by much less than 1 percent/less than 1 percent over No Action.	*This subalternative does not apply to ORR.*	During peak construction/operation total employment would increase by much less than 1 percent/much less than 1 percent over No Action.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
Local transportation would not change appreciably.		Local transportation would change from free flow to a restricted condition during construction. Operation would not have an effect.	Local transportation would change from free flow to a restricted condition during construction. Local transportation would not change appreciably during operation.		Local transportation would change from a restricted condition to a further restricted condition during construction. Local transportation would not be affected during operation.		
Socioeconomics - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
There would be a small reduction in total employment during construction and operation.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade With RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative							
Normal Radiological Impacts							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	The annual dose from the *Modify Existing Zone 12 Storage Facility* to the MEI of the public would be $<1.8 \times 10^{-8}$ mrem. The estimated fatal cancer risk for the MEI of the public would be $<4.5 \times 10^{-13}$ from 50 years of operation. The annual dose from the *Modify Existing Zone 12 Storage Facility* to the public within 80 km would be $<6.3 \times 10^{-6}$ person-rem. The estimated number of fatal cancers to the public is $<1.6 \times 10^{-7}$ from 50 years of operation.	*This subalternative does not apply to ORR.*	The annual dose from the *Modify Actinide Packaging and Storage Facility* to the MEI of the public would be 6.8×10^{-6} mrem. The estimated fatal cancer risk for the MEI of the public would be 1.7×10^{-10} from 50 years of operation. The annual dose from the *Modify Actinide Packaging and Storage Facility* to the public within 80 km would be 2.9×10^{-4} person-rem. The estimated number of fatal cancers to the public is 7.2×10^{-6} from 50 years of operation.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade With RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative (continued)							
Normal Radiological Impacts (continued)							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	The average annual dose from the *Modify Existing Zone 12 Storage Facility* to the involved worker would be 116 mrem. The estimated fatal cancer risk for the average involved worker would be 2.3×10^{-3} from 50 years of operation. The annual total dose from the *Modify Existing Zone 12 Storage Facility* to the involved workforce would be 3 person-rem, which would result in an estimated 0.06 fatal cancer from 50 years of operation.	*This subalternative does not apply to ORR.*	The average annual dose from the *Modify Actinide Packaging and Storage Facility* to the involved worker would be 250 mrem. The estimated fatal cancer risk for the average involved worker would be 5.0×10^{-3} from 50 years of operation. The annual dose from the *Modify Actinide Packaging and Storage Facility* to the total involved workforce would be 7.5 person-rem, which would result in an estimated 0.15 fatal cancer from 50 years of operation.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade With RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative (continued)							
Hazardous Chemical Impacts							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	The HI and cancer risk for the public for *Modify Existing Zone 12* would be 0 and 0, respectively. The HI and cancer risk for the worker for *Modify Existing Zone 12* would be 0 and 0, respectively.	*This subalternative does not apply to ORR.*	The HI and cancer risk for the public for *Modify Actinide Packaging and Storage Facility* would be 1.5×10^{-6} and 0, respectively. The HI and cancer risk for the worker for *Modify Actinide Packaging and Storage Facility* would be 2.1×10^{-4} and 0, respectively.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade With RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative (continued)							
Facility Accidents							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	Based on the estimated maximum impacts from a set of accidents that propagate radioactive exposure to a worker 1,000 m from the release point for ***Modify Existing Zone 12***, the probability of cancer/risk to worker would be $7.2 \times 10^{-6}/1.4 \times 10^{-5}$.	*This subalternative does not apply to ORR.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point for ***Modify Actinide Packaging and Storage Facility***, the probability of cancer/risk to worker would be $1.2 \times 10^{-5}/2.9 \times 10^{-6}$.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
			Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary for *Modify Existing Zone 12*, the probability of cancer/risk to the MEI would be $2.9 \times 10^{-6}/5.8 \times 10^{-6}$.		Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary for *Modify Actinide Packaging and Storage Facility*, the probability of cancer/risk to the MEI would be $2.9 \times 10^{-7}/7.0 \times 10^{-8}$.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade with RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative (continued)							
Facility Accidents (continued)							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for *Modify Existing Zone 12* would be: Population: Cancer fatalities: 4.4×10^{-4} Cancer fatalities risk: 8.8×10^{-4}.	*This subalternative does not apply to ORR.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for *Modify Actinide Packaging and Storage Facility* would be: Population: Cancer fatalities: 1.4×10^{-3} Cancer fatalities risk: 3.4×10^{-4}.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade Without RFETS Pu or LANL Pu Subalternative							
Normal Radiological Impacts							
The annual dose from the *Modify Existing FMEF* and *Construct New 200 West Area Storage Facility* to the MEI of the public would be 1.8×10^{-6} mrem. The estimated fatal cancer risk for the MEI of the public from 50 years of operation would be 4.5×10^{-11}.	*This subalternative does not apply to NTS.*	The annual dose from the *Modify Existing and Construct New ANL-W Storage Facility* to the MEI of the public would be 5.1×10^{-7} mrem. The estimated fatal cancer risk for the MEI of the public would be 1.3×10^{-11} from 50 years of operation.	The annual dose from the *Modify Existing Zone 12 Storage Facility* to the MEI of the public would be $<1.8 \times 10^{-8}$ mrem. The estimated fatal cancer risk for the MEI of the public would be $<4.5 \times 10^{-13}$ from 50 years of operation.	The annual dose from the *Modify Existing Y–12 Plant Storage Facility* to the MEI of the public would be 2.2×10^{-7} mrem. The estimated fatal cancer risk for the MEI of the public would be 5.5×10^{-12} from 50 years of operation.	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
The annual dose from the *Modify Existing FMEF* and *Construct New 200 West Area Storage Facility* to the public within 80 km would be 4.7×10^{-5} person-rem. The estimated number of fatal cancers to the public is 1.2×10^{-6} from 50 years of operation.		The annual dose from the *Modify Existing and Construct New ANL-W Storage Facility* to the public within 80 km would be 3.2×10^{-6} person-rem. The estimated number of fatal cancers to the public is 7.2×10^{-8} from 50 years of operation.	The annual dose from the *Modify Existing Zone 12 Storage Facility* to the public within 80 km would be $<6.3 \times 10^{-6}$ person-rem. The estimated number of fatal cancers to the public is $<1.6 \times 10^{-7}$ from 50 years of operation.	The annual dose from the *Modify Existing Y–12 Plant Storage Facility* to the public within 80 km would be 3.4×10^{-6} person-rem. The estimated number of fatal cancers to the public is 8.5×10^{-8} from 50 years of operation.			

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade Without RFETS Pu or LANL Pu Subalternative (continued)							
Normal Radiological Impacts (continued)							
The average annual dose from the *Modify Existing FMEF* and *Construct New 200 West Area Storage Facility* to the involved worker would be 250 mrem. The estimated fatal cancer risk for the average involved worker would be 5.0×10^{-3} from 50 years of operation.	*This subalternative does not apply to NTS.*	The average annual dose from the *Modify Existing and Construct New ANL-W Storage Facility* to the involved worker would be 405 mrem. The estimated fatal cancer risk for the average involved worker would be 8.1×10^{-3} from 50 years of operation.	The average annual dose from the *Modify Existing Zone 12 Storage Facility* to the involved worker would be 116 mrem. The estimated fatal cancer risk for the average involved worker would be 2.3×10^{-3} from 50 years of operation.	The average annual dose from the *Modify Existing Y–12 Plant Storage Facility* to the involved worker would be 28 mrem. The estimated fatal cancer risk for the average involved worker would be 5.6×10^{-4} from 50 years of operation.	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
The annual total dose from the upgraded storage facility to the involved workforce would be 52 person-rem, which would result in an estimated 1.0 fatal cancer from 50 years of operation.		The annual total dose from the *Modify Existing and Construct New ANL-W Storage Facility* to the involved workforce would be 18 person-rem, which would result in an estimated 0.36 fatal cancer from 50 years of operation.	The annual total dose from the *Modify Existing Zone 12 Storage Facility* to the involved workforce would be 3 person-rem, which would result in an estimated 0.06 fatal cancer from 50 years of operation.	The annual total dose from the *Modify Existing Y–12 Plant Storage Facility* to the involved workforce would be 3 person-rem, which would result in an estimated 0.060 fatal cancer from 50 years of operation.			

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade Without RFETS Pu or LANL Pu Subalternative (continued)							
Hazardous Chemical Impacts							
The HI and cancer risk for the public for *Modify Existing FMEF* and *Construct New 200 West Area* would be 9.4×10^{-7} and 0, respectively.	*This subalternative does not apply to NTS.*	The HI and cancer risk for the public/worker for *Modify Existing and Construct New ANL-W* would be 1.2×10^{-5} and 5.9×10^{-8}, respectively.	The HI and cancer risk for the public for *Modify Existing Zone 12* would be 0 and 0, respectively.	The HI and cancer risk for the public for *Modify Existing Y–12 Plant* would be 8.6×10^{-5} and 0, respectively.	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
The HI and cancer risk for the worker for *Modify Existing FMEF* and *Construct New 200 West Area* would be 1.9×10^{-5} and 0, respectively.		The HI and cancer risk for the worker for *Modify Existing and Construct New ANL-W* would be 3.7×10^{-4} and 1.2×10^{-5}, respectively.	The HI and cancer risk for the worker for *Modify Existing Zone 12* would be 0 and 0, respectively.	The HI and cancer risk for the worker for *Modify Existing Y–12 Plant* would be 5.7×10^{-4} and 0, respectively.			

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade Without RFETS Pu or LANL Pu Subalternative (continued)							
Facility Accidents							
Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point for *Modify Existing FMEF* and *Construct New 200 West Area*, the probability of cancer/risk to worker would be $1.8x10^{-5}/5.7x10^{-6}$.	*This subalternative does not apply to NTS.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point for *Modify Existing and Construct New ANL-W*, the probability of cancer/risk to worker would be $2.3x10^{-5}/7.5x10^{-5}$.	Based on the estimated maximum impacts from a set of accidents that propagate radioactive exposure to a worker 1,000 m from the release point for *Modify Existing Zone 12*, the probability of cancer/risk to worker would be $7.2x10^{-6}/1.4x10^{-5}$.	Based on the estimated maximum impacts from a set of accidents analyzed for environmental assessment analyses, the maximum impacts and annual risks for *Modify Existing Y–12 Plant*, would be reduced approximately 80 percent for the expected risk, resulting in a latent cancer fatality risk of $5.7x10^{-8}$ to worker.	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary for *Modify Existing FMEF* and *Construct New 200 West Area*, the probability of cancer/risk to MEI would be $1.8x10^{-7}/5.7x10^{-8}$.		Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary for *Modify Existing and Construct New ANL-W*, the probability of cancer/risk to MEI would be $1.6x10^{-6}/5.0x10^{-6}$.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary for *Modify Existing Zone 12*, the probability of cancer/risk to MEI would be $2.9x10^{-6}/5.8x10^{-6}$.	Based on the estimated maximum impacts from a set of potential accidents analyzed for environmental assessment analyses, the maximum impacts and annual risks for *Modify Existing Y–12 Plant*, would be reduced approximately 80 percent for the expected risk, of $5.1x10^{-7}$ to the MEI.			

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade Without RFETS Pu or LANL Pu Subalternative (continued)							
Facility Accidents (continued)							
Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for *Modify Existing FMEF* and *Construct New 200 West Area* would be: Population: Cancer fatalities: 1.3×10^{-5} Cancer fatalities risk: 4.2×10^{-4}.	*This subalternative does not apply to NTS.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for *Modify Existing and Construct New ANL-W* would be: Population: Cancer fatalities: 5.1×10^{-4} Cancer fatalities risk: 1.6×10^{-3}.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for *Modify Existing Zone 12* would be: Population: Cancer fatalities: 4.4×10^{-4} Cancer fatalities risk: 8.8×10^{-4}.	Based on the estimated maximum impacts from a set of potential accidents analyzed for environmental assessment analyses, the maximum impacts and annual risks for *Modify Existing Y–12 Plant* would be reduced approximately 80 percent from the expected risk, resulting in a latent cancer fatality risk of 7.4×10^{-6} to population.	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative (continued)							
Normal Radiological Impacts							
The annual dose from the *Modify Existing FMEF* and *Construct New 200 West Area Storage Facility* to the MEI of the public would be 1.8×10^{-6} mrem. The estimated fatal cancer risk for the MEI of the public from 50 years of operation would be 4.5×10^{-11}.	*This subalternative does not apply to NTS.*	The annual dose from the *Modify Existing and Construct New ANL-W Storage Facility* to the MEI of the public would be 5.1×10^{-7} mrem. The estimated fatal cancer risk for the MEI of the public would be 1.3×10^{-11} from 50 years of operation.	The annual dose from the *Modify Existing Zone 12 Storage Facility* to the MEI of the public would be $<1.8 \times 10^{-8}$ mrem. The estimated fatal cancer risk for the MEI of the public would be $<4.5 \times 10^{-13}$ from 50 years of operation.	*This subalternative does not apply to ORR.*	The annual dose from the *Modify Actinide Packaging and Storage Facility* to the MEI of the public would be 6.8×10^{-6} mrem. The estimated fatal cancer risk for the MEI of the public would be 1.7×10^{-10} from 50 years of operation.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
The annual dose from the *Modify Existing FMEF* and *Construct New 200 West Area Storage Facility* to the public within 80 km would be 4.7×10^{-5} person-rem. The estimated number of fatal cancers to the public is 1.2×10^{-6} from 50 years of operation.		The annual dose from the *Modify Existing and Construct New ANL-W Storage Facility* to the public within 80 km would be 3.2×10^{-6} person-rem. The estimated number of fatal cancers to the public is 7.2×10^{-8} from 50 years of operation.	The annual dose from the *Modify Existing Zone 12 Storage Facility* to the public within 80 km would be $<6.3 \times 10^{-6}$ person-rem. The estimated number of fatal cancers to the public is $<1.6 \times 10^{-7}$ from 50 years of operation.		The annual dose from the *Modify Actinide Packaging and Storage Facility* to the public within 80 km would be 2.9×10^{-4} person-rem. The estimated number of fatal cancers to the public is 7.2×10^{-6} from 50 years of operation.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative (continued)							
Normal Radiological Impacts (continued)							
The average annual dose from the *Modify Existing FMEF* and *Construct New 200 West Area Storage Facility* to the involved worker would be 250 mrem. The estimated fatal cancer risk for the average involved worker would be 5.0×10^{-3} from 50 years of operation.	*This subalternative does not apply to NTS.*	The average annual dose from the *Modify Existing and Construct New ANL-W Storage Facility* to the involved worker would be 405 mrem. The estimated fatal cancer risk for the average involved worker would be 8.1×10^{-3} from 50 years of operation.	The average annual dose from the *Modify Existing Zone 12 Storage Facility* to the involved worker would be 116 mrem. The estimated fatal cancer risk for the average involved worker would be 2.3×10^{-3} from 50 years of operation.	*This subalternative does not apply to ORR.*	The average annual dose from the *Modify Actinide Packaging and Storage Facility* to the involved worker would be 250 mrem. The estimated fatal cancer risk for the average involved worker would be 5.0×10^{-3} from 50 years of operation.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
The annual total dose from the upgraded storage facility to the involved workforce would be 52 person-rem, which would result in an estimated 1.0 fatal cancer from 50 years of operation.		The annual total dose from the *Modify Existing and Construct New ANL-W Storage Facility* to the involved workforce would be 18 person-rem, which would result in an estimated 0.36 fatal cancer from 50 years of operation.	The annual total dose from the *Modify Existing Zone 12 Storage Facility* to the involved workforce would be 6 person-rem, which would result in an estimated 0.12 fatal cancer from 50 years of operation.		The annual total dose from the *Modify Actinide Packaging and Storage Facility* to the involved workforce would be 7.5 person-rem, which would result in an estimated 0.15 fatal cancer from 50 years of operation.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative (continued)							
Hazardous Chemical Impacts							
The HI and cancer risk for the public for *Modify Existing FMEF* and *Construct New 200 West Area* would be 9.4×10^{-7} and 0, respectively.	*This subalternative does not apply to NTS.*	The HI and cancer risk for the public/worker for *Modify Existing and Construct New ANL-W* would be 1.2×10^{-5} and 5.9×10^{-8}, respectively.	The HI and cancer risk for the public for *Modify Existing Zone 12* would be 0 and 0, respectively.	*This subalternative does not apply to ORR.*	The HI and cancer risk for the public for *Modify Actinide Packaging and Storage Facility* would be 1.6×10^{-6} and 0, respectively.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
The HI and cancer risk for the worker for *Modify Existing FMEF* and *Construct New 200 West Area* would be 1.9×10^{-5} and 0, respectively.		The HI and cancer risk for the worker for *Modify Existing and Construct New ANL-W* would be 3.7×10^{-4} and 1.2×10^{-5}, respectively.	The HI and cancer risk for the worker for *Modify Existing Zone 12* would be 0 and 0, respectively.		The HI and cancer risk for the worker for *Modify Actinide Packaging and Storage Facility* would be 2.2×10^{-4} and 0, respectively.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative (continued)							
Facility Accidents							
Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point for *Modify Existing FMEF* and *Construct New 200 West Area*, the probability of cancer/risk to worker would be $1.8x10^{-5}/5.9x10^{-6}$.	*This subalternative does not apply to NTS.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point for *Modify Existing and Construct New ANL-W*, the probability of cancer/risk to worker would be $1.7x10^{-5}/5.6x10^{-6}$.	Based on the estimated maximum impacts from a set of accidents that propagate radioactive exposure to a worker 1,000 m from the release point for *Modify Existing Zone 12*, the probability of cancer/risk to worker would be $1.0x10^{-5}/3.2x10^{-5}$.	*This subalternative does not apply to ORR.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point for *Modify Actinide Packaging and Storage Facility*, the probability of cancer/risk to worker would be $1.2x10^{-5}/3.9x10^{-6}$.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary for *Modify Existing FMEF* and *Construct New 200 West Area*, the probability of cancer/risk to MEI would be $1.8x10^{-7}/5.9x10^{-8}$.		Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary for *Modify Existing and Construct New ANL-W*, the probability of cancer/risk to MEI would be $1.8x10^{-7}/5.9x10^{-8}$.	Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary for *Modify Existing Zone 12*, the probability of cancer/risk to MEI would be $4.0x10^{-6}/1.3x10^{-5}$.		Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary for *Modify Actinide Packaging and Storage Facility*, the probability of cancer/risk to MEI would be $2.9x10^{-7}/9.5x10^{-8}$.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Public and Occupational Health and Safety - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative (continued)							
Facility Accidents (continued)							
Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for *Modify Existing FMEF* and *Construct New 200 West Area* would be: Population: Cancer fatalities: 1.3×10^{-3} Cancer fatalities risk: 4.3×10^{-4}.	*This subalternative does not apply to NTS.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for *Modify Existing and Construct New ANL-W* would be: Population: Cancer fatalities: 3.9×10^{-4} Cancer fatalities risk: 1.3×10^{-4}.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for *Modify Existing Zone 12* would be: Population: Cancer fatalities: 5.7×10^{-4} Cancer fatalities risk: 1.8×10^{-3}.	*This subalternative does not apply to ORR.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for *Modify Actinide Packaging and Storage Facility* would be: Population: Cancer fatalities: 1.4×10^{-3} Cancer fatalities risk: 4.6×10^{-4}.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
Public and Occupational Health and Safety - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
The decrease in the incremental impacts to workers and the population for total site operations from the accident-free storage facility would occur in proportion to the decrease in amount of material. The risk due to accidents would also decrease.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Waste Management - Upgrade With RFETS Pu (Pits to Pantex, Non-Pit Materials to SRS) Subalternative - Preferred Alternative							
This subalternative does not apply to Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply to INEL.*	The annual net increase in generation due to *Modify Existing Zone 12 South* for liquid/solid would be as follows: TRU: 0 m^3/0.8 m^3 Mixed TRU: 0 m^3/ 0 m^3 LLW: 0.08 m^3/ 138 m^3 Mixed LLW: 0.2 m^3/ 8 m^3 HAZ: 1 m^3/1.5 m^3 Nonhaz (sanitary): 12,900 m^3/275 m^3 Nonhaz (other): Included in sanitary/344 m^3.	*This subalternative does not apply to ORR.*	The net annual increase or decrease in generation due to *Modify Actinide Packaging and Storage Facility* for liquid/solid would be as follows: TRU: 0 m^3/0 m^3 Mixed TRU: 0 m^3/ 0 m^3 LLW: 0 m^3/ 0 m^3 Mixed LLW: 0 m^3/ 0 m^3 HAZ: 0 m^3/ 0.56 m^3 Nonhaz (sanitary): 1,490 m^3/13 m^3 Nonhaz (other): Included in sanitary/13 m^3.	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Waste Management - Upgrade Without RFETS Pu or LANL Pu Subalternative							
The annual net increase in generation due to *Modify Existing FMEF* and *Construct New 200 West Area* for liquid/solid would be as follows:	*This subalternative does not apply to NTS.*	The annual net increase in generation due to *Modify Existing and Construct New ANL-W* for liquid/solid would be as follows:	The annual net increase in generation due to *Modify Existing Zone 12 South* for liquid/solid would be as follows:	The annual net increase in generation due to *Modify Existing Y–12 Plant* for liquid/solid would be as follows:	*This subalternative does not apply to SRS.*	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
TRU: 0 m^3/20 m^3		TRU: 0.004 m^3/2 m^3	TRU: 0 m^3/0.8 m^3	TRU: 0 m^3/0 m^3			
Mixed TRU: 0 m^3/ 0 m^3		Mixed TRU: 0 m^3/ 1 m^3	Mixed TRU: 0 m^3/ 0 m^3	Mixed TRU: 0 m^3/ 0 m^3			
LLW: 0.08 m^3/ 85 m^3		LLW: 0.79 m^3/500m^3	LLW: 0.08 m^3/ 138 m^3	LLW: 0.04 m^3/ 3 m^3			
Mixed LLW: 0 m^3/ 5 m^3		Mixed LLW: 0.015 m^3/27 m^3	Mixed LLW: 0.2 m^3/ 8 m^3	Mixed LLW: 0.02 m^3/0.8 m^3			
HAZ: 0.57 m^3/4 m^3		HAZ: 0.15 m^3/1 m^3	HAZ: 1 m^3/1.5 m^3	HAZ: Included in Mixed LLW/ Included in Mixed LLW			
Nonhaz (sanitary): 8,330 m^3/917 m^3		Nonhaz (sanitary): 7,600 m^3/240 m^3	Nonhaz (sanitary): 12,900 m^3/275 m^3	Nonhaz (sanitary): 0.8 m^3/31 m^3			
Nonhaz (other): Included in sanitary/0 m^3.		Nonhaz (other): Included in sanitary/310 m^3.	Nonhaz (other): Included in sanitary/344 m^3.	Nonhaz (other): 0.8 m^3/0.8 m^3.			

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Waste Management - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative							
The net annual increase in generation due to *Modify Existing FMEF* and *Construct New 200 West Area* for liquid/solid would be as follows:	*This subalternative does not apply to NTS.*	The net annual increase in generation due to *Modify Existing and Construct New ANL-W* for liquid/solid would be as follows:	The net annual increase in generation due to *Modify Existing Zone 12 South* for liquid/solid would be as follows:	*This subalternative does not apply to ORR.*	The net annual increase/decrease in generation due to *Modify Actinide Packaging and Storage Facility* for liquid/solid would be as follows:	*This subalternative does not apply to RFETS.*	*This subalternative does not apply to LANL.*
TRU: 0 m^3/21 m^3		TRU: 0.004 m^3/2 m^3	TRU: 0.02 m^3/10 m^3		TRU: 0 m^3/0 m^3		
Mixed TRU: 0 m^3/ 0 m^3		Mixed TRU: 0 m^3/ 1 m^3	Mixed TRU: 0 m^3/ 4 m^3		Mixed TRU: 0 m^3/ 0 m^3		
LLW: 0.08 m^3/89 m^3		LLW: 0.79 m^3/ 500 m^3	LLW: 2 m^3/ 1,260 m^3		LLW: 0 m^3/ 0 m^3		
Mixed LLW: 0 m^3/ 5 m^3		Mixed LLW: 0.14 m^3/27 m^3	Mixed LLW: 0.2 m^3/ 65 m^3		Mixed LLW: 0 m^3/ 0 m^3		
HAZ: 0.57 m^3/4 m^3		HAZ: 1.3 m^3/ 1 m^3	HAZ: 2 m^3/2 m^3		HAZ: 0 m^3/ 0.8 m^3		
Nonhaz (sanitary): 8,780 m^3/967 m^3		Nonhaz (sanitary): 10,300 m^3/346 m^3	Nonhaz (sanitary): 109,500 m^3/ 1,560 m^3		Nonhaz (sanitary): 1,806 m^3/18 m^3		
Nonhaz (other): Included in sanitary/0 m^3.		Nonhaz (other): Included in sanitary/440 m^3.	Nonhaz (other): Included in sanitary/1,900 m^3.		Nonhaz (other): Included in sanitary/18 m^3.		
Waste Management - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
The volume of operational waste would decrease in proportion to the amount of material excluded.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Intersite Transportation of Fissile Materials- Upgrade with RFETS Pu (Pits to Pantex, Non-Pits Materials to SRS) Subalternative - Preferred Alternative							
This subalternative does not apply at Hanford.	*This subalternative does not apply to NTS.*	*This subalternative does not apply at INEL.*	Transport of RFETS Pu pits to Pantex would have maximum potential fatalities of 6.4×10^{-3}.	*This subalternative does not apply at ORR.*	Transport of all non-pit materials to SRS would have maximum potential fatalities of 0.06.	The risk associated with transport of RFETS materials would be 0.067.	*This subalternative does not apply at LANL.*
Intersite Transportation of Fissile Materials - Upgrade Without RFETS Pu or LANL Pu Subalternative							
There would be no material transported, therefore the maximum potential fatalities would be 0.	There would be no material transported, therefore the maximum potential fatalities would be 0.	There would be no material transported, therefore the maximum potential fatalities would be 0.	There would be no material transported, therefore the maximum potential fatalities would be 0.	There would be no material transported, therefore the maximum potential fatalities would be 0.	There would be no material transported, therefore the maximum potential fatalities would be 0.	There would be no material transported, therefore the maximum potential fatalities would be 0.	There would be no material transported, therefore the maximum potential fatalities would be 0.
Intersite Transportation of Fissile Materials - Upgrade With All or Some RFETS Pu and LANL Pu Subalternative							
Transport of all materials to Hanford would have maximum potential fatalities of 0.05.	*This subalternative does not apply to NTS.*	Transport of all materials to INEL would have maximum potential fatalities of 0.03.	Transport of all materials to Pantex would have maximum potential fatalities of 0.03.	HEU would continue to be stored, and no additional material would be transported.	Transport of all materials to SRS would have maximum potential fatalities of 0.09.	Transport of all materials from RFETS would have maximum potential fatalities of 0.09.	Transport of all materials from LANL would have maximum potential fatalities of 0.09.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Upgrade Alternative							
Environmental Justice							
No high or adverse impacts from normal operations or accidents that would disproportionately impact minority or low-income populations.	*This alternative does not apply to NTS.*	No high or adverse impacts from normal operations or accidents that would disproportionately impact minority or low-income populations.	No high or adverse impacts from normal operations or accidents that would disproportionately impact minority or low-income populations.	No high or adverse impacts from normal operations or accidents that would disproportionately impact minority or low-income populations.	No high or adverse impacts from normal operations or accidents that would disproportionately impact minority or low-income populations.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Land Resources							
New Pu Storage Facility would require 58.5 ha of land area during construction, of which 56 ha would be used during operation. A portion of the facility site is previously disturbed land. A buffer zone would be provided between the facility and the site boundary.	*Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel/New Pu Storage Facility* would disturb 29 ha/58.5 ha of land area during construction, of which 27 ha/56 ha would be used during operation. A buffer zone would be provided between the facility and the site boundary. However, use of P-Tunnel for storage could impact weapons effects testing.	*New Pu Storage Facility* would disturb 58.5 ha of land during construction, of which 56 ha would be used during operation. A buffer zone would be provided between the facility and the site boundary.	*Construct New and Modify Existing Zone 12 South Facilities/New Pu Storage Facility* would not cause new land disturbance during construction or operation. During construction, 60.5 ha/58.5 ha of land area would be required of which 58 ha/56 ha would be used during operation. A buffer zone would be provided between the facility and the site boundary.	*This alternative does not apply to ORR.*	*New Pu Storage Facility* would disturb 58.5 ha during construction, of which 56 ha would be used during operation. A buffer zone would be provided between the facility and the site boundary.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
The alternative would be consistent with the current VRM Class 5 designation.	The subalternatives would be consistent with the current VRM Class 5 designation.	The alternative would be consistent with the current VRM Class 5 designation.	The subalternatives would be consistent with the current VRM Class 5 designation.		The alternative would change the current VRM Class 4 designation to Class 5.		
Land Resources - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Impacts would be the same as all the previous subalternatives, except less land area would be required because the size of the facilities would be smaller.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Site Infrastructure							
Minimal impacts from *Construct New Pu Storage Facility* would occur. Site infrastructure would be capable of supporting operations without major modifications. Operation would increase site infrastructure above current site availability as follows:	*Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel* and *Construct New Pu Storage Facility* would not impact site infrastructure during construction. Natural gas would be most affected during operation. Operation would increase site infrastructure above current site availability as follows:	*Construct New Pu Storage Facility* requirements would constitute a small change in site resource requirements. Site infrastructure would be capable of supporting operations without major modifications. Operation impacts would increase site infrastructure above current site availability as follows:	Construction and operations of the *Construct New and Modify Existing Zone 12 Facilities/New Pu Storage Facility* would not affect site infrastructure during construction. Electrical energy would have the highest percentage increase over No Action but would not exceed available site resources. Operation impacts would increase site infrastructure above current site availability as follows:	*This alternative does not apply to ORR.*	Construction would not impact site infrastructure for *Construct New Pu Storage Facility.* Operation impacts would be minimal and would increase site infrastructure above current site availability as follows:	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
EE: 0 MWh/yr	EE: 20,096 and 0 MWh/yr	EE: 0 MWh/yr	EE: 0/0 MWh/yr		EE: 0 MWh/yr		
PEL: 0 MWe	PEL: 0 and 0 MWe	PEL: 0 MWe	PEL: 0/0 MWe		PEL: 0 MWe		
Oil: 0 l/yr	Oil: 38,000 and 38,000 l/yr	Oil: 0 l/yr	Oil: 0/0 l/yr		Oil: 46,000 l/yr		
Gas: 0 m^3/yr	Gas: 3,200,000 and 2,800,000 m^3/yr	Gas: 0 m^3/yr	Gas: 0/0 m^3/yr		Gas: 0 m^3/yr		
Coal: 0 t/yr.	Coal: 0 and 0 t/yr.	Coal: 11,000 t/yr.	Coal: 0/0 t/yr.		Coal: 4,200 t/yr.		

Site Infrastructure - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative

Site infrastructure would be able to accommodate this subalternative. There would be a reduction in the use of electrical energy because electric usage is dependent on the amount of material used.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Water Resources							
The total percent increase in surface water use/discharge during construction for *Construct New Pu Storage Facility* would be 0.6/3.1.	The total percent increase in surface water use/discharge for *Modify Existing Tunnel Drifts and Construct New Material Handling Building P-Tunnel* and *New Pu Storage Facility* during construction would be 0/0 and 0/0.	The total percent increase in surface water use for *New Pu Storage Facility* during construction would be 0. Discharge would be recycled.	The total percent increase in surface water use/discharge for *Construct New and Modify Existing Zone 12 Facilities* and *New Pu Storage Facility* during construction would be 0/0 and 0/0.	*This alternative does not apply to ORR.*	The total percent increase in surface water use for *New Pu Storage Facility* during construction would be 0. Discharge would be recycled.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
The total percent increase in groundwater use/discharge during construction for *Construct New Pu Storage Facility* would be 0/0.	The total percent increase in groundwater use/discharge for *Modifying P-Tunnel* and *New Pu Storage Facility* during construction would be 1.5/9.5 and 3.5/9.5.	The total percent increase in groundwater use/discharge for *New Pu Storage Facility* during construction would be 1.1/1.4.	The total percent increase in groundwater use/discharge for *Construct New and Modify Existing Zone 12 Facilities* and *New Pu Storage Facility* during construction would be 32.1/5.7 and 34.1/5.7.		The total percent increase in groundwater use/discharge for *New Pu Storage Facility* during construction would be 0.6/1.1.		
The total percent increase in surface water use/discharge during operation for *Construct New Pu Storage Facility* would be 0.8/0.	The total percent increase in surface water use/discharge during operation for *Modifying P-Tunnel* and *New Pu Storage Facility* would be 0/0 and 0/0.	The total percent increase in surface water use during operation for *New Pu Storage Facility* would be 0. Discharge would be recycled.	The total percent increase in surface water use/discharge during operation for *Construct New and Modify Existing Zone 12 Facilities* and *New Pu Storage Facility* would be 0/0 and 0/0.		The total percent increase in surface water use during operation for *New Pu Storage Facility* would be 0. No surface water would be used. Discharge would be recycled.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Water Resources (continued)							
The total percent increase in groundwater use/discharge during operation for *Construct New Pu Storage Facility* would be 0/0.	The total percent increase in groundwater use/discharge for *Modifying P-Tunnel* and *New Pu Storage Facility* during operation would be 5.4/0 and 4.6/0.	The total percent increase in groundwater use/discharge for *New Pu Storage Facility* during operation would be 0.9/0.	The total percent increase in groundwater use/discharge for *Construct New and Modify Existing Zone 12 Facilities* and *New Pu Storage Facility* during operation would be 44.2/0 and 39.4/0.	*This alternative does not apply to ORR.*	The total percent increase in groundwater use/discharge for *New Pu Storage Facility* during operation would be 2.7/24.1.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Water Resources (continued) - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Impacts for construction and operation would be slightly less than the other subalternatives.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Biological Resources							
Construction and operation of *New Pu Storage Facility* would disturb 58.5 ha of terrestrial sagebrush habitat. Construction would affect animal populations.	Construction and operation of *Modify Existing P-Tunnel/New Pu Storage Facility* would disturb 0 ha/58.5 ha of terrestrial habitat. Construction would affect animal populations. However, *Modify Existing P-Tunnel* would have minimal impact because construction would take place on disturbed area.	Construction and operation of the *New Pu Storage Facility* would disturb 58.5 ha of terrestrial habitat. Construction would affect animal populations.	Construction and operation of the *New and Modify Existing Zone 12 South* and *New Pu Storage Facility* would have minimal impact on biological resources due to use of disturbed areas of the site.	*This alternative does not apply to ORR.*	Construction and operation *New Pu Storage Facility* would disturb 58.5 ha of terrestrial habitat. Construction would affect animal populations.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Construction and operation would not affect wetlands and aquatic resources.	Construction and operation of both options would not affect wetland and aquatic resources.	Construction and operation would not affect wetlands and aquatic resources.	Construction-related ground disturbance may increase the potential for sediment runoff to playa wetlands and aquatic habitat.		During construction and operation there would be minimal effect on wetlands and aquatic resources.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Biological Resources (continued)							
Federal-listed threatened and endangered species would not be affected. A number of State-listed and candidate species could lose nesting/breeding and foraging habitat.	Construction and operation of the *Modify Existing P-Tunnel* would have minimal effect on threatened and endangered species since the habitat is already disturbed. For the *New Pu Storage Facility*, the desert tortoise is the only Federal-listed species that could be affected during construction and operation. Any candidate plant species could be affected during land clearing activities.	Federal-listed threatened and endangered species would not be affected. Several State-status species may lose breeding and foraging habitat. One State-listed sensitive plant species could be potentially affected by construction.	Impacts to threatened and endangered species are not expected.	*This alternative does not apply to ORR.*	Federal-listed threatened and endangered species would not be affected. Several special status species could be affected by construction due to land clearing activities or habitat changes.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Biological Resources (continued) - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Impacts would have same effects as the other subalternative because the size of the facilities would be similar.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Cultural and Paleontological Resources							
No NRHP-eligible prehistoric and historic resources occur within the 58.5 ha that would be disturbed for *Construct New Pu Storage Facility* during construction. Operation would not result in additional impact.	Some NRHP-eligible prehistoric and historic resources may occur within the 29 ha/58.5 ha that would be disturbed during construction of *Modify Existing P-Tunnel/New Pu Storage Facility*. Operation would not result in additional impact.	It is unlikely that NRHP-eligible prehistoric and historic resources occur within the 58.5 ha that would be disturbed during construction of *New Pu Storage Facility*. Operation would not result in additional impact.	Impacts to prehistoric or historic resources are not anticipated within the construction area of the *Construct New and Modify Existing Zone 12* and *New Pu Storage Facility*. Operation would not result in additional impact.	*This alternative does not apply to ORR.*	Some prehistoric and historic resources may occur within the 58.5 ha that would be disturbed during construction of *New Pu Storage Facility*. Operation would not result in additional impact.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Some Native American resources may be affected by construction and operation.	Some Native American resources may be affected by construction and operation.	Some Native American resources may be affected by construction and operation.	It is unlikely that Native American resources would be affected by construction and operation.		Some Native American resources may be affected by construction and operation.		
Some paleontological resources may be affected by construction.	Some paleontological resources may be affected by construction.	Some paleontological resources may be affected by construction.	Intact paleontological resources probably do not occur within the project area.		SRS does not contain scientifically valuable paleontological remains.		
Cultural and Paleontological Resources - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Impacts would be similar to those for the other subalternatives because the amount of land disturbed would be the same.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Socioeconomics							
During peak construction/operation of the *New Pu Storage Facility* employment would increase less than 1 percent/less than 1 percent over No Action.	During peak construction/operation of the *Modify Existing P-Tunnel* and *New Pu Storage Facility*, employment would increase less than 1 percent/less than 1 percent and much less than 1 percent/much less than 1 percent, respectively, over No Action.	During peak construction/operation of *New Pu Storage Facility* employment would increase slightly more than 1 percent/ approximately 1 percent over No Action.	During peak construction/operation of *New Facility and Modify Existing Building in Zone 12* and *New Pu Storage Facility* employment would increase less than 1 percent/approximately 1 percent and by almost 1 percent/approximately 1 percent over No Action.	*This alternative does not apply to ORR.*	During peak construction/operation of *New Pu Storage Facility* employment would increase less than 1 percent/less than 1 percent over No Action.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Local transportation would not change appreciably.	Local transportation would not change appreciably.	Local transportation would change from free flow to a restricted condition during construction. Operation would not have an effect.	Local transportation would change from free flow to a restricted condition during construction. Local transportation would not change appreciably during operation.		Local transportation would change from a restricted condition to a further restricted condition during construction. Local transportation would not be affected during operation.		
Socioeconomics - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
There would be a small reduction in total employment during construction and operation.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Public and Occupational Health and Safety							
Normal Radiological Impacts							
The annual dose from the *New Pu Storage Facility* to the MEI of the public would be $2.5x10^{-6}$ mrem, and the estimated risk of fatal cancer would be $6.2x10^{-11}$ from 50 years of operation.	The annual dose from the *Modify Existing P-Tunnel/New Pu Storage Facility* to the MEI of the public for the new facility would be $5.6x10^{-6}$ mrem/ $1.3x10^{-6}$ mrem, and the estimated risk of fatal cancer would be $1.4x10^{-10}$/ $3.2x10^{-11}$ from 50 years of operation.	The annual dose from the *New Pu Storage Facility* to the MEI of the public would be $1.6x10^{-6}$ mrem, and the estimated risk of fatal cancer would be $4.0x10^{-11}$ from 50 years of operation.	The annual dose from the *New and Modify Existing Zone 12/New Pu Storage Facility* to the MEI of the public would be $9.5x10^{-6}$ mrem/ $9.5x10^{-6}$ mrem, and the estimated risk of fatal cancer would be $2.4x10^{-10}$/ $2.4x10^{-10}$ from 50 years of operation.	*This alternative does not apply to ORR.*	The annual dose from the *New Pu Storage Facility* to the MEI of the public would be $1.4x10^{-5}$ mrem, and the estimated risk of fatal cancer would be $3.5x10^{-10}$ from 50 years of operation.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
The annual total dose from the *New Pu Storage Facility* to the public within 80 km would be $1.1x10^{-4}$ person-rem. This would result in an estimated $2.8x10^{-6}$ fatal cancer from 50 years of operation.	The annual total dose from the *Modify Existing P-Tunnel/New Pu Storage Facility* to the public within 80 km for the new facility would be $1.7x10^{-6}$/$2.6x10^{-6}$ person-rem. This would result in an estimated $4.3x10^{-8}$/$6.5x10^{-8}$ fatal cancer from 50 years of operation.	The annual total dose from the *New Pu Storage Facility* to the public within 80 km would be $1.8x10^{-5}$ person-rem. This would result in an estimated $4.5x10^{-7}$ fatal cancer from 50 years of operation.	For the new facility the annual total dose from the *New and Modify Existing Zone 12/ New Pu Storage Facility* to the within 80 km public would be $5.5x10^{-5}$/$5.2x10^{-5}$ person-rem. This would result in an estimated $1.4x10^{-6}$/$1.3x10^{-6}$ fatal cancer from 50 years of operation.		The annual total dose from the *New Pu Storage Facility* to the public within 80 km would be $9.2x10^{-4}$ person-rem. This would result in an estimated $2.3x10^{-5}$ fatal cancer from 50 years of operation.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Public and Occupational Health and Safety (continued)							
Normal Radiological Impacts (continued)							
The average annual dose from the *New Pu Storage Facility* to the involved worker would be 258 mrem. The estimated fatal cancer risk for the average involved worker would be 5.2×10^{-3} from 50 years of operation.	The average annual dose from the *Modify Existing P-Tunnel/New Pu Storage Facility* to the involved worker would be 262/258 mrem. The estimated fatal cancer risk for the average involved worker would be 5.2×10^{-3}/5.2×10^{-3} from 50 years of operation.	The average annual dose from the *New Pu Storage Facility* to the involved worker would be 258 mrem. The estimated fatal cancer risk for average involved worker would be 5.2×10^{-3} from 50 years of operation.	The average annual dose from the *New and Modify Existing Zone 12/ New Pu Storage Facility* to the involved worker would be 254/ 258 mrem. The estimated fatal cancer risk for the average involved worker would be 5.1×10^{-3}/5.2×10^{-3} from 50 years of operation.	*This alternative does not apply to ORR.*	The average annual dose from the *New Pu Storage Facility* to the involved worker would be 258 mrem. The estimated fatal cancer risk for the average involved worker would be 5.2×10^{-3} from 50 years of operation.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
New Pu Storage Facility would result in an annual dose to the total involved workforce of 24 person-rem, which would result in an estimated 0.48 fatal cancer from 50 years of operation.	*Modify Existing P-Tunnel/New Pu Storage Facility* would result in an annual dose to the total involved workforce of 30/24 person-rem, which would result in an estimated 0.60/0.48 fatal cancer from 50 years of operation.	*New Pu Storage Facility* would result in an annual dose to the total involved workforce of 24 person-rem, which would result in an estimated 0.48 fatal cancer from 50 years of operation.	*New and Modify Existing Zone 12/ New Pu Storage Facility* would result in an annual dose to the total involved workforce of 31/24 person-rem, which would result in an estimated 0.62/0.48 fatal cancer from 50 years of operation.		*New Pu Storage Facility* would result in an annual dose to the total involved workforce of 24 person-rem, which would result in an estimated 0.48 fatal cancer from 50 years of operation.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Public and Occupational Health and Safety (continued)							
Hazardous Chemical Impacts							
The HI and cancer risk from *New Pu Storage Facility* for chemical impacts to the public would be 4.0×10^{-6} and 2.7×10^{-8}, respectively.	The HI and cancer risk from *Modify Existing P-Tunnel* for chemical impacts to the public would be 2.5×10^{-6} and 4.1×10^{-9}, respectively.	The HI and cancer risk from *New Pu Storage Facility* for chemical impacts to the public would be 4.5×10^{-5} and 5.9×10^{-8}, respectively.	The HI and cancer risk from *New and Modify Existing Zone 12/New Pu Storage Facility* for chemical impacts to the public would be 1.4×10^{-4} and 1.5×10^{-7}, respectively.	*This alternative does not apply to ORR.*	The HI and cancer risk from *New Pu Storage Facility* for chemical impacts to the public would be 2.8×10^{-6} and 7.5×10^{-9}, respectively.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
The HI and cancer risk from *New Pu Storage Facility* for chemical impacts to the worker would be 2.8×10^{-4} and 1.2×10^{-5}, respectively.	The HI and cancer risk from *Modify Existing P-Tunnel* for chemical impacts to the worker would be 5.1×10^{-4} and 6.4×10^{-6}, respectively.	The HI and cancer risk from *New Pu Storage Facility* for chemical impacts to the worker would be 1.3×10^{-3} and 1.2×10^{-5}, respectively.	The HI and cancer risk from *New and Modify Existing Zone 12/New Pu Storage Facility* for chemical impacts to the worker would be 7.0×10^{-4} and 6.2×10^{-6}, respectively.		The HI and cancer risk from *New Pu Storage Facility* for chemical impacts to the worker would be 6.0×10^{-4} and 1.1×10^{-5}, respectively.		
	The HI and cancer risk from *New Pu Storage Facility* for chemical impacts to the public would be 2.3×10^{-6} and 4.1×10^{-9}, respectively.						
	The HI and cancer risk from *New Pu Storage Facility* for chemical impacts to the worker would be 4.7×10^{-4} and 6.4×10^{-6}, respectively.						

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Public and Occupational Health and Safety (continued)							
Facility Accidents							
Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point, the probability of cancer/risk to worker for the *New Pu Storage Facility* would be: $1.8x10^{-5}/5.7x10^{-5}$.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point, the probability of cancer/risk to worker for the *Modify Existing P-Tunnel/New Pu Storage Facility* would be: $1.3x10^{-5}/4.0x10^{-5}$ and $1.2x10^{-5}/3.9x10^{-5}$.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point, the probability of cancer/risk to worker for the *New Pu Storage Facility* would be: $1.7x10^{-5}/5.4x10^{-5}$.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point, the probability of cancer/risk to worker for the *New and Modify Existing Zone 12* and *Construct New Pu Storage Facility* would be: $1.0x10^{-5}/3.2x10^{-5}$ and $7.2x10^{-6}/2.3x10^{-5}$.	*This alternative does not apply to ORR.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker 1,000 m from the release point, the probability of cancer/risk to worker for the *New Pu Storage Facility* would be: $1.2x10^{-5}/3.8x10^{-5}$.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Public and Occupational Health and Safety (continued)							
Facility Accidents (continued)							
Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary, the probability of cancer/risk to worker for the *New Pu Storage Facility* would be: $1.8\times10^{-7}/5.7\times10^{-7}$.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary, the probability of cancer/risk to worker for the *Modify Existing P-Tunnel /New Pu Storage Facility* would be: $2.2\times10^{-6}/6.9\times10^{-6}$ and $2.9\times10^{-7}/9.1\times10^{-7}$.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary, the probability of cancer/risk to worker for the *New Pu Storage Facility* would be: $1.8\times10^{-7}/5.8\times10^{-7}$.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary, the probability of cancer/risk to worker for the *New and Modify Existing Zone 12 Facility* and *Construct New Pu Storage Facility* would be: $4.0\times10^{-6}/1.3\times10^{-5}$ and $2.9\times10^{-6}/9.2\times10^{-6}$.	*This alternative does not apply to ORR.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the MEI located at the site boundary, the probability of cancer/risk to worker for the *New Pu Storage Facility* would be: $2.9\times10^{-7}/9.3\times10^{-7}$.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Public and Occupational Health and Safety (continued)							
Facility Accidents (continued)							
Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks would be: *New Pu Storage Facility* Population: Cancer fatalities: 1.3×10^{-3} Cancer fatalities risk: 4.2×10^{-3}.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks would be: *Modify Existing P-Tunnel* Population: Cancer fatalities: 1.6×10^{-5} Cancer fatalities risk: 5.1×10^{-5} *New Pu Storage Facility* Population: Cancer fatalities: 3.0×10^{-5} Cancer fatalities risk: 9.4×10^{-5}.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks would be: *New Pu Storage Facility* Population: Cancer fatalities: 3.9×10^{-4} Cancer fatalities risk: 1.2×10^{-3}.	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks would be: *New and Modify Existing Zone 12 Facility* Population: Cancer fatalities: 5.7×10^{-4} Cancer fatalities risk: 1.8×10^{-3} *Construct New Pu Storage Facility* Population: Cancer fatalities: 4.4×10^{-4} Cancer fatalities risk: 1.4×10^{-3}.	*This alternative does not apply to ORR.*	Based on the estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks would be: *New Pu Storage Facility* Population: Cancer fatalities: 1.4×10^{-3} Cancer fatalities risk: 4.5×10^{-3}.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Public and Occupational Health and Safety (continued)- Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
The decrease in the incremental impacts to workers and the population for total site operations from the accident-free storage facility would occur in proportion to the decrease in amount of material. The risk due to accidents would also decrease.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Waste Management							
During construction and operation, all categories of waste would be managed at Hanford.	During construction and operation, all categories of waste would be managed at NTS.	During construction and operation, all categories of waste would be managed at INEL.	During construction and operation, all categories of waste would be managed at Pantex.	*This alternative does not apply to ORR.*	During construction and operation, all categories of waste would be managed at SRS.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
The net increase in generation due to *New Pu Storage Facility* for liquid/solid would be as follows:	The net increase in generation due to *Modify Existing P-Tunnel* for liquid/solid would be as follows:	The net increase in generation due to *New Pu Storage Facility* for liquid/solid would be as follows:	The net increase in generation due to *New and Modify Existing Zone 12 Facility* for liquid/solid would be as follows:		The net increase or decrease in generation due to *New Pu Storage Facility* for liquid/solid would be as follows:		
TRU: 0.02 m^3/10 m^3	TRU: 0.02 m^3/10 m^3	TRU: 0.02 m^3/10 m^3	TRU: 0.02 m^3/10 m^3		TRU: 0.02 m^3/2 m^3		
Mixed TRU: 0m^3/ 4 m^3	Mixed TRU: 0 m^3/ 4 m^3	Mixed TRU: 0 m^3/ 4 m^3	Mixed TRU: 0 m^3/ 4 m^3		Mixed TRU: 0 m^3/ 4 m^3		
LLW: 2/1,260 m^3	LLW: 2 m^3/1,260 m^3	LLW: 2 m^3/1,260 m^3	LLW: 2 m^3/1,260 m^3		LLW: 2 m^3/1,220 m^3		
Mixed LLW: 0.2 m^3/ 65 m^3	Mixed LLW: 0.2 m^3/ 65 m^3	Mixed LLW: 0.2 m^3/ 65 m^3	Mixed LLW: 0.2 m^3/ 65 m^3		Mixed TRU: 0.2 m^3/ 65 m^3		
HAZ: 2 m^3/2 m^3	HAZ: 2 m^3/2 m^3	HAZ: 2 m^3/2 m^3	HAZ: 2 m^3/2 m^3		HAZ: 2 m^3/2 m^3		
Nonhaz (sanitary): 110,000 m^3/ 1,140 m^3	Nonhaz (sanitary): 135,000 m^3/ 1,620 m^3	Nonhaz (sanitary): 65,900 m^3/ 1,320 m^3	Nonhaz (sanitary): 109,500 m^3/ 1,560 m^3.		Nonhaz (sanitary): 149,720 m^3/ -814 m^3		
Nonhaz (other): Included in sanitary/1,400 m^3.	Nonhaz (other): Included in sanitary/2,000 m^3.	Nonhaz (other): Included in sanitary/1,600 m^3.	Nonhaz (other): Included in sanitary/1,900 m^3.		Nonhaz (other): Included in sanitary/1,800 m^3.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Waste Management (continued)							
	The net increase in generation due to *New Pu Storage Facility* for liquid/solid would be as follows: TRU: 0.02 m^3/10 m^3 Mixed TRU: 0 m^3/ 4 m^3 LLW: 2 m^3/1,260 m^3 Mixed LLW: 0.2 m^3/ 65 m^3 HAZ: 2 m^3/2 m^3 Nonhaz (sanitary): 114,000 m^3/ 1,500 m^3 Nonhaz (other): Included in sanitary/1,900 m^3.		The net increase in generation due to *New Pu Storage Facility* for liquid/solid would be as follows: TRU: 0.02 m^3/10 m^3 Mixed TRU: 0 m^3/ 4 m^3 LLW: 2 m^3/1,260 m^3 Mixed TRU: 0.2 m^3/ 65 m^3 HAZ: 2 m^3/2 m^3 Nonhaz (sanitary): 97,800 m^3/ 1,440 m^3 Nonhaz (other): Included in sanitary/1,800 m^3.				
Waste Management (continued) - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
The volume of operational waste would decrease in proportion to the amount of material excluded.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Intersite Transportation[a]							
Maximum potential fatalities from intersite transportation of Pu to a consolidated (*New Pu Storage Facility*) storage site would be 0.27.	Maximum potential fatalities from intersite transportation of Pu to a consolidated (*Upgrade P-Tunnel*) storage site would be 0.17. Maximum potential fatalities from intersite transportation of Pu to a consolidated (*New Pu Storage Facility*) storage site would be 0.17.	Maximum potential fatalities from intersite transportation of Pu to a consolidated (*New Pu Storage Facility*) storage site would be 0.20.	Maximum potential fatalities from intersite transportation of Pu to a consolidated (*Upgrade Facility*) storage site would be 0.08. Maximum potential fatalities from intersite transportation of Pu to a consolidated (*New Pu Storage Facility*) storage site would be 0.08.	*This alternative does not apply to ORR.*	Maximum potential fatalities from intersite transportation of Pu to a consolidated (*New Pu Storage Facility*) storage site would be 0.35.	The risk associated with transport of RFETS materials would have a range between 0.08 and 0.35.	The risk associated with transport of LANL materials would have a range between 0.08 and 0.35.

[a] Detailed information is provided in the classified Appendix.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Consolidation Alternative							
Environmental Justice							
No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	*This alternative does not apply to ORR.*	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income population.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populationss.
Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.		Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Land Resources *New Pu and HEU Storage Facility* would disturb 89.5 ha of land area during construction, of which 87 ha would be used during operation. A portion of the facility is on previously disturbed land. A buffer zone would be provided between the facility and the site boundary.	*Modify Existing P-Tunnel/New Pu and HEU Storage Facility* would disturb 29 ha/89.5 ha of land area during construction, of which 27 ha/87 ha would be used during operation. However, use of the P-Tunnel could impact weapons effects testing. A buffer zone would be provided between the facility and the site boundary.	*New Pu and HEU Storage Facility* would disturb 89.5 ha of land area during construction, of which 87 ha would be used during operation. A buffer zone would be provided between the facility and the site boundary.	*New Pu and HEU Storage Facility* would require 89.5 ha of land area during construction, of which 87 ha would be used during operation. No new land disturbance would occur during construction nor would previously disturbed land be used during operation. A buffer zone would be provided between the facility and the site boundary.	*New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant/New Pu Storage Facility and Modify Existing HEU Storage Facility Y–12 Plant/New Pu and HEU Storage Facility* would disturb 58.5 ha/58.5 ha/ 89.5 ha of land area during construction, of which 56 ha/56 ha/87 ha would be used during operation. A buffer zone would be provided between the facility and the site boundary.	*New Pu and HEU Storage Facility* would disturb 89.5 ha of land area during construction, of which 87 ha would be used during operation. A buffer zone would be provided between the facility and the site boundary.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
The alternative would be consistent with the current VRM Class 5 designation.	All options would be consistent with the current VRM Class 5 designation.	The alternative would be consistent with the current VRM Class 5 designation.	The alternative would be consistent with the current VRM Class 5 designation.	All options would change the current VRM Class 4 designation to Class 5, due to a potential visual impact to roadways with high sensitivity levels.	The alternative would change the current VRM Class 4 designation to Class 5.		

Land Resources - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative

Impacts would be the same as all the previous subalternatives, except less land area would be required because the size of the facilities would be smaller.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Site Infrastructure							
There would be minimal impact from construction of the *New Pu and HEU Storage Facility*. Site infrastructure would be capable of supporting operations without major modifications. Operation impacts would increase site infrastructure above current site availability as follows:	*Modify Existing P-Tunnel/New Pu and HEU Storage Facility* would not impact site infrastructure. Operation impact are in the areas of electrical energy and fuel requirements. Operation impacts would require slight increases in site infrastructure above current site availability as follows:	Construction requirements of the *New Pu and HEU Storage Facility* would constitute a small change in site resource requirements. Site infrastructure would be capable of supporting operation without major modifications. Operation impacts would require slight increases in site infrastructure above current site availability as follows:	Construction of the *New Pu and HEU Storage Facility* would require small increases in available oil resources. During operation all the site infrastructure resources required would be less than site availability. Operation impacts would increase site infrastructure above current site availability as follows:	Construction of *New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant/New Pu Storage and Modify Existing HEU Storage Facility Y–12 Plant* would not affect site infrastructure. Construction of *New Pu and HEU Storage Facility* would consume approximately 25 percent more resources than constructing the other two options. Some additional coal and oil would be needed during operation of all options. Operation would require slight increases in site infrastructure above current site availability as follows:	Construction of the *New Pu and HEU Storage Facility* would have minimal impact on site infrastructure. Operation impacts would be minimal and would require slight increases in site infrastructure above current site availability as follows:	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
EE: 0 MWh/yr	EE: 37,096/ 13,096 MWh/yr	EE: 0 MWh/yr	EE: 0 MWh/yr	EE: 0/0/0 MWh/yr	EE: 0 MWh/yr		
PEL: 0 MWe	PEL: 0/0 MWe	PEL: 0 MWe	PEL: 0 MWe	PEL: 0/0/0 MWe	PEL: 0 MWe		
Oil: 0 l/yr	Oil: 38,000/ 38,000 l/yr	Oil: 0 l/yr	Oil: 0 l/yr	Oil:11,000/11,000/ 13,000 l/yr	Oil: 47,000 l/yr		
Gas: 0 m^3/yr	Gas: 3,600,000/ 3,200,000 m^3/yr	Gas: 0 m^3/yr	Gas: 0 m^3/yr	Gas: 0/0/0 m^3/yr	Gas: 0 m^3/yr		
Coal: 0 t/yr.	Coal: 0/0 t/yr.	Coal: 14,000 t/yr.	Coal: 0 t/yr.	Coal: 5,500/5,663/ 5,973 t/yr	Coal: 4,800 t/yr.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Site Infrastructure - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Site infrastructure would be able to accommodate this subalternative. There would be a reduction in the use of electrical energy because electric usage is dependent on the amount of material used.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Water Resources							
The total percent increase in surface water use/discharge during construction for *New Pu and HEU Storage Facility* would be 0.8/5.1.	The total percent increase in surface water use/discharge during construction for *Modify Existing P-Tunnel* and *New Pu and HEU Storage Facility* would be 0/0 and 0/0.	The total percent increase in surface water use/discharge during construction for *New Pu and HEU Storage Facility* would be 0/0.	The total percent increase in surface water use/discharge during construction for *New Pu and HEU Storage Facility* would be 0/0.	The total percent increase in surface water use/discharge during construction for *New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant, New Pu Storage and Modify Existing HEU Storage Facility Y–12 Plant,* and *New Pu and HEU Storage Facility* would be 0.6/0.3, 0.6/0.5, and 0.7/0.6, respectively.	The total percent increase in surface water use/discharge during construction for *New Pu and HEU Storage Facility* would be 0/0.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
The total percent increase in groundwater use/discharge during construction for *New Pu and HEU Storage Facility* would be 0/0.	The total percent increase in groundwater use/discharge during construction for *Modify Existing P-Tunnel* and *New Pu and HEU Storage Facility* would be 1.5/10.6 and 4.4/14.4, respectively.	The total percent increase in groundwater use/discharge during construction for *New Pu and HEU Storage Facility* would be 1.4/2.4.	The total percent increase in groundwater use/discharge during construction for *New Pu and HEU Storage Facility* would be 42/8.7.	The total percent increase in groundwater use/discharge during construction for *New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant, New Pu Storage and Modify Existing HEU Storage Facility Y–12 Plant,* and *New Pu and HEU Storage Facility* would be 0/0, 0/0, and 0/0, respectively.	The total percent increase in groundwater use/discharge during construction for *New Pu and HEU Storage Facility* would be 0.8/1.9.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Water Resources (continued)							
The total percent increase in surface water use/discharge during operation for *New Pu and HEU Storage Facility* would be 1.1/0.	The total percent increase in surface water use/discharge during operation for *Modify Existing P-Tunnel* and *New Pu and HEU Storage Facility* would be 0/0 and 0/0.	The total percent increase in surface water use/discharge during operation for *New Pu and HEU Storage Facility* would be 0/0.	The total percent increase in surface water use/discharge during operation for *New Pu and HEU Storage Facility* would be 0/0.	The total percent increase in surface water use/discharge during operation for *New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant, New Pu Storage and Modify Existing HEU Storage Facility Y–12 Plant,* and *New Pu and HEU Storage Facility* would be 1.9/6, 1.9/6, and 2.4/7.6, respectively.	The total percent increase in surface water use/discharge during operation for *New Pu and HEU Storage Facility* would be 0/0.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
The total percent increase in groundwater use/discharge during operation for *New Pu and HEU Storage Facility* would be 0/0.	The total percent increase in groundwater use/discharge during operation for *Modify Existing P-Tunnel/New Pu and HEU Storage Facility* would be 7.9/0 and 6.3/0.	The total percent increase in groundwater use/discharge during operation for *New Pu and HEU Storage Facility* would be 1.2/0.	The total percent increase in groundwater use/discharge during operation for *New Pu and HEU Storage Facility* would be 52.2/0.	The total percent increase in groundwater use/discharge during operation for *New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant, New Pu Storage and Modify Existing HEU Storage Facility Y–12 Plant,* and *New Pu and HEU Storage Facility* would be 0/0, 0/0 and 0/0, respectively.	The total percent increase in groundwater use/discharge during operation for *New Pu and HEU Storage Facility* would be 3.5/30.7.		
Water Resources (continued) - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Impacts for construction and operation would be slightly less than the other subalternatives.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Biological Resources							
Construction and operation of *New Pu and HEU Storage Facility* would disturb 89.5 ha of terrestrial habitat. Construction would affect animal populations.	Construction and operation of *Modify Existing P-Tunnel/ New Pu and HEU Storage Facility* would disturb 29 ha/89.5 ha of terrestrial habitat. Construction would affect animal populations. However, *Modify Existing P-Tunnel* would have minimal construction impact because it would take place on disturbed areas.	Construction and operation of *New Pu and HEU Storage Facility* would disturb 89.5 ha of terrestrial habitat. Construction would affect animal populations.	Construction and operation of *New Pu and HEU Storage Facility* would have minimal impact on biological resources due to use of disturbed areas of the site.	Construction and operation of *New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant/New Pu Storage and Modify Existing HEU Storage Facility Y–12 Plant/New Pu and HEU Storage Facility* would disturb 58.5 ha/ 58.5 ha/89.5 ha of terrestrial habitat. Construction would affect animal populations.	Construction and operation of *New Pu and HEU Storage Facility* would disturb 89.5 ha of terrestrial habitat. Construction would affect animal populations.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Construction and operation would have no effect on wetlands and aquatic resources.	Construction and operation of both options would not affect wetland and aquatic resources.	Construction and operation would have no effect on wetlands and aquatic resources.	Construction-related ground disturbance may increase the potential for sediment runoff to wetlands and aquatic habitat.	Direct impacts to wetlands during construction are not anticipated except possibly along East Fork Poplar Creek. Discharges during construction and operation would not affect associated wetlands and aquatic resources. Soil erosion during construction and operation could cause water quality changes.	During construction and operation, there would be minimal effect on wetlands and aquatic resources.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Biological Resources (continued)							
Federal-listed threatened and endangered species would not likely be affected. A number of State-listed and candidate species could lose nesting, breeding, and foraging habitat.	Construction and operation of the *Modify Existing P-Tunnel* would have minimal effect on threatened and endangered species since the habitat is already disturbed. For the *New Pu Storage Facility* option, the desert tortoise is the only Federal-listed species that could be affected during construction and operation. Any candidate plant species could be affected during land clearing activities.	Federal-listed threatened and endangered species would not likely be affected. Several State-status species could lose breeding and foraging habitat. One state-listed sensitive plant species could be potentially affected by construction.	Impacts to threatened and endangered species would not be expected.	Federal-listed threatened and endangered species would not likely be affected. The Tennessee dace (deemed in need of management by the State) could be affected by siltation. A number of State-protected plants could also be impacted by clearing activities.	Federal-listed threatened and endangered species would not likely be affected. Several special status species could be affected by construction due to land clearing activities or habitat changes.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Biological Resources - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Impacts would have same effects as the other subalternative because the size of the facilities would be similar.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Cultural and Paleontological Resources							
No NRHP-eligible prehistoric or historic resources exist within the 89.5 ha that would be disturbed during construction of the *New Pu and HEU Storage Facility*. Operation would not result in additional impact.	Some NRHP-eligible prehistoric and historic resources may exist within the 29 ha/89.5 ha that would be disturbed during construction of the *Modify Existing P-Tunnel/New Pu and HEU Storage Facility*. Operation would not result in additional impact.	It is unlikely that NRHP-eligible prehistoric and historic resources exist within the 89.5 ha that would be disturbed during construction of the *New Pu and HEU Storage Facility*. Operation would not result in additional impact.	Impacts to prehistoric and historic resources are not anticipated within the previously disturbed construction area of the *New Pu and HEU Storage Facility*. Operation would not result in additional impact.	Some NRHP-eligible prehistoric and historic resources may exist within the up to 58.5 ha/58.5 ha/89.5 ha that would be disturbed during construction of the *New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant/New Pu Storage and Modify Existing HEU Storage Facility Y–12 Plant/New Pu and HEU Storage Facility*. Operation would not result in additional impact.	Some prehistoric and historic resources may exist within the 89.5 ha that would be disturbed during construction of the *New Pu and HEU Storage Facility*. Operation would not result in additional impact.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Some Native American resources may be affected by construction and operation.	Some Native American resources may be affected by construction and operation.	Some Native American resources may be affected by construction and operation.	It is unlikely that Native American resources would be affected by construction and operation.	Some Native American resources may be affected by construction and operation.	Some Native American resources may be affected by construction and operation.		
Some paleontological resources may exist within the land to be disturbed during construction.	Some paleontological resources may exist within the land to be disturbed during construction.	Some paleontological resources may be affected by construction.	Intact paleontological resources probably do not occur within the project area.	ORR does not contain scientifically valuable paleontological remains.	SRS does not contain scientifically valuable paleontological remains.		
Cultural and Paleontological Resources - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
Impacts would be similar to those for the other subalternatives because the amount of land disturbed would be the same.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Socioeconomics							
During peak construction/operation of the *New Pu and HEU Storage Facility* the percent growth in employment would be less than 1 percent/less than 1 percent over No Action.	During peak construction/operation of the *Modify Existing P-Tunnel* and *New Pu and HEU Storage Facility* the percent growth in employment would be less than 1 percent/much less than 1 percent and less than 1 percent/less than 1 percent, respectively, over No Action.	During peak construction/operation of the *New Pu and HEU Storage Facility* the percent growth in employment would be about 2 percent/slightly more than 1 percent over No Action.	During peak construction/operation of the *New Pu and HEU Storage Facility* the percent growth in employment would be 1 percent/1.2 percent over No Action.	During peak construction/operation of the *New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant, New Pu Storage and Modify Existing HEU Storage Facility Y–12 Plant*, and *New Pu and HEU Storage Facility* the percent growth in employment would be less than 1 percent/less than 1 percent over No Action for all options.	During peak construction/operation of the *New Pu and HEU Storage Facility* the percent growth in employment would be about 1 percent/less than 1 percent over No Action.	*This subalternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Local transportation would not change appreciably.	Local transportation would not change appreciably.	Local transportation would change from free flow to a somewhat restricted condition during construction. Operation would not have an effect.	Local transportation would change from free flow to a somewhat restricted condition during construction. Local transportation would not change appreciably during operation.	Local transportation would not change appreciably.	Local transportation would change from a somewhat restricted condition to a further restricted condition during construction. Local transportation would not change appreciably during operation.		

Socioeconomics - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative

There would be a small reduction in total employment during construction and operation.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Public and Occupational Health and Safety							
Normal Radiological Impacts							
The annual dose from the *New Pu and HEU Storage Facility* to the MEI of the public would be $2.5x10^{-6}$ mrem and the estimated risk of fatal cancer for the MEI of the public would be $6.2x10^{-11}$ from 50 years of operation.	For the *Modify Existing P-Tunnel/New Pu and HEU Storage Facility* would result in an annual dose of $5.6x10^{-6}$/ $1.3x10^{-6}$ mrem to the MEI of the public and the estimated fatal cancer risk for the MEI of the public would be $1.4x10^{-10}$/ $3.2x10^{-11}$ from 50 years of operation.	The annual dose from the *New Pu and HEU Storage Facility* to the MEI of the public would be $1.6x10^{-6}$ mrem and the estimated risk of fatal cancer for the MEI of the public would be $4.0x10^{-11}$ from 50 years of operation.	The annual dose from the *New Pu and HEU Storage Facility* to the MEI of the public would be $9.6x10^{-6}$ mrem and the estimated risk of fatal cancer for the MEI of the public would be $2.4x10^{-10}$ from 50 years of operation.	For *New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant/New Pu Storage and Modify Existing HEU Storage Facility Y–12 Plant/New Pu and HEU Storage Facility*, the annual dose to the MEI of the public would be $4.5x10^{-5}$/$4.5x10^{-5}$/ $4.5x10^{-5}$ mrem and the estimated risk of fatal cancer for the MEI of the public would be $1.1x10^{-9}$/$1.1x10^{-9}$/ $1.1x10^{-9}$ from 50 years of operation.	The annual dose from the *New Pu and HEU Storage Facility* to the MEI of the public would be $1.4x10^{-5}$ mrem and the estimated risk of fatal cancer for the MEI of the public would be $3.5x10^{-10}$ from 50 years of operation.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Public and Occupational Health and Safety (continued)							
Normal Radiological Impacts (continued)							
The annual total dose from the *New Pu and HEU Storage Facility* to the public within 80 km would be $1.1x10^{-4}$ person-rem. This would cause an estimated $2.8x10^{-6}$ fatal cancers from 50 years of operation.	The annual total dose from the *Modify Existing P-Tunnel/New Pu and HEU Storage Facility* to the public within 80 km would be $1.7x10^{-6}/2.6x10^{-6}$ person-rem for new facility storage. This would cause an estimated $4.3x10^{-8}/6.5x10^{-8}$ fatal cancers from 50 years of operation.	The annual total dose from the *New Pu and HEU Storage Facility* to the public within 80 km would be $1.8x10^{-5}$ person-rem. This would cause an estimated $4.5x10^{-7}$ fatal cancers from 50 years of operation.	The annual total dose from the *New Pu and HEU Storage Facility* to the public within 80 km would be $5.3x10^{-5}$ person-rem. This would cause an estimated $1.3x10^{-6}$ fatal cancers from 50 years of operation.	For *New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant/New Pu Storage and Modify Existing HEU Storage Facility Y–12 Plant/New Pu and HEU Storage Facility*, the annual total dose to the public within 80 km would be $8.7x10^{-4}/8.7x10^{-4}/8.7x10^{-4}$ person-rem. This would cause an estimated $2.2x10^{-5}/2.2x10^{-5}/2.2x10^{-5}$ fatal cancers from 50 years of operation.	The annual dose from the *New Pu and HEU Storage Facility* to the public within 80 km would be $8.8x10^{-4}$ person-rem. This would cause an estimated $2.2x10^{-5}$ fatal cancers from 50 years of operation.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Public and Occupational Health and Safety (continued)							
Normal Radiological Impacts (continued)							
The average annual dose from the *New Pu and HEU Storage Facility* to the involved worker would be 264 mrem. The estimated fatal cancer risk for the average involved worker would be $5.3x10^{-3}$ from 50 years of operation.	The average annual dose from the *Modify Existing P-Tunnel/New Pu and HEU Storage Facility* to the involved worker for the new facility would be 262/ 264 mrem. The estimated fatal cancer risk for the average involved worker would be $5.2x10^{-3}/5.3x10^{-3}$ from 50 years of operation.	The average annual dose from the *New Pu and HEU Storage Facility* to the involved worker would be 264 mrem. The estimated fatal cancer risk for the average involved worker would be $5.3x10^{-3}$ from 50 years of operation.	The average annual dose from the *New Pu and HEU Storage Facility* to the involved worker would be 264 mrem. The estimated fatal cancer risk for the average involved worker would be $5.3x10^{-3}$ from 50 years of operation.	For *New Pu Storage Facility and Maintain Existing HEU Storage Facility Y–12 Plant/New Pu Storage and Modify Existing HEU Storage Facility Y–12 Plant/New Pu and HEU Storage Facility*, the average annual dose from the collocated storage facility to the involved worker would be 264/264/ 264 mrem. The estimated fatal cancer risk for the average involved worker would be $5.3x10^{-3}/5.3x10^{-3}/5.3x10^{-3}$ from 50 years of operation.	The average annual dose from the *New Pu and HEU Storage Facility* to the involved worker would be 264 mrem. The estimated fatal cancer risk for the average involved worker would be $5.3x10^{-3}$ from 50 years of operation.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Public and Occupational Health and Safety (continued)							
Normal Radiological Impacts (continued)							
New Pu and HEU Storage Facility would result in an annual dose to the total involved workforce of 25 person-rem which would result in an estimated 0.50 fatal cancers from 50 years of operation.	*Modify Existing P-Tunnel/New Pu and HEU Storage Facility* would result in an annual dose to the total involved workforce of 40/25 person-rem which would result in an estimated 0.80/0.50 fatal cancers from 50 years of operation.	*New Pu and HEU Storage Facility* would result in an annual dose to the total involved workforce of 25 person-rem which would result in an estimated 0.50 fatal cancers from 50 years of operation.	*New Pu and HEU Storage Facility* would result in an annual dose to the total involved workforce of 25 person-rem which would result in an estimated 0.50 fatal cancers from 50 years of operation.	*New Pu Storage Facility and Maintain Existing Y–12 Plant, New Pu Storage and Modify Existing Y–12 Plant*, and *New Pu and HEU Storage Facility* would result in an annual dose to the total involved workforce of 25 person-rem which would result in an estimated 0.50 fatal cancers from 50 years of operation.	*New Pu and HEU Storage Facility* would result in an annual dose to the total involved workforce of 25 person-rem which would result in an estimated 0.50 fatal cancers from 50 years of operation.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Public and Occupational Health and Safety (continued)							
Hazardous Chemical Impacts							
The HI and cancer risk for *New Pu and HEU Storage Facility* for chemical impacts to the public would be $1.6x10^{-5}$ and $2.7x10^{-8}$, respectively.	The HI and cancer risk for *Modify Existing P-Tunnel Storage Facility* for chemical impacts to the public would be $2.8x10^{-6}$ and $4.1x10^{-9}$, respectively.	For *New Pu and HEU Storage Facility* the HI and cancer risk for chemical impacts to the public would be $7.7x10^{-5}$ and $5.9x10^{-8}$, respectively.	The HI and cancer risk for *New Pu and HEU Storage Facility* for chemical impacts to the public would be $2.0x10^{-4}$ and $1.5x10^{-7}$, respectively.	For all subalternatives the HI and cancer risk for chemical impacts to the public would be $1.5x10^{-4}$ and $1.6x10^{-7}$, respectively.	The HI and cancer risk for *New Pu and HEU Storage Facility* for chemical impacts to the public would be $6.2x10^{-6}$ and $7.5x10^{-9}$, respectively.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
The HI and cancer risk for *New Pu and HEU Storage Facility* for chemical impacts to the worker would be $7.1x10^{-4}$ and $1.2x10^{-5}$, respectively.	The HI and cancer risk for *Modify Existing P-Tunnel Storage Facility* for chemical impacts to the worker would be $5.6x10^{-4}$ and $6.4x10^{-6}$, respectively. For *New Pu and HEU Storage Facility* the HI and cancer risk for chemical impacts to the public would be: $4.2x10^{-6}$ and $4.1x10^{-9}$, respectively. For *New Pu and HEU Storage Facility* the HI and cancer risk for chemical impacts to the worker would be: $7.2x10^{-4}$ and $6.4x10^{-6}$, respectively.	For *New Pu and HEU Storage Facility* the HI and cancer risk for chemical impacts to the worker would be $1.9x10^{-3}$ and $1.2x10^{-5}$, respectively.	The HI and cancer risk for *New Pu and HEU Storage Facility* for chemical impacts to the worker would be $9.3x10^{-4}$ and $6.2x10^{-6}$, respectively.	For all subalternatives the HI and cancer risk for chemical impacts to the worker would be $1.3x10^{-3}$ and $1.3x10^{-5}$, respectively.	The HI and cancer risk for *New Pu and HEU Storage Facility* for chemical impacts to the worker would be $1.0x10^{-3}$ and $1.1x10^{-5}$, respectively.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Public and Occupational Health and Safety (continued)							
Facility Accidents							
Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to a worker 1,000 m from the release point, the probability of cancer risk to the worker would be: $1.8x10^{-5}/5.7x10^{-5}$.	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to a worker 1,000 m from the release point, the probability of cancer risk to the worker for *P-Tunnel* and *New Pu and HEU Storage Facility* would be: $1.3x10^{-5}/4.0x10^{-5}$ and $1.2x10^{-5}/3.9x10^{-5}$, respectively.	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to a worker 1,000 m from the release point, the probability of cancer risk to the worker would be: $1.7x10^{-5}/5.4x10^{-5}$.	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to a worker 1,000 m from the release point, the probability of cancer risk to the worker would be: $7.2x10^{-6}/2.3x10^{-5}$.	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to a worker 619 m from the release point, the probability of cancer risk to the worker for all options would be: $2.5x10^{-5}/7.9x10^{-5}$.	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to a worker 1,000 m from the release point, the probability of cancer risk to the worker would be: $1.2x10^{-5}/3.8x10^{-5}$.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the MEI of the public located at the site boundary, the probability of cancer risk to the MEI of the public would be: $1.8x10^{-7}/5.7x10^{-7}$.	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the MEI of the public located at the site boundary, the probability of cancer risk to the MEI of the public for the *P–Tunnel* and *New Pu and HEU Storage Facility* would be: $2.2x10^{-6}/6.9x10^{-6}$ and $2.9x10^{-7}/9.1x10^{-7}$, respectively.	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the MEI of the public located at the site boundary, the probability of cancer risk to the MEI of the public would be: $1.8x10^{-7}/5.8x10^{-7}$.	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the MEI of the public located at the site boundary, the probability of cancer risk to the MEI of the public would be: $2.9x10^{-6}/9.2x10^{-6}$.	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the MEI of the public located at the site boundary, the probability of cancer risk to the MEI of the public for all options would be: $3.1x10^{-5}/9.9x10^{-5}$.	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the MEI of the public located at the site boundary, the probability of cancer risk to the MEI of the public would be: $2.0x10^{-7}/6.3x10^{-7}$.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Public and Occupational Health and Safety (continued)							
Facility Accidents (continued)							
Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks would be:	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks would be:	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks would be:	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks would be:	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks for all options would be:	Based on the estimated impacts from a set of potential accidents that propagate radioactive releases to the general population residing within 80 km, the maximum impacts and 50-year facility lifetime risks would be:	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
Population: Cancer fatalities: 1.3×10^{-3} Cancer fatalities risk: 4.2×10^{-3}.	*P-Tunnel* Population: Cancer fatalities: 1.6×10^{-5} Cancer fatalities risk: 5.1×10^{-5} *New Pu and HEU Storage Facility* Population: Cancer fatalities: 3.0×10^{-5} Cancer fatalities risk: 9.4×10^{-5}.	Population: Cancer fatalities: 3.9×10^{-4} Cancer fatalities risk: 1.2×10^{-3}.	Population: Cancer fatalities: 4.4×10^{-4} Cancer fatalities risk: 1.4×10^{-3}.	Population: Cancer fatalities: 5.3×10^{-3} Cancer fatalities risk: 1.7×10^{-2}.	Population: Cancer fatalities: 1.4×10^{-3} Cancer fatalities risk: 4.6×10^{-3}.		

Public and Occupational Health and Safety - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative

The decrease in the incremental impacts to workers and the population for total site operations from the accident-free storage facility would occur in proportion to the decrease in amount of material. The risk due to accidents would also decrease.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Waste Management							
During construction and operation, all categories of waste would be managed at Hanford.	During construction and operation, all categories of waste would be managed at NTS.	During construction and operation, all categories of waste would be managed at INEL.	During construction and operation, all categories of waste would be managed at Pantex except LLW which would be shipped to NTS unless new LLW facilities were built.	During construction and operation, all categories of waste would be managed at ORR.	During construction and operation, all categories of waste would be managed at SRS.	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*
The annual net increase in generation due to collocation for liquid/solid would be as follows:	The increase due to collocation (P-Tunnel) for liquid/solid would be as follows:	The annual net increase in generation due to collocation for liquid/solid would be as follows:	The annual net increase in generation due to collocation for liquid/solid would be as follows:	The annual net increase in generation due to collocation (new Pu facility) liquid/solid would be as follows:	The annual net increase in generation due to upgrade for liquid/solid would be as follows:		
TRU: 0.02 m^3/10 m^3	TRU: 0.02 m^3/10 m^3	TRU: 0.02 m^3/10 m^3	TRU: 0.02 m^3/10 m^3	TRU: 0.02 m^3/10 m^3	TRU:0.02 m^3/2 m^3		
Mixed TRU: 0 m^3/ 4 m^3	Mixed TRU: 0 m^3/ 4 m^3	Mixed TRU: 0 m^3/ 4 m^3	Mixed TRU: 0 m^3/ 4 m^3	Mixed TRU: 0 m^3/ 4 m^3	Mixed TRU: 0 m^3/ 4 m^3		
LLW: 2.1 m^3/ 1,300 m^3	LLW: 2.1 m^3/ 1,300 m^3	LLW: 2.1 m^3/ 1,300 m^3	LLW: 2.1 m^3/ 1,300 m^3	LLW: 2 m^3/1,260 m^3	LLW: 2.1 m^3/ 1,260 m^3		
Mixed LLW: 0.2 m^3/ 66 m^3	Mixed LLW: 0.2 m^3/ 66 m^3	Mixed LLW: 0.2 m^3/ 66 m^3	Mixed LLW: 0.2 m^3/ 66 m^3	Mixed LLW: 0.2 m^3/ 65 m^3	Mixed LLW: 0.2 m^3/ 66 m^3		
HAZ: 2 m^3/2 m^3	HAZ: 2 m^3/2 m^3	HAZ: 2 m^3/2 m^3	HAZ: 2 m^3/2 m^3	HAZ: 2 m^3/2 m^3	HAZ: 2 m^3/2 m^3		
Nonhaz (sanitary): 146,000 m^3/ 1,760 m^3	Nonhaz (sanitary): 189,000 m^3/ 1,960 m^3	Nonhaz (sanitary): 86,800 m^3/ 1,720 m^3	Nonhaz (sanitary): 129,500 m^3/ 1,840 m^3	Nonhaz (sanitary): 136,630 m^3/ 1,340 m^3	Nonhaz (sanitary): 195,780 m^3/ -414 m^3		
Nonhaz (other): Included in sanitary/2,200 m^3.	Nonhaz (other): Included in sanitary/2,500 m^3.	Nonhaz (other): Included in sanitary/2,100 m^3.	Nonhaz (other): Included in sanitary/2,300 m^3.	Nonhaz (other): Included in sanitary/1,700 m^3.	Nonhaz (other): Included in sanitary/2,300 m^3.		

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Waste Management (continued)							
This option does not apply to Hanford.	The net increase in generation due to *New Pu and HEU Storage Facility* for liquid/solid would be as follows: TRU: 0.02 m^3/10 m^3 Mixed TRU: 0 m^3/ 4 m^3 LLW: 2.1 m^3/ 1,300 m^3 Mixed LLW: 0.2 m^3/ 66 m^3 Haz: 2 m^3/2 m^3 Nonhaz (sanitary): 153,000 m^3/ 1,900 m^3 Nonhaz (other): Included in sanitary/2,400 m^3.	*This option does not apply to INEL.*	*This option does not apply to Pantex.*	The net increase in generation due to collocation (new Pu and upgrade HEU) of waste liquid/solid would be as follows: TRU: 0.02 m^3/10 m^3 Mixed TRU: 0 m^3/ 4 m^3 LLW: 2 m^3/1,263 m^3 Mixed LLW: 0.2 m^3/ 66 m^3 HAZ: 2 m^3/2 m^3 Nonhaz (sanitary): 136,630 m^3/ 1,370 m^3 Nonhaz (other): 0.8 m^3/1,700 m^3 The net increase in generation due to collocation (new Pu and HEU) for liquid/solid would be as follows: TRU: 0.02 m^3/10 m^3 Mixed TRU: 0 m^3/ 4 m^3 LLW: 1.7m^3/ 1,300 m^3 Mixed LLW: -0.2 m^3/ 66 m^3 HAZ: 2 m^3/2 m^3 Nonhaz (sanitary): 171,840 m^3/ 1,720 m^3 Nonhaz (other): -0.4 m^3/2,200 m^3.	*This option does not apply to SRS.*	*This alternative does not apply to RFETS.*	*This alternative does not apply to LANL.*

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Waste Management (continued) - Not Including Strategic Reserve and Weapons Research and Development Materials Subalternative							
The volume of operational waste would decrease in proportion to the amount of material excluded.							

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Intersite Transportation of Fissile Materials							
Maximum potential fatalities from intersite transportation of Pu and HEU to a consolidated and collocated (*New Pu and HEU Storage Facility*) storage site would be 1.07.	Maximum potential fatalities from intersite transportation of Pu and HEU to a consolidated and collocated (*New Pu and HEU Storage Facility*) storage site would be 0.83 Maximum potential fatalities from intersite transportation of Pu and HEU to a consolidated and collocate (new facility) storage site range from 0 to 0.83.	Maximum potential fatalities from intersite transportation of Pu and HEU to a consolidated and collocated (*New Pu and HEU Storage Facility*) storage site would be 0.87.	Maximum potential fatalities from intersite transportation of Pu and HEU to a consolidated and collocated (*New Pu and HEU Storage Facility*) storage site would be 0.46.	Maximum potential fatalities from intersite transportation of Pu and HEU to a consolidated and collocated (*New Pu and HEU Storage Facility*) storage site would be 0.29. Maximum potential fatalities from intersite transportation of Pu and HEU to a consolidated and collocate (new Pu and upgrade HEU facility) storage site range from 0 to 0.29. Maximum potential fatalities from intersite transportation of Pu and HEU to a consolidated and collocate (new Pu and existing HEU facility) storage site range from 0 to 0.29.	Maximum potential fatalities from intersite transportation of Pu and HEU to a consolidated and collocated (*New Pu and HEU Storage Facility*) storage site would be 0.50.	The risk associated with transport of RFETS materials would have a range between 0.29 and 1.07.	The risk associated with transport of LANL materials would have a range between 0.29 and 1.07.

Table 2.5–2. Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives—Continued

Hanford Site	Nevada Test Site	Idaho National Engineering Laboratory	Pantex Plant	Oak Ridge Reservation	Savannah River Site	Rocky Flats Environmental Technology Site	Los Alamos National Laboratory
Collocation Alternative							
Environmental Justice							
No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations		
Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.	Transportation accidents would be random events along transportation corridors; thus, there would not be any disproportionate impacts to minority or low-income populations.

Table 2.5–3

Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)

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Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)

Pit Disassembly/ Conversion Facility (*Preferred Alternative- Hanford, INEL, Pantex, or SRS*)	Plutonium Conversion Facility (*Preferred Alternative- Hanford or SRS*)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative — Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative — Deep Borehole Complex	Immobilization: Vitrification Alternative (*Preferred Alternative- Hanford or SRS*)[a]	Immobilization: Ceramic Immobilization Alternative (*Preferred Alternative- Hanford or SRS*)[a]
Land Resources						
The facility would disturb 14 ha of land area for construction, of which 12 ha would be used during operation. The operating facility would be located in a 1.6-km (1-mi) buffer zone totaling 1,853 ha.	The facility would disturb 36 ha of land area for construction, of which 28 ha would be used during operation. The operating facility would be located in a 1.6-km (1-mi) buffer zone totaling 1,416 ha.	The facility would disturb 63 ha of land area for construction, of which 57 ha would be used during operation. The operating facility would be located in a 1.6-km (1-mi) buffer zone totaling 2,041 ha.	The facility would disturb 28.3 ha of land area for construction, of which 18.2 ha would be used during operation. The need for buffer zones would be determined during site-specific, tiered NEPA documentation.	The facility would disturb 63 ha of land area for construction, of which 57 ha would be used during operation. The operating facility would be located in a 1.6-km (1-mi) buffer zone totalling 2,041 ha.	The facility would disturb 24 ha of land area for construction, of which 12 ha would be used during operation. The need for buffer zones would be determined during site-specific, tiered NEPA documentation.	The facility would disturb 20 ha of land area for construction, of which 12 ha would be used during operation. The need for buffer zones would be determined during site-specific, tiered NEPA documentation.
The alternative would be consistent with a VRM Class 5 designation.	The alternative would be consistent with a VRM Class 5 designation.	The VRM classification would be determined after the site is selected.	The alternative would be consistent with a VRM Class 5 designation. Construction of the facility could change existing VRM Class 4 designation to Class 5, due to a potential visual impact to roadways with high sensitivity levels.	The VRM classification would be determined after the site is selected.	The alternative would be consistent with a VRM Class 5 designation. Construction of the facility could change existing VRM Class 4 designation to Class 5, due to a potential visual impact to roadways with high sensitivity levels.	The alternative would be consistent with a VRM Class 5 designation. Construction of the facility could change existing VRM 4 designation to Class 5, due to a potential visual impact to roadways with high sensitivity levels.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility** ***(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit)** ***(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Land Resources				
No disturbance or additional land area would be required since an existing facility would be used. As an existing facility, a buffer zone is established.	The facility would disturb 121 ha of land area for construction, of which 81 ha would be used during operation. The operating facility would be located in a 1.6-km (1-mi) buffer zone totalling 890 ha.	No disturbance or additional land area would be required due to the existing conditions. As an existing facility, a buffer zone is established.	No disturbance or additional land area would be required since the reactor is partially completed. The buffer zone is established.	Two-unit large or small facility would disturb 284 ha of land area for construction, of which 138 ha would be used during operation. Buffer zones would be established in accordance with applicable NRC regulations.
The alternative would be consistent with a VRM Class 5 designation.	The alternative would be consistent with a VRM Class 5 designation. Construction of the facility could change existing VRM Class 4 designation to Class 5.	The VRM classification of the developed area would likely be Class 5.	The VRM classification would likely be Class 5.	The alternative would be consistent with a VRM Class 5 designation. Construction of the facility could change existing VRM Class 3 and 4 designations to Class 5. Potential visual impact to roadways with high sensitivity levels could occur.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (Preferred Alternative- Hanford, INEL, Pantex, or SRS)	Plutonium Conversion Facility (Preferred Alternative- Hanford or SRS)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative (Preferred Alternative- Hanford or SRS)[a]	Immobilization: Ceramic Immobilization Alternative (Preferred Alternative- Hanford or SRS)[a]
Site Infrastructure						
Site infrastructure requirements and increase over site availability are as follows:	Site infrastructure requirements and increase over site availability are as follows:	Site infrastructure requirements and increase over site availability are as follows:	Site infrastructure requirements and increase over site availability are as follows:	Site infrastructure requirements and increase over site availability are as follows:	Site infrastructure requirements and increase over site availability are as follows:	Site infrastructure requirements and increase over site availability are as follows:
Construction Requirement (annual): EE: 2,500 MWh PEL: 5 MWe Oil: 126,200 l Gas: 0 m^3	**Construction** Requirement (annual): EE: 1,100 MWh PEL: <1 MWe Oil: 157,850 l Gas: 0 m^3	**Construction** Requirement (annual): EE: 600 MWh Oil: 2,133,000 l Gas: 0 m^3	**Construction** Requirement (annual): EE: 10,200 MWh PEL: 2 MWe Oil: 3,000,000 l Gas: 0 m^3	**Construction** Requirement (annual): EE: 567 MWh Oil: 2,000,000 l Gas: 0 m^3	**Construction** Requirement (annual): EE: 2,000 MWh PEL: 5 MWe Oil: 94,000 l Gas: 0 m^3	**Construction** Requirement (annual): EE: 8,000 MWh PEL: 1.5 MWe Oil: 2,200,000 l Gas: 0 m^3
Range of increase: EE: 0 MWh PEL: 0 MWe Oil: 0 to 126,200 l Gas: 0 m^3	Range of increase: EE: 0 MWh PEL: 0 MWe Oil: 0 to 157,850 l Gas: 0 m^3	Range of increase: EE: 0 MWh Oil: 0 l Gas: 0 m^3	Range of increase: EE: 0 MWh PEL: 0 MWe Oil: 0 to 3,000,000 l Gas: 0 m^3	Range of increase: EE: 0 MWh PEL: 0 MWe Oil: 0 l Gas: 0 m^3	Range of increase: EE: 0 MWh PEL: 0 MWe Oil: 0 to 94,000 l Gas: 0 m^3	Range of increase: EE: 0 MWh PEL: 0 MWe Oil: 0 to 2,200,000 l Gas: 0 m^3

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative-Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Site Infrastructure				
Infrastructure requirement and increase over site availability would be as follows:	Infrastructure requirement and increase over site availability would be as follows:	Infrastructure would be minimal since facility exists. Infrastructure requirement over site availability would be as follows:	There would be no impacts to site infrastructure during construction or operation.	Infrastructure requirement and increase over site availability would be as follows:
Construction: Would be minimal.	**Construction:** Requirement (annual): EE: 833 MWh PEL:1 MWe Oil: 126,180 l Gas: 0 m^3 Range of increase: EE: 0 MWh PEL: 0 to 0.5 MWe Oil: 0 to 126,180 l Gas: 0 m^3.	**Construction:** Would have no impact.	**Construction:** Would be minimal.	**Construction (large or small reactor):** Requirement (annual): EE: 20,000 MWh PEL: 20 MWe Oil: 946,000 l Gas: 0 m^3 Range of increase: EE: 0 MWh PEL: 0 to 7 MWe Oil: 0 to 946,000 l Gas: 0 m^3.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility *(Preferred Alternative- Hanford, INEL, Pantex, or SRS)*	Plutonium Conversion Facility *(Preferred Alternative- Hanford or SRS)*	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative — Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative — Deep Borehole Complex	Immobilization: Vitrification Alternative *(Preferred Alternative- Hanford or SRS)*[a]	Immobilization: Ceramic Immobilization Alternative *(Preferred Alternative- Hanford or SRS)*[a]
Site Infrastructure (continued)						
Operation: Requirement (annual): EE: 20,000 MWh PEL: 5 MWe Oil: 28,000 l Gas: 3,398,000 m^3 Range of Increase: EE: 0 MWh PEL: 0 MWe Oil: 0 to 28,000 l Gas: 0 to 3,398,000 m^3.	**Operation:** Requirement (annual): EE: 21,000 MWh PEL: 5 MWe Oil: 39,750 l Gas: 4,361,000 m^3 Range of Increase: EE: 0 MWh PEL: 0 MWe Oil: 0 to 39,750 l Gas: 0 to 4,361,000 m^3.	**Operation:** Requirement (annual): EE: 6,500 MWh PEL: 2 MWe Oil: 774,400 l Gas: 5,100,000 m^3 Possible Increase: EE: 0 MWh PEL: 0 MWe Oil: 774,100 l Gas: 5,100,000 m^3.	**Operation:** Requirement (annual): EE: 35,000 MWh PEL: 5 MWe Oil: 210,000 l Gas: 3,800,000 m^3 Range of Increase: EE: 0 MWh PEL: 0 MWe Oil: 0 to 210,000 l Gas: 0 to 3,800,000 m^3.	**Operation:** Requirement (annual): EE: 6,100 MWh PEL: 2 MWe Oil: 773,280 l Gas: 4,810,000 m^3 Possible Increase: EE: 0 MWh PEL: 0 MWe Oil: 773,280 l Gas: 4,810,000 m^3.	**Operation:** Requirement (annual): EE: 12,000 MWh PEL: 3 MWe Oil: 378,500 l Gas: 0 m^3 Range of Increase: EE: 0 MWh PEL: 0 MWe Oil: 0 to 378,500 l Gas: 0 m^3.	**Operation:** Requirement (annual): EE: 25,000 MWh PEL: 3 MWe Oil: 190,000 l Gas: 3,500,000 m^3 Range of Increase: EE: 0 MWh PEL: 0 MWe Oil: 0 to 190,000 l Gas: 0 to 3,500,000 m^3.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility** ***(Preferred Alternative-Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit)** ***(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Site Infrastructure (continued)				
Operation: Requirement (annual): EE: 2,400 MWh PEL: 0.008 MWe Oil: 0 l Gas: 0 m^3 Possible increase: EE: 0 MWh PEL: 0 MWe Oil: 0 l Gas: 0 m^3	**Operation:** Requirement (annual): EE: 13,000 MWh PEL: 5 MWe Oil: 20,000 l Gas: 2,350,000 m^3 Range of increase: EE: 0 MWh PEL: 0 to 4.5 MWe Oil: 0 to 20,000 l Gas: 0 to 2,350,000 m^3	**Operation:** Requirement (annual): EE: 700,000 to 1,100,000 MWh PEL: 96 to 140 MWe Oil: 757,000 l Gas: 0 m^3 Possible increase: EE: 0 MWh PEL: 0 MWe Oil: 0 l Gas: 0 m^3	**Operation:** Requirement (annual): EE: 700,000 to 1,100,000 MWh PEL: 96 to 140 MWe Oil: 757,000 l Gas: 0 m^3 Range of increase: EE: 0 MWh PEL: 0 MWe Oil: 0 l Gas: 0 m^3	**Operation (large reactor):** Requirement (annual): EE: 1,100,000 MWh PEL: 140 MWe Oil: 757,000 l Gas: 0 m^3 Range of increase: EE: 0 to 1,048,096 MWh PEL: 0 to 127 MWe Oil: 0 to 757,000 l Gas: 0 m^3 **Operation (small reactor):** Requirement (annual): EE: 580,000 MWh PEL: 75 MWe Oil: 416,000 l Gas: 0 m^3 Range of increase: EE: 0 to 528,096 MWh PEL: 0 to 62 MWe Oil: 0 to 416,000 l Gas: 0 m^3

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (Preferred Alternative-Hanford, INEL, Pantex, or SRS)	Plutonium Conversion Facility (Preferred Alternative-Hanford or SRS)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative (Preferred Alternative-Hanford or SRS)[a]	Immobilization: Ceramic Immobilization Alternative (Preferred Alternative-Hanford or SRS)[a]
Air Quality and Noise						
During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.	During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.	During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.	During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.	During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.	During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.	During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.
During operation, site is expected to comply with ambient air quality standards and guidelines.	During operation, site is expected to comply with ambient air quality standards and guidelines.	During operation, site is expected to comply with ambient air quality standards and guidelines.	During operation, site is expected to comply with ambient air quality standards and guidelines.	During operation, site is expected to comply with ambient air quality standards and guidelines.	During operation, site is expected to comply with ambient air quality standards and guidelines.	During operation, site is expected to comply with ambient air quality standards and guidelines.
No appreciable change in offsite noise levels would occur.	No appreciable change in offsite noise levels would occur.	No appreciable change in offsite noise levels would occur.	No appreciable change in offsite noise levels would occur.	No appreciable change in offsite noise levels would occur.	No appreciable change in offsite noise levels would occur.	No appreciable change in offsite noise levels would occur.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Air Quality and Noise				
During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.	During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.	During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.	During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.	During construction, site is expected to comply with ambient air quality standards and guidelines. However, PM_{10} and TSP concentrations are expected to increase during peak construction period.
During operation, site is expected to comply with ambient air quality standards and guidelines.	During operation, site is expected to comply with ambient air quality standards and guidelines.	During operation, site is expected to comply with ambient air quality standards and guidelines.	During operation, site is expected to comply with ambient air quality standards and guidelines.	During operation, site is expected to comply with ambient air quality standards and guidelines.
No appreciable change in offsite noise levels would occur.	No appreciable change in offsite noise levels would occur.	No appreciable change in offsite noise levels would occur.	No appreciable change in offsite noise levels would occur.	No appreciable change in offsite noise levels would occur.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Deep Borehole			Immobilization	
Pit Disassembly/ Conversion Facility *(Preferred Alternative-Hanford, INEL, Pantex, or SRS)*	**Plutonium Conversion Facility** *(Preferred Alternative-Hanford or SRS)*	**Direct Disposition Alternative**	**Immobilized Disposition Alternative**		**Vitrification Alternative** *(Preferred Alternative-Hanford or SRS)*[a]	**Ceramic Immobilization Alternative** *(Preferred Alternative-Hanford or SRS)*[a]
			Ceramic Immobilization Facility	**Deep Borehole Complex**		
Water Resources						
Facility water requirement and discharge during construction would be as follows: 1.9 MLY and 1.9 MLY, respectively.	Facility water requirement and discharge during construction would be as follows: 2.4 MLY and 2.4 MLY, respectively.	Water requirement and wastewater generation from construction for a generic site would be as follows: Surface water (SW) or Groundwater (GW): 15.1 MLY Wastewater (WW): 12.0 MLY, respectively.	Facility water requirement and discharge during construction would be as follows: 38 MLY and 29.6 MLY, respectively.	Water requirement and wastewater generation from construction for a generic site would be as follows: SW or GW: 15.1 MLY WW:12.0 MLY, respectively.	Facility water requirement and discharge during construction would be as follows: 10.6 MLY and 4.6 MLY, respectively.	Facility water requirement and discharge during construction would be as follows: 38 MLY and 28.8 MLY, respectively.
Water requirement and wastewater generation from construction over No Action would be as follows: SW: 0.01 percent GW: 0.01 to 0.8 percent WW: 0.08 to 2.3 percent.	Water requirement and wastewater generation from construction over No Action would be as follows: SW:.0.02 percent GW: 0.02 to 1.0 percent WW: 0.1 to 2.9 percent.		Water requirement and wastewater generation from construction over No Action would be as follows: SW: 0.3 percent GW: 0.3 to 15.2 percent WW: 1.3 to 36.1 percent.		Water requirement and wastewater generation from construction over No Action would be as follows: SW: 0.07 to 0.08 percent GW: 0.08 to 4.3 percent WW: 0.2 to 5.6 percent.	Water requirement and wastewater generation from construction over No Action would be as follows: SW: 0.3 percent GW: 0.3 to 15.3 percent WW: 1.3 to 35.1 percent.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Water Resources				
Facility water requirement/ wastewater generation during construction would be as follows: 15 MLY/0 MLY.	Facility water requirement/ wastewater generation during construction would be as follows: 1.9 MLY/1.9 MLY.	There would be no impacts to water (surface or groundwater) resources or wastewater.	Facility water requirements generation during construction would be as follows: 220 MLY.	Facility water requirement/ wastewater generation during construction would be as follows: Large: 126 MLY/104 MLY Small: 76 MLY/59 MLY
Water requirement and wastewater generation from construction over No Action would be as follows SW: 0 percent GW: 0.02 percent WW: 0 percent.	Water requirement and wastewater generation from construction over No Action would be as follows: SW: 0.01 percent GW: 0.01 to 0.8 percent WW: 0.08 to 2.3 percent.			Water requirement and wastewater generation from construction over No Action would be as follows: Large Reactor: SW: 0.9 percent GW: 1.0 to 50.6 percent WW: 4.5 to 127 percent Small Reactor: SW: 0.5 to 0.6 percent GW: 0.6 to 30.5 percent WW: 2.6 to 72 percent.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (Preferred Alternative- Hanford, INEL, Pantex, or SRS)	Plutonium Conversion Facility (Preferred Alternative- Hanford or SRS)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative (Preferred Alternative- Hanford or SRS)[a]	Immobilization: Ceramic Immobilization Alternative (Preferred Alternative- Hanford or SRS)[a]
Water Resources (continued)						
Facility water requirement and discharge during operation would be 94.6 MLY and 85.2 MLY, respectively.	Facility water requirement and discharge during operation would be 80.5 MLY and 15 MLY, respectively.		Facility water requirement and discharge during operation would be 320 MLY and 123.9 MLY, respectively.		Facility water requirement and discharge during operation would be 250 MLY and 197 MLY, respectively.	Facility water requirement and discharge during construction would be 250 MLY and 98 MLY, respectively.
Water requirement and wastewater generation from operation over No Action would be as follows:	Water requirement and wastewater generation from operations above No Action levels would be as follows:	Water requirement and wastewater generation from operation for a generic site would be as follows:	Water requirement and wastewater generation from operation over No Action would be as follows:	Water requirement and wastewater generation from operation for a generic site would be as follows:	Water requirement and wastewater generation from operation over No Action would be as follows:	Water requirement and wastewater generation from operation over No Action would be as follows:
SW: 0.6 to 0.7 percent	SW: 0.6 percent	SW: 165.4 MLY	SW:2.2 to 2.4 percent	SW:165.4 MLY	SW: 1.7 to 1.9 percent	SW: 1.7 to 1.9 percent
GW: 0.7 to 38.0 percent	GW: 0.6 to 32.3 percent	GW: 165.4 MLY	GW: 2.4 to 129 percent	GW: 165.4 MLY	GW: 1.9 to 100.4 percent	GW: 1.9 to 100 percent
WW: 3.7 to 103.9 percent.	WW: 0.7 to 18.2 percent.	WW: 17.4 MLY.	WW: 5.4 to 151 percent.	WW: 17.4 MLY.	WW: 8.7 to 240 percent.	WW: 4.3 to 119.5 percent.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative-Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Water Resources (continued)				
Facility water requirement/ wastewater generation during operation would be as follows: 17.4 MLY/0 MLY.	Facility water requirement/ wastewater generation during operation would be as follows: 56.8 MLY/43.5 MLY.	There would be no impacts to water (surface or groundwater) resources or wastewater.	Facility water requirements during operation would be as follows: 69,084 MLY.	Facility water requirement/ wastewater generation during operation would be as follows: (Wet Site) Large: 60,560 MLY/341 MLY Small: 27,252 MLY/189 MLY (Dry Site) Large: 341 MLY/341 MLY Small: 189.3 MLY/189 MLY
Water requirement and wastewater generation from operation over No Action would be as follows: SW: 0 percent GW: 0.04 percent WW: 0 percent.	Water requirement and wastewater generation from operations above No Action levels would be as follows: SW: 0.4 percent GW: 0.4 to 5.1 percent WW: 1.9 to 53 percent.			Water requirement and wastewater generation from operation over No Action would be as follows: Large Reactor: SW: 47.4 to 448 percent GW: 2.6 to 137 percent WW: 15 to 415.9 percent Small Reactor: SW: 21.3 to 202 percent GW: 1.4 to 75.9 percent WW: 8.3 to 230 percent.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility *(Preferred Alternative-Hanford, INEL, Pantex, or SRS)*	Plutonium Conversion Facility *(Preferred Alternative-Hanford or SRS)*	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative *(Preferred Alternative-Hanford or SRS)*[a]	Immobilization: Ceramic Immobilization Alternative *(Preferred Alternative-Hanford or SRS)*[a]
Biological Resources						
Construction would result in the disturbance of 14 ha of terrestrial habitat and affect animal populations on undisturbed land at Hanford, NTS, and INEL. Construction on previously disturbed developed areas at Pantex, ORR and SRS would result in minimal impact.	Construction would result in the disturbance of 36 ha of terrestrial habitat and affect animal populations on undisturbed land at Hanford, NTS, and INEL. Construction on previously disturbed developed areas at Pantex, ORR and SRS would result in minimal impact.	Construction would result in the disturbance of 63 ha of terrestrial habitat and affect animal populations.	Construction would result in the disturbance of 28.3 ha of terrestrial habitat and affect animal populations on undisturbed land at Hanford, NTS, INEL, and ORR. Construction on previously disturbed developed areas at Pantex and SRS would result in minimal impact.	Construction would result in the disturbance of 63 ha of terrestrial habitat and affect animal populations.	Construction would result in the disturbance of 24 ha of terrestrial habitat and affect animal populations on undisturbed land at Hanford, NTS, INEL, and ORR. Construction on previously disturbed developed areas at Pantex and SRS would result in minimal impact.	Construction would result in the disturbance of 20 ha of terrestrial habitat and affect animal populations on undisturbed land at Hanford, NTS, INEL, and ORR. Construction on previously disturbed developed areas at Pantex and SRS would result in minimal impact.
Wetlands and aquatic resources would not be affected, except for possible minor impacts to playas at Pantex during operation.	Wetlands and aquatic resources would not be affected, except for possible minor impacts to playas at Pantex during construction.	In general, direct impacts to wetlands and aquatic resources from construction and operation would not be expected at dry sites.	Wetlands and aquatic resources would not be affected, except for possible minor impacts to playas at Pantex and site streams at ORR.	In general, direct impacts to wetlands and aquatic resources from construction and operation would not be expected at dry sites.	Wetlands and aquatic resources would not be affected, except for possible minor impacts to playas at Pantex and site streams at ORR.	Wetlands and aquatic resources would not be affected, except for possible minor impacts to playas at Pantex and site streams at ORR.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility** ***(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit)** ***(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Biological Resources				
There would be no impact to biological resources since existing facilities would be used and no additional disturbance of land area or habitat would occur.	Construction would disturb 121 ha of terrestrial habitat and affect animal populations on undisturbed land at Hanford, NTS, INEL, ORR, and SRS. Construction on previously disturbed/developed area at Pantex would result in minimal impact.	There would be no impacts to biological resources from use of an existing facility.	There would be minimal impact to terrestrial resources during construction and operation since previously disturbed land would be used.	Construction would disturb 284 ha (two-unit large or small) of terrestrial habitat and affected animal populations.
	Wetlands and aquatic resources would not be affected, except for possible minor impacts to playas at Pantex and several site streams.		During operation, wastewater discharges and salt drift from cooling towers could impact wetlands. Construction may impact wetlands and aquatic species from sedimentation of nearby water bodies. Operation would lead to an increase in impingement, entrainment, and thermal impacts to aquatic organisms.	In general, direct impacts to wetlands and aquatic resources from construction and operation would not be expected at dry sites, except for impacts to playas at Pantex. During operation, impacts to several site rivers, streams, and playas are possible, including increased sedimentation, stream bank scouring, and an increase in impingement, entrainment, and thermal impacts.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (Preferred Alternative- Hanford, INEL, Pantex, or SRS)	Plutonium Conversion Facility (Preferred Alternative- Hanford or SRS)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative (Preferred Alternative- Hanford or SRS)[a]	Immobilization: Ceramic Immobilization Alternative (Preferred Alternative- Hanford or SRS)[a]
Biological Resources (continued)						
One Federal-listed threatened species, the desert tortoise, at NTS may be affected during construction and operation.	One Federal-listed threatened species, the desert tortoise, at NTS maybe affected during construction and operation.	Construction and operation would have the potential to affect threatened and endangered species.	One Federal-listed threatened species, the desert tortoise, at NTS may be affected during construction and operation.	Construction and operation would have the potential to affect threatened and endangered species.	One Federal-listed threatened species, the desert tortoise, at NTS may be affected during construction and operation.	One Federal-listed threatened species, the desert tortoise, at NTS may be affected during construction and operation.
Several State-listed and candidate species at several sites could be affected by the disturbance of breeding, nesting, and foraging habitat.	Several State-listed and candidate species at several sites could be affected by the disturbance of breeding, nesting, and foraging habitat.		Several State-listed and candidate species at several sites could be affected by the disturbance of breeding, nesting, and foraging habitat.		Several State-listed and candidate species at several sites could be affected by the disturbance of breeding, nesting, and foraging habitat.	Several State-listed and candidate species at several sites could be affected by the disturbance of breeding, nesting, and foraging habitat.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative-Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Biological Resources (continued)				
	One Federal-listed threatened species, the desert tortoise, at NTS may be affected during construction and operation.		Threatened and endangered species are unlikely to be impacted by construction activities. Impacts during operation are possible.	One Federal-listed threatened species, the desert tortoise at NTS, may be affected during construction and operation. The smooth purple coneflower at SRS and bald eagle at Pantex may be affected during construction only.
	Several State-listed and candidate species at several sites could be affected by the disturbance of breeding, nesting, and foraging habitat.			Several Federal candidate and State-listed species could be affected by construction activity or by loss of breeding, nesting, and foraging habitat.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (Preferred Alternative- Hanford, INEL, Pantex, or SRS)	Plutonium Conversion Facility (Preferred Alternative- Hanford or SRS)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative (Preferred Alternative- Hanford or SRS)[a]	Immobilization: Ceramic Immobilization Alternative (Preferred Alternative- Hanford or SRS)[a]
Cultural and Paleontological Resources						
Some NRHP-eligible prehistoric and historic resources may exist within the 14 ha that would be disturbed during construction. Operation would not result in additional impact.	Some NRHP-eligible prehistoric and historic resources may exist within the 36 ha that would be disturbed during construction. Operation would not result in additional impact.	Impacts to cultural and paleontological resources could be addressed in tiered NEPA documents.	Some NRHP-eligible prehistoric and historic resources may exist within the 28.3 ha that would be disturbed during construction. Operation would not result in additional impact.	Impacts to cultural and paleontological resources could be addressed in tiered NEPA documents.	Some NRHP-eligible prehistoric and historic resources may exist within the 24 ha that would be disturbed during construction. Operation would not result in additional impact.	Some NRHP-eligible prehistoric and historic resources may exist within the 20 ha that would be disturbed during construction. Operation would not result in additional impact.
Some Native American resources may be affected by construction and operation.	Some Native American resources may be affected by construction and operation.		Some Native American resources may be affected by construction and operation.		Some Native American resources may be affected by construction and operation.	Some Native American resources may be affected by construction and operation.
Some paleontological resources may occur within the acreage to be disturbed.	Some paleontological resources may occur within the acreage to be disturbed.		Some paleontological resources may occur within the acreage to be disturbed.		Some paleontological resources may occur within the acreage to be disturbed.	Some paleontological resources may occur within the acreage to be disturbed.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Cultural and Paleontological Resources				
There would be no impact to NRHP-eligible prehistoric and historic resources.	Some NRHP-eligible prehistoric and historic resources may exist within the 121 ha that would be disturbed during construction.	There would be no impact to NRHP-eligible prehistoric and historic resources.	It is unlikely that prehistoric and historic resources would be affected.	Some NRHP-eligible prehistoric and historic resources may exist within the 284 ha (two-unit large or small) that would be disturbed during construction.
There would be no impact to Native American resources.	Some Native American resources may be affected by construction and operation.	There would be no impact to Native American resources.	Some Native American resources may be affected by operation.	Some Native American resources may be affected by construction and operation.
There would be no impact to paleontological resources.	Some paleontological resources may exist within the acreage to be disturbed.	There would be no impact to paleontological resources.	There would be no impact to paleontological resources.	Some paleontological resources may occur within the acreage to be disturbed.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility *(Preferred Alternative- Hanford, INEL, Pantex, or SRS)*	Plutonium Conversion Facility *(Preferred Alternative- Hanford or SRS)*	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative *(Preferred Alternative- Hanford or SRS)*[a]	Immobilization: Ceramic Immobilization Alternative *(Preferred Alternative- Hanford or SRS)*[a]
Socioeconomics						
Employment for construction would require 185 workers at peak construction and 376 workers annually for life of operations.	Employment for construction would require 358 workers at peak construction and 883 workers annually for the life of operations.	Employment for construction would require 870 workers at peak construction and 342 workers annually for life of operation.	Employment for construction would require 1,000 workers at peak construction and 900 workers annually for life of operation.	Employment for construction would require 810 workers at peak construction and 280 workers annually for life of operation.	Employment for construction would require 382 workers at peak construction and 768 workers annually for life of operation.	Employment for construction would require 1,000 workers at peak construction and 860 workers annually for life of operation.
Employment increases from operation would be about 2 percent.	Employment would increase to a maximum of about 2 percent during operation at some sites.	Indirect jobs created from operations range from 0 to 350.	Employment increases from operation would increase about 2 percent.	Indirect jobs created from operations range from 0 to 350.	Employment increases from operation would be increase almost 2 percent.	Employment increases from operation would be increase about 2 percent.
Changes to local transportation range from no appreciable change to somewhat restricted conditions only during operation. Local transportation would not change appreciably during construction.	Changes to local transportation range from no appreciable change to somewhat restricted conditions only during operation. Local transportation would not change appreciably during construction.	Local transportation should not change appreciably.	Changes to local transportation range from no appreciable change to somewhat restricted conditions during both construction and operation.	Local transportation should not change appreciably.	Changes to local transportation range from no appreciable change to somewhat restricted conditions only during operation. Local transportation would not change appreciably during construction.	Changes to local transportation range from no appreciable change to somewhat restricted conditions during both construction and operation.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility** ***(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit)** ***(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Socioeconomics				
Construction is not required for this alternative. Employment increase would be 83 workers during full operation.	Employment for construction would require 475 workers at peak construction and 500 workers annually for life operations.	Construction is not required for this alternative (direct and indirect jobs).	Employment would increase less than 1 percent during construction. (direct and indirect jobs).	Employment for construction would require 3,500 workers at peak construction and 830 workers annually for life of operations at the larger evolutionary LWR and 500 workers annually for the life of operations at the small evolutionary LWR.
Indirect jobs created from operations are 223.	Employment at representative sites would increase about 1 percent during operation.	Employment increase would be between 40 and 105 total jobs (direct and indirect jobs).	Employment at representative site would increase less than 1 percent during operation (direct and indirect jobs).	During operation, employment would increase by approximately 1 percent.
Local transportation would not be affected.	Local transportation would not change appreciably.	Local transportation would not be affected.	Local transportation may change from free flow to a somewhat restricted condition during both construction and operation.	Changes to local transportation range from somewhat restricted conditions only during construction to somewhat restricted conditions during both construction and operation.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (*Preferred Alternative- Hanford, INEL, Pantex, or SRS*)	Plutonium Conversion Facility (*Preferred Alternative- Hanford or SRS*)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative — Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative — Deep Borehole Complex	Immobilization: Vitrification Alternative (*Preferred Alternative- Hanford or SRS*)[a]	Immobilization: Ceramic Immobilization Alternative (*Preferred Alternative- Hanford or SRS*)[a]
Public and Occupational Health and Safety						
Normal Radiological Impacts						
The annual dose from this facility to the MEI of the public would range from $1.5x10^{-4}$ to $1.4x10^{-2}$ mrem.	The annual dose from this facility to the MEI of the public would range from $9.5x10^{-5}$ to $9.2x10^{-3}$ mrem.	The annual dose from this facility to the MEI of the public at representative sites would range from $2.7x10^{-9}$ to $9.4x10^{-8}$ mrem.	The annual dose from this facility to the MEI of the public at representative sites would range from $1.6x10^{-8}$ to $5.9x10^{-7}$ mrem.	The annual dose from this complex to the MEI of the public at representative sites would range from $3.4x10^{-9}$ to $1.2x10^{-7}$ mrem.	The annual dose from this facility to the MEI of the public at representative sites would range from $7.2x10^{-6}$ to $2.5x10^{-4}$ mrem.	The annual dose from this facility to the MEI of the public at representative sites would range from $1.2x10^{-7}$ to $4.2x10^{-6}$ mrem.
The estimated risk of fatal cancer for the MEI of the public from facility lifetime operations would range from $7.6x10^{-10}$ to $7.0x10^{-8}$.	The estimated risk of fatal cancer for the MEI of the public from facility lifetime operations would range from $4.8x10^{-10}$ to $4.6x10^{-8}$.	The estimated risk of fatal cancer for the MEI of the public from facility lifetime operations would range from $1.4x10^{-14}$ to $4.7x10^{-13}$.	The estimated risk of fatal cancer for the MEI of the public from facility lifetime operations would range from $8.0x10^{-14}$ to $3.0x10^{-12}$.	The estimated risk of fatal cancer for the MEI of the public from facility lifetime operations would range from $1.7x10^{-14}$ to $6.0x10^{-13}$.	The estimated risk of fatal cancer for the MEI of the public from facility lifetime operations would range from $3.6x10^{-11}$ to $1.3x10^{-9}$.	The estimated risk of fatal cancer for the MEI of the public from facility lifetime operations would range from $6.0x10^{-13}$ to $2.1x10^{-11}$.
The annual total dose from this facility to the public within 80 km would range from $2.9x10^{-4}$ to 0.12 person-rem and would result in an estimated $1.5x10^{-6}$ to $6.0x10^{-4}$ fatal cancers from facility lifetime operations.	The annual total dose from this facility to the public within 80 km would range from $1.9x10^{-4}$ to 0.074 person-rem and would result in an estimated $9.5x10^{-7}$ to $3.7x10^{-4}$ fatal cancers from facility lifetime operations.	The annual total dose from this facility to the public within 80 km would range from $5.3x10^{-9}$ to $1.8x10^{-6}$ person-rem and would result in an estimated $2.7x10^{-11}$ to $9.0x10^{-9}$ fatal cancers from facility lifetime operations.	The annual total dose from this facility to the public within 80 km would range from $3.3x10^{-8}$ to $1.2x10^{-5}$ person-rem and would result in an estimated $1.7x10^{-10}$ to $6.0x10^{-8}$ fatal cancers from facility lifetime operations.	The annual total dose from this complex to the public within 80 km would range from $6.6x10^{-9}$ to $2.2x10^{-6}$ person-rem and would result in an estimated $3.3x10^{-11}$ to $1.1x10^{-8}$ fatal cancers from facility lifetime operations.	The annual total dose from this facility to the public within 80 km would range from $1.4x10^{-5}$ to $5.0x10^{-3}$ person-rem and would result in an estimated $7.0x10^{-8}$ to $2.5x10^{-5}$ fatal cancers from facility lifetime operations.	The annual total dose from this facility to the public within 80 km would range from $1.7x10^{-7}$ to $6.7x10^{-5}$ person-rem and would result in an estimated $8.5x10^{-10}$ to $3.4x10^{-7}$ fatal cancers from facility lifetime operations.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Public and Occupational Health and Safety				
Normal Radiological Impacts				
The annual dose from this facility to the MEI of the public would be $7.6x10^{-4}$ mrem. The estimated risk of fatal cancer for the MEI of the public from facility lifetime operations would be $3.8x10^{-9}$.	The annual dose from this facility to the MEI of the public would range from $6.8x10^{-5}$ to 0.015 mrem. The estimated risk of fatal cancer for the MEI of the public from facility lifetime operations would range from $5.8x10^{-10}$ to $1.3x10^{-7}$.	The annual incremental dose from the reactor to the MEI of the public would range from $-1.1x10^{-2}$ to $2.0x10^{-2}$ mrem. The estimated incremental risk of fatal cancer for the MEI of the public from facility lifetime operations would range from $-9.6x10^{-8}$ to $1.7x10^{-7}$.	The annual dose from the reactor to the MEI of the public would be 0.57 mrem. The estimated risk of fatal cancer for the MEI of the public from facility lifetime operations would be $4.9x10^{-6}$.	The range of annual dose from the reactor to the MEI of the public: Large: 0.034 to 4.9 mrem Small: 0.025 to 2.8 mrem The estimated risks of fatal cancer for the MEI of the public from facility lifetime operations: Large: $2.9x10^{-7}$ to $4.1x10^{-5}$ Small: $2.1x10^{-7}$ to $2.4x10^{-5}$.
The annual total dose from this facility to the public within 80 km would be 0.016 person-rem, which would result in an estimated $8.0x10^{-5}$ fatal cancer for the public from facility lifetime operations.	The annual total dose from this facility to the public within 80 km would range from $1.4x10^{-4}$ to 0.14 person-rem, which would result in an estimated $1.2x10^{-6}$ to $1.2x10^{-3}$ fatal cancer for the public from facility lifetime operations.	The annual incremental total dose from the reactor to the public within 80 km would range from -0.046 to 0.20 person-rem, which would result in an estimated $3.8x10^{-3}$ to $1.7x10^{-4}$ incremental fatal cancer for the public from facility lifetime operations.	The annual total dose from the reactor to the public within 80 km would be 0.61 person-rem, which would result in an estimated $5.2x10^{-3}$ fatal cancer for the public from facility lifetime operations.	The range of annual total dose from the reactor to the public within 80 km would be: Large: 0.032 to 32 person-rem Small: 0.022 to 24 person-rem The range of fatal cancer for the total public from facility lifetime operations: Large: $2.7x10^{-4}$ to 0.27 Small: $1.9x10^{-4}$ to 0.21.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (*Preferred Alternative-Hanford, INEL, Pantex, or SRS*)	Plutonium Conversion Facility (*Preferred Alternative-Hanford or SRS*)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative (*Preferred Alternative-Hanford or SRS*)[a]	Immobilization: Ceramic Immobilization Alternative (*Preferred Alternative-Hanford or SRS*)[a]
Public and Occupational Health and Safety (continued)						
Normal Radiological Impacts (continued)						
The average annual dose from this facility to the involved worker would be 200 mrem. The estimated fatal cancer risk for the average involved worker would be 8.0×10^{-4} from facility lifetime operations.	The average annual dose from this facility to the involved worker would be 233 mrem. The estimated fatal cancer risk for the average involved worker would be 9.3×10^{-4} from facility lifetime operations.	The average annual dose from this facility to the involved worker would be 13 mrem. The estimated fatal cancer risk for the average involved worker would be 5.2×10^{-5} from facility lifetime operations (10 years).	The average annual dose from this facility to the involved worker would be 244 mrem. The estimated fatal cancer risk for the average involved worker would be 9.8×10^{-4} from facility lifetime operations.	The average annual dose from this facility to the involved worker would be 13 mrem. The estimated fatal cancer risk for the average involved worker would be 5.2×10^{-5} from facility lifetime operations.	The average annual dose from this facility to the involved worker would be 200 mrem. The estimated fatal cancer risk for the average involved worker would be 8.0×10^{-4} from facility lifetime operations.	The average annual dose from this facility to the involved worker would be 279 mrem. The estimated fatal cancer risk for the average involved worker would be 1.1×10^{-3} from facility lifetime operations.
The annual dose from this facility to the workforce would be 83 person-rem, and the number of fatal cancers from facility lifetime operations would be 0.34.	The annual dose from this facility to the workforce would be 133 person-rem, and the number of fatal cancers from facility lifetime operations would be 0.53.	The annual dose from this facility to the workforce would be 2.7 person-rem, and the number of fatal cancers from facility lifetime operations would be 0.011.	The annual dose from this facility to the workforce would be 110 person-rem, and the number of fatal cancers from facility lifetime operations would be 0.44.	The annual dose from this facility to the workforce would be 2.2 person-rem, and the number of fatal cancers from facility lifetime operations would be 8.8×10^{-3}.	The annual dose from this facility to the workforce would be 110 person-rem, and the number of fatal cancers from facility lifetime operations would be 0.44.	The annual dose from this facility to the workforce would be 120 person-rem, and the number of fatal cancers from facility lifetime operations would be 0.46.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Public and Occupational Health and Safety (continued)				
Normal Radiological Impacts (continued)				
The average annual dose from this facility to the involved worker would be 40 mrem. The estimated fatal cancer risk for the average involved worker would be $1.6x10^{-4}$ from facility lifetime operations.	The average annual dose from this facility to the involved worker would be 250 mrem. The estimated fatal cancer risk for the average involved worker would be $1.7x10^{-3}$ from facility lifetime operations.	The average annual incremental dose from the reactor to the involved worker would range from 1.3 to 2.7 mrem. The estimated incremental fatal cancer risk for the average involved worker would range from $8.0x10^{-6}$ to $1.8x10^{-5}$ from facility lifetime operations.	The average annual dose from the completed reactor to the involved worker would be 360 mrem. The estimated fatal cancer risk for the average involved worker would be $2.4x10^{-3}$ from facility lifetime operations.	The average annual doses to the involved worker would be 810/ 800 mrem for the large/small reactor, respectively. The estimated fatal cancer risk for the average involved worker would be $5.5x10^{-3}$/$5.4x10^{-3}$ for large/ small reactor, respectively, from facility lifetime operations.
The annual dose from this facility to the involved workforce would be 2.9 person-rem, and the estimated number of fatal cancers from facility lifetime operations would be 0.012.	The annual dose from this facility to the involved workforce would be 31 person-rem, and the estimated number of fatal cancers from facility lifetime operations would be 0.21.	The annual incremental dose from this reactor to the involved workforce would be 1.6 person-rem, and the estimated incremental number of fatal cancers from facility lifetime operations would be $1.1x10^{-2}$.	The annual dose from this reactor to the involved workforce would be 380 person-rem, and the estimated number of fatal cancers from facility lifetime operations would be 2.6.	The annual dose from this reactor to the involved workforce would be 170 person-rem for the large reactor and 100 person-rem for the small reactor. The estimated number of fatal cancers from facility lifetime operations would be 1.2 for the large reactor and 0.68 for the small reactor.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (Preferred Alternative- Hanford, INEL, Pantex, or SRS)	Plutonium Conversion Facility (Preferred Alternative- Hanford or SRS)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative (Preferred Alternative- Hanford or SRS)[a]	Immobilization: Ceramic Immobilization Alternative (Preferred Alternative- Hanford or SRS)[a]
Public and Occupational Health and Safety (continued)						
Hazardous Chemical Impacts						
The chemical HI/cancer risk for the MEI of the public would be between $4.0x10^{-6}$/0 and $1.6x10^{-4}$/0.	The chemical HI/cancer risk for the MEI of the public would be between $4.3x10^{-6}$/ $4.7x10^{-9}$ and $6.2x10^{-4}$/ $1.9x10^{-7}$.	The chemical HI/cancer risk for the MEI of the public would be $1.2x10^{-3}$/0.	The chemical HI/cancer risk for the MEI of the public would be between $2.3x10^{-4}$/0 and $9.1x10^{-3}$/0.	The chemical HI/cancer risk for the MEI of the public would be $1.2x10^{-3}$/0.	The chemical HI/cancer risk for the MEI of the public would be between $1.0x10^{-4}$/0 and $3.9x10^{-3}$/0.	The chemical HI/cancer risk for the MEI of the public would be between $3.9x10^{-4}$/0 and $1.5x10^{-2}$/0.
The site worker HI/ cancer risk would be between $2.6x10^{-4}$/0 and $5.3x10^{-4}$/0.	The site worker HI/ cancer risk would be between $8.0x10^{-4}$/ $7.2x10^{-6}$ and $3.3x10^{-3}$/$1.5x10^{-5}$.	The site worker HI/ cancer risk would be 0.29/0.	The site worker HI/ cancer risk would be between $7.2x10^{-2}$/0 and 0.15/0.	The site worker HI/ cancer risk would be 0.28/0.	The site worker HI/ cancer risk would be between $1.9x10^{-2}$/0 and $4.0x10^{-2}$/0.	The site worker HI/ cancer risk would be between $8.1x10^{-2}$/0 and 0.17/0.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility** ***(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit)** ***(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Public and Occupational Health and Safety (continued)				
Hazardous Chemical Impacts				
The chemical HI/cancer risk for the MEI of the public would be $1.8x10^{-6}$/0.	The chemical HI/cancer risk for the MEI of the public would be between $4.9x10^{-6}$/0 and $1.9x10^{-4}$/0.	The chemical HI/cancer risk for the MEI of the public would not change.	The chemical HI/cancer risk for the MEI of the public and site worker would not increase due to construction. Operation impacts would be the same as stated in the Bellefonte Final PEIS (May 1974).	The chemical HI/cancer risk would be as follows: Maximally exposed member of the public would be $2.8x10^{-8}$/0 to $1.1x10^{-6}$/0 for the large reactor and $2.8x10^{-8}$/0 to $1.1x10^{-6}$/0 for the small reactor.
The site worker HI would be $1.6x10^{-5}$/0.	The site worker HI/cancer risk would be between $8.0x10^{-4}$/0 and $1.7x10^{-3}$/0.	The chemical HI/cancer risk for the site worker would not change.		Site worker range would be $7.8x10^{-6}$/0 to $1.6x10^{-5}$/0 for the large reactor and $7.8x10^{-6}$/0 to $1.6x10^{-5}$/0 for the small reactor.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (Preferred Alternative-Hanford, INEL, Pantex, or SRS)	Plutonium Conversion Facility (Preferred Alternative-Hanford or SRS)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative (Preferred Alternative-Hanford or SRS)[a]	Immobilization: Ceramic Immobilization Alternative (Preferred Alternative-Hanford or SRS)[a]
Public and Occupational Health and Safety (continued)						
Facility Accidents						
Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to a worker at 1,000 m from the release point (or at the site boundary if less than 1,000 m) to the MEI of the public located at the site boundary and to the general population residing within 80 km from each site, the maximum and minimum impacts to population and corresponding 10-year facility lifetime risks to population, worker, and MEI of the public would be:	Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to a worker at 1,000 m from the release point (or at the site boundary if less than 1,000 m) to the MEI of the public located at the site boundary and to the general population residing within 80 km from each site, the maximum and minimum impacts to population and corresponding 10-year facility lifetime risks to population, worker, and MEI of the public would be:	Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to a worker at 1,000 m from the release point (or at the site boundary if less than 1,000 m) to the MEI of the public located at the site boundary and to the general population residing within 80 km from the reference site, the range of impacts to population and corresponding 10-year facility lifetime risks to population, worker, and MEI of the public would be:	Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to a worker at 1,000 m from the release point (or at the site boundary if less than 1,000 m) to the MEI of the public located at the site boundary and to the general population residing within 80 km from each site, the maximum and minimum impacts to population and corresponding 10-year facility lifetime risks to population, worker, and MEI of the public would be:	Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to a worker at 1,000 m from the release point (or at the site boundary if less than 1,000 m) to the MEI of the public located at the site boundary and to the general population residing within 80 km from the reference site, the range of impacts to population and corresponding 10-year facility lifetime risks to population, worker, and MEI of the public would be:	Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to a worker at 1,000 m from the release point (or at the site boundary if less than 1,000 m) to the MEI of the public located at the site boundary and to the general population residing within 80 km from each site, the maximum and minimum impacts to population and corresponding 10-year facility lifetime risks to population, worker, and MEI of the public would be:	Based on the estimated impacts from a set of potential accidents that propagate radioactive exposure to a worker at 1,000 m from the release point (or at the site boundary if less than 1,000 m) to the MEI of the public located at the site boundary and to the general population residing within 80 km from each site, the maximum and minimum impacts to population and corresponding 10-year facility lifetime risks to population, worker, and MEI of the public would be:

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Public and Occupational Health and Safety (continued)				
Facility Accidents				
The estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a noninvolved worker at 230 m, the MEI at the site boundary and the general population residing within 80 km from the site; and corresponding to a 10-year facility lifetime risk would be:	The estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker at 1,000 m from the release point or at the site boundary if less than 1,000 m, to the MEI of the public located at the site boundary, and to the general population residing within 80 km from each site; and the maximum and minimum impacts to population and corresponding 17-year facility lifetime risks to population, worker, and MEI of the public would be:	The estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker at 1,000 m from the release point or at the site boundary if less than 1,000 m, to the MEI of the public located at the site boundary, and to the general population residing within 80 km from each site; and the maximum and minimum impacts to population and corresponding 17-year facility lifetime risks to population, worker, and MEI of the public would be:	The estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker at 1,000 m from the release point or at the site boundary if less than 1,000 m, to the MEI of the public located at the site boundary, and to the general population residing within 80 km from each site; and the maximum and minimum impacts to population and corresponding 17-year facility lifetime risks to population, worker, and MEI of the public would be:	The estimated maximum impacts from a set of potential accidents that propagate radioactive exposure to a worker at 1,000 m from the release point, to the MEI of the public located at the site boundary, and to the general population residing within 80 km from each site; and the maximum and minimum impacts to population and corresponding 17-year facility lifetime risks to population, worker, and MEI of the public would be:

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (Preferred Alternative- Hanford, INEL, Pantex, or SRS)	Plutonium Conversion Facility (Preferred Alternative- Hanford or SRS)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative — Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative — Deep Borehole Complex	Immobilization: Vitrification Alternative (Preferred Alternative- Hanford or SRS)[a]	Immobilization: Ceramic Immobilization Alternative (Preferred Alternative- Hanford or SRS)[a]
Public and Occupational Health and Safety (continued)						
Facility Accidents (continued)						
Probability of cancer fatality/risk to: Worker at 1,000 m or at the site boundary if less than 1,000 m: $1.1\times10^{-13}/4.9\times10^{-17}$ to $1.5\times10^{-4}/7.5\times10^{-7}$ (at 772 m)	**Probability of cancer fatality/risk to:** Worker at 1,000 m or at the site boundary if less than 1,000 m: $8.2\times10^{-14}/3.7\times10^{-17}$ to $1.1\times10^{-4}/5.6\times10^{-7}$	**Probability of cancer fatality/risk to:** Worker at 1,000 m or at the site boundary if less than 1,000 m: $2.1\times10^{-14}/2.1\times10^{-16}$ to $1.4\times10^{-5}/1.4\times10^{-9}$	**Probability of cancer fatality/risk to:** Worker at 1,000 m or at the site boundary if less than 1,000 m: $2.3\times10^{-16}/2.3\times10^{-18}$ to $1.4\times10^{-5}/1.4\times10^{-9}$	**Probability of cancer fatality/risk to:** Worker at 1,000 m or at the site boundary if less than 1,000 m: $2.3\times10^{-17}/2.3\times10^{-19}$ to $1.4\times10^{-5}/1.4\times10^{-10}$	**Probability of cancer fatality/risk to:** Worker at 1,000 m or at the site boundary if less than 1,000 m: $6.9\times10^{-13}/6.9\times10^{-15}$ to $6.9\times10^{-6}/6.9\times10^{-8}$	**Probability of cancer fatality/risk to:** Worker at 1,000 m or at the site boundary if less than 1,000 m: $1.5\times10^{-11}/1.5\times10^{-16}$ to $4.2\times10^{-4}/4.2\times10^{-9}$
MEI: $2.7\times10^{-15}/1.2\times10^{-18}$ to $1.9\times10^{-4}/9.3\times10^{-7}$	**MEI:** $2.1\times10^{-15}/9.3\times10^{-19}$ to $1.4\times10^{-4}/7.0\times10^{-7}$	**MEI:** $4.7\times10^{-16}/4.7\times10^{-18}$ to $2.9\times10^{-6}/2.9\times10^{-10}$	**MEI:** $5.7\times10^{-18}/5.7\times10^{-20}$ to $2.9\times10^{-6}/2.9\times10^{-10}$	**MEI:** $5.2\times10^{-19}/5.2\times10^{-21}$ to $2.9\times10^{-6}/2.9\times10^{-11}$	**MEI:** $1.7\times10^{-14}/1.7\times10^{-16}$ to $1.4\times10^{-6}/1.4\times10^{-8}$	**MEI:** $3.5\times10^{-13}/3.5\times10^{-18}$ to $8.6\times10^{-5}/8.6\times10^{-10}$
Population: Number of cancer fatalities/risk: $4.5\times10^{-13}/2.0\times10^{-16}$ to $3.5\times10^{-2}/1.7\times10^{-4}$.	**Population:** Number of cancer fatalities/risk: $3.4\times10^{-13}/1.5\times10^{-16}$ to $2.6\times10^{-2}/1.3\times10^{-4}$.	**Population:** Number of cancer fatalities/risk: $8.4\times10^{-14}/8.4\times10^{-16}$ to $6.3\times10^{-4}/6.3\times10^{-8}$.	**Population:** Number of cancer fatalities/risk: $9.3\times10^{-16}/9.3\times10^{-18}$ to $6.3\times10^{-4}/6.3\times10^{-8}$.	**Population:** Number of cancer fatalities/risk: $9.3\times10^{-17}/9.3\times10^{-19}$ to $6.3\times10^{-4}/6.3\times10^{-9}$.	**Population:** Number of cancer fatalities/risk: $2.8\times10^{-12}/2.8\times10^{-14}$ to $1.8\times10^{-3}/1.8\times10^{-5}$.	**Population:** Number of cancer fatalities/risk: $7.0\times10^{-11}/7.0\times10^{-16}$ to $1.9\times10^{-2}/1.9\times10^{-7}$.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative-Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Public and Occupational Health and Safety (continued)				
Facility Accidents (continued)				
Probability of cancer fatality/ risk to:	**Probability of cancer fatality/ risk to:**	**Probability of cancer fatality/ risk to:**	**Probability of cancer fatality/ risk to:**	**Probability of cancer fatality/ risk to:**
Worker at 1,000 m or at site boundary if less than 1,000 m: $5.2\times10^{-7}/5.2\times10^{-10}$	**Worker at 1,000 m or at site boundary if less than 1,000 m:** $1.1\times10^{-13}/8.1\times10^{-17}$ to $1.4\times10^{-4}/1.3\times10^{-6}$	**Worker at 1,000 m or at site boundary if less than 1,000 m:** $1.0/2.2\times10^{-6}$ to $0.79/1.1\times10^{-4}$ to	**Worker at 1,000 m or at site boundary if less than 1,000 m:** $1.0/2.2\times10^{-6}$ to $0.79/1.1\times10^{-4}$ to	**Worker at 1,000 m or at site boundary if less than 1,000 m:** $2.6\times10^{-7}/4.5\times10^{-11}$ to $2.8\times10^{-2}/6.1\times10^{-8}$
MEI: $3.5\times10^{-8}/3.5\times10^{-11}$	**MEI:** $4.3\times10^{-15}/3.3\times10^{-18}$ to $1.8\times10^{-4}/1.6\times10^{-6}$	**MEI:** $1.0/2.2\times10^{-6}$ to $0.86/1.2\times10^{-4}$	**MEI:** $1.0/2.2\times10^{-6}$ to $0.86/1.2\times10^{-4}$	**MEI:** $6.3\times10^{-9}/1.1\times10^{-12}$ to $3.5\times10^{-2}/7.7\times10^{-8}$
Population: Number of cancer fatalities/risk: $3.7\times10^{-6}/3.7\times10^{-9}$.	**Population:** Number of cancer fatalities/risk: $4.5\times10^{-13}/3.4\times10^{-16}$ to $3.7\times10^{-2}/3.2\times10^{-4}$.	**Population:** Number of cancer fatalities/risk: $7.3\times10^{3}/0.016$ to $5.9\times10^{3}/0.15$.[b]	**Population:** Number of cancer fatalities/risk: $7.3\times10^{3}/0.016$ to $5.9\times10^{3}/0.15$.[b]	**Population:** Number of cancer fatalities/risk: $5.6\times10^{-7}/9.6\times10^{-11}$ to $22/7.9\times10^{-6}$.
		A typical accident scenario where use of MOX fuel would replace UO_2 fuel would increase latent cancer fatalities by up to 8 percent (see Table 4.3.5.2.9–5).	A typical accident scenario where use of MOX fuel would replace UO_2 fuel would increase latent cancer fatalities by up to 8 percent (see Table 4.3.5.2.9–5).	

[b]The accident conditions include the following: (1) a large population near the LWR, and (2) meteorological conditions for dispersal leading to large doses. These conditions would not necessarily be reflective of actual site conditions.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (Preferred Alternative- Hanford, INEL, Pantex, or SRS)	Plutonium Conversion Facility (Preferred Alternative- Hanford or SRS)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative (Preferred Alternative- Hanford or SRS)[a]	Immobilization: Ceramic Immobilization Alternative (Preferred Alternative- Hanford or SRS)[a]
Public and Occupational Health and Safety (continued)						
Facility Accidents (continued) - Preferred Alternative						
The maximum and minimum impacts to population and corresponding 10-year facility lifetime risks to population, worker, and MEI of the public would be:	The maximum and minimum impacts to population and corresponding 10-year facility lifetime risks to population, worker, and MEI of the public would be:	This alternative does not apply to the Preferred Alternative.	This alternative does not apply to the Preferred Alternative.	This alternative does not apply to the Preferred Alternative.	The maximum and minimum impacts to population and corresponding 3.5-year[c] facility lifetime risks to population, worker, and MEI of the public would be:	The maximum and minimum impacts to population and corresponding 3.5-year[c] facility lifetime risks to population, worker, and MEI of the public would be:
Probability of cancer fatality/risk to: Worker at 1,000 m or at the Site Boundary if less than 1,000 m: $1.1\times10^{-13}/4.9\times10^{-17}$ to $1.3\times10^{-4}/6.4\times10^{-7}$	**Probability of cancer fatality/risk to: Worker at 1,000 m or at the Site Boundary if less than 1,000 m:** $1.3\times10^{-13}/6.0\times10^{-17}$ to $9.7\times10^{-5}/4.8\times10^{-7}$				**Probability of cancer fatality/risk to: Worker at 1,000 m or at the Site Boundary if less than 1,000 m:** $1.1\times10^{-12}/3.8\times10^{-15}$ to $6.9\times10^{-6}/2.4\times10^{-8}$	**Probability of cancer fatality/risk to: Worker at 1,000 m or at the Site Boundary if less than 1,000 m:** $2.4\times10^{-11}/8.4\times10^{-17}$ to $4.2\times10^{-4}/1.5\times10^{-9}$
MEI: $2.7\times10^{-15}/1.2\times10^{-18}$ to $5.1\times10^{-6}/2.5\times10^{-8}$	**MEI:** $3.3\times10^{-15}/1.5\times10^{-18}$ to $3.8\times10^{-6}/1.9\times10^{-8}$				**MEI:** $1.7\times10^{-14}/6.0\times10^{-17}$ to $1.1\times10^{-7}/3.8\times10^{-10}$	**MEI:** $3.5\times10^{-13}/1.2\times10^{-18}$ to $6.0\times10^{-6}/2.1\times10^{-11}$
Population: Number of cancer fatalities/risk: $5.9\times10^{-12}/2.7\times10^{-15}$ to $9.9\times10^{-3}/5.0\times10^{-5}$.	**Population:** Number of cancer fatalities/risk: $1.5\times10^{-11}/6.7\times10^{-15}$ to $7.0\times10^{-3}/3.5\times10^{-5}$.				**Population:** Number of cancer fatalities/risk: $3.4\times10^{-6}/4.5\times10^{-13}$ to $8.4\times10^{-4}/2.9\times10^{-6}$.	**Population:** Number of cancer fatalities/risk: $3.2\times10^{-9}/1.1\times10^{-14}$ to $6.1\times10^{-3}/2.1\times10^{-8}$.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

[c] For purpose of analysis, approximately 30 percent surplus Pu would be immobilized, and approximately 70 percent surplus Pu would be used in reactors; therefore, the total duration for the campaign would reduced, resulting in reduced lifetime risks.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility** ***(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit)** ***(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Public and Occupational Health and Safety (continued)				
Facility Accidents (continued) - Preferred Alternative				
This alternative does not apply to the Preferred Alternative.	The maximum and minimum impacts to population and corresponding 11-year[c] facility lifetime risks to population, worker, and MEI of the public would be: **Probability of cancer fatality/ risk to:** **Worker at 1,000 m or at the site boundary if less than 1,000 m:** $1.1\times10^{-13}/5.3\times10^{-17}$ to $1.3\times10^{-4}/7.1\times10^{-7}$ **MEI:** $6.2\times10^{-15}/3.0\times10^{-18}$ to $2.0\times10^{-5}/1.1\times10^{-7}$ **Population:** Number of cancer fatalities/risk: $4.5\times10^{-13}/2.2\times10^{-16}$ to $3.7\times10^{-2}/2.1\times10^{-4}$.	The maximum and minimum impacts to population and corresponding 11-year[c] facility lifetime risks to population, worker, and MEI of the public would be: **Probability of Cancer fatality/ risk to:** **Worker at 1,000 m or at the site boundary if less than 1,000 m:** $1.0 / 1.4\times10^{-6}$ to $0.79 / 7.2\times10^{-5}$ **MEI:** $1.0 / 4.8\times10^{-6}$ to $0.86 / 7.8\times10^{-5}$ **Population:** Number of cancer fatalities/risk: $7.3\times10^{3} / 0.010$ to $5.9\times10^{3} / 0.098$.[b] A typical accident scenario where use of MOX fuel would replace UO_2 fuel would increase latent cancer fatalities by up to 8 percent (see Table 4.5.2.9–5).	This alternative does not apply to the Preferred Alternative.	This alternative does not apply to the Preferred Alternative.

[b] The accident conditions include the following: (1) a large population near the LWR, and (2) meteorological conditions for dispersal leading to large doses. These conditions would not necessarily be reflective of actual site conditions.

[c] For purpose of analysis, approximately 30 percent surplus Pu would be immobilized, and approximately 70 percent surplus Pu would be used in reactors; therefore, the total duration for the campaign would reduced, resulting in reduced lifetime risks.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (*Preferred Alternative- Hanford, INEL, Pantex, or SRS*)	Plutonium Conversion Facility (*Preferred Alternative- Hanford or SRS*)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative — Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative — Deep Borehole Complex	Immobilization: Vitrification Alternative (*Preferred Alternative- Hanford or SRS*)[a]	Immobilization: Ceramic Immobilization Alternative (*Preferred Alternative- Hanford or SRS*)[a]
Waste Management						
The increases in the annual generation of liquid/solid waste over No Action are as follows:	The increases in the annual generation of liquid/solid waste over No Action are as follows:	The increases in the annual generation of liquid/solid waste for a generic site over No Action are as follows:	The increases in the annual generation of liquid/solid waste over No Action are as follows:	The increases in the annual generation of liquid/solid waste for a generic site over No Action are as follows:	The increases in the annual generation of liquid/solid waste over No Action are as follows:	The increases in the annual generation of liquid/solid waste over No Action are as follows:
TRU: 0 m^3/67 m^3	TRU: 3.2 m^3/278 m^3	TRU: 0.2 m^3/0.2 m^3	TRU: 110 m^3/150 m^3	TRU: 0.5 m^3/0.5 m^3	TRU: 0.8 m^3/99 m^3	TRU: 75 m^3/99 m^3
Mixed TRU: 0 m^3/ 4 m^3	Mixed TRU: 0 m^3/ 191 m^3	Mixed TRU: 0 m^3/ 0.04 m^3	Mixed TRU: 0 m^3/ 1.5 m^3	Mixed TRU: 0 m^3/ 0.1 m^3	Mixed TRU: 0 m^3/ 0.7 m^3	Mixed TRU: 0 m^3/ 0.7 m^3
LLW: 4 m^3 /102 m^3	LLW: 56 m^3/1,743 m^3	LLW: 2 m^3/5 m^3	LLW: [10] m^3/23 m^3	LLW: 3 m^3/6 m^3	LLW: 7 m^3/14 m^3	LLW:7 m^3/14 m^3
Mixed LLW: 0.4 m^3/ 1.7 m^3	Mixed LLW: 0.04 m^3/ 191 m^3	Mixed LLW: 0 m^3/0 m^3	Mixed LLW: 0 m^3/ 0.3 m^3	Mixed LLW: 0 m^3/0 m^3	Mixed LLW: 0 m^3 / 0.15 m^3	Mixed LLW: 0 m^3/ 0.15 m^3
HAZ: 2 m^3/0.7 m^3	HAZ: 2 m^3/11 m^3	HAZ: 110 m^3/17 m^3	HAZ: 45 m^3/23 m^3	HAZ: 141 m^3/15 m^3	HAZ: 19 m^3/19 m^3	HAZ: 38 m^3/19 m^3
Nonhaz (sanitary): 85,200 m^3/100 m^3	Nonhaz (sanitary): 15,000 m^3 /2,060 m^3	Nonhaz (sanitary): 10,600 m^3/306 m^3	Nonhaz (sanitary): 43,000 m^3/910 m^3	Nonhaz (sanitary): 9,460 m^3/291 m^3	Nonhaz (sanitary): 34,000 m ^{3}/920 m^3	Nonhaz (sanitary): 34,000 m^3/920 m^3
Nonhaz (other): Included in sanitary/ 3 m^3.	Nonhaz (other): 56 m^3/0 m^3.	Nonhaz (other): 6,800 m^3/1,250 m^3.	Nonhaz (other): 186,900 m^3/15 m^3.	Nonhaz (other): 6,060 m^3/1,250 m^3.	Nonhaz (other): 269,000 m ^{3}/15 m^3.	Nonhaz (other): 170,000 m^3/15 m^3.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative- Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Waste Management				
		Spent nuclear fuel generation would increase approximately 14 t (PWR) and 3 t (BWR).	Spent nuclear fuel generation would increase approximately 22 t to 47 t per reactor.	Spent nuclear fuel generation would increase approximately 38.2 t/ reactor for large (2 reactors) and 17.7 t/reactor for small (4 reactors).
The net increase in the annual generation of liquid/solid waste as a result of electrometallurgical treatment of surplus materials is as follows:	The net increase in the annual generation of liquid/solid waste over No Action is as follows:	There would be no increase in the amount of waste generated.	The range of increase in the annual generation of liquid/solid waste for a representative site over No Action is as follows:	The range of increase in the annual generation of liquid/solid waste over No Action is as follows:
TRU: 0 m^3/6 m^3	TRU: 0 m^3/ 306 m^3	TRU: 0 m^3/0 m^3	TRU: Not generated.	TRU: Not generated.
Mixed TRU: 0 m^3/0.8 m^3	Mixed TRU: 0 m^3/4 m^3	Mixed TRU: 0 m^3/0 m^3	Mixed TRU: Not generated.	Mixed TRU: Not generated.
LLW: 2 m^3/55 m^3	LLW: 4 m^3/153 m^3	LLW: 0 m^3/0 m^3	LLW:18,930 m^3/57-637 m^3	LLW: Large: 18,900 m^3/500 m^3 Small: 2,990 m^3/270 m^3
Mixed LLW: 0 m^3/0.8 m^3	Mixed LLW: 0.8 m^3/38 m^3	Mixed LLW: 0 m^3/0 m^3	Mixed LLW: 0 m^3/102 m^3	Mixed LLW: Large: 0 m^3/5 m^3 Small: 0 m^3/5 m^3
HAZ: 0 m^3/0.8 m^3	HAZ: 4 m^3/153 m^3	HAZ: 0 m^3/0 m^3	HAZ: Included in solid/ 27 m^3	HAZ: Large: Included in solid/ 27 m^3 Small: Included in solid/27 m^3
Nonhaz (sanitary): 1,550 m^3/1,500 m^3	Nonhaz (sanitary): 43,300 m^3/76 m^3	Nonhaz: 0 m^3/0 m^3	Nonhaz (sanitary): 341,000 m^3/5,280 m^3	Nonhaz (sanitary): Large: 23,900,000 (wet site) 342,000 m^3 (dry site)/5,280 m^3 Small: 11,000,000 (wet site) 190,000 (dry site)/3,210 m^3.
Nonhaz (other): 2,990 m^3/0.8 m^3	Nonhaz (other): 227 m^3/84 m^3	Nonhaz (other): 0 m^3/0 m^3	Nonhaz (other): Included in sanitary/4,430 m^3	Nonhaz (other): Large: Included in sanitary/ 4,430 m^3 Small: Included in sanitary/ 2,680 m^3

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility *(Preferred Alternative-Hanford, INEL, Pantex, or SRS)*	Plutonium Conversion Facility *(Preferred Alternative-Hanford or SRS)*	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative *(Preferred Alternative-Hanford or SRS)*[a]	Immobilization: Ceramic Immobilization Alternative *(Preferred Alternative-Hanford or SRS)*[a]
Intersite Transportation[d]						
Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to pit disassembly/ conversion range from 0 to 0.203.	Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to Pu conversion range from 0 to 0.635.	Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to direct disposition alternative through Pu conversion facility range from 0 to 1.18.	Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to ceramic immobilization facility through Pu conversion facility is included in borehole complex.	Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to borehole complex through Pu conversion and ceramic immobilization facilities range from 0 to 2.12.	Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to HLW repository through Pu conversion and vitrification range from 0 to 1.43.	Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to HLW repository through ceramic immobilization range from 0 to 1.43.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

[d] Detailed information is provided in the classified Appendix.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors			
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative-Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**	**CANDU Reactor Alternative**
Intersite Transportation[d]					
Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to electrometallurgical treatment through pit disassembly/conversion and Pu conversion facility range from 0 to 0.923.	Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to MOX fuel fabrication site range from 0 to 0.552.	The potential fatalities from the intersite transportation of Pu from existing storage sites to existing light water reactor through pit disassembly/conversion and Pu conversion including transport of SNF to HLW repository site facility range from 0 to 5.65.	Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to partially completed light water reactor through pit disassembly/conversion and Pu conversion including transport of SNF to HLW repository site range from 0 to 5.65.	Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to evolutionary light water reactor through pit disassembly/conversion and Pu conversion facility including transport of SNF to HLW repository site range from: 0 to 5.65 (large) and 0 to 5.65 (small).	Maximum potential fatalities from the intersite transportation of Pu from existing storage sites to U.S./Canadian border range from 0 to 5.00.

[d] Detailed information is provided in the classified Appendix.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

Pit Disassembly/ Conversion Facility (Preferred Alternative- Hanford, INEL, Pantex, or SRS)	Plutonium Conversion Facility (Preferred Alternative- Hanford or SRS)	Deep Borehole: Direct Disposition Alternative	Deep Borehole: Immobilized Disposition Alternative: Ceramic Immobilization Facility	Deep Borehole: Immobilized Disposition Alternative: Deep Borehole Complex	Immobilization: Vitrification Alternative (Preferred Alternative- Hanford or SRS)[a]	Immobilization: Ceramic Immobilization Alternative (Preferred Alternative- Hanford or SRS)[a]
Environmental Justice						
No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.

Table 2.5–3. Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives (Including the Preferred Alternative)—Continued

		Domestic Reactors		
Electrometallurgical Treatment Alternative	**MOX Fuel Fabrication Facility *(Preferred Alternative-Hanford, INEL, Pantex, or SRS)***	**Existing Light Water Reactors Alternative (per single unit) *(Preferred Alternative)***	**Partially Completed LWR Alternative (per single unit)**	**Evolutionary LWR Alternative (per single unit)**
Environmental Justice				
No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.	No high or adverse impacts from normal operations or accidents that could disproportionately affect minority or low-income populations.

Chapter 3
Affected Environment

3.1 DESCRIPTION OF ENVIRONMENTAL RESOURCES

The affected environment descriptions presented in this chapter provide the context for understanding the environmental consequences described in Chapter 4. As such, they serve as a baseline from which any environmental changes that may be brought about by implementation of the proposed action and alternatives can be identified and evaluated. The DOE sites evaluated include Hanford, NTS, INEL, Pantex, ORR, SRS, RFETS, and LANL. All eight DOE sites were evaluated under the No Action Alternative, and the first six were evaluated for long-term storage and disposition alternatives. Six of the DOE sites were evaluated for various disposition alternatives (for example, evolutionary LWR). The generic sites evaluated include a borehole site, a commercial MOX fuel fabrication facility, an existing LWR, and a partially completed LWR. The natural and human resources, as well as the facility-related resources that may be affected by the proposed action, are grouped into the following interest areas for analysis in this PEIS:

- Land resources
- Site infrastructure
- Air quality and noise
- Water resources
- Geology and soils
- Biological resources
- Cultural and paleontological resources
- Socioeconomics
- Public and occupational health and safety
- Waste management

In addition, the existing conditions and potential environmental impacts of intersite transportation of materials and environmental justice associated with the proposed action are described in Sections 4.4 and 4.5, respectively.

The alternatives defined in Chapter 2 are associated with the long-term storage of weapons-usable fissile materials and disposition of surplus Pu. In addition to these proposed actions, the No Action Alternative has also been assessed.

3.1.1 LAND RESOURCES

Definition of Resources

Land resources comprise all of the terrestrial areas available for economic production, residential or recreational use, governmental activities (for example, energy research facilities), or for natural resource protection. Primary concerns would be caused by changes in land use; conflicts with the objectives of applicable land-use plans, policies, and controls; and the degree of contrast between proposed development and the existing visual landscape. Potential effects to special status lands (for example, prime farmland, wilderness study area, or Wild and Scenic River), if any, are highlighted. The use or development of land resources is subject to regulation and must conform to governmental plans, policies, and controls at Federal, State, and local (regional, county, and municipal) levels.

Land Use. Land may be characterized by its potential for the location of human activities (land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources (biological, geological, cultural, water, and air).

Visual Resources. Visual resources are natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The more visual variety that exists with harmony, the more aesthetically pleasing the landscape.

Approach to Defining Environmental Setting

Land Use. The environmental setting for land resources was defined by first delineating the region of influence (ROI) and then gathering information on land-use patterns and densities pertaining to that area. The land-use ROI for alternatives to be constructed at current DOE installations includes lands within 3.22 km (2 mi) of the DOE sites. Land use associated with alternatives for which site-specific locations have not been identified are described generically, based on existing information about typical locations. Land-use data were obtained from data input reports; reviews of related environmental documents; information supplied by appropriate Federal, State, or local governmental agencies; maps; and photographs.

Visual Resources. Visual resource assessments were based on the Bureau of Land Management (BLM) VRM methodology. Management classes describe the different degrees of modification allowed to the basic elements of the landscape and are used to assess the visual effect of proposed development. Class designations are derived from an inventory of scenic quality, sensitivity levels, and distance zones of a particular area. The elements of scenic quality are landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modification. Scenic value is determined by variety and harmonious composition of the elements of scenic quality. Sensitivity levels are determined by user volumes and user attention. Distance zones concern the relative visibility from travel routes or observation points. Distance zones include the following categories: foreground, 0.0 to 0.8 km (0 to 0.5 mi); middleground, 0.8 to 4.8 km (0.5 to 3 mi); background, 4.8 to 8 km (3 to 5 mi); and seldom seen, 8 km (5 mi) to infinity and areas blocked or screened from view. To determine how the visual resources of the site could be affected, the contrast of proposed development to the existing visual landscape (that is, visual resource inventory) and the sensitivity of viewpoints is analyzed.

The existing landscape at each analyzed site is assigned a VRM classification ranging from 1 to 5. Class 1 would apply to pristine areas, including designated wilderness areas and Wild and Scenic Rivers. Class 2 would apply to areas with very limited land development activity, resulting in contrasts that are seen but do not attract attention. Class 3 would apply to areas where contrasts caused by development activity are evident, but the natural landscape still dominates. Class 4 would apply to areas where contrasts caused by human activities

attract attention and are dominant features of the landscape in terms of scale, but repeat the form, line, color, and texture of the characteristic landscape. Class 5 would apply to areas where contrasts caused by human activities are the dominant feature of the landscape to the point that the natural landscape character no longer exists. For alternatives involving new facilities at non-DOE sites, a generic environmental baseline was developed based on existing resource data from representative sites.

3.1.2 SITE INFRASTRUCTURE

Definition of Resources

Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various alternative actions. The resources described and analyzed in this PEIS include electrical power and electrical load capacity requirements; natural gas, coal, and oil fuel requirements; and transportation networks, including roads and rail access.

Approach to Defining Environmental Setting

For existing DOE sites that may be selected or analyzed for actions under the proposed alternatives, projections of electricity availability, site development plans, and other DOE mid- and long-range planning documents were utilized to describe existing site infrastructure conditions. The ROI for existing DOE sites has been limited to the boundaries of those sites.

Under some of the PEIS alternatives, specific candidate sites are not identified. As a result, no planning documents are available to provide descriptions of the site infrastructure or to establish a detailed baseline from which environmental consequences can be estimated. For these cases, generic environmental baselines based on existing information about typical locations were developed in order to define conditions. For alternatives involving new facilities at non-DOE sites, the ROI is large enough to encompass the non-DOE site and the infrastructure construction to support the new facilities.

3.1.3 AIR QUALITY AND NOISE

Definition of Resources

Air Quality. Air pollution refers to any substance in the air that could harm human or animal populations, vegetation, or structures, or that unreasonably interferes with the comfortable enjoyment of life and property. For the purpose of this document, only outdoor air pollutants are addressed. Pollutants may include almost any natural or artificial compound capable of being airborne. They may be in the form of solid particles, liquid droplets, gases, or in combinations of these forms. Generally, they can be categorized as primary pollutants (those emitted directly from identifiable sources) and secondary pollutants (those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric constituents, with or without photoactivation). Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

Ambient air quality in a given location has been described as the concentration of various pollutants in the atmosphere compared to the corresponding standards. Ambient air quality standards have been established by Federal and State agencies, allowing an adequate margin of safety for protection of public health and welfare from adverse effects associated with pollutants in the ambient air. Pollutant concentrations higher than the corresponding standards are considered unhealthy. Concentrations below the corresponding standards are considered acceptable.

The pollutants of concern are primarily those for which Federal and State ambient air quality standards have been established, including criteria pollutants, hazardous air pollutants, and other toxic air compounds. The criteria pollutants are those defined in 40 Code of Federal Regulations (CFR) 50, *National Primary and Secondary Ambient Air Quality Standards.* The hazardous air pollutants and other toxic compounds are listed in Title III of the 1990 *Clean Air Act* (CAA) as amended through May 1992, those regulated by the National Emissions Standards for Hazardous Air Pollutants (NESHAP), and those that have been proposed or adopted in regulations or are listed in guidelines by the respective States.

Noise. Sound results from the compression and expansion of air or some other medium when an impulse is transmitted through it. Sound requires a source of energy and a medium for transmitting the sound wave. The propagation of sound is affected by various factors, including meteorology, topography, and barriers. Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment.

Sound level measurements recorded to determine effects on humans are compensated by an A-weighted scale that accounts for the hearing response characteristics of the human ear. Sound levels are expressed in decibels (dB), or in the case of A-weighted measurement, decibels A-weighted (dBA). EPA has developed guidelines for noise levels for different land-use classifications. Some States and localities have established noise control regulations or zoning ordinances that specify acceptable noise levels by land-use category. These regulations are discussed in Appendix F for each site.

Approach to Defining Environmental Setting

Air Quality. The ROI for air quality would encompass the area surrounding the candidate site that is potentially affected by air emissions caused by the storage and disposition alternatives. Generally, the air quality impact area would cover a few kilometers downwind from the source. The area of the ROI depends on emission source characteristics, pollutant types, emission rates, and meteorological and topographical conditions. For the purpose of identifying the maximum air quality impacts from the proposed alternatives, an area within 10 km (6 mi) of the emission source has been selected as the impact area to be used in the air quality modeling analysis.

Meteorological and climatological data for each candidate site are obtained from the most recent site-specific environmental reports or *Local Climatological Data, Annual Summaries* produced by the National Oceanic and Atmospheric Administration (NOAA). One year of sequential hourly representative National Weather Service data from National Climatic Data Center or onsite meteorological data from the candidate site were obtained for air modeling analyses.

Areas with air quality better than the National Ambient Air Quality Standards (NAAQS) are designated as being in attainment; areas with air quality worse than the NAAQS are classified as nonattainment areas. Areas may be designated as unclassified when there is a lack of data to form a basis for an attainment status designation. The United States is divided into attainment, nonattainment, and unclassified areas by county, metropolitan statistical area, consolidated metropolitan statistical area, or portions thereof. Air Quality Control Regions (AQCR) designated by EPA are listed in 40 CFR 81, *Designation of Areas for Air Quality Planning Purposes.*

For locations that are in an attainment area, Prevention of Significant Deterioration (PSD) regulations limit pollutant emissions from new sources and establish allowable increments of pollutant levels. Three PSD classifications are designated based on criteria established in the CAA amendments. Class I areas include national wilderness areas, memorial parks larger than 20.2 square kilometers (km^2) (7.8 square miles [mi^2]), and national parks larger than 24.3 km^2 (9.4 mi^2). Class II areas include all areas not designated as Class I. Class III areas, which would allow greater deterioration than Class II areas, have not been designated.

Designation as a nonattainment area triggers control requirements designed to achieve attainment status by specified dates. In addition, facilities that constitute major new emission sources cannot be constructed in a nonattainment area without permits that impose stringent pollution control requirements to ensure progress toward compliance.

Baseline air quality of the affected environment is based on model predicted pollutant concentrations for existing sources at each site using concentrations presented in existing source documents or by modeling recent emissions data. Emissions data for existing sources are based on permit applications, the most recent site-specific environmental reports, or emission inventories.

For the generic environments used to establish a context for comparison of relative impacts from Pu disposition technologies, the assessment of potential air impacts resulting from the implementation of these technology options is not directed to specific locations, but instead to a generic site in the continental United States. For a generic site, no site-specific air pollutant emissions data can be determined. Generic site information pertaining to air quality is described with respect to air quality within the continental United States. Site-specific air quality analyses of applicable disposition alternatives would be addressed in tiered NEPA documentation, as appropriate.

Toxic air pollutants are addressed in both the air quality and noise section and the public and occupational health section for each of the candidate sites. In the air quality section, the maximum concentration of toxic air pollutants at or beyond the site boundary is compared with a Federal, State, or local standard to determine compliance. In the Public and Occupational Health section, a health risk is calculated based upon chemical concentration and toxicity compared to the Reference Concentration (RfC) for the public and the Permissible Exposure Level (PEL) for workers for noncancer causing chemicals and slope factors for the public and workers for cancer causing chemicals. The cancer effects are a risk that is based on the slope factor (cancer potency) for chemicals that are regulated as carcinogens.

These differences in analytical methods result in the different pollutants analyzed between the air quality analysis and the public and occupational health analysis. In the air quality analysis, toxic pollutants with low emission rates in most cases will result in extremely low concentrations at the site boundary and therefore are not presented in the air quality analysis. In the public and occupational health analysis, many of the same chemical pollutants may expose an onsite worker located 100 m (328 ft) from the emission source to a health risk, and therefore are presented in this analysis. The hazardous chemical pollutants used by these two

disciplines to evaluate impacts will be different. Compliance to standards does not consider what health effects are expected nor the interaction between several chemicals that may together cause adverse health responses even if they separately are at below standard concentrations.

Noise. Noise from facility operations and traffic has the potential to affect local human and animal populations. Because most nontraffic noise associated with construction and operation of the proposed facilities is located at sufficient distance from offsite noise-sensitive receptors, the contribution to offsite noise levels is expected to be small. Impacts associated with access routes, including noise from increased traffic, are not analyzed in this document because information that would be needed for such an assessment has not been developed at this programmatic level of analysis. No acoustics-related impacts are anticipated to affect DOE's decision on the proposed facilities. The level of detail describing both the onsite and offsite acoustical environment is presented accordingly.

To provide a context for comparison of these potential acoustical impacts, the existing acoustical environment has been briefly described in terms of existing noise sources, sound level measurements that are available for the ROI, and the range of sound levels that is typical of the land uses in the ROI. The ROI for each of the alternatives includes its site and surrounding areas where related activities might increase noise levels, including transportation corridors in which noise levels could be affected by proposed activities.

In recent years, several DOE sites have compiled sound-level data representative of adjacent areas and transportation routes that serve the site. Where these data are available, they are presented. The *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA-550/9-74-004, March 1974) has identified ranges of sound levels that are typical of various land uses. These ranges of sound levels have been presented for each DOE site. For generic sites, a broad range of sound levels has been identified based on typical land uses adjacent to these types of sites.

3.1.4 WATER RESOURCES

Definition of Resources

Surface Water. Surface water includes marine or freshwater bodies that occur above the ground surface, including rivers, streams, lakes, ponds, rainwater catchments, embayments, and oceans. Surface water quality is characterized by the concentration of inorganic, organic, and biological constituents in surface waters. Surface water bodies are classified based on designated uses that are to be protected (for example, drinking water supply, contact recreation, or cold water fish habitat). Federal, State, and local regulations set standards and criteria that apply to the different classifications. Potable water sources (both surface and groundwater) are regulated by the *Safe Drinking Water Act* (SDWA), while the *Clean Water Act* (CWA) protects the overall quality of the Nation's surface waters. These regulations are summarized in Appendix J.

Groundwater. Groundwater resources are defined as the aquifers underlying the site and their extensions down the hydraulic gradients to, and including, discharge points and the first major users. Groundwater quality, like that of surface water, is characterized by the concentration of its inorganic, organic, and biological constituents. Geology, soils, and the quality of surface water and other sources of aquifer recharge are the main factors affecting groundwater quality.

The quantity of groundwater an aquifer yields is directly related to its geologic properties. In general, the higher the porosity (a measure of void space) and permeability (the interconnectedness of the void space), the greater the aquifer yield. The recharge rate is the rate at which groundwater accumulates in the aquifer and represents the rate at which groundwater can be withdrawn from the aquifer without a net reduction in the quantity of groundwater in storage. Groundwater resources are specifically protected by Federal law under SDWA by the Sole Source Aquifer and Wellhead Protection programs. State and local regulations may provide additional protections, classifications, standards, or criteria.

Approach to Defining Environmental Setting

Surface Water. Surface and groundwater affected by or used in conjunction with site activities define the affected environment in terms of water resources. Surface water resource elements include surface water bodies, flow characteristics, stream classifications, and floodplains.

In support of surface water impact assessment, data obtained from documents (U.S. Geological Survey [USGS] and other Federal Government technical reports and State and local reports and databases) are used to describe major surface water features and to establish current or baseline surface water conditions at the sites. Current surface water usage includes use of surface water or offsite sources (municipal water). The existing water supply was evaluated to determine quantities of available water, capacity of the supplier, and existing water rights, agreements, or allocations. Major stream flows and stream classifications are identified when they are used as a water source or receive effluent discharge from the site. In cases where low flow data are unavailable, average flow data are used.

The water quality of potentially affected receiving waters are determined by reviewing current monitoring data primarily for radiological and nonradiological parameters. Significant known surface water contamination at the site is described. Where applicable, the site NPDES permits are briefly described and the status of compliance with permit limits and requirements is summarized.

One hundred-year floodplains and flooding history of the site, when applicable, are identified at the sites to determine whether areas of the site might be affected by high waters. When possible, the 500-year floodplain is also identified. Specific facility locations will be addressed in tiered environmental analyses, as required.

To define a reasonable generic surface water quality affected environment for alternatives that are not site-specific, a range of existing surface water quality conditions has been presented using water resources data from USGS.

Although baseline surface water quality may be defined by a multitude of parameters, for the purposes of this PEIS the baseline will be defined by those constituents expected to be released or affected by the disposition alternatives. Baseline conditions for parameters such as those regulated under SDWA will provide a basis for evaluating impacts of these alternatives.

Water usage and availability at a generic site are characterized by precipitation. In areas where rainfall is abundant and population is dense, water supply is commonly obtained from local surface water reservoirs and shallow wells. In arid climates, water supply is commonly obtained from deep wells and manmade lakes created by damming major rivers. In humid climates, water supply is generally derived from surface water taken from major waterways. Local constraints include seasonal fluctuations in precipitation, consumption by other facilities using the same water supply, and State regulations, such as the water appropriation permit requirements.

Groundwater. For site-specific analyses, the affected environment discussion includes a description of the potentially affected groundwater basins. The aquifers underlying the site, their extension down the hydraulic gradient to, and including, discharge points, and the first major users are described. The local aquifers are described in terms of the extent, thickness, character of rock formations, recharge and discharge areas, and quality of the groundwater. Aquifers are classified by Federal and State authorities according to use and quality. The Federal classifications include Class I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively. Class III is not considered a potential source of drinking water and is of limited beneficial use. Sole source aquifers are identified when located near a DOE site. When applicable, current groundwater usage at the site is identified. Any allocations, existing water rights, or agreements are briefly described.

Available data on existing groundwater quality conditions are compared to Federal and State groundwater quality standards, effluent limitations, and safe drinking water standards. When applicable, known contaminated groundwater areas at the site are described.

Generic descriptions of groundwater availability are developed based on general water supply characteristics. Overdraft of groundwater occurs when water is withdrawn from sources that cannot be renewed or is withdrawn more quickly than it can be recharged. Several areas of the country are experiencing critical groundwater overdraft more than 1,900 million l/day (500 million gal/day) of overdraft, and have low surface water availability relative to demand (VDL 1990a:725).

Many other areas of the country are experiencing moderate overdrafts of 80 to 1,900 million l/day (21.2 to 500 million gal/day) with moderate-to-low levels of surface water availability relative to demand. Other areas experience no overdraft of groundwater supplies or have an adequate supply of surface water relative to demand. The settlement of inter- and intrastate water rights issues that are ongoing or may occur could cause the potential water availability for an area to change and are discussed as applicable.

3.1.5 GEOLOGY AND SOILS

Definition of Resources

Geology resources are consolidated or unconsolidated earth materials, including mineral assets, such as ore and aggregate materials, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts.

Approach to Defining Environmental Setting

The ROI for geology and soil resources comprises all areas subject to physical disturbance by construction and operational activities associated with an alternative. The exact location of each alternative is not known at this time. Therefore, the ROI may vary from either the area disturbed, for those sites already identified, to the entire site, for those alternatives whose location is unspecified. For alternatives not linked to specific candidate sites, a generic description encompassing a range of likely geologic and soil settings was developed.

The occurrence of geology and soil resources, as well as their status and viability at the various sites proposed, can vary greatly. The geology and soil resources were considered both with respect to the identification of those portions of the resource that could be affected by the alternative and the presence of natural conditions that may affect the alternative. Geology and soil conditions that may affect the integrity and safety of the proposed alternatives are a primary consideration. Specific geologic considerations include seismic activity (vibratory ground motion), volcanism, unique geologic resources, and karst terrain. Specific soil considerations include suitability of soil for construction, soil quality, and erosion.

The physiographic province and geologic setting have been provided for specific sites. For those alternatives that are not site-specific, a range of conditions has been provided. Earthquake potential was evaluated based on the frequency, magnitude, and intensity of past events; the location and distribution of epicenters; and the location of capable faults as defined in 10 CFR 100, Appendix A. The potential for volcanic activities was similarly evaluated. Areas of past mass movements (landslides and other forms of material transport) and conditions favorable for future mass movement were identified, including karst terrains, landslide-susceptible rock and soil materials, and excessive slopes.

Information on the geology and soil resources was derived from the most recent and applicable reports, aerial photographs, and other literature (for example, environmental assessments [EAs], EISs, and facility plans). For those alternatives where the site location has not been identified, information may have been obtained through the following additional sources: DOE; BLM; Bureau of Reclamation, Mineral Management Service; EPA; USGS; and the Soil Conservation Service.

3.1.6 BIOLOGICAL RESOURCES

Definition of Resources

Biological resources are defined as terrestrial and aquatic ecosystems characterized by the presence of native and naturalized flora and fauna. For the purposes of this PEIS, biological resources include terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Although wetlands and threatened and endangered species could be considered as either terrestrial or aquatic resources, they have been identified for separate analysis in this PEIS because of their special regulatory status.

Terrestrial Resources. Terrestrial resources are defined as those plant and animal species and communities that are most closely associated with the land. For the purposes of this PEIS, terrestrial resources include the major plant communities present in a site or region and the vegetation, amphibians, reptiles, birds, and mammals found within them. Scientific names of non-special status species (both terrestrial and aquatic) listed in the text are provided in Appendix K.

Wetlands. Wetlands are defined by the U.S. Army Corps of Engineers (COE) and EPA as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3). Thus, wetlands are delineated based upon the occurrence of characteristic vegetation, soils, and hydrology (USCOE 1987a:13-14).

Aquatic Resources. Aquatic resources are defined as those plant and animal species and communities that are most closely associated with a water environment. For the purposes of this PEIS, aquatic resources include the major habitats present in a site or region and the fish species found within them.

Threatened and Endangered Species. Endangered species are defined under the *Endangered Species Act* (ESA) of 1973 (see Appendix J) as those in danger of extinction throughout all or a large portion of their range. Threatened species are defined as those species likely to become endangered within the foreseeable future. The U.S. Fish and Wildlife Service (USFWS) may designate areas of critical habitat for threatened and endangered species. Critical habitat is defined as specific areas that contain physical and biological features essential to the conservation of species and that may require special management considerations or protection. Species that are Federal proposed or candidates for listing as threatened or endangered species do not receive legal protection under ESA. However, the USFWS recommends that impacts to these species be considered in project planning since their status can be changed to threatened or endangered in the foreseeable future. The USFWS has recently changed the classification of species under review for listing as threatened or endangered (61 FR 7596). Proposed species include those plants and animals for which a proposed rule to list as threatened or endangered has been published. Candidate species include those plants and animals for which the USFWS has on file sufficient information on biological vulnerability and threat to support issuance of a proposed rule for listing as endangered or threatened. Candidate species previously included Category 1 (species appropriate for listing as protected) and Category 2 (species possibly appropriate for listing as protected). Due to the recent rule change, candidate species include only those which are appropriate for listing as protected species (i.e., species formerly listed as Category 1). The Category 2 designation has been omitted. Some of the species previously identified as Federal candidate Category 2 in the Storage and Disposition Draft PEIS also have a State status and continue to be evaluated for potential impacts. However, due to the change in candidate classification described above, many species have been eliminated from proposed site threatened and endangered species lists. At the State level, protected species are classified into a variety of categories, including endangered, threatened, sensitive, protected, in need of management, of concern, monitored, or species of special concern.

Approach to Defining Environmental Setting

Since some alternatives presented in this PEIS are site-specific and others are not, the existing environment is discussed at two levels. Where alternatives are associated with specific sites, such as for the storage alternatives, or an assumed location on a DOE site for a number of disposition facilities, the existing environment of those actual sites is addressed. However, these sites are only described when previously undisturbed areas would be affected. Biological resources addressed include terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Where site locations have not been selected, a more generic discussion is presented. This discussion addresses selected biological resources, including natural habitats (both terrestrial and aquatic), wetlands, threatened and endangered species, and migratory birds. The ROI for site-specific alternatives includes the entire DOE site under consideration, while for non-site-specific alternatives it includes conditions representing various regions of the United States within which the alternative could be located. Data sources used include site-specific studies, as well as regional summaries, as appropriate. Specific data sources include DOE site studies, National Wetland Inventory (NWI) Maps, and USFWS and Natural Heritage Program records on threatened and endangered species.

3.1.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Definition of Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. For this PEIS, cultural resources are separated into prehistoric, historic, and Native American resources. Paleontological resources, although not governed by the same laws on historic preservation, represent a similar type of surface or buried resource that may be affected in the same way as cultural resources. Paleontological resources also will be considered in this section.

Prehistoric Resources. Prehistoric resources are physical properties that remain from human activities that predate written records. These resources generally are identified as either isolated artifacts, sites, or districts. Isolated artifacts may include stone or bone tools, or remains of ceramic pottery. Sites may contain concentrations of artifacts (for example, stone tools and ceramic sherds), features (for example, remains of campfires, residences, or food storage pits), and plant and animal remains. All of these resources can be used to reconstruct life in a region or at a limited location. Depending on their age, complexity, integrity, and relationship to one another, sites may be important for, and capable of, yielding otherwise inaccessible information about past populations.

Historic Resources. Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date no earlier than 1492. Historic resources include architectural structures or districts (for example, religious, commercial, or residential structures, dams, and bridges), archaeological objects, and archaeological features (for example, foundations of mills or residences, trails, and trash dumps). Ordinarily, sites less than 50 years old are not considered historic for analytical purposes, but exceptions can be made for younger properties if they are of exceptional importance, such as structures associated with Cold War themes (36 CFR 60.4).

Native American Resources. Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land-use conflicts. Native American resources can include geological or geographic elements such as mountains or creeks; certain species of plants and animals; cemeteries, battlefields, trails, and pueblos; and archaeological sites.

Paleontological Resources. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age. They include casts, molds, and trace fossils such as burrows or tracks. Fossil localities typically include surface outcrops, areas where subsurface deposits are exposed by ground disturbance, and environments that favor preservation, such as caves, peat bogs, and tar pits. These resources are important because they provide scientific information on paleoenvironments and the evolutionary history of plants and animals.

Approach to Defining Environmental Setting

The ROI for cultural and paleontological resources is bounded in three ways. First, there is the general natural setting. This is the location of the resource within a specific geological and geographical region, which can include significant bodies of water such as rivers or lakes; topography, such as slopes, plains, or mountains; and plants and animals that once inhabited or still inhabit the region. Because this natural region affects the location of a given prehistoric or historic resource and the life of its inhabitants, information regarding it is important for describing cultural or paleontological resources. Second, there are the modern political boundaries of the site. This PEIS includes data based on surveys of cultural and paleontological resources that may include an entire site or may include a portion of a specific site. Finally, and most specifically, there is the area directly affected or disturbed by a proposed alternative during construction or operation, including visual intrusions to the

settings or environmental context, unauthorized artifact collecting, and vandalism. In the cases of prehistoric, historic, and paleontological resources, Federal and State regulations regarding impacts are usually expressed in terms of the last ROI definition. Native American resources affected may also include viewsheds, plant communities, or resources such as mountains that are outside the potentially disturbed acreage, but may still be affected by a proposed alternative. Effects to Native American resources also include visual and audio intrusions to sacred sites and reduced access to traditional use areas. In this PEIS, each of these increasingly focused ROIs is addressed. For generic alternatives where a site is not specified, the ROI is described as a range of potentially affected resources.

Data used to assess the potentially affected cultural or paleontological resources at specific sites include information regarding the historic and prehistoric context of the proposed project area, its geology and paleontological potential, and the possible presence of sites, districts, or objects that may be eligible for listing on the National Register of Historic Places (NRHP) or may be significant to Native American groups. For non-site-specific alternatives, a general description of possible cultural or paleontological resources is presented.

Prehistoric Resources. The affected environment section for prehistoric resources includes a brief overview of the number and types of prehistoric sites in the ROI, if known, and their status on the NRHP. A summary of existing information about prehistoric resources in the ROI is provided, and the types of sites that are likely to occur are discussed.

Historic Resources. The affected environment section for historic resources includes a brief overview of the number and types of historic sites in the ROI, if known, and their status on the NRHP. The overview consists of a summary of existing information about historic resources in the ROI and a discussion of the types of sites that are likely to exist.

Native American Resources. The affected environment section for Native American resources includes a brief overview of the regional Native American groups whose resources may be affected, along with the number and types of sites, use areas, and other resources in the ROI, if known, and their status or significance. A summary of existing information about Native American resources in the ROI is provided, and the type of resources that are likely to exist is discussed.

Paleontological Resources. The affected environment section for paleontological resources includes a description of known paleontological localities and geological formations in the project areas that may be fossil-bearing.

3.1.8 SOCIOECONOMICS

Definition of Resources

Socioeconomics comprises the social, economic, and demographic characteristics of an area. The socioeconomic environment can be affected by changes in employment, income, and population, which, in turn, can affect area resources such as housing, community services, and infrastructure.

The socioeconomic analysis assesses the environmental consequences of demographic and economic changes resulting from proposed alternatives. The study focuses on the potential impacts of a change in the number of workers and their families on the economy, housing availability, community services, and infrastructure. This PEIS assesses health care, education, and public safety as representative indicators of community services. Local transportation is assessed as a representative indicator of community infrastructure. [Text deleted.]

Approach to Defining Environmental Setting

The socioeconomic environment is defined for two geographic regions: the regional economic area (REA) and the ROI. REAs are used to assess potential effects on the regional economy, and ROIs are used to assess effects that are more localized in political jurisdictions surrounding the sites.

The REA for each site encompasses a broad market that involves trade among and between regional industrial and service sectors and is characterized by strong economic linkages between the communities in the region. These linkages determine the nature and magnitude of multiplier effects of economic activity (purchases, earnings, and employment) at each site. REAs are defined by the U.S. Bureau of Economic Analysis (BEA) and consist of an economic node that serves as the center of economic activity and the surrounding counties that are economically related and include the places of work and residences of the labor force.

Potential demographic impacts were assessed for the ROI, a smaller geographic area where the housing market and local community services would be the most affected. Site-specific ROIs were identified as those counties where approximately 90 percent of the current DOE and contractor employees reside. This residential distribution reflects existing commuting patterns and attractiveness of area communities for people employed at each site and is used to estimate the future distribution of in-migrating workers. Impacts from technologies that would be located at an existing DOE site or that have sites identified as representative locations for analysis purposes were assessed using a site-specific ROI. Technology alternatives for which sites have not been identified, such as the deep borehole, were assessed using a more generic approach.

The most recent data available were used in the socioeconomic analyses. Data were obtained from sources such as the U.S. Bureau of the Census, the BEA, the Federal Bureau of Investigation, the American Medical Association, the American Hospital Association, State and local government publications, and telephone interviews with State and local government officials.

Socioeconomic issues and concerns focus primarily on how changes in the regional economy facilitated by construction and operation of a proposed alternative could affect the demographic composition and economic capacity of the host communities. Proposed alternatives could result in increased employment at potential sites, perhaps leading to population increases and associated changes in demand for community resources. The amount of change depends on the construction and operational requirements of the proposed alternatives and the socioeconomic capacity of the communities in the region where these alternatives may be sited.

New employment opportunities could be created in the regions where proposed alternatives would be located. Generally, the proposed alternatives would directly generate new income and jobs in construction, engineering, sciences, management, and support. Indirect income and job opportunities could also be created as a result of these new jobs to support new demand for goods and services generated from construction and operation

activities. These new jobs could be filled by existing available labor in the region, or workers could in-migrate from other areas to fill the jobs. The regions where proposed alternatives are located could benefit economically as a result of an increase in income, and the unemployment rate in the region could fall if new jobs are filled locally.

Increased income and employment opportunities are generally regarded as benefits to many communities. Local businesses gain additional customers, and local governments gain an increase in tax revenues. However, if the attraction of new jobs causes an influx of new workers and their families, this in-migration could overburden the housing market, community services, and infrastructure. Of concern is whether or not communities can absorb this new growth within existing systems or through expansion at a reasonable pace and cost.

The duration of the proposed alternative is an important issue. If the proposed alternative is a large construction effort of short duration with little or no operational employment following, there could be a boom-and-bust effect. Initially, there could be rapid economic expansion and increased demand for housing, community services, and infrastructure. Housing prices may rise, and services and infrastructure may have to be expanded or will become congested beyond capacity. After construction is complete and workers out-migrate to find work elsewhere, unemployment may rise, additional housing vacancies may occur, and expanded community services and infrastructure may be underutilized and more expensive to maintain. Some regions with sophisticated and varied economies can absorb rapid economic expansions and contractions without experiencing significant impacts, but for other communities the boom-and-bust effect could be devastating.

Local transportation discussions characterize the transportation systems in the ROI. The affected environment section describes the locations and general features of the ROI transportation networks, which include road, rail, air, and waterway systems. In addition, current and planned improvements to the road network that will affect access to the site are discussed, as well as public transportation to the site.

General information regarding local transportation modes in the ROI was obtained from local DOT and environmental documents. Roadways to be analyzed for traffic congestion were determined using current employee commuting patterns. Current levels of service designations for these roadways were calculated using information from the DOT, other socioeconomic analyses, and a transportation model designed from the *Highway Capacity Manual #209* equations and factors. This model is used to estimate future baseline No Action projections as well as level of service impacts associated with alternatives.

3.1.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Definition of Resources

Public and occupational health and safety issues include the determination of potentially adverse effects on human health and safety that result from acute and chronic exposures to ionizing radiation and hazardous chemicals. The degree of hazard is directly related to the type and quantity of the particular radioactive or chemical material to which the person is exposed and to the duration of this exposure. For normal operations, the exposures have been converted to potential cancers and/or noncancer effects of an acute or a chronic nature. [Text deleted.]

Approach to Defining Environmental Setting

The current radiological and chemical environments at the various sites considered in this PEIS help characterize the setting and serve as a baseline against which impacts associated with the various alternative actions can be compared. Of particular importance are the radiological and hazardous chemical doses that workers and the public receive from exposures associated with both the natural background and existing site operations. These doses may result in health effects. To characterize each site's operational culture, an accident history is presented, past and ongoing health studies of people who work onsite or live in the vicinity are described, and the site's emergency management program is discussed.

Existing site environmental descriptions originate from a series of environmental and radioactive release reports issued annually by DOE sites or sites licensed by the NRC. These reports present the levels of radioactivity and hazardous chemicals in various environmental media (such as air, water, and vegetation) on the site, in the immediate vicinity of the site, and at various distances from the site boundary out to more than 100 km (62 mi). Radiological and chemical doses to individual members of the public and to population groups (including the total population within 80 km [50 mi] of the site) are also given in these reports. The main source of information used to establish existing health impacts to workers, both individual and collective, is the compilation of occupational exposures issued annually by DOE and NRC. Accident histories and the results of epidemiological studies were obtained from many literature sources, including incidence reports and medical journals.

Several methods were used to determine the environmental setting for generic sites. These included the use of regional or national average background radiological and chemical doses and concentrations, the assumption of radiological and chemical doses and concentrations that have been averaged over a number of representative sites; and the presentation of ranges of values associated with representative sites. For a generic borehole site, the current DOE sites proposed in the PEIS adequately bound normal operational radiological and chemical conditions in terms of population density and meteorological conditions; therefore, for the purposes of a generic analysis of the disposition technologies, ranges of conditions are presented. For a generic commercial reactor site, existing normal radiological impacts for representative commercial reactor sites and releases were determined, and a range of results is presented. For a generic commercial MOX fuel fabrication site, normal radiological impacts for representative commercial fuel fabrication sites and their releases were used to establish the range of conditions.

Toxic air pollutants are addressed in both the Air Quality and Noise section and the Public and Occupational Health and Safety section for each of the sites considered in this PEIS. In the air quality section, the maximum concentration of toxic air pollutants at or beyond the site boundary is compared with a Federal, State, or local standard to determine compliance. In the Public and Occupational Health and Safety section, a health risk is calculated based upon chemical concentration and toxicity compared to the RfC for the public and the PEL for workers for noncancer causing chemicals and slope factors for the public and workers for cancer causing chemicals. The cancer effects are a risk that is based on the slope factor (cancer potency) for chemicals that are regulated as carcinogens.

These differences in analytical method result in the different pollutants between the air quality analysis and the public and occupational health analysis. In the air quality analysis, toxic pollutants with low emission rates in most cases will result in extremely low concentrations at the site boundary and therefore are not presented in the air quality analysis. In the public and occupational health analysis, many of these same chemical pollutants may expose an onsite worker located 100 m (328 ft) from the emission source to a health risk and therefore are presented in this analysis. The hazardous chemical pollutants used by these two resource areas to evaluate impacts will be different. Compliance to standards in air quality does not consider what health effects are expected nor the interaction between several chemicals that may together cause health responses even if they separately are at below standard concentrations.

3.1.10 WASTE MANAGEMENT

Definition of Resources

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. Waste management accepts waste produced by DOE's processing, manufacturing, remediation, D&D, and research activities. The waste is managed using appropriate treatment, storage, and disposal technologies and in compliance with all applicable Federal and State statutes and DOE orders. Appendix E defines the waste categories (high-level, TRU, low-level, mixed, hazardous, and nonhazardous) managed by DOE. Although spent nuclear fuel is not categorized with nuclear waste, it is included in the waste management section of this PEIS, since it is radioactive material that must be stored, managed, and handled. Wastes are generated and categorized by their health hazard and handling requirements. Treated waste is waste that, following generation, has been altered chemically or physically to reduce its toxicity or to prepare it for storage or disposal. Waste treatment can include volume reduction activities, such as incineration or compaction, which may be performed on waste before storage, disposal, or both. Stored waste is waste that, following generation (and usually some treatment), is being retained (temporarily) in a retrievable manner and monitored pending disposal. Disposed waste is waste that has been put in final emplacement to ensure its isolation from the environment and with no intention of retrieval. Deliberate action would be required to regain access to the waste. Disposed wastes include materials placed in a geological repository and buried in landfills.

Approach to Defining Environmental Setting

In order to operate most of its facilities, DOE has entered into numerous agreements with States and EPA to address compliance issues concerning certain aspects of environmental regulatory requirements that have arisen due to either the age of DOE facilities or the uniqueness of DOE operations. For the most part, DOE facilities are in compliance with a major portion of all environmental regulatory requirements, and these compliance agreements address a few specific situations. Appendix E summarizes the applicable Federal statutes and DOE Orders relevant to waste management. In the siting and construction of new facilities, the intent is to meet current regulations; to reach the goal of maximum recycle, minimum waste generation, and no liquid discharges to the surface; and to treat and stabilize unavoidable wastes sufficiently for storage (greater than 90 days) or permanent disposal either onsite or offsite.

Both DOE and the sites maintain waste management databases and publish documents as a reporting mechanism to disclose and gauge progress in meeting environmental regulatory requirements. These databases and reports represent key sources of data that were used for analysis for the waste management resource area. Specific examples include the Waste Management Information System database; the *Integrated Database for U.S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics Report*; and the *Mixed Waste Inventory Report*. Other site-specific documents include Annual Waste Minimization and Generation Reports, Site Treatment Plans, Pollution Prevention and Waste Minimization Awareness Plans, Annual Environmental Reports, and Waste Management Plans.

For the generic borehole site, a pristine condition was assumed. For example, no waste generation activities or waste management facilities exist. The generic fuel fabrication facility was compiled from characteristics based on several existing commercial fuel fabricator facilities.

Site-specific data from existing representative LWRs were used to develop a generic existing LWR site. For the generic partially completed reactor, an approach similar to that used for the generic existing LWR site was taken. However, because completion of construction has been deferred, maintenance and limited engineering design work are the only activities. Therefore, only a description of waste management practices that would go into effect once the reactors are operational is provided.

3.2 HANFORD SITE

Hanford, established in 1943 as one of the three original Manhattan Project sites, is located in the State of Washington just north of Richland (see Figures 2.2.1–1 and 2.2.1–2). Hanford was a U.S. Government nuclear materials production site that included nuclear reactor operation, storage and reprocessing of spent nuclear fuel, and management of radioactive and dangerous wastes. Present Hanford programs are diversified and include management of radioactive wastes, R&D for advanced reactors, renewable energy technologies, waste disposal technologies and cleanup of contamination, and Pu stabilization and storage.

Hanford is owned and used primarily by DOE, but small portions of it are owned, leased, or administered by other government agencies. Public access is limited to travel on the Route 4 and Route 10 access roads as far as the Wye Barricade, Highways 24 and 240, and the Columbia River. By restricting access onsite, the public is buffered from the smaller areas formerly used for production of nuclear materials and currently used for waste storage and disposal. Only about 6 percent of the land area has been disturbed and is actively used, leaving mostly open vacant land with widely scattered facilities. The entire Hanford Site has been designated a National Environmental Research Park (NERP).

Hanford includes extensive production, service, research, and development areas. Onsite programmatic and general-purpose facilities total approximately 799,337 m^2 (8,600,000 ft^2) of space. Fifty-one percent (407,658 m^2 [4,390,000 ft^2]) is general-purpose space, including offices, support laboratories, shops, warehouses, and other support facilities. The remaining 391,679 m^2 (4,216,000 ft^2) of space are programmatic facilities comprising processing, evaporation, filtration, waste recovery, waste treatment, waste storage facilities, and R&D laboratories. More than half of the general-purpose and programmatic facilities are more than 30 years old. Facilities designed to perform previous missions are being evaluated for reuse in the cleanup mission (HF DOE 1993c:2). The existing facilities are grouped into the following numbered operational areas (see Figure 2.2.1–2):

- The 100 Areas, located on the southern shore of the Columbia River, are the site of eight retired Pu production reactors and the dual-purpose N Reactor, all of which have been permanently shut down since 1991. The 100 Areas cover about 1,100 ha (2,720 acres).

- The 200 West and 200 East Areas are located on a plateau and are about 8 and 11 km (5 and 7 mi), respectively, south of the Columbia River. Historically, these areas have been dedicated to fuel reprocessing; Pu processing, fabrication, and storage; and waste management and disposal activities. The 200 Areas cover about 1,600 ha (3,950 acres).

- The 300 Area, located just north of the city of Richland, is the site of nuclear and nonnuclear research and development to include the Pacific Northwest Laboratory (PNL). This area covers 150 ha (370 acres).

- The 400 Area, approximately 8 km (5 mi) northwest of the 300 Area, is the location of the recently shut down FFTF and FMEF. FFTF is an advanced liquid metal-cooled research reactor that was used in the testing of breeder reactor systems. FMEF consists of several connected buildings. The six-level Process Building (427 Building) is the main structure of the FMEF and encloses approximately 17,000 m^2 (183,000 ft^2) of operating area. This building has never been operated and is free of contamination. The exterior walls are reinforced concrete, and the cell walls are constructed of high-density concrete. The facility was designed and constructed for spent fuel examination and was subsequently partially converted for MOX fuel fabrication.

- The 600 Area comprises the remainder of Hanford, which includes most of the undisturbed land and has the following key attributes:

- Fitzner-Eberhardt Arid Lands Ecology Reserve (ALE), set aside for ecological studies
- Living sand dunes
- Cultural/historical facilities and sites
- Hanford Reach free-flowing Columbia River
- Old growth sagebrush/habitat areas
- A patrol training facility
- A low-level radioactive waste disposal site, which is leased by the State of Washington and subleased to a commercial enterprise (U.S. Ecology)
- Washington Public Power Supply System (WPPSS) nuclear power plants
- Waste Sampling and Characterization Facility
- Support facilities and infrastructure (for example, roads, railroads, telecommunications, water treatment and distribution, electrical transmission lines/substations, fire/ambulance, and access control facilities, borrow pits, and a landfill)
- DOE waste disposal sites
- A 260-ha (640-acre) parcel of land transferred to the State of Washington as a potential site for a hazardous waste disposal facility
- Meteorological towers and facilities
- A wildlife refuge under revocable use permit to the USFWS
- A recreational game management area under revocable use permit to the State of Washington Department of Fish and Wildlife
- A gravitational-wave observatory, presently under construction

- The 700 Area is the administrative center in downtown Richland and consists of government-owned buildings (for example, the Federal Building).
- The 1100 and 3000 Areas are support areas located in north Richland. The 1100 Area includes support services such as general stores and transportation maintenance. The 3000 Area is being vacated but still contains some administrative and support facilities.

In addition, there are DOE-leased facilities and DOE contractor privately owned facilities, which support Hanford operations, located on private land south of the 300 Area and outside of the 1100 and 3000 Areas (HF PNL 1994b:5).

Department of Energy Activities. The Hanford mission is to clean up the site, provide scientific and technological excellence to meet global needs, and to partner the economic diversification of the region (HF DOE 1994a:3-6). The current DOE activities that support Hanford's mission are shown in Table 3.2–1. In

the area of waste management, Hanford has embarked on a long-range cleanup program in compliance with the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) and applicable Federal, State, and local laws. DOE has set a goal of cleaning up Hanford's waste sites and bringing its facilities into compliance with Federal, State, and local environmental laws by the year 2028 (HF PNL 1994b:3). In addition, as part of the cleanup mission, DOE has the responsibility to safely store, handle, and stabilize Pu materials and spent fuel.

Table 3.2–1. Current Missions at Hanford Site

Mission	Description	Sponsor
Waste management	Store defense wastes and handle, store, and dispose of radioactive, hazardous, mixed, or sanitary wastes from current operations	Assistant Secretary for Environmental Management
Environmental restoration	Restore approximately 1,100 inactive radioactive, hazardous, and mixed waste sites and about 100 surplus facilities	Assistant Secretary for Environmental Management
Research and development	Conduct research in the fields of energy, health, safety, environmental sciences, molecular sciences, environmental restoration and waste management research and development, and national security activities	Various DOE Program Managers
Technology development	Develop new technologies for environmental restoration and waste management, including site characterization and assessment methods, and waste minimization	Various DOE Program Managers
Economic transition	Use the cleanup and science and technology mission elements to help the community establish a diversified and stable economic base over the long term	Assistant Secretary for Environmental Management

Source: HF DOE 1994a; HF PNL 1994b.

Non-Department of Energy Activities. In addition to the DOE mission-related activities listed in Table 3.2–1, Hanford has some unique and diverse assets and non-DOE missions, such as the following:

- The Fitzner-Eberhardt ALE Reserve, 31,100 ha (76,800 acres), established in 1967, is managed by Battelle Pacific Northwest Laboratory for DOE with assistance from the Nature Conservancy as a habitat and wildlife reserve and nature research center
- The area north of the Columbia River that is managed in part by the Washington State Department of Wildlife as the Wahluke Slope Wildlife Recreation Area and in part by USFWS as Saddle Mountain National Wildlife Refuge
- The Washington Nuclear Plant–2 (WNP–2) 1,100 MWe reactor operated by WPPSS and also the partially completed WNP–1 reactor
- The Laser Interferometer Gravitational-Wave Observatory, operated by the National Science Foundation as one of two widely separated installations (within the United States) that are operated in unison as a single gravitational-wave observatory
- Hanford Meteorological Station and towers
- An observatory and radio telescope facilities located on Rattlesnake Mountain
- The U.S. Ecology commercial low-level radioactive waste disposal site on State-leased lands near the center of Hanford

3.2.1 LAND RESOURCES

Land Use. The discussion of land resources at Hanford includes land use at Hanford and surrounding area. Hanford encompasses approximately 145,000 ha (358,000 acres) of mostly vacant land in the south-central area of the State of Washington. The land area is relatively flat and dominated by grasses and sagebrush. The Columbia River, which flows through the site, is the area's most important geographical feature. [Text deleted.]

Existing Land Use. Existing generalized land uses at Hanford and its vicinity are shown in Figure 3.2.1–1. All land within Hanford is owned by the Federal Government and is administered and controlled by DOE. Land use in the area southeast of Hanford includes residential, commercial, and industrial development in the Tri-Cities area. This area, encompassing the cities of Richland, Kennewick, and Pasco, is the closest population center and has about 107,000 residents. Agriculture is a major land use in the remaining area surrounding Hanford.

Hanford contains a variety of widely dispersed facilities, including old reactors, R&D facilities, the WPPSS nuclear power facility, consisting of the incomplete WNP-1 reactor and the complete WNP-2 reactor, and various production and processing plants within the specialized operational areas described in Section 3.2. As shown in Figure 3.2.1–1, sensitive open space areas include the Fitzner-Eberhardt ALE Reserve, approximately 31,100 ha (76,800 acres) near Rattlesnake Mountain; and two areas north of the Columbia River: the Saddle Mountain National Wildlife Refuge (12,220 ha [30,200 acres]), which is administered by USFWS, and the Wahluke Unit Columbia Basin Wildlife Area (22,260 ha [55,000 acres]), which is managed by the Washington State Department of Fish and Wildlife (HF NPS 1994a:314,315).

Public access to ALE Reserve and Saddle Mountain National Wildlife Refuge is prohibited (HF DOE 1992b:24,34). Other special status lands within the vicinity include McNary National Wildlife Refuge, administered by USFWS, and Columbia River Islands Area of Critical Environmental Concern (ACEC) and McCoy Canyon, both administered by BLM (Figure 2.2.1–2). McNary National Wildlife Refuge and Columbia River Islands ACEC consist of several islands within the Columbia River that are closed to public access for approximately 6 months of the year (HF NPS 1994a:315,316). The U.S. Department of Agriculture, National Resources Conservation Service does not identify prime farmland on Hanford. However, some soil mapping units have the potential to be prime farmland soils if irrigated (WA USDA 1996a:1).

In 1975, DOE designated the entire Hanford Site area as a NERP, an outdoor laboratory for ecological research to study the environmental effects of energy developments. The Hanford NERP is a sagebrush-steppe habitat that contains a wide range of arid land ecosystems and offers the opportunity to examine linkages between terrestrial, subsurface, and aquatic environments on a systems basis (DOE 1985a:1,3). The closest residence is approximately 30 m (98 ft) from the north Hanford boundary. There is also a mobile home park approximately 60 m (197 ft) from the south boundary.

Land-Use Planning. The DOE Richland Operations Office (RL) has undertaken comprehensive land-use planning to define how best to utilize land at Hanford for the next 30 to 40 years. The December 1994 Secretary of Energy Policy requires RL to manage its land and facilities as valuable national resources. The resulting Comprehensive Land-Use Plan (CLUP) will identify existing and planned future land uses with accompanying restrictions, cover a specific timeframe, and be updated as needed. The development and evaluation of the CLUP will be integrated with the upcoming *Hanford Remedial Action Environmental Impact Statement.* Together, these processes will identify land-use cleanup scenarios, create a remediation baseline for the environmental restoration program, and provide a framework for the future management and utilization of land at Hanford.

Private lands bordering Hanford are subject to the planning regulations of Benton, Franklin, and Grant Counties, and the city of Richland. The majority of Hanford, particularly the site area not reserved as a buffer, is situated within Benton County. Benton County and the city of Richland currently have a comprehensive land-use planning process under way, with statutory mandated deadlines under the State of Washington *Growth*

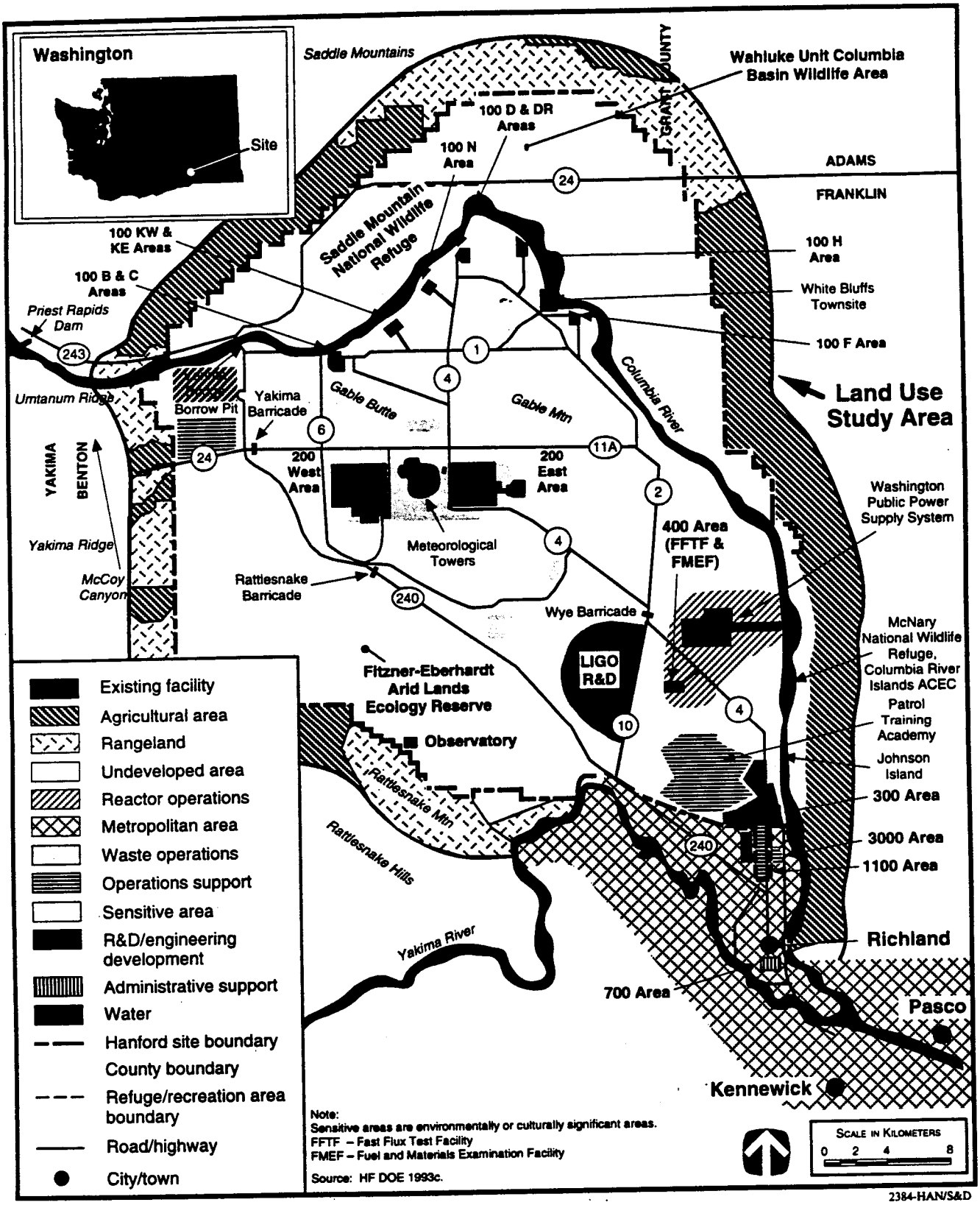


Figure 3.2.1–1. Generalized Land Use at Hanford Site and Vicinity.

Management Act (GMA) of 1990. The GMA requires Benton County and the city of Richland to include portions of Hanford in their plans.

The county and city planning could be carried out independently, without any integration with DOE. This would have a significant potential for overlap and duplication, which would result in public confusion as to how the plans relate to each other. To avoid this, RL's integrated CLUP/HRA-EIS process includes coordinating internal organizational and external involvement activities. Tribal Nations, local cities, counties, and State and Federal agencies are voluntarily and cooperatively participating in the preparation of the CLUP to eliminate duplication of efforts and attempt to identify and resolve conflicts early on. A single integrated Geographical Information System data management system is being used to ensure optimum consistency and compatibility among the end products each government agency is developing. The CLUP is scheduled to be implemented by RL in April 1997, after the ROD from the HRA EIS is issued.

Visual Resources. Hanford is located in the Pasco Basin of the Columbia Plateau north of the city of Richland, which is at the confluence of the Yakima and Columbia Rivers. Site topography ranges from generally flat to gently rolling. In the north-central part of the site, two small east-west ridges, Gable Butte and Gable Mountain, rise approximately 60 m (197 ft) and 180 m (591 ft), respectively, above the surrounding terrain. Rattlesnake Hills, Rattlesnake Mountain, Umtanum Ridge, and Yakima Ridge are located along the southwestern and western site boundaries, and the Saddle Mountains are located along the northern site boundary. The Columbia River flows through the northern part of the site and, turning south, forms part of the eastern site boundary. A 79.7-km (49.5-mi) segment of the Columbia River extending downstream from below Priest Rapids Dam to near Johnson Island (river mile 346.5 to 396) is currently protected and is part of a Proposed Action designating this segment of the Hanford Reach as a Wild and Scenic River (HF NPS 1994a:5,62,311). The Yakima River runs along a small portion of the southern site boundary (Figure 3.2.1–1).

The site is dominated by widely spaced low brush and grasslands, typical of the regional shrub-steppe desert. A large area of unvegetated mobile sand dunes is located along the eastern site boundary, and unvegetated blowouts are scattered throughout the site. Hanford consists mostly of undeveloped land, with widely spaced clusters of industrial buildings located along the southern and western banks of the Columbia River and at several interior locations. The WPPSS nuclear power facility is also located along the west bank of the Columbia River. The adjacent visual landscape consists mainly of rural rangeland and farms; the city of Richland, part of the Tri-Cities area, is the only adjoining urban area. Construction and operation of the DOE and WPPSS facilities have disturbed the character of the landscape within their respective areas. The DOE and WPPSS facilities are brightly lit at night and highly visible from many areas. The plume of steam that rises high into the air at the WPPSS facility is also highly visible from the surrounding area, including portions of the Tri-Cities area. The developed areas of Hanford are consistent with a VRM Class 5 designation. The remainder of the site ranges from a VRM Class 3 to Class 4 designation.

Viewpoints affected by DOE and WPPSS facilities are primarily associated with the public access roadways (including State Highways 24 and 240, Hanford Road, Horn Rapids Road, and Route 4 South/Stevens Drive), the bluffs along the east bank of the Columbia River, and the north edge of the city of Richland. Views of DOE facilities from the surface of the Columbia River are generally blocked by high river banks; however, stack plumes from the WPPSS facility are visible. Because of the semi-arid climate, views can exceed 80 km (50 mi); however, topographic relief provides significant visual screening of the Hanford facilities.

The most sensitive visual areas include the Columbia River, because of its potential designation as a Wild and Scenic River, and the northern part of the city of Richland that borders the site, because of the high-density commercial and residential land use. Route 4 South/Stevens Drive is the only affected public access roadway with high traffic volumes. However, since this route primarily serves the DOE and WPPSS facilities, user sensitivity is low. Although some facilities are visible from the east bank of the Columbia River, densities are low and, in most instances, the viewing distances are great.

3.2.2 SITE INFRASTRUCTURE

Baseline Characteristics. Activities at Hanford are concentrated at facilities in several general areas previously described in Section 3.2. To support these missions, an extensive infrastructure exists. Baseline site infrastructure characteristics are shown in Table 3.2.2–1.

Table 3.2.2–1. Hanford Site Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	420	420
Railroads (km)	204	204
Electrical		
Energy consumption (MWh/yr)	345,500	1,678,700
Peak load (MWe)	58	281
Fuel		
Natural gas (m^3/yr)	459,200	20,804,000
Oil and propane (l/yr)	9,334,800	14,775,000
Coal (t/yr)	41,580	91,708
Steam (kg/hr)	40,847	40,847

Source: HF DOE 1990e.

The site infrastructure provides for transportation of personnel and most material shipments by road. Bulk materials (primarily coal), large equipment, irradiated fuel, and radioactive solid and liquid wastes are transported by rail. High-level and low-level liquid radioactive wastes from past process operations are transported between waste management facilities by encased pipeline. Large barged shipments (decommissioned submarine reactor cores) are routinely offloaded at the Port of Benton dock facility (on the Columbia River in north Richland) and transported to a site disposal facility using special multiwheeled trailers.

Hanford has a network of paved roads. Only 104 km of the 420 km (65 of 261 mi) of these roads are accessible to the public. Hanford is also crossed by State Route 240, which is the main route traveled by the public. Most onsite employee travel is on Route 4, the primary highway from the Tri-Cities to most Hanford outer area work locations. A recently constructed access road between State Route 240 and the 200 West Area has alleviated peak traffic congestion on Route 4. Access to the outer areas (100 and 200 Areas) is controlled by DOE at the Yakima, Wye, and the new Rattlesnake barricades.

Onsite rail transport is provided by a short-line railroad owned by DOE, which controls all access. Hanford's railroad is a Class III Railroad System, as defined by the Federal Railroad Administration. Its common carrier tie is with the Union Pacific Railroad in Richland. A series of maintenance upgrades to the site's main trackage was completed in 1994. The Hanford railroad will continue to support site cleanup in a variety of ways, such as transporting liquid waste, contaminated soils, construction materials, spent nuclear fuel, large equipment, and closure materials.

Electricity, the only regional utility service supplied to Hanford, is provided by the Bonneville Power Administration (BPA). A site electrical transmission and distribution system is used to provide power to the majority of Hanford. The city of Richland distributes power for about 3 percent of the total site usage. Hanford is a Priority Firm customer, and the BPA is contractually obligated to provide as much power as the site requires. Being a Priority Firm customer ensures that, in the event of severe regional power shortages, Hanford (along with other Priority Firm customers) would be the last level of BPA service to be shut off. Power to the BPA grid is dominated by hydropower (more than 70 percent), which provides a typically reliable source of power.

Hydropower is normally more constrained by seasonal variation in peak demand than in meeting momentary peak demand levels. The Northwest Sub-Regional Power Pool capabilities are shown in Table 3.2.2–2.

Natural gas, provided by the Cascade Natural Gas Corporation, is currently used in a few locations on Hanford. Fuel oil and propane are also used in some areas. Coal is currently used to fuel the 200 East Area central steam plant, which also supplies steam to the 200 West Area. The steam system (production and distribution) in the 200 Areas was built in the 1940s, and upgrade and replacement are required to maintain reliability. Natural gas, in conjunction with distributed package boilers, is planned for alternative steam production and heating systems. These improvements are planned for 1996.

Table 3.2.2–2. Northwest Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	34%
Nuclear	3%
Hydro/geothermal	46%
Oil/gas	7%
Other[b]	11%
Total Annual Production	256,404,000 MWh
Total Annual Load	250,045,000 MWh
Energy Exported Annually	6,359,000 MWh
Generating Capacity	49,596 MWe
Peak Demand	33,325 MWe
Capacity Margin[c]	13,655 MWe

[a] Percentages do not total 100 percent due to rounding.

[b] Includes power from both utility and nonutility sources.

[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

The Columbia River is the primary source of raw water for Hanford. The average annual river flow through the site is approximately 203 million l/minute (min) (50 million gal/min). The Export Water System, with a capacity of 124,900 l/min (33,000 gal/min), serves the 200 Areas and most of the shutdown 100 (reactor) Areas. The 100 K East and K West Areas have an independent river source. Wells supply water to the 400 Area and a variety of low-use facilities at remote locations. The administrative and research areas in north Richland are supplied with water by the city of Richland.

Most of the weapons-usable Pu at Hanford is stored in the PFP. The PFP is a group of buildings located in an enhanced security portion of 200 West Area around the 234-5Z Building. The total area (all levels) is approximately 25,000 m^2 (270,000 ft^2), including processing and all service/support space.

The PFP complex includes the following: Pu processing systems in gloveboxes and cells, HVAC systems (some with multiple stages of HEPA filtration), analytical laboratory, developmental laboratory, maintenance shops, administrative offices; security features, and fire suppression systems. Additional services, such as fire protection, medical services, security support, steam, water, and electrical power, are provided to the PFP from site services. [Text deleted.]

The original purpose of the PFP was to convert Pu nitrate into metal ingots and weapons components. The facility is essentially self-sustaining; its process capability is supported by scrap recycle capability, Pu storage, and maintenance/repair facilities. The 234-5Z Building has no identified future missions beyond Pu stabilization

and is programmed for D&D. The newer 2736-Z Pu storage vault and two ancillary structures are located immediately south of the 234-5Z Building and provide 8,224 storage spaces for Pu. This facility will continue to be utilized for Pu storage until new facilities are constructed or the Pu is shipped offsite. Approximately 25 percent of 2736-Z has been dedicated as a vault where Pu material can be stored under IAEA surveillance.

The ROD resulting from the *Plutonium Finishing Plant Stabilization Final Environmental Impact Statement* (DOE/EIS-0244-F) decided to remove Pu material in holdup in the PFP and stabilize the holdup and other Pu-bearing material at the PFP. Following stabilization, Pu will be in a form suitable for interim storage in existing vaults at the PFP Facility. Low Pu content material could be treated to meet WIPP Waste Acceptance Criteria.

Another existing facility complex at Hanford that could be used to store or process Pu is the FMEF. The FMEF consists of several connected buildings located in the 400 Area. The six-level Process Building (427 Building), the main structure of the facility, has an attached single-level mechanical wing on the west side and an emergency power wing at the northwest corner. The Process Building encloses approximately 17,650 m^2 (190,000 ft^2) of operating area and extends from 30 m (100 ft) above grade to about 11 m (36 ft) below grade. This building has never been operated and is free of contamination. The exterior walls are made of reinforced concrete 0.3 m (1.0 ft) thick and the cell walls are constructed of high-density concrete 1.2 m (4.0 ft) thick. Some of the walls within the facility are used as both load-bearing and radiation-shielding walls. In some locations, high-density concrete is used for cell-shielding walls because of specific shielding requirements. The other building within the FMEF complex is a two-level building (4682 Building), which is connected to the south side of the Process Building. The 4682 Building is divided into two portions: (1) the administrative portion known as the entry wing and (2) the shop portion, which was designed to house the Fuel Assembly Area for fabrication of MOX fuel and test assemblies for the FFTF.

3.2.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The climate at Hanford and in the surrounding region is characteristically that of a semiarid steppe. The humidity is low, and winters are mild. The average annual temperature is 11.8 °C (53.3 °F); average monthly temperatures range from a minimum of -1.5 °C (29.3 °F) in January to a maximum of 24.7 °C (76.5 °F) in July. The average annual precipitation is 16.0 cm (6.3 in). The prevailing winds at Hanford are from the northwest. The average annual windspeed is 3.4 m/second (s) (7.6 miles per hour [mph]) (HF PNL 1994b:83-84). Additional information related to meteorology and climatology at Hanford is presented in Appendix F.

Ambient Air Quality. Most of Hanford is located within the South-Central Washington Intrastate Control AQCR (#230) with a small portion of the site being located in the Eastern Washington-Northern Idaho Interstate AQCR (#62). None of the areas within Hanford and its surrounding counties are designated as a nonattainment area (40 CFR 81.348) with respect to NAAQS for criteria pollutants (40 CFR 50). Applicable NAAQS and Washington Ambient Air Quality Standards are presented in Appendix F.

Four PSD (40 CFR 52.21) Class I areas have been designated in the vicinity of Hanford: Goat Rocks Wilderness Area, located 145 km (90 mi) west of the site; Mount Rainier National Park, located 160 km (99 mi) west of the site; Mount Adams Wilderness Area, located 153 km (95 mi) southwest of the site; and Alpine Lakes Wilderness Area, located 177 km (110 mi) northwest of the site.

Since the creation of the PSD program in 1977, permits were obtained for nitrogen dioxide (NO_2) emissions from Pu-uranium extraction and uranium oxide plants located in the 200 Area. The maximum increases in the annual NO_2 concentration at the Hanford boundary were estimated to be negligible (Table 3.2.3-1).

Ambient air quality within and near the Hanford boundary is currently monitored for NO_2 and particulate matter. The ambient air quality data collected during the last few years are either very small percentages of the limits set in applicable ambient standards (sulfur dioxide [SO_2] and carbon monoxide [CO]) or substantially lower than the limits set in applicable ambient standards.

At Hanford, the major sources of criteria air pollutants (pollutants for which a NAAQS has been written including PM_{10}, SO_2, NO_2, CO, ozone [O_3], and lead [Pb]) are coal-burning boilers and fugitive coal piles. Other emissions include other process emissions, vehicular emissions, and temporary emissions from various construction activities. Most of the process emissions at Hanford will have been discontinued, and space heating requirements will be met by burning natural gas by 2005 as reflected in the No Action emissions presented in Appendix F.

Table 3.2.3–1 presents the baseline ambient air concentrations for criteria pollutants and other pollutants of concern at Hanford. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. The major noise sources within Hanford include various facilities, equipment, and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials handling equipment, and vehicles). Data from two noise surveys indicate that background noise levels (measured as 24-hour equivalent sound level) at Hanford range from 30 to 60.5 dBA (Appendix F). The 24-hour background sound level at undeveloped areas at Hanford ranges from 24 to 36 dBA, except when high winds elevate sound levels (HF PNL 1994a:4.145). The primary source of noise at the site and nearby residences is traffic. Most Hanford industrial facilities are at a sufficient distance from the site boundary that noise levels at the boundary from these sources are not measurable or are barely distinguishable from background noise levels.

The State of Washington has established noise standards for different source and receptor areas. Hanford belongs to source area Class C (industrial). The maximum allowable noise level for residential, commercial, and

Table 3.2.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Hanford Site, 1994

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000[b]	0.7
	1-hour	40,000[b]	2.6
Lead	Calendar Quarter	1.5[b]	<0.01
	24-hour	0.5[c]	<0.01
Nitrogen dioxide	Annual	100[b]	0.2
Ozone	1-hour	235[b]	[d]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	0.01
	24-hour	150[b]	0.1
Sulfur dioxide	Annual	52[c]	0.8
	24-hour	260[c]	6.6
	3-hour	1,300[b]	22.9
	1-hour	1,018[c]	47.9
	1-hour	655[c,e]	47.9
Mandated by the State of Washington			
Gaseous fluoride	30-day	0.8[c]	[f]
	7-day	1.7[c]	[f]
	24-hour	2.9[c]	[f]
	12-hour	3.7[c]	[f]
Total suspended particulates	Annual	60[c]	0.01
	24-hour	150[c]	0.1
Hazardous and Other Toxic Compounds			
Arsenic	Annual	0.00023[c,g]	0.00019
Cadmium	Annual	0.00056[c,g]	0.00008
Chromium	24-hour	1.7[c,g]	0.0029
Copper	24-hour	3.3[c,g]	0.0018
Formaldehyde	Annual	0.077[c,g]	0.00017
Manganese	24-hour	0.4[c,g]	0.0040
Nickel	Annual	0.0021[c,g]	0.00097
Polycyclic organic matter	24-hour	[h]	0.19
Selenium	24-hour	0.67[c,g]	0.00036
Vanadium	24-hour	0.17[c,g]	0.010

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging time.

[b] Federal and State standard.

[c] State standard.

[d] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[e] The standard is not to be exceeded more than twice in any seven consecutive days.

[f] No sources of the pollutant have been identified.

[g] Risk-based acceptable source impact levels.

[h] No State standard for indicated averaging time.

Source: 40 CFR 50; HF 1995a:1; WA Ecology 1994a.

industrial receptor areas is 50 to 70 dBA (Appendix F). Hanford is currently in compliance with State and Federal noise regulations.

3.2.4 WATER RESOURCES

Surface Water. Major surface water features at Hanford are the Columbia River (northern and eastern sections), the Yakima River, springs along the Columbia River and on Rattlesnake Mountain, and onsite ponds (Figure 3.2.4–1).

The flow of the Columbia River is regulated by 11 dams within the United States, 7 upstream and 4 downstream of the site (HF PNL 1994a:4.40). Located approximately 10 km (6.2 mi) upstream of Hanford, the Priest Rapids Dam is the nearest dam, while McNary is the nearest dam downstream (80 km [50 mi]). The portion of the Columbia River between these dams is referred to as the Hanford Reach. Flows through the Hanford Reach fluctuate significantly and are controlled primarily by operations at Priest Rapids Dam. The annual average flow rate in the vicinity of Priest Rapids Dam is approximately 3,360 cubic meters (m^3)/s (118,642 cubic feet [ft^3]/s) (HF PNL 1994a:4.40).

The Yakima River, bordering a short length of the southern portion of Hanford, has a low annual flow rate compared to the Columbia River (HF PNL 1994a:4.42). The average annual flow rate is about 104 m^3/s (3,673 ft^3/s). Approximately one-third of Hanford is drained by the Yakima River System.

Rattlesnake Springs and Snively Springs, located on the western part of Hanford, form small surface streams. Rattlesnake Springs flows for about 3 km (1.9 mi) before disappearing into the ground (Figure 3.2.4–1). Cold Creek and its tributary, Dry Creek, are ephemeral streams located in the southern portion of Hanford (HF PNL 1994a:4.42). These streams drain areas to the west of Hanford and cross the southwestern part of the site toward the Yakima River. Surface flow, when it occurs, infiltrates rapidly and disappears into the surface sediments in the western part of the site.

The primary uses of the Columbia River include the production of hydroelectric power, transportation, and extensive irrigation in the Mid-Columbia Basin (HF PNL 1994a:4.40). Another principle use of the river is by the fishery industry. Several communities located along the Columbia River rely on the river as their source of drinking water and for recreational purposes. Water from the Columbia River along the Hanford Reach is also used as a source of drinking water by several onsite facilities and for industrial uses.

Large Columbia River floods have occurred in the past, but the likelihood of recurrence of large-scale flooding has been reduced by the construction of several flood-control and water-storage dams upstream of the site (HF PNL 1994a:4.42). Major floods on the Columbia River are typically the result of rapid melting of the winter snowpack over a wide area augmented by above-normal precipitation. The largest flood on record occurred June 7, 1894, with a peak discharge at Hanford of 21,000 m^3/s (741,615 ft^3/s). The floodplain associated with the 1894 flood was limited to within approximately 3 km (1.9 mi) of the banks of the river. The largest recent flood took place in 1948, with an observed peak discharge of 20,000 m^3/s (706,300 ft^3/s) at Hanford. The probability of flooding at the magnitude of the 1894 and 1948 floods has been greatly reduced because of upstream regulation by dams (HF PNL 1994a:4.42).

Major flooding of the Yakima River, which has occurred several times this century, could extend into a small portion of the southern section of Hanford, but the upstream Yakima River is physically separated from Hanford by Rattlesnake Mountain, which would prevent major flooding on Hanford (HF PNL 1994a:4.43). There are no Federal Emergency Management Agency (FEMA) floodplain maps for the Hanford Reach of the Columbia River. FEMA only maps developing areas, and the Hanford Reach is specifically excluded.

Surface Water Quality. The State of Washington has classified the stretch of the Columbia River from Grand Coulee to the Washington-Oregon border, which includes the Hanford Reach, as Class A, excellent raw drinking water, recreation area, and wildlife habitat. The Columbia River is currently in compliance with applicable State and Federal drinking water standards (HF PNL 1994a:4.58).

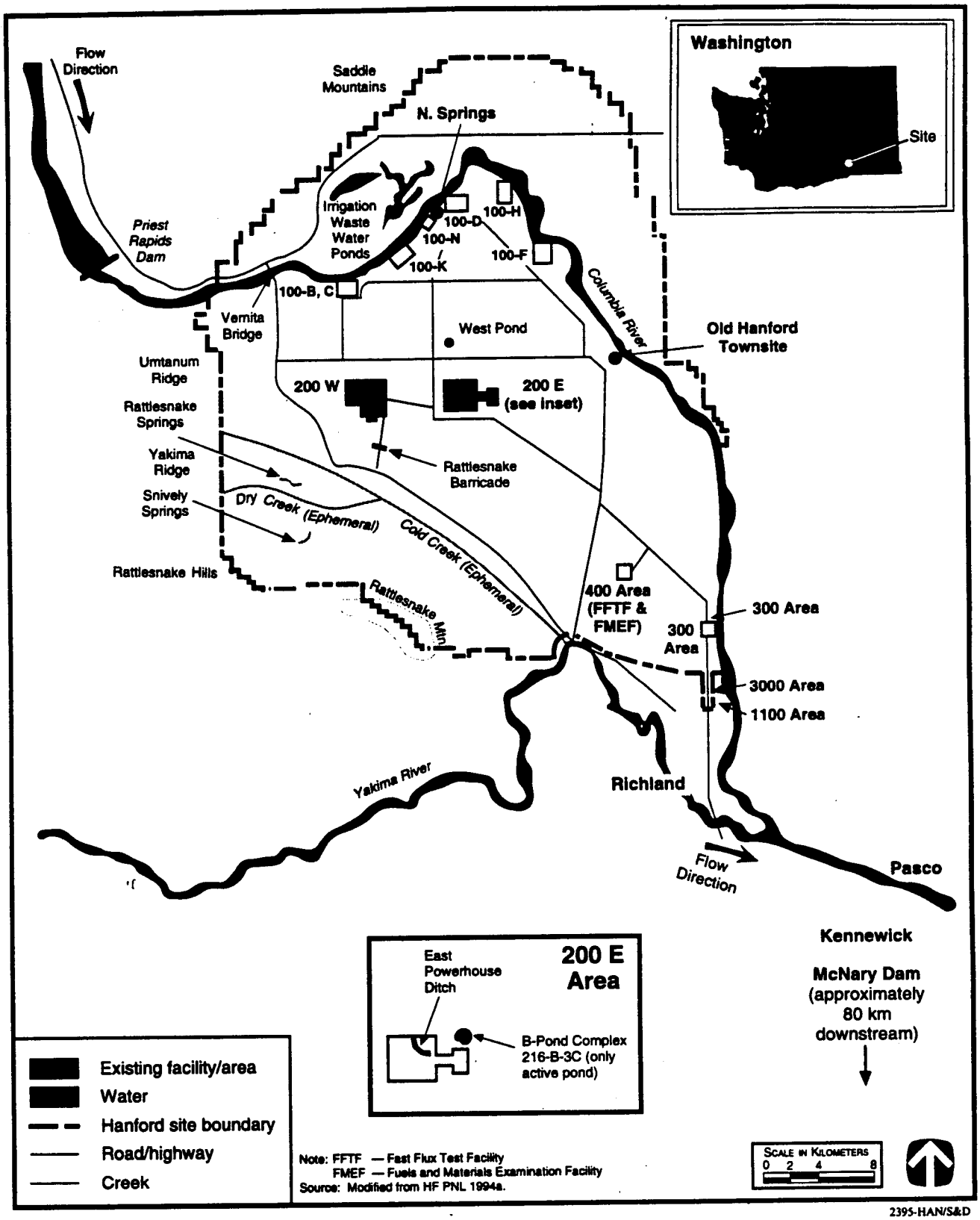


Figure 3.2.4–1. Surface Water Features at Hanford Site.

Water samples have been collected periodically from the Hanford Reach of the Columbia River. Radionuclides consistently detected in the river during 1993 were iodine-129 (I-129), strontium-90 (Sr-90), tritium, U-234, and uranium-238 (U-238). In addition, technetium-99 (Tc-99), U-238, and Pu-239/240 were detected in 50 percent or more of the samples analyzed during the year. Total alpha and beta measurements were similar to previous years and were approximately 5 percent or less of the applicable drinking water standards of 15 and 50 picocuries (pCi)/l (4 pCi/gal and 13.2 pCi/gal), respectively. These measurements are useful indicators of the general radiological quality of the river and, because results are obtained quickly, provide an early indication of changes in radioactive contamination levels. Tritium measurements at Richland were all well below State and Federal drinking water standards. All nonradiological water quality standards were met for Class A-designated water (HF PNL 1994a:4.58). Surface water quality data downstream of Hanford are presented in Table 3.2.4–1.

Surface Water Rights and Permits. The Department has asserted, and continues to assert, a federally reserved water withdrawal right to obtain water from the Columbia River. Currently, Hanford withdraws approximately 13.5 billion l/yr (3.57 billion gal/yr) of water from the Columbia River.

Groundwater. Groundwater under Hanford occurs in unconfined and confined aquifers. The unconfined aquifer lies within the boundaries of the Pasco Basin contained within glaciofluvial sands and gravels of the Hanford Formation as well as the fluvial and lacustrine sediments of the Ringold Formation. Across the site, groundwater generally flows easterly through sands and gravels of the middle member of the Ringold Formation of the unconfined aquifer. The base of the aquifer is the Columbia River Basalt or, in some areas, the clay zones of the lower member of the Ringold Formation. The aquifer thickness ranges from 15 to 61 m (49 to 200 ft), where it thins along the flanks of bordering structures. As a result of local water disposal to surface ponds, the water table has risen as much as 27 m (89 ft) in the 200 West Area (HF PNL 1994a:4.54). This has caused groundwater mounding, including radial and northward flow components, in the 200 Areas. Depth to groundwater ranges from approximately 24 to 80 m (79 to 262 ft) across Hanford. Figure 3.2.4–2 shows the water table elevations and the direction of groundwater movement.

The unconfined aquifer is recharged from rainfall and runoff from higher bordering elevations to the west, water infiltrating from small ephemeral streams, river water along influent reaches of the Yakima and Columbia Rivers, and upward leakage from the lower confined aquifers and from artificial recharge (agricultural irrigation and waste disposal operations at Hanford). In the Hanford vicinity, groundwater is discharged primarily along the Columbia River, with lesser amounts going to the Yakima River (HF PNL 1994a:4.52).

The confined aquifers at Hanford consist of sedimentary interbeds and interflow zones that occur between basalt flows in the Columbia River Basalt Group. Main water-bearing portions of the interflow zones occur within a network of interconnecting vesicles and fractures of the flow tops or flow bottoms. The confined aquifers are continuous throughout most of the Pasco Basin except where the aquifers have been eroded or stratigraphically pinched out. The thickness of these aquifers varies from several centimeters to at least 52 m (171 ft). Recharge of the confined aquifer occurs primarily where the basalt formations are at or near ground levels as water infiltrates from precipitation and stream runoff at areas including the Rattlesnake Hills, Yakima Ridge, Umtanum Ridge, and the Saddle Mountains. Groundwater from these confined aquifers is also discharged to the Columbia River (HF PNL 1994a:4.91).

Groundwater Quality. Groundwater quality at Hanford has been affected by liquid waste released to the soil column by past and ongoing site operations. [Text deleted.] Minor quantities of the longest-lived radionuclides have reached the water table via a failed groundwater monitoring well casing and through reverse well injection, a disposal practice that was discontinued at Hanford in 1947. The unconfined aquifer contains both radiological and nonradiological contaminants at concentrations exceeding water quality criteria and standards. Table 3.2.4–2 shows the unconfined groundwater quality at Hanford. Tritium and I-129 have been detected in the confined aquifer. Contamination in the confined aquifer, however, is typically limited to areas where there is exchange with the unconfined aquifer (HF PNL 1994a:4.52).

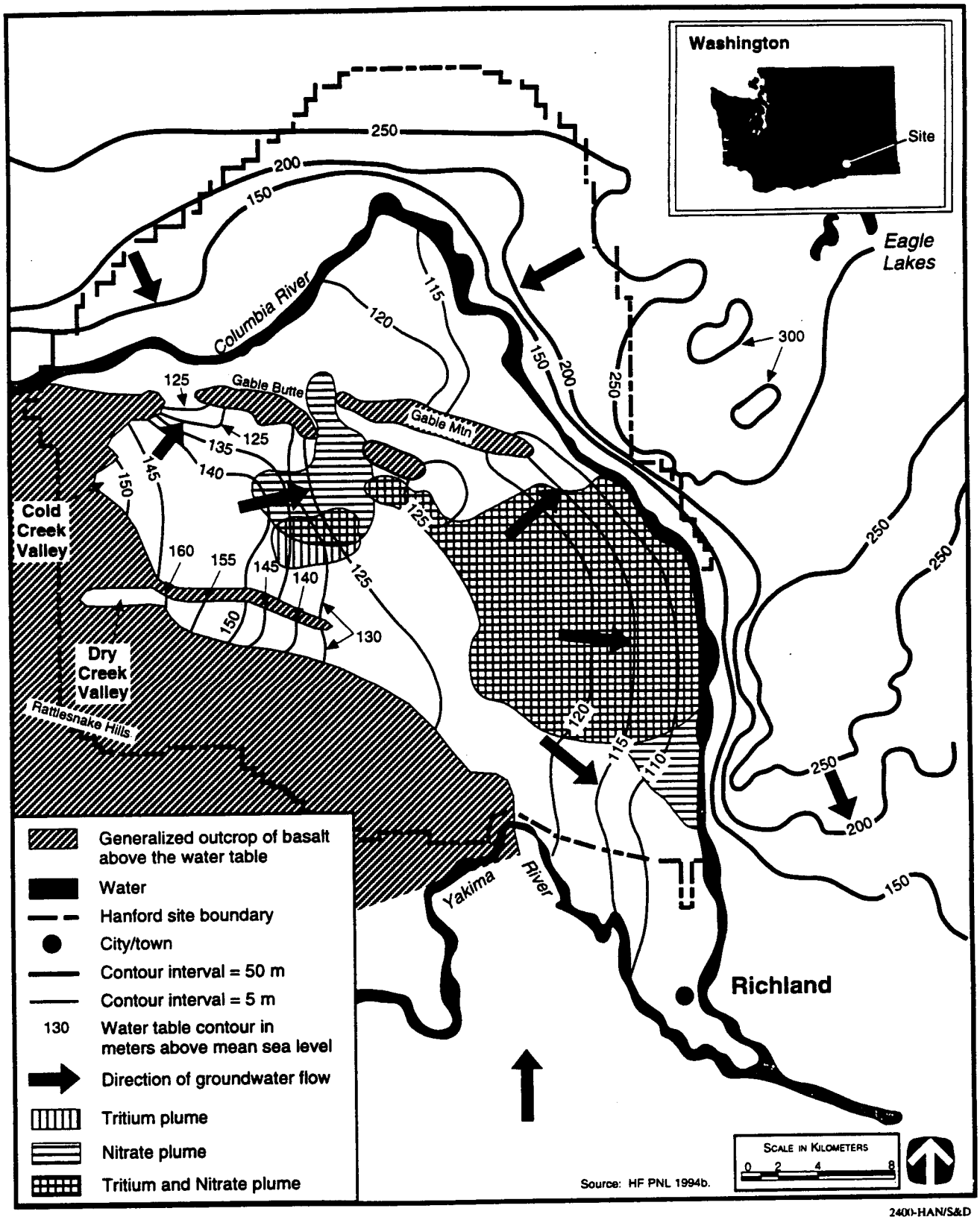


Figure 3.2.4–2. Water Table Elevations and Major Plumes for the Unconfined Aquifer at Hanford Site, June 1993.

Table 3.2.4–1. Summary of Columbia River Surface Water Quality Monitoring at Hanford Site (Richland Pumphouse), 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[b]	Concentration[a] High	Concentration[a] Low
Alpha (gross)	pCi/l	15[c]	1.69	$<1.18\times10^{-3}$
Barium	mg/l	2[c]	0.036	0.029
Beta (gross)	pCi/l	50[d]	2.8	NR
Calcium	mg/l	NA	22.1	17.0
Chloride	mg/l	250[e]	1.2	1.01
Chromium	mg/l	0.1[c]	$<2.0\times10^{-2}$	5.4×10^{-3}
Copper	mg/l	1.0[c]	0.0033	<0.002
Fluoride	mg/l	4[c], 2[e]	0.3	0.1
Iodine-129	pCi/l	20[f]	0.00014	NR
Iron	mg/l	0.3[e]	0.0673	0.034
Magnesium	mg/l	NA	5.367	4.055
Manganese	mg/l	0.05[e]	0.0071	<0.0014
Nitrate	mg/l	10[c]	0.58	0.35
pH	pH units	6.5-8.5[e]	8.6	8.1
Potassium	mg/l	NA	1.225	0.087
Plutonium-239/240	pCi/l	1.2[f]	7.82×10^{-5}	$<3.25\times10^{-6}$
Sodium	mg/l	NA	2.83	2.436
Strontium-90	pCi/l	400[f]	1.37×10^{-1}	$<2.39\times10^{-2}$
Sulfate	mg/l	250[e]	11.6	8.2
Technetium-99	pCi/l	4,000[f]	0.25	NR
Tritium	pCi/l	80,000[f]	162	48.6
Uranium-234	pCi/l	20[f]	3.56×10^{-1}	1.89×10^{-1}
Uranium-235	pCi/l	24[f]	2.20×10^{-2}	$<-5.05\times10^{-4}$
Uranium-238	pCi/l	24[f]	3.19×10^{-1}	1.44×10^{-1}
Zinc	mg/l	5[e]	<0.02	<0.0026

[a] Data are average values from four separate sampling events.

[b] For comparison purposes only.

[c] National Primary Drinking Water Regulations (40 CFR 141).

[d] Proposed National Primary Drinking Water Regulations: Radionuclides (56 FR 33050).

[e] National Secondary Drinking Water Regulations (40 CFR 143).

[f] DOE Derived Concentration Guides (DCG) for water (DOE Order 5400.5), DCG values are based on a committed effective dose of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored location. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the background environmental level.

Note: mg/l=milligrams per liter; pCi/l=picocuries per liter; NA=not applicable; NR=not reported.

Source: HF PNL 1994a.

Tritium and nitrate plumes have been identified in the unconfined aquifer at Hanford. Because both are ubiquitous in liquid waste streams and are highly mobile in groundwater, they can be used as good indicators of the extent of groundwater contamination at Hanford. The major plume of tritium-contaminated groundwater has continued to move eastward over the years and has seeped into the Columbia River (HF PNL 1992a:157). The generalized locations of the major plumes are shown on Figure 3.2.4–2.

Groundwater Availability, Use, and Rights. Groundwater in the Pasco Basin area is used for domestic, industrial, and agricultural purposes. The principal groundwater users within Hanford are the FFTF, the PNL, and remote

Table 3.2.4–2. Groundwater Quality Monitoring in the Unconfined Aquifer at Hanford Site, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Existing Conditions 1993 High	Existing Conditions 1993 Low
1,2-Dichloroethylene	mg/l	0.007[b]	180	<dL
Carbon tetrachloride	mg/l	0.005[b]	7	<dL
Cesium-137	pCi/l	120[c]	2,087[d]	<dL
Chromium	mg/l	0.1[b]	19.1	<dL
Cobalt-60	pCi/l	400[c]	423	<dL
Iodine-129	pCi/l	20[c]	64.2	<dL
Nitrate	mg/l	10[b]	870	<dL
Plutonium-239/240	pCi/l	1.2[c]	125[d]	<dL
Strontium-90	pCi/l	400[c]	7,890[e]	<dL
Technetium-99	pCi/l	4,000[c]	20,500[f]	<dL
Tetrachloroethylene	mg/l	0.005[b]	0.0059	<dL
Trichloroethylene	mg/l	0.005[b]	0.061	<dL
Tritium	pCi/l	80,000[c]	3,590,000[g]	<dL
Uranium, Total	mg/l	0.02[h]	3,320[i]	<dL

[a] For comparison purposes only.
[b] National Primary Drinking Water Regulations (40 CFR 141).
[c] DOE DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose of 100 mrem per year; however, because the drinking water maximum containment level is based on 4 mrem per year, the number listed is 4 percent of the DCG.
[d] Found in well 299-E28-25.
[e] Found in well 299-E28-23.
[f] Found in well 299-W19-24.
[g] Found in well 299-E17-9.
[h] Proposed National Primary Drinking Water Regulations, Radionuclides (56 FR 33050).
[i] Found in well 299-W19-29.
Note: dL=detection limit.
Source: HF PNL 1994c.

training and laboratory facilities. Currently, DOE asserts a federally reserved water withdrawal right with respect to its existing Hanford operations and withdraws approximately 195 million l/yr (51.6 million gal/yr).

3.2.5 GEOLOGY AND SOILS

Geology. Hanford is located in a portion of the Pasco Basin, a topographic and structural depression in the southwest corner of the Columbia Basin physiographic subprovince. The Columbia Basin is a subprovince of the Columbia Intermontane physiographic province and is characterized by generally low-relief hills with incised river drainages. The Columbia Plateau is that portion of the Columbia Intermontane physiographic province that is underlain by the Columbia River Basalt Group and includes the Columbia Basin (HF PNL 1994a:4.20). The site is bounded on the west, southwest, and north by anticlinal ridges that trend eastward from the Cascade Mountains; on the east by the Columbia River with its steep, west-facing white bluffs; and on the southeast by the confluence of the Yakima and Columbia Rivers.

The stratigraphy of Hanford consists of Miocene-age and younger rocks which overlay older Cenozoic sedimentary and volcaniclastic basement rock. The major geologic units underlying Hanford are, in ascending order: subbasalt (basement) rocks, the Columbia River Basalt Group, the Ellenburg Formation, the Ringold Formation, the Plio-Pleistocene unit, early "Palouse" soil, and the Hanford Formation.

The Pasco Basin is filled with greater than 3 km (1.8 mi) of basalt of the Columbia River Basalt Group that overlies probable metasedimentary and metavolcanic rocks intruded by Mesozoic granitic rocks (HF DOE 1995g:4-7). The Columbia River Basalt Group consists of an accumulation of Eocene- to Pliocene-age basalt flows emitted concurrently with basin subsidence. Within and overlying the basalt sequence are tuffs and tuffaceous sediments of the Ellenburg Formation. This unit is overlain by the Mio-Pliocene Ringold Formation, a sequence of fluvial-lacustrine gravels and sands and floodplain silts and clays. These sediments were deposited by the ancestral Columbia River and its tributaries that flowed across the Pasco Basin after volcanic activity ceased. The upper part of the Ringold Formation is represented by an approximately 12-m (40-ft) bed in the western part of Hanford. The Plio-Pleistocene unit is a locally derived unit consisting of a sidestream alluvium and/or pedogenic calcrete and occurs at the unconformity between the Ringold Formation and the Hanford Formation (HF PNL 1994a:4.27). Overlying this unit in the Cold Creek syncline area is an aeolian silt and fine grained sand (early "Palouse" soil).

The tertiary sediments and basalts were locally eroded and truncated by a sequence of gigantic floods that took place within the past 100,000 years. These floods formed a channeled scabland that crosses the central and northeastern part of Hanford. This flooding deposited as much as 162 m (532 ft) of sands, gravels (Pasco Gravel), and clays (Touchet Beds) of the Hanford Formation. These units are, in turn, overlain by Holocene aeolian, alluvial, and landslide deposits interbedded with three to four thin, regional ash falls. Tectonic activity has continued through the Holocene, as evidenced by progressive warping of the Ringold Formation, decreasing upward through the section, and tilting of the Touchet Beds.

Hanford lies on the Hanford alluvial plain. Basalt outcrops are exposed on anticlinal ridges at Gable Mountain, Gable Butte, and the Saddle Mountains in the northern part of the reservation and on Rattlesnake Hills and Yakima Ridge, overlapping the western and southwestern edges of the reservation. Other than gravel, no economically viable geologic resources have been identified at Hanford.

The Modified Mercalli Intensity (MMI) scale, which evaluates earthquake intensity, and the Richter scale, which measures an earthquake's magnitude and energy, are both used to assess potential earthquake risk. Table 3.2.5–1 illustrates the approximate correlation between the MMI scale, the Richter scale, and maximum ground acceleration.

According to the 1994 Uniform Building Code, Hanford is in seismic zone 2B (ICBO 1994a). However, for this PEIS, Uniform Building Code Seismic Zones 2A and 2B were consolidated into Seismic Zone 2 (Figure 3.2.5–1). Seismic Zones 2A and 2B differ only in that Seismic Zone 2B represents the potential for slightly more damage than 2A corresponding to an earthquake intensity VII on the MMI scale.

Table 3.2.5–1. The Modified Mercalli Intensity Scale of 1931, With Approximate Correlations to Richter Scale and Maximum Ground Acceleration[a]

Modified Mercalli Intensity[b]	Observed Effects of Earthquake	Approximate Richter Magnitude[c]	Maximum Ground Acceleration[d]
I	Usually not felt	<2	negligible
II	Felt by persons at rest, on upper floors or favorably placed	2-3	<0.003 G
III	Felt indoors; hanging objects swing; vibration like passing of light truck occurs; might not be recognized as earthquake	3	0.003 to 0.007 G
IV	Felt noticeably by persons indoors, especially in upper floors; vibration occurs like passing of heavy truck; jolting sensation; standing automobiles rock; windows, dishes, and doors rattle; wooden walls and frames may creak	4	0.007 to 0.015 G
V	Felt by nearly everyone; sleepers awaken; liquids disturbed and may spill; some dishes break; small unstable objects are displaced or upset; doors swing; shutters and pictures move; pendulum clocks stop or start		0.015 to 0.03 G
VI	Felt by all; many are frightened; persons walk unsteadily; windows and dishes break; objects fall off shelves and pictures fall off walls; furniture moves or overturns; weak masonry cracks; small bells ring; trees and bushes shake	5	0.03 to 0.09 G
VII	Difficult to stand; noticed by car drivers; furniture breaks; damage moderate in well built ordinary structures; poor quality masonry cracks and breaks; chimneys break at roof line; loose bricks, stones, and tiles fall; waves appear on ponds and water is turbid with mud; small earthslides; large bells ring	6	0.07 to 0.22 G
VIII	Automobile steering affected; some walls fall; twisting and falling of chimneys, stacks, and towers; frame houses shift if on unsecured foundations; damage slight in specially designed structures, considerable in ordinary substantial buildings; changes in flow of wells or springs; cracks appear in wet ground and steep slopes		0.15 to 0.3 G
IX	General panic; masonry heavily damaged or destroyed; foundations damaged; serious damage to frame structures, dams and reservoirs; underground pipes break; conspicuous ground cracks	7	0.3 to 0.7 G
X	Most masonry and frame structures destroyed; some well built wooden structures and bridges destroyed; serious damage to dams and dikes; large landslides; rails bent	8	0.45 to 1.5 G
XI	Rails bent greatly; underground pipelines completely out of service	9	0.5 to 3 G
XII	Damage nearly total; large rock masses displaced; objects thrown into air; lines of sight distorted		0.5 to 7 G

[a] This table illustrates the approximate correlation between the MMI scale, the Richter scale, and maximum ground acceleration.

[b] Intensity is a unitless expression of observed effects.

[c] Magnitude is an exponential function of seismic wave amplitude, related to the energy released.

[d] Acceleration is expressed in relation to the earth's gravitational acceleration (G).

Source: ICSSC 1985a; PPI 1994a.

Seismicity of the Columbia Plateau, as determined by the rate of earthquakes per area and the historical magnitude of these events, is relatively low when compared with other regions of the Pacific Northwest, the Puget Sound area, and western Montana/eastern Idaho (areas where several large earthquakes, Richter magnitude greater than 7, have occurred). Between 1870 and 1980, only five earthquakes occurred in the Columbia Plateau region that had MMI of VI or greater, and all these events occurred prior to 1937. The largest known earthquake in the Columbia Plateau (magnitude 5.75 and maximum MMI of VII) occurred in 1936 around Milton-Freewater, Oregon, approximately 100 km (62 mi) southeast of Hanford. In the central portion

of the Columbia, the largest earthquakes near Hanford were two earthquakes that occurred in 1918 and 1973. Each was approximate magnitude 4.5 and MMI V, and located north of Hanford. Most of the earthquakes in the central Columbia Plateau occur north or northeast of the Columbia River as "earthquake swarms," which are clusters of low intensity earthquakes (MMI less than V) occurring over a short period of time (HF PNL 1994a:4.36).

Most known faults at Hanford are associated with anticlinal fold axes and include thrust, reverse, and normal faults. Faulting has occurred concurrently with folding. The age of latest displacement for the major features is less than 10.5 million years, but some steep dipping faults in the Rattlesnake Hills uplift may be as young as 7,000 years. Some faults in Central Gable Mountain (north-central Hanford) are capable faults as defined in 10 CFR 100, Appendix A.

Landslides are present in the region and have been generally attributed to earthquake activity. Recent findings, however, suggest these features are actually related to glacial flooding and periods of soil saturation with water. Only the slopes of the enclosing anticlinal ridges, including Gable Mountain and White Bluffs, are steep enough for landslide concern. White Bluffs east of the Columbia River poses the greatest concern because of the clay-rich nature of some beds above the river level, the discharge of large quantities of irrigation water into the ground atop the cliffs, the surface incline toward the Columbia River, and the eastward channel migration of the Columbia and its undercutting of the adjacent bluffs. Landslides could fill the Columbia River channel and divert water onto the reservation.

Several major volcanoes are located in the Cascade Range west of Hanford, including Mount Adams, located 164 km (102 mi) from Hanford, and Mount St. Helens, located approximately 218 km (134 mi) west-southwest from Hanford. As a result of the 1980 Mount St. Helens eruption, approximately 0.1 cm (0.04 in) of volcanic ash fell in a 9-hour period at Hanford.

Soils. Hanford is primarily underlain by soils of the Ritzville-Willis, Warden-Shano, Walla-Walla-Endicott-Lickskillet, and Hezel-Quincy-Burbank associations. These soils tend to vary in texture from sand to silty and sandy loam derived from five types of parent material: recent alluvium, old alluvium (glacial outwash), windblown sand, lacustrine deposits, and loess. The mineralogy of these soils results from weathering of local basalts, igneous and metamorphic rocks exposed to the north and east. The hazard of soil erosion varies from slight to severe. Water erosion becomes more severe with increasing slope; wind erosion becomes more severe on water-eroded slopes. The soils at Hanford are considered acceptable for standard construction techniques.

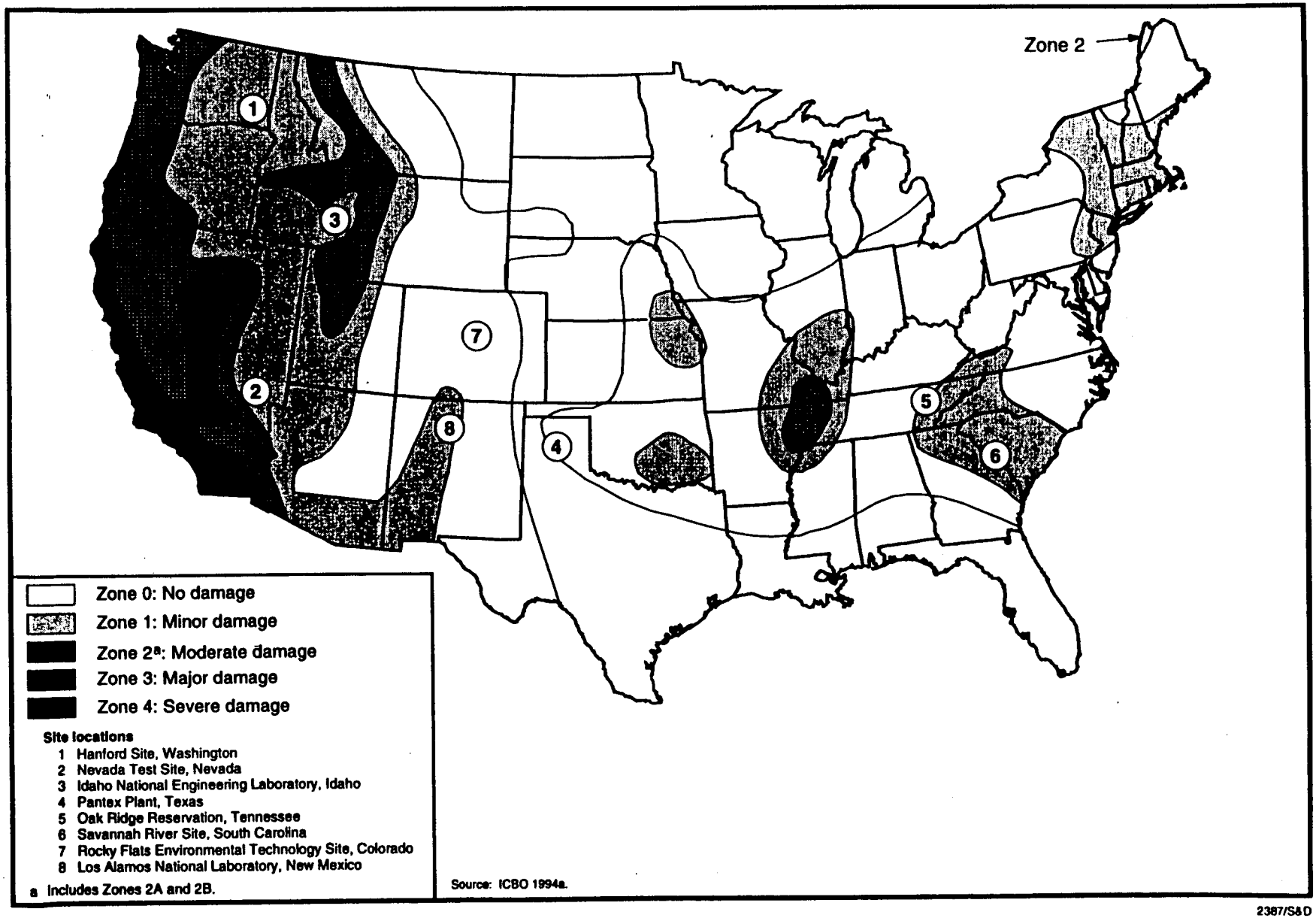


Figure 3.2.5–1. Seismic Zone Map of the United States.

3.2.6 BIOLOGICAL RESOURCES

Terrestrial Resources. Vegetation at Hanford has been characterized as shrub-steppe. Present site development consists of clusters of large buildings that are found at widely spaced locations. Developed areas encompass about 6 percent of the site. The remaining areas of the site can be divided into 10 major plant communities (Figure 3.2.6–1). Hanford is dominated by communities in which big sagebrush is a major component. Other plant communities contain a variety of grasses and herbaceous plants. Areas previously disturbed by agricultural activities are dominated by nonnative species, such as cheatgrass. Trees are uncommon on the site, but those that are present include cottonwood and willow, which are both found near water bodies, and a few other deciduous species, which were originally planted near farmsteads as windbreaks. Nearly 600 species of plants have been identified at Hanford (DOE 1995o:4-85).

Hanford provides suitable habitat for numerous animal species, including 12 species of amphibians and reptiles, 187 species of birds, and 39 species of mammals (HF PNL 1994a:4.99,4.103). Common animal species at Hanford include the side-blotched lizard, gopher snake, western meadowlark, horned lark, Great Basin pocket mouse, and black-tailed jackrabbit. Trees planted around former farmsteads serve as nesting platforms for several species of birds, including hawks, owls, ravens, magpies, and great blue herons; these trees also serve as night roosts for bald eagles (HF PNL 1994a:4.92,4.93). The Hanford Reach of the Columbia River, including several sparsely vegetated islands, provides nesting habitat for the Canadian goose, ring-billed gull, Forster's tern, and great blue heron. Although several game animals are found at Hanford, only waterfowl hunting is permitted onsite north of the Columbia River (HF 1992a:1). Numerous raptors, such as the Swainson's hawk and red-tailed hawk, and carnivores, such as the coyote and bobcat, are found on Hanford. A variety of migratory birds has been found at Hanford. Migratory birds, as well as their nests and eggs, are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Vegetative cover in the vicinity of the 200 Area, the proposed location of storage facilities, falls within the sagebrush and cheatgrass-Sandberg bluegrass community (Figure 3.2.6–1). Associated shrubs and grasses of this community include gray rabbitbrush, green rabbitbrush, hopsage, snowy buckwheat, Indian rice grass, thickspike wheatgrass, and needle-and-threadgrass. Common animal species found on the proposed site are expected to be similar to those described for Hanford as a whole.

Wetlands. Primary wetland areas at Hanford are found in the riparian zone along the Columbia River. The extent of this zone varies, but it includes large stands of willows, grasses, and other plants. This area has been extensively affected by hydropower operations at Priest Rapids Dam (DOE 1995o:4-89).

Other large areas of wetlands at Hanford can be found north of the Columbia River within the Saddle Mountain National Wildlife Refuge and the Wahluke Wildlife Unit Columbia Basin Area. These two areas encompass all the lands extending from the north bank of the Columbia River northward to the site boundary and east of the Columbia River down to Ringold Springs. Wetland habitat in these areas consists of fairly large ponds resulting from irrigation runoff. These ponds have extensive stands of cattails and other emergent aquatic vegetation surrounding the open water regions. They are extensively used as nesting sites by waterfowl (HF PNL 1994a:4.113).

On the western side of Hanford, Rattlesnake Springs supports a riparian zone of about 2.5 km (1.6 mi) in length, featuring watercress, bulrush, spike rush, cattail and peachleaf willow. Snively Springs also contains a diverse biotic community similar to Rattlesnake Springs (HF PNL 1994a:4.112).

Several semi-permanent artificial ponds and ditches that receive cooling water or irrigation wastewater are also present on Hanford near the 200 Area and support wetland vegetation (that is, cattails, reeds, and willows) around their periphery. These wetlands provide habitat for songbirds, shorebirds, and waterfowl.

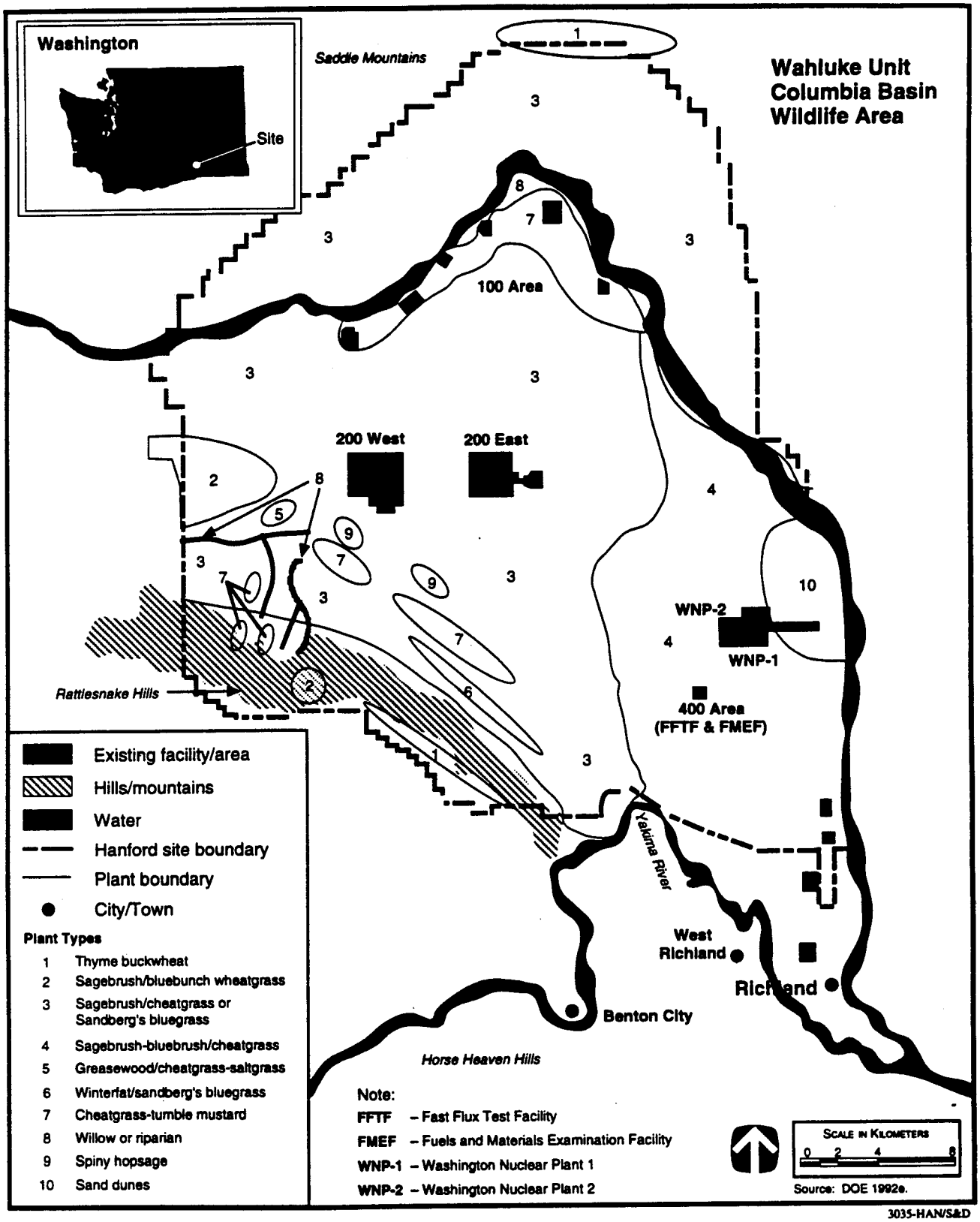


Figure 3.2.6–1. Distribution of Plant Communities at Hanford Site.

Aquatic Resources. Aquatic resources on Hanford include the Columbia River, ephemeral streams, springs, surface ponds, and ditches. The Columbia River flows along the northern and eastern edges of Hanford (HF PNL 1994a:4.106).

The Hanford Reach supports 44 anadromous and resident species of fish. Many of the fish species present in the Hanford Reach are dependent upon flowing water and rocky substrate for at least part of their life cycles. Fall chinook salmon, steelhead trout, mountain whitefish, and smallmouth bass spawn in this area. The destruction of other mainstream Columbia River spawning areas by dams has increased the relative importance of the Hanford Reach for spawning (HF PNL 1994a:4.110).

The Hanford Reach provides a migration route to upstream spawning areas for spring, summer, and fall adult chinook salmon, coho salmon, sockeye salmon, and steelhead trout. It also provides rearing habitat for the salmonid juveniles in their downstream migration to the sea. Principal resident fish species sought by anglers in the Hanford Reach include mountain whitefish, white sturgeon, smallmouth bass, crappie, catfish, walleye, and perch (HF PNL 1994a:4.110,4.112).

The Yakima River borders the southern portion of Hanford. Game fish found in the river in the vicinity of the site are smallmouth bass, steelhead trout, and channel catfish. Cold Creek and its tributary, Dry Creek, are ephemeral streams within the Yakima River drainage system along the southern boundary of Hanford. These streams do not support any fish populations (HF 1992a:2; HF PNL 1994a:4.42).

There are several springs at Hanford. Rattlesnake Springs and Snively Springs, located in the western portion of the site, form short streams which seep into the ground (Figure 3.2.4–1). None of the springs support any fish populations (HF PNL 1984a:3.40; HF PNL 1994a:4.112).

The release of wastewater at Hanford facilities has created four semipermanent artificial ponds and several ditches that did not exist before these facilities were built. These are temporary and will disappear if the industrial release of water is terminated. All of the ponds, except West Pond and one ditch on the site, support goldfish. West Pond was created by a rise in the water table and is not fed by surface flow; thus, it is alkaline and has a reduced complement of biota (Figure 3.2.4–1) (HF PNL 1978a:2,3,5,10,13).

Threatened and Endangered Species. Sixty-five federally and State-listed threatened, endangered, and other special status species may be found in the vicinity of Hanford, 13 of these are federally or State-listed as threatened or endangered (Table 3.2.6–1). Forty-one species listed in Table 3.2.6–1 have been observed at Hanford or the Hanford Reach of the Columbia River, including nine of the federally or State-listed endangered or threatened species. Once specific project site locations have been determined, site surveys will verify the presence of special status species. No critical habitat, as defined in ESA (50 CFR 17.11 and 17.12), exists on Hanford.

The bald eagle is the only federally listed species known to be found at Hanford. It is a regular winter resident along the Hanford Reach, where it forages for salmon and waterfowl. Trees in the historic Hanford Townsite area are used by eagles for perching; however, eagles do not nest at Hanford. The peregrine falcon is a migrant in the Hanford area. The Aleutian Canada goose and Oregon silverspot butterfly are not known to occur on the site.

Several State-listed animal species have been observed at Hanford. The ferruginous hawk is known to nest on transmission towers and forages over much of the site. Habitats similar to those used by this species for foraging are relatively common at Hanford; however, nesting sites are more limited (DOE 1992e:4-26). Pygmy rabbits have only rarely been seen at Hanford. [Text deleted.] Species occurring along the Hanford Reach include the American white pelican and sandhill crane. The sandhill crane is also found in upland habitats (DOE 1992e:4-27; DOE 1995o:4-93).

State-listed plant species observed at Hanford include Columbia milk-vetch, Columbia yellowcress, and dwarf desert primrose. Columbia milk-vetch has been found onsite on top of Umtanum Ridge above the Midway substation. Columbia yellowcress occurs in the wetted zone of the water's edge along the Columbia River. It has been observed between the 100 B Area and the old Hanford Townsite. Dwarf desert primrose is known to grow in Ringold Flats and in a gravel pit approximately 2.5 km (1.6 mi) north of Wye Barricade (Figure 3.2.1–1) (HF WHC 1992a:3-1,3-5,3-6). Other State-listed plant species found in the vicinity of Hanford include northern wormwood and Hoover's desert parsley.

Table 3.2.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Hanford Site

Common Name	Scientific Name	Status[a]	
		Federal	State
Mammals			
Fringed myotis	*Myotis thysanodes*	NL	M
Long-eared myotis	*Myotis evotis*	NL	M
Long-legged myotis	*Myotis volans*	NL	M
Merriam's shrew[b]	*Sorex merriami*	NL	C
Northern grasshopper mouse[b]	*Onychomys leucogaster*	NL	M
Pacific western big-eared bat[b]	*Plecotus townsendii townsendii*	NL	C
Pallid bat[b]	*Antrozous pallidus*	NL	M
Pygmy rabbit[b]	*Brachylagus idahoensis*	NL	E
Sagebrush vole[b]	*Lagurus curtatus*	NL	M
Small-footed myotis	*Myotis ciliolabrum*	NL	M
[Text deleted.]			
Birds			
Aleutian Canada goose[c]	*Branta canadensis leucopareia*	T	E
American white pelican[b,d]	*Pelecanus erythrorhynchos*	NL	E
Ash-throated flycatcher	*Myiarchus cinerascens*	NL	M
Bald eagle[b,c,d]	*Haliaeetus leucocephalus*	T	T
Black tern[b]	*Chlidonius niger*	NL	M
Black-crowned night heron	*Nycticorax nycticorax*	NL	M
Black-necked stilt	*Himantopus mexicanus*	NL	M
Common loon[d]	*Gavia immer*	NL	C
Ferruginous hawk[b]	*Buteo regalis*	NL	T
Flammulated owl[b]	*Otus flammeolus*	NL	C
Forester's tern	*Sterna forsteri*	NL	M
Golden eagle	*Aquila chrysaetos*	NL	C
Grasshopper sparrow	*Ammodramus savannarum*	NL	M
Gray flycatcher	*Empidonax wrightii*	NL	M
Great blue heron[b]	*Ardea herodias*	NL	M
[Text deleted.]			
Lewis' woodpecker[b]	*Melanerpes lewis*	NL	C
Loggerhead shrike[b]	*Lanius ludovicianus*	NL	C
Long-billed curlew	*Numenius americanus*	NL	M
Northern goshawk[b]	*Accipiter gentilis*	NL	C
Osprey	*Pandion haliaetus*	NL	M
Peregrine falcon[b,c]	*Falco peregrinus*	E (S/A)	E
Prairie falcon[b]	*Falco mexicanus*	NL	M
Sage sparrow[b]	*Amphispiza belli*	NL	C
Sage thrasher	*Oreoscoptes montanus*	NL	C
Sandhill crane[b,d]	*Grus canadensis*	NL	E

Table 3.2.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Hanford Site—Continued

Common Name	Scientific Name	Status[a]	
		Federal	State
Birds (continued)			
Swainson's hawk[b]	*Buteo swainsoni*	NL	C
Turkey vulture	*Cathartes aura*	NL	M
Western bluebird[b]	*Sialia mexicana*	NL	C
Western burrowing owl[b]	*Athene cunicularia hypugea*	NL	C
Western grebe	*Aechmophorus occidentalis*	NL	M
Western sage grouse[b]	*Centrocerus urophasianus phaios*	NL	C
Reptiles			
Desert night snake[b]	*Hypsiglena torquata*	NL	M
Amphibians			
Woodhouse's toad[b]	*Buo woodhousei*	NL	M
Fish			
Mountain sucker[d]	*Catostomus platyrhnchus*	NL	M
Piute sculpin[d]	*Cottus beldingi*	NL	M
Reticulate sculpin[d]	*Cottus perplexus*	NL	M
Sandroller[d]	*Percopsis transmontana*	NL	M
Invertebrates			
Columbia River tiger beetle	*Cicindela columbica*	NL	C
Giant Columbia River limpet	*Fisherola nuttalli*	NL	C
Great Columbia River spire snail[d]	*Fluminicola columbianus*	NL	C
Oregon silverspot butterfly	*Speyeria zerene hippolyta*	T	E
Plants			
Bristly cyptantha	*Cryptantha interrupta*	NL	M2
Columbia milk-vetch[b]	*Astragalus columbianus*	NL	T
Columbia yellowcress[b]	*Rorippa columbiae*	NL	E
Dense sedge[b]	*Carex densa*	NL	S
Desert dodder	*Cuscuta denticulata*	NL	M1
Dwarf desert primrose[b]	*Oenothera pygmaea*	NL	T
False-pimpernel[b]	*Lindernia dubia var. anagallidea*	NL	S
Gray cryptantha[b]	*Cryptantha leucophaea*	NL	S
Hoover's desert parsley	*Lomatium tuberosum*	NL	T
Northern wormwood	*Artemisia campestris borealis var. wormskioldii*	NL	E
Piper's daisy[b]	*Erigeron piperianus*	NL	S
Shining flatsedge[b]	*Cyperus bipartitus*	NL	S
Southern mudwort[b]	*Limosella acaulis*	NL	S
Thompson's sandwort[b]	*Arenaria franklinii var thompsonii*	NL	M2

[a] Status codes: C=State candidate; E=endangered; M=monitored animal; M1=monitored plant - Group 1 (additional field work needed); M2=monitored plant - Group 2 (unresolved taxonomic question); NL=not listed; S=State sensitive; S/A=protected under the similarity of appearance provision of the *Endangered Species Act*; T=threatened.

[b] Species observed on Hanford Site.

[c] USFWS Recovery Plan exists for this species.

[d] Occurs along the Hanford Reach of the Columbia River.

Source: 50 CFR 17.11; 50 CFR 17.12; DOE 1992e; DOE 1995o; HF PNL 1994a; HF WHC 1992a; WA DNR 1994a; WA DOW 1994a.

Sagebrush habitat is considered priority habitat by the State of Washington because of its relative scarcity in the State and its use as a nesting and breeding habitat by loggerhead shrikes, burrowing owls, sage sparrows, pygmy rabbits, sage thrashers, western sage grouse, and sagebrush voles. Most of these species have been observed at Hanford.

The proposed storage site contains sagebrush habitat that is potentially suitable for use by the species listed above. The loggerhead shrike has been frequently observed in the vicinity and is known to select tall big sagebrush as nest sites. The 200 Area also contains a portion of the foraging range of nesting ferruginous hawks (DOE 1995o:4-93).

3.2.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Within the boundaries of Hanford, 248 prehistoric sites have been identified. A number of these sites have been identified along the Middle Columbia River and in inland areas away from the river but near other water sources. Some dispersed evidence of human occupation has been found in the arid lowlands. Sites include pithouse villages, campsites, cemeteries, spirit quest monuments (rock cairns), hunting camps and blinds, game drive complexes, quarries in mountains and rocky bluffs, hunting and kill sites in lowland stabilized dunes, and small, temporary camps near water located away from the river.

The NRHP lists 47 prehistoric resources at Hanford. Two of these are individual sites: the Hanford Island Site and the Paris Site. The remaining sites are divided into seven archaeological districts. Four sites, including Vernita Bridge, Tsulim, and two others, are considered eligible for the NRHP by the State Historic Preservation Officer (SHPO). In addition, a Determination of Eligibility nomination has been prepared for Gable Mountain/ Gable Butte, a traditional cultural property district (DOE 1995o:4-29).

All inventory and evaluation of cultural resources at Hanford is conducted within the framework of the *Hanford Cultural Resources Management Plan* (PNL-6942 UC-600, June 1989). Archaeological surveys have been conducted at Hanford since 1926, and slightly less than 10 percent of the area has been examined. These surveys have included studies of Gable Mountain, Gable Butte, Snively Canyon, Rattlesnake Mountain, Rattlesnake Springs, and a portion of the Basalt Waste Isolation Project Reference Repository Location. Most of the surveys have focused on islands and on a 400-m (1,312-ft) wide area on either side of the river. From 1991 through 1995, the 100 Areas were surveyed, and new sites were identified. Excavations have been conducted at several sites on the river banks and islands and at two unnamed sites. Test excavations have been conducted at the Wahluke, Vernita Bridge, and Tsulim sites, and at other sites in Benton County.

Facilities could be built or upgraded adjacent to or within the 200 or 400 Areas. An archaeological survey has been conducted in all undeveloped parts of the 200 East Area and half of the 200 West Area (HF PNL 1994a:4.127, 4.128). No prehistoric sites were identified. Because most of the 200 Areas are either developed or disturbed, it is unlikely that they contain intact archaeological deposits. Most of the 400 Area is disturbed and therefore is unlikely to contain intact prehistoric or historic sites. A cultural resources survey found 12 ha (30 acres) undisturbed in the 400 Area, and no sites were identified either within the 400 Area or within 2 km (1 mi) of the 400 Area. The *Hanford Cultural Resources Management Plan* provides for survey work before construction and has contingency guidelines for handling the discovery of previously unknown archaeological resources encountered during construction.

Historic Resources. There are 202 historic archaeological sites and other historic localities identified at Hanford. Pre-Hanford-era sites and localities include homesteads, ranches, trash scatters, dumps, gold mine tailings, roads, and townsites, including the Hanford townsite and the East White Bluffs townsite and ferry landing.

Lewis and Clark were the first European-Americans to come to this region, during their expedition of 1803 to 1806. Fur trappers soon followed. In the 1860s, settlement began in the area. Chinese miners came to work the gravel bars for gold. Farmers and cattlemen came to the area in the 1880s. The towns of Hanford, White Bluffs, and Ringold were established and grew. Two additional ferry operations, one at Wahluke and one at Richland, were established. The Hanford Engineering Works, a part of the Manhattan Project, was established in 1943. During that year, the residents were evacuated and nearly all the structures were subsequently razed. Pu produced at the Hanford 100 B-Reactor was used in the first nuclear explosion, at the White Sands Missile Range in New Mexico, and later in the bomb that was dropped on Nagasaki, Japan (DOE 1995o:4-32). The Hanford 100 B-Reactor is listed as a National Mechanical Engineering Landmark, a National Historical Civil Engineering Landmark, a National Nuclear Engineering Landmark, and is listed on the NRHP (HF PNL 1991a:6-3).

Because Hanford played an important role in the Manhattan Project and the subsequent Cold War Era, a number of its structures may be eligible for the NRHP. Although not all of these structures meet the Secretary of the Interior's 50-year requirement for eligibility, they fall under the broad themes of the Manhattan Project and Cold War Era nuclear production. They include buildings and structures found mainly in the 100, 200, and 300 Areas.

The historic White Bluffs Freight Road, once an Indian road, crosses diagonally through the 200 West Area. The road has been determined NRHP-eligible by the SHPO, but the segment in the 200 West Area is considered a noncontributing element. A 100-m (328-ft) easement protects the road. Manhattan Project and Cold War Era structures are in the 200 Areas; they have not been evaluated for NRHP eligibility.

Native American Resources. Because of its location on the Columbia and Yakima Rivers, Hanford has been home to Native Americans for thousands of years. The Wanapum and the Chamnapum band of the Yakama tribe lived along the Columbia River at what is now Hanford. Some of their descendants still live nearby at Priest Rapids, northwest of Hanford. Other groups that visited or lived intermittently at Hanford include the Palus, who lived on the lower Snake River, the Walla Walla, the Nez Perce, and the Umatilla (DOE 1995o:4-31). All these people retain secular and religious ties to the area. The Yakama, Umatilla, and Nez Perce have all been declared "Affected Indian Tribes," as defined in the NWPA of 1982. As such, these tribes and the Wanapum people, who live about 8 km (5 mi) west of the Hanford boundary, are active in decisions regarding the site. The tribes have expressed concerns regarding hunting, fishing, and pasture rights and access to plant and animal communities and important sites (HF DOE 1990e:2-20).

The Washane, or Seven Drums religion, originated among the Wanapum people on what is now Hanford and is still practiced by many people on the Yakama, Umatilla, Warm Springs, and Nez Perce Reservations. The first Washane ceremony took place at Coyote Rapids (HF DOE 1990e:3-60). Certain indigenous plants and animals found at Hanford are used in religious ceremonies. Sites sacred to Native Americans at Hanford include remains of prehistoric villages, cemeteries, ceremonial longhouses or lodges, rock art, fishing stations, and vision quest sites. Culturally important localities and geographic features include Rattlesnake Mountain, Gable Mountain, Gable Butte, Goose Egg Hill, Coyote Rapids, and the White Bluffs portion of the Columbia River.

Paleontological Resources. There are three geologic units at Hanford: the Columbia River Basalt group, the Ringold Formation, and the Hanford Formation. Pliocene and Pleistocene Age remains have been identified at Hanford. The Upper Ringold Formation dates to the Late Pliocene and contains fish, reptile, amphibian, and mammal fossil remains. Late Pleistocene Tuchet beds have yielded mammoth bones. These beds are composed of fluvial sediments deposited along ridge slopes that surround Hanford.

3.2.8 SOCIOECONOMICS

Socioeconomic characteristics described for Hanford include employment, regional economy, population, housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses nine counties surrounding Hanford in Washington (Table L.1–1). Statistics for population, housing, community services, and local transportation are presented for the ROI, a three-county area in which 90.8 percent of all Hanford employees reside: Benton County (78.8 percent), Franklin County (8.9 percent), and Yakima County (3.1 percent) (Table L.1–2). In 1996, Hanford employed approximately 14,586 persons (approximately 4 percent of the total employment in the REA).

Regional Economy Characteristics. Selected employment and regional economy statistics for the Hanford REA are summarized in Figure 3.2.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 10.3 percent to 254,777. The 1994 unemployment rate in the REA was 9.1 percent, significantly higher than the rate of 6.4 percent in Washington. In 1993, the REA per capita income of $18,501 was 15 percent lower than Washington's per capita income of $21,839.

Employment patterns in the REA parallel those in Washington, with manufacturing, retail trade, and services providing the majority of jobs. The service sector accounts for the highest percentage of employment in both the REA and Washington, 26.3 percent and 27.4 percent, respectively.

Population and Housing. Population and housing trends in the ROI are summarized in Figure 3.2.8–2. The ROI population, which totalled 379,693 in 1994, increased 19.8 percent during the period 1980 to 1994, much lower than the 29.3-percent increase in Washington. Population growth rates among the three counties composing the ROI, range from 18.1 percent in Benton County to 21.9 percent Franklin County.

Between 1980 and 1990, the number of housing units in the ROI increased by about 5 percent, compared to the 20-percent increase in Washington. However, homeowner and renter vacancy rates in 1990 were about the same in both the Hanford ROI and Washington, approximately 1 percent and 6 percent, respectively.

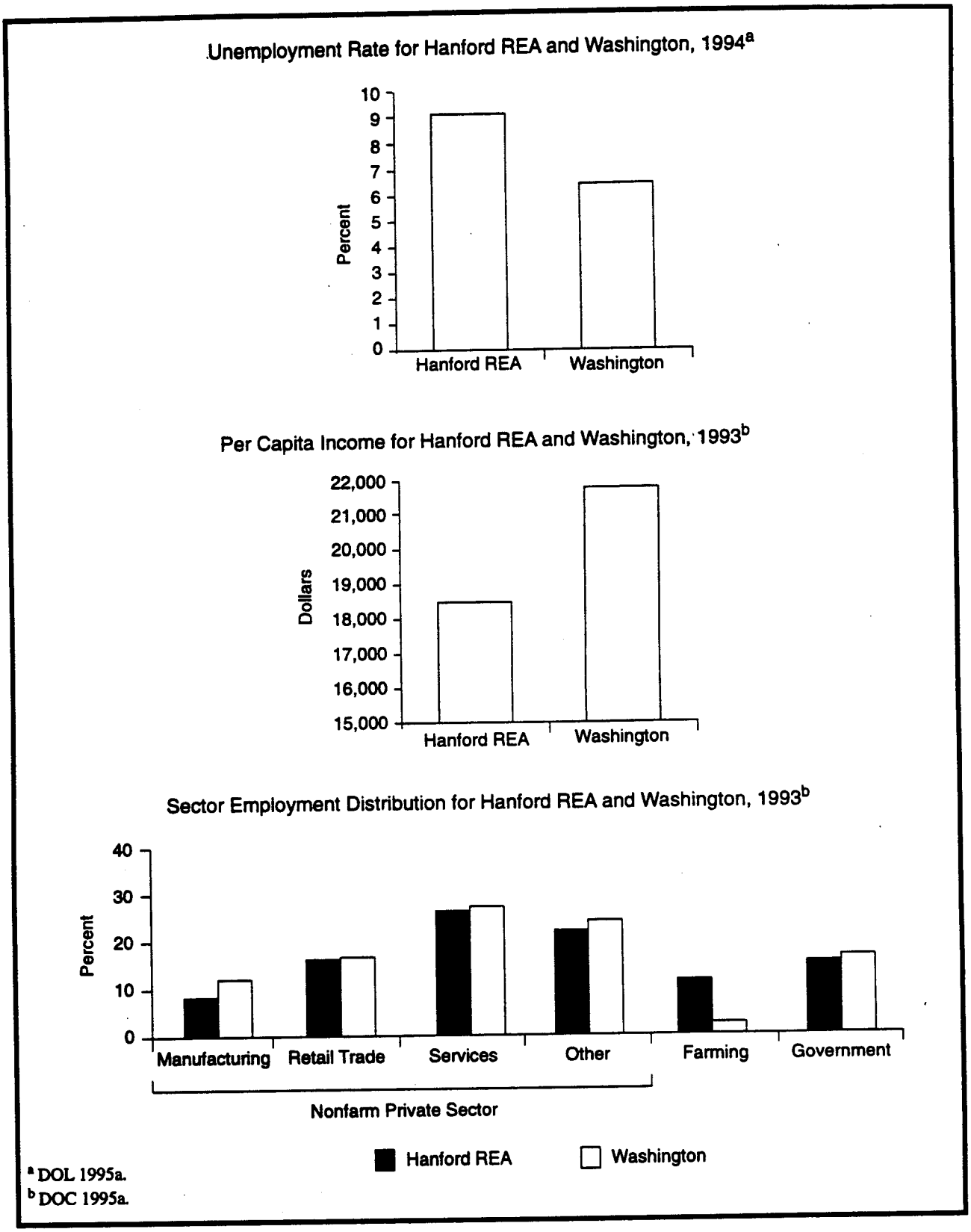
Community Services. Community services described for the Hanford ROI are education, public safety, and health care. Figure 3.2.8–3 presents school district characteristics for the Hanford ROI, and Figure 3.2.8–4 presents public safety and health care characteristics.

Education. Twenty-five school districts provide public education in the Hanford ROI. As shown in Figure 3.2.8–3, school districts were operating at capacities ranging from 63 percent to 125 percent in 1994. The student-to-teacher ratios in the ROI ranged from a low of 5.9:1 in the Kahlotus district to a high of 21.5:1 in the Kiona-Benton district. The average student-to-teacher ratio in the ROI was 18.9:1.

Public Safety. Fifteen city and county law enforcement agencies provide police protection in the ROI. In 1994 the highest sworn officer-to-population ratio in the ROI was 1.85 sworn officers per 1,000 persons in the city of Pasco. The ROI average officer-to-population ratio was 1.6 officers per 1,000 persons. Figure 3.2.8–4 displays the ratio of sworn police officers to population for the Hanford ROI counties and cities.

Thirty-seven fire departments provide fire protection services for the Hanford ROI. The principal municipal fire departments include both professional and volunteer staff. In 1995, the greatest staffing strength relative to population was in Franklin County, with 7.7 firefighters per 1,000 persons (Figure 3.2.8–4). The ROI average firefighter-to-population ratio was 4.0 firefighters per 1,000 persons.

Health Care. Eight hospitals serve the three-county region, with the majority operating well below capacity. In 1994, a total of 465 physicians served the ROI. Figure 3.2.8–4 shows that the average physician-to-population ratio in the ROI was 1.2 physicians per 1,000 persons, and the hospital bed-to-population ratio ranged from 2.0 beds per 1,000 persons in Benton County to 2.3 beds per 1,000 persons in Franklin and Yakima Counties.



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.2.8–1. Employment and Local Economy for the Hanford Site Regional Economic Area and the State of Washington.

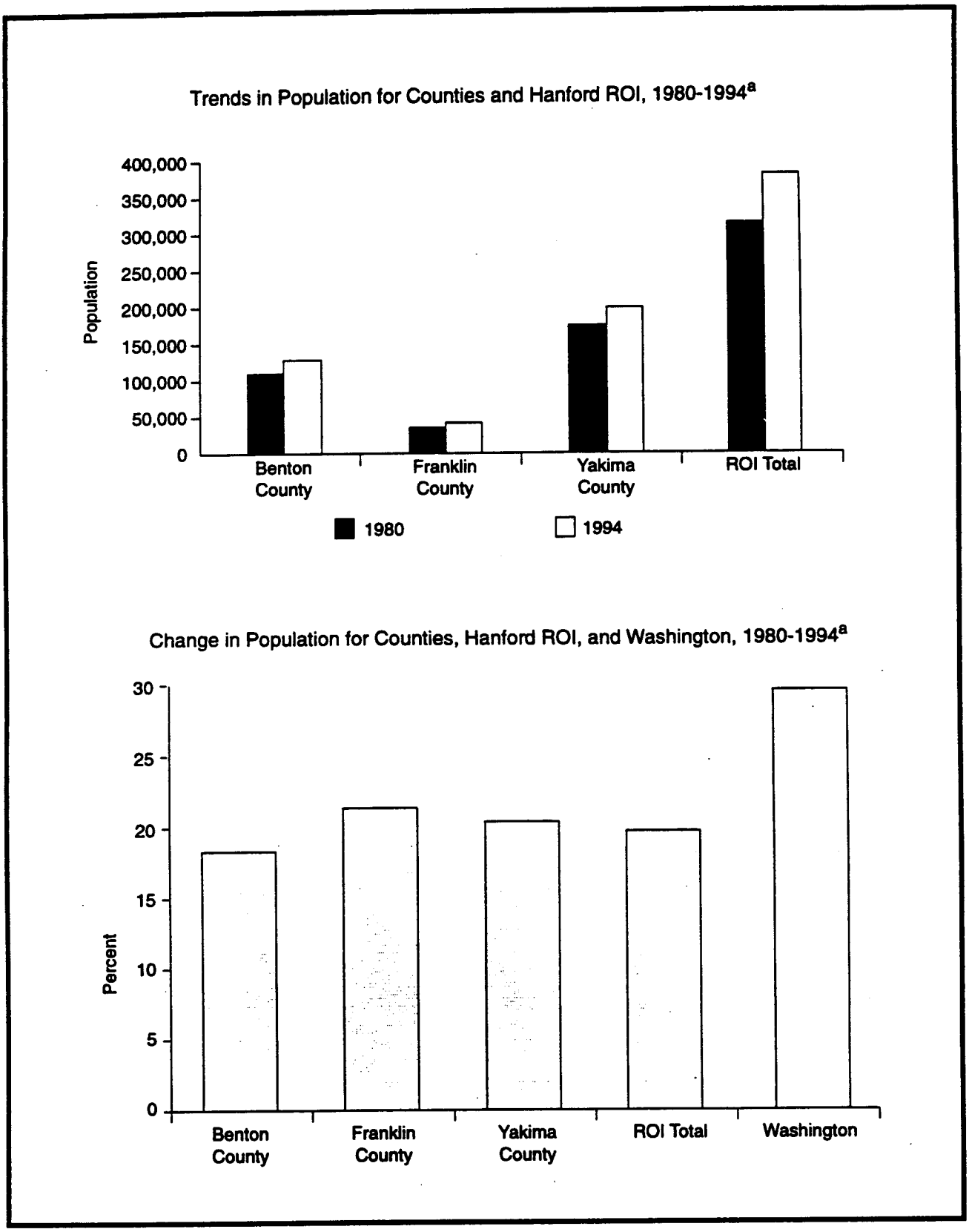
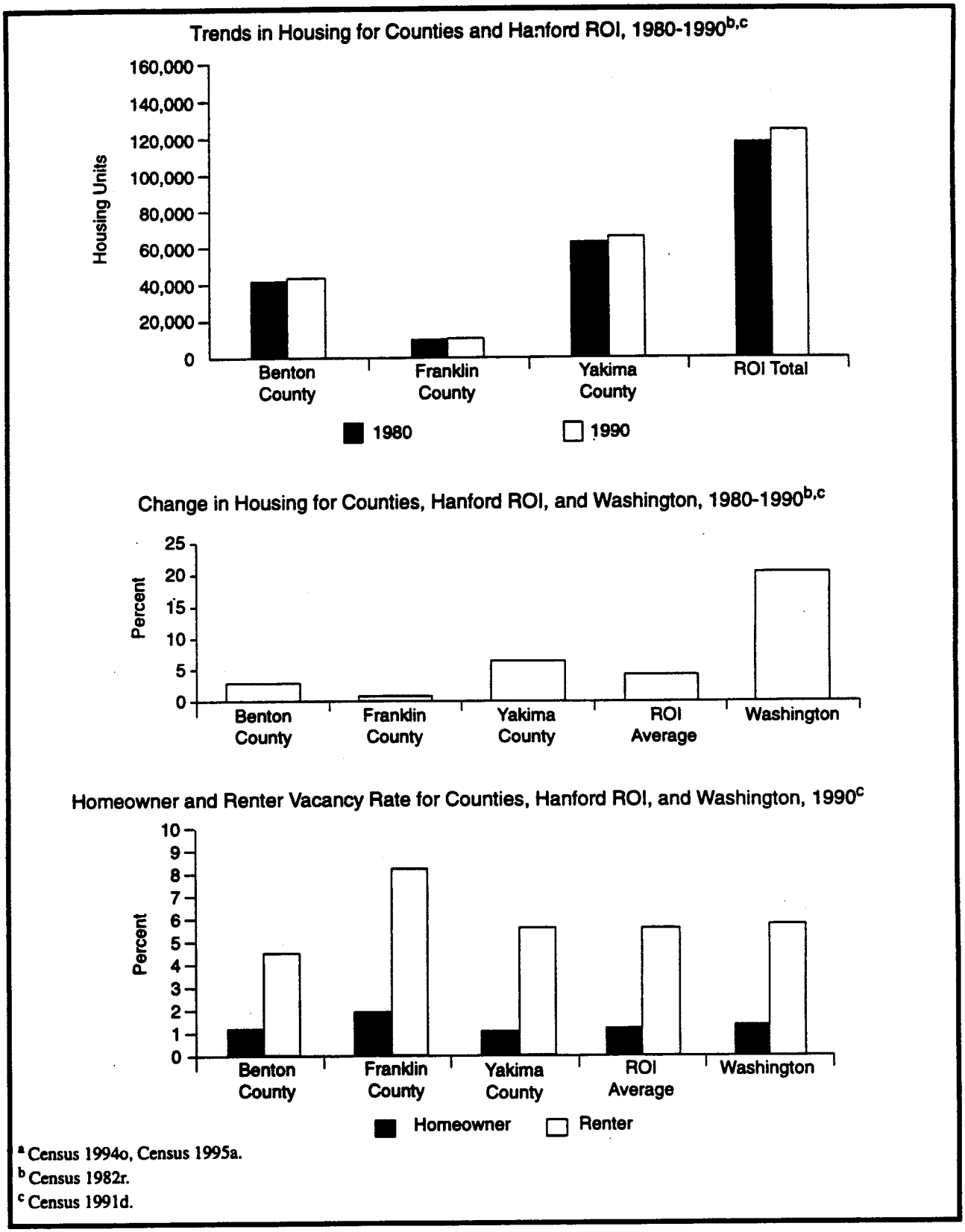
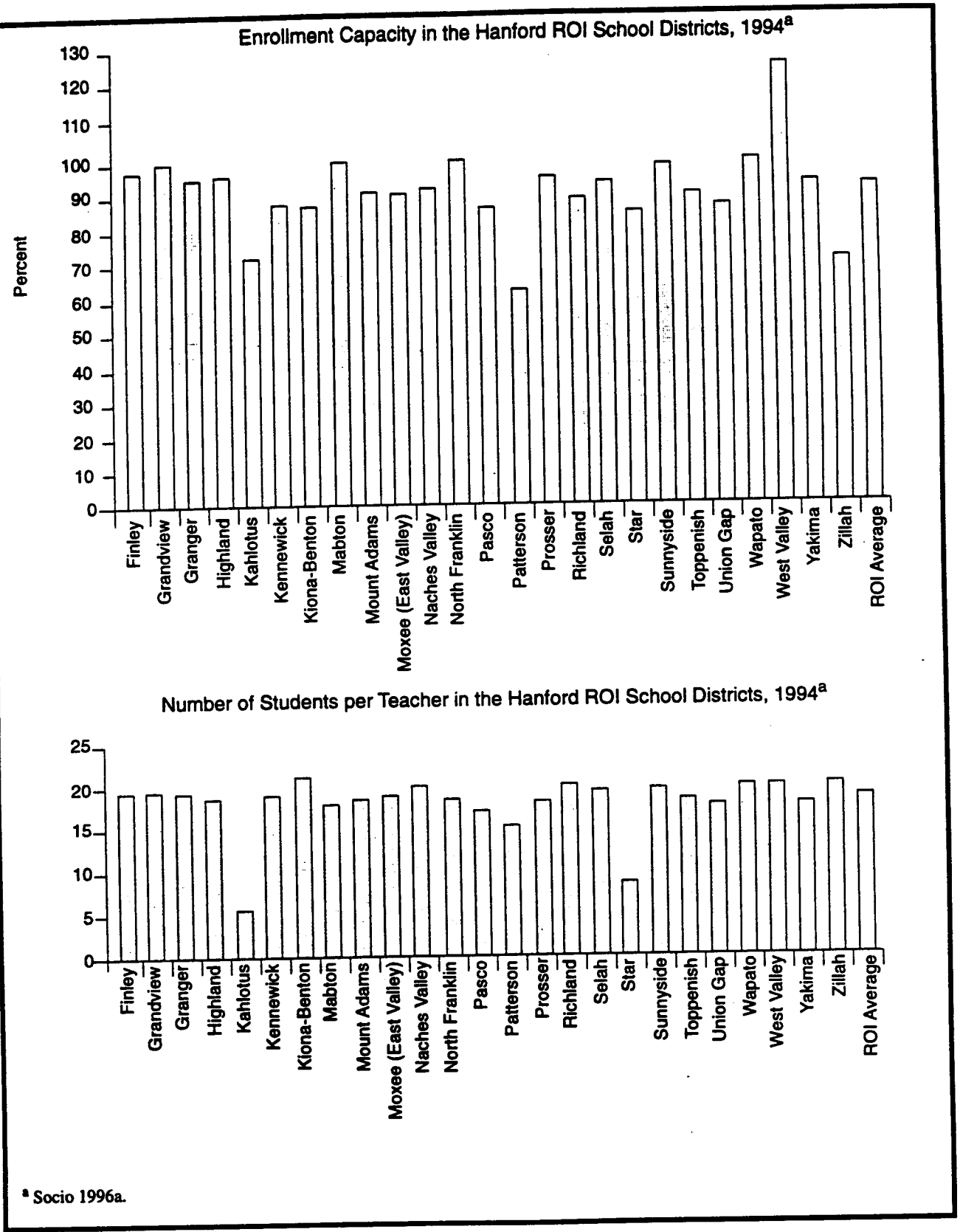


Figure 3.2.8–2. Population and Housing for the Hanford Site Region of Influence and the State of Washington.



[a] Census 1994o, Census 1995a.
[b] Census 1982r.
[c] Census 1991d.

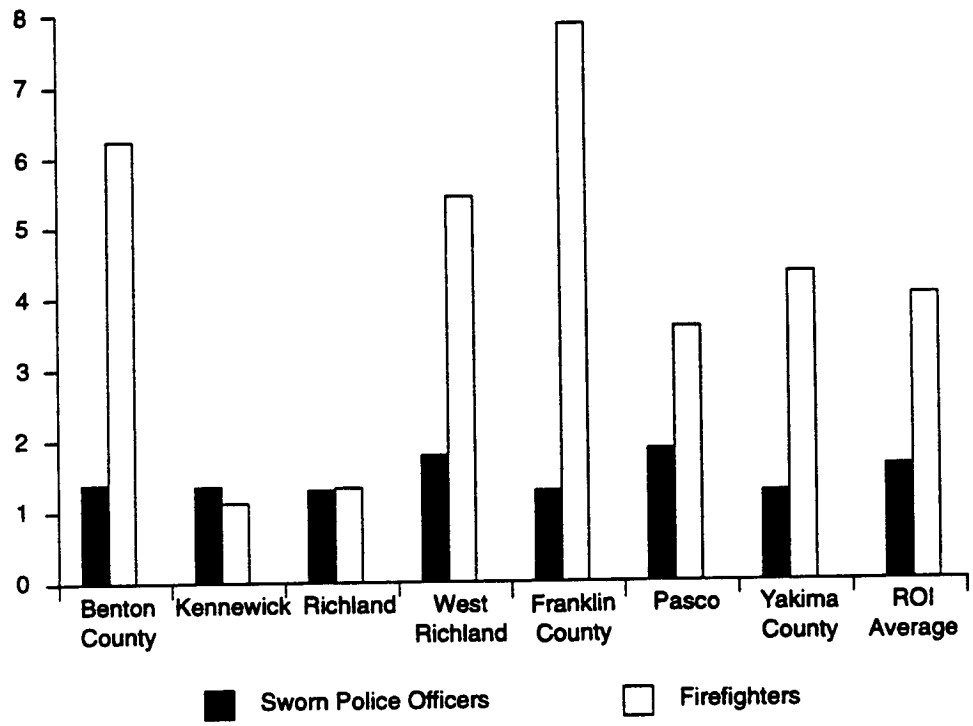
Figure 3.2.8–2. Population and Housing for the Hanford Site Region of Influence and the State of Washington—Continued.



[a] Socio 1996a.

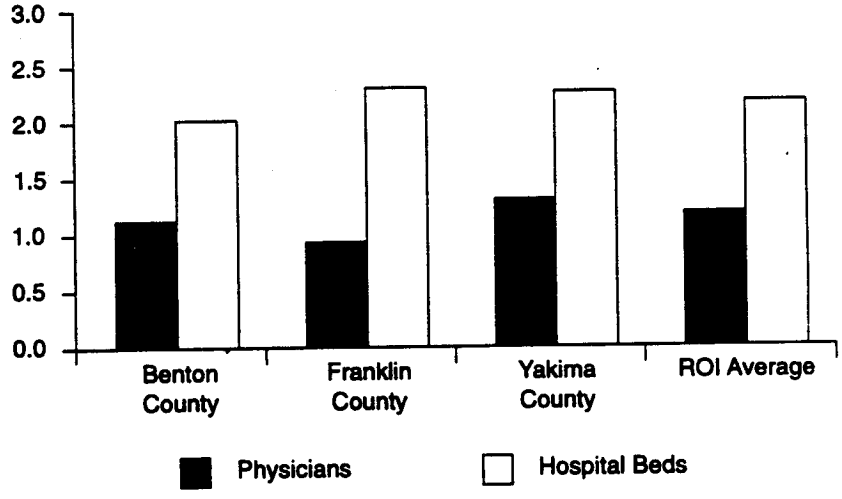
Figure 3.2.8–3. School District Characteristics for the Hanford Site Region of Influence.

Number of Sworn Police Officers (1994) and Firefighters (1995) per 1,000 Persons in the Hanford ROI[a]



Note: Non-ROI city values are included in county totals.

Number of Physicians and Hospital Beds per 1,000 Persons in the Hanford ROI, 1994[b]



[a] Census 1995a; DOC 1996a; DOC 1996b; DOJ 1995a; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.2.8–4. Public Safety and Health Care Characteristics for the Hanford Site Region of Influence.

Local Transportation. Interstate highways and State Routes provide access between Hanford and metropolitan areas (see Figure 2.2.1–1 and Figure 2.2.1–2). The east-west highways, Interstate 90 and Interstate 84, are located north and south of the site, respectively. Interstate 90 is the major link west to Seattle and east to Spokane. Interstate 84 is the major link to Portland, Oregon. Interstate 90 and Interstate 84 are connected by Interstate 82, which is located southwest of Hanford. Interstate 182 is located southeast of the site and provides an east-west corridor linking Interstate 82 to the Tri-Cities (Richland, Kennewick, and Pasco) area.

Vehicular access to Hanford is provided by several highways. State Route 240 is the preferred route from the Tri-Cities area. State Route 240 connects to the Richland bypass highway, which interconnects with Interstate 182. State Route 243 exits the site's northwestern boundary and serves as a primary link between the site and Interstate 90. State Route 24 enters the site from the west and continues eastward across the northernmost portion of the site and intersects State Route 26 approximately 16 km (10 mi) east of the site boundary. State Route 240 traverses the site in the southwestern section.

There are no current road improvement projects that affect access to Hanford. However, two projects currently in the planning stage could affect access to Hanford in the future. These projects are a realignment of State Route 240 from Stevens Drive to State Route 224 and an asphalt overlay of State Route 24 from Taylor Ranch to State Route 241 (WA DOT 1995a:1). The one road segment in the ROI that could be affected by the storage and disposition alternatives is State Route 240 from State Route 24 to State Route 224. In 1995, this road segment operated at level of service B.

The local intercity transit system, Ben Franklin Transit, supplies bus service between the Tri-Cities and Hanford. Both private interests and Ben Franklin Transit provide van pooling opportunities in the ROI.

Onsite rail transport is provided by a short-line railroad owned and operated by DOE. There is a total of 161 km (100 mi) of track. This line connects with the Union Pacific line just south of the Yakima River. The Union Pacific line interchanges with the Washington Central and Burlington Northern and Santa Fe at Kennewick. The rail system is mainly used to deliver coal to various boiler plants at Hanford. The rail system delivers equipment and material to the various facilities when rail shipment is more convenient than truck. There is no passenger rail service at Hanford.

In the ROI, the Columbia River is used as an inland waterway for barge transportation from the Pacific Ocean. The Port of Benton provides a barge slip where shipments arriving at Hanford may be off-loaded (HF County 1996a:1). [Text deleted.]

Tri-Cities Airport located near the city of Pasco provides jet air passenger and cargo service by both national and local carriers. Numerous smaller private airports are located throughout the ROI (DOT 1992a:7-325).

3.2.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of Hanford are shown in Table 3.2.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to Hanford operations.

Table 3.2.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Hanford Site Operation

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic and cosmogenic radiation	30
External terrestrial radiation	30
Internal terrestrial radiation	40
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	365

[a] HF PNL 1994b.

[b] NCRP 1987a.

Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from Hanford operations provide another source of radiation exposure to individuals in the vicinity of Hanford. Types and quantities of radionuclides released from Hanford operations in 1993 are listed in the *Hanford Site Environmental Report for Calendar Year 1993* (PNL-9823). Doses to the public resulting from these releases are presented in Table 3.2.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1993 report were used in the development of the reference environment's (No Action) radiological releases and resulting impacts for the year 2005 (Section 4.2.1.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from Hanford operations in 1993 is approximately 1.6×10^{-8}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of Hanford operations is less than 2 chances in 100 million. (Note that it takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Based on the same risk estimator, 1.8×10^{-4} excess fatal cancers are projected in the population living within 80 km (50 mi) of Hanford from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based upon this mortality rate, the number of fatal cancers expected during 1993 in the population living within 80 km (50 mi) of Hanford was 760. This number of expected fatal cancers is much higher than the estimated 1.8×10^{-4} fatal cancers that could result from Hanford operations in 1993.

Table 3.2.9–2. Radiation Doses to the Public From Normal Hanford Site Operation in 1993 (Committed Effective Dose Equivalent)

	Atmospheric Releases[a]		Liquid Releases		Total	
Members of the General Public	**Standard[b]**	**Actual**	**Standard[b]**	**Actual[c]**	**Standard[b]**	**Actual**
Maximally exposed individual (mrem)	10	0.020	4	0.012	100	0.032
Population within 80 km[d] (person-rem)	None	0.25	None	0.11	100	0.36
Average individual within 80 km[e] (mrem)	None	6.6×10^{-4}	None	2.9×10^{-4}	None	9.5×10^{-4}

[a] Includes direct radiation dose from surface deposits of radioactive material.

[b] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (see 58 FR 16268). If the potential total dose exceeds the value, it is required that the contractor operating the facility notify DOE.

[c] The actual dose value given in the column under Liquid Releases conservatively includes all water pathways, not just the drinking water pathway.

[d] In 1993, this population was approximately 380,000.

[e] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: HF PNL 1994b.

Hanford workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in the facilities. Table 3.2.9–3 presents the average worker, maximally exposed worker, and total cumulative worker dose to Hanford workers from operations in 1992. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to Hanford workers from normal operations in 1992 is projected to be 0.10.

Table 3.2.9–3. Radiation Doses to Workers From Normal Hanford Site Operation in 1992 (Committed Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard[a]**	**Actual**
Average worker (mrem)	ALARA	27.3
Maximally exposed worker (mrem)	5,000	3,000
Total workers[b] (person-rem)	ALARA	258

[a] DOE's goal is to maintain radiological exposure as low as reasonably achievable.

[b] The number of badged workers in 1992 was approximately 9,470.

Source: 10 CFR 835; DOE 1993n:7.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Hanford Site Environmental Report for Calendar Year 1993* (PNL-9823). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in that document.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain

hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface water during swimming, soil through direct contact, or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are presented in Section 3.2.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements) contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and through inspection of mitigation measures. Health impacts to the public may occur during normal operations at Hanford via inhalation of air containing hazardous chemicals released to the atmosphere by Hanford operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.2.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to Hanford workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Hanford workers are also protected by adherence to Occupational Safety and Health Administration (OSHA) and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm. Therefore, worker health conditions at Hanford are expected to be substantially better than required by standards.

Health Effects Studies. Three epidemiological studies and a feasibility study have been conducted on communities around Hanford to determine if there are any excess cancers in the general population. One study found no excess cancers but identified an elevated rate of neural tube defects in progeny. This elevated rate was not attributed to parental employment at Hanford. A second study suggested that neural tube defects were associated with cumulative radiation exposure and also showed other defects that statistically were associated with employment at Hanford, but not with parental radiation exposure. The third study did not show any cancer risk associated with living near the facility.

Many epidemiologic studies have been carried out on the Hanford workers, including updated cohort analyses over the years. The studies have consistently shown a statistically significant elevated risk of death from multiple myeloma among Hanford male workers associated with radiation exposure. The excess was observed only among workers exposed to 10 radiation absorbed doses (rads) or more. Other studies have also identified an elevated risk of death from pancreatic cancers, but the elevated risk disappeared in a recent re-analysis of the updated cohort. Among Hanford female workers, studies have reported an elevated risk of deaths from musculoskeletal and connective tissue systems.

A more detailed description of the studies reviewed and the findings is found in Section M.4.2.

[Text deleted.]

Accident History. There have been 127 nuclear-process-related incidents with some degree of safety significance at Hanford over its period of operation. These do not include less-significant instances of radioactivity release or contamination during normal operations, which have been the subject of other reviews. The 127 incidents fall into 3 significant categories, based on the seriousness of the actual or potential consequences.

Fourteen of the incidents were Category 1, indicating that serious injury, radiation release or exposure above limits, substantial actual plant damage, or a significant challenge to safety resulted. Forty-six events were Category 2, less severe than Category 1, but involving significant cost or a less significant threat to safety. The remaining 67 incidents were Category 3, causing minor radiation exposure or monetary cost, or involving a violation of operating standards without a serious threat to safety (HF 1993a:1). [Text deleted.]

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

Accordingly, DOE RL has developed and maintains a comprehensive set of emergency preparedness plans and procedures for Hanford to support onsite and offsite emergency management actions in the event of an accident. The DOE RL also provides technical assistance to other Federal agencies and to State and local governments. Hanford contractors are responsible for ensuring that emergency plans and procedures are prepared and maintained for all facilities, operations, and activities under their jurisdiction, and for directing implementation of those plans and procedures during emergency conditions. The DOE RL, contractor, and the State and local government plans are fully coordinated and integrated. Emergency control centers have been established by the DOE RL and its contractors for the principal work areas to provide oversight and support to emergency response actions within those areas.

3.2.10 WASTE MANAGEMENT

This section outlines the major environmental regulatory structure and ongoing waste management activities for Hanford. A more detailed discussion of the ongoing waste management operations is provided in Section E.2.1. Table 3.2.10–1 presents a summary of waste management activities at Hanford for 1993.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations rising from its past operations at Hanford. The DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance, with applicable requirements and financial penalties for nonachievement of agreed-upon milestones.

The EPA placed Hanford on the National Priorities List (NPL) on November 3, 1989. In accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), DOE has entered into the Tri-Party Agreement with EPA and the State of Washington to govern the environmental compliance and cleanup of Hanford. Hanford has been divided into four aggregate waste sites (100, 200, 300, and 1100 Areas). An aggressive environmental restoration program is underway involving all areas of the site, using priorities established in the Tri-Party Agreement.

Hanford is the only DOE site with a preexisting agreement (Tri-Party Agreement) that meets the legal requirements specified under *Federal Facility Compliance Act*. Having this agreement exempts Hanford from having to develop a site treatment plan. This exemption is supported by written exemptions from the State of Washington and EPA. Both agencies determined that the *Report on Hanford Site Land Disposal Restrictions for Mixed Waste*, required by the Tri-Party Agreement, meets the intent of a site treatment plan. Hanford manages spent nuclear fuel and the following waste categories: high-level, TRU, low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. On April 29, 1992, DOE decided to discontinue reprocessing spent nuclear fuel solely to recover valuable materials. After the completion of several ongoing programmatic and site-specific reviews pursuant to NEPA, DOE will make decisions concerning the treatment and stabilization of the current Hanford inventory of spent nuclear fuel. Currently, spent N-Reactor, Shippingport Reactor, FFTF, and miscellaneous nuclear reactor fuel is stored in water-filled basins. Since spent nuclear fuel is not classified as waste, its management does not come under the regulations that apply to hazardous wastes, but instead is regulated by DOE Orders. Decisions concerning future receipt and management of spent nuclear fuel at Hanford will be made in accordance with the amended ROD published in the *Federal Register* on March 8, 1996 (61 FR 9441), for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F). The ROD specifies that spent nuclear fuel will be managed at Hanford, INEL, or SRS. Hanford production reactor fuel will remain at Hanford. As of 1995, Hanford has 2,133 t (2,351 tons), or 81 percent, of the total DOE existing spent fuel inventory. According to this ROD, a total of 12 shipments of non-Hanford produced reactor spent fuel will be sent from Hanford to INEL. Each shipment, either by truck or by rail, is assumed to consist of one shipping container. Hanford will not receive any additional fuel. As a result of this action, and assuming no final disposition, by the year 2035 Hanford will have 2,132 t (2,350 tons), or 78 percent, of the total existing DOE redistributed and newly generated inventory in the form of production reactor spent nuclear fuel (61 FR 9441).

A follow-on tiered, site-specific NEPA analysis for the management of the spent nuclear fuel from the K Basins was published in January 1996, *Final Environmental Impact Statement, Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, Richland, Washington* (DOE/EIS-0245). Based on the analysis, an ROD was published in March 1996 (61 FR 10736). The decision consists of removing the spent nuclear fuel from the basins, vacuum drying, conditioning and sealing the spent nuclear fuel in inert-gas

Table 3.2.10–1. Spent Nuclear Fuel and Waste Management Activities at Hanford Site

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent Nuclear Fuel	None	Encapsulation	Planned	Reactor Basins. Non-Hanford production reactor spent fuel to be sent to INEL	2,133 t[a]	None—HLW Program in the future	NA
High-Level							
Liquid	None	Evaporation[b,c]	50,000[c]	Tank Farm	146,000[d]	NA	NA
Solid	None	NA	NA	NA	NA	None—HLW Program in the future	NA
Transuranic							
Liquid	None	See HLW	See HLW	Tank Farm	See HLW	NA	NA
Solid	271	None	NA	Containers on asphalt pads	15,370	None—WIPP or alternate facility in the future	None
Mixed Transuranic							
Liquid	0	See HLW	See HLW	Tank Farm	See HLW	NA	NA
Solid	98	None	NA	Containers on asphalt pads	15,370	None—WIPP or alternate facility in the future	None
Low-Level							
Liquid	None	Evaporation, separation, solidification	Evaporator in service, new vitrification facilities planned	None	NA	NA	NA
Solid	3,390	Compaction	4,000[e]	Not Stored	NA	Burial	902,900[f]
Mixed Low-Level							
Liquid	3,760	Evaporation, ion exchange[c]	50,000	Storage tanks, basins planned	446,500[g]	None	NA
Solid	1,505[h]	None	NA	RCRA facility, retrievable	1,218,700	Landfill, LLW Burial Grounds 218-E-NN	See solid LLW
Hazardous							
Liquid	See solid	None	NA	RCRA building	See solid	Commercial[i]	NA

Table 3.2.10–1. Spent Nuclear Fuel and Waste Management Activities at Hanford Site—Continued

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Solid	560[j]	None	NA	RCRA building	127	Commercial[i]	NA
Nonhazardous (Sanitary)							
Liquid	246,000[k]	None	NA	None	NA	Septic tanks, french drains	Expandable
Solid	5,107	None	NA	None	NA	Richland Sanitary Landfill	Expandable
Nonhazardous (Other)							
Liquid	Included in sanitary	None	NA	None	NA	Percolation ponds, leachfields	Expandable
Solid	Included in sanitary	None	NA	None	NA	Landfill	Expandable

[a] Spent nuclear fuel is normally expressed in metric tons not cubic meters.

[b] Vitrification planned.

[c] 242-A Evaporator restarted in April 1994 after upgrades were completed. Assumes 242-A Evaporator as treatment method for liquid HLW and liquid TRU and mixed TRU.

[d] Consists of HLW and liquid TRU wastes in Double-Shell Tanks; Pu recovery and extraction aging waste. Includes 241-AN, 241-AP, 241-AW, 241-AY, 241-AZ, and 241-SY Tank Farms.

[e] Compaction by LLW Compactor (213-W).

[f] Includes the LLW Burial Grounds (unit 218-E-NN) and Low-Level Mixed Waste Disposal Facility (Project W-025).

[g] Assumes storage of liquid mixed LLW in tanks and planned basins.

[h] Consists of 1,500 m^3 of RCRA-regulated mixed LLW and 8.2 t of *Toxic Substances Control Act*-regulated mixed LLW. Volume estimate for TSCA-regulated mixed LLW was made based on a density factor of 1,500 kg/m^3.

[i] Offsite at RCRA facility.

[j] Consists of 628 t (RCRA-regulated), 72.8 t (State-regulated), and 139 t (TSCA-regulated). A volume estimate was made based on a density factor of 1,500 kg/m^3 for solids.

[k] No data. Estimate made based on employment of 14,856 and 30 gal/person/day for 250 days.

Note: NA=not applicable.

Source: 61 FR 9441; DOE 1993h; DOE 1994d; DOE 1994k; HF DOE 1993a; HF MMES 1993a; HF WHC 1995c; ORNL 1993a.

filled canisters for dry vault storage in a new facility, to be built at Hanford, for up to 40 years pending decisions on ultimate disposition.

High-Level Waste. High-level waste was generated in the recovery of uranium and Pu from spent fuel generated in the production reactors. All of this radioactive waste is considered mixed waste because of its toxic and hazardous constituents as defined by RCRA. It must be remotely handled because of its high radiation levels. The waste was generated as liquids and sludges and stored in underground tanks where the sludges and salts in the liquid have precipitated out of solution as porous solids (called salt cake) and settled to the bottom of the tanks. The liquid above the solids has been pumped from the older, single-shelled tanks into newer, double-shelled tanks. The liquids that remain in the porous salt cake will be removed by boring holes through the salt cake and extracting liquids from near the tank bottoms. The wastes are segregated and handled according to their hazardous nature (corrosivity, chemical stability, heat generation rates), and require special monitoring and venting. Cooling is needed for some of these wastes. The wastes are concentrated by evaporation and returned to the tanks for storage until final processing to a form suitable for disposal in a Federal repository. It is planned to vitrify HLW water-soluble sludges and selected radionuclides separated from liquids retrieved from the tanks. Vitrification of all waste from tanks is expected to be completed by 2028. In addition to this liquid and solid HLW, an inventory of encapsulated Cs and Sr is stored in the Waste Encapsulation and Storage Facility in a water-cooled pool. Some of this material was used as irradiation sources in, for example, radiography and food irradiation. [Text deleted.]

Transuranic Waste. Before 1970, TRU waste was buried in near-surface trenches. These wastes will require retrieval, segregation, processing, certification, and packaging before their final disposal. At the same time, the burial sites themselves will require extensive remediation. TRU wastes generated since 1970 have been separately stored in near-surface trenches (both lined and unlined) or in aboveground buildings. These wastes will also require assay, recertification, and possibly repackaging. Some TRU wastes generated since 1986 have been packaged and certified to the WIPP WAC. The best available treatment technologies will be utilized, as required, on a case-by-case basis, to process the retrieved wastes before repackaging and certification for WIPP. Storage facility expansion for these wastes at the Hanford Site Central Waste Complex is anticipated as remedial operations continue. Treatment of contact-handled TRU wastes will be provided in the future at the Waste Retrieval and Processing Facility. The waste in the underground storage tanks described in the previous HLW section contains some Pu. The final disposition of this waste awaits the development of technology and agreements with stakeholders and regulatory bodies. All currently generated contact-handled TRU waste is being placed in above-grade storage buildings at the Hanford Site Central Waste Complex and the TRU Storage and Assay Facility. TRU wastes will be maintained in storage until a suitable disposal facility is qualified for TRU waste disposal. Hanford would develop the appropriate treatment capabilities to meet the criteria of the designated repository. Mixed TRU waste quantities are included in the TRU waste category, since all these wastes are destined for ultimate disposal in WIPP depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste.

Low-Level Waste. Low-level waste is generated when separated from HLW, TRU waste, and mixed wastes in the processing of tank wastes, and also from remediation activities. Solid LLW is accumulated at the originating sites, compacted, and shipped to the Low-Level Burial Ground in the Hanford Central Waste Complex located in the 200 West Area. Additional LLW is received from offsite generators and disposed of in a series of unlined near-surface trenches. The LLW resulting from the tank waste remediation system waste preteatment program will be vitrified by the end of 2028; as a near-term contingency, the Grout Facility will be maintained in a standby condition. The vitrifed LLW will be disposed of onsite in the 200 Area at Hanford by the tank waste remediation system program.

Mixed Low-Level Waste. Ninety-nine percent of the mixed waste at Hanford is contained in tank farms. The only treatment facility currently in place for these wastes is the 242-A Evaporator, which operates to reduce the volume of these wastes. Solid waste is segregated by its hazardous characteristics (ignitability, corrosivity,

reactivity, and toxicity) and stored in buildings in the mixed waste storage facility. Defueled submarine reactor compartments continue to be received and disposed of in earthen trenches. These compartments have contained polychlorinated biphenyls (PCBs), but the Navy has a program to remove PCBs before the compartment disposal. Previously disposed mixed waste will be evaluated, treated, and disposed of according to designated criteria. Facilities completed or under construction to treat mixed wastes at Hanford are the Effluent Retention Facility, Effluent Treatment Facility (ETF) (filtration, oxidation, and ion exchange), 200 and 300 Area Treated Effluent Disposal Facility, LLW Vitrification Facility (stabilization), and the Waste Receiving and Processing Facility. Some of these facilities are scheduled to begin operations before the year 2000 to meet legally obligated milestones established in the Tri-Party Agreement and in consent orders.

Hazardous Waste. Hazardous waste is generated by various activities at PNL and from remediation and maintenance processes onsite. Except for the Interim Hazardous Waste Treatment Facility, which performs distillation, neutralization, and solidification, there are no treatment facilities for hazardous waste at Hanford; therefore, these wastes are accumulated in satellite storage areas (for less than 90 days) or at interim RCRA-permitted facilities, such as the Nonradioactive Dangerous Waste Storage Facility (Building 616), and at PNL (Building 305-B). The waste is shipped offsite by truck using DOT-approved transporters for treatment and disposal at RCRA-permitted facilities. A facility is being planned at PNL to dispose of the small volume of PNL hazardous waste and to be used for treatment technology development and demonstration.

Nonhazardous Waste. Wastewater from the process areas is treated in the 200 West Area Treatment Facility and then discharged to percolation ponds. In the future, these waste streams will be processed in an integrated liquid effluent system using a combination of local and central treatment systems. Sanitary wastewater is discharged to individual septic tanks and subsurface disposal systems. No data are collected on these waste streams. New systems will be added as processes move to different areas of the site. Sanitary wastes are estimated from standard engineering data for Hanford. Nonhazardous solid wastes are disposed of in the 600 Area central landfill. In October 1995, it was announced that DOE and the city of Richland reached an agreement to send the site's nonregulated and nonradioactive solid wastes to the Richland Sanitary Landfill. Coal waste is disposed of in landfills near the 200 East and 200 West Area powerhouses.

3.3 NEVADA TEST SITE

The Nevada Test Site is located in the southeastern part of Nye County in southern Nevada. The location of NTS within the State of Nevada is illustrated in Figure 2.2.2–1. NTS is operated by a management and integration contractor under the direction of the Nevada Operations Office. It is a remote, secure facility for conducting underground testing of nuclear weapons and evaluating the effects of nuclear weapons on military communications systems, electronics, satellites, sensors, and other materials. The first nuclear test at NTS was conducted in January 1951. Since the signing of the *Threshold Test Ban Treaty* in 1974, it has been the only U.S. site used for nuclear weapons testing.

Approximately one-half of the land (located in the eastern and northwestern portions of the site) is used for nuclear weapons testing, one-quarter (located in the western portion of the site) is reserved for future missions, and one-quarter is used for research and development and other facility requirements. Facilities include nuclear device assembly, diagnostic canister assembly, hazardous liquid spill, and the Radioactive Waste Management Site (RWMS). Figure 2.2.2–2 indicates the location of existing facilities within NTS.

In addition, Yucca Mountain, an area located on the western boundary of the site, is being characterized as directed by the NWPA of 1982, as amended, to determine its suitability as a repository for the disposal of commercial and DOE-owned spent nuclear fuel and radioactive HLW. DOE published an NOI for the preparation of an EIS (August 7, 1995) to evaluate a proposed action to construct, operate, and eventually close a geological repository.

Activities at NTS are concentrated in several general areas. Most of the onsite work is related to defense program activities, although environmental management, other DOE, and non-DOE activities are conducted as well. NTS is a unique facility because it is a large, open area into which access is tightly controlled; it has a substantial infrastructure; and it has the capability to handle and run tests using hazardous or radioactive materials. Because of this, activities other than nuclear testing, including mobile missile transporter tests and nuclear rocket tests, have been carried out for other Federal departments and agencies.

Department of Energy Activities. The NTS was established as the site within the United States where underground testing of nuclear weapons would occur. Since that time, other missions have been added due to the nature of the site. Likewise some activities have been terminated or not actively pursued. The current missions at NTS are shown in Table 3.3–1.

Table 3.3–1. Current Missions at Nevada Test Site

Mission	Description	Sponsor
Defense	Stockpile stewardship, including the maintenance of readiness to conduct an underground nuclear test, if directed	Assistant Secretary for Defense Programs
Waste management	Safe and permanent disposal of waste through either disposal on the NTS or to offsite commercial waste treatment or disposal facilities	Assistant Secretary for Environmental Management
Environmental restoration	Identify contaminated areas and cleanup those areas, as appropriate	Assistant Secretary for Environmental Management
Nondefense research & development	Original research efforts by the DOE, universities, industry, and other federal agencies	Various Federal Departments and Agencies
Work for others	Use of NTS areas and facilities by other groups and agencies for activities such as military training exercises	Various Federal Departments and Agencies

Source: DOE 1995i.

In addition to DOE nuclear testing activities at NTS, the Defense Special Weapons Agency has conducted tests that provide DoD with data regarding vulnerability and survivability of nuclear and nonnuclear weapons systems produced by the United States. DOE defense activities at NTS are closely related to Defense Special Weapons Agency activities, with both contributing to national security. The moratorium on U.S. nuclear testing began in October 1992 in accordance with the Hatfield Amendment. At the same time, however, the President required that NTS retain the capability to resume testing if authorized. Before the moratorium, nuclear testing was limited to those tests that supported the safety and reliability of the Nation's nuclear stockpile. [Text deleted.] In July 1993, the President extended the moratorium on nuclear tests (both DOE and DoD) indefinitely, but continued to require testing capabilities at NTS.

A facility for DOE activities, the 9,300 m^2 (100,000 ft^2) DAF, is located south of Control Point One in Area 6. Both LANL and LLNL can use this facility for conducting multiple operations with high explosives and nuclear devices simultaneously. Because of its multiple facilities areas that include assembly cells, assembly bays, high bays, radiographic facilities, special nuclear materials laboratories, high explosive (HE) storage, special nuclear material storage, shipping and receiving areas, and associated administrative and support areas, all aspects of nuclear device preparations could be handled in this one facility. In addition, the facility could provide increased overall security and allow easier entrance and exit accessibility for the workers during hazardous operations. There would be no manufacturing of special nuclear material at this facility.

There are active radioactive and mixed waste disposal areas onsite in Areas 3 and 5. The only major environmental management facility anticipated for NTS is a waste management facility to handle TRU wastes. A major program to characterize the groundwater at NTS is in progress to determine regional flow paths and rates and to detect any migration of contamination from past nuclear testing.

Although the principal activity at NTS has been the underground testing of nuclear devices, DOE is also involved in a number of other activities, including:

- The Yucca Mountain site in southern Nevada is being evaluated for its suitability as a repository to dispose of commercial and DOE-owned spent nuclear fuel and HLW. The Yucca Mountain Site Characterization Office (YMSCO) is conducting the site characterization activities and reports directly to Office of Civilian Radioactive Waste Management. However, because Yucca Mountain is collocated with NTS, the DOE Nevada Operations Office provides some administrative support services to YMSCO.

- The Spill Test Facility in Area 5 was completed in 1986. It is operated on a fee basis for commercial users as a basic research tool to study the dynamics of accidental releases of hazardous materials and to evaluate the effectiveness of various foams and fire retardants in accidents involving chemicals and hazardous materials.

Non-Department of Energy Activities. The main non-DOE activity at NTS was the Defense Special Weapons Agency's use of the site as a nuclear weapons effects testing facility in Area 12. Weapons effects tests were conducted to study a number of nuclear effects, including x-rays, gamma rays, neutrons, electromagnetic pulse, air blast, ground and water shock, propagation, and temperature. These tests assessed military systems in a nuclear environment. These tests were carried out in underground tunnels, including the P-Tunnel which is being considered for long-term storage alternatives in this PEIS. Various other military exercises and training activities are currently carried out at NTS.

3.3.1 LAND RESOURCES

Land Use. The NTS occupies approximately 350,000 ha (approximately 864,000 acres) (NT DOE 1996c:4-1; NT DOE 1994d:2) in southern Nye County of southern Nevada, with the southwestern boundary located approximately 16 km (10 mi) from California. The town of Indian Springs and Indian Springs Air Force Auxiliary Field in northeast Clark County, Nevada, are located 39 km (24.2 mi) southeast of the NTS boundary. All of the land within NTS is owned by the Federal Government and is administered, managed, and controlled by DOE. NTS is entirely bordered by Federal land—to the north, east, and west by Nellis Air Force Range, and to the south by land administered by the BLM.

In the mid-1800s, lands that now comprise NTS were included within the boundary of the Ruby Valley Treaty between the United States and the Western Bands of the Shoshone Indians. In 1951, the Shoshone tribe sought compensation for the loss of aboriginal title to these lands and was later awarded $26 million (NT DOE 1995e:2). The land area that today constitutes the current NTS configuration was withdrawn from all forms of appropriation under the public land laws, including mining and mineral-leasing laws through four Public Land Orders and a Memorandum of Understanding with the U.S. Air Force (NT DOE 1996c:4-5, 4-8, 4-9). The NTS boundary is defined by the four land withdrawals (NT DOE 1996f:2). On February 12, 1952, Public Land Order 805 reserved approximately 176,040 ha (435,00 acres) of land for use by the Atomic Energy Commission (AEC) as a weapons testing site. Approximately 15,540 ha (38,400 acres) were reserved for the use of the AEC in connection with NTS under Public Land Order 1662 on June 20, 1958. The lands described under this Public Land Order are not considered for any storage and disposition alternative and therefore are not addressed in this PEIS (NT DOE 1996c:4-5).

On December 19, 1961, approximately 128,691 ha (318,000 acres) of land previously reserved for use by the U.S. Air Force were transferred to the jurisdiction of the AEC for use in connection with NTS for test facilities, roads, utilities, and safety distances under Public Land Order 2568. Approximately 8,542 ha (21,108 acres) of land were reserved for the jurisdiction of the AEC for use in connection with NTS on August 3, 1965 under Public Land Order 3759. The northern portions of Areas 19 and 20, which encompass approximately 42,994 ha (106,240 acres), is managed by DOE as part of NTS in accordance with a 1963 Memorandum of Understanding with the U.S. Air Force. This memorandum was superseded by a Memorandum of Understanding between the U.S. Air Force and DOE/NV in 1982 (NT DOE 1996c:4-5). Therefore, the NTS site boundary does not include Pahute Mesa (NT DOE 1996f:2).

Existing Land Use. Generalized land uses at NTS and its vicinity are shown in Figure 3.3.1–1. NTS is divided into three major regions (Figure 3.3.1–2). The northern and eastern regions of NTS constitute the underground nuclear weapons test area. Nuclear test ranges are located at Yucca Flat, Pahute Mesa, Rainier Mesa, and Buckboard Mesa. The southwestern region of NTS (Area 25) provides support for nonweapons and nonnuclear weapons programs, such as the site characterization studies at Yucca Mountain, and for short-term activities, such as the Nuclear Weapons Accident Exercises conducted by the Nuclear Emergency Search Team. The remaining region contains the nonnuclear explosives test area and primary administrative and support area of NTS. NTS is subdivided into numbered areas, many of which are used or reserved for specific purposes.

In 1992, DOE designated all of NTS as a NERP. The NERP is used by the national scientific community as an outdoor laboratory for research on the effects of human activities on the desert ecosystem (DOE 1994u:v,31). There is no prime farmland present within NTS. Past agricultural activities were limited to an EPA agricultural and animal radiological research facility that closed in 1981. Offsite agricultural activity occurs on the south side of U.S. Route 95 and is limited to a cattle allotment granted by the BLM.

The Timber Mountain Caldera National Natural Landmark is located in the northwest portion of NTS. It is separated from much of NTS by mountains along its eastern border. A recommendation to include approximately 539,000 ha (1,333,000 acres) of the Desert National Wildlife Range (DNWR), which is managed by the USFWS, in the National Wilderness Preservation System has been tabled (NV FWS 1994a:3-5,3-6). This

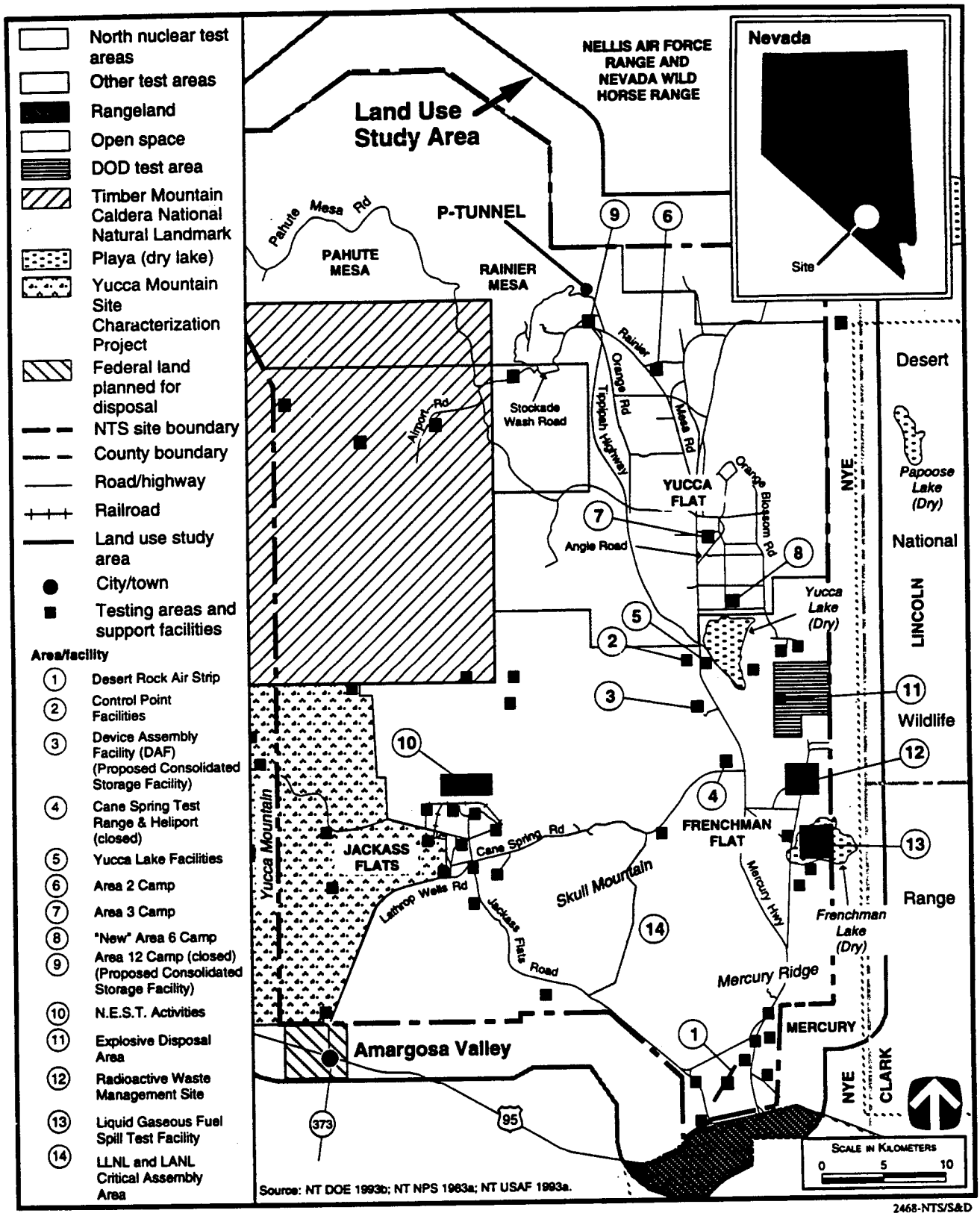


Figure 3.3.1–1. Generalized Land Use at Nevada Test Site and Vicinity.

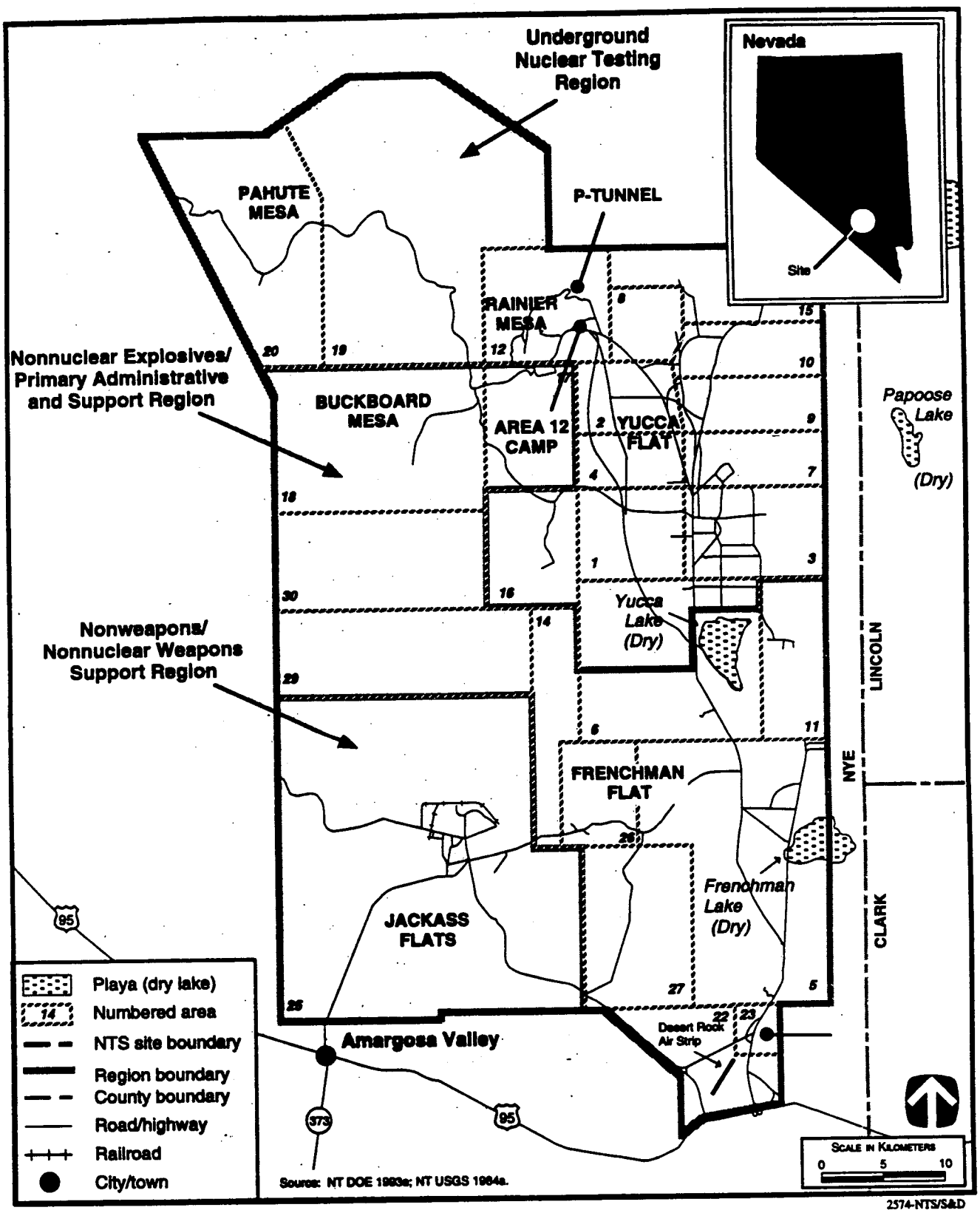


Figure 3.3.1–2. Generalized Regions at Nevada Test Site.

area of the DNWR is also part of the Nellis Air Force Range; it is jointly managed by the U.S. Air Force and USFWS. Public entry to this part of the wildlife range is generally prohibited by the Air Force, however, public entry that is allowed onto the DNWR does not occur in areas with views of NTS (NTS 1995a:6). The closest residence is located 2 km (1.3 mi) south of the NTS boundary, in the unincorporated town of Amargosa Valley.

Land-Use Planning. The Department has prepared a sitewide EIS for NTS that analyzes the environmental impacts associated with managing NTS and its resources. Four alternatives, including No Action, are presented in the EIS, with land-use and zoning categories described for each alternative. Land-use planning does not occur at the State level in Nevada; however, counties and other municipalities may plan if they so choose. The recently adopted Nye County comprehensive plan is a policy document that permits Nye County to begin a process of establishing a comprehensive land-use plan and zoning ordinance. No municipalities within Nye County have adopted land-use plans, policies, or controls (NT County 1995a:1).

Visual Resources. The NTS is located in a transition area between the Mojave Desert and the Great Basin. Vegetation characteristic of both deserts are found on NTS. The topography of NTS consists of a series of north-south oriented mountain ranges separated by broad, low-lying valleys and flats. Site topography is also characterized by the presence of numerous subsidence craters resulting from past nuclear testing. The southwestern Nevada volcanic field, which includes portions of NTS, is a nested, multicaldera volcanic field. The facilities of NTS are widely distributed across this desert setting.

The area surrounding NTS is unpopulated to sparsely populated desert and rural lands. Access to areas that would have views of NTS is controlled by NTS or the U.S. Air Force; therefore, there are few viewpoints accessible to the general public. Public viewpoints of NTS along U.S. Route 95, the principal highway between Tonopah and Las Vegas, are limited to Mercury Valley due to the various mountain ranges surrounding the NTS southern boundary. The primary viewpoint in the Mercury Valley is a roadside turnoff containing Nevada Historical Marker No. 165 of the Nevada State Park System, entitled "Nevada Test Site." The NTS facilities within 8 km (5 mi) are visible from this viewpoint. The main base camp at Mercury, located in Area 23, is well defined at night by facility lighting. The developed areas of NTS are consistent with a BLM VRM Class 5 designation. Other areas range from Class 2 to Class 4.

3.3.2 SITE INFRASTRUCTURE

Baseline Characteristics. Activities at NTS are concentrated at facilities in several general areas. Section 3.3 describes current NTS missions. To support these missions, an extensive infrastructure exists, as shown in Table 3.3.2–1.

Table 3.3.2–1. Nevada Test Site Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	640	1,100[a]
Railroads (km)	0	0
Electrical		
Energy consumption (MWh/yr)	121,460	176,844
Peak load (MWe)	27	45
Fuel		
Natural gas (m^3/yr)	0	0
Oil (l/yr)	5,716,000	5,716,000
Coal (t/yr)	0	0
Steam (kg/hr)	0	0

[a] Includes paved and unpaved roads.
Source: NTS 1993a:4.

The onsite transportation capability at NTS provides for safe and secure movement of nuclear materials. Movements are made via truck to and around the site. Improved and unimproved roads cover most of the NTS. Railbeds have existed in both Areas 25 and 26 for experimental purposes. These railbeds are neither maintained nor connected. Currently, there is no operating rail on NTS.

The regional electric power pool in which NTS is located, and from which it draws power, is the California-Southern Nevada Power Area. Electricity is provided by two independent 138-kilovolt (kV) lines. The capacity of the system is approximately 45 MWe. The site is near a major electrical hub that ties into several other areas.

Coal, nuclear, hydroelectric and geothermal, and oil and gas all contribute significantly to the region's electrical power system. Generating capacity margin for the regional pool is at 21 percent of current peak demand (see Table 3.3.2–2).

The NTS water supply system consists of 13 supply wells, pumps, booster pumps, and many sumps, reservoirs, chlorinator water softeners, and 160 km (100 mi) of supply lines. This water system is capable of producing 284 million l/week (75 million gal/week).

A major facility that could be used to store materials within the scope of this PEIS is the P-Tunnel complex located in Area 12 in the northern portion of NTS. This facility is a 1,000 m (3,281 ft) tunnel with multiple side drifts and an average earth cover of approximately 260 m (853 ft). The tunnel and drifts vary in dimension, but most are larger than 4 m (13 ft) in diameter and are lined with shotcrete. The Defense Special Weapons Agency used the P-Tunnel to perform underground nuclear effects tests.

Table 3.3.2–2. California–Southern Nevada Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel	
Coal	14%
Nuclear	15%
Hydro/geothermal	19%
Oil/gas	22%
Other[a]	30%
Total Annual Production	246,012,000 MWh
Total Annual Load	293,262,000 MWh
Energy Imported Annually[b]	45,400,000 MWh
Generating Capacity	61,681 MWe
Peak Demand	57,028 MWe
Capacity Margin[c]	11,809 MWe

[a] Includes power from both utility and nonutility sources.

[b] Energy imported is not the difference of production and load due to positive net pumped storage.

[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

3.3.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The climate at NTS and in the surrounding region is characterized by limited precipitation, low humidity, and large diurnal temperature ranges. The lower elevations are characterized by hot summers and mild winters, which are typical of other Great Basin desert areas. As elevation increases, precipitation increases and temperatures decrease (NT DOE 1986b:3-46).

The average annual temperature at NTS is 19.5 °C (67.1 °F); temperatures range from an average daily minimum of 0.9 °C (33.6 °F) in January to an average daily maximum of 41.1 °C (105.9 °F) in July. The average annual precipitation at NTS is 10.5 cm (4.13 in). Prevailing winds at NTS vary by location. The average annual windspeed is 4.2 m/s (9.4 mph) (NOAA 1994d:3). Additional information related to meteorology and climatology at NTS is presented in Appendix F.

Ambient Air Quality. The NTS is located within the Nevada AQCR (#147). The region is designated as an attainment area (40 CFR 81.329) with respect to NAAQS for criteria pollutants. Applicable NAAQS and Nevada State ambient air quality standards are presented in Appendix F.

Two PSD (40 CFR 52.21) Class I areas in the vicinity of NTS are Grand Canyon National Park, approximately 193 km (120 mi) southeast of the site, and Sequoia National Park, California, approximately 169 km (105 mi) west-southwest of the site. Since the creation of the PSD program in 1977, no PSD permits have been required for any emissions source at NTS.

The primary emission sources of criteria air pollutants at NTS include particulates from construction and other surface disturbances, fugitive dust from unpaved roads, various pollutants from fuel-burning equipment, incineration, open burning, and volatile organic chemicals (VOCs) from fuel storage facilities. A summary of emission estimates for sources at NTS is presented in Appendix F.

Table 3.3.3–1 shows the site baseline ambient air concentrations for criteria pollutants and other pollutants of concern at NTS. No hazardous air pollutants or other toxic compound sources are indicated. Baseline concentrations are in compliance with applicable guidelines and regulations. Elevated levels of O_3 and PM_{10} may occur occasionally because of pollutants transported into the area by wind or because of local sources of fugitive particulates. Concentrations of other criteria pollutants are low because there are no large emission sources nearby. The nearest nonattainment area is the Las Vegas area (40 CFR 81.329), located approximately 105 km (65 mi) southeast of NTS.

Noise. Major noise emission sources within NTS include various industrial facilities, equipment and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials handling equipment, and vehicles), and aircraft operations. No known noise surveys have been conducted at NTS to determine background sound levels. Most industrial facilities at NTS are at sufficient distance from the site boundary that noise levels at the boundary from these sources would not be measurable or would be barely distinguishable from background noise levels.

The acoustic environment around NTS is primarily uninhabited desert and small rural communities. In the uninhabited desert, the major sources of noise are natural physical phenomena, such as wind, rain, and wildlife activities, and an occasional airplane. The wind is the predominant noise source. Desert noise levels as a function of wind have been measured at an upper limit of 22 dBA for a still desert and 38 dBA for a windy desert (Webb 1983a:170). A background sound level of 30 dBA is probably a reasonable estimate. This agrees with other estimates of sound levels for rural areas. Annual rural-community day and night average sound levels (DNL) have been estimated in the range of 35 to 50 dBA and are considered to be a reasonable estimate for Indian Springs, Mercury, and the town of Amargosa Valley (EPA 1974a:B-4). Except for the prohibition of nuisance noise, neither the State of Nevada nor its local governments have established specific numerical environmental noise standards applicable to NTS.

Table 3.3.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Nevada Test Site, 1990-1992

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Baseline Concentration[b] ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000[c]	2,290
	1-hour	40,000[c]	2,748
Lead	Calendar Quarter	1.5[c]	[d]
Nitrogen dioxide	Annual	100[c]	[d]
Ozone	1-hour	235[c]	[e]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[c]	9.4
	24-hour	150[c]	106
Sulfur dioxide	Annual	80[c]	8.4
	24-hour	365[c]	94.6
	3-hour	1,300[c]	725
Mandated by the State of Nevada			
Hydrogen sulfide	1-hour	112[f]	[d]

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging time.

[b] Modeled concentration based on permit data except for CO which are monitored values.

[c] Federal and State standard.

[d] No sources of this pollutant have been identified.

[e] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[f] State standard.

Source: 40 CFR 50; NT REECO 1990a; NV DCNR 1992a; NV DCNR 1995a.

3.3.4 WATER RESOURCES

Surface Water. There are no continuously flowing streams on NTS. The most noticeable natural hydrologic features of NTS are the playas (lake beds) that collect stormwater runoff. Runoff in the eastern half of the site ultimately collects in the playas of Yucca Flat and Frenchman Flat. In the northeastern portion, runoff drains outside the test site and onto the Nellis Air Force Range Complex. In the western half and southernmost portion, runoff is carried offsite towards the Amargosa Desert. Figure 3.3.4–1 shows the location of the playas and flats. A few natural springs can be found at NTS. Surface water is not used at NTS.

There have been no studies conducted to assess 500-year floodplain boundaries at NTS. Two 100-year flood analyses have been conducted; these analyses show no runoff from a 100-year storm affecting the proposed project areas. One analysis was for Jackass Flats, but it is not near the proposed project areas. The 100-year floodplain study has been completed for the radioactive waste management site located in Area 5. This showed water flowed to the Frenchman Lake region of Area 5. However, the proposed project areas are in a region where flash flooding occurs due to locally isolated intense convection storms. These floods normally last less than 6 hours (NT DOE 1992d:4-27).

Surface Water Quality. There are no NPDES permits for the site as there are no wastewater discharges to onsite or offsite surface waters. However, the State has issued sewage discharge permits for sewage lagoons and ponds for NTS facilities. Because there are no surface waters at or near the proposed project area, and because there will be no withdrawal or discharge to natural surface waters at NTS, the assessment of surface water quality is not applicable.

Surface Water Rights and Permits. Surface water rights are not an issue because NTS facilities do not withdraw surface water for use nor do they discharge effluents directly to natural surface waters.

Groundwater. The NTS is located within three groundwater subbasins of the Death Valley Groundwater Basin. Groundwater beneath the eastern portion of NTS is located in the Ash Meadows Subbasin; the western portion is located in the Alkali Flat Furnace Creek Ranch Subbasin; and a small part of the northwestern corner is located in the Oasis Valley Subbasin (Figure 3.3.4–2). The actual subbasin boundaries, however, are poorly defined. Three general aquifers are present at NTS: the Lower Carbonate (the deepest), the Volcanic, and the Valley-Fill (the shallowest) (NT DOE 1992d:4-14). Other aquifers are present to a limited extent under the area, but their water-bearing potential has not been thoroughly investigated. Limited aquifers may occur in other volcanic units, including lava flows and bedded tuffs.

The Lower Carbonate is the regional aquifer and is comprised of carbonate rocks of Middle Cambrian through Devonian age. The saturated thickness of this confined aquifer ranges from approximately 100 m to over 1,000 m (328 ft to over 3,280 ft). This aquifer drains in a south-southwest direction, under Yucca and Frenchman Flats, toward Ash Meadows (NT DOE 1992d:4-14). However, due to the large topographic changes across the area and the importance of fractures to groundwater flow in this aquifer, local flow directions can vary significantly from this regional trend. The unconfined Volcanic and Valley-Fill aquifers range in thickness from close to 0 to about 610 m (2,000 ft) and occur in the Frenchman and Yucca Flats drainage basins, respectively (NT DOE 1992d:4-17).

Depth to groundwater at NTS ranges from approximately 150 m to over 700 m (492 ft to over 2,300 ft). It is approximately 490 m (1,607 ft) at Yucca Flat, 250 m (820 ft) at Frenchman Flat, and over 700 m (2,300 ft) at Pahute Mesa. However, there are areas of perched water that lie at considerably shallower depths.

Recent estimates of the perennial yield of all NTS aquifers (that is, the total amount that can be removed on an annual basis without resulting in a net depleting of the groundwater reservoir) range from 57 billion l (15 billion gal) (NT USGS 1988a) to 38 billion l (10 billion gal) (NT DOE 1992b:41-43). Groundwater is recharged from infiltration of precipitation in the northern and eastern mountain ranges and from underflow from upgradient

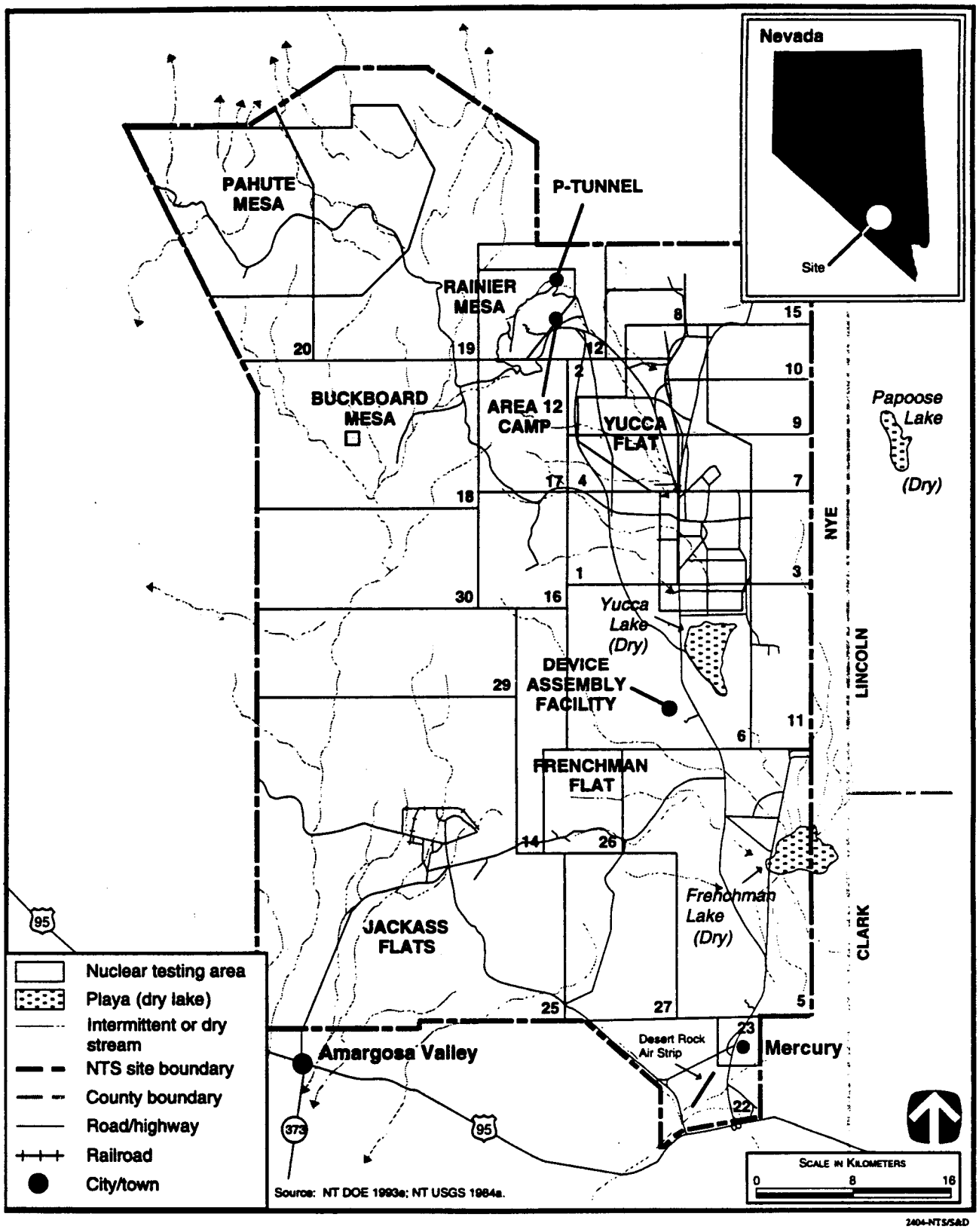


Figure 3.3.4–1. Surface Water Features at Nevada Test Site.

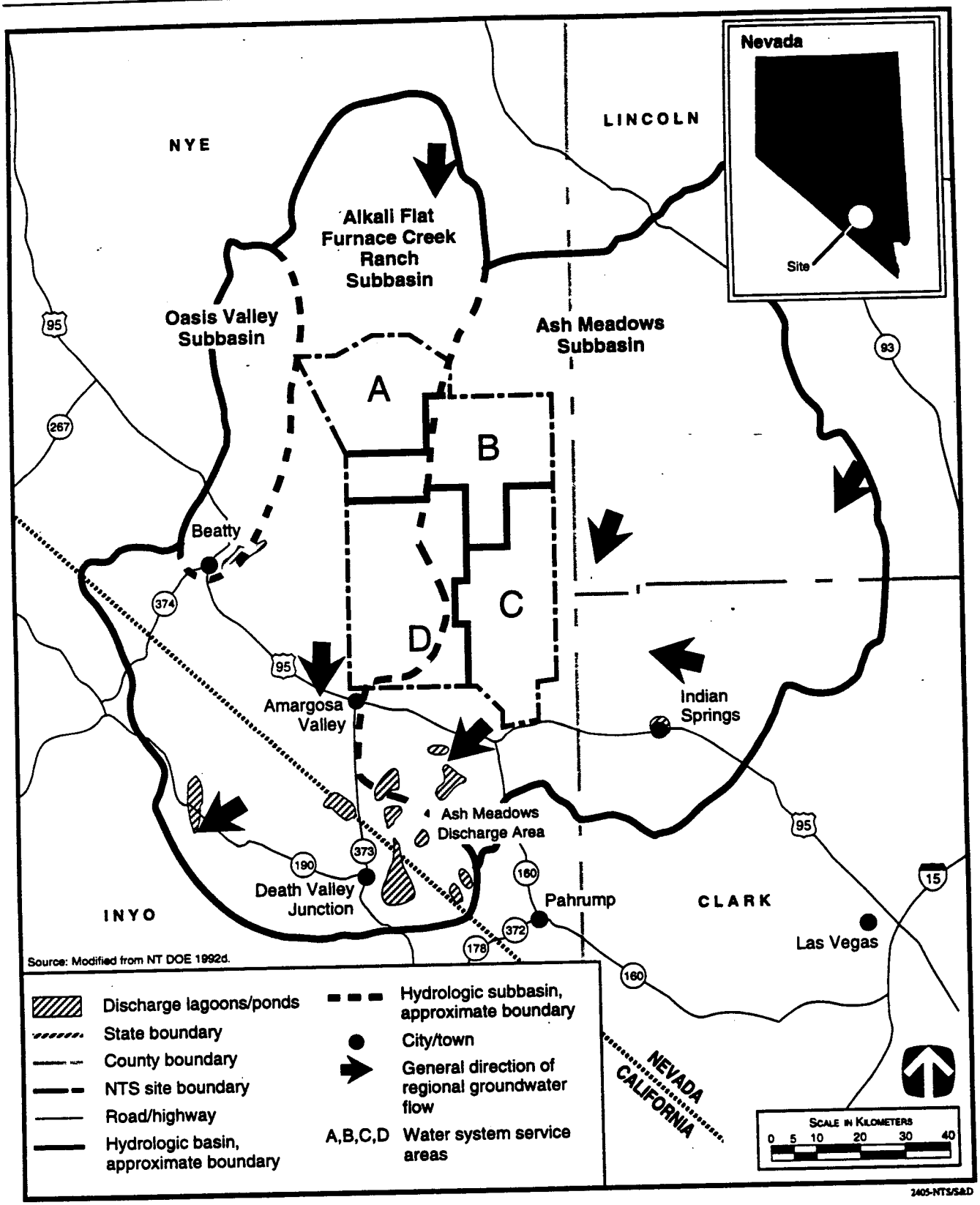


Figure 3.3.4–2. Groundwater Hydrologic Units at Nevada Test Site and Vicinity.

areas. Natural discharge from the aquifers primarily occurs from evaporation and transpiration in the Amargosa Valley (including Ash Meadows) and Death Valley areas (Figure 3.3.4–2).

Devils Hole is a water-filled limestone cavern near Ash Meadows, approximately 48 km (29.8 mi) southwest of the NTS southern boundary, and is known to contain the endangered Devils Hole pupfish. Groundwater pumping at Ash Meadows was curtailed by order of the U.S. Supreme Court in order to protect the endangered Devils Hole pupfish by maintaining water levels at Devils Hole. Studies have shown, however, that historical pumping at NTS at rates that exceed current rates was probably unrelated to observed declines at Devils Hole (NT DOE 1993b:4-27).

Groundwater Quality. Currently, aquifers beneath NTS have not been classified by EPA. However, during an independent study (NT DOE 1989a:11), the aquifers beneath NTS were classified as Class IIa and Class IIb (groundwater currently used for drinking water). In 1972, the DOE Nevada Operations Office instituted a Long-Term Hydrological Monitoring Program to be operated by the EPA under an Interagency Agreement. Groundwater is monitored on and around NTS, and at two off-NTS sites in Nevada. Only wells drilled previously for water supply or exploratory purposes are being used in the monitoring program. In compliance with the SDWA and a State of Nevada drinking water supply system permit, drinking water wells and industrial use distribution systems are sampled and analyzed on a monthly basis. Groundwater samples collected are analyzed for a standard suite of parameters and constituents, including radioactive materials, nonradioactive materials, hydrogen-ion concentration (pH), total dissolved solids (TDS) and other field parameters.

Groundwater under portions of NTS has been affected as a result of nuclear testing activities conducted during the last 43 years. Additionally, 20 percent of the tests have been conducted below the water table or have been close enough that effects have extended below it. Table 3.3.4–1 shows the groundwater quality at NTS.

Table 3.3.4–1. Groundwater Quality Monitoring at Nevada Test Site, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Potable Water Distribution System	
			High	Low
Alkalinity	mg/l	NA	270	64
Alpha (gross)	pCi/l	15[b]	11	0.62
Arsenic	mg/l	0.05[b]	0.012	<0.003[c]
Barium	mg/l	2.0[b]	0.15	0.00
Beta (gross)	pCi/l	50[d]	13	3.2
Chromium	mg/l	0.1[b]	<0.005[c]	<0.005[c]
Lead	mg/l	0.015[b]	<0.005[c]	<0.005[c]
Nitrate	mg/l	10[b]	6.8	1.2
pH	pH units	6.5-8.5[e]	8.66	7.70
Sodium	mg/l	NA	103	30
Total dissolved solids	mg/l	500[e]	639	283
Tritium	pCi/l	80,000[f]	120	0.93

[a] For comparison purposes only.
[b] National Primary Drinking Water Regulations (40 CFR 141).
[c] Below detection limit.
[d] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).
[e] National Secondary Drinking Water Regulations (40 CFR 143).
[f] DOE DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose of 100 mrem per year. However, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.
Note: NA=not applicable.
Source: NT DOE 1994b.

Due to the past nuclear testing activities at NTS, radionuclide monitoring has been an important component of the groundwater monitoring program at the site. In general, tritium is the only radionuclide that appears in sampled water. Samples collected in 1993 show tritium concentrations ranging from 120 pCi/l (454 pCi/gal), in a non-potable supply well located in the northwestern part of NTS, to 0.93 pCi/l (3.5 pCi/gal), in a potable supply well located in the southeastern part of NTS. Subsurface migration of tritium to offsite areas is possible, but the probability of tritium reaching offsite wells or springs is minimal. It is also thought that the Lower and Upper Carbonate aquifers would most likely be the aquifers in which tritium might migrate to offsite areas.

Groundwater Availability, Use, and Rights. Groundwater is the only local source of industrial and drinking water supply in the NTS area. Numerous production wells are located on NTS and distributed among various areas of the site. Figure 3.3.4–2 shows how the NTS water system has been divided into four water service areas (A, B, C, and D) based on the location of the water supply system and support facilities. Water usage on NTS is largely for potable, construction, and dust control purposes. Water supply wells at NTS draw water from the Lower and Upper Carbonate, the Volcanic, and the Valley-Fill aquifers. The total water usage in 1994 was 2,400 million l/yr (634 million gal/yr), of which 1.3 million l/yr (343.3 million gal/yr) were withdrawn from the Ash Meadows Subbasin, and 1,100 million l/yr (290.5 million gal/yr) were withdrawn from the Alkali Flat Furnace Creek Ranch Subbasin (Figure 3.3.4–2). The pumping capacity for all the water supply wells at NTS is estimated at 14,800 million l/yr (3,900 million gal/yr) (NTS 1993a:6).

The State of Nevada strictly controls all surface and groundwater withdrawals. The Appropriation Doctrine governs the acquisition and use of water rights. However, it is an established principle that when land is withdrawn from public use and reserved for Federal purposes, the Government's right to associated water may be implied. NTS has been withdrawn from public use and thus possesses an unqualified water right sufficient to meet the purposes of the NTS land withdrawal, subject to water rights that existed at the time the land for NTS was withdrawn.

Since the Federal Government has not waived its sovereign immunity with respect to Nevada's well drilling laws, it is not subject to these requirements. While DOE Nevada Operation Office is not legally required to follow Nevada water appropriation and well drilling requirements, there is no objection to responding to requests for information and cooperating in other respects with the Nevada Division of Water Resources as a gesture of goodwill.

3.3.5 GEOLOGY AND SOILS

Geology. The NTS is located in the southern part of the Great Basin section of the Basin and Range physiographic province in an intermediate position between the high, topographically closed basins in central Nevada and the low, connected basins of the Amargosa Desert-Death Valley region to the southwest. NTS consists of three flats (Yucca, Jackass, and Frenchman) surrounded by mountains. Local geology is characterized by mountains of Precambrian and Paleozoic sedimentary rocks and Tertiary volcanic tuffs and lavas. Sedimentary rocks are complex, folded, and faulted carbonates in the upper and lower parts and shale and sandstone in the middle section. Volcanic rocks are predominantly Tertiary tuffs with some basalts and scattered granitic plutons. Potential geologic resources within the NTS boundaries include silver, gold, tungsten, molybdenum, zeolites, barite, and fluorite.

The general region has been tectonically active in the recent past and has numerous faults. NTS lies in an area of moderate historic seismic activity on the southern margin of the southern Nevada, East-West Seismic Belt in Seismic Zones 2 and 3, indicating that moderate-to-major damage could occur as a result of an earthquake (Figure 3.3.5–1). More than 4,000 earthquakes have been recorded within a 241-km (150-mi) radius of NTS. Most of these were minor events, with Richter magnitudes of less than 5.5 and MMIs that may correlate to maximum ground acceleration of 0.03 gravity (Figure 3.3.5–1). The largest seismic event on record took place 161 km (100 mi) west in Owens Valley, California, and had an estimated Richter magnitude of 8.3 (NT DOE 1988a:3-117). On June 29, 1992, an earthquake of magnitude 5.6 occurred in the southwest corner of the site under Little Skull Mountain (Figure 3.3.5–1). The maximum ground acceleration from this earthquake was approximately 0.21 g at Amargosa Valley.

The Yucca and Carpetbag Faults were active during the Late Quaternary, and both are considered to be capable faults by the definition outlined in 10 CFR 100, Appendix A. The Yucca Fault has undergone surface rupture within the past few thousand to tens-of-thousands of years. Some earthquakes can be directly associated with the fault trace and also beyond the south end of the mapped section in the Yucca Pass, suggesting that the fault may continue in that direction. No significant vertical surface displacement has occurred on the Carpetbag Fault system during the past 150,000 years, but there is evidence of episodes of fracturing and possible minor faulting from 30,000 to 240,000 years ago, with average recurrence interval of about 25,000 years for the last 125,000 years. The Carpetbag Fault has been mapped in the subsurface beyond the southern end of Yucca Basin and may project to the northeast. Possible magnitude, intensity, and acceleration of earthquakes along the Yucca and Carpetbag Faults have not been estimated.

The Cane Spring Fault does not show Holocene displacement but is thought to have been the source of a 4.3 Richter magnitude earthquake in 1971. The maximum credible earthquake associated with the Cane Spring Fault is expected to produce a peak acceleration of 0.67 g with a 6.7 Richter magnitude. The recurrence interval is estimated to be 10,000 to 30,000 years. The Cane Spring Fault extends to the southwest and is connected in the deep subsurface to a third capable fault, the Rock Valley Fault, which has been the epicenter for several earthquakes of Richter magnitudes between 3 and 4 since 1992.

The most recent volcanic activity in the immediate area was 0.3 million years ago, and the likelihood for renewed activity in the next 10,000 years is slight (NT LANL 1983a:7). NTS lies approximately 241 km (150 mi) southeast of the Long Valley area of California, an area of potential volcanic eruption of the Mount St. Helens type.

Soils. Soils at NTS include three major types: shallow soils developed in the uplands and mountains; soils on valley fill and nearly-level-to-moderately sloping outwash plains, alluvial fans, and fan aprons; and playas and soils on nearly level flats and basins. Possible erosion hazards range from slight to severe while the shrink-swell potential ranges from low to high for some of these soils. The potential for wind erosion and shrink-swell increases in the playas and basins. The potential for water erosion increases with increasing slope. The soils at NTS are considered acceptable for standard construction techniques.

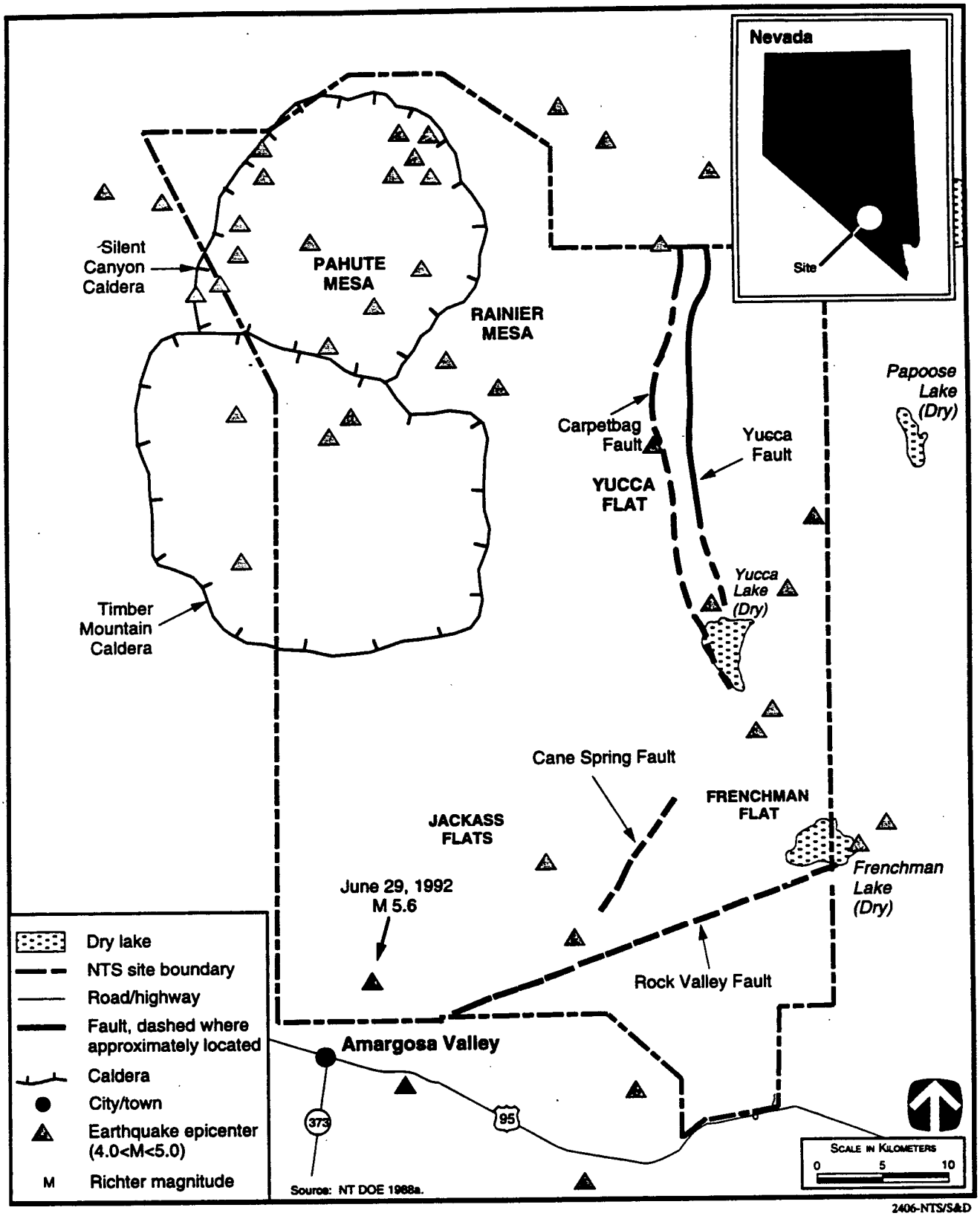


Figure 3.3.5–1. Major Fault Systems, Calderas, and Historic Earthquakes in the Nevada Test Site Region.

3.3.6 BIOLOGICAL RESOURCES

Terrestrial Resources. The NTS lies in a transition area between the Mojave and Great Basin Deserts. As a result, flora and fauna that are characteristic of both deserts are found within the site boundaries (NT ERDA 1976a:34). Approximately 33 km^2 (12.7 mi^2) of NTS have been developed, which represents about 1 percent of the site; thus, natural plant communities are found across most of NTS (NT DOE 1988d:3,4,6,7). The site has been divided into nine major plant communities, as shown in Figure 3.3.6–1.

Of the plant communities present onsite, the mountains, hills and mesas, sagebrush, creosote bush, and hopsage-desert thorn communities are the most extensive. Saltbush and desert thorn communities occupy more limited areas adjacent to the playas in Frenchman and Yucca Flats. Introduced plants such as red brome, cheatgrass, and Russian thistle have become important species in some areas. These plants rapidly invade disturbed areas and delay revegetation by native species (NT Hunter 1991a:1 of abstract). A total of 711 taxa of vascular plants have been identified on or near NTS (NT ERDA 1976a:34).

Terrestrial wildlife found on NTS includes 33 species of reptiles, 222 species of birds, and 49 species of mammals (NT Greger 1992a; NTS 1990a:1; NTS 1990a:2). Species common to NTS include the side-blotched lizard, western shovel-nosed snake, black-throated sparrow, red-tailed hawk, Merriam's kangaroo rat, and Great Basin pocket mouse. Water holes, both natural and manmade, are important to many species of wildlife, including game animals such as pronghorn and mule deer (NT Greger nda). Hunting is not permitted anywhere on NTS. Raptors such as the turkey vulture and rough-legged hawk, and carnivores such as the long-tailed weasel and bobcat, are two ecologically important groups on NTS. A variety of migratory birds has been found at NTS. Migratory birds, as well as their nests and eggs, are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Vegetative cover in the area of Frenchman Flat proposed for the consolidated Pu storage facility (which is also the assumed analysis site for a number of disposition alternatives) falls primarily within the creosote bush community (Figure 3.3.6–1). Fauna found in this area would be expected to be closely associated with Mojave desert fauna, and species could include the banded gecko, desert iguana, Gambel's quail, greater roadrunner, round-tailed ground squirrel, and cactus mouse. Vegetation within the alternative consolidated Pu storage facility site (P-Tunnel location) falls within the mountains, hills, and mesas and blackbrush communities. Fauna found in this more northerly location would be most closely associated with Great Basin desert fauna. Animal species present could include the sagebrush lizard, western skink, Great Basin pocket mouse, and Great Basin kangaroo rat (NT ERDA 1976a:47,48,56).

Wetlands. The NWI maps of NTS have not been prepared nor have wetlands been delineated on the site. However, small wetland areas (less than 0.4 ha [1 acre]) may be associated with NTS springs (NTS 1992a:5). There are no known wetlands in either of the proposed storage facility sites.

Aquatic Resources. Potential aquatic habitat on NTS includes surface drainages, playas, springs, and manmade reservoirs. There are no continuously flowing streams on the site and permanent surface water sources are limited to a few small springs. These surface drainages, playas, and springs are unable to support permanent fish populations (DOE 1995w:2.4-61,2.4-62). Manmade water reservoirs located throughout the site support three introduced species of fish: bluegill, goldfish, and golden shiners (NTS 1992a:6). There are no known aquatic resources in either of the proposed storage facility sites.

Threatened and Endangered Species. There are nine federally and State-listed threatened, endangered, and other special status species found in the vicinity of NTS. Eight of these are federally or State-listed as threatened or endangered or protected under State law (Table 3.3.6–1). Eight species listed in Table 3.3.6–1 have been observed on NTS. Once specific project locations have been determined, site surveys will verify the presence of special status species. No critical habitat for threatened or endangered species, as defined in the ESA (50 CFR 17.11; 50 CFR 17.12), exists on NTS.

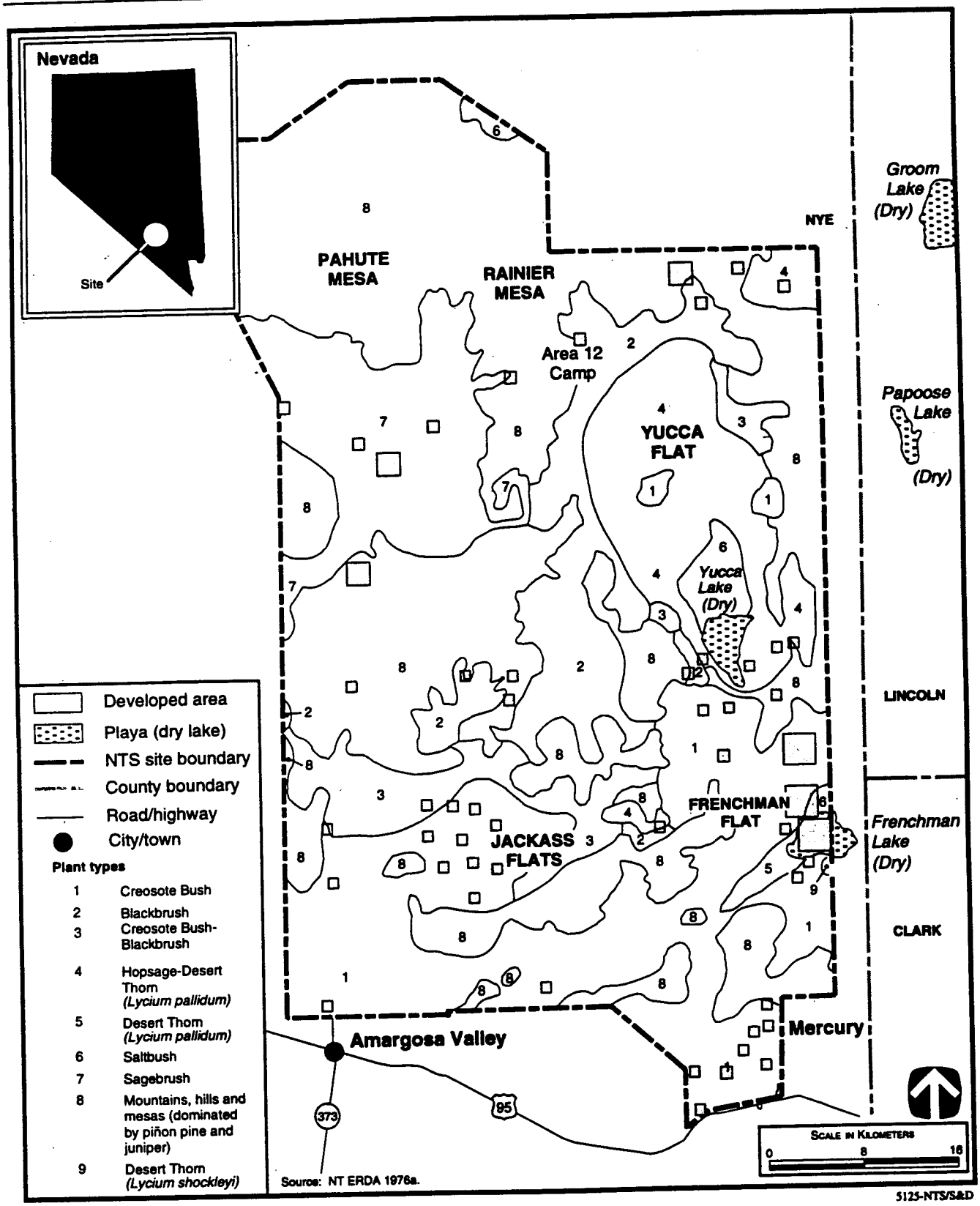


Figure 3.3.6–1. Distribution of Plant Communities at Nevada Test Site.

Table 3.3.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Nevada Test Site

Common Name	Scientific Name	Status[a]	
		Federal	State
Mammal			
[Text deleted.]			
Spotted bat[b]	*Euderma maculatum*	NL	T
[Text deleted.]			
Birds			
American peregrine falcon[c,d]	*Falco peregrinus anatum*	E	T
Arctic peregrine falcon[c]	*Falco peregrinus tundrius*	E(S/A)	T
Bald eagle[b,d]	*Haliaeetus leucocephalus*	T	T
[Text deleted.]			
Mountain plover[b]	*Charadrius montanus*	C	NL
[Text deleted.]			
Reptiles			
[Text deleted.]			
Desert tortoise [b,e]	*Gopherus agassizii*	T	T
Fish			
Devils Hole pupfish[d,f]	*Cyprinodon diabolis*	E	E
Plants			
[Text deleted.]			
Beatley milkvetch[b]	*Astragalus beatleyae*	NL	CE
[Text deleted.]			
Mojave fishhook cactus[b]	*Sclerocactus polyancistrus*	NL	CY
[Text deleted.]			

[a] Status codes: C=Federal candidate; CE=critically endangered by authority of NRS 527.270 (State Division of Forestry); CY=protected by authority of NRS 522.60–.120 (Nevada Cacti and Yucca Law); E=endangered; NL=not listed; S/A=protected under the similarity of appearances provision of the ESA; T=threatened.

[b] Species recorded on NTS.

[c] Peregrine falcon seen on NTS; however not identified to subspecies level.

[d] USFWS Recovery Plan exists for this species.

[e] Species known to occur on the proposed new consolidated storage facility site.

[f] Only known location of this species is outside the NTS 48.3 km southwest of the proposed new consolidated storage facility site. This species is included here due to offsite groundwater concerns.

Note: Nevada Department of Wildlife is currently revising the state threatened and endangered species list.

Source: 50 CFR 17.11; 50 CFR 17.12; 61 FR 7596; DOE 1995w; NT DOE 1995j; NT DOE 1996c; NT DOI 1995a; NT ERDA 1976a; NV FWS 1989a; NV NHP 1995a.

The federally and State-listed peregrine falcon and bald eagle are considered rare migrants to NTS. The threatened desert tortoise is the only resident species known to inhabit NTS that is protected under ESA. The range of the desert tortoise lies in the southern third of the site (Figure 3.3.6–2). The abundance of tortoises on NTS is considered low to very low relative to other areas within this species' geographic range. Densities of tortoises on NTS range from 0 to 17 individuals per square kilometer (0 to 45 individuals per square mile), with most habitats probably having densities of 0 to 8 individuals per square kilometer (0 to 20 individuals per square mile) (NT DOE 1991b:3-23). The only known population of the Devils Hole pupfish lives in Devils Hole, a water-filled limestone cavern in Ash Meadows, approximately 48 km (29.8 mi) southwest of NTS. There is concern over the survival of the pupfish and other sensitive species found in the Ash Meadows area due to the threat of declining water levels (NT DOI 1991a:1,4-6; NT ERDA 1977a:2-134,2-135,4-28,4-29).

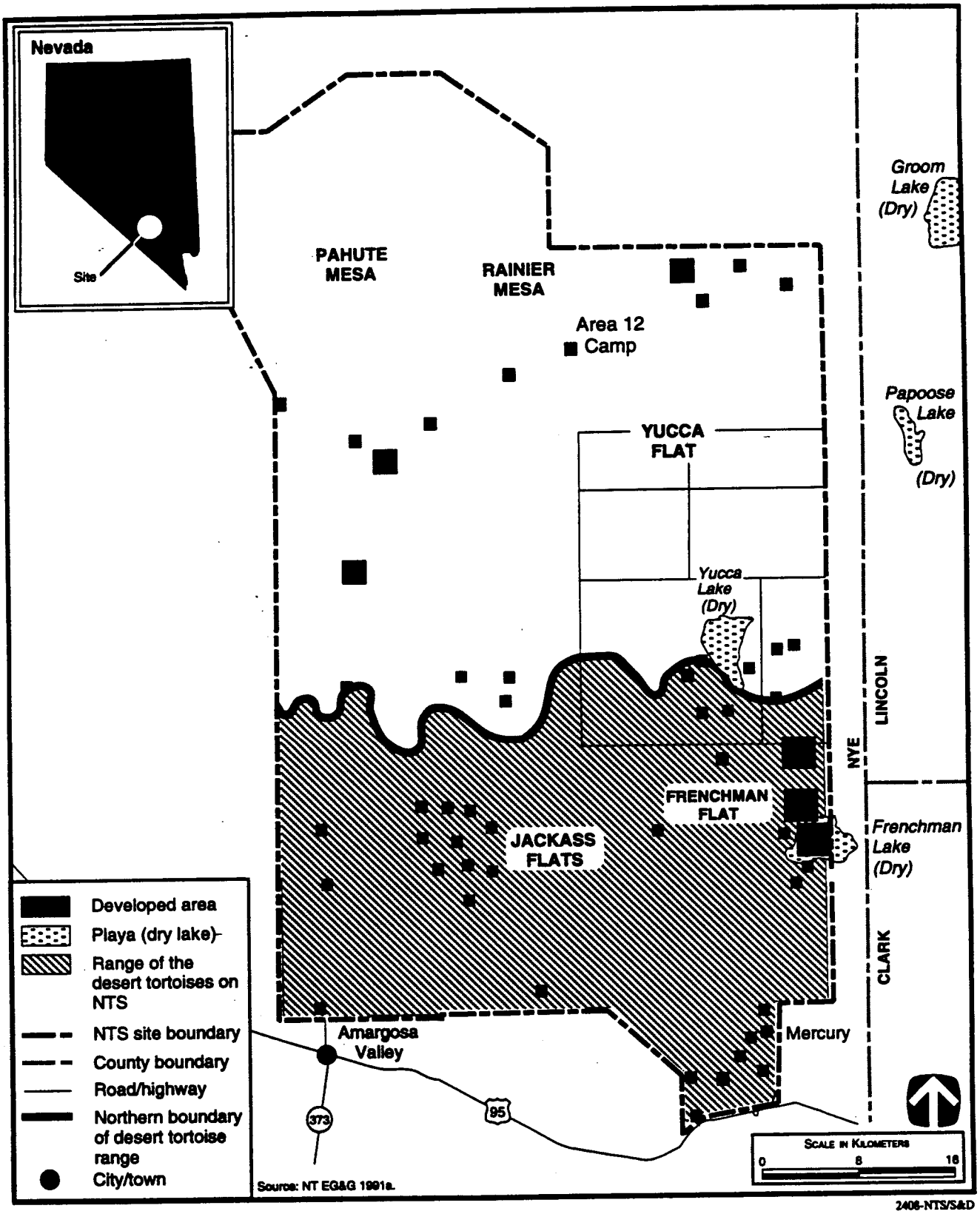


Figure 3.3.6–2. Distribution of Desert Tortoise at Nevada Test Site.

Table 3.3.6–1 identifies two State-protected plant species at NTS. [Text deleted.] The Federal-candidate mountain plover is a migrant species that has also been observed onsite. Although their distribution is unclear, the spotted bat has been recorded on NTS (Table 3.3.6–1).

The area within Frenchman Flat proposed for storage facilities (which is also the assumed analysis site for a number of disposition alternatives) is within the range of the desert tortoise. Both tortoise remains and scat have been observed in the proposed site area (NT EG&G 1991a:14,15,31). The alternate storage facility location (P-Tunnel project location) lies far north of the desert tortoise range. Occurrence of other special status species around the proposed project locations is unknown.

3.3.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. [Text deleted.] Prehistoric site types identified on NTS include habitation sites with wood and brush structures, windbreaks, rock rings, and cleared areas; rockshelters; petroglyphs (rock art); hunting blinds; rock alignments; quarries; temporary camps; milling stations; roasting ovens or pits; water caches; and limited activity locations. Milling stations are especially prevalent near the Yucca Lake playa margins. Several prehistoric rockshelters have been identified on Hogback Ridge. Approximately 6 percent of NTS has been inventoried for cultural resources. This includes all lands managed through a Memorandum of Agreement with Nellis Air Force Base. Excluding sites in the Yucca Mountain project area, approximately 1,600 prehistoric sites have been recorded. Hundreds of prehistoric sites have been identified in both Yucca Flat and Frenchman Flat; some of which may be eligible for listing on the NRHP. Additional prehistoric sites may occur in unsurveyed portions of NTS.

Historic Resources. Historic site types on NTS include mines and prospects, trash dumps, settlements, campsites, ranches, homesteads, developed spring heads, roads, trails, and nuclear weapons development sites. Historic resources associated with nuclear testing are common in both Yucca and Frenchman Flats. Nuclear test site structures and associated debris, including instrumentation stands and temporary storage bunkers, are also located within NTS. The test site area at Frenchman Flat, which includes the remains of many of these structures, has been recommended to the SHPO as a historic district. Excluding the Yucca Mountain project area, over 60 historic sites have been recorded. The only site currently listed on the NRHP is Sedan Crater. The crater was created in 1962 as part of the Plowshare Program, whose aim was to identify peaceful uses for nuclear explosions. It is located in Yucca Flat. The Emigrant Trail used by the "49ers" that traverses the southwestern corner of NTS is considered eligible for inclusion on the NRHP. Additional historic sites may occur in unsurveyed portions of NTS.

Native American Resources. The lands and resources of NTS have held an important place in the lives of Native Americans for centuries, and the area has been used continuously by many tribes. At the time of European-American contact, southern Nevada was inhabited by the Western Shoshone and the Southern Pahute. These peoples lived together in small groups from the spring through the fall. During winter, villages composed of several families were established in warmer places, close to preserves of pine nuts, seeds, and dried meats. Groups came to NTS from a broad region during the hunting season and relied on both animal and plant resources there that were crucial for their survival and cultural practices.

The NTS contains numerous ceremonial resources and power places that are critical for the continuation of Native American culture, religion, and society. Until the mid-1900s, traditional festivals involving religious and secular activities attracted Native American people to the area from as far as western California. There are numerous resources at NTS that are important to Native American groups. These resources include burials, ceremonial sites, musical stones, medicine rocks, petroglyphs, and traditional use areas. Local plants important in ritual and ceremonial activities include jimsonweed, juniper, greasewood, creosote, Indian tobacco, piñon pine, buckbush, and scrub oak. Concern has been expressed about the availability and accessibility of such resources.

Consultation with Native American cultural and religious leaders has been conducted for other projects at or near NTS to identify traditional cultural resources that may be affected by Federal actions and to obtain Native American recommendations for mitigating potential impacts on traditional cultural resources. DOE has established ongoing consultation with 17 Native American tribal organizations that have cultural ties to NTS. According to the American Indian Writers Subgroup of the Consolidated Group of Tribes and Organizations (CGTO), despite the loss of some traditional lands to pollution and reduced access, the Native American people have neither lost their ancestral ties to nor have forgotten their cultural resources on NTS. There is continuity in the Native American use of and broad cultural ties to NTS. Native American people continue to value and recognize the central role of these lands in their continued survival (NT DOE 1996c:4-162).

Paleontological Resources. The surface geology of NTS is characterized by alluvium-filled valleys surrounded by ranges composed of Precambrian and Paleozoic sedimentary rocks and Tertiary volcanic tuffs and lavas. The Precambrian and Paleozoic rocks at NTS represent relic deposits made in shallow water at the submerged edge of a continental platform that ran from Mexico to Alaska and existed throughout most of the Paleozoic. Although the Precambrian sedimentary deposits contain no fossils or only a few poorly preserved fossils, the Paleozoic marine limestones are moderately to abundantly fossiliferous. Marine fossils found in the same Paleozoic formations on Nellis Air Force Range, adjacent to NTS to the north, include trilobites, conodonts, ostracods, solitary and colonial corals, brachiopods, algae, gastropods, and archaic fish. These fossils, however, are relatively common and have low research potential.

Tertiary volcanic deposits are not expected to contain fossils; however, the Late Pleistocene terrestrial vertebrate fossils of the Rancholabrean Land Mammal Age could be expected in the Quaternary deposits. The possibility of finding mammoth, horse, camel, and bison remains might be expected because such fossils have been found at Tule Springs, 56 km (35 mi) from the southern edge of NTS, and in Nye Canyon. Fossils found at Tule Springs include bison, deer, a small donkey-like horse, camel, Columbia mammoth, ground sloth, giant jaguar, bobcat, coyote, muskrat, and a variety of rabbits, rodents, and birds. This paleontological assemblage has high research potential. Although no known fossil localities have been recorded to date, Quaternary deposits with paleontological materials may occur on NTS. Other Pleistocene resources include pack rat middens, which are studied by scientists at the University of Nevada, Reno, the Desert Research Institute, and the New Mexico Institute of Mines and Technology to investigate paleoclimatic regimes.

3.3.8 SOCIOECONOMICS

Socioeconomic characteristics described for NTS include employment, regional economy, population, housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses 11 counties surrounding NTS in Nevada, Arizona, and Utah (Table L.1–1). Statistics for population, housing, community services, and local transportation are presented for the ROI, a two-county area in which 97 percent of all NTS employees reside: Clark County (82 percent) and Nye County (15 percent). In 1991, NTS employed approximately 7,700 persons (2.1 percent of the total REA employment) (Table L.1–3). [Text deleted.]

Regional Economy Characteristics. Selected employment and regional economy statistics for the REA are summarized in Figure 3.3.8–1. The civilian labor force in the REA increased approximately 64 percent between 1980 and 1990, reaching 506,394 in the latter year. Total employment in the REA was 587,533 in 1994. In that year, the regional unemployment rate in the REA was 6.1 percent, comparable to the rate in Arizona (6.4 percent) and Nevada (6.2 percent), but much higher than the rate in Utah (3.7 percent). The 1993 per capita income in the REA was $20,561, lower than Nevada's per capita income of $22,727, but higher than the per capita income in Arizona or Utah, $18,085 and $16,354, respectively.

Employment patterns in the REA parallel those in Arizona, Nevada, and Utah, with manufacturing, retail trade, and service providing the majority of nonfarm private sector jobs. The service sector is the primary source of employment in both the REA and Nevada providing 43.5 percent and 43.4 percent of jobs, respectively. This sector is less dominant in Arizona and Utah, accounting for 30.2 percent and 28.6 percent of total employment in those states, respectively.

Population and Housing. Population and housing trends in the ROI are summarized in Figure 3.3.8–2. Population in the ROI increased 103.4 percent between 1980 and 1994, reaching 960,088 at the end of the period. This rate of increase surpassed Nevada's population growth of 82.0 percent during the same period.

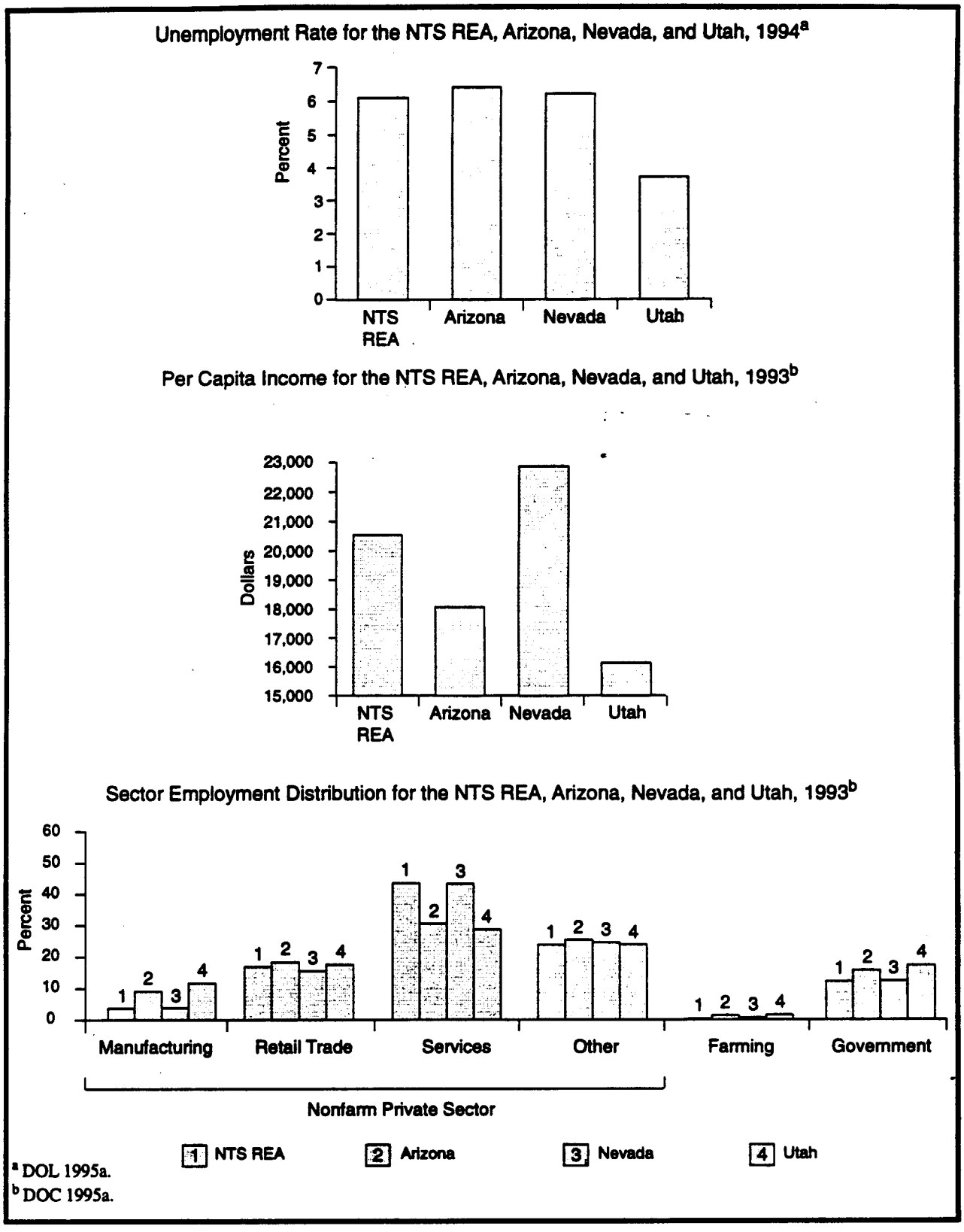
The total number of housing units in the ROI also increased significantly between 1980 and 1990, increasing by 65.9 percent compared to a 52.6 percent increase within Nevada. In 1990, homeowner and renter vacancy rates in the NTS ROI were similar to those in Nevada, approximately 2 percent and 9 percent, respectively.

Community Services. Community services described for the NTS ROI are education, public safety, and health care. Figure 3.3.8–3 presents school district characteristics for the NTS ROI, and Figure 3.3.8–4 presents public safety and health care characteristics.

Education. Two school districts provide public education services and facilities in the NTS ROI. During the 1994-95 school year, the Nye County School District had an enrollment of 4,170 students while the Clark School District had an enrollment of 156,348 students. The two school districts operated at 85 and 100 percent of capacity, respectively, as shown in Figure 3.3.8–3. The average student-to-teacher ratio in the ROI was 19.6:1.

Public Safety. Five city and county law enforcement agencies provide police protection in the ROI. In 1994, the highest ratio of sworn officer-to-population in the two-county region was in Nye County, with 3.3 officers per 1,000 persons. The average ROI officer-to-population ratio was 2.0 officers per 1,000 persons. [Text deleted.]

During 1995, a total of 1,505 regular and volunteer firefighters provided fire protection services to the ROI. The rural county departments include both professional and volunteer staff, while the city districts are exclusively professional. Among the firefighting departments, the Nye County Fire Department has the highest firefighter-to-population ratio with 6.1 firefighters per 1,000 persons, although most of the firefighters are



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.3.8–1. Employment and Local Economy for the Nevada Test Site Regional Economic Area and the States of Arizona, Nevada, and Utah.

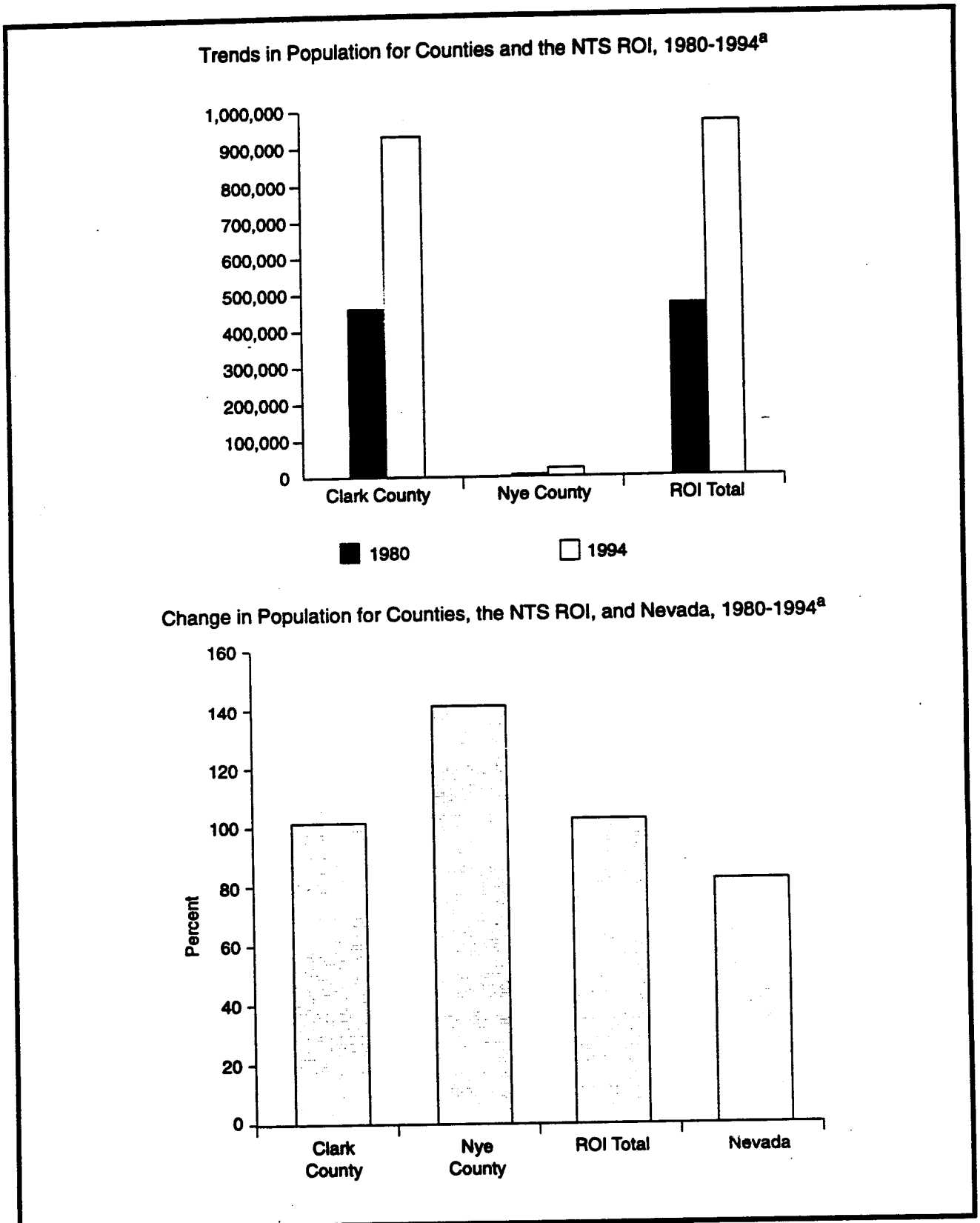
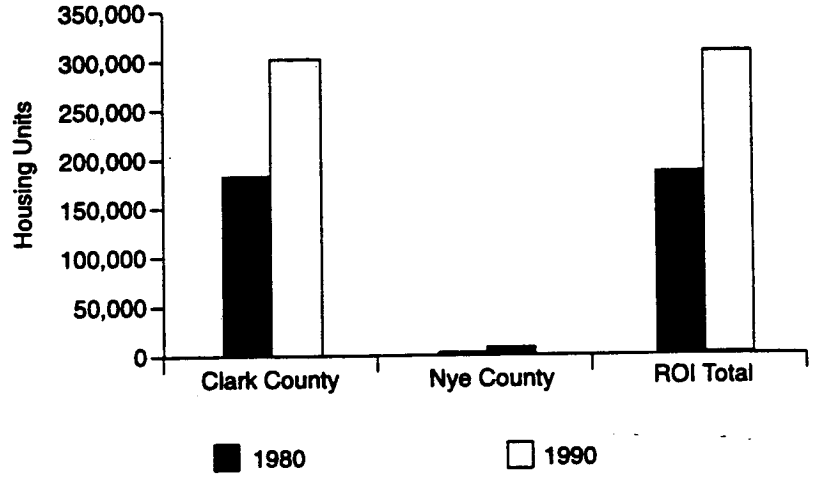
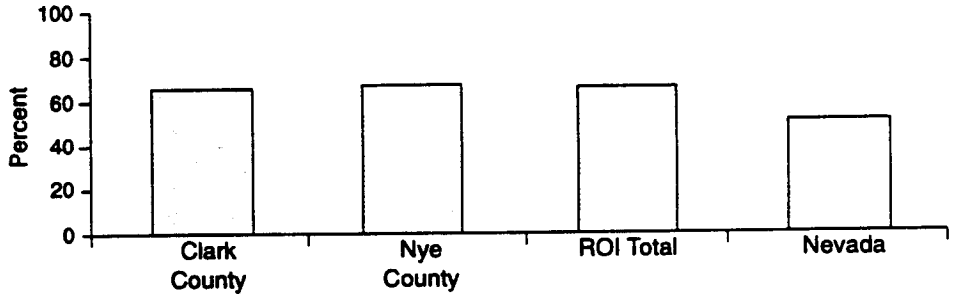


Figure 3.3.8–2. Population and Housing for the Nevada Test Site Region of Influence and the State of Nevada.

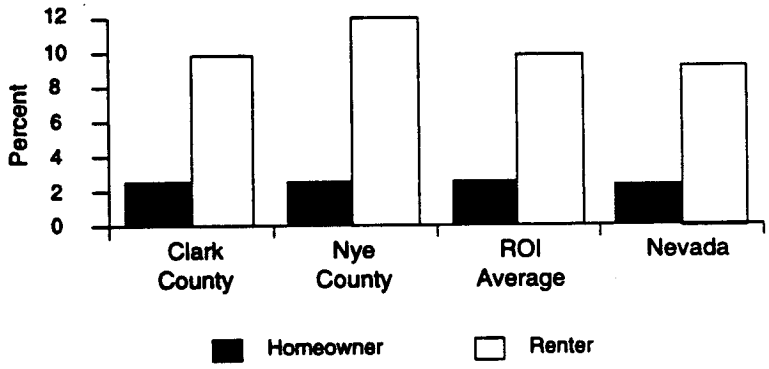
Trends in Housing for Counties and the NTS ROI, 1980-1990[b,c]



Change in Housing for Counties, the NTS ROI, and Nevada, 1980-1990[b,c]

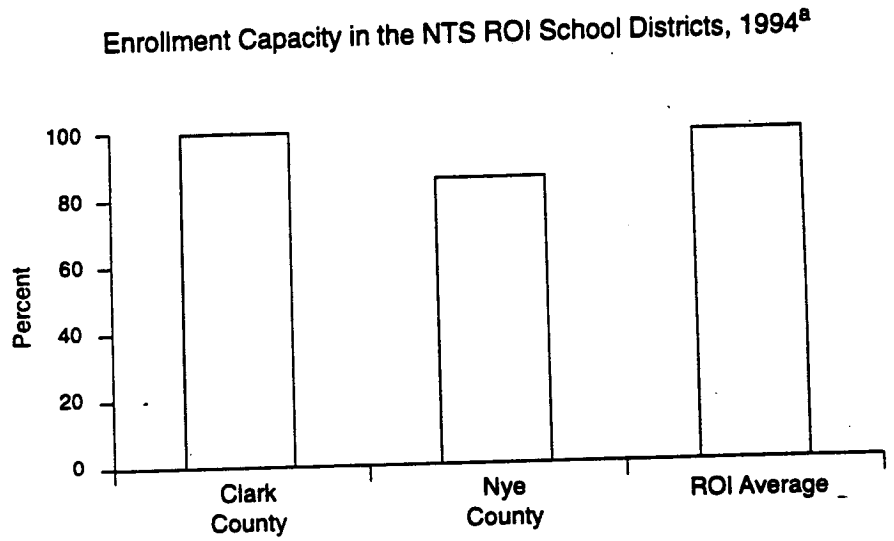


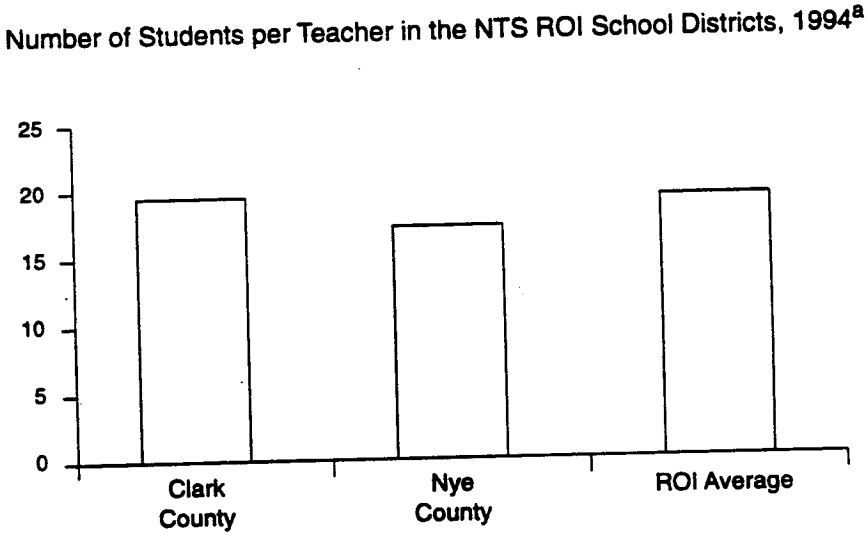
Homeowner and Renter Vacancy Rate for Counties, the NTS ROI, and Nevada, 1990[c]



[a] Census 1994o; Census 1995a.
[b] Census 1982a.
[c] Census 1991g.

Figure 3.3.8–2. Population and Housing for the Nevada Test Site Region of Influence and the State of Nevada—Continued.

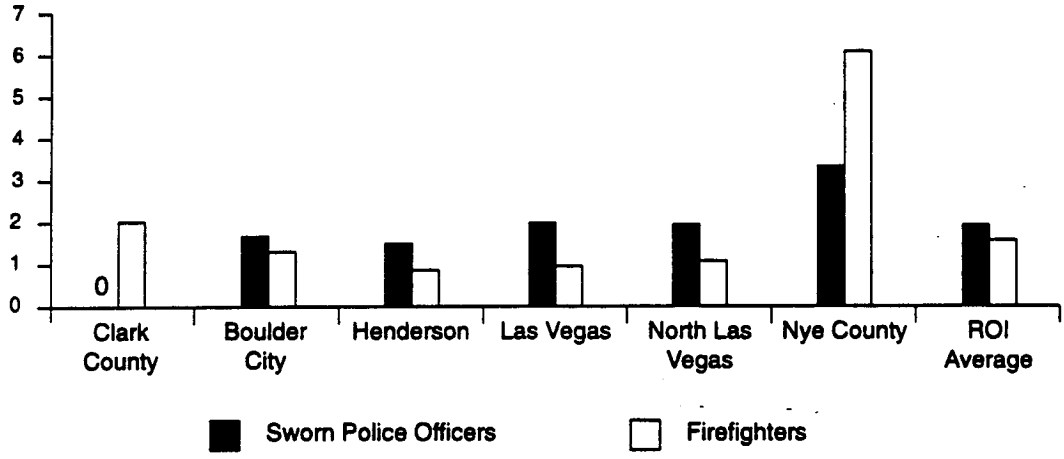




[a] Socio 1996a.

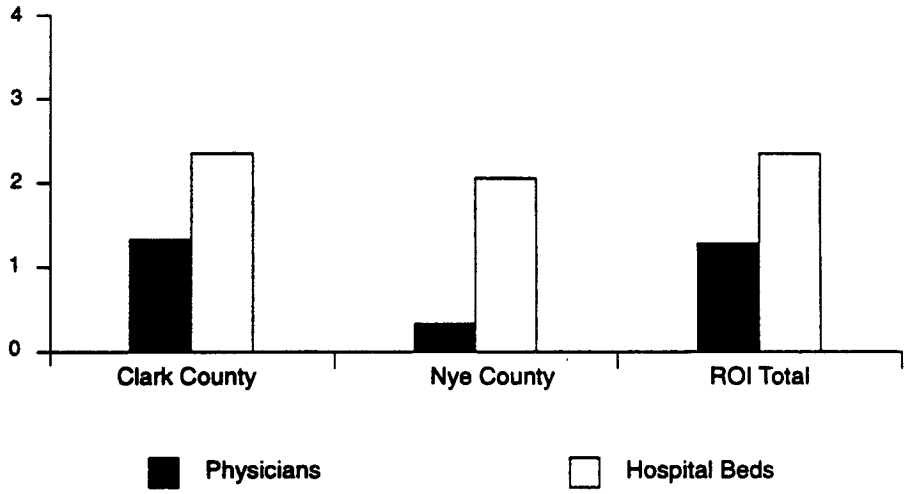
Figure 3.3.8–3. School District Characteristics for the Nevada Test Site Region of Influence.

Number of Sworn Police Officers (1994) and Firefighters (1995) per 1,000 Persons in the NTS ROI[a]



Note: Non-ROI city values are included in county totals. The Las Vegas police force also serves unincorporated Clark County.

Number of Physicians and Hospital Beds per 1,000 Persons in the NTS ROI, 1994[b]



[a] Census 1995a; DOC 1996a; DOC 1996b; DOJ 1995a; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.3.8–4. Public Safety and Health Care Characteristics for the Nevada Test Site Region of Influence.

volunteers (Figure 3.3.8–4). [Text deleted.] The average ROI firefighter-to-population ratio was 1.6 firefighters per 1,000 persons.

Health Care. Nine hospitals serve the two-county region, all operating well below capacity. In 1994, a total of 1,244 physicians served the ROI. Figure 3.3.8–4 shows that the physician-to-population ratio ranged from 0.3 physicians per 1,000 persons in Nye County to 1.3 physicians per 1,000 persons in Clark County. The ROI average physician-to-population ratio was 1.3 physicians per 1,000 persons. The hospital bed-to-population ratio ranged from 2.1 beds per 1,000 persons in Nye County to 2.4 beds per 1,000 persons in Clark County.

Local Transportation. Vehicular access to NTS is provided by U.S. Route 95 to the south (see Figure 2.2.2–1 and Figure 2.2.2–2). [Text deleted.] Road segments providing access to NTS experience little traffic congestion outside of the Las Vegas metropolitan area. There are no current or planned road improvement projects that would affect access to NTS (NV DOT 1995a:1).

Two road segments in the ROI could be affected by the storage and disposition alternatives. The first is U.S. 95 from Business Route U.S. 95 to just south of Nevada State Route 160. This segment operated at level of service A in 1995. The second is U.S. 95 from just south of Nevada State Route 160 to just south of Nevada State Route 266. This segment operated at level of service C in 1995.

Although there is no public transportation system serving NTS, a contract bus service for workers is available at a nominal cost. The major railroad in the ROI is the Union Pacific Railroad located approximately 80 km (50 mi) east of NTS near Las Vegas. There are no navigable waterways within the ROI.

McCarran International Airport in Las Vegas provides jet air passenger and cargo service from both national and local carriers. Numerous smaller private airports are located throughout the ROI.

3.3.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of NTS are shown in Table 3.3.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to NTS operations.

Table 3.3.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Nevada Test Site Operation

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation	
Cosmic and external terrestrial radiation[a]	74
Internal terrestrial radiation[b]	39
Radon in homes (inhaled)[b]	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	378

[a] Derived from information on cosmic and terrestrial radiation given in EPA 1981b.

[b] NCRP 1987a.

Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from NTS operations provide another source of radiation exposure to individuals in the vicinity of NTS. Types and quantities of radionuclides released from NTS operations in 1993 are listed in the *U.S. Department of Energy Nevada Operations Office Annual Site Environment Report–1993* (DOE/NV/11432-123). The doses to the public resulting from these releases are presented in Table 3.3.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1993 report were used in the development of the reference environment's (No Action) radiological releases and resulting impacts at NTS in the year 2005 (Section 4.2.2.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from NTS operations in 1993 is estimated to be 2.4×10^{-9}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of NTS operations is about 2 chances in 1 billion. (Note that it takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Based on the same risk estimator, 6×10^{-6} excess fatal cancers are projected in the population living within 80 km (50 mi) of NTS from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national rate, the number of fatal cancers expected during 1993 from all causes in the population living within 80 km (50 mi) of NTS was 44. This number of expected fatal cancers is much higher than the estimated 6×10^{-6} fatal cancers that could result from NTS operation in 1993.

Table 3.3.9–2. Radiation Doses to the Public From Normal Nevada Test Site Operation in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	0.0048	4	0	100	0.0048
Population within 80 km[b] (person-rem)	None	0.012	None	0	100	0.012
Average individual within 80 km[c] (mrem)	None	5.5×10^{-4}	None	0	None	5.5×10^{-4}

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (see 58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] In 1993, this population was approximately 21,750.

[c] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: NT DOE 1994b.

The NTS workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.3.9–3 presents the average worker, maximally exposed worker, and total cumulative worker dose to NTS workers from operation in 1992. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to NTS workers from normal operation in 1992 is estimated to be 0.0008.

Table 3.3.9–3. Radiation Doses to Workers From Normal Nevada Test Site Operation in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	2.6
Maximally exposed worker (mrem)	5,000	750
Total workers[b] (person-rem)	ALARA	2

[a] DOE's goal is to maintain radiological exposure as low as reasonably achievable.

[b] The number of badged workers in 1992 was approximately 780.

Source: 10 CFR 835; DOE 1993n:7.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *U.S. Department of Energy Nevada Operations Office Annual Site Environment Report–1993* (DOE/NV/11432-123). The concentrations of radioactivity in various environmental media (including air and water) and in animal tissue in the site region (onsite and offsite) are also presented in the same document.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in

contact (for example, soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.3.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements), contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at NTS via inhalation of air containing hazardous chemicals released to the atmosphere by NTS operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.3.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to NTS workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. NTS workers are also protected by adherence to OSHA and EPA standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operation processes ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm. Therefore, worker health conditions at NTS are expected to be substantially better than required by standards.

Health Effects Studies. The epidemiologic studies on groups surrounding NTS have concentrated on health effects in soldiers and children associated with nuclear testing rather than operation emissions. Results are contradictory regarding the observed leukemia incidence and deaths in exposed children, with some studies reporting excess, whereas others report no excess. Analytical methods used in some of these studies were questionable. For soldiers, the results regarding leukemia and polycythemia vera differ from two studies relating to nuclear test explosions. However, reanalyses showed leukemia, respiratory, and other cancers to be associated only with exposure to higher doses (for example, more than 300 millirem [mrem] for leukemia cases). For a more detailed description of the study findings reviewed, refer to Section M.4.3.

Accident History. Nuclear testing began at NTS in 1951. There were some 100 atmospheric nuclear explosions before the Limited Test Ban Treaty was implemented in 1963. Since then, all nuclear tests have been conducted underground.

Since 1970, there have been 126 nuclear tests, which resulted in a release to the atmosphere of approximately 54,000 Curies (Ci) of radioactivity. Of this amount, 11,500 Ci were accidental due to containment failure (massive releases or seeps) and late-time seeps (small releases after a test when gases diffuse through pore spaces of the overlying rock). The remaining 42,500 Ci were operational releases. From the perspective of human health risk, if the same person had been standing at the boundary of NTS in the area of maximum concentration of radioactivity for every test since 1970, that person's total exposure would be equivalent to 32 extra minutes of normal background exposure, or the equivalent of one-thousandth of a single chest x ray (OTA 1989a:4,5). [Text deleted.]

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

The *NTS Emergency Preparedness Plan* is designed to minimize or mitigate the impact of any emergency upon the health and safety of employees and the public. The plan integrates all emergency planning into a single entity to minimize overlap and duplication and to ensure proper responses to emergencies not covered by a plan or directive. The manager of the DOE Nevada Operations Office has the responsibility to manage, counter, and recover from an emergency occurring at NTS.

The plan provides for identification and notification of personnel for any emergency that may develop during operational and nonoperational hours. The Nevada Operations Office receives warnings, weather advisories, and any other communications that provide advance warning of a possible emergency. The plan is based upon current DOE Nevada Operations Office vulnerability assessments, resources, and capabilities regarding emergency preparedness.

3.3.10 WASTE MANAGEMENT

This section outlines the major environmental regulatory structure and ongoing waste management activities for NTS. A more detailed discussion of the ongoing waste management operations is provided in Section E.2.2. Table 3.3.10–1 presents a summary of waste management activities at NTS for 1993.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations rising from its past operations at NTS. The Department is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed-upon milestones.

The Department has decided that underground testing areas should be governed pursuant to the provisions of CERCLA. Preliminary Assessment/Site Investigation Reports and a Hazardous Ranking System package were provided to the EPA for use in determining whether or not NTS should be included on the NPL. In May 1993, the State of Nevada issued a letter to DOE indicating it did not appear that EPA would make a decision on the NPL status of the NTS in the near future. DOE has published the *NTS Site Treatment Plan* and *Federal Facility Compliance Act Consent Order* addressing environmental restoration and waste management on NTS. A mutual consent agreement between the State of Nevada and DOE, updated in June 1995, permits NTS to use the available capacity of the TRU Waste Storage Pad for the storage of onsite generated mixed waste that does not meet RCRA land disposal provisions.

The DOE Nevada Operations Office completed a waste minimization plan for NTS in 1991 and created an organization whose mission is to promote waste minimization and pollution prevention and to ensure compliance with DOE requirements. NTS currently generates waste from ongoing operations and remediation associated with past activities and receives waste from other DOE facilities. NTS manages the following waste categories: TRU, low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. The NTS does not generate or manage spent nuclear fuel.

High-Level Waste. The NTS does not generate or manage HLW.

Transuranic Waste. From 1974 to 1990, 612 m^3 (800 cubic yards [yd^3]) of mixed TRU waste was received from LLNL and is stored on an 8,300-m^2 (89,300-ft^2) asphalt storage pad at Area 5 of NTS (NT REECO 1995a:21). DOE and the State of Nevada signed a Settlement Agreement and NTS received a RCRA Part B Permit in July, 1992, allowing the DOE Nevada Operations Office to retain this inventory of mixed TRU waste subject to an appropriate permitting process. None of these waste packages are WIPP-certified. They will have to be certified before shipment to WIPP depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste. These wastes have been moved to a 1,995-m^2 (21,470-ft^2) polyvinyl chloride-coated polyester fabric-covered building for storage until WIPP is determined to be a suitable disposal facility pursuant to the requirements of 40 CFR 191 and 40 CFR 268 (NT DOE 1996b:BV-38). If WIPP is suitable, this mixed TRU waste will not have to be treated before disposal. NTS has areas of Pu-contaminated soil for which treatment technology is being developed. This activity may produce additional volumes of TRU or mixed TRU waste.

Low-Level Waste. In eight areas at NTS, LLW has been generated and disposed of, but currently only Areas 3 and 5 are active for disposal. Bulk waste is disposed of in Area 3, and packaged classified and unclassified waste is disposed of in Area 5. Disposal of onsite waste began in 1971, and in 1978 operations expanded to receive wastes generated offsite. In 1995, 15 generators shipped LLW to NTS for disposal. An additional 9 generators are applying or awaiting for approval (NT DOE 1996c:4-48,4-49). As of September 1994, approximately 300,000 m^3 (392,000 yd^3) in Area 3 (NT DOE 1996c:4-33) and, as of December 1993, approximately

Table 3.3.10–1. Waste Management Activities at Nevada Test Site

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Transuranic[a]	None	None	None	Containers on covered asphalt pad	612[b]	None–WIPP or alternate facility in the future	NA
Low-Level							
Liquid	Included in solid	None	None	None	None	None	None[c]
Solid	178[d]	None	None	None	None	Shallow burial and greater confinement	500,000[e]
Mixed Low-Level							
Liquid	None	None	None	Containers on TRU waste storage pad	1,150	None	None
Solid	None	None	None	Containers on TRU waste storage pad	Same as liquid	Shallow burial	90,626[f]
Hazardous							
Liquid	34.6[g]	None	Planned	RCRA-permitted storage	62[h]	Contracted offsite	NA
Solid	Included in liquid[i]	None	None	RCRA-permitted storage	Included in liquid	Contracted offsite	NA
Nonhazardous (Sanitary)							
Liquid	Included in solid	Septic fields	As required	None	None	Septic fields	As required
Solid	7,170[g]	None	None	None	None	Landfill (onsite)	Expandable as required: as of November 1994, 459,000 m^3 available[j]
Nonhazardous (Other)							
Liquid	Included in sanitary	Septic fields	As required	None	None	Septic fields	As required
Solid	Included in sanitary	None	None	None	None	Landfill (onsite)	Expandable as required

[a] All TRU waste at NTS is considered to be mixed until further characterization is completed.
[b] 612 m^3 TRU (LLNL waste) stored pending WIPP availability. An additional capacity of 528 m^3 is available for mixed LLW storage.
[c] 408 m^3 was previously disposed, but liquid LLW is no longer disposed.
[d] Additional volume of LLW disposed of from on and offsite locations was 18,604 m^3.
[e] Area 3 and 5.
[f] Pit 3, Area 5 RWMS.
[g] Assumes a density factor of 1.0 t/m^3.
[h] Area 5 Hazardous Waste Storage Unit.
[i] Includes 2.5 m^3 TSCA waste.
[j] Disposal capacity is composed of three landfills.

Note: NA=not applicable.

Source: DOE 1995w; NT DOE 1994f; NT DOE 1996b; NT REECO 1994a; NT REECO 1995a; NTS 1993a:4; NTS 1995a:3.

167,400 m^3 (218,900 yd^3) in Area 5 (NT REECO 1994a:12) of LLW have been disposed of. Standard shallow land burial techniques have been employed.

Mixed Low-Level Waste. Disposal of mixed waste received from RFETS has taken place at NTS. Environmental restoration at NTS facilities could generate additional volumes of mixed wastes which will require some form of treatment. Mixed waste generated in the State of Nevada that meets land disposal restrictions of RCRA can be disposed of in the Area 5 Mixed Waste Disposal Unit, Pit 3. [Text deleted.] The Nevada Division of Environmental Protection provides RCRA oversight for NTS. The 1992 revised RCRA Part B Permit application, to include a separate mixed waste storage and disposal unit at NTS, in accordance with the provisions of the *Federal Facility Compliance Act*, has been submitted to the State of Nevada. A mutual consent agreement between the State of Nevada and DOE permits the storage of mixed LLW on the TRU waste storage pads. DOE has published the *NTS Site Treatment Plan* and *Federal Facility Compliance Act Consent Order* that establishes the basis for mixed LLW treatment, storage, and disposal at NTS.

Hazardous Waste. Hazardous wastes result from ongoing operations that utilize solvents, lubricants, fuel, Pb, metals, motor oil, and acids. Hazardous wastes are accumulated at satellite areas, stored at the Area 5 RCRA-permitted hazardous waste storage unit, and shipped offsite by truck using DOT-approved transporters to a commercial RCRA-permitted facility. Additional accumulation areas and new equipment are planned to prevent the possibility of cross contamination with radioactive wastes (creating mixed wastes) in handling these materials. PCB-contaminated waste is accumulated and stored in the Area 6 *Toxic Substances Control Act* (TSCA) Waste Accumulation Unit. Accumulated PCB waste is shipped offsite to a commercial TSCA treatment, storage, and disposal facility. Hazardous waste generation is decreasing as the result of an aggressive waste minimization program and will substantially decrease in the future due to the present moratorium on nuclear testing.

Nonhazardous Waste. Nonhazardous sanitary wastes are expected to be generated at the current rates for several years into the future, then decline assuming the present moratorium on underground weapons testing continues. Liquid nonhazardous wastes are disposed of in septic tanks, sumps, or in ponds; solid wastes are disposed of in landfills at various locations on the site. Recycling of paper, metals, glass, plastics, and cardboard has already resulted in some decreases in waste quantities. Solid waste landfills located in Areas 6, 9, and 23 are in use for the disposal of solid nonhazardous wastes. The Area 6 landfill is a Class III landfill that accepts hydrocarbon-burdened soil and debris. The Area 9 landfill is a Class II landfill as it accepts less than 18 t (20 tons) of solid waste per day. The Area 9 landfill is allowed to receive all types of nonhazardous solid waste, excluding radioactive waste, free liquids, and asbestos. Its current capacity is approximately 990,000 m^3 (1.3 million yd^3). Due to changes in State regulatory requirements, the Area 9 landfill will undergo partial closure and reopen as a Class III construction and demolition landfill. The Area 23 landfill receives all types of nonhazardous solid waste with nonpathogenic hospital waste, dead animals, and asbestos-containing materials being buried in separate cells that are identified by concrete markers. The current capacity is approximately 450,000 m^3 (589,000 yd^3). The Area 23 landfill is scheduled to remain in operation as a Class II landfill after modification to comply with the new State regulations (NT DOE 1996c:4-37).

3.4 IDAHO NATIONAL ENGINEERING LABORATORY

The Idaho National Engineering Laboratory is located in southeastern Idaho near Idaho Falls (Figure 2.2.3–1). The main site is 55 km (34 mi) west of Idaho Falls, 61 km (38 mi) northwest of Blackfoot, and 35 km (22 mi) east of Arco. There are also DOE activities in Idaho Falls. The facility has approximately 445 km (277 mi) of roads, both paved and unpaved, and 48 km (30 mi) of railroad track.

There are 450 buildings and 2,000 support structures at INEL with more than 279,000 m^2 (3,000,000 ft^2) of floor space in varying conditions of utility (Figure 2.2.3–2). INEL has approximately 25,100 m^2 (270,000 ft^2) of covered warehouse space and an additional 18,600 m^2 (200,000 ft^2) of fenced yard space. The total area of the various machine shops is 3,035 m^2 (32,665 ft^2).

There have been 52 research and test reactors at INEL used over the years to test reactor systems, fuel and target design, and overall safety. In addition to its nuclear reactor research, other INEL facilities are operated to support nuclear operations. These facilities include HLW and LLW processing and storage sites, hot cells, analytical laboratories, machine shops, laundry, railroad, and administrative facilities. Other activities include management of one of DOE's largest storage sites for LLW and TRU waste. Until 1992, spent reactor fuels were reprocessed at the ICPP to recover enriched uranium and other isotopes. Due to a DOE decision to terminate spent fuel reprocessing, the ICPP was transferred to the DOE Office of Environmental Management (EM) Program for disposition. The ICPP contains the waste calcination facility, which processes liquid HLW streams to a calcined solid (granular form). Beginning in the early part of the next century, the waste immobilization facility will convert the calcined solids into a glass ceramic for ultimate disposal in a Federal repository. Additionally, miscellaneous spent fuel from both DOE and commercial sources is scheduled for interim storage at the ICPP. Within the existing security perimeter, the Fuel Processing Restoration Facility is a special nuclear material storage and processing facility that is 95-percent complete and has never been operated.

Department activities at INEL have been divided among eight distinct and geographically separate function areas as listed in Table 3.4–1. The current functions at INEL can be further grouped into two major categories: EM activities and other DOE activities.

Department of Energy Activities. Environmental management activities include R&D for waste processing at the Power Burst Facility and providing waste management expertise to the RWMC. The Power Burst Facility supports facilities in R&D for waste reduction programs and the Boron Neutron Capture Therapy Program. Waste management efforts at INEL are directed toward safe and environmentally sound treatment, storage, and disposal of radioactive, hazardous, and sanitary waste generated from facility operations. Major waste reduction facilities include the Waste Engineering Development Facility, the Waste Experimental Reduction Facility, and the Mixed Waste Storage Facility.

The following additional DOE activities are located at INEL (see Figure 2.2.3–2):

- The Test Area North (TAN) complex is the northernmost facility within INEL and consists of several experimental reactors and support facilities conducting R&D activities on reactor performance. These facilities include the technical support facility, the containment test facility, the water reactor research test facility, and the inertial engine test facility. The inertial engine test facility has been abandoned, and no future programs are planned. The remaining facilities support ongoing programs.

- Materials testing and environmental monitoring activities were conducted in the Auxiliary Reactor Area. The facilities in this area are scheduled for D&D.

- The ANL-W facility area consists of several major complexes, including EBR II, Transient Reactor Test Facility, ZPPR, HFEF, FCF, and FMF. The EBR II was being used to demonstrate the Integral Fast Reactor concept. The Transient Reactor Test Facility and the ZPPR are used to conduct reactor

Table 3.4–1. Current Missions at Idaho National Engineering Laboratory

Mission	Description	Sponsor
Argonne National Laboratory-West	Perform breeder reactor irradiation tests Provide storage of Pu material	Office of Nuclear Energy; Assistant Secretary for Environmental Management
Radioactive Waste Management Complex	Provide waste management functions for present and future site and Department needs	Assistant Secretary for Environmental Management
Power Burst Area	Perform waste processing, technology research, and development. Provide interim storage for hazardous wastes	Assistant Secretary for Environmental Management
Test Area North	Perform research on reactor safety operations and conduct a specific manufacturing capability project	Office of Nuclear Energy
Test Reactor Area	Perform irradiation service, develop nuclear instruments, and conduct safety programs. Develop methods to meet radioactive release limits	Office of Nuclear Energy; Office of Naval Reactors
Idaho Chemical Processing Plant	Operations are focused on spent fuel storage and high level waste processing	Assistant Secretary for Environmental Management
Naval Reactors Facility	Standby facility for conducting ship propulsion reactor research and training	Office of Naval Reactors
Central Facilities Area	Provide centralized support services for the site	Idaho Operations Office

Source: INEL 1995a:1.

reactor analysis and safety experiments. The HFEF provides a large inert-atmosphere containment for handling and examining irradiated reactor fuel. The FCF has been modified for the Integral Fast Reactor program to demonstrate remote reprocessing and refabrication in the fuel cycle. The FMF is used to manufacture metallic fuel elements for the fuel cycle and store Pu material.

- Supporting facilities at ANL-W include the Radioactive Liquid Waste Treatment Facility, the Radioactive Scrap and Waste Facility, the Radioactive Sodium Storage Facility, and the Sodium Process Facility. The Radioactive Liquid Waste Treatment Facility processes low-level (aqueous) liquid waste. TRU waste from ANL-W is stored at the Radioactive Scrap and Waste Facility. Contact-handled mixed waste is stored in the Radioactive Sodium Storage Facility (sodium-contaminated), and remote-handled mixed waste is stored at the Radioactive Scrap and Waste Facility. The Sodium Process Facility was built to process reactor sodium.

- The Test Reactor Area (TRA) contains the Advanced Test Reactor. This reactor is used for irradiation testing of reactor fuels and material properties; instrumentation for naval reactors; and production of radioisotopes in support of nuclear medicine, industrial applications, research, and product sterilization. Wastes from this facility are handled by the RWMC.

- The Naval Reactors Facility is operated for DOE and the U.S. Navy by Westinghouse Electric Corporation under jurisdiction of DOE's Pittsburgh Naval Reactors Office. Included at this facility are the submarine prototypes and the expended core facility. Activities include testing of advanced design equipment and new systems for current naval nuclear power propulsion plants and obtaining data for future designs.

- The Central Facilities Area (CFA) provides sitewide support services, including transportation, shop services, health services, radiation monitoring, and administrative offices.

Non-Department of Energy Activities. Non-DOE activities at INEL include research being conducted by NOAA, USGS, and various institutions of higher learning. These activities support the designation of INEL as a National Environmental Research Park (NERP).

3.4.1 LAND RESOURCES

Land Use. The INEL is located within Bingham, Bonneville, Butte, Clark, and Jefferson Counties, 35.4 km (22 mi) west of downtown Idaho Falls in southeastern Idaho. The site covers approximately 230,700 ha (570,000 acres), all of which is owned by the Federal Government and is administered, managed, and controlled by DOE. The Federal Government also owns approximately 75 percent of the land bordering INEL; this land is administered by the BLM. Twenty-four percent of adjacent land is privately owned, with the remaining 1 percent held by the State of Idaho.

Existing Land Use. Generalized land uses at INEL and in the vicinity are shown in Figure 3.4.1–1. About 2 percent of the land within INEL (4,600 ha [11,400 acres]) is used for operating areas and facilities. The developed INEL facilities are situated within a central core area of 91,000 ha (225,000 acres) designated as open space. A buffer zone consisting of 139,600 ha (345,000 acres) surrounding the central core area has been created within INEL boundaries. The BLM has entered into a Memorandum of Understanding with DOE to permit private individuals to graze livestock on the buffer zone rangeland. However, the grazing of livestock is prohibited within the central core area and within 3.2 km (2 mi) of any nuclear facilities. Other agricultural activities consist of approximately 56 ha (138 acres) of irrigated cropland located adjacent to State Routes 28 and 33, and west of the Mud Lake community. No prime farmland lies within the INEL boundaries. In 1975, DOE designated most of INEL as an NERP. It is used by the national scientific community as an outdoor laboratory for research on changes to the natural environment caused by human activities.

Offsite land use within 3.2 km (2 mi) of INEL is shown in Figure 3.4.1–1. This offsite land is primarily used for livestock and agricultural purposes. The closest residence to INEL boundary is 300 m (984 ft) east of the site (approximately 11 km [7 mi] northwest of the unincorporated community of Mud Lake).

Two National Natural Landmarks border INEL: Big Southern Butte (2.4 km [1.5 mi] south) and Hell's Half Acre (2.6 km southeast [1.6 mi]). A portion of Hell's Half Acre National Natural Landmark is designated as a Wilderness Study Area. The Black Canyon Wilderness Study Area is located adjacent to INEL and 15 km (9 mi) west-northwest of TAN. The BLM is considering the Black Canyon Wilderness Study Area for Wilderness Area designation (DOE 1995v:4.5-2). The Cedar Butte Wilderness Study Area is located 4 km (2 mi) south of INEL and 14 km (9 mi) southeast of EBR-I. The BLM does not recommend the Cedar Butte Wilderness Study Area for Wilderness Area designation.

Land-Use Planning. Lands surrounding INEL are subject to Federal and State planning laws and regulations. Land-use planning in Idaho is derived from the *Local Planning Act* of 1975, which requires that each county adopt its own land-use planning and zoning guidelines. County plans applicable to lands bordering INEL include the *Clark County Planning and Zoning Ordinance and Land Use Plan*, the *Bonneville County Comprehensive Plan*, the *Bingham County Zoning Ordinance and Planning Handbook*, the *Jefferson County Comprehensive Plan*, and the *Butte County Comprehensive Plan* (DOE 1995v:4.2–5). Land-use planning for INEL administrative and laboratory facilities located in the city of Idaho Falls is subject to Idaho Falls planning and zoning restrictions. The Idaho Falls zoning ordinance designates these INEL facility areas as I&M-1, Industrial and Manufacturing (IN City 1995a:1).

Visual Resources. The INEL generally consists of open desert land containing sagebrush. The surrounding volcanic cones, domes, and mountain ranges are visible throughout INEL. Much of INEL is the typical open, undeveloped, desert landscape characteristic of the Snake River Plain. The generally low-density character of the INEL facilities have the appearance of commercial/industrial complexes and are dispersed throughout the site. The approximate height of these structures ranges from 3 m (10 ft) to 30 m (100 ft), with a few stacks and towers that reach 76 m (250 ft). Although many INEL facilities are visible from highways, most facilities are located over 0.8 km (0.5 mi) from public roads (DOE 1995v:4.5-1). Industrial use of the developed area within INEL is consistent with a BLM VRM Class 5 designation; other areas range from VRM Class 2 to Class 4.

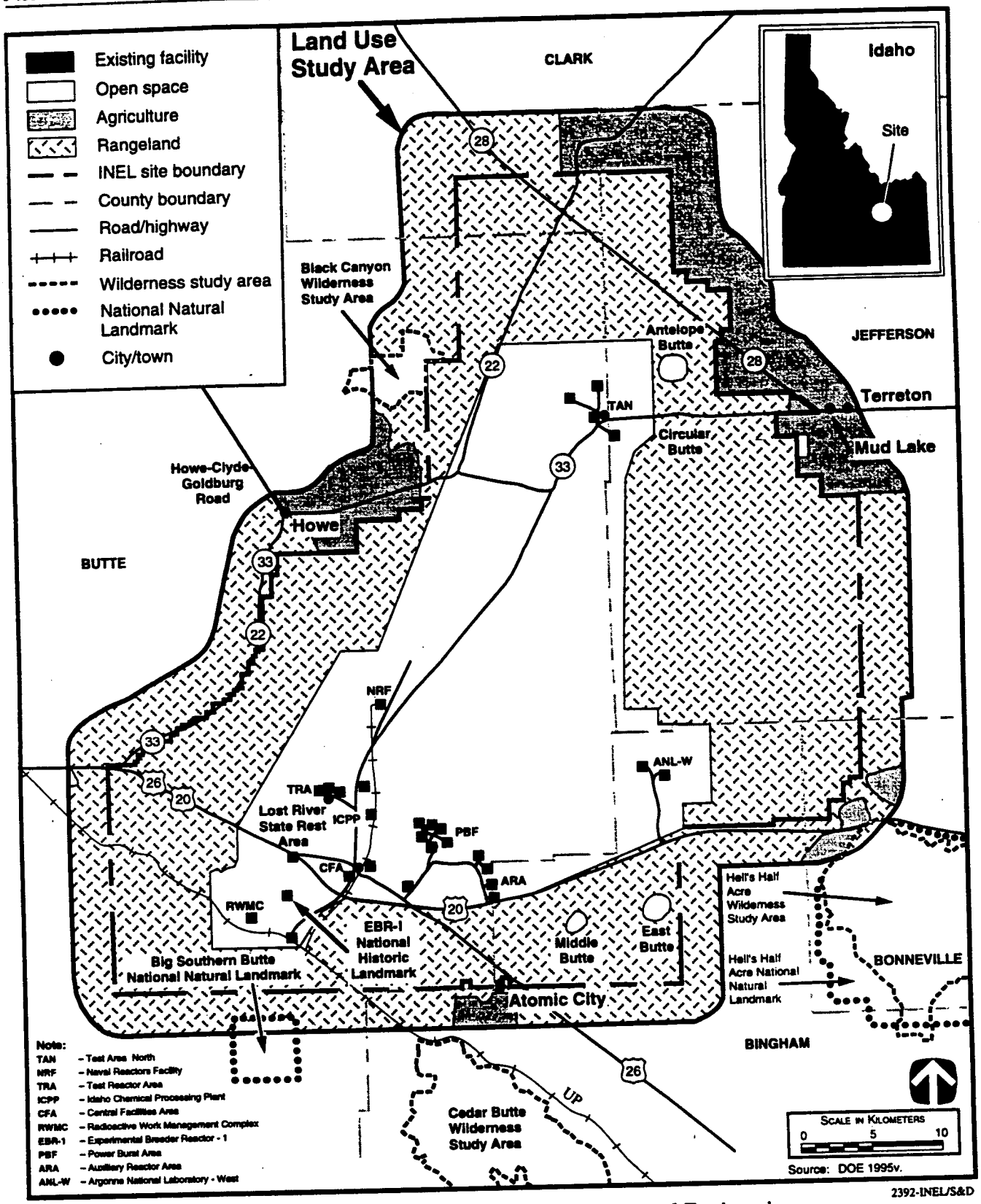


Figure 3.4.1–1. Generalized Land Use at Idaho National Engineering Laboratory and Vicinity.

The Lost River State Rest Area, located along U.S. Route 20/26 (Figure 3.4.1–1), is approximately 5 km (3 mi) southwest of the TRA. Views from the Black Canyon Wilderness Study Area (Figure 3.4.1–1) include agricultural land use and the facilities of INEL. INEL facilities are visible from the Cedar Butte Wilderness Study Area. Views of the facilities from these Wilderness Study Areas are distant and therefore have a minor effect on the overall natural appearance of the area. Craters of the Moon National Monument and Wilderness Area are both approximately 20 km (12.5 mi) southwest from the closest INEL boundary.

3.4.2 SITE INFRASTRUCTURE

Baseline Characteristics. The INEL contains extensive production, service, and research facilities. Not all of these facilities are in operation or are needed today. To support site missions, an extensive infrastructure exists, as shown in Table 3.4.2–1. Pu remaining from various research programs is stored at the ANL-W site in the ZPPR and FMF vaults. The road infrastructure provides intrasite transportation requirements. The railroad infrastructure supports large-volume deliveries of coal and oversized structural components. INEL does not have a connection to local natural gas lines.

Table 3.4.2–1. Idaho National Engineering Laboratory Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	445[a]	445[a]
Railroads (km)	48	48
Electrical		
Energy consumption (MWh/yr)	232,500	394,200
Peak load (MWe)	42	124
Fuel		
Natural gas (m^3/yr)	0	0
Oil (l/yr)[b]	5,820,000	16,000,000
Coal (t/yr)	11,340	11,340
Steam (kg/hr)	40,800	40,800

[a] Includes paved and unpaved roads.
[b] Amount includes fuel oil and propane.
Source: DOE 1995j; INEL 1993a:5.

The subregional electrical power pool area in which INEL is located and from which it draws its power is the Northwest Power Pool Area, a part of the Western Systems Coordinating Council. INEL draws its electrical power predominantly from hydroelectric and coal-fired power generating plants. Characteristics of this power pool are given in Table 3.4.2–2.

Table 3.4.2–2. Northwest Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	34%
Nuclear	3%
Hydro/geothermal	46%
Oil/gas	7%
Other[b]	11%
Total Annual Production	256,404,000 MWh
Total Annual Load	250,045,000 MWh
Energy Exported Annually	6,359,000 MWh
Generating Capacity	49,596 MWe
Peak Demand	33,325 MWe
Capacity Margin[c]	13,655 MWe

[a] Percentages do not total 100 percent due to rounding.

[b] Includes power from both utility and non utility sources.

[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

3.4.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The climate at INEL and in the surrounding region is characteristically that of a semiarid steppe. The average annual temperature at INEL is 5.6 °C (42.0 °F); average monthly temperatures range from a minimum of -8.8 °C (16.1 °F) in January to a maximum of 20.0 °C (68 °F) in July. The average annual precipitation at INEL is 22.1 cm (8.7 in) (IN DOE 1989b:55,77). Prevailing winds at INEL are southwest to west-northwest with a secondary maximum frequency from the north-northeast to northeast. The average annual windspeed is 3.4 m/s (7.5 mph). Additional information related to meteorology and climatology at INEL is presented in Appendix F.

Ambient Air Quality. The INEL is located within the Eastern Idaho Intrastate AQCR (#61). None of the areas within INEL and its surrounding counties are designated as nonattainment areas (40 CFR 81.313) with respect to the NAAQS for criteria pollutants (40 CFR 50). The nearest nonattainment area for particulate matter is in Pocatello, about 80 km (50 mi) to the south. Applicable NAAQS and Idaho State ambient air quality standards are presented in Appendix F.

Three PSD (40 CFR 52.21) Class I areas have been designated in the vicinity of INEL: Craters of the Moon National Monument, Idaho, approximately 53 km (33 mi) west-southwest from the center of the site; Yellowstone National Park, Idaho-Wyoming, approximately 143 km (89 mi) east-northeast from the center of the site; and Grand Teton National Park, Wyoming, approximately 145 km (90 mi) east from the center of the site (IN DOE 1991b:4-11).

Since the creation of the PSD program in 1977, PSD permits were obtained by INEL for two major emission sources: the Coal-Fired Steam-Generating Facility next to the ICPP and the Fuel Processing Restoration Facility, which is not expected to be operated (IN DOE 1980a; IN DOE 1988h).

Historically, the primary emission sources of criteria air pollutants at INEL are the calcination of liquid waste, the combustion of coal for steam generation at the ICPP, and the combustion of fuel oil for heating at various INEL facilities. Other emissions and sources include fugitive particulates from waste-burial activities and coal piles, other processes, vehicles, and temporary emissions from various construction activities. A total of 26 toxic air pollutants have been identified that are emitted from existing INEL facilities in quantities exceeding the screening levels established by the State of Idaho (ID DHW 1995a:103-116; ID DHW 1995b:116-119). Emission estimates for these sources are presented in Appendix F.

Ambient concentration limits for hazardous and toxic air pollutants (to be used by the State as one of the criteria in evaluating construction permit applications for a new emission source) have been adopted by the Idaho Department of Health and Welfare (ID DHW 1995a:103-116; ID DHW 1995b:116-119). The annual emission rates of hazardous and toxic air pollutants from existing INEL facilities during 1990 are listed in Appendix F.

Table 3.4.3–1 presents the baseline ambient air concentrations for criteria pollutants and other pollutants of concern at INEL. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. Major noise emission sources within INEL include various industrial facilities, equipment, and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials handling equipment, and vehicles). Most INEL industrial facilities are at a sufficient distance from the site boundary that noise levels at the boundary from these sources would not be measurable or would be barely distinguishable from background noise levels.

Table 3.4.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Idaho National Engineering Laboratory, 1990

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000[b]	284
	1-hour	40,000[b]	614
Lead	Calendar Quarter	1.5[b]	0.001
Nitrogen dioxide	Annual	100[b]	4
Ozone	1-hour	235[b]	[c]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	5
	24-hour	150[b]	80
Sulfur dioxide	Annual	80[b]	6
	24-hour	365[b]	135
	3-hour	1,300[b]	579
Mandated by the State of Idaho			
Total suspended particulates	Annual	60[d]	5
	24-hour	150[d]	80
Hazardous and Other Toxic Compounds			
Acetaldehyde	Annual	0.45[e]	0.011
Ammonia	Annual	180[e]	6.0
Arsenic	Annual	0.00023[e]	0.00009
Benzene	Annual	0.12[e]	0.029
Butadiene	Annual	0.0036[e]	0.001
Carbon tetrachloride	Annual	0.067[e]	0.0060
Chloroform	Annual	0.043[e]	0.00040
Cyclopentane	Annual	17,000[e]	2.7
Formaldehyde	Annual	0.077[e]	0.012
Hexavalent chromium	Annual	0.000083[e]	0.00006
Hydrazine	Annual	0.00034[e]	0.000001
Hydrochloric acid	Annual	7.5[e]	0.98
Mercury	Annual	1[e]	0.042
Methylene chloride	Annual	0.24[e]	0.006
Naphthalene	Annual	500[e]	18
Nickel	Annual	0.0042[e]	0.0027
Nitric acid	Annual	50[e]	0.64
Perchloroethylene	Annual	2.1[e]	0.11
Phosphorus	Annual	1[e]	0.30
Potassium hydroxide	Annual	20[e]	0.20
Proprionaldehyde	Annual	4.3[e]	0.30
Styrene	Annual	1,000[e]	1.3
Toluene	Annual	3,750[e]	370
Trichloroethylene	Annual	0.077[e]	0.00097

Table 3.4.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations and Guidelines at Idaho National Engineering Laboratory, 1990—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (continued)			
Trimethylbenzene	Annual	1,230[c]	100
Trivalent chromium	Annual	5[e]	0.036

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Federal and State standard.

[c] Data not available from source document.

[d] State standard.

[e] Acceptable air concentrations listed in Rules for the Control of Air Pollution in Idaho apply only to new (not existing) sources and are used here as reference levels.

Note: Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

Source: 40 CFR 50; DOE 1995v; ID DHW 1995a; ID DHW 1995b.

Existing INEL-related noises of public significance are from the transportation of people and materials to and from the site and in-town facilities via buses, trucks, private vehicles, helicopters, and freight trains. Noise measurements along U.S. Highway 20 about 15 m (50 ft) from the roadway indicate that the sound level from traffic ranges from 64 to 86 dBA (IN DOE 1990b:62), and that the primary source is buses (71 to 80 dBA). While few people reside within 15 m (50 ft) of the roadway, the results indicate that INEL traffic noise might be objectionable to members of the public residing near principal highways or busy bus routes. The acoustic environment along the INEL site boundary in rural areas and at nearby areas away from traffic noise is typical of a rural location, with DNL in the range of 35 to 50 dBA (EPA 1974a:B-4). Except for the prohibition of nuisance noise, neither the State of Idaho nor its local governments have established any regulations that specify acceptable community noise levels.

3.4.4 WATER RESOURCES

Surface Water. Flowing surface water in the INEL area consists of three intermittent streams that drain the adjacent mountains: Big Lost River, Little Lost River, and Birch Creek. The streams usually begin to flow in the spring and are dry by early- to mid-summer. The Big Lost River and Birch Creek are the only surface waters that flow onto the site on a regular basis. The Little Lost River does not enter the site under normal flow conditions. Since much of the flow in these streams is diverted upstream for irrigation, it is possible that several years can pass without any flow entering the INEL boundaries. The USGS is responsible for monitoring the streams, but the only onsite monitoring station is for the Big Lost River. Surface water features near INEL are depicted in Figure 3.4.4–1.

The Big Lost River flows onto the site at the southern part of its western boundary and flows northeastward to the Big Lost River sinks (Playas 1 through 3) (DOE 1992e:4-66). Water flow in the Big Lost River is controlled by the MacKay Dam located approximately 73 km (45 mi) upstream from INEL. Local rainfall and snowmelt are the primary contributors to the surface water flows. Most precipitation is rapidly infiltrated into the soil or evaporated.

Surface water is not used on INEL as a source of drinking water, nor is it used as a receptor for wastewater discharge. Nonradioactive liquid effluents are disposed of primarily to a waste ditch, a lined evaporation pond, an industrial waste pond, five different seepage ponds, and sewage treatment facilities.

Several areas of INEL, such as TAN, TRA, and CFA currently divert stormwater into drainage ditches and discharge flow into soils away from the work area. A large drainage ditch equipped with an automatic sampler surrounds the RWMC to ensure that radionuclides are not transported from the area by stormwater.

Flooding at INEL by the Big Lost River has largely been averted by a flood diversion system constructed in 1958 and upgraded in 1984. The flood diversion system consists of a small dam to direct flow through a diversion channel into four spreading areas (IN DOE 1991b:4-17). The flood diversion system is designed to contain a 300-year flood.

Surface Water Quality. The Big Lost River (from its source to the playas) is designated by the Idaho Department of Health and Welfare's Water Quality Standards and Wastewater Treatment Requirements for the following uses: agricultural and domestic water supply, cold water biota, salmonid spawning, primary and secondary contact recreation, and special resource waters (ID DHW 1992a).

The USGS is responsible for monitoring the surface water quality at INEL. The most recent water samples collected within the facility boundaries were collected from the Big Lost River below the diversion dam in June 1995, when the river flowed for several weeks. The results of the analysis and the Idaho Water Quality Standards for the Protection of Domestic Water Supplies are presented in Table 3.4.4–1. The analytical results indicate that there are no parameters in exceedance of the water quality criteria.

Surface Water Rights and Permits. Surface water rights are not an issue at INEL because INEL facilities do not withdraw surface water for use nor do they discharge effluents directly to natural surface waters.

Groundwater. The Snake River Plain Aquifer, classified by EPA as a Class I sole source aquifer, is located beneath the entire INEL site and covers a total area of approximately 24,860 km^2 (9,600 mi^2) in southeastern Idaho. The aquifer serves as a primary source for drinking water and crop irrigation in the Snake River Basin (IN DOE 1995f:99). It is composed of 610 to 3,048 m (2,000 to 10,000 ft) of lava flows, rhyolite, and interbedded sediments and is believed to contain 1,200 to 2,500 trillion l (317 to 660 trillion gal) of water.

Water from Henry's Fork of the Snake River infiltrates the subsurface and supplies a significant amount of water to the Snake River Plain Aquifer below INEL. Additional recharge to the aquifer comes from the Big Lost River,

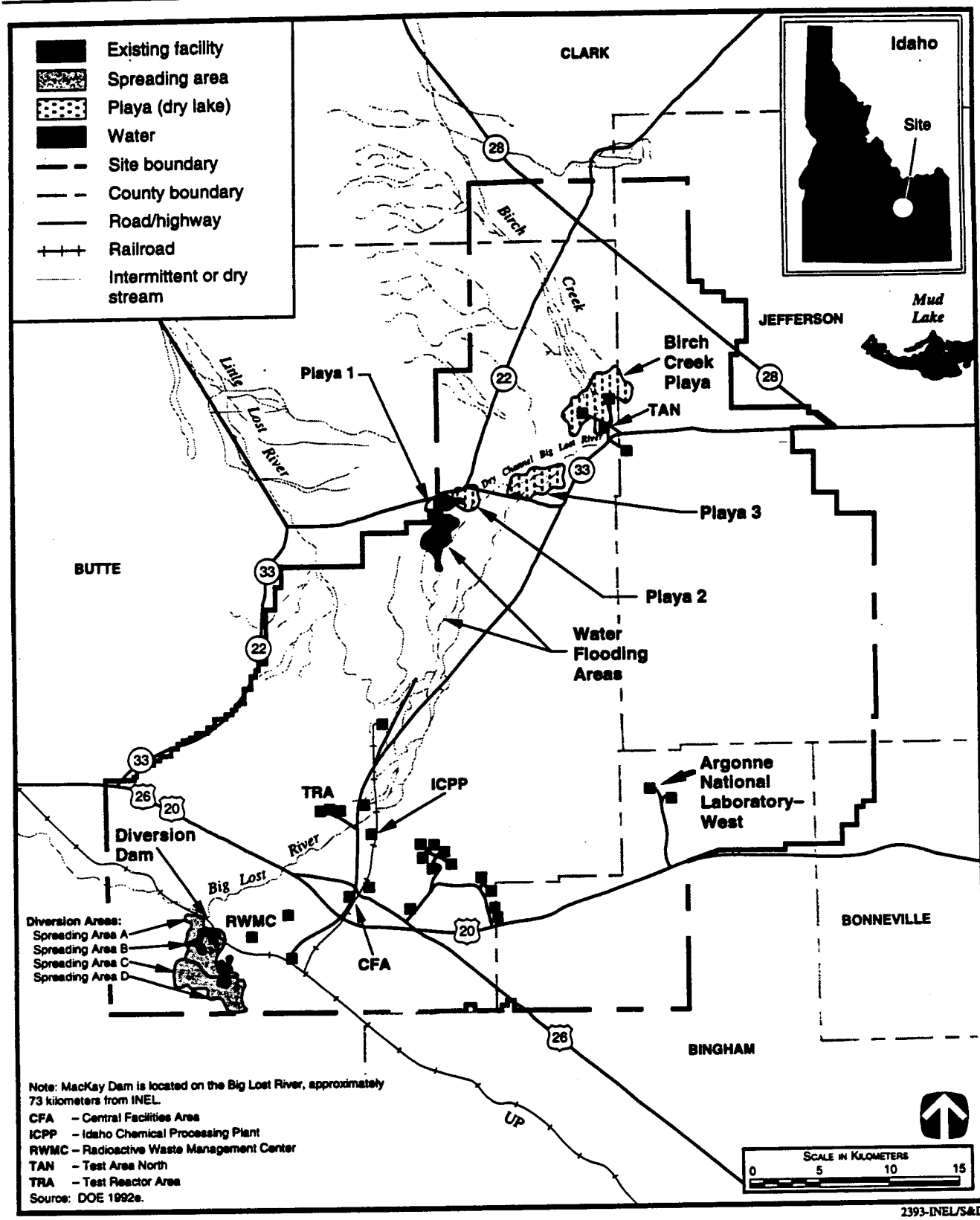


Figure 3.4.4–1. Surface Water Features at Idaho National Engineering Laboratory.

Little Lost River, and Birch Creek, which originates in the mountains to the northwest of INEL, flows onto the site during a few months of the year, and sinks into its porous soils. Precipitation and snowmelt also contribute to its recharge. Local groundwater movement is complicated, but overall, groundwater flows laterally at an average rate of 1.5 to 6.1 m (4.9 to 20 ft) per day to the south and southwest, as shown in Figure 3.4.4–2. The groundwater emerges in springs (about 8 trillion l [2.1 trillion gal] annually) along the Snake River from Milner (located to the west of Burley) to Bliss, Idaho, and from Blackfoot to American Falls Reservoir in the region west of Pocatello, Idaho (IN DOE 1995f:3). Depth to the water table ranges from 60 m (200 ft) below the ground surface in the northeast corner of INEL to 300 m (1,000 ft) in the southeast corner (DOE 1992e:4-69).

Table 3.4.4–1. Summary of Big Lost River Surface Water Quality Monitoring at Idaho National Engineering Laboratory, 1995

Parameter	Unit of Measure	Water Quality Criteria[a]	Maximum Water Body Concentration
Arsenic	mg/l	0.05[b]	.0002
Barium	mg/l	1.0[c]	<0.0085
Cadmium	mg/l	0.005[b]	<0.001
Chromium	mg/l	0.05[c]	0.0042
Lead	mg/l	0.015[b]	<0.001
Mercury	mg/l	0.002[b,c]	<0.0001
pH	pH units	6.5-8.5[c]	8.4
Selenium	mg/l	0.01[b,c]	0.001
Silver	mg/l	0.05[b,c]	<0.001
Temperature	°C	22[c]	15

[a] For comparison purposes only.
[b] National Primary Drinking Water Regulation (40 CFR 141).
[c] State of Idaho Water Quality Criteria.
Source: ID DHW 1992a; IN USGS 1995a.

Perched water tables occur in the INEL area. The presence of these perched water bodies is believed to be beneficial to water quality in the Snake River Plain Aquifer. These perched water bodies slow waste migration, allow for radioactive decay, and spread any waste plumes over a wider area for greater dilution (DOE 1992e:4-70).

Groundwater Quality. There are several "networks" of monitoring wells drilled and maintained by USGS. These include the INEL-wide facility groundwater monitoring group and well networks for RCRA- and CERCLA-required monitoring. Groundwater beneath INEL is monitored by groups including USGS, DOE's site contractor, LITCO, other DOE contractors, and the State of Idaho. USGS has drilled more than 120 wells in the Snake River Plain Aquifer and 100 in the perched zone on and near INEL. Water supply wells, monitoring wells, and offsite water supply wells are routinely sampled for chemical and radiological constituents (DOE 1992e:4-70).

Historically, there has been radionuclide contamination of the Snake River Plain Aquifer. Between 1952 and 1988, approximately 30,900 Ci of tritium were disposed of into wells and infiltration ponds at INEL (mainly from the ICPP, TRA, and also the TAN). No tritium is currently disposed of to the groundwater at INEL, but large tritium plumes are present in the Snake River Plain Aquifer and in perched groundwater under the ICPP and TRA (Figure 3.4.4–2) (IN USGS 1988a:7). Tritium occurs at elevated levels in some monitoring wells and has been detected in groundwater near the southern boundary of INEL, 14.5 km (9 mi) south of the ICPP and TRA. The average concentration of tritium in water from six INEL production wells has remained constant since 1990 (IN DOE 1995f:72). In 1994, the highest tritium concentrations occurring in INEL drinking water were in the area of the CFA; the concentration ranged from 12,600 to 18,000 pCi/l (47,697 to 68,138 pCi/gal) (IN DOE

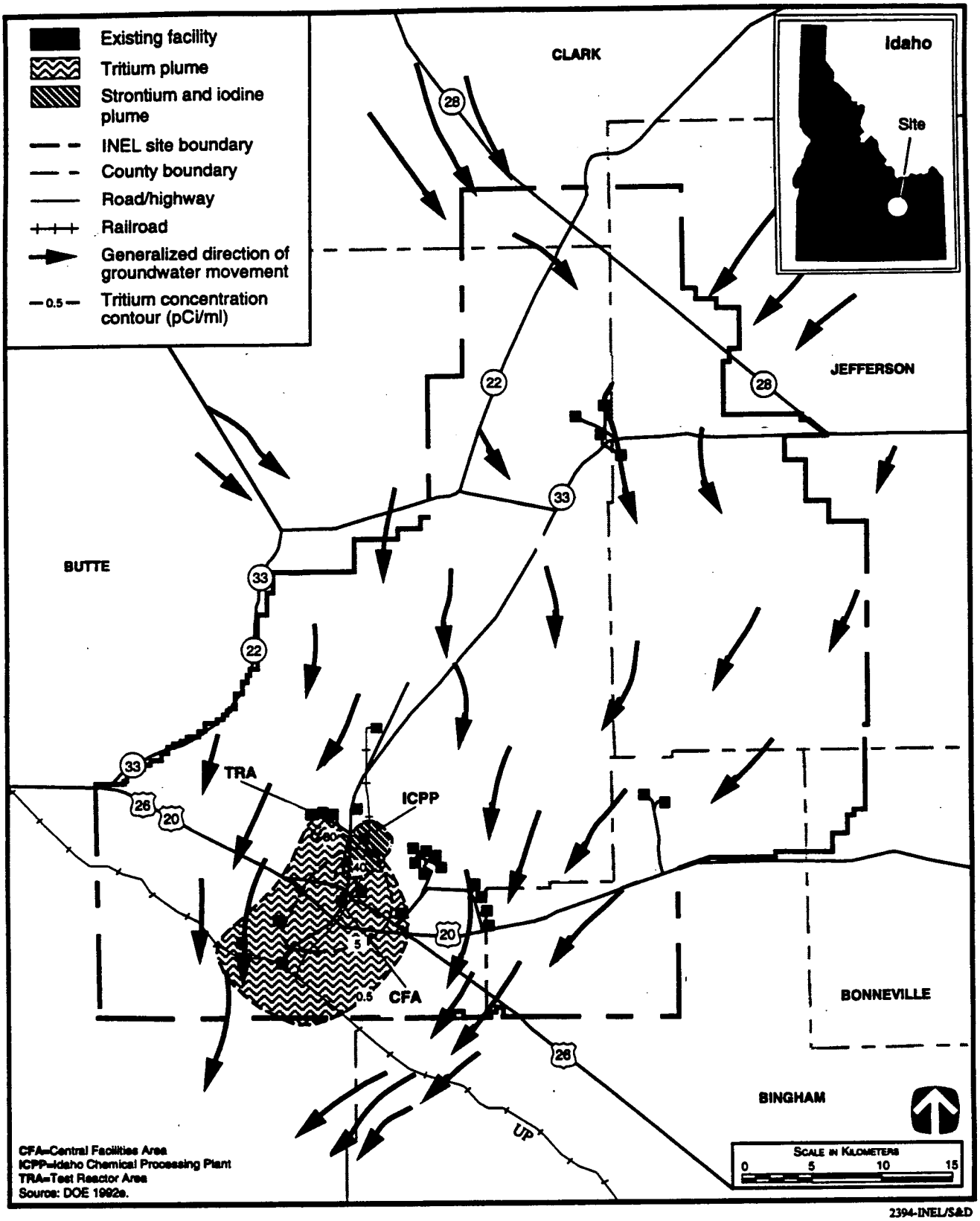


Figure 3.4.4–2. Generalized Groundwater Flow and Groundwater Contamination at Idaho National Engineering Laboratory and Vicinity.

1995f:71). The elimination of tritium disposal, coupled with its radioactive decay, and dilution and dispersion within the groundwater reservoir are factors contributing to a 93-percent decrease in tritium concentration levels from 1961 to 1994.

Other radionuclides of significance include Cs-137, I-129 and Sr-90. Cs-137 is strongly adsorbed on mineral grains in the soils, so it is unlikely that it will reach the aquifer in significant amounts. As shown in Figure 3.4.4–2, plumes have been delineated for Sr and I.

Groundwater contamination from the injection well at TAN is being remediated as specified in a 1994 ROD and subsequent Fact Sheet. Another 1994 ROD addresses groundwater contamination at RWMC. Buried drums in this area released VOCs (for example, trichloroethylene) that have migrated downward to the Snake River Plain Aquifer. However, concentrations of these compounds were found to be below drinking water standards (IN DOE 1995f:32).

Samples from 32 offsite USGS wells beyond the southern and western site boundaries were taken in 1994. All gross alpha concentrations were within the expected concentration range for naturally occurring alpha activity in the aquifer underlying the INEL and surrounding areas. According to USGS reports, alpha-emitting wastes from site operations have not migrated far from their entrance into the aquifer near ICPP (IN DOE 1995f:69). None of the offsite water samples collected during 1994 contained detectable concentrations of tritium or gross beta activity radionuclides.

Nonradioactive wastes, including sodium chloride, sulfuric acid, sodium hydroxide, and organics, have also been discharged to ponds within many of the operating areas. In the past, wastewater has also been injected into deep disposal wells at the TRA and ICPP. The TDS concentrations of the injected wastewaters were approximately twice those present in the natural groundwater (IN USGS 1988a:20). There are no plans to use injection wells for future wastewater disposal. Monitoring of the Snake River Plain Aquifer for nonradiological constituents, including sodium chloride, total chromium, trace metals, and nitrates, showed concentrations for these contaminants to be at or below background levels at least 4 km (2.5 mi) inside the nearest site boundary (IN DOE 1994c:54).

Only nonradioactive and nonhazardous liquid wastes are currently discharged into the sanitary and service waste disposal systems. All hazardous and radioactive wastes are stored or disposed of in approved facilities designed to preclude further groundwater contamination. Groundwater quality data is shown in Table 3.4.4–2.

Groundwater Availability, Use, and Rights. The Snake River Plain Aquifer is the source of all water used at INEL. The combined pump capacity of the 27 onsite production wells averaged approximately 7.9 billion l/yr (2.1 billion gal/yr) from 1982 through 1985. This is 0.3 percent of the 2.44 trillion l/yr (645 billion gal/yr) of groundwater withdrawn from the aquifer in the Eastern Snake River Plain. Most of the water withdrawn from the aquifer in the Eastern Snake River Plain (2.34 trillion l/yr [619 billion gal/yr]) is used for agriculture. After use and treatment, approximately 63 percent of the quantity of groundwater withdrawn at INEL is disposed of in wells and ponds (DOE 1992e:4-73).

In the INEL ROI, Idaho Falls, Pocatello, and Rigby maintain water supply systems. All of the community drinking water systems draw their raw water from the Snake River Plain Aquifer. In 1991, the combined water supply capacity for these systems was approximately 538 million l/day (142.1 million gal/day). The combined demand averaged about 204 million l/day (53.9 million gal/day), or 38 percent of capacity.

The Department holds a Federal Reserved Water Right for the INEL site, which permits a water pumping capacity of 2.3 m^3/s (80 ft^3/s) and a maximum water consumption of 43 billion l/yr (11.4 billion gal/yr) for drinking, process water, and noncontact cooling (DOE 1992e:4-74). Because it is a Federal Reserved Water Right, INEL's priority on water rights dates back to its establishment in 1950. The legal and administrative framework for the water rights adjudication process is currently being evaluated for the State of Idaho.

Table 3.4.4–2. Groundwater Quality Monitoring at Idaho National Engineering Laboratory, 1994

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Drinking Water and Production Wells	
			High	Low
1-Dichlorobenzene	mg/l	0.075[b]	0.0007	0.0007
1,1,1-Trichloroethane	mg/l	0.2[b]	0.0028	<dL
Alpha (gross)	pCi/l	15[b]	2.8	<dL
Barium	mg/l	1.0[c]	0.09	0.003
Beta (gross)	pCi/l	50[d]	8.0	<dL
[Text deleted.]				
Carbon tetrachloride	mg/l	0.005[b]	0.0006	<dL
Chloroform	mg/l	0.1[b]	0.0047	<dL
Chromium	mg/l	0.05[b]	0.007	0.003
Strontium-90	pCi/l	400[e]	0.8	<dL
Tetrachloroethylene	mg/l	0.005[b]	0.0047	<dL
Trichloroethylene	mg/l	0.005[b]	0.0166	<dL
Tritium	pCi/l	80,000[e]	18,000	1,300

[a] For comparison purposes only.

[b] National Primary Drinking Water Regulations (40 CFR 141).

[c] State water quality criteria.

[d] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[e] DOE's DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.

Note: dL=detection limit.

Source: IN DOE 1995f.

3.4.5 GEOLOGY AND SOILS

Geology. The INEL occupies a relatively flat area on the northwestern portion of the Eastern Snake River Plain. The INEL area consists of a broad plain that has been built up from the eruptions of multiple flows of basaltic lava. INEL is bordered by Centennial Range Mountains on the north and the overthrust belt on the east. The Eastern Snake River Plain consists of Miocene and younger volcanic rocks that probably rest upon older sedimentary and plutonic rocks, as well as faulted remains of Eocene volcanic rocks. Within INEL, economically viable sand, gravel, and pumice resources have been identified. Several quarries have supplied these materials to various onsite construction projects.

The oldest faults in the region occur both to the north and south of INEL and are approximately 40 to 65 million years old. The Arco Segment of the Lost River Fault and the Howe Segment of the Lemhi Fault are range-front normal faults associated with the Basin and Range Province and have been active during recent geologic time (100,000 to 15,000 years ago); they are considered to be the closest capable faults to INEL by the definition outlined in 10 CFR 100, Appendix A. These faults terminate approximately 30 km (19 mi) from the INEL boundary (Figure 3.4.5–1).

The INEL is located in Seismic Zone 2B. For this PEIS, Uniform Building Code Seismic Zones 2A and 2B are included in Seismic Zone 2 (Figure 3.2.5–1), indicating that moderate damage could occur as a result of an earthquake. Seismic Zone 3 is located in adjacent regions to the north, east, and south of INEL.

The INEL is situated on the Eastern Snake River Plain, an area of low seismicity. The Plain is bordered by the seismically active Centennial Tectonic Belt to the north and the Intermountain Seismic Belt to the east and southeast. Historical and recent seismic data cataloged by NOAA, the National Earthquake Information Center (NEIC), the University of Utah, and the INEL Seismic Network indicates that earthquakes in the region occur primarily in the Intermountain Seismic Belt and Centennial Tectonic Belt (including the mountains and valleys of the Basin and Range province which bound the Plain on the north and south) (IN DOE 1991b:4-28). The seismic characteristics of the Plain and the adjacent Basin and Range province are different; earthquakes and active faulting are associated with the Basin and Range tectonic activity, whereas the Plain has historically experienced few and small earthquakes (DOE 1995j:4.6-1).

[Text deleted.] Historically there have been several earthquakes in the region surrounding INEL (Figure 3.4.5–1). However, none of these occurred within approximately 48 km (30 mi) of the site. The largest historic earthquake near INEL took place in 1983, approximately 107 km (66 mi) to the northwest, near Borah Peak in the Lost River Range. The earthquake had a Richter magnitude of 7.3 with a resulting peak ground acceleration of 0.022 to 0.078 g at INEL (DOE 1995j:4.6-1). An earthquake of greater than 5.5 magnitude can be expected approximately every 10 years within a 321-km (200-mi) radius of INEL.

The only recorded earthquake on the Eastern Snake River Plain with a Richter magnitude greater than 5.5 was the 1905 event that had a magnitude of 5.7. Recent interpretations of the event, however, have suggested that its epicenter was more likely to have been in Utah or Nevada. The distribution of earthquakes at and near INEL from 1884 to 1989 (Figure 3.4.5–1) clearly shows that the Eastern Snake River Plain has a low rate of seismicity.

Volcanic hazards at INEL can come from sources inside or outside the Snake River Plain. Volcanic hazards include the effects of lava flows, ground deformation (fissures, uplift, subsidence), volcanic earthquakes (associated with magmatic processes as distinct from earthquakes associated with tectonics), and ash flows or airborne ash deposits. Most of the basaltic volcanic activity occurred from 4 million to 2,100 years ago at the Craters of the Moon National Monument 20 km (12.5 mi) southwest of INEL. The rhyolite domes along the Axial Volcanic Zone formed between 1.2 and 0.3 million years ago and have a recurrence interval of about 200,000 years. Therefore, the probability of future dome formation affecting INEL site facilities is very low (DOE 1995j:4.6-9).

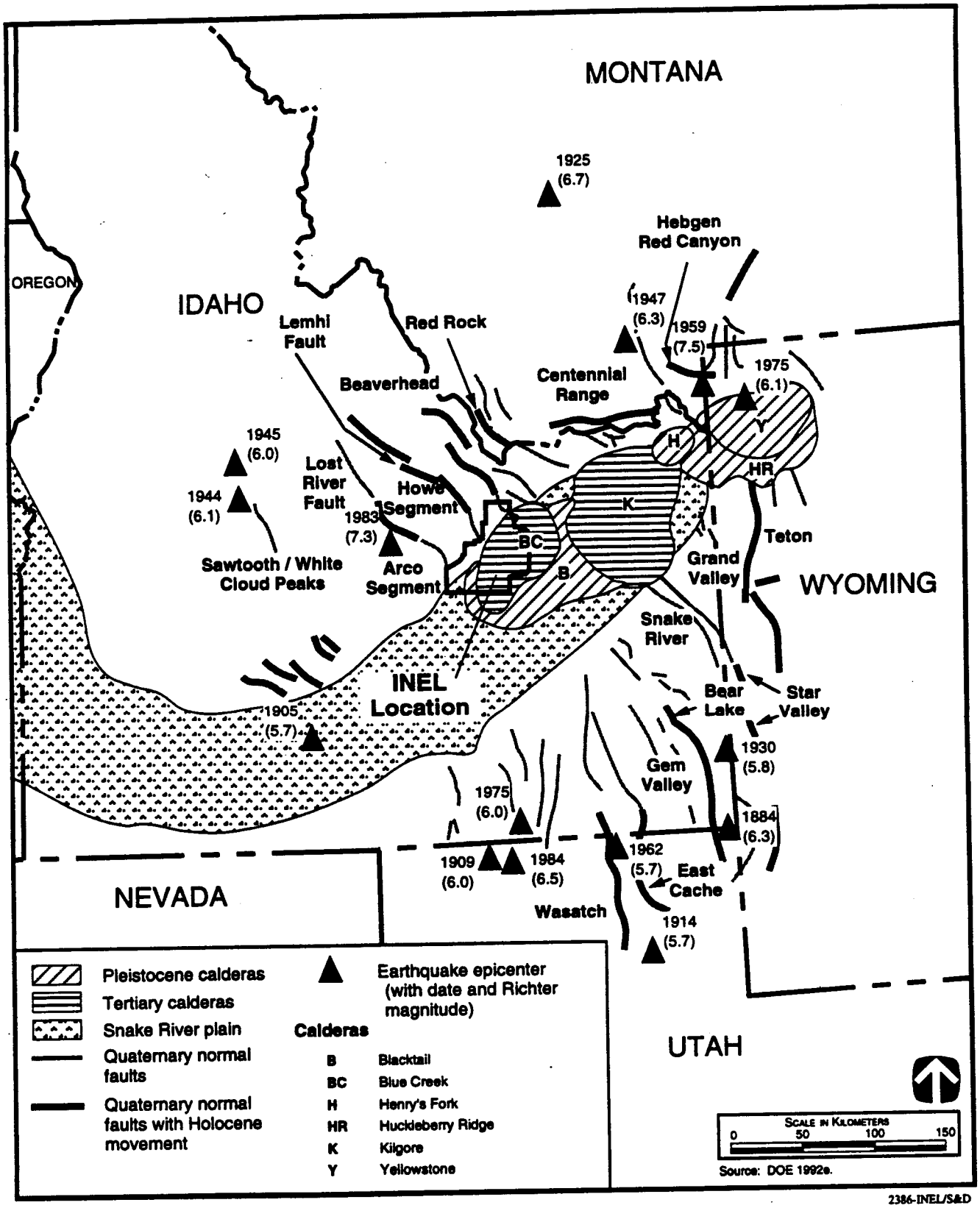


Figure 3.4.5–1. Major Fault Systems, Calderas, and Historic Earthquakes in the Idaho National Engineering Laboratory Region.

Catastrophic Yellowstone type volcanic eruptions have occurred three times in the past 2 million years, but the INEL site lies more than 160 km (99 mi) southwest from the Yellowstone Caldera rim, and high-altitude winds would not disperse Yellowstone ash in the direction of INEL. Additionally, the infrequency, distance, and unfavorable dispersal of pyroclastic flows or ash fallout from future Yellowstone eruptions are not expected to affect the INEL site (DOE 1995j:4.6-9).

Basaltic lava flows and eruptions from fissures or vents have been considered in this PEIS. Based on a probability analysis of the volcanic history in and near the southcentral INEL area, the Volcanism Working Group estimated that the conditional probability that basaltic volcanism would affect a south-central INEL site location is less than 2.5×10^{-5} per year (once per 40,000 years or longer), where the hazard associated with Axial Volcanic Zone volcanism is greatest. The probability of a volcanic event affecting INEL site facilities farther north, where both silicic and basaltic volcanism have been older and less frequent, is estimated to be less than 1.0×10^{-6} per year (once every million years or longer). The statistics of 116 measured INEL-area lava flow lengths and areas were used to define the two lava flow hazard zones (Figure 3.4.5–2). The mean lava flow length plus one standard deviation from the mean corresponds to 14 km (8.7 mi). The hazard for a particular site within or near a volcanic zone is much lower, typically by an order of magnitude or more, and must be assessed on a site-specific basis (DOE 1995j:4.6-9).

Soils. The INEL soils are derived from volcanic and clastic rocks from nearby highlands (IN DOE 1986a:4). In the southern part of INEL, the soils are gravelly to rocky and generally shallow. The northern portion is composed mostly of unconsolidated clay, silt, and sand. Generally, the soils are acceptable for standard construction techniques and consist of wind-blown sand and silt lying in patches over a bedrock of basaltic lava. These soils have a low-to-moderate water erosion hazard and a moderate-to-high wind erodibility. Shrink-swell potential is generally low to moderate.

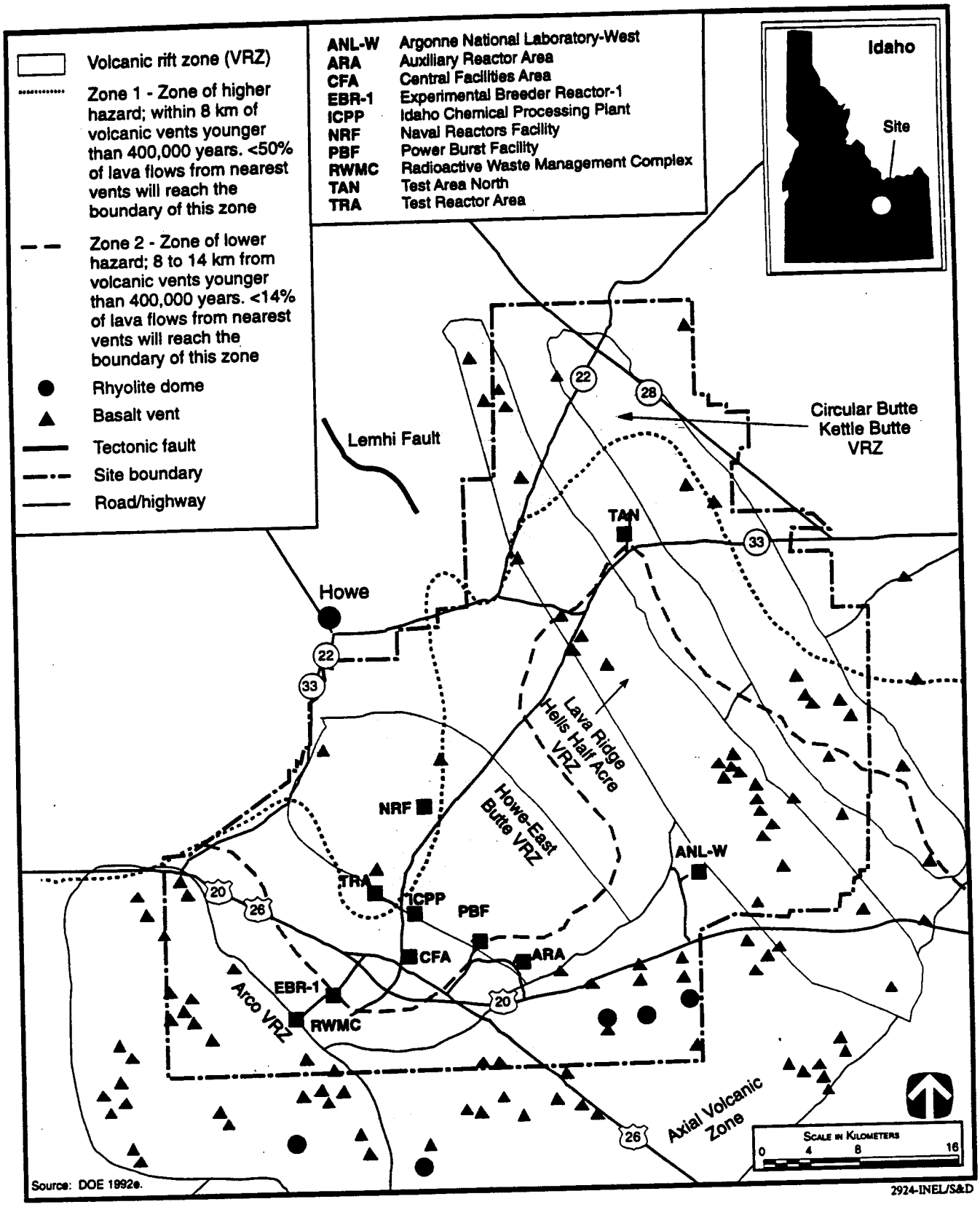


Figure 3.4.5–2. Major Volcanic Rift and Lava Flow Hazard Zones at the Idaho National Engineering Laboratory Region.

3.4.6 BIOLOGICAL RESOURCES

Terrestrial Resources. The INEL lies in a cool desert ecosystem dominated by shrub-steppe communities. Most land within the site is relatively undisturbed and provides important habitat for species native to the region. Facilities and operating areas occupy 2 percent of INEL; approximately 60 percent of the area around the periphery of the site is grazed by sheep and cattle (DOE 1992e:4-76). Although sagebrush communities occupy about 80 percent of INEL, a total of 20 plant communities have been identified (IN DOE 1986a:4) (Figure 3.4.6–1). The interspersion of low and big sagebrush communities in the northern portion of INEL, and the juniper communities located in the northwestern and southeastern portions of the site are considered sensitive habitats (IN DOE 1986a:4,8). The former provides critical winter and spring range for sage grouse and pronghorn, while the latter is important to nesting raptors and songbirds. Riparian vegetation, primarily cottonwood and willow, along the Big Lost River and Birch Creek also provides nesting habitat for hawks, owls, and songbirds (DOE 1992e:4-76). In total, 398 plant taxa have been documented on INEL (IN DOE 1978a:129-131).

The INEL supports numerous animal species, including 1 amphibian, 9 reptile, 184 bird, and 37 mammal species (DOE 1992e:4-76). Common animals on INEL include the short-horned lizard, gopher snake, sage sparrow, Townsend's ground squirrel, and black-tailed jackrabbit. Important game animals include the sage grouse, mule deer, elk, and pronghorn. During some winters, 4,500 to 6,000 pronghorn, or about 30 percent of Idaho's total population, may be found on INEL. Pronghorn wintering areas are located in the northeastern portion of the site, in the area of the Big Lost River sinks, in the west-central portion of the site along the Big Lost River, and in the south-central portion of the site (IN DOE 1978a:221-222). Hunting is permitted only within about 1 km (0.6 mi) of the northern site boundary. Pronghorn, which is the only species taken, are hunted in order to control damage to agricultural land (INEL 1992a:2). Numerous raptors, such as the golden eagle and prairie falcon, and carnivores, such as the coyote and mountain lion, are also found on INEL. A variety of migratory birds has been found at INEL. Migratory birds, as well as their nests and eggs, are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Within the proposed site for the storage facility (which is also the assumed analysis site for the evolutionary LWR), shallow soils (which occupy most of the area) are dominated by big sagebrush (Figure 3.4.6–1). In low-lying areas of deep soil, the dominant vegetation is perennial grasses. Isolated stands of juniper also exist in the area. Cheatgrass, an aggressive European annual that readily replaces native species in disturbed areas, is also present. Elk use areas in the vicinity of the site during the fall, winter, and spring, but pronghorn use is relatively low. Pronghorn wintering areas are located no closer than about 6.5 km (4 mi) from the site area. Sage grouse are known to use the site but not for breeding. The isolated stands of juniper in the area provide potential nesting habitat for hawks and owls (DOE 1992e:4-76).

Wetlands. The NWI maps prepared by the USFWS have been completed for most of INEL. The NWI maps indicate that the primary wetland areas are associated with the Big Lost River, the Big Lost River spreading areas, and the Big Lost River sinks, although smaller (less than about 0.4 ha [1 acre]) isolated wetlands also occur. Wetlands associated with the Big Lost River are classified as riverine/intermittent, indicating a defined stream channel with flowing water during only part of the year.

The Big Lost River spreading areas and Big Lost River sinks are seasonal wetlands and are located approximately 15 km (9.3 mi) southwest and 24 km (14.9 mi) north of the proposed new consolidated Pu storage facility site (and analysis site for the evolutionary LWR), respectively (Figure 2.3–3). These areas can provide more than 809 ha (2,000 acres) of wetland habitat during wet years. Riparian wetland vegetation exists along the Big Lost River and along Birch Creek. Plants found along the Big Lost River, which is located about 2.5 km (1.6 mi) west of the proposed site, are in poor condition due to recent years of only intermittent flows.

Aquatic Resources. Aquatic habitat on INEL is limited to the Big Lost River, Little Lost River, Birch Creek, and a number of liquid-waste disposal ponds (see Figure 3.4.4–1). All three streams are intermittent and drain

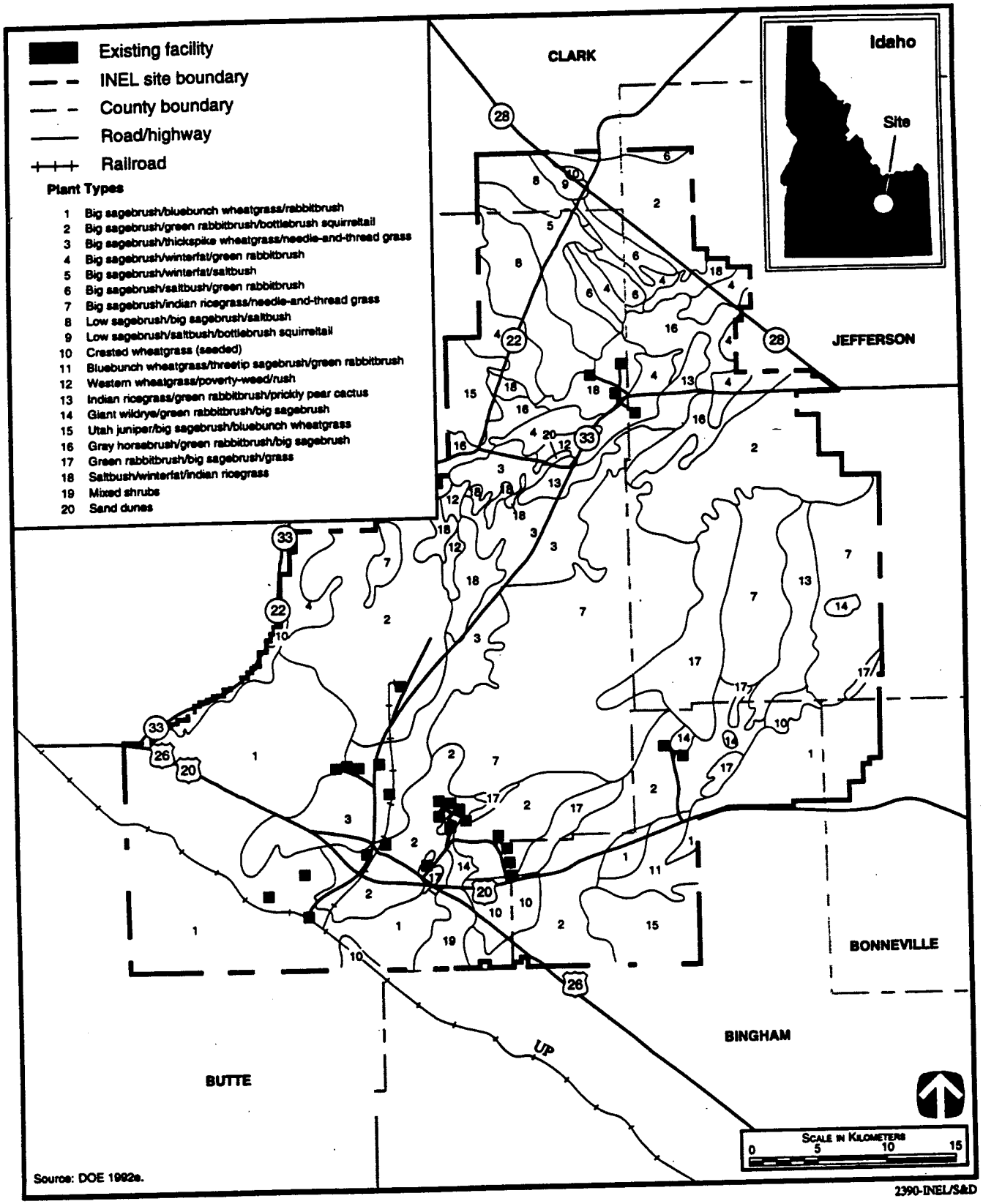


Figure 3.4.6–1. Distribution of Plant Communities at Idaho National Engineering Laboratory.

into four sinks in the north-central part of INEL. Historically, six species of fish have been observed in the Big Lost River: brook trout, rainbow trout, mountain whitefish, speckled dace, shorthead sculpin, and kokanee salmon (DOE 1992e:4-78; DOE 1992h:G-11).

The Little Lost River, located west of INEL, and Birch Creek, located north of the proposed new consolidated Pu storage facility site (and assumed analysis site for the evolutionary LWR), enter INEL only during periods of high flow (IN EG&G nda:22). Surveys of fish in these surface water bodies have not been conducted. The liquid waste disposal ponds on INEL, while considered aquatic habitat, do not support fish (INEL 1992a:4). No aquatic habitat occurs on the proposed site, which is located about 2.5 km (1.6 mi) east of the Big Lost River.

Threatened and Endangered Species. Nineteen federally and State-listed threatened, endangered, and other special status species may be found on and in the vicinity of INEL. Two of these species are federally and State-listed as threatened or endangered (Table 3.4.6–1). Twelve species listed in Table 3.4.6–1 have been observed at INEL, including the two threatened and endangered species. Once specific project locations have been determined, site surveys will determine the presence of special status species. No critical habitat for threatened or endangered species, as defined in the ESA (50 CFR 17.11; 50 CFR 17.12), exists on INEL (DOE 1992e:4-78).

The bald eagle has rarely been seen in the western and northern portions of INEL. The peregrine falcon has only occasionally been observed in the northern portions of the site. [Text deleted.]

Several of the species listed in Table 3.4.6–1 may occur in the vicinity of the proposed storage site (and assumed location for the evolutionary LWR). The pygmy rabbit is common at INEL, but its distribution is patchy (DOE 1995j:4.9-4). The Townsend's western big-eared bat (which roosts in caves at INEL) and the other bat species have not been observed in the area of the proposed site but could potentially occur. [Text deleted.]

The State of Idaho does not maintain a list of threatened or endangered plant species. Plants that are considered rare in Idaho are included in a State Watch List. The tree-like oxytheca, listed by the State as a sensitive species, has been found in the area of the proposed site (DOE 1992e:4-79).

Table 3.4.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Idaho National Engineering Laboratory

Common Name	Scientific Name	Status[a]	
		Federal	State
Mammals			
Fringed myotis	*Myotis thysanodes*	NL	SSC
[Text deleted.]			
Pygmy rabbit[b]	*Brachylagus idahoensis*	NL	SSC
[Text deleted.]			
Spotted bat	*Euderma maculatum*	NL	SSC
Townsend's western big-eared bat[b]	*Plecotus townsendii townsendii*	NL	SSC
Western pipistrelle	*Pipistrellus hesperus*	NL	SSC
[Text deleted.]			
Birds			
American white pelican	*Pelecanus erythrorhynchos*	NL	SSC
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	E
Common loon	*Gavia immer*	NL	SSC
[Text deleted.]			
Great egret	*Casmerodius albus*	NL	SSC
Northern goshawk	*Accipiter gentilis*	NL	SSC
Peregrine falcon[b,c]	*Falco peregrinus*	E (S/A)	E
[Text deleted.]			
Plants[d]			
King's bladderpod[b]	*Lesquerella kingii var. cobrensis*	NL	M
Lemhi milkvetch[b]	*Astragalus aquilonius*	NL	S
Nipple cactus[b]	*Coryphantha missouriensis*	NL	M
Painted milkvetch[b]	*Astragalus ceramicus var. apus*	NL	M
Plains milkvetch[b]	*Astragalus gilviflorus*	NL	SP1
Spreading gilia[b]	*Ipomopsis polycladon*	NL	SP2
Tree-like oxytheca[b]	*Oxytheca dendroidea*	NL	S
Winged-seed evening primrose[b]	*Camissonia pterosperma*	NL	S

[a] Status codes: E=endangered; M=monitor; NL=not listed; S=sensitive; S/A=protected under the similarity of appearance provision of the ESA; SP1=State Priority 1 (in danger of becoming extinct in the state); SP2=State Priority 2 (likely to be classified as Priority 1 if factors contributing to decline remain unchanged); SSC=State special concern.

[b] Species observed on INEL.

[c] USFWS Recovery Plan exists for this species.

[d] State status of plant species is designated by the Idaho Native Plant Society.

Source: 50 CFR 17.11; 50 CFR 17.12; DOE 1992e; DOE 1995j; ID DFG 1994a; IN DOE 1984a.

3.4.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric resources identified on INEL include residential bases, campsites, rock shelters, hunting blinds, rock alignments, lithic quarries, and limited activity locations, including lithic and ceramic scatters, hearths, and concentrations of fire-affected rock. As of 1994, over 100 cultural resources surveys had been conducted, and approximately 4 percent of INEL had been inventoried for cultural resources (DOE 1995v:4.4-1). Resources include 688 prehistoric sites and 753 prehistoric isolates. Of the prehistoric sites that have been recorded, approximately 95 percent are lithic scatters or locations. Most sites have not yet been formally evaluated and are considered potentially eligible for the NRHP. Additional NRHP-eligible sites are likely to occur on INEL. A Draft Cultural Resources Management Plan has been prepared and is currently in the comment stage.

Historic Resources. Thirty-eight historic sites and 27 historic isolates have been identified on INEL; most are related to either agriculture (for example, homesteads and irrigation canals) or ranching (for example, sheep and cattle camps). Goodale's Cutoff, a spur of the Oregon Trail, is still recognizable in the southwestern corner of INEL. Experimental Breeder Reactor I, the first reactor to achieve a self-sustaining chain reaction using Pu instead of uranium as the principal fuel component, is listed on the NRHP and is designated a National Historic Landmark. Various other nuclear reactors and associated buildings, such as those at Auxiliary Reactor Area-I, -II, -III, the Borax Reactor, Materials Test Reactor, Engineering Test Reactor, and the Hot Shop, are considered eligible for the NRHP. Although such facilities are not yet 50 years old, they are of exceptional scientific and engineering significance and have played major roles in the development of nuclear science since World War II. Based on current studies, additional historic sites are likely to occur in unsurveyed portions of INEL.

Native American Resources. At the time of European-American contact, the area was inhabited by nomadic hunters and gatherers consisting of two linguistically distinct groups: the Shoshone and the Bannock. Horses enabled the Shoshone and Bannock to increase their foraging range, congregate in larger groups, and protect their possessions from other groups. Winter camps were reportedly scattered along major river drainages. Groups dispersed during the other seasons, probably moving across what is now INEL as they used floral and faunal resources, and obsidian from Big Southern Butte or Howe Point.

Important Native American resources that might be found in the proposed project area include buttes, caves, village shrines, rock art, burials, vision quest sites, and plants such as bluegrass, willow, and cattail. It is worth noting that many natural resources at INEL are viewed as cultural resources by Native Americans. As one example, sagebrush is used as a tool, for clothing, and for medicinal purposes. INEL recently initiated general consultation with the Shoshone-Bannock tribe and a Working Agreement between the two groups exists. While specific sites or traditional use areas have not yet been identified, the Shoshone and Bannock tribes consider INEL part of their ancestral homeland and have expressed support for the use of scientific methods to preserve cultural resources.

Paleontological Resources. The Snake River Plain is composed of numerous superimposed basalt lava flows that came from low-shield volcanoes, fissures, and tubes during the last two billion years. Except for a small area of Paleozoic deposits in the northwest corner of INEL, almost 75 percent of the facility is basalt flows covered with loess. The remainder of INEL (primarily in the north and northwest portions of the facility) is alluvial and aeolian sediments; fluvial sediments are found along the drainages.

As of 1994, 31 fossil localities have been identified at INEL. Fluvial sediments have yielded Late Pleistocene terrestrial vertebrate fossils, including mammoth, mastodon, horse, camel, and bison. Gastropods, microfauna, plant fossils, opal phytoliths, and pollen have also been recovered. Volcanic tubes and blisters serve as sediment traps and many in the older basalt flows contain fossils of small and medium-sized mammals. While most of these fossils date to the Holocene (within the last 10,000 years), some date to the Pleistocene-Holocene transition of about 11,500 years ago. Because these assemblages may contain both vertebrate and floral remains, such localities would have high research potential.

3.4.8 SOCIOECONOMICS

Socioeconomic characteristics described for INEL include employment and regional economy, population and housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses 13 counties around INEL located in Idaho and Wyoming (Table L.1–1). Statistics for population and housing, community services, and local transportation are presented for the ROI, a five-county area (located in Idaho) in which 97.2 percent of all INEL employees reside: Bannock County (5.6 percent), Bingham County (12.6 percent), Bonneville County (69.2 percent), Butte County (2.5 percent), and Jefferson County (7.3 percent). [Text deleted.] In 1996, INEL employed 6,547 persons (IN DOE 1996b:1) (This total does not include some contractor employees.)

Regional Economy Characteristics. Selected employment and regional economy statistics for the INEL REA are summarized in Figure 3.4.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 10.4 percent to the 1990 level of 119,700. The 1994 unemployment in the REA was 5.4 percent, which was about the same as the unemployment for Idaho (5.6 percent) and Wyoming (5.3 percent). The region's per capita income of $16,674 in 1993 was approximately 5 percent less than Idaho's per capita income of $17,511 and 15.4 percent less than Wyoming's per capita income of $19,719.

In 1993, the percentage of total employment involving the private sector activity of retail trade was similar in the REA (18 percent), Idaho, and Wyoming as shown in Figure 3.4.8–1. Service activities in the REA (27 percent of total employment) represented about a 4- and 4.5-percent greater share than in Idaho and Wyoming, respectively. Manufacturing in the REA (9 percent) represented a 3-percent smaller share of total employment than in Idaho and a 6-percent larger share than in Wyoming.

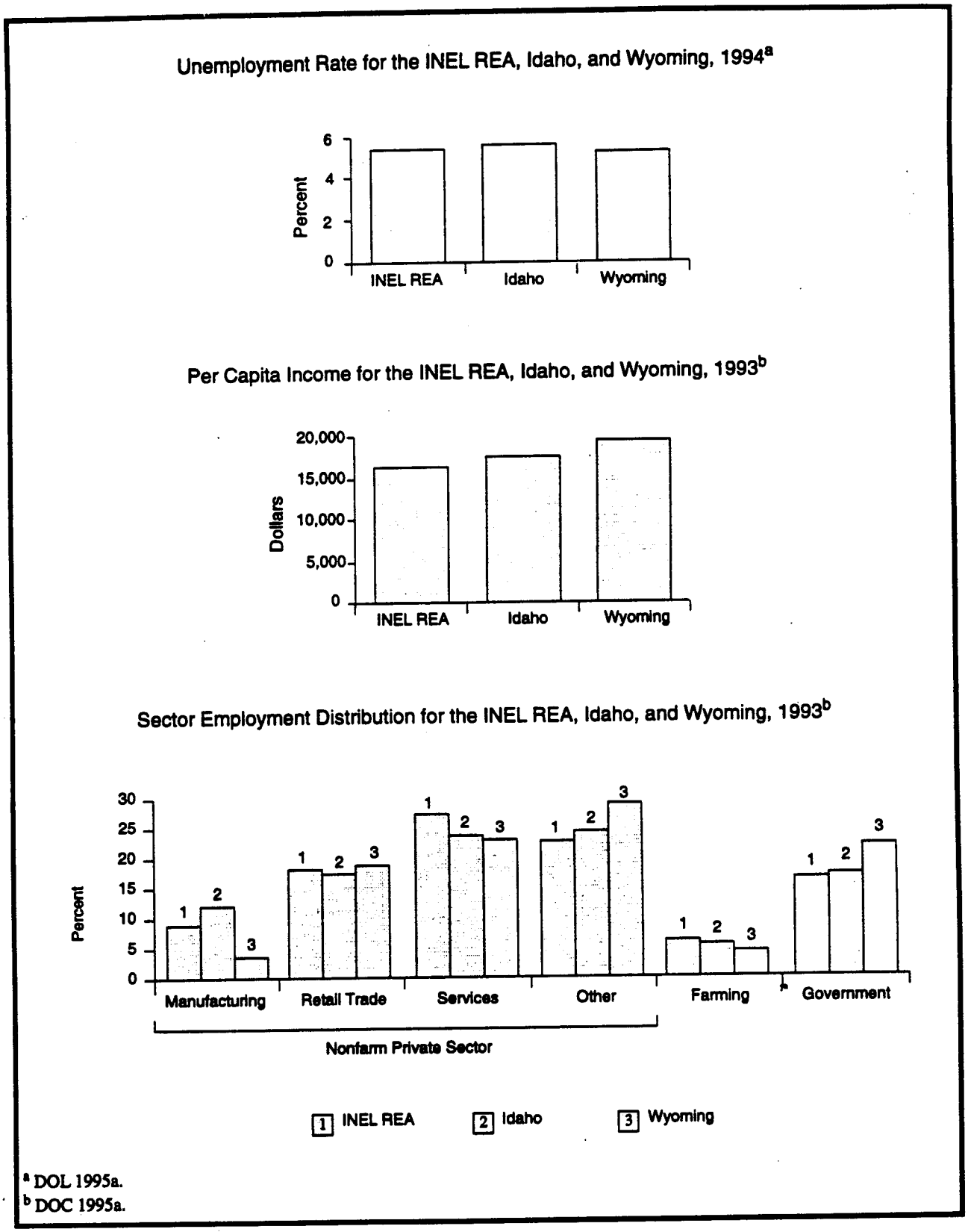
Population and Housing. In 1994, the ROI population totaled 212,610. Between 1980 and 1994, the ROI population grew by 14.0 percent, compared to 20.0 percent in Idaho. Within the ROI, Jefferson County experienced the largest increase at 20.4 percent, while Butte County's population decreased by 8.9 percent. Population and housing trends are summarized in Figure 3.4.8–2.

The increase in the total number of housing units in the ROI between 1980 and 1990, 6.5 percent, was approximately 3.5 percent less than the increase in the number of housing units in Idaho. The total number of housing units in the ROI for 1990 was 71,025. The 1990 ROI homeowner and renter vacancy rates, 2.2 and 8.5 percent, respectively, were similar to those in Idaho.

Community Services. Education, public safety, and health care characteristics were used to assess the level of community services in the INEL ROI. Figure 3.4.8–3 presents school district characteristics for the INEL ROI. Figure 3.4.8–4 presents public safety and health care characteristics.

Education. In 1994, 14 school districts provided public education services and facilities in the INEL ROI. As shown in Figure 3.4.8–3, these school districts operated at between 38-percent (Swan Valley School District) and 101.2-percent (Firth School District) capacity. The average student-to-teacher ratio for the INEL ROI in 1994 was 18.5:1. The Shelley School District had the highest ratio at 22.2:1.

Public Safety. City, county, and State law enforcement agencies provided police protection to the residents in the ROI. In 1994, a total of 340 sworn police officers were serving the five-county ROI. Idaho Falls employed the largest number of officers (82) and Bannock County had the highest officer-to-population ratio (2.5 sworn officers per 1,000 persons). The average ROI officer-to-population ratio was 1.6 officers per 1,000 persons. Figure 3.4.8–4 compares police force strengths across the ROI.



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.4.8–1. Employment and Local Economy for the Idaho National Engineering Laboratory Regional Economic Area and the States of Idaho and Wyoming.

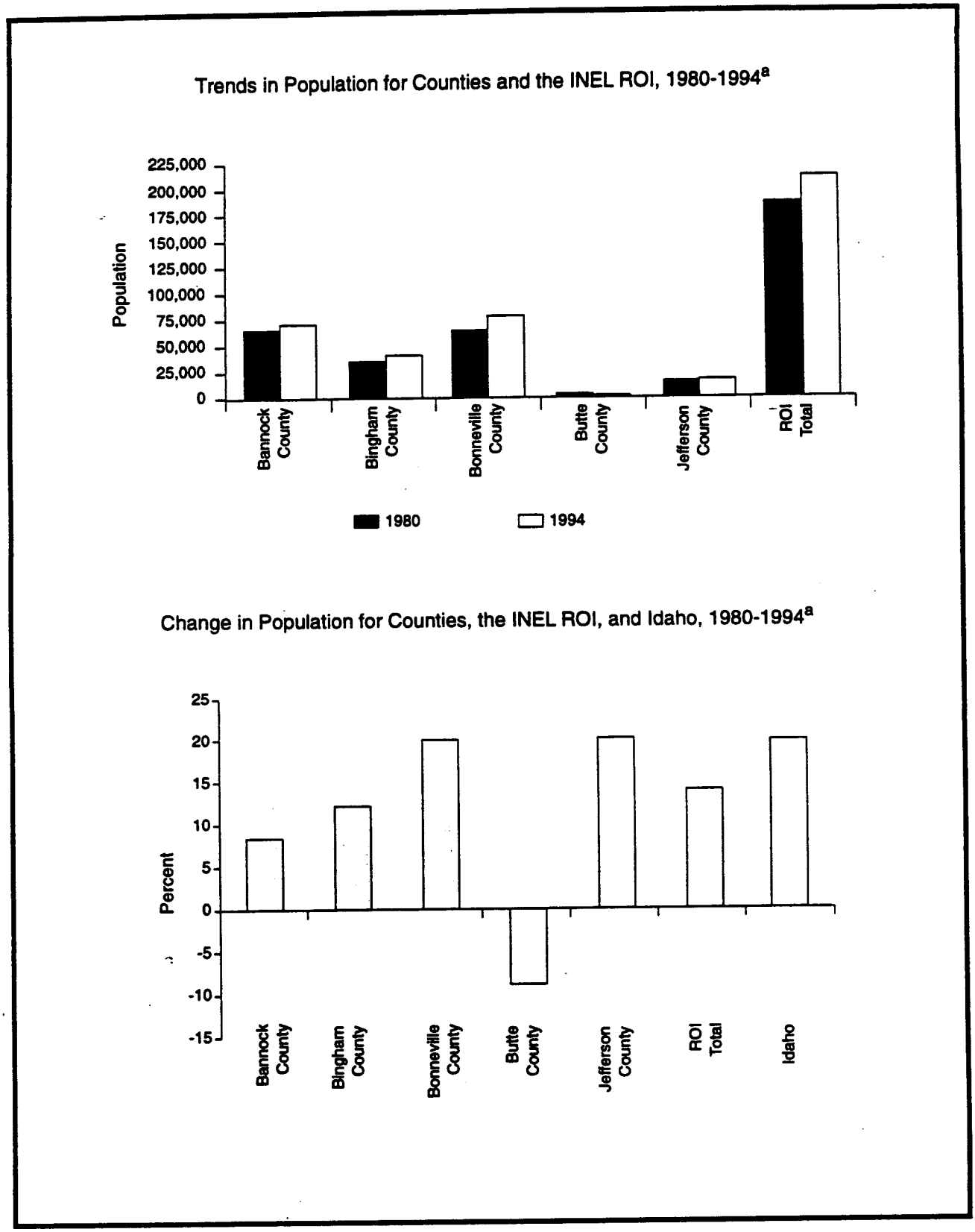
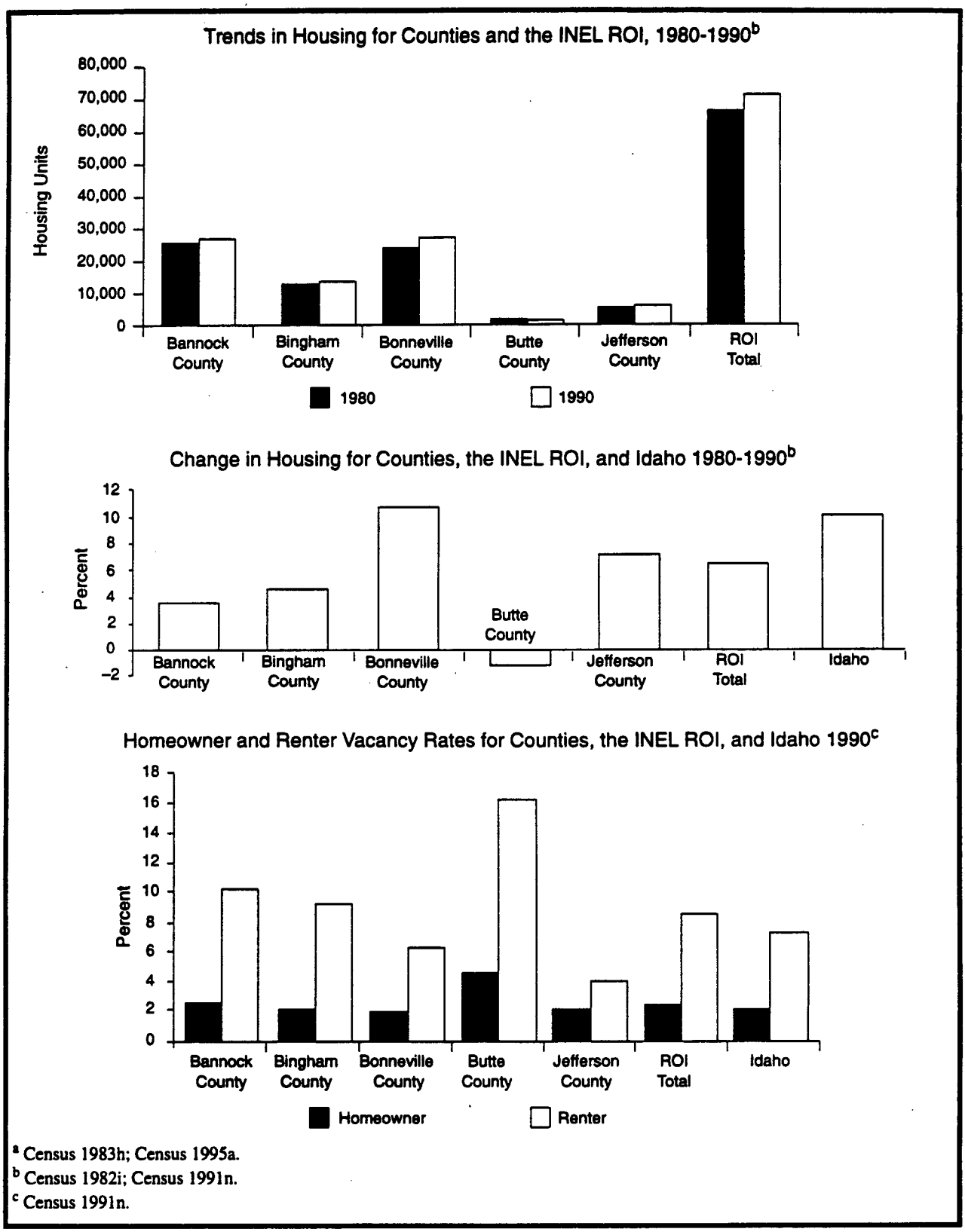
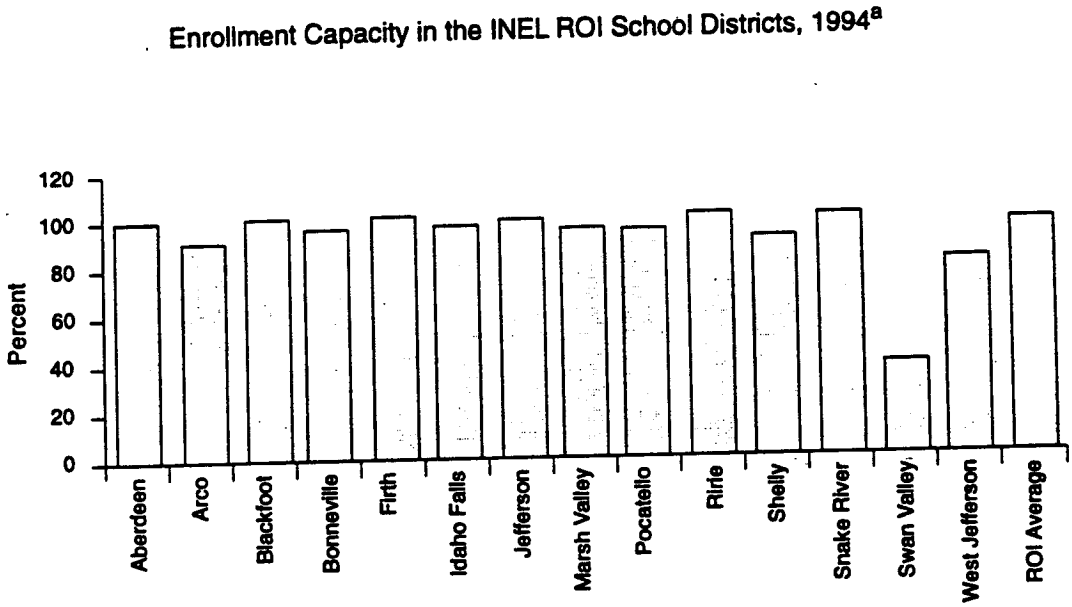


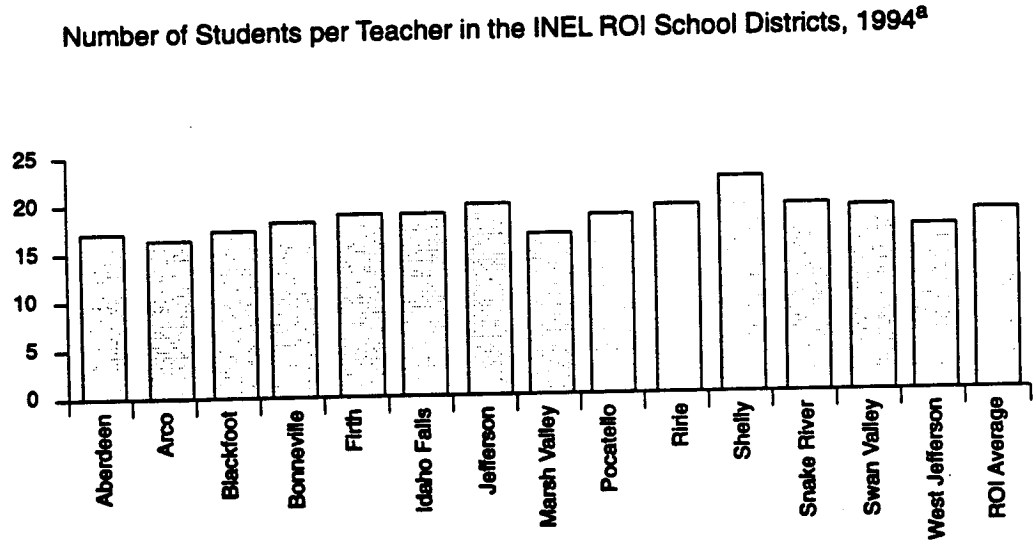
Figure 3.4.8–2. Population and Housing for the Idaho National Engineering Laboratory Region of Influence and the State of Idaho.



[a] Census 1983h; Census 1995a.
[b] Census 1982i; Census 1991n.
[c] Census 1991n.

Figure 3.4.8–2. Population and Housing for the Idaho National Engineering Laboratory Region of Influence and the State of Idaho—Continued.

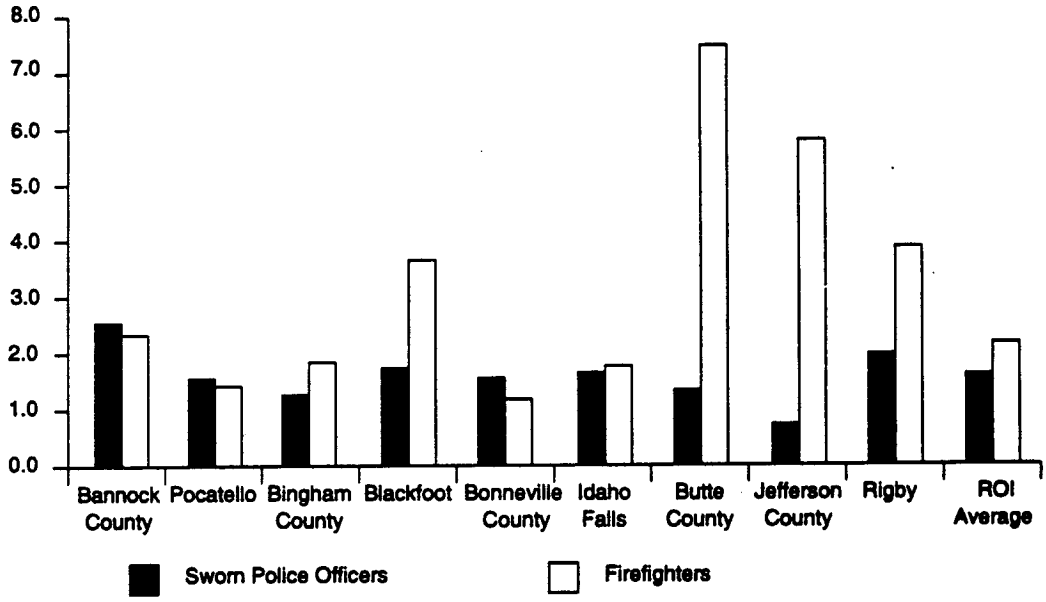




Source: Socio 1996a.

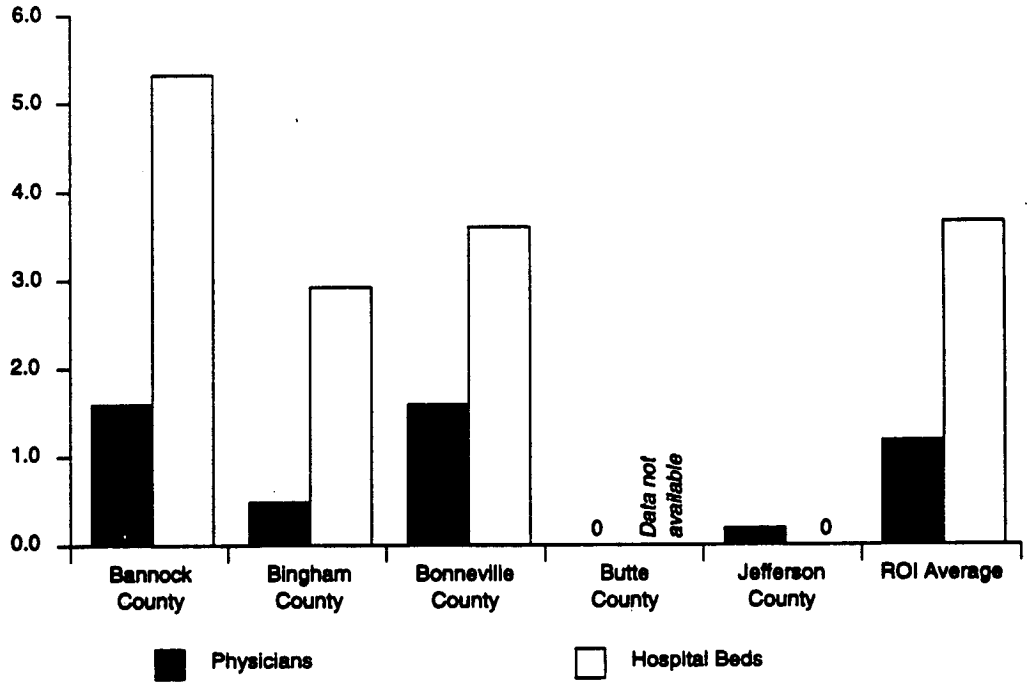
Figure 3.4.8–3. School District Characteristics for the Idaho National Engineering Laboratory Region of Influence.

Number of Sworn Police Officers (1994) and Firefighters (1995) per 1,000 Persons in the INEL ROI[a]



Note: Except for ROI cities, city sworn police officers and firefighters are included in the county totals.

Number of Physicians and Hospital Beds per 1,000 Persons in the INEL ROI, 1994[b]



[a] Census 1993n; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b; DOJ 1995a; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.4.8–4. Public Safety and Health Care Characteristics for the Idaho National Engineering Laboratory Region of Influence.

Fire protection services in the INEL ROI were provided by 465 paid and volunteer firefighters in 1995. The district with the highest firefighter-to-population ratio was located in Butte County, with 7.5 firefighters per 1,000 persons, as indicated in Figure 3.4.8–4. Jefferson County employed the greatest number of firefighters (90). The average firefighter-to-population ratio in the ROI was 2.2 per 1,000 persons.

Health Care. There were five hospitals serving the five-county ROI in 1994. Figure 3.4.8–4 displays the hospital bed-to-population ratios for the INEL ROI counties. During 1994, all hospitals were operating at below capacity, with hospital occupancy rates ranging from 48.0 percent in Bannock County to 60.8 percent in Bingham County.

In 1994, a total of 264 physicians served the ROI, with the majority (129) located in Bonneville County. Figure 3.4.8–4 shows that the physician-to-population ratios for the ROI ranged from no physicians in Butte County to 1.6 physicians per 1,000 persons in Bonneville County and Bannock County. The average ROI physician-to-population ratio was 1.2 physicians per 1,000 persons.

Local Transportation. Vehicular access to INEL is provided by U.S. Routes 20 and 26 to the south and State Routes 22 and 33 to the north. U.S. Routes 20 and 26 and State Routes 22 and 33 all share rights-of-way west of INEL (see Figure 2.2.3–1 and Figure 2.2.3–2).

There is one current road improvement project affecting access to INEL. U.S. Route 20 is being upgraded from two to four lanes and turn lanes are being added at intersections from 2 to 5 km (1 to 3 mi) west of Idaho Falls. In addition, there are four planned road improvement projects that could affect future access to INEL. The first is an upgrade from two to four lanes and the addition of turn lanes at intersections from 5 to 8 km (3 to 5 mi) west of Idaho Falls. The second is the resurfacing of State Route 33 from the intersection of State Routes 28 and 33 to 13 km (8 mi) east of this intersection. The third is the resurfacing of Interstate 15 from Fort Hall to South Blackfoot. The last is the asphalt chip seal of U.S. Route 26 from the U.S. Route 20 and U.S. Route 26 intersection to Blackfoot (ID DOT 1995a:1).

There are two road segments that could be affected by the storage and disposition alternatives. The first road segment is U.S. Route 20 from U.S. Routes 26 and 91 at Idaho Falls to U.S. Route 26 East. In 1995 this road segment operated at level of service D. The second road segment is U.S. Routes 20 and 26 from U.S. Route 26 East to State Routes 22 and 33. This segment operated at level of service B in 1995.

The Department shuttle vans provide transportation between INEL facilities and Idaho falls for the 4,000 DOE and contractor personnel who work at INEL. The major railroad in the ROI is the Union Pacific Railroad. The railroad's Blackfoot-to-Arco branch provides rail service to the southern portion of INEL. A DOE-owned spur connects the Union Pacific Railroad to INEL by a junction at Scovill Siding. There are no navigable waterways within the ROI capable of accommodating waterborne transportation of material shipments to INEL.

Fanning Field in Idaho Falls and Pocatello Municipal Airport in Pocatello provide jet air passenger and cargo service for both national and local carriers. Numerous smaller private airports are located throughout the ROI.

3.4.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of INEL are shown in Table 3.4.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to INEL operations.

Table 3.4.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Idaho National Engineering Laboratory Operation

Sources	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic radiation	39
External terrestrial radiation	59
Internal terrestrial	40
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	403

[a] IN DOE 1994c.
[b] NCRP 1987a.
Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from INEL operations provide another source of radiation exposure to individuals in the vicinity of INEL. Types and quantities of radionuclides released from INEL operations in 1993 are listed in *The Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1993* (DOE/ID-12082 [93]). The doses to the public resulting from these releases are presented in Table 3.4.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1993 report were used in the development of the reference environment's (No Action) radiological releases and resulting impacts at INEL in the year 2005 (Section 4.2.3.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-roentgen equivalent man (rem) to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from INEL operations in 1993 is estimated to be 1.5×10^{-8}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of INEL operations is about 2 chances in 100 million. (Note that it takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Based on the same risk estimator, 1.5×10^{-4} excess fatal cancers are projected in the population living within 80 km (50 mi) of INEL from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national mortality rate, the number of fatal cancers expected during 1992 from all causes in the population

Table 3.4.9–2. Radiation Doses to the Public From Normal Idaho National Engineering Laboratory Operation in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	0.030	4	0	100	0.030
Population within 80 km[b] (person-rem)	None	0.30	None	0	100	0.30
Average individual within 80 km[c] (mrem)	None	0.0025	None	0	None	0.0025

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (see 58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] In 1993, this population was approximately 121,500.

[c] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: IN DOE 1994c.

living within 80 km (50 mi) of INEL was 243. This number of expected fatal cancers is much higher than the estimated 1.5×10^{-4} fatal cancers that could result from INEL operations in 1993.

Idaho National Engineering Laboratory workers receive the same doses as the general public from background radiation but also receive an additional dose from working in the facilities. Table 3.4.9–3 presents the average worker, maximally exposed workers, and total cumulative worker dose to INEL workers from operations in 1992. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to INEL workers from normal operations in 1992 is estimated to be 0.030.

Table 3.4.9–3. Radiation Doses to Workers From Normal Idaho National Engineering Laboratory Operation in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	14.2
Maximally exposed worker (mrem)	5,000	1,000
Total workers[b] (person-rem)	ALARA	75

[a] DOE's goal is to maintain radiological exposure as low as reasonably achievable.

[b] The number of badged workers in 1992 was approximately 5,270.

Source: 10 CFR 835; DOE 1993n:7.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in *The Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1993* (DOE/ID-12082[93]). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in that document.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface water during swimming, or soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.4.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements), contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at INEL via inhalation of air containing hazardous chemicals released to the atmosphere by INEL operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway. At INEL, the risk to public health from water ingestion and direct exposure pathways is low because the surface water resource (Big Lost River) is not used for drinking or as a receptor for wastewater discharges.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.4.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to INEL workers during normal operation may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. INEL workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm. Therefore, worker health conditions at INEL are expected to be substantially better than required by the standards.

Health Effects Studies. No occupational epidemiological studies have been conducted at INEL to date, but two epidemiological studies have been conducted on communities surrounding INEL to determine if there are any excess cancers in the general population. No excess cancer mortality was reported, although excess cancer incidence was observed. However, no association of the excess cancer incidence with INEL was established. For a more detailed description of the study findings reviewed, refer to Section M.4.4.

Accident History. A recent study, the *Idaho National Engineering Laboratory Historical Dose Evaluation* (DOE/ID-12119), was conducted by DOE to estimate the potential offsite radiation doses for the entire operating history of INEL. Releases resulted from a variety of tests and experiments as well as a few accidents at INEL. The study concluded that these releases contributed to the total radiation dose during test programs of the 1950s and early 1960s. The frequency and size of releases has declined since that time. Based on information reported in the study, there have been no serious unplanned or accidental releases of radioactivity or other hazardous substance at INEL facilities in the last 10 years of operation. [Text deleted.]

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered.

The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

Participating government agencies whose plans are interrelated with the INEL Emergency Plan for Action include the State of Idaho, Bingham County, Bonneville County, Butte County, Clark County, Jefferson County, the Bureau of Indian Affairs, and Fort Hall Indian Reservation. INEL contractors are responsible for responding to emergencies that occur at their facilities. When an emergency condition exists at a contractor facility, the Emergency Action Director is responsible for recognition, classification, notifications, and protective action recommendations. At INEL, emergency preparedness resources include fire protection from onsite and offsite locations and radiological and hazardous chemical material response. Emergency response facilities include an emergency control center at each facility, at the INEL warning communication center, and at the INEL site emergency operations center. There are also seven INEL medical facilities available to provide routine and emergency service.

3.4.10 WASTE MANAGEMENT

This section outlines the major environmental regulatory structure and ongoing waste management activities for INEL. A more detailed discussion of the ongoing waste management operations is provided in Section E.2.3. Table 3.4.10–1 presents a summary of waste management activities at INEL for 1992.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations at INEL. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed-upon milestones.

The EPA placed INEL on the NPL on December 21, 1989. DOE has entered into a Federal Facility Agreement and Consent Order with EPA and the State of Idaho to coordinate cleanup activities at INEL under a comprehensive strategy. This agreement integrates DOE's CERCLA response obligations with RCRA and *Hazardous Waste Management Act* of 1986 corrective action obligations. In this process, INEL has been divided into 10 waste area groups. Each group is subdivided into separate operable units composed of potential release sites that are considered together for assessment and cleanup activities. Ongoing assessments are characterizing the nature and extent of contamination. Aggressive plans are in place to achieve early remediation of sites that represent the greatest risk to workers and the public. The goal is to complete remediation of contaminated sites at INEL to support delisting from the NPL by 2019. INEL manages spent nuclear fuel and the following waste categories: high-level, TRU, low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. Spent nuclear fuel had been stored and processed at the ICPP. Processing was terminated with DOE's decision to halt reprocessing of spent nuclear fuel. INEL has received spent nuclear fuel from Three Mile Island, reactor tests, and the gas-cooled reactor and Naval Reactors Programs. Spent nuclear fuel from these programs and from reactor experiments at INEL is in storage in various locations. The bulk of the fuel is stored at the ICPP. Interim management of the spent nuclear fuel (pending the availability of a geologic repository) will be in accordance with the ROD published in the *Federal Register* on June 1, 1995 (60 FR 28680) and amended on March 8, 1996 (61 FR 9441), for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F). As a result of this ROD as amended, INEL will manage DOE's non-aluminum-clad spent fuel. This will require 114 shipments of aluminum-clad spent fuel to SRS and receipt of 1,133 shipments of non-aluminum-clad spent fuel. This spent fuel then will be placed in interim storage.

High-Level Waste. High-level waste at INEL was generated in the process of extracting useful isotopes from spent nuclear fuel at the ICPP. Most of this fuel was from the Naval Reactors Program. Most aqueous solutions from spent nuclear fuel processing and isotope extraction were concentrated by evaporation and separated into LLW and HLW streams in the Process Equipment Waste Evaporator. The liquid HLW is stored in subsurface tanks and then transformed into solid metallic oxides in a granular form by calcination. The calcine is stored in stainless steel bins in near-surface concrete vaults where it awaits further processing into a form suitable for emplacement in a Federal repository. As a result of the ROD for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F), calcination will resume until all liquid HLW is calcined. This will permit INEL to meet the requirements of a December 1991 consent order with the State of Idaho and EPA to cease use of existing storage tanks without constructing new tanks. Subsequently, the calcined waste will be treated to meet RCRA provisions on a schedule to be negotiated with the State of Idaho under the *Federal Facility Compliance Act.*

Table 3.4.10–1. Spent Nuclear Fuel and Waste Management Activities at Idaho National Engineering Laboratory

Category	1992 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent Nuclear Fuel	1.4 t[a,b] heavy metal	Conditioning and stabilization	Under assessment[c]	Pools, dry facility	261 t[c,d] heavy metal	None—High-Level Waste Program in the future	None
High-Level							
Liquid	560[b]	Evaporation, calcination	470[e]	Tank farm, after evaporation prior to calcination	13,400[f]	NA	NA
Solid[g]	None[b]	Decontamination, filter leach	238[h]	Bins inside concrete vaults	7,110[i]	None—High-Level Waste Program in the future	None
Transuranic							
Liquid	None	NA	NA	NA	NA	NA	NA
Solid	1	Decontamination, filter leach, calcination	595[j]	Asphalt pads and vaults in the ground or under earthen cover or tarps	206,000[k]	None—WIPP or alternate facility in the future	None
Low-Level							
Liquid	None	Evaporation, Ion exchange	11,600[l]	Tank farm after evaporation prior to calcination	With HLW	NA	NA
Solid	11,300	Incineration and compaction	3,350[m]	NA	NA	Onsite burial	180,000[n]
Mixed							
Liquid	5	Evaporation, fractionation, and calcination	11,600[l]	Tank farm	With HLW	None	None
Solid	51	Incineration and compaction	3,350[m]	Mixed waste storage facilities	115,000[o]	None	None

Table 3.4.10–1. Spent Nuclear Fuel and Waste Management Activities at Idaho National Engineering Laboratory—Continued

Category	1992 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Hazardous							
Liquid	Included in solid	Offsite and percolation ponds	Under assessment[c]	Percolation ponds	Under assessment[c]	Offsite	NA
Solid	835[p]	Offsite	NA	Hazardous waste storage facility	Under assessment[c]	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	50,800	Percolation ponds	NA	NA	NA	NA	NA
Nonhazardous (Other)							
Liquid	Included in sanitary	Recycle	NA	NA	NA	NA	NA
Solid	62,000	Segregate and recycle	NA	NA	NA	Industrial and asbestos waste landfills	1,830,000 to 3,060,000[q]

[a] Spent nuclear fuel is normally expressed in metric tons, not cubic meters.
[b] 1993 data.
[c] Capacity will be increased to accommodate ROD from the *DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, as amended.
[d] Current capacity includes ICPP, TAN, ANL-W, NRF, PBF, and TRA.
[e] New waste calcining facility.
[f] ICPP tank farm.
[g] Solid HLW produced by calcination of liquid HLW.
[h] ICPP debris treatment, HEPA filter leach.
[i] ICPP calcine bin sets.
[j] ICPP new waste calcining facility, debris treatment, HEPA filter leach.
[k] ANL-W, ICPP, RWMC.
[l] Liquid effluent treatment facility, potable water treatment, new waste calcining facility.
[m] ICPP debris treatment, HEPA filter leach, waste experimental reduction facility, lead treatment sodium processing facility, TAN cask dismantlement.
[n] 37,000 m^3 available as of 1991. Additional 67,000 m^3 expansion capacity potentially available.
[o] ANL-W, ICPP, PBF, RWMC, TAN.
[p] 760 m^3 recyclable.
[q] Remaining capacity.
Note: NA= not applicable; WERF= Waste Experimental Reduction Facility.
Source: 60 FR 28680; 61 FR 9441; DOE 1995i; DOE 1995v; IN DOE 1995d; INEL 1993a:5.

Transuranic Waste. Transuranic wastes are stored at the RWMC. This inventory represents more than half of the total DOE inventory. There is very little TRU waste generation at INEL. Most of the TRU waste in storage was received from RFETS. As a result of the ROD from the *Department of Energy Programmatic Spent Nuclear Fuel and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F), and pending the ROD to be issued from the *DOE Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive Hazardous Waste* (DOE/EIS-0200-D) and in compliance with the *INEL Site Treatment Plan*, INEL may receive TRU waste from other facilities for treatment. After treatment, the waste would be returned to the generator for storage and eventual transport to a Federal repository. TRU wastes are currently being stored pending approval of WIPP as a repository for these wastes. Assuming WIPP is determined to be a suitable repository for these wastes, pursuant to the requirements of 40 CFR 191 and 40 CFR 268, these wastes will be treated to meet the WIPP WAC and packaged in accordance with DOE and DOT requirements for transport to WIPP for disposal depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste.

Before 1970, when the AEC first required segregation of TRU wastes from other wastes, TRU wastes were buried in earthen trenches at the RWMC. This waste must be retrieved and repackaged to meet the current WIPP WAC. Wastes generated or received from offsite since 1970 are stored in a form designed for eventual retrieval. Since 1972, TRU wastes have been stored on Pad A in the RWMC. Most of this waste will require certification and repackaging. A new facility, the Advanced Mixed Waste Treatment Project, is being designed to accomplish this task. Some waste has radioactivity levels high enough that there are no certified or licensed transportation capabilities for it. Further study will be required for its eventual disposal. While the EPA has issued a notice of noncompliance for TRU waste stored at the RWMC, a proposed plan for the treatment and storage of TRU wastes has been documented in the Federal Facility Agreement and Consent Order, which addresses EPA and State of Idaho concerns, while also meeting DOE's concerns for worker protection. Some of the waste now handled as TRU or mixed TRU is alpha-contaminated LLW and mixed LLW. A strategy for treatment and disposal of this waste has yet to be established. Onsite and offsite treatment is being investigated.

Low-Level Waste. The bulk of LLW generated at INEL is the result of work in contaminated areas and consists of materials such as rags, bags, scrap metal, and used protective clothing. A large volume of LLW is generated in the D&D activities associated with environmental restoration. In addition, small amounts of LLW may be received from offsite for treatment and disposal. These materials must be treated by the operating facility to meet the WAC of the receiving facility, and conformity to these criteria must be verified by the receiving facility. Solid LLW at INEL is sent to the Waste Experimental Reduction Facility for compaction, sizing, incineration, and stabilization before shipment for disposal at the RWMC. The Waste Experimental Reduction Facility will be used to incinerate LLW. It is undergoing modifications to processes and procedures and is expected to be in operation in mid-1996.

Mixed Low-Level Waste. The volume of mixed LLW generated at INEL is small. Mixed LLW is stored in several areas onsite awaiting treatment capacities to be developed to treat the specific nature of a wide variety of different mixed waste streams. As a result of the ROD (60 FR 28680) from the *DOE Programmatic Spent Fuel and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final EIS* (DOE/EIS-0203-F), pending the ROD from the *DOE Waste Management Programmatic Environmental Impact Statement for the Managing Treatment, Storage, and Disposal of Radioactive Hazardous Waste* (DOE/EIS-0200-D), and in compliance with the consent order resulting from the *INEL Site Treatment Plan*, INEL may accept offsite mixed LLW for treatment. Waste residuals would be returned to the generator or shipped elsewhere for disposal. Mixed LLW is planned to be processed to RCRA Land Disposal Restriction (LDR) treatment standards through the Waste Experimental Reduction Facility incinerator beginning in June 1996, in the Advanced Mixed Waste Treatment Project beginning June 1998 through June 2000, and in the Sodium Processing Facility in March 1997. The use of commercial treatment facilities is also being considered. Large volumes of wastewater are processed in the Process Equipment Waste Evaporator, resulting in a

concentrated mixed waste that is sent to the HLW tank farm and eventually stabilized in a fluidized bed calciner. Condensate from the Process Equipment Waste Evaporator is converted into a concentrated acidic solution in the Liquid ETF. This concentrate is either recycled as a scrubber solution for the calciner or sent to the HLW tank farm for storage. The Liquid ETF eliminates residual discharge of hazardous and radioactive contaminants into wastewater percolation ponds, which was the former practice, in accordance with a consent order signed on October 7, 1992. Current mixed waste plans are documented in the *INEL Site Treatment Plan*, which was prepared in compliance with the *Federal Facility Compliance Act* of 1992.

Hazardous Waste. Hazardous wastes are generated at separate facilities at INEL and are staged for shipment offsite to commercial RCRA-permitted treatment and disposal facilities. Offsite shipments are surveyed to determine that the wastes have no radioactive content (are not mixed waste). The major onsite RCRA-permitted hazardous waste storage facility is located in the CFA. The Waste Handling Facility Project at ANL-W will be implemented to handle ANL-W waste. A recycling program has been established, and in 1992, 760 m^3 (994 yd^3) of hazardous wastes were recycled.

Nonhazardous Waste. Nonhazardous waste generated at INEL facilities is disposed of onsite in a landfill complex in the CFA and at the Bonneville County landfill. The onsite landfill complex contains separate areas for sanitary, industrial, and asbestos waste. Sewage is directed to surface impoundments in accordance with terms of the October 7, 1992, consent order, and the water is allowed to evaporate. The resulting sludge is placed in the landfill. Solids are separated and reclaimed where possible. The goal of the INEL waste minimization program is to reduce the nonhazardous waste quantities generated by 50 percent over the next 5 years. The landfill area at INEL is 4.8 ha (12 acres) and is being expanded by 91 ha (225 acres) to provide capacity for at least the next 30 years (60 FR 28680).

3.5 PANTEX PLANT

Pantex is located in the Texas Panhandle in Carson County along U.S. Highway 60 and lies about 27 km (17 mi) northeast of downtown Amarillo. Figure 2.2.4–1 indicates the location of Pantex, and Figure 2.2.4–2 shows the location of primary facilities and industrial zones within the site's boundary.

Pantex lies on the Llano Estacado (staked plains) portion of the Great Plains. The topography at Pantex is relatively flat, characterized by rolling grassy plains and numerous natural playa basins. The term "playa" is used to describe the more than 17,000 ephemeral lakes in the Texas Panhandle, usually less than 1 km (0.6 mi) in diameter, that receive water runoff from the surrounding area. The region is a semiarid farming and ranching area. Pantex is surrounded by agricultural land, but several significant industrial facilities are also located nearby.

Pantex is Government-owned and contractor-operated. The Mason & Hanger-Silas Mason Company has been the operating contractor since 1956. Since 1991, the environmental, health, and safety programs have been subcontracted to Battelle Memorial Institute.

Pantex was first used by the U.S. Army for loading conventional ammunition shells and bombs from 1942 to 1945. In 1951, the AEC arranged to begin rehabilitating portions of the original plant and constructing new facilities for nuclear weapons operations. The current missions are shown in Table 3.5–1. Weapons assembly, disassembly, and stockpile surveillance activities involve handling (but not processing) of encapsulated uranium, Pu, and tritium, as well as a variety of nonradioactive hazardous or toxic chemicals. Environmental restoration of the facility is a recent addition to operations at the plant.

Table 3.5–1. Current Missions at Pantex Plant

Mission	Description	Sponsor
Plutonium Storage	Provide storage of pits from dismantled nuclear weapons	Assistant Secretary for Defense Programs
High Explosive(s) Components	Manufacture for use in nuclear weapons	Assistant Secretary for Defense Programs
Weapon Assembly	Assemble new nuclear weapons for the stockpile	Assistant Secretary for Defense Programs
Weapon Maintenance	Retrofit, maintain, and repair stockpile weapons	Assistant Secretary for Defense Programs
Quality Assurance	Stockpile quality assurance testing and evaluation	Assistant Secretary for Defense Programs
Weapon Disassembly	Disassemble stockpile weapons as required	Assistant Secretary for Defense Programs
Test/Training Programs	Assemble nuclear weapon-like devices for training	Assistant Secretary for Defense Programs
Weapons Dismantlement	Dismantle nuclear weapons no longer required	Assistant Secretary for Defense Programs
Development Support	Provide support to design agencies as requested	Assistant Secretary for Defense Programs
Environmental Management	Environmental Restoration and Waste Management Activities	Assistant Secretary for Environmental Management

Source: PX 1995a:2

Department of Energy Activities. All DOE activities at Pantex, except for environmental restoration and some waste management programs, fall under the DOE Office of the Assistant Secretary for Defense Programs (DP). Historically, DOE's national security mission for Pantex primarily included assembly and delivery to DoD of a variety of nuclear weapons. Today, the primary role of Pantex is the disassembly of U.S. nuclear weapons being returned to DOE by DoD. This operation is in compliance with the negotiated downsizing of the United States and the former Soviet nuclear forces. Disassembly of a nuclear weapon includes removal of the fissile material. Subsequent storage of pits is the mission of major relevance to this PEIS.

Other activities that have been, and will continue to be, conducted under DOE's national security mission include certain maintenance and monitoring activities of the remaining nuclear weapons stockpile, modification and assembly of existing nuclear weapons systems, and production of HE components for nuclear weapons. DOE also conducts quality evaluation of weapons, quality assurance testing of weapons components, and R&D activities supporting nuclear weapons at the plant. DOE's responsibilities are mandated by statutes, Presidential directives, and congressional authorization and appropriations.

Waste management operations at Pantex in the near term (1996 to 1997) would add facilities to enhance capabilities to adequately handle existing waste streams. Improved facilities for hazardous waste staging, treatment, and storage would be coupled with increased use of commercial offsite facilities to treat mixed waste streams. The change in mission emphasis from assembly to disassembly of nuclear weapons would cause an increase in some waste streams and a decrease in others. New waste-handling capacities would be required to meet this need, but upon completion of the current backlog of dismantlements due to stockpile reduction, waste generation would decrease.

Non-Department of Energy Activities. Texas Tech University pursues agricultural activities on both DOE-owned and DOE-leased property.

3.5.1 LAND RESOURCES

Land Use. Pantex is located within Carson County in the Panhandle region of Texas, 27 km (17 mi) east-northeast of downtown Amarillo. Pantex operational activities are situated within 6,030 ha (14,900 acres) of land, of which approximately 3,683 ha (9,100 acres) are owned by the Federal Government and the remaining 2,347 ha (5,800 acres) are leased from Texas Tech University primarily to provide a safety and security buffer zone. All owned and leased buildings on the site are administered, managed, and controlled by DOE. DOE owns an additional remote tract of 436 ha (1,077 acres) of undeveloped land at Pantex Lake located approximately 4 km (2.5 mi) northeast of the main plant site. This property is held by DOE to retain the water rights. Total Pantex area equals 6,466 ha (15,977 acres).

Existing Land Use. Generalized land uses at Pantex and the vicinity are shown on Figure 3.5.1–1. The Texas Tech Agriculture Research operations use DOE-owned land not actively used for Pantex operations, as well as the property leased to DOE for agricultural purposes. Agricultural activities generally consist of dry farming and livestock grazing. A limited amount of crop irrigation occurs. Soil map units classified as prime farmland soils by the U.S. Department of Agriculture, National Resources Conservation Service exist onsite. However, the potential for farmland conversion by activities at Pantex is not an issue since Pantex is exempt from compliance with the *Farmland Protection Policy Act* (PX DOE 1995a:1). Land area leased from Texas Tech also contains one residence and one trailer located approximately 6 km (3.7 mi) southwest of the weapons assembly and disassembly and HE production core (PX DOE 1996b:4-94).

The land surrounding Pantex is rural private property. The closest offsite residences are approximately 48 m (157 ft) from the plant boundary in the western and northeastern sectors. Most of the surrounding land is prime farmland when irrigated, with the exception of the area northwest of the plant site, which is rangeland. Some property owners have enrolled their land in the Federal Conservation Reserve Program. Under terms of the program, the land is placed in a dormant state for 10 years and cannot be cultivated or grazed. The majority of the land, however, is cultivated. The land is generally dry farmed; however, some fields are irrigated from local playas or from the Ogallala Aquifer. The Iowa Beef Packers, Inc., packing plant is the only industrial activity within 3.2 km (2.0 mi) of Pantex.

Land-Use Planning. Within the State of Texas, land-use planning occurs only at the municipal level. The city of Amarillo comprehensive plan has designated land for future growth. The direction for future residential development is anticipated to occur toward the southwest, away from Pantex. The East Planning Area of the city, which extends to within 3.2 km (2 mi) of Pantex, has historically been one of the slower growing residential areas. Because of the presence of the airport and industrial use in this area, the comprehensive plan encourages compatible use rather than residential use. The largest residential area in the East Planning Area is the base housing of the former Amarillo Air Force Base. The base housing has been converted to rental housing and is located approximately 8 km (5 mi) southwest of the plant boundary.

Visual Resources. Pantex is sited within a landscape typical of the High Plains region of Texas consisting of cultivated cropland and rangeland. Pantex consists of operational facilities of the plant and the inactive facilities of the former World War II ammunition plant. These industrial land uses are surrounded by cropland and rangeland that blend into the offsite viewscape. The developed areas of Pantex are consistent with VRM Class 5 designation. The remainder of Pantex ranges from VRM Class 3 to Class 4.

Public access within Pantex and its buffer areas is strictly controlled and limited to authorized personnel, visitors, and the agricultural lessee and sublessees. Public access adjacent to the plant perimeter is limited to three Texas Farm-to-Market Roads and U.S. Route 60. The most visible, and therefore most sensitive, viewpoint of Pantex facilities is located 2.4 km (1.5 mi) southeast at the intersection of U.S. Route 60 and Texas Farm-to-Market Road 2373. U.S. Route 60 is part of the Texas Plains Trail, a scenic road with Pantex a designated point of interest. The view of the plant along this highway is visible, appearing as low clusters of buildings on a flat horizon. Because of their height, the cylindrical water towers are the most visible feature. The operations areas

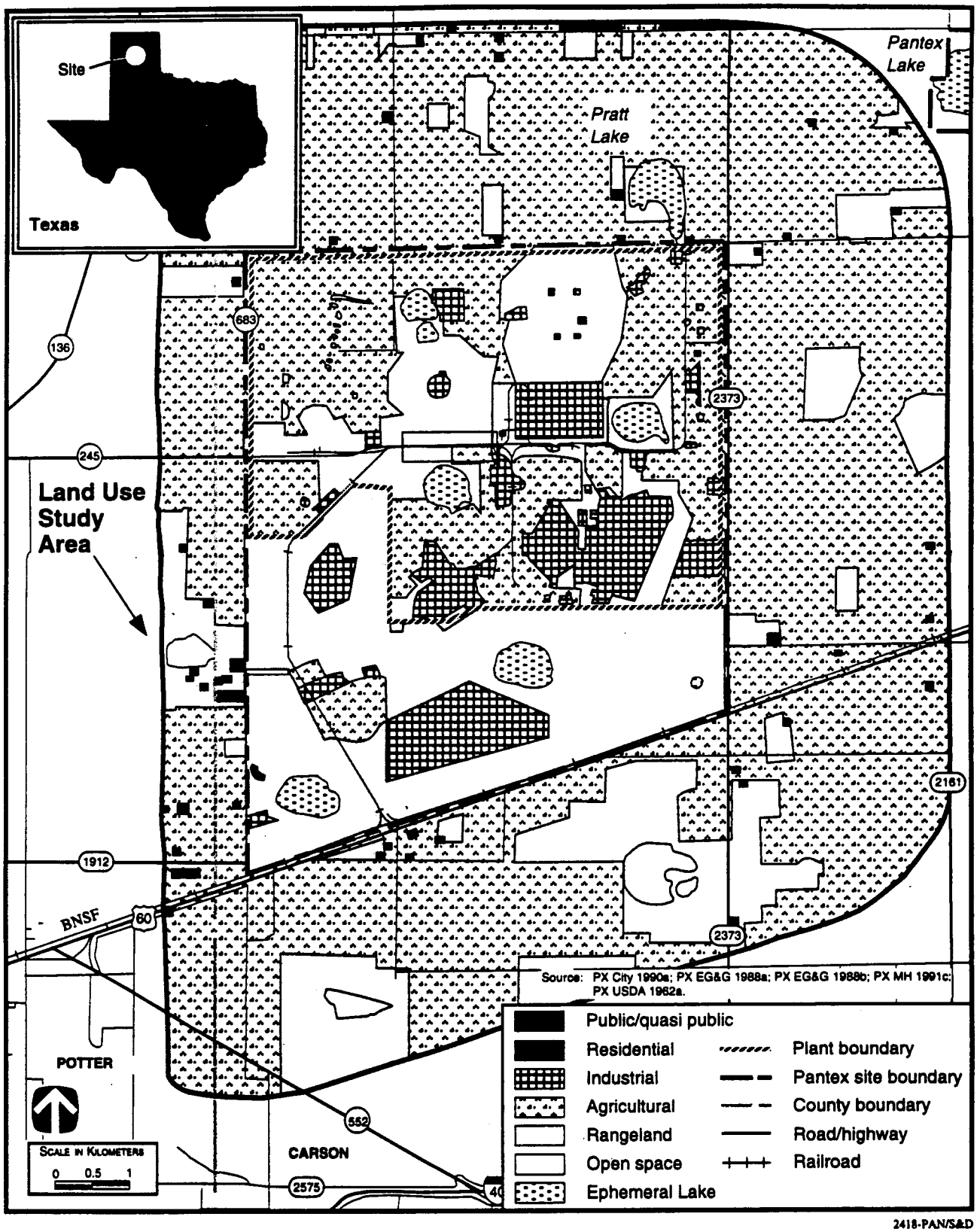


Figure 3.5.1–1. Generalized Land Use at Pantex Plant and Vicinity.

are well defined at night by the intense security lighting. The plant operations areas are also visible from Interstate 40, with the closest viewpoint being the rest area approximately 10 km (6 mi) away. This viewpoint is similar to that described for U.S. Route 60, but because of the greater distance, the plant facilities are not as prominent. The plant facilities are generally visible from the low-density rural housing that surrounds the site.

3.5.2 SITE INFRASTRUCTURE

Baseline Characteristics. Section 3.5 describes current Pantex missions. Baseline characteristics are shown in Table 3.5.2–1.

Table 3.5.2–1. Pantex Plant Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	76	76
Railroads (km)	27	27
Electrical		
Energy consumption (MWh/yr)	84,420	201,480
Peak load (MWe)	13.6	23
Fuel		
Natural gas (m^3/yr)	14,600,000	289,000,000
Oil (l/yr)	1,775,720	1,775,720
Coal (t/yr)	0	0
Steam (kg/hr)	59,524	68,040

Source: PX 1995a:1; PX DOE 1995d; PX DOE 1996b.

Pantex is tied to the Burlington Northern Santa Fe Railroad, formerly known as the Atchison, Topeka, and Santa Fe Railroad, through a spur that enters the plant from the southwest running just north of U.S. Highway 60. This spur provides access to the entire Burlington Northern Santa Fe system as well as to other railroads. Currently, the spur is being used only for concrete shipments.

Electric generating capacities by fuel types within the sub-regional power pool supplying power to Pantex provide the larger fractions by coal, oil, and gas turbine production, respectively. The remaining is provided by small amounts of nuclear, hydroelectric, and other sources. The sub-regional electric power pool from which Pantex draws its power is the West Central Power Pool. The sub-regional power pool electrical summary is shown in Table 3.5.2–2.

Natural gas at Pantex is supplied by Anthem Energy. From calendar year 1987 through fiscal year 1994, gas use has generally increased from a low of 11,889 million m^3 (424,605 million ft^3) in 1988 to a high of 15,033 million m^3 (536,893 million ft^3) in 1993. Both current and future supplies appear to be adequate. Much of the region is underlain by natural gas deposits, and there are consequently many small local suppliers in addition to the major companies.

Five wells, which are pumped into a common line and into ground storage tanks, supply water to Pantex. There are a total of 24.2 million l (6.4 million gal) of ground storage capacity. Two elevated storage tanks totaling 1,374,000 l (363,000 gal) provide pressure to the system. Water use at Pantex has ranged from 1,052 to 1,192 million l (278 to 315 million gal) annually from 1989 through 1993. In addition, water sold to Texas Tech University ranged from 235 to 344 million l (62 to 91 million gal) annually during the same period.

Operations at Pantex are housed in 476 buildings, containing 230,200 m^2 (2,483,000 ft^2) of work space. Magazines in Zone 4 consist of 95 buildings used for staging nuclear weapons, storage of explosives, and interim storage of pits. Current pit storage capability consists of 22 Modified Richmond and Steel Arch Construction magazines, all of which have necessary utility support and material access control. Current capacity for pit storage is 20,000 pits.

Table 3.5.2–2. West Central Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	59%
Nuclear	7%
Hydro/geothermal	1%
Oil/gas	32%
Other[b]	1%
Total Annual Production	107,607,000 MWh
Total Annual Load	104,681,000 MWh
Energy Exported Annually[c]	2,926,000 MWh
Generating Capacity	24,642 MWe
Peak Demand	20,578 MWe
Capacity Margin[d]	4,064 MWh

[a] Percentages do not total 100 percent due to rounding.

[b] Includes power from both utility and non-utility sources.

[c] Energy exported is not the difference of production and load due to negative net pumped storage.

[d] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

3.5.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The climate at Pantex and in the surrounding region is characterized as semi-arid with hot summers and relatively cold winters. The average annual temperature in the Amarillo region is 13.8 °C (56.9 °F); temperatures range from an average daily minimum of -5.7 °C (21.8 °F) in January to an average daily maximum of 32.8 °C (91.1 °F) in July. The average annual precipitation is 49.7 cm (19.6 in). Prevailing wind directions at Pantex are from the south to southwest. The average annual windspeed is 6.0 m/s (13.5 mph) (NOAA 1994c:3). Additional information related to meteorology and climatology at Pantex is presented in Appendix F.

Ambient Air Quality. Pantex is located within the Amarillo-Lubbock Intrastate AQCR (#211), which is currently designated as "attainment" or "unclassified" by EPA (40 CFR 81.344) with respect to the NAAQS for criteria pollutants (40 CFR 50). Appendix F lists the NAAQS for these criteria pollutants. These standards have been adopted by the State of Texas (TX NRCC 1995b:28). There are no PSD Class I areas within 100 km (62 mi) of Pantex.

Historically, the primary emission sources of criteria pollutants at Pantex are the steam plant boilers, the explosives burning operation, and emissions from onsite vehicles (PX DOE 1983a:3-8,3-11). Potential emission sources of hazardous/toxic air pollutants include the high explosives synthesis facility, the explosives burning operation and paint spray booths, miscellaneous laboratories, and other small operations. With the exception of thermal treatment of HE at the Burning Ground, most stationary points of nonradioactive atmospheric releases are from fume hoods and building exhaust systems with HEPA filters.

Table 3.5.3–1 presents the baseline ambient air concentration for criteria pollutants and other pollutants of concern at Pantex. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. Major noise emission sources within Pantex include various industrial facilities, equipment, and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, construction and materials handling equipment, vehicles, weapons firing, alarms, and explosives detonation). Most Pantex industrial facilities are at a sufficient distance from the site boundary to make noise levels at the boundary from these sources barely distinguishable from background noise. However, some noise from explosives detonation can be heard at residences north of the site and weapons firing can be heard at residences west of the site.

The acoustic environment along the Pantex boundary and at nearby residences away from traffic noise is typical of a rural location, with DNL in the range of 35 to 50 dBA (EPA 1974a:B-4). Noise survey results in areas adjacent to Pantex indicate that ambient sound levels are generally low, with natural sounds and distant traffic being the primary sources. Traffic, aircraft, trains, and agricultural activities result in higher short-term levels especially near roads (PX DOE 1995i:11-1,11-23). Traffic is the primary source of noise at the site boundary and at residences located near roads. Plant traffic contributes little to overall traffic noise. However, traffic noise is expected to dominate sound levels along major roads in the area, such as U.S. Route 60. The residents that have the highest potential for being affected by noise from plant traffic along Pantex access routes are those living along Farm-to-Market Roads 2373 and 683.

Other sources of noise include aircraft, wind, insect activity, and agricultural activity. Except for the prohibition of nuisance noise, neither the State of Texas nor its local governments have established any regulations that specify acceptable community noise levels.

Table 3.5.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Pantex Plant, 1993

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000[b]	161
	1-hour	40,000[b]	924
Lead	Calendar Quarter	1.5[b]	0.01
Nitrogen dioxide	Annual	100[b]	0.90
Ozone	1-hour	235[b]	[c]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	8.73
	24-hour	150[b]	88.5
Sulfur dioxide	Annual	80[b]	<0.01
	24-hour	365[b]	<0.01
	3-hour	1,300[b]	<0.01
	30-minute	1,045[d]	<0.01
Mandated by the State of Texas			
Hydrogen fluoride	30-day	0.8[d]	<0.27
	7-day	1.6[d]	<0.27
	24-hour	2.9[d]	0.27
	12-hour	3.7[d]	0.38
	3-hour	4.9[d]	1.52
Hydrogen sulfide	30-minute	111[d]	[e]
Sulfuric acid	24-hour	15[d]	[e]
	1-hour	50[d]	[e]
Total suspended particulates	3-hour	200[d]	[e]
	1-hour	400[d]	[e]
Hazardous and Other Toxic Compounds			
1,1,1-Chloroethane	30-minute[f]	500[d]	127
	Annual	50[d]	0.53
1,1,2-Trichloroethane	30-minute[f]	550[d]	17.3
	Annual	55[d]	0.08
2-Nitropropane	30-minute[f]	50[d]	8.55
	Annual	5[d]	0.04
Alcohols	30-minute[f]	[g]	195
	Annual	[g]	0.70
Benzene	30-minute[f]	30[d]	19.40
	Annual	3[d]	0.05
Carbon disulfide	30-minute[f]	30[d]	22.60
	Annual	3[d]	0.09
Carbon tetrachloride	30-minute[f]	126[d]	19.7
	Annual	13[d]	0.08
Chlorobenzene	30-minute[f]	460[d]	19.5
	Annual	46[d]	0.08

Table 3.5.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Pantex Plant, 1993—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (continued)			
Chromium	30-minute[f]	1[d]	0.10
	Annual	0.1[d]	0.002
Cresol	30-minute[f]	5[d]	0.41
	Annual	[h]	0.002
Cresylic acid	30-minutef	5[d]	0.51
	Annual	[h]	0.002
Dibenzofuran	30-minute[f]	[h]	0.001
	Annual	[h]	0.00002
Ester glycol ethers	30-minute[f]	[h]	35.9
	Annual	[h]	0.15
Ethyl benzene	30-minute[f]	2,000[d]	31.1
	Annual	434[d]	0.13
Ethylene dichloride	30-minute[f]	40[d]	9.58
	Annual	4[d]	0.04
Formaldehyde	30-minute[f]	15[d]	0.37
	Annual	1.5[d]	0.004
Hydrogen chloride	30-minute[f]	75[d]	5.98
	Annual	0.1[d]	0.09
Ketones	30-minute[f]	[h]	33.4
	Annual	[h]	0.14
Mercury	30-minute[f]	0.5[d]	0
	Annual	0.05[d]	0
Methanol	30-minute[f]	2,620[d]	245
	Annual	262[d]	0.58
[Text deleted.]			
Methyl ethyl ketone	30-minute[f]	3,900[d]	1,400
	Annual	590[d]	5.10
Methylene chloride	30-minute[f]	260[d]	180
	Annual	26[d]	0.74
Methyl isobutyl ketone	30-minute[f]	2,050[d]	4.45
	Annual	205[d]	0.02
Naphthalene	30-minute[f]	440[d]	0.005
	Annual	50[d]	0.0001
[Text deleted.]			
Nitrobenzene	30-minute[f]	24[d]	0.51
	Annual	5[d]	0.002
Phenol	30-minute[f]	154[d]	0.03
	Annual	19[d]	0.0006
Tetrachloroethylene	30-minute[f]	340[d]	17.6
	Annual	34[d]	0.07

Table 3.5.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Pantex Plant, 1993—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (continued)			
Toluene	30-minute[f]	1,880[d]	568
	Annual	188[d]	1.73
Trichloroethene	30-minute[f]	[h]	51.1
	Annual	[h]	0.21
Trichloroethylene	30-minute[f]	1350[d]	51.1
	Annual	135[d]	0.21
Triethylamine	30-minute[f]	40[d]	1.08
	Annual	4[d]	0.002
Xylene	30-minute[f]	3,700[d]	145
	Annual	434[d]	0.47

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Federal and State standard.

[c] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[d] State standard.

[e] Data not available from source document.

[f] 1-hour predicted concentrations were used for the 30-minute standard.

[g] The Texas Natural Resources Conservation Commission does not have an Effects Screening Level (ESL) for the family of alcohols. If ambient levels of air contaminants exceed the screening levels, it does not necessarily indicate a problem. It is just a trigger for a more in-depth review. The most stringent ESL for a single alcohol may be exceeded if applied to the family of alcohols.

[h] No State standard for indicated averaging time.

Source: 40 CFR 50; PX DOE 1996b; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a.

3.5.4 WATER RESOURCES

Surface Water. There are no streams or rivers at Pantex, and all site water requirements are met by groundwater. All surface water drains to playas, natural closed depressions that collect runoff to form ephemeral lakes. There are seven playas associated with Pantex. Playas 1 through 3 are located on DOE-owned property, Playas 4 and 5 are on DOE-leased property, Pantex Lake (also a playa) is located approximately 4 km (2.5 mi) northeast of the site boundary, and Pratt Lake is located just north of the site boundary (Figure 3.5.4–1). The only major stream in the area is the Canadian River, which is located approximately 40 km (25 mi) north of Pantex. Since surface runoff at the Plant flows into all playa basins, the Canadian River is not affected by activities at Pantex.

Playas are a significant part of the surface and subsurface hydrologic systems at Pantex. All playas at the site receive stormwater runoff from Pantex vicinity. Playa 1 receives continuous discharges from the Pantex Wastewater Treatment Facility. Steam condensate, noncontact cooling water from buildings, and stormwater runoff are directed to Playas 1, 2, and 4. Playa 3 receives stormwater runoff from the Pantex Burning Ground. Pantex activities have not discharged to Playa 5, but past activities included discharge of treated effluents to Pantex Lake. There are also a number of playas adjacent to Pantex that receive drainage from perimeter portions of the site. Playas provide a source of groundwater recharge, although the rate of recharge is unknown. Studies currently are being conducted to determine this rate.

Because there are no onsite or nearby flowing streams, floodplains exist only in association with the playas. A previous floodplain assessment concluded that the only incidence of flooding would be at some sites including the wastewater treatment plant of Playa 1 and some relict World War II bunkers southwest of Playa 4 (LLNL 1988a:XV). This limited flooding would not affect the operations at Pantex. The 500-year floodplain is also associated with the playas; its boundaries generally follow those of the 100-year floodplain and typically extend only up to several hundred feet beyond the 100-yr boundaries. The exception is Playa 3 where the 500-yr and Standard Project Flood runoff into Playa 3 will overflow out of the drainage basin creating shallow (less than 30 cm [1 ft]) flooding of the drainage basins for Playas 1 and 2. The 100-year floodplain associated with Pratt Lake extends into the far northeast corner of Pantex.

Surface Water Quality. The NPDES program of the CWA is administered by EPA in the State of Texas. In addition, discharge of wastewaters to waters defined as "Waters of the United States" within the State of Texas requires a wastewater discharge permit from the Texas Natural Resources Conservation Commission (TNRCC) in accordance with the Texas Water Code (PX Battelle 1992a:2-12).

In November 1990, Pantex submitted an NPDES permit application for Playas 1, 2, and 4, which is currently under review by Region 6 of EPA. Pantex also submitted an NPDES stormwater discharge permit application in October 1991. The NPDES stormwater permit was issued in February 1995.

The TNRCC allows Pantex to discharge wastewaters into Playas 1 and 2. In December 1990, Pantex filed an application to modify its wastewater discharge permit to allow discharge of both industrial wastewater and rainwater runoff into Playa 4. An application for a renewal of the TNRCC wastewater discharge permit #2296 is on file and is currently under negotiation. Surface water quality sampling results from 1994 confirm that Pantex was in compliance with all discharge water quality regulations for Playa 1. With exception of a high water level in Playa 1 in July 1994, due to a rainfall event, all permit requirements were met (PX DOE 1995d:2-10).

Surface water monitoring is conducted at Playas 1, 2, 3, at the main plant, at Pantex Lake, and at Bushland Playa, an offsite control playa (60 km [37.5 mi] southwest of Pantex) used for comparative purposes. There are some differences in the parameters monitored among the playas, but the results of the 1994 monitoring activities at Playa 1 are presented as representative of the water quality of all the playas at Pantex (Table 3.5.4–1). Bushland Playa contained water in August, September, November, and December in 1994; results were within historical limits.

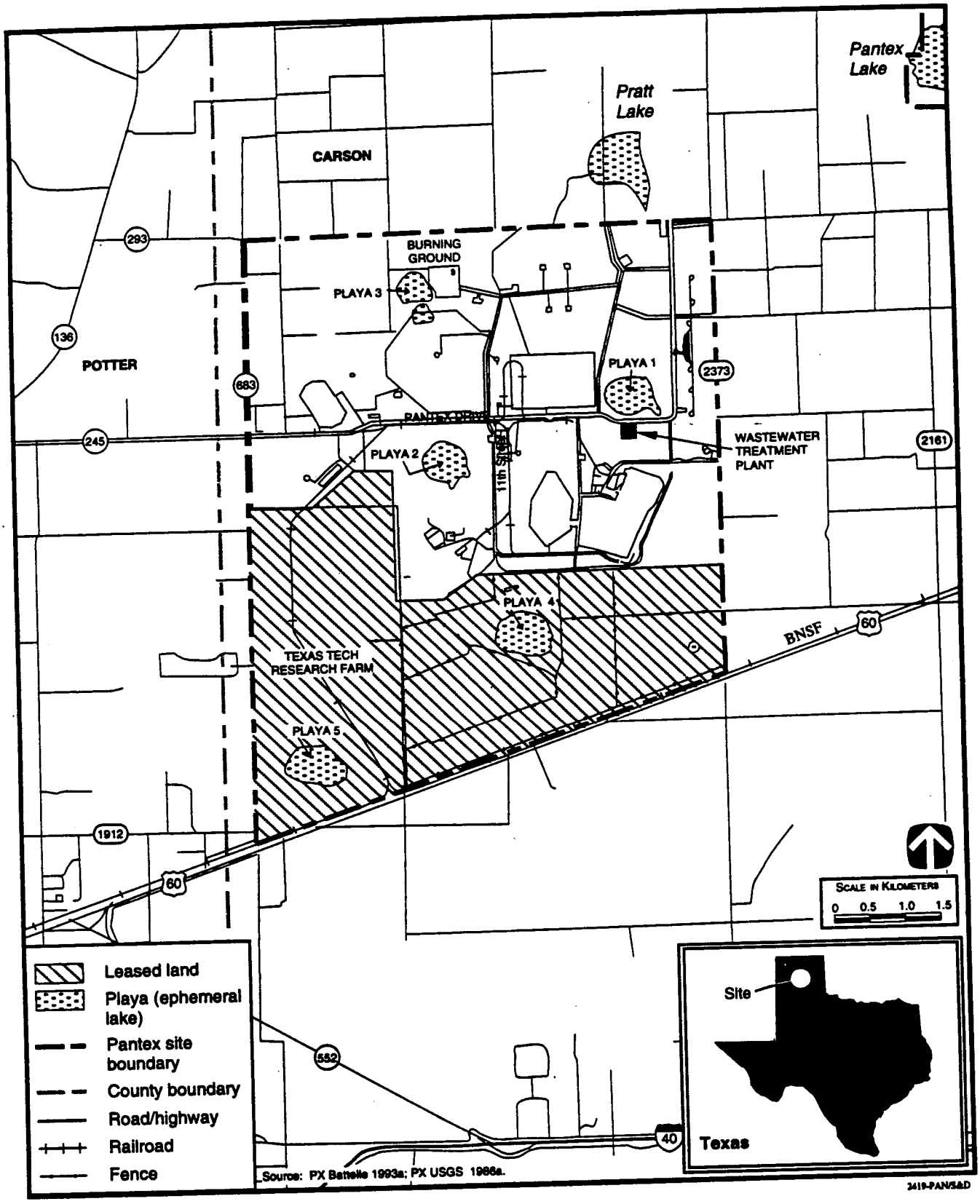


Figure 3.5.4–1. Surface Water Features at Pantex Plant.

Table 3.5.4–1. Summary of Playa 1 Surface Water Quality Monitoring at Pantex Plant, 1994

Parameter	Unit of Measure	Water Quality Criteria[a]	Water Body Concentration	
			High	Low
Alpha (gross)	pCi/l	15[b]	7±3	0±4
[Text deleted.]				
Ammonia (as N)	mg/l	NA	1.5	0.095
Arsenic	mg/l	0.05[b,c]	0.01	0.004
Barium	mg/l	2.0[b]	0.3	0.1
Beta (gross)	pCi/l	50[d]	22±4	8±6
[Text deleted.]				
Cadmium	mg/l	0.005[b]	<dL[e]	<dL[e]
Chloride	mg/l	250[f]	270	16
Chromium	mg/l	0.1[b]	0.01	0.003
Copper	mg/l	1.0[f]	0.01	0.005
Cyanide	mg/l	0.2[b]	0.009	0.005
Fluoride	mg/l	2[f],4[b]	2.4	0.48
HMX*	mg/l	NA	<dL[e]	<dL[e]
Iron	mg/l	0.3[f]	11	0.51
Lead	mg/l	0.015[b]	0.005	0.002
Manganese	mg/l	0.05[f]	0.4	0.07
Mercury	mg/l	0.002[b]	0.0002	0.0002
Oil and grease	mg/l	NA	14	0.48
PETN*	mg/l	NA	<dL[e]	<dL[e]
Plutonium-239/240	pCi/l	1.2[g]	0.03±0.01	0±0.03
Radium-226	pCi/l	5.0[b]	0.6±0.4	0.1±0.2
Radium-228	pCi/l	5.0[b]	1.1±0.7	0±0.5
RDX*	mg/l	NA	<dL[e]	<dL[e]
Sulfate (as SO_4)	mg/l	250[f]	80.2	4
TNT*	mg/l	NA	<dL[e]	<dL[e]
Tritium	pCi/l	80,000[g]	0.23±0.21	0±0.15
Uranium-234	pCi/l	20[g]	4.3±0.4	0±0
Uranium-238	pCi/l	24[g]	2.1±0.3	0.1±0.1
Zinc	mg/l	5.0[f]	0.08	0.006

[a] For comparison purposes only.

[b] National Primary Drinking Water Regulations (40 CFR 141).

[c] Texas State water quality criteria. Parameters are considered in exceedance only when their concentrations surpass State water quality criteria. General criteria do not apply to instances in which surface water, as a result of natural phenomena, exhibit characteristics beyond the limits established.

[d] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[e] All samples were below detection limit. Detection limits varied throughout the year.

[f] National Secondary Drinking Water Regulations (40 CFR 143).

[g] DOE DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored concentration. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the environmental level.

Note: *=high explosive(s) compounds; NA=not applicable; dL= detection limit.

Source: PX DOE 1995d.

Surface Water Rights and Permits. Water rights in Texas fall under the Doctrine of Prior Appropriations. Under this doctrine, the user who first appropriated water for a beneficial use has priority to use available water supply over a user claiming rights at a later time. Courts also recognize riparian rights legally granted from Spanish-American Agreements. The TNRCC is the administrator for water rights and is the permit-issuing authority.

Groundwater. Pantex is located on the Texas High Plains aquifer system, which is the southernmost extension of a regional aquifer that extends from Texas to South Dakota (PX WDB 1993a:1). The two principal water-bearing units beneath Pantex and adjacent areas are the Ogallala Aquifer and the Dockum Group Aquifer. In addition, perched groundwater occurs locally, particularly under the southeast portion of Pantex, at approximate depths ranging from 64 to 88 m (210 to 290 ft) (PX DOE 1996b:4-65). The occurrence of perched groundwater has been attributed to a fine-grained zone of silty sands and clays that limits the downward movement of groundwater. Perched groundwater collects in buried gravel and sand channel deposits that are on top of the fine-grained zone. Deep wells in the northeast corner of Pantex, completed at depths of 183 to 244 m (600 to 800 ft) into the Ogallala Formation, have provided the water supply at Pantex for over 40 years. In 1994, Pantex reported a total production of 836 million l (221 million gal) of water from onsite production wells (PX DOE 1996b:4-77) and has a capacity to produce 1,900 million l/yr (500 million gal/yr) (PX DOE 1995g:10).

The Ogallala Aquifer beneath Pantex has not been classified by EPA. However, it is the only source of drinking water for Pantex. Depth to water in the Ogallala Aquifer ranges from 104 m (340 ft) at the southern boundary of DOE-leased property at Pantex to 140 m (460 ft) at the northern boundary (PX DOE 1996b:4-57). The saturated thickness of the Ogallala Formation ranges from 15.2 m (50 ft) to more than 120 m (400 ft), and in some areas it is capable of yielding in excess of 4,000 lpm (1,060 gal/min), or 2.1 billion l/yr (554.8 million gal/yr) (PX DOE 1996b:4-69). Estimates of annual recharge rates to the Ogallala Aquifer vary from 0.02 to 4.1 cm/yr (0.01 to 1.6 in/yr) (PX DOE 1996b:4-69, 4-71) based on earlier studies that investigated slow regional infiltration of precipitation and recent studies that explored percolation of water through playa lakes and leakage from the Dockum Group Aquifer into the Ogallala Aquifer (PX WDB 1993a:2).

The withdrawal of water from the Ogallala Aquifer continues to exceed recharge, causing water levels to decline in the Pantex area at a rate of approximately 0.6 to 1.5 m/yr (2 to 5 ft/yr) (PX DOE 1995d:1-9). From 1980 to 1990, the city of Amarillo well field north of Pantex experienced up to 20 m (60 ft) of water-level decline, which may have contributed to a depression in the groundwater surface northeast of Pantex (PX WDB 1993a:11). In 1990, the recoverable volume of water in storage and available for use in the Ogallala Aquifer in the High Plains aquifer system was estimated at 515 trillion l (136 trillion gal) (PX DOE 1996b:4-71). The groundwater flow direction beneath Pantex is to the northeast (PX DOE 1995d:1-8). Figure 3.5.4–2 shows the direction of the groundwater flow in the Ogallala Aquifer beneath Pantex.

An agreement between Pantex and the city of Amarillo is currently being negotiated to develop reclaimed wastewater from the city of Amarillo Hollywood Road Wastewater Treatment Plant. The plant is currently discharging approximately 9,671 million l/yr (2,555 million gal/yr) of the advanced treated wastewater and will be discharging approximately twice that much by 2010. The use of reclaimed wastewater could curtail the annual decline rate of the Ogallala Aquifer.

Groundwater Quality. Pantex's groundwater monitoring program includes monitoring wells distributed throughout the facility and onsite Ogallala production wells. Groundwater samples collected from the monitoring wells that tap the perched and Ogallala aquifers are analyzed for a standard suite of parameters and constituents, including volatile organics, HE, pesticides, herbicides, semivolatile organics, trace metals, radioactive materials (including gross alpha and gross beta measurements), and field parameters (including total dissolved solids and pH).

Historically, only limited metal contamination has been found in some of the wells monitoring the Ogallala Aquifer. Table 3.5.4–2 shows the water quality in the Ogallala Aquifer in 1994. Groundwater samples from the perched zone, however, contain a variety of constituents that are either above background levels or drinking

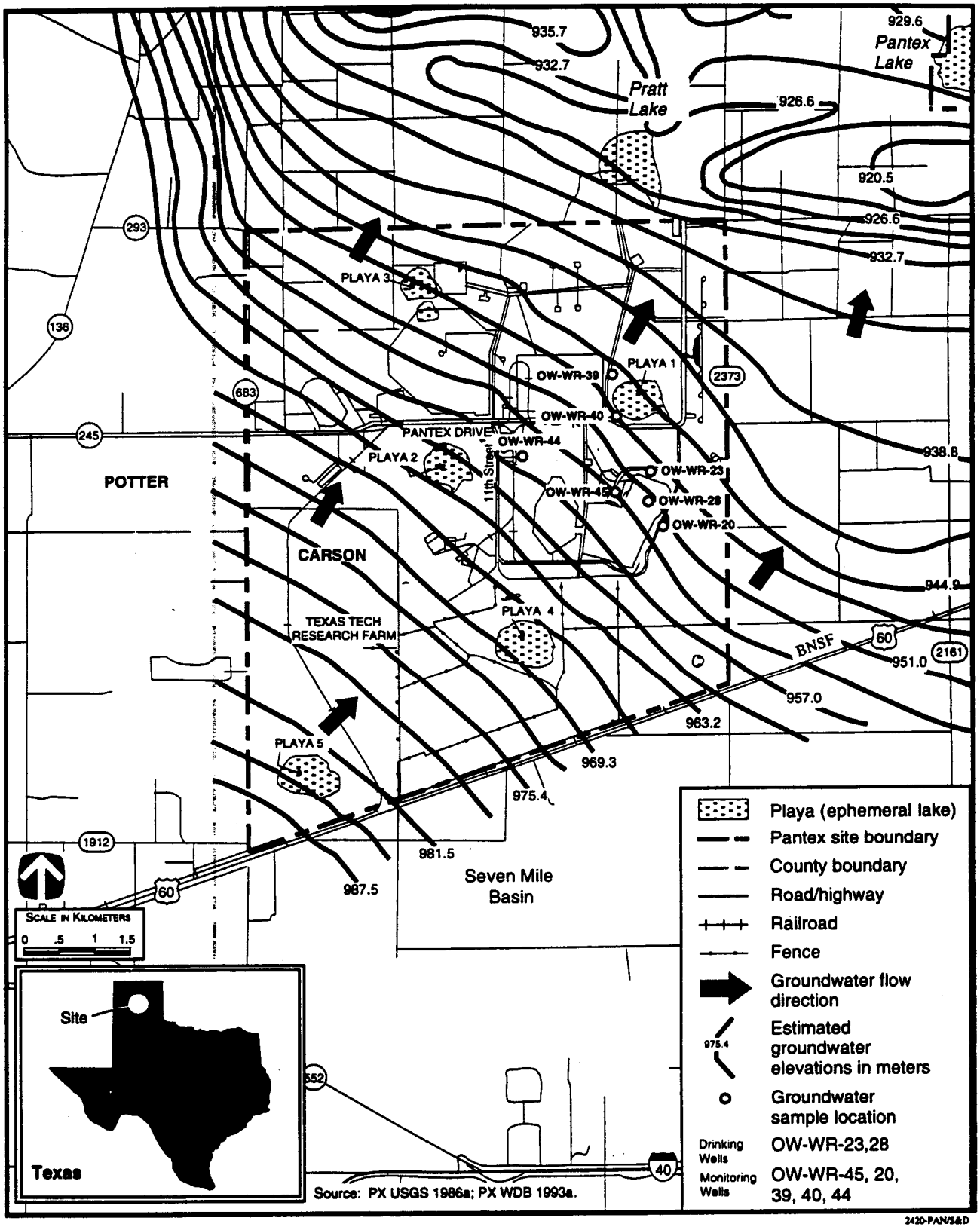


Figure 3.5.4–2. Water Table Elevations for the Ogallala Aquifer at Pantex Plant.

Table 3.5.4–2. Groundwater Quality Monitoring (Ogallala Aquifer Wells) at Pantex Plant, 1994

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Drinking Water Wells		Monitoring Wells	
			High	Low	High	Low
1,2-Dichloroethane	mg/l	0.005[b]	<0.005	<0.005	<0.005	<0.005
Barium	mg/l	2.0[b]	0.16	0.1	0.19	0.12
Chromium	mg/l	0.1[b]	0.007	<0.005	0.007	<0.005
Copper	mg/l	1.0[c]	0.046	<0.005	0.01	<0.005
HMX*	mg/l	NA	<0.020	<0.020	<0.020	<0.020
Iron	mg/l	0.3[c]	0.06	<0.01	1.49	<0.01
Lead	mg/l	0.015[b]	<0.005	<0.005	0.007	<0.005
Nitrate	mg/l	10[b]	1.85	1.37	2.19	0.767
pH	pH units	6.5-8.5[c]	7.7	7	8.1	6.7
RDX*	mg/l	NA	<0.020	<0.020	<0.020	<0.020
Sulfate	mg/l	250[c]	23	21	26	16
Total dissolved solids	mg/l	500[c]	320	240	384	210
Total organic carbon	mg/l	NA	1	<1	2	<1
Total organic halogens	mg/l	NA	5	<1	23	<3
Trichloroethylene	mg/l	0.005[b]	<0.005	<0.005	<0.005	<0.005
Tritium	pCi/l	80,000[d]	0.25	<MDA[e]	0.14	<MDA[e]
Uranium-234	pCi/l	20[d]	4.8	3.7	5.5	0.8
Uranium-238	pCi/l	24[d]	2.8	1.5	2.8	0.9
Zinc	mg/l	5.0[c]	0.18	<0.005	1.9	<0.005

[a] For comparison purposes only.
[b] National Primary Drinking Water Regulations (40 CFR 141).
[c] National Secondary Drinking Water Regulations (40 CFR 143).
[d] DOE DCG for water (DOE Order 5400.5). DCG values are based on 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.
[e] Results were less than the Minimum Detectable Activity (MDA).
Note: *=high explosive(s) compounds; NA=not applicable.
Source: PX DOE 1995d.

water standards or are not naturally occurring. These include 1,2-dichloroethane, trichloroethylene, chromium, iron, and the HE RDX and HMX. Table 3.5.4–3 shows the water quality in the perched zone in 1994. Groundwater quality in the perched aquifer has been affected by activities that have occurred over the past 40 years at Pantex. Since the perched aquifer is the shallowest water-bearing zone in the area, it is the first groundwater unit affected by migration of contaminants that were released from past industrial operations. These operations generated HE materials, organic solvents, and metals in liquid and solid waste. The direction and rates of contaminant movement of the perched aquifer are still under investigation, but are expected to be controlled by the location of buried channel deposits, direction and rate of groundwater movement, and source areas of historical contamination. Contaminants are believed to have reached the perched aquifer through historical vertical infiltration from ditches, landfills, and other past localized source areas. Downward migration of perched groundwater could potentially affect the groundwater quality of the underlying Ogallala Aquifer. However, no contamination from HE, organic compounds, or radionuclides has been detected in Ogallala wells onsite (PX DOE 1996b:4-77). In 1995, trace levels (less than 1 part per billion) of RDX were detected in wells tapping the upper portion of the Ogallala east of the plant.

Groundwater Availability, Use, and Rights. Five production wells in the northeast corner of Pantex serve the plant's industrial and potable water needs. During 1994, the plant pumped 836 million l (221 million gal) of

Table 3.5.4–3. Groundwater Quality Monitoring (Perched Zone Wells) at Pantex Plant, 1994

Contaminant	Unit of Measure	Water Quality Criteria and Standards[a]	Water Body Concentration	
			High	Low
1,2-Dichloroethane	mg/l	0.005[b]	0.14	<0.005
Alpha (gross)	pCi/l	15[b]	11	<MDA[c]
Barium	mg/l	2.0[b]	0.25	0.047
Beta (gross)	pCi/l	50[d]	13	<MDA[c]
Chromium	mg/l	0.1[b]	1.95	<0.005
Copper	mg/l	1.0[e]	0.01	<0.005
HMX*	mg/l	NA	0.07	<0.02
Iron	mg/l	0.3[e]	3.55	<0.01
Lead	mg/l	0.015[b]	<0.005	<0.005
Nitrate	mg/l	10[b]	4.8	<0.01
pH	pH units	6.5-8.5[e]	9.0	6.7
RDX*	mg/l	NA	1.1	<0.020
Sulfate	mg/l	250[e]	56	12
Total dissolved solids	mg/l	500[e]	518	160
Total organic carbon	mg/l	NA	15	<1
Total organic halogens	mg/l	NA	259	<1
Trichloroethylene	mg/l	0.005[b]	0.15	<0.005
Tritium	pCi/l	80,000[f]	0.33	<MDA[c]
Uranium-234	pCi/l	20[f]	5.5	0.8
Uranium-238	pCi/l	24[f]	3.0	0.2
Zinc	mg/l	5.0[e]	0.684	<0.005

[a] For comparison purposes only.

[b] National Primary Drinking Water Regulations (40 CFR 141).

[c] Results were less than the MDA.

[d] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[e] National Secondary Drinking Water Regulations (40 CFR 143).

[f] DOE DCG for water (DOE Order 5400.5). DCG values are based on 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.

Note: The following wells were used to determine the contaminant range:
PM-19 (Perched Monitoring Northwest Playa One)
PM-20 (Perched Monitoring Zone 12 Sensor Bed)
PM-38 (Perched Monitoring Northeast Playa One)
PM-44 (Perched Monitoring Building 16-1)
PM-45 (Perched Monitoring Southeast Building 12-2)
PM-106 (Perched Monitoring Northeast Plant)
*=high explosive(s) compounds; NA=not applicable.

Source: PX DOE 1995d.

water from the Ogallala Aquifer, while the city of Amarillo pumped 23.9 billion l (6.3 billion gal) from its Carson County well field located north and northeast of the plant (PX DOE 1996b:4-77). The estimated sustainable groundwater producing capacity of the Ogallala is approximately 2 billion l/yr (0.528 billion gal/yr). Pantex Lake, located adjacent to the Amarillo water-well field, is available for drilling additional water wells if needed for future Pantex operations.

The Ogallala Formation is also a source of municipal and industrial water for nearby towns and cities and for irrigation water to nearby farms. In the Pantex area, the cities of Amarillo and Canyon maintain community

water systems (see Figure 2.2.4–1 for regional map). The city of Amarillo draws its raw water from groundwater and Lake Meredith and has the capacity to supply 103,660 million l/yr (27,376 million gal/yr). The city of Canyon maintains the capacity to supply approximately 9,490 million l/yr (2,506 million gal/yr) from its own wells and may purchase up to 6,935 million l/yr (1,831 million gal/yr) from the city of Amarillo.

Groundwater is controlled by the individual landowner in Texas. The TNRCC and the Texas Water Development Board are the two State agencies with major involvement in groundwater fact finding, data gathering, and analysis. Groundwater management is the responsibility of local jurisdictions through Groundwater Management Districts. The Pantex facility is located in Panhandle Groundwater District 3, which has the authority to require permits and limit the quantity of water pumped. Presently, the Panhandle Groundwater District does not limit the quantity of water pumped.

3.5.5 GEOLOGY AND SOILS

Geology. Pantex is located on the Southern High Plains of the Texas Panhandle. The topography at Pantex consists of flat to gently rolling plains. There are no unique geologic landforms, and the only distinctive features are playas that are spaced more or less uniformly throughout the site. The playas are about 500 to 1,000 m (1,640 to 3,280 ft) across, with clay bottoms and depths to approximately 9 m (30 ft).

Pantex is underlain by the Blackwater Draw Formation which consists of a sequence of buried soils with an upper unit consisting of silt, clay, and caliche and a 12- to 23-m (39- to 76-ft thick) lower unit consisting of silty sand with caliche. The Ogallala Formation underlies the Blackwater Draw Formation and consists of interbedded sands, silts, clays, and gravels. The Ogallala Formation is underlain by the sedimentary rocks of the Dockum Group which are underlain by the Upper and Middle permian layers, which are composed predominantly of thick and widespread deposits of salt. The Lower Permian consists predominantly of complex accumulations of shale, limestone and argillaceous limestone, and dolomite. Some Permian formations of the Southern High Plains contain salt beds. The dissolution of these beds have resulted in sinkholes and fractures in nearby Armstrong and Hutchinson Counties, Texas. No sinkholes or fractures have been identified in Carson County. Recent work using shallow seismic data has determined that the structure beneath the playas on Pantex Plant and adjacent areas shows displacement of Ogallala strata. This displacement is attributed to the dissolution of underlying salt beds (PX DOE 1996b:4-31). No economically viable geologic resources have been identified at Pantex.

No capable faults as defined in 10 CFR 100, Appendix A, are present in the vicinity of Pantex. Three major subsurface faults and one minor surface fault occur near the Pantex site area (PX DOE 1995i:2-11). The longest fault, approximately 250 km (155 mi) long, is located about 40 km (25 mi) north of the site. A 70-km (43-mi) long fault is located about 8 km (5 mi) south of the site and a 64-km (40-mi) long fault is located about 11 km (7 mi) north of the site. The minor fault is surficial, about 6 km (4 mi) long, and located about 32 km (20 mi) northwest of the site.

Pantex lies on the boundary zone between Seismic Zones 0 and 1, indicating little or no damage could occur as a result of an earthquake (Figure 3.2.5–1). This area is relatively free from earthquakes. Twenty-five earthquakes with MMIs of VI (Table 3.2.5–1) have been recorded in the Texas Panhandle (PX DOE 1996b:4-33). There is no volcanic hazard at Pantex because there are no known areas of active volcanism in the Texas Panhandle.

Soils. Pantex is underlain by soils of the Pullman-Randall association. The Pullman-Randall soil association consists of nearly level to gently sloping deep noncalcareous clays and clay loams. Pullman soils underlie most of the Pantex area, but Randall soils occur in the vicinity of the playas and depressions. Water and wind erosion and shrink-swell potential are moderate to high for most of the soil units (PX USDA 1962a:2,9-15; PX USDA 1980a:32). However, the soils at Pantex are acceptable for standard construction techniques.

3.5.6 BIOLOGICAL RESOURCES

Terrestrial Resources. Pantex is located within a treeless portion of the High Plains that is classified as mixed prairie. The High Plains vegetational area is a southern extension of the short- and mid-grass prairies of the Western Great Plains. The primary vegetation of the High Plains includes short-grasses (that is, buffalo-grass and blue grama) and mid-grasses (that is, little bluestem, sideoats grama, and western wheatgrass) (PX DOE 1991a:2). Approximately 25 percent of the site, including land leased from Texas Tech University, has been developed (PX 1992a:5). Much of the remainder of the site is currently being managed as native and improved pasture or cultivated by the University or its tenant farmers (PX DOE 1983a:3-20,3-23). Small areas of relatively undisturbed vegetation exist around playas. Some protection for native habitat is also provided where plant operations preclude agricultural activities. Vegetation within these areas is primarily grasses and herbs, although barrel cactus is also present (PX DOE 1995d:5-3,5-4). A site vegetation map is not available (PX 1992a:6). While the area proposed for storage facilities has been largely disturbed by past activities, the assumed analysis site for the evolutionary LWR is in agricultural use. A total of 229 plant species have been identified on the Pantex Site (PX DOE 1993c:2).

Terrestrial wildlife species occurring on Pantex include 7 amphibian, 8 reptile, 43 bird, and 19 mammal species (PX DOE 1994c:4,5; PX DOE 1994d:7-11). Common bird species known to occur in the vicinity of Pantex include the western meadowlark, mourning dove, horned lark, and several species of sparrows. Common species of mammals found in the vicinity of Pantex include the black-tailed jackrabbit, black-tailed prairie dog, and hispid cotton rat (PX 1994a:1; PX DOE 1991a:2). Among the game animals occurring onsite are the desert cottontail, northern bobwhite, scaled quail, mourning dove, and numerous waterfowl species (PX 1994a:1). Hunting is not permitted at Pantex (PX 1992a:5). Common raptors on Pantex include the Swainson hawk, American kestrel, and burrowing owl (PX DOE 1994b:3,5). Carnivores present include the badger and coyote. A variety of migratory birds has been found at Pantex. Migratory birds, as well as their nests and eggs are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Wetlands. Wetlands at Pantex are associated with the five playa basins occurring on the site, and Pantex Lake (also a playa), located approximately 5 km (3 mi) northeast of the site. The NWI map identifies Playas 1 through 5 and part of Pantex Lake as wetlands. Playas 1, 2, and 3 are classified by the USFWS as palustrine systems. The larger Playas, 4 and 5, and most of Pantex Lake are classified as lacustrine systems. Playas 1, 2, and 4 currently receive stormwater discharge. There are numerous smaller wetlands (approximately 4 ha [10 acres] or less) located on western and southwestern parts of Pantex in areas that are largely grazed or farmed (PX 1992a:4). While these wetlands have not been delineated using COE criteria (USCOE 1987a:13-14), they are classified on NWI maps as palustrine systems. Situated along the central flyway migratory route, the Pantex playas are important to migratory birds and also provide valuable habitat for nesting and wintering species. While the consolidated Pu storage facility site does not contain any of the smaller wetlands noted above, the assumed analysis site for the evolutionary LWR could contain one such wetland.

Aquatic Resources. Aquatic habitat at Pantex is limited to five ephemeral playas (including Pantex Lake), one permanent playa, and several ponds and ditches. Although the playas and ditches may provide habitat for amphibians and macroinvertebrates, they do not support any fish populations (PX 1992a:5), except for a small pond at the southeast corner of Pantex Lake, which supports a population of minnows (PX DOE 1996b:4-139). Aquatic resources do not occur on the consolidated Pu storage facility site or the assumed analysis site for the evolutionary LWR.

Threatened and Endangered Species. Ten federally or State-listed threatened, endangered, and other special status species may be found on or in the vicinity of Pantex; eight of these are federally or State-listed as threatened or endangered (Table 3.5.6–1). Five species listed in Table 3.5.6–1 have been observed on Pantex, including four of the federally or State-listed threatened or endangered species. Once specific project locations have been determined, site surveys will verify the presence of special status species. The discussion presented

Table 3.5.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Pantex Plant

Common Name	Scientific Name	Status[a] Federal	State
Mammals			
[Text deleted.]			
Swift fox[b]	*Vulpes velox*	C	NL
[Text deleted.]			
Birds			
American peregrine falcon[c]	*Falco peregrinus anatum*	E	E
Arctic peregrine falcon	*Falco peregrinus tundrius*	E (S/A)	T
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	E
[Text deleted.]			
Interior least tern[c]	*Sterna antillarum athalassos*	E	E
[Text deleted.]			
Mountain plover	*Charadrius montanus*	C	NL
[Text deleted.]			
White-faced ibis[b]	*Plegadis chihi*	NL	T
Whooping crane[b,c]	*Grus americana*	E	E
Reptiles			
Smooth green snake	*Opheodrys vernalis*	NL	E
[Text deleted.]			
Texas horned lizard[b]	*Phrynosoma cornutum*	NL	T

[a] Status codes: C=Federal candidate; E=endangered; NL=not listed; S/A=protected under the similarity of appearance provision of the ESA; T=threatened.

[b] Species observed on the Pantex Plant site.

[c] USFWS Recovery Plan exists for this species.

Source: 50 CFR 17.11; 50 CFR 17.12; 61 FR 7596; PX DOE 1996b; PX MH 1994c; TX PWD 1993a; TX PWD 1995a; TX PWD 1995b.

in this section is generally applicable to Pantex as a whole. No critical habitat for threatened and endangered species, as defined in the ESA (50 CFR 17.11; 50 CFR 17.12), exists on Pantex.

The bald eagle is a winter resident that has been observed foraging at playas on the site each year. Prairie dog towns provide feeding habitat for bald eagles and other raptors. The whooping crane, an infrequent migrant in the Texas Panhandle, was observed foraging onsite and in the surrounding area in the fall of 1990 (PX 1992a:3). Migratory peregrine falcons (undetermined subspecies) have been observed hunting shorebirds and waterfowl near area playas (PX WTS 1992a:1). [Text deleted.] Possible swift fox dens have been found on Pantex. The Texas horned lizard is known to reside on the site. [Text deleted.] White-faced ibis forage at the playas.

There is little undisturbed habitat at Pantex that would accommodate any of the threatened, endangered, and other special status species, other than the Texas horned lizard, listed in Table 3.5.6–1. Most of these species are attracted to the playas, which provide water and foraging habitat. No federally or State-listed plant species are known to occur on Pantex. However, there are three cactus species at Pantex that may be proposed for a watchlist of potentially threatened plant species (PX DOE 1993c:15-16).

3.5.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric site types identified at Pantex include small temporary campsites and limited activity locations characterized by surface scatters of artifacts. Archaeological surveys at Pantex have systematically covered approximately one-half of the facility. Approximately 60 prehistoric sites have been recorded to date on DOE and Texas Tech University property. Some of the sites contain heat-altered rock and artifact types that suggests food processing. These prehistoric campsites tend to be clustered near the Pantex playa drainages. Of 23 archaeological sites tested, only one has been determined potentially eligible for listing on the NRHP. It is a late prehistoric bison kill or butchering site north of Pantex Lake. Some areas where the facilities would be located have not been systematically surveyed for prehistoric resources. However, a site location model has been developed and tested at Pantex, and indicates it is highly unlikely that such sites are present. In this model, prehistoric sites would be located only within 0.4 km (0.25 mi) of playas or their obvious drainages. A Programmatic Agreement to ensure regulatory compliance at Pantex will be in place by fiscal year 1997, and a cultural resource management plan is being developed. Implementation of this plan, which will supersede the Programmatic Agreement, is scheduled for 1998. An interim programmatic agreement is in place to ensure regulatory compliance, and potential impacts are evaluated on a case-by-case basis.

Historic Resources. The Pantex facility was originally constructed in 1942 as a World War II bomb-loading plant on land claimed from local farmers. To date, 12 historic archaeological sites associated with these original farmsteads have been located and recorded. These sites have minimal integrity and are highly unlikely to be eligible for the NRHP. All of Pantex has been surveyed for World War II-era structures and foundations, and all such properties have been systematically recorded. Based on information gathered during surveys, Zone 4, originally constructed as a High Explosive Storage Area for ammonium nitrate, does not appear to possess the architectural integrity necessary to be eligible for the NRHP. The Texas SHPO prepared a list of 45 buildings in Zones 11 and 12 that may be eligible for NRHP listing. The Cold War historic context has not yet been fully defined for Pantex. When completed, it is probable that a number of plant structures will be determined NRHP eligible.

Native American Resources. Native Americans known to have potential interests in Pantex include the Comanche Tribe of Oklahoma; the Kiowa Tribe of Oklahoma; the Apache Tribe of Oklahoma; the Cheyenne-Arapaho Tribe of Oklahoma; the Wichita and Affiliated Tribes; the Caddo Tribe of Oklahoma; the Delaware Tribe of Western Oklahoma; and the Fort Sill Apache Tribe. Four of these tribes, the Fort Sill Apache Tribe, the Apache Tribe of Oklahoma, the Kiowa Tribe of Oklahoma, and the Comanche Tribe of Oklahoma, have recognized traditional interests in Pantex. DOE is performing a historic treaties search and a public outreach program to involve Native American stakeholders in decisionmaking related to the use of Pantex land and the protection of cultural resources. Traditional cultural properties have not been identified at Pantex, but the remains of temporary historic campsites and hunting locations are possible.

Paleontological Resources. The surficial geology of the Pantex area consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the High Plains, this formation contains Late Pleistocene vertebrate remains, including bison, camel, horse, mammoth, and mastodon, with occasional evidence of their use by humans. [Text deleted.]

3.5.8 SOCIOECONOMICS

Socioeconomic characteristics described for Pantex include employment, regional economy, population, housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA, which encompasses 32 counties surrounding Pantex in Texas and New Mexico (Table L.1–1). Statistics for population, housing, community services, and local transportation are presented for the ROI, a four-county area in which 95.8 percent of all Pantex employees reside: Armstrong County (1.4 percent), Carson County (5.4 percent), Potter County (34.4 percent), and Randall County (54.6 percent) (Table L.1–5). In 1994, Pantex employed 3,559 persons (1.8 percent of the total REA employment).

Regional Economy Characteristics. Selected employment and regional economy statistics for the Pantex REA are summarized in Figure 3.5.8–1. Between 1980 and 1990, the civilian labor force increased 9.3 percent to 209,786. In 1994, the unemployment rate in the REA was 4.8 percent, lower than 6.4 percent unemployment in Texas and 6.3 percent unemployment in New Mexico. The 1993 per capita income in the REA was $19,312, higher than the per capita income in both Texas ($19,145) and New Mexico ($16,346).

Employment patterns in the REA closely parallel those in Texas and New Mexico, with manufacturing, retail trade, and service providing the majority jobs. The service sector accounts for the largest percentage of employment in both Texas and New Mexico, 27.7 percent and 28.3 percent, respectively, as well as in the region, 22.1 percent.

Population and Housing. Population and housing trends in the Pantex ROI are summarized in Figure 3.5.8–2. The ROI population, which totaled 205,684 in 1994, grew 12.8 percent between 1980 and 1994, less than half the growth rate of Texas (29.2 percent) during the same period. Within the ROI, the population of Carson County fell by 1.5 percent, while Randall County's grew 25.4 percent.

The increase in the total number of housing units in the ROI between 1980 and 1990 was approximately 11 percent, less than half the 26.3-percent increase in Texas. In Randall County, however, the number of housing units increased 28.3 percent during the same period. In 1990, homeowner and rental vacancy rates in the Pantex ROI were similar to those in Texas, approximately 3 percent and 14 percent, respectively.

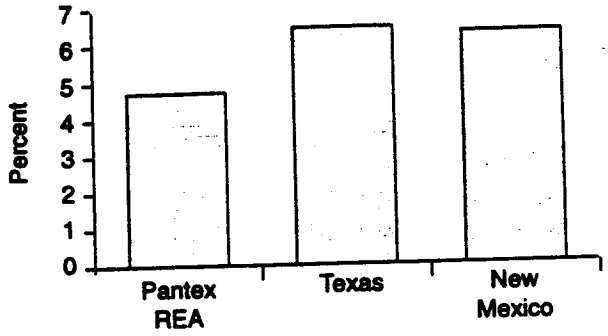
Community Services. Community services described for the Pantex ROI are education, public safety, and health care. Figure 3.5.8–3 presents school district characteristics for the Pantex ROI, and Figure 3.5.8–4 presents public safety and health care characteristics.

Education. In 1994, the nine school districts that provided public education services and facilities in the Pantex ROI ranged in enrollment size from 229 students in the Groom School District to 28,925 students in the Amarillo School District. As shown in Figure 3.5.8–3, school districts were operating between 63.5 and 99.7 percent of capacity. The average student-to-teacher ratio for the ROI was 16.3:1.

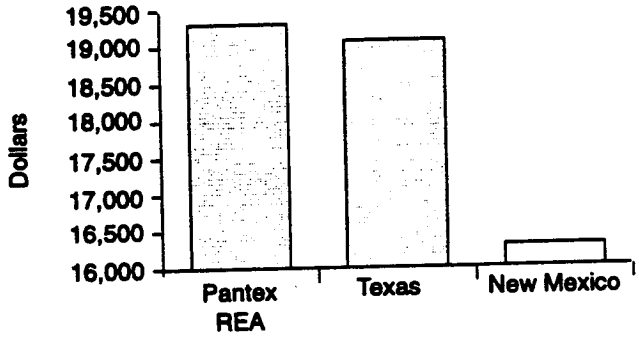
Public Safety. Six city and county law enforcement agencies provide police protection in the ROI. In 1994, the city of Amarillo maintained the largest police force in the ROI, with 253 officers. The average ROI officer-to-population ratio was 2.3 officers per 1,000 persons. Figure 3.5.8–4 displays the sworn police officer-to-population ratios for the ROI counties and cities.

Ten fire departments consisting of a total of 491 regular and volunteer firefighters provided fire protection services in 1995. The city of Amarillo had the largest department in the ROI, with 213 paid firefighters. The highest firefighter-to-population ratio was 19.0 firefighters per 1,000 persons in Armstrong County. The average ROI firefighter-to-population ratio was 2.3 firefighter per 1,000 persons.

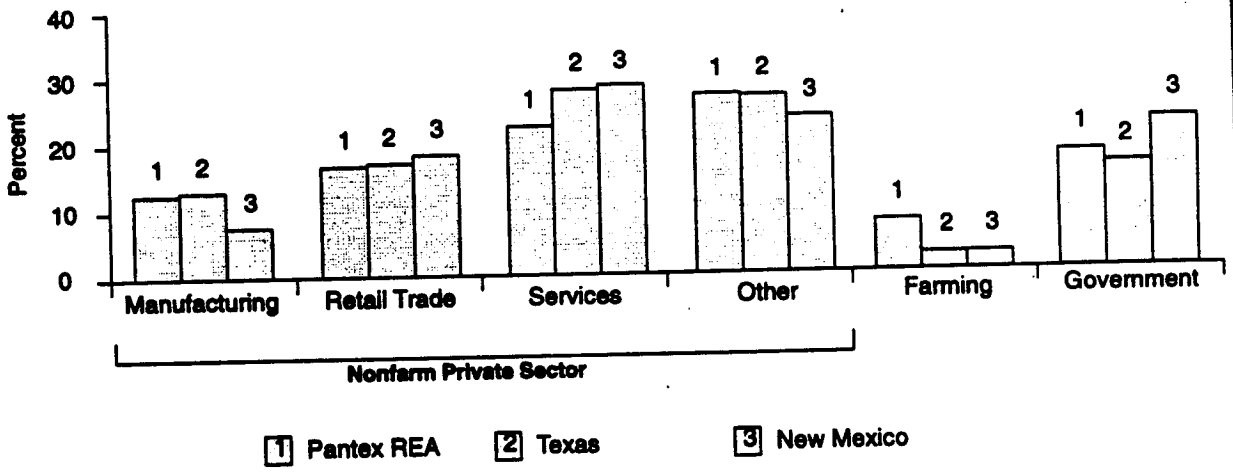
Unemployment Rate for the Pantex Plant REA, Texas, and New Mexico, 1994[a]



Per Capita Income for the Pantex Plant REA, Texas, and New Mexico, 1993[b]



Sector Employment Distribution for the Pantex Plant REA, Texas, and New Mexico, 1993[b]



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.5.8–1. Employment and Local Economy for the Pantex Plant Regional Economic Area and the States of Texas and New Mexico.

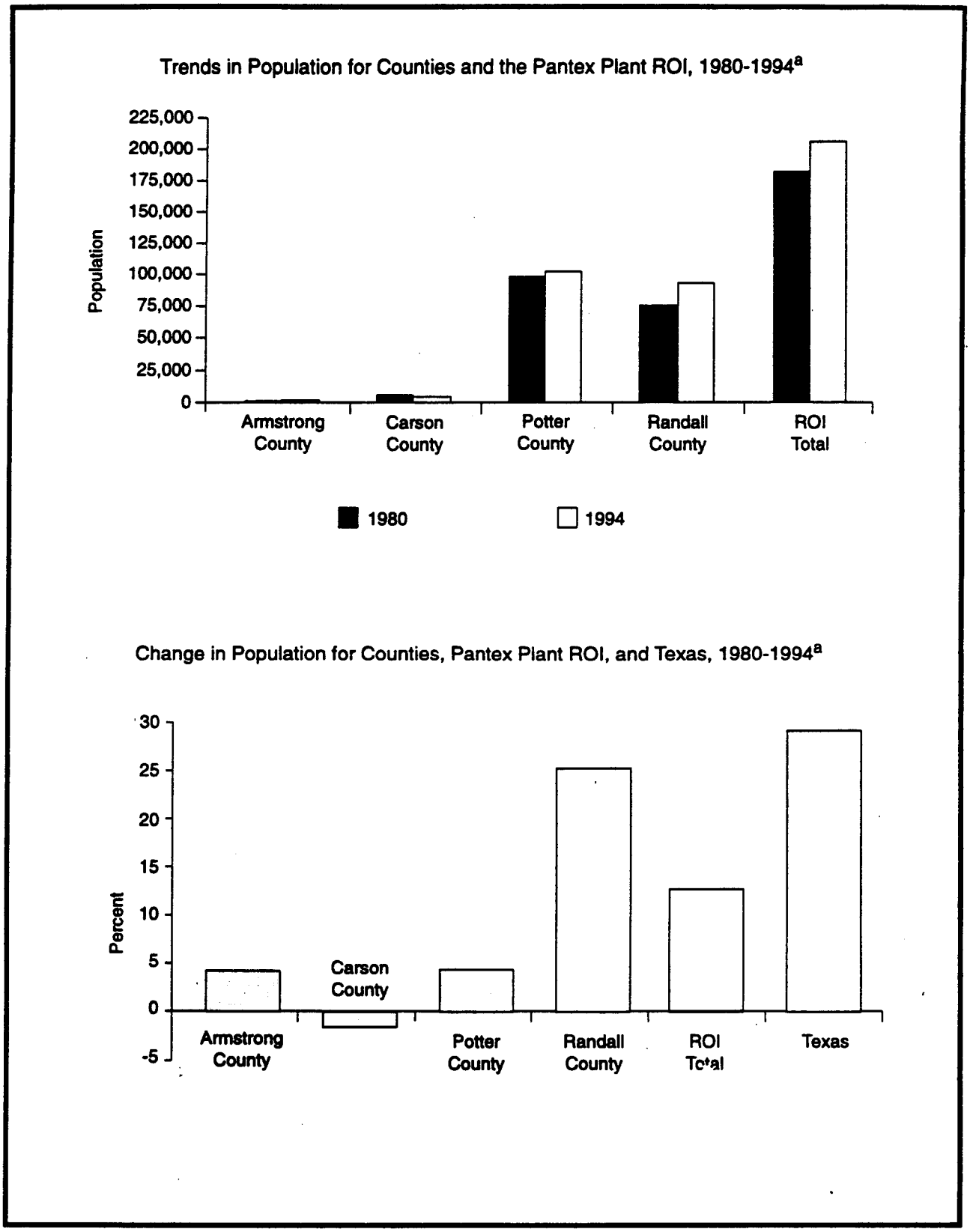
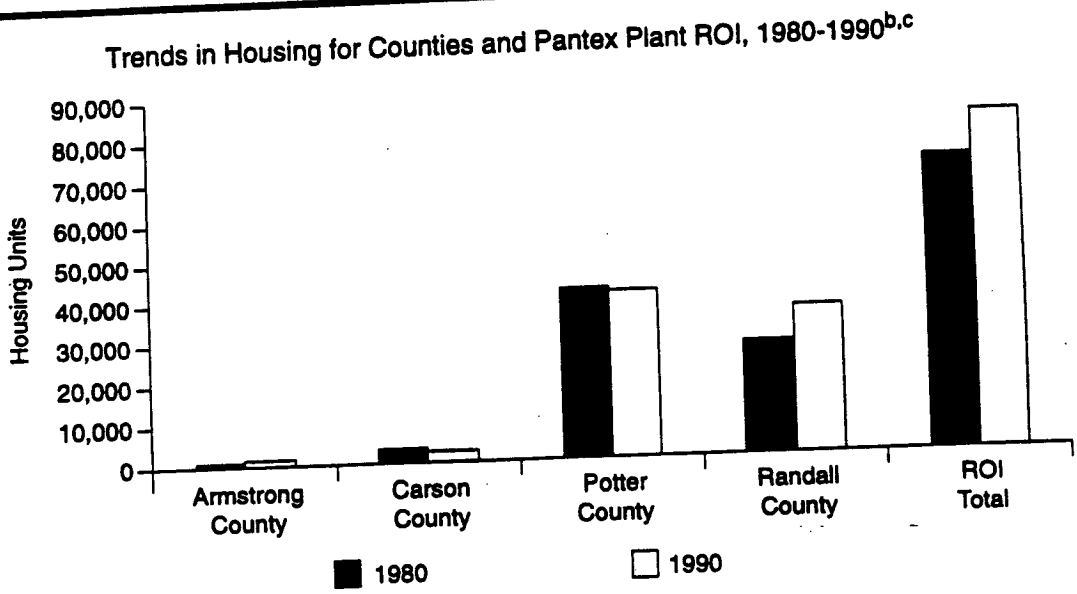
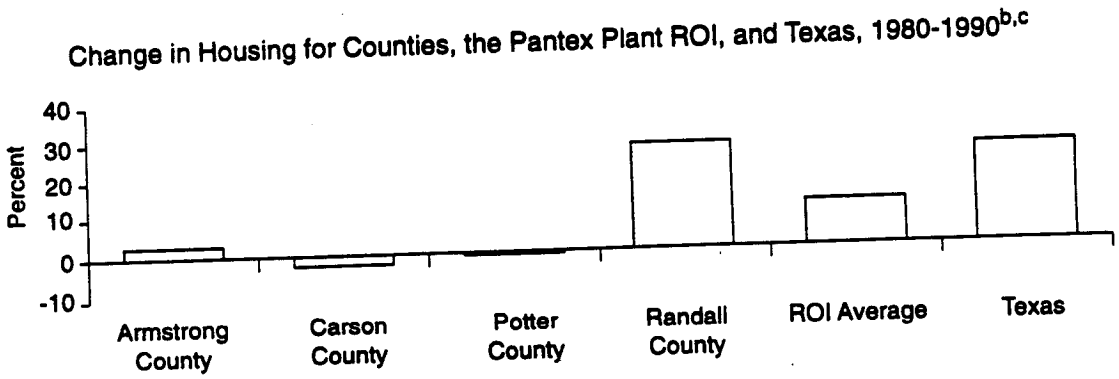
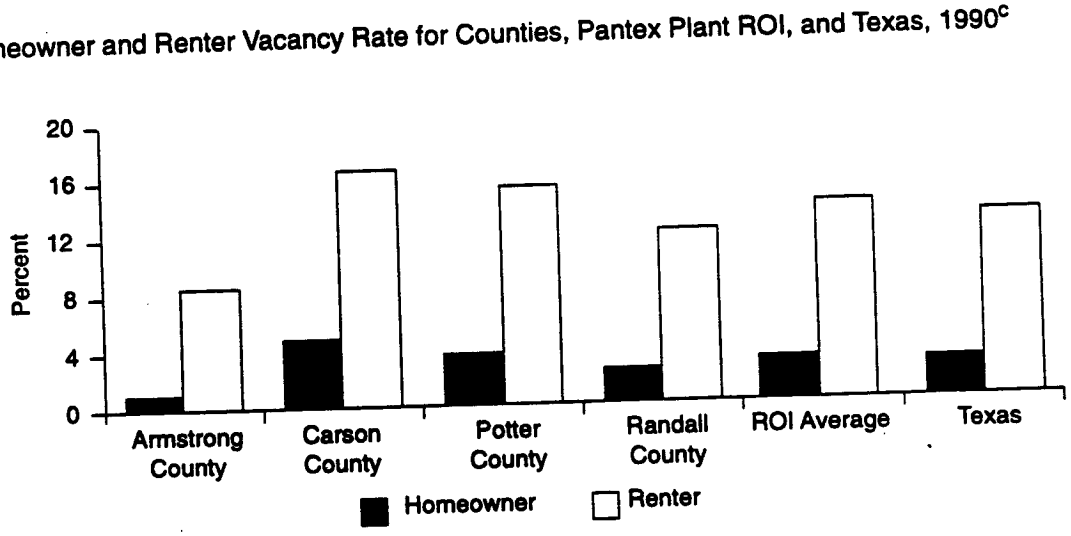


Figure 3.5.8–2. Population and Housing for the Pantex Plant Region of Influence and the State of Texas.

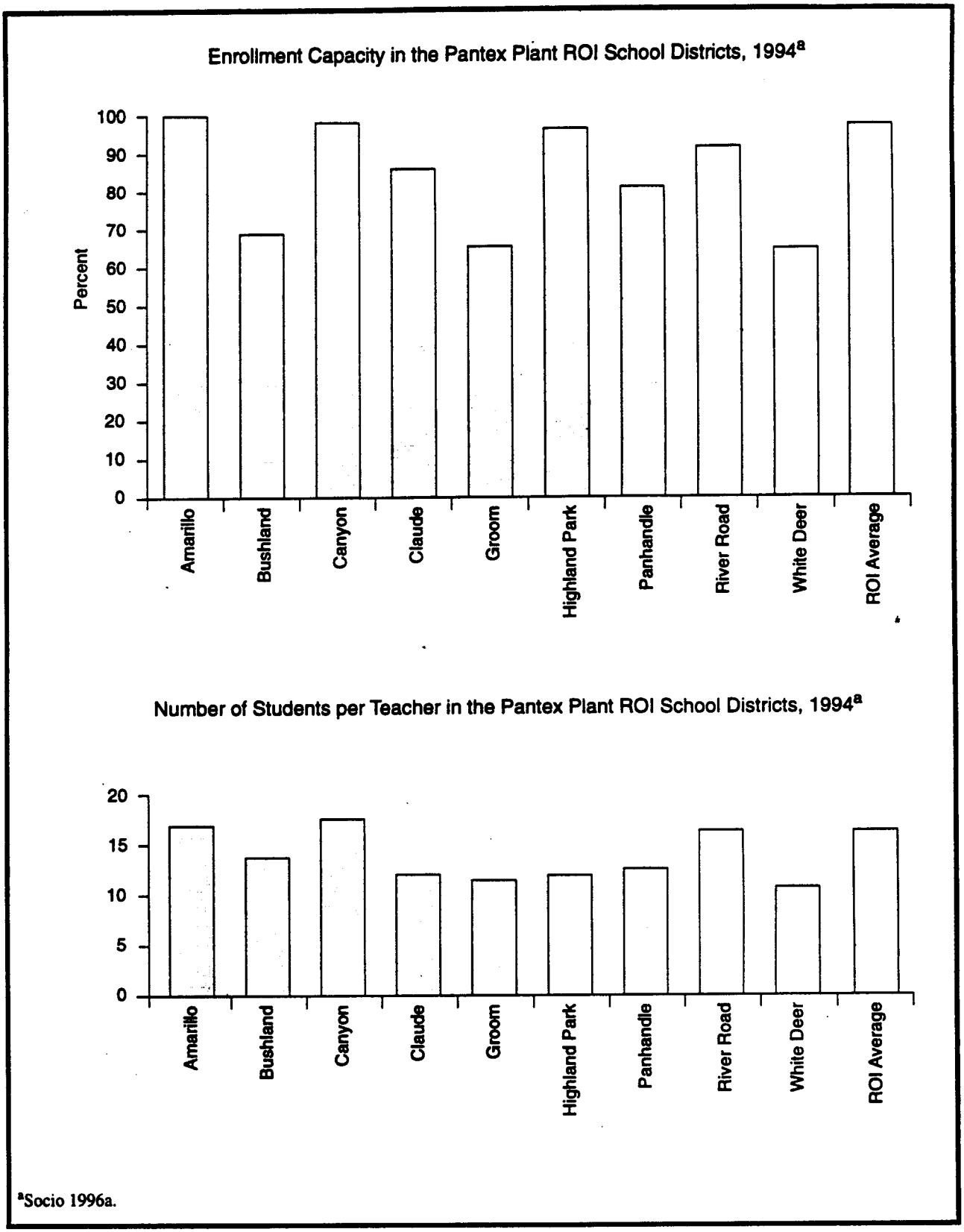






[a] Census 1994o; Census 1995a
[b] Census 1982a.
[c] Census 1991m.

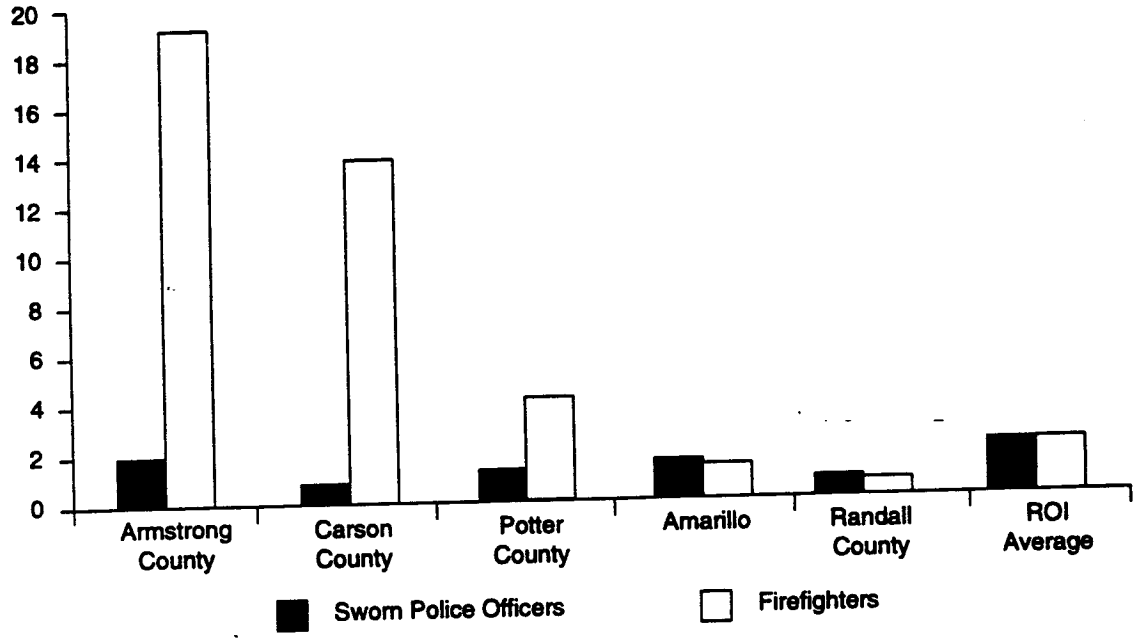
Figure 3.5.8–2. Population and Housing for the Pantex Plant Region of Influence and the State of Texas—Continued.



[a]Socio 1996a.

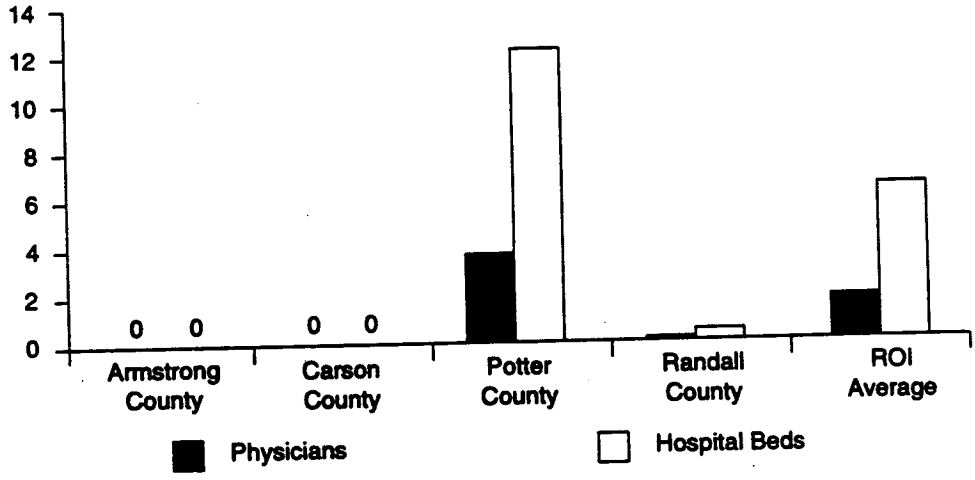
Figure 3.5.8–3. School District Characteristics for the Pantex Plant Region of Influence.

Number of Sworn Police Officers (1994) and Firefighters (1995) per 1,000 Persons in the Pantex Plant ROI[a]



Note: Non-ROI city values are included in county totals. Amarillo police and firefighters serve both Potter and Randall Counties.

Number of Physicians and Hospital Beds per 1,000 Persons in the Pantex Plant ROI, 1994[b]



[a] Census 1995a; DOC 1996a; DOC 1996b; DOJ 1995a; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.5.8–4. Public Safety and Health Care Characteristics for the Pantex Plant Region of Influence.

Health Care. Six hospitals serve the four-county ROI, all operating well below capacity. The highest hospital bed-to-population ratio was 12.3 beds per 1,000 persons in Potter County. There are no hospitals in Armstrong or Carson Counties; medical emergencies in these counties are customarily transported to the cities of Amarillo or Pampa via ambulance service. In 1994, a total of 407 physicians served the ROI. Figure 3.5.8–4 shows that the highest physician-to-population ratio was 3.8 physicians per 1,000 persons in Potter County while there were no physicians in Carson and Armstrong Counties. The average physician-to-population ratio in the ROI was 2.0 physicians per 1,000 persons.

Local Transportation. Vehicular access to Pantex is provided by Farm-to-Market Roads 683 to the west and 2373 to the east. Both roads connect with Farm-to-Market Road 293 to the north and U.S. Highway 60 to the south. No major improvements are scheduled or currently ongoing for roads providing immediate access to Pantex (see Figure 2.2.4-1 and Figure 2.2.4-2).

Four road segments in the ROI could be affected by the storage and disposition alternatives. The first is I-27 from Local Route 335 at Amarillo to I-40 at Amarillo. This segment operated at level of service A in 1995. The second is Farm-to-Market Route 683 from U.S. 60 to Farm-to-Market Route 293. This segment operated at level of service A in 1995. The third is Farm-to-Market Route 2373 from I-40 to U.S. 60. This segment operated at level of service A in 1995. The fourth is Farm-to-Market Route 2373 from U.S. 60 to Farm-to-Market Route U.S. 60. The segment operated at level of service A in 1995.

Amarillo City Transit provides public transport service to Amarillo, but the service does not extend to Pantex. The major railroad in the Pantex ROI is the Burlington Northern and Santa Fe Railroad, a mainline which forms the southern boundary of Pantex and provides direct access to the site. There are no navigable waterways within the ROI capable of accommodating material transports to the plant.

Amarillo International Airport provides jet air passenger and cargo service from national and local carriers. Several smaller private airports are located throughout the ROI.

3.5.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of Pantex are shown in Table 3.5.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to Pantex operations.

Table 3.5.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Pantex Plant Operation

Sources	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation	
Cosmic and external terrestrial radiation[a]	95
Internal terrestrial radiation[b]	39
Radon in homes (inhaled)[b]	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	399

[a] PX DOE 1995d.

[b] NCRP 1987a.

Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from Pantex operations provide another source of radiation exposure to people in the vicinity of Pantex. Types and quantities of radionuclides released from Pantex operations in 1994 are listed in the *1994 Environmental Report for Pantex Plant* (DOE/AL/65030-9506). The doses to the public resulting from these releases are given in Table 3.5.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1994 report were used in the development of the reference environment (No Action) radiological releases and resulting impacts at Pantex in the year 2005 (Section 4.2.4.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from Pantex operations in 1994 is estimated to be 2.9×10^{-11}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of Pantex operations is less than 3 chances in 100 billion. (Note that it takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Based on the same risk estimator, 7×10^{-8} excess fatal cancers are projected in the population living within 80 km (50 mi) of Pantex from normal operations in 1994. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this mortality rate, the number of fatal cancers expected to occur during 1994 from all causes in the population living within 80 km (50 mi) of Pantex was 550. This number of expected fatal cancers is much higher than the estimated 5×10^{-8} fatal cancers that could result from Pantex operations in 1994.

Table 3.5.9–2. Radiation Doses to the Public From Normal Pantex Plant Operation in 1994 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	5.8×10^{-5}	4	0	100	5.8×10^{-5}
Population within 80 km[b] (person-rem)	None	1.4×10^{-4}	None	0	100	1.4×10^{-4}
Average individual within 80 km[c] (mrem)	None	5.0×10^{-7}	None	0	None	5.0×10^{-7}

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (see 58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] In 1994, this population was approximately 275,000.

[c] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: PX DOE 1995d.

Pantex workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.5.9–3 presents the average worker, maximally exposed worker, and total cumulative worker dose to Pantex workers from operations in 1994. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to Pantex workers from normal operations in 1994 is estimated to be 0.012.

Table 3.5.9–3. Radiation Doses to Workers From Normal Pantex Plant Operation in 1994 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	10
Maximally exposed worker (mrem)	5,000	660
Total workers[b] (person-rem)	ALARA	30

[a] DOE's goal is to maintain radiological exposure as low as reasonably achievable.

[b] The number of badged workers in 1994 was approximately 2,980.

Source: 10 CFR 835; PX DOE 1995d.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *1994 Environmental Report for Pantex Plant* (DOE/AL/65030-9506). In addition, the concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are presented in the same reference. Past discharges to Playa 1 were substantial, but as in 1994, they were mainly nonradiological. However, this playa is located onsite and is not used as a drinking water source. Appropriate monitoring is conducted to ensure that contamination of any kind from this playa will not reach drinking water supplies.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface water during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.5.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements), contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at Pantex via inhalation of air containing hazardous chemicals released to the atmosphere by Pantex operations. Risks to public health from other possible pathways such as ingestion of contaminated drinking water or by direct exposure are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.5.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. All annual concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to Pantex workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with particular work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Pantex workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemical utilized in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at Pantex are expected to be substantially better than required by the standards.

Health Effects Studies. Only one cancer incidence and mortality study was conducted on the general population in communities surrounding the Pantex facility (with data collected between 1980 and 1990), and only one study of workers (employed between 1951 and 1978) has been done. No significant excess cancer mortality was found, and the analysis on excess cancer incidence had too few cases to be considered reliable. Workers were reported to show a non-statistically significant excess of brain cancer and leukemia in the study conducted, but the small number of cases could be attributed to chance alone. For a more detailed description of the studies reviewed and the findings, refer to Section M.4.5.

Accident History. There have been no Pu-dispersing detonation accidents during nuclear weapons operations at Pantex. In 1989, during a weapon disassembly and retirement operation, a release of tritium in the assembly cell occurred. As a result, four workers received negligible doses and a fifth worker received a dose of 1.4 mrem. [Text deleted.]

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with planning, preparedness, and response.

Pantex has an Emergency Management Plan, with guidance on implementation provided by a series of Emergency Preparedness Procedures manuals, to protect life and property within the facility, the health and welfare of surrounding areas, and the defense interests of the Nation during any credible emergency situation. Formal mutual assistance agreements have been made with the Amarillo Fire Department, the National Guard, and St. Anthony's Hospital. Under accident conditions, an emergency coordinating team of DOE and Pantex contractor management personnel would initiate the Pantex Emergency Plan and coordinate all onsite actions.

If offsite areas could be affected, the Texas Department of Public Safety would be notified immediately and would make emergency announcements to the public and local governmental agencies in accordance with Annex R of the *State of Texas Emergency Management Plan.* Pantex has Radiological Assistance Teams with a total of 46 personnel who are equipped and trained to respond to an accident involving radioactive contamination either onsite or offsite. In addition, the Joint Nuclear Accident Coordination Center in Albuquerque, New Mexico, can be called upon should the need arise. This would mobilize radiation emergency response teams from DOE, DoD, and other participating Federal agencies.

3.5.10 WASTE MANAGEMENT

This section outlines the major environmental regulatory structure and ongoing waste management activities for Pantex. A more detailed discussion of the ongoing waste management operations is provided in Section E.2.4. Table 3.5.10–1 presents a summary of waste management activities at Pantex for 1994.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations at Pantex. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements.

On July 29, 1991, EPA Region 6 proposed Pantex for listing on the NPL of Superfund cleanup sites. EPA placed Pantex on the NPL on May 31, 1994. The DOE Amarillo Area Office is currently negotiating a tri-party Federal Facility Agreement with the EPA and the State of Texas. Currently, all environmental restoration activities are conducted in compliance with an RCRA permit issued in April 1991, as modified in February 1996. Environmental restoration activities are expected to be completed in 2000.

Pantex's waste management goals are to avoid waste generation or minimize the volumes of wastes generated to the extent that is technologically and economically practicable; reduce the hazard of waste through substitution or process modification; minimize contamination of existing or proposed real property and facilities; minimize exposure and associated risk to human health and the environment; and ensure safe, efficient and compliant long-term management of all wastes. Pantex manages the following waste categories: TRU, low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. Pantex does not generate or manage spent nuclear fuel.

High-Level Waste. Pantex does not generate or manage HLW.

Transuranic Waste. Pantex does not generate or manage TRU waste as a result of normal operations. In the unlikely event that any TRU waste is generated, there are established procedures to manage this waste.

Low-Level Waste. Low-level waste generated at Pantex consists of contaminated parts from weapons assembly and disassembly functions and radioactive waste materials associated with these functions, such as protective clothing, cleaning materials, filters, and other similar materials. As shown in Table 3.5.10–1, Pantex generates a small quantity of liquid LLW. Liquid LLW is being stored onsite awaiting a treatment process. Compactible wastes are processed at Pantex's Solid Waste Compaction Facility and stored along with the noncompactible materials for shipment to a DOE-approved disposal site or a commercial vendor. Pantex's LLW is currently shipped to NTS for disposal.

Mixed Low-Level Waste. Mixed LLW is generated during various production, maintenance, modifications, and dismantlement functions. These wastes consist primarily of small quantities of materials such as radioactively- contaminated solvents and wipes contaminated by organic solvents and radioactive scrap metals. Mixed LLW is currently stored onsite in RCRA-permitted facilities. Pantex has received exemptions to DOE Order 5820.2A for mixed waste shipments to two RCRA-permitted commercial facilities. One shipment had been made as of June 1994. Pantex developed the *Pantex Plant Federal Facility Compliance Act Compliance Plan* to provide mixed waste treatment capability for all mixed waste streams in accordance with the *Federal Facility Compliance Act* of 1992. This plan was approved by the TNRCC and adapted through an Agreed Order on September 27, 1995. The Agreed Order, signed by the State of Texas on October 2, 1995, requires implementation of this plan.

Table 3.5.10–1. Waste Management Activities at Pantex Plant

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Low-Level							
Liquid	33	Solidification onsite pending	12	Staged for processing	Varies[a]	None	NA
Solid	122	Compaction	168	Staged for shipment	Included in liquid low-level	Shipped offsite to NTS	NA
Mixed Low-Level							
Liquid	1	None onsite encapsulation pending	Planned	Staged for future treatment	1,470[b]	NA	NA
Solid	15	Compaction and open burning (HE only)	Planned	Staged for future treatment	Included in liquid mixed LLW	In accordance with Pantex Site Treatment Plan	NA
Hazardous							
Liquid[c]	16	Offsite	Variable	Staged for shipment	Included in liquid mixed LLW	Shipped offsite	NA
Solid	185[d]	Open burning[e]	Variable	Staged for shipment	Included in liquid mixed LLW	Shipped offsite	NA
Nonhazardous (Sanitary)							
Liquid	476,000[f]	Evaporation and filtration	898,000[g]	None	NA	Playa 1	898,000 m^3/yr[g]
Solid	1,150[h]	Compaction	1,020	None	NA	Landfill (offsite)	NA

Table 3.5.10–1. Waste Management Activities at Pantex Plant—Continued

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Other)							
Liquid	4,190[i]	Carbon absorption/ filtration	Included in liquid sanitary	None	NA	Playa 1 and 2	Included in liquid sanitary
Solid	47,400[j]	Compaction	Included in solid sanitary	None	NA	Landfill (onsite)– construction debris only	Expandable

[a] Total amount of storage capacity available for LLW is a function of the percentage of total capacity currently occupied by hazardous wastes and mixed LLW.

[b] Operating capacity. Permitted storage can accommodate both LLW and mixed LLW.

[c] Includes solvent-contaminated wastewater and spent organic solvents contaminated with explosives.

[d] Includes 177 m^3 of RCRA-regulated and 8 m^3 of TSCA-regulated (PCB and asbestos-contaminated) wastes.

[e] High explosives-contaminated wastes only. Open burning is done in thermal treatment units (trays, pans, and flashing pads) on a per burn basis.

[f] Sewage wastewater.

[g] Permit limit.

[h] Data reported as 824,407 kg. For analysis 720 kg/m^3 density assumed (PX 1995a:2). Includes 820 m^3 of waste disposed at Amarillo landfill and 327 m^3 disposed at other offsite treatment/disposal facilities.

[i] Includes 3,790 m^3 of wastewater discharged to Playa 1. Treatment is filtration only and is not included in treatment capacity.

[j] Construction debris.

Note: NA=not applicable.

Source: PX 1995a:2; PX DOE 1995d; PX DOE 1995i; PX DOE 1996b.

Hazardous Waste. Pantex received a RCRA Part B hazardous waste permit from EPA and TNRCC on April 25, 1991. This permit authorizes Pantex to manage hazardous and industrial solid wastes listed in the permit. The permit also requires Pantex to notify TNRCC of the discovery of any release of hazardous waste or hazardous constituents that may have occurred from any solid waste management unit. This permit specifically excluded the RCRA units at the Burning Ground. These units operated under interim status with a written grant of authority from TNRCC for air emissions. A Class 3 permit modification was submitted to add the RCRA units at the Burning Ground to the permit; however, it was contested by members of the public. After the settlement of the contested case hearing, Pantex received the Class 3 modification effective February 16, 1996. In this modification the RCRA units at the Burning Ground were added to the permit with the exception of the cages and flashing pits which were specifically excluded. The cages have been dismantled and removed and are currently undergoing closure. Under the modification the flashing pits will continue to be permitted under interim status for one year after which they must undergo closure. The written grant of authority is no longer in place as the modification contains air emissions provisions for all RCRA units, with additional provisions for the Burning Ground units.

Much of the hazardous waste generated at Pantex comes from high explosive operations, electroplating, photographic, and various other operations also generate hazardous waste streams. High explosives, high-explosive support material, high-explosive-contaminated materials, and high-explosive-contaminated solid wastes are burned under controlled conditions at the Burning Ground. Ash, debris, and residue resulting from this burning are transported offsite for approved disposal at a commercial RCRA-permitted facility. All other hazardous wastes generated at Pantex, including various chemicals, solvents, heavy metals, and other hazardous constituents, are manifested and shipped offsite by DOT-certified transporters for recycle or disposal at a commercial RCRA-permitted facility.

Nonhazardous Waste. Nonhazardous liquid and solid sanitary wastes are generated at Pantex. Sewage and some pretreated industrial wastewater are treated by a sanitary sewage treatment system. The liquid effluent from the system is discharged into a playa, which then either evaporates or infiltrates into the ground. Stormwater discharges are regulated by a NPDES permit. A proposed upgrade to the sanitary wastewater treatment system would permit all industrial wastewater and sewage to be treated at one location.

Nonhazardous solid waste generated onsite consists primarily of paper, cardboard, construction wastes, and cafeteria waste. Only construction wastes are disposed of onsite. Until late 1989, sanitary waste was disposed of at the onsite sanitary landfill. Since then, sanitary waste has been transported to the city of Amarillo landfill for disposal. Waste asbestos is sent to an offsite permitted landfill.

3.6 OAK RIDGE RESERVATION

The ORR is located in Oak Ridge, Tennessee (Figure 2.2.5–1), and contains ORNL, Y–12, and the K–25 Site. The primary focus of ORNL is conducting basic and applied scientific research and technology development. Y–12 engages in national security activities and manufacturing outreach to U.S. industries. K–25 serves as an operations center for ORR's environmental restoration and waste management programs. The locations of facilities within ORR are illustrated in Figure 2.2.5–2.

Department of Energy Activities. These activities can be categorized as defense programs, environmental management, and other DOE missions. The current missions and functions at ORR are described in Table 3.6–1.

The ORR DP assignments are performed at Y–12 and include storing uranium and lithium materials and weapons parts, maintaining the capability to fabricate components for nuclear weapons, dismantling nuclear weapon components returned from the national stockpile, processing special nuclear materials, and providing special production support to the DOE design agencies and other DOE programs.

Table 3.6–1. Current Missions at Oak Ridge Reservation

Mission	Description	Sponsor
Uranium and lithium storage	Store enriched uranium, depleted uranium, and lithium materials and parts	Assistant Secretary for Defense Programs
Weapons components	Maintain capability to fabricate uranium and lithium components and parts for nuclear weapons	Assistant Secretary for Defense Programs
Dismantlement activities	Dismantle nuclear weapon components returned from the stockpile	Assistant Secretary for Defense Programs
Special nuclear material	Process uranium	Assistant Secretary for Defense Programs
Support services	Provide support to design agencies	Assistant Secretary for Defense Programs
Environmental restoration and waste management	Waste management and D&D activities at ORNL, Y–12, and K–25	Assistant Secretary for Environmental Management
Research and development	ORNL basic research and development in energy, health, and environment	Office of Energy Research; Assistant Secretary for Environment, Safety and Health; Office of Nuclear Energy
Isotope production	ORNL produces radioactive and stable isotopes not available elsewhere	Office of Nuclear Energy
Educational and research programs	Oak Ridge Institute for Science and Education programs in the areas of health, environment, and energy	Office of Energy Research; Assistant Secretary for Environment, Safety and Health; Office of Nuclear Energy
Work for other Federal agencies	Meteorological, reactor safety, environmental research	NOAA, NRC, EPA
Technology transfer	Programs to transfer unique technologies developed at ORR to private industry	Department of Energy

Source: OR LMES 1995e; OR DOE 1994c.

The Y–12 Plant was constructed as part of the World War II Manhattan Project. The site's first mission was the separation of U-235 from natural uranium by electromagnetic separation. The magnetic separators were taken out of commission at the end of 1946, when gaseous diffusion became the accepted process for enriching uranium. Missions have evolved and changed with the end of the Cold War resulting in a reduction of Y–12's weapon component production mission. Due to the reduced workloads, the operational space at Y–12 is being

significantly downsized. However, since Y–12 is designated as the interim DOE repository for unirradiated enriched uranium, the present interim storage space is being expanded in existing facilities to accommodate additional enriched uranium returned from stockpiled weapons and other DOE sites. The majority of this HEU would be housed in facilities currently utilized for HEU storage. The remaining HEU would be stored in facilities currently being converted into storage areas. This expansion of the plant's storage capacity is an ongoing DOE-approved effort to prepare Y–12 for the large quantity of HEU arriving over the next few years.

The Y–12 Plant continues to maintain the capability to fabricate nuclear weapon components as a major mission. Maintaining production capability involves the ability to fabricate materials into components, inspect and certify the components, and produce weapons subassemblies from the components.

As nuclear weapons are removed from the stockpile, they must be dismantled, and materials and parts appropriately dispositioned. These returned materials and components, as well as those currently located at Y–12, are safely and securely placed in interim storage.

The Y–12 Plant also provides fabrication support to DOE's weapon design laboratories at LANL, LLNL, and Sandia National Laboratories (SNL), and produces components design evaluations for these customers. In addition, Y–12 performs some stockpile surveillance activities to ensure reliability of the nuclear stockpile.

Environmental management activities are in progress at each of the major facilities within ORR. These activities consist of environmental remediation and restoration, D&D of surplus facilities, and waste management. DOE's Center for Environmental Technology and Center for Waste Management are located at K–25. Environmental restoration and waste management activities at ORR are discussed in detail in Section 3.6.10 and Appendix E.

Oak Ridge Reservation, in conjunction with the Oak Ridge Institute for Science and Education, supports other offices and missions within DOE (Energy Research, ES&H, Nuclear Energy).

Non-Department of Energy Activities. Non-DOE activities pursued at ORR include missions and programs of the NOAA, which conducts meteorological and atmospheric diffusion research that is supported by itself and DOE. This work is done at the Atmospheric Turbulence and Diffusion Laboratory and field sites on ORR. This laboratory also provides services to DOE contractors and operates the Weather Instrument Telemetering Monitoring System for DOE. In addition, ORR provides support to other Federal agencies (NRC, EPA, and others), and private industry in conducting basic scientific research; engineering technology development and transfer; and educational research in the areas of health, environment, and energy.

3.6.1 LAND RESOURCES

Land Use. The ORR consists of approximately 13,980 ha (34,500 acres) located mostly within the corporate limits of the city of Oak Ridge, approximately 19 km (12 mi) west of Knoxville, Tennessee. All the land within ORR is owned by the Federal Government and is administered, managed, and controlled by DOE. One alternative proposes to site a new facility on a section of land located on undeveloped land south of Bear Creek Road along the Clinch River. The potential site is not within the ORR boundary, but it is owned by the TVA.

Existing Land Use. Generalized land uses at ORR and in the vicinity are shown in Figure 3.6.1–1. Land uses within ORR can be grouped into four classifications: industrial, forest/undeveloped, public/quasi-public, and water. The industrial areas account for approximately 4,700 ha (11,600 acres) of the total site acreage. About 500 ha (1,240 acres) are used for a security buffer zone around various facilities. About 300 ha (741 acres) of ORR's land is classified as public land and consists mainly of the 36-ha (89-acre) Clark Center Recreational Park, numerous small public cemeteries, and an onsite public road (OR DOE 1989a:5-10). The remaining area, about 8,500 ha (21,000 acres), consists of forest/undeveloped land, some of which is managed as pine plantations for production of pulpwood and saw timber. The DOE water treatment facility, which provides water to many ORR facilities and the city of Oak Ridge, is located just north of Y–12. There are no prime farmlands on ORR.

In 1980, DOE designated a portion of ORR's undeveloped land as a NERP. As of July 1994, the NERP consisted of segments totalling 5,008 ha (12,375 acres) spread over ORR. The NERP is used by the national scientific community as an outdoor laboratory for environmental science research on the impact of human activities on the eastern deciduous forest ecosystem (DOE 1994u:37,51).

Land bordering ORR is predominantly rural and used largely for residences, small farms, forest land, and pasture land. The city of Oak Ridge, adjacent to the northeast portion of ORR, has a typical urban mix of residential, public, commercial, and industrial land uses. There are four residential areas along the northern boundary of ORR; each has several houses within 30 m (98 ft) of the site boundary.

Land-Use Planning. The ORR has other facilities planned. Proposed short-range projects (1995 through 1999) include the Composite Materials Laboratory, Center for Biological Sciences, Mixed Waste Treatment Facility, Recycle and Materials Processing Facility, Process Waste Treatment Facility, Industrial Landfill Expansion and Upgrades, and Steam Plant Waste Water Treatment Facility. Figure 3.6.1–2 shows potential facility areas in relation to existing ORR facilities.

The majority of ORR lies within the city of Oak Ridge. A small portion of the northwest corner of ORR lies outside the city, in Roane County. The Oak Ridge Area Land Use Plan (city of Oak Ridge) designates ORR with the following land uses: residential, office/institutional, industrial, public, and undesignated (OR City 1995a:1). The city of Oak Ridge zoning ordinance classifies the entire ORR as Forest, Agriculture, Industry, and Research District (OR City 1995a:2). The Roane County zoning ordinance does not classify ORR lands, rather, it identifies ORR as a DOE Reservation (OR City 1995a:3).

Visual Resources. The ORR landscape is characterized by a series of ridges and valleys that trend in a northeast-to-southwest direction. The vegetation is dominated by deciduous forest mixed with some coniferous forest. Much of ORR's open field area (about 2,000 ha [4,940 acres]) has been planted in shortleaf and loblolly pine; smaller areas have been planted in a variety of deciduous and coniferous trees (OR DOE 1989a:3-14). The DOE facilities are brightly lit at night, making them especially visible. The developed areas of ORR are consistent with BLM's VRM Class 5 designation. The remainder of ORR ranges from a VRM Class 3 to Class 4 designation.

The viewshed consists mainly of rural land. The city of Oak Ridge is the only adjoining urban area. Sensitive viewpoints affected by DOE facilities are primarily associated with Interstate 40, State Highway 62, 95, and 58;

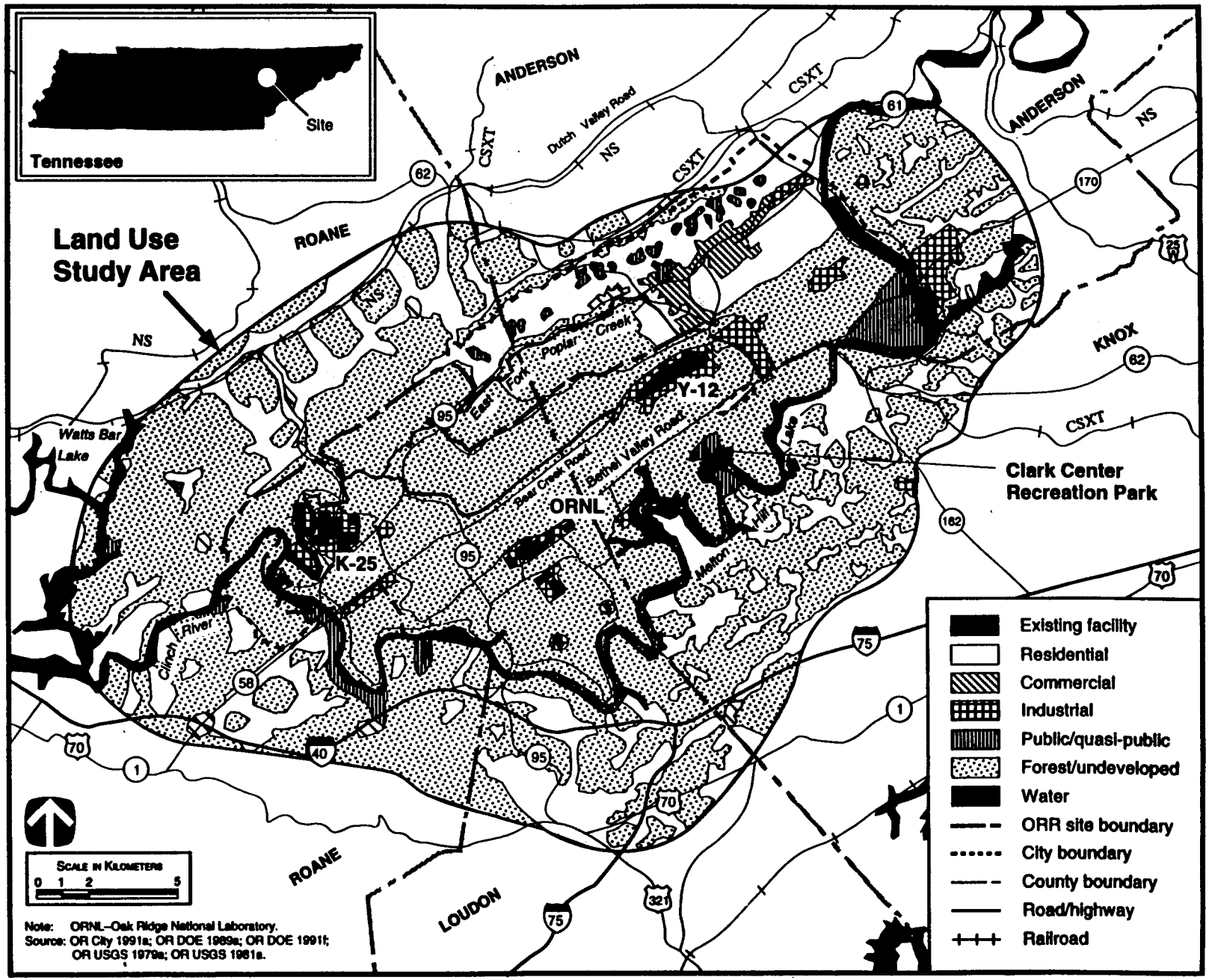


Figure 3.6.1–1. Generalized Land Use at Oak Ridge Reservation and Vicinity.

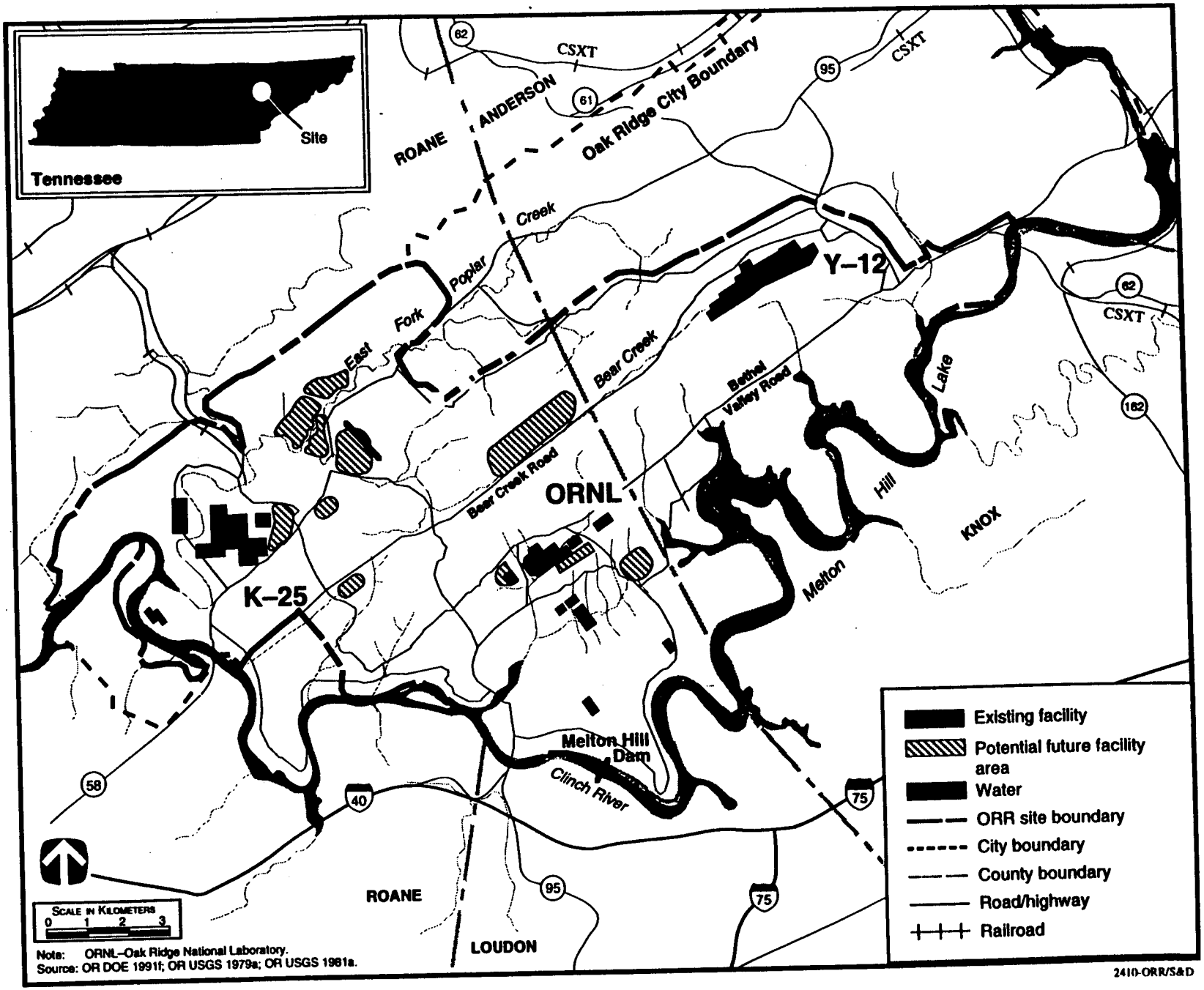


Figure 3.6.1–2. Primary Existing and Proposed Facilities at Oak Ridge Reservation.

and Bethel Valley and Bear Creek Roads. The Clinch River/Melton Hill Lake, and the bluffs on the opposite side of the Clinch River also have views of ORR, but views of most of the existing DOE facilities are blocked by terrain and/or vegetation. Although only a small portion of State Highways 62 crosses ORR, it is a major route for traffic to and from Knoxville and other communities (OR DOE 1989a:3-29). Views are limited by the hilly terrain, heavy vegetation, and generally hazy atmospheric conditions. Partial views of the DOE water treatment plant facilities can be seen from the urban areas of the city of Oak Ridge.

3.6.2 SITE INFRASTRUCTURE

Baseline Characteristics. To support ORR missions, an extensive infrastructure exists, as shown in Table 3.6.2–1.

Table 3.6.2–1. Oak Ridge Reservation Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	71	71
Railroads (km)	27	27
Electrical		
Energy consumption (MWh/yr)	726,000	13,880,000
Peak load (MWe)	110	2,100
Fuel		
Natural gas (m^3/yr)	95,000,000	250,760,000
Oil (l/yr)	416,000	416,000[a]
Coal (t/yr)	16,300	16,300[a]
Steam (kg/hr)	150,000	150,000

[a] Oil and coal availability is unlimited, figures are for current use.

Source: OR LMES 1996i; OR DOE 1994c.

Oak Ridge Reservation is served by three major highways, the mainline of two railroads, a regional airport, and a barge facility on the Inland Waterway system. A well-maintained system of interstate, regional, and local highways supports the onsite road network of approximately 71 km (44 mi) of roadway. Rail spurs connect onsite facilities to national lines of the Norfolk Southern and CSX Transport systems. There are 27 km (17 mi) of onsite rail to service operations at ORNL, Y–12, and K–25. Existing barge facilities on the Clinch River, adjacent to State Route 58, provide access to the Inland (Tennessee-Tombigbee) Waterway system via the Tennessee River to ports ranging from the Great Lakes to the Gulf of Mexico.

Numerous high-voltage transmission lines from the TVA power systems supply electric power to major plants on ORR. Transmission lines serving other areas also cross the site. Current energy consumption is 726 gigawatt-hours/yr, with a peak load of 110 MWe. The current load capacity at ORR is 805 MWe. The current reserve capacity is 1,295 MWe. A 56-cm (22-in) main from East Tennessee Natural Gas in Knoxville is available onsite. The current quantity of natural gas furnished to ORR upon demand is limited to 0.687 million m^3/day (24.3 million ft^3/day), with 0.42 million m^3/day (14.8 million ft^3/day) interruptible upon a 4-hour notice. The current natural gas consumption is approximately 95 million m^3/yr (3,350 million ft^3/yr). Oil and coal availability is unlimited, with current consumption of 416,000 l/yr (110,000 gal/yr) of oil and 16,300 t/yr (18,000 tons/yr), respectively. Steam is used and generated at approximately 150,000 kg/hr (330,000 lb/hr).

Oak Ridge Reservation is located in the Southeastern Electric Reliability Council regional power pool and draws its power from the TVA Subregion. Characteristics of this power pool are given in Table 3.6.2–2. The total system generation capacity is 33,370 MWe, with a peak demand of 28,127 MWe. The mix of fuels utilized in generating this power pool requirement is predominantly coal and nuclear with 49 and 39 percent, respectively, followed by hydroelectric power generation at 11 percent. Less than 1 percent of the electrical generation requirements is produced using oil and natural gas. TVA is typically a net exporter of power, with approximately 2.4 million megawatt-hours (MWh) exported annually.

Eight facilities at Y–12 are currently used to store enriched uranium or process it for storage. These facilities would continue to be used for the interim storage of HEU as described in the Y–12 EA. The buildings are all located within the existing controlled and secured protected area of Y–12. Buildings 9204-2, 9204-2E, and

Table 3.6.2–2. Tennessee Valley Authority Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	49%
Nuclear	39%
Hydro/geothermal	11%
Oil/gas	<1%
Other	0%
Total Annual Production	159,842,000 MWh
Total Annual Load	156,987,000 MWh
Energy Exported Annually[b]	2,407,000 MWh
Generating Capacity	31,840 MWe
Peak Demand	28,127 MWe
Capacity Margin[c]	4,550 MWe

[a] Percentages do not total 100 percent due to rounding.

[b] Energy exported is not the difference of production and load due to negative net pumped storage.

[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

9204-4, located in the western portion of Y–12, are all large, multistory, industrial-type buildings that have been modified several times since their construction. Building 9204-2 is approximately 25,100 m^2 (270,000 ft^2), Building 9204-2E is approximately 14,100 m^2 (151,000 ft^2), and Building 9204-4 is approximately 25,400 m^2 (274,000 ft^2). Building 9206, centrally located within Y–12, is a 4,000 m^2 (43,000 ft^2) structure with a 1,900 m^2 (20,000 ft^2) second story in its central portion. Building 9212, centrally located within Y–12, is a multistory facility that spans approximately 9,300 m^2 (100,000 ft^2). Building 9215 is an approximately 11,800 m^2 (127,000 ft^2) two-story structure that is centrally located within Y–12. Building 9720-5 is a single-story warehouse that includes approximately 3,700 m^2 (40,000 ft^2) of storage space. This facility is the principal storage location for HEU as described in the Y–12 EA. Building 9998 is a multifloor structure with approximately 2,260 m^2 (24,000 ft^2). Buildings 9998 and 9215 are integrally connected and may be considered as a single-building complex. Buildings other than these eight may be modified for the interim storage of HEU as described in the Y–12 EA.

3.6.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The Cumberland and Great Smoky Mountains have a moderating influence on the climate at ORR. Winters are generally mild and summers warm, with no noticeable extremes in precipitation, temperature, or winds.

The average annual temperature at ORR is 13.7 °C (56.6 °F); temperatures vary from an average daily minimum of -3.8 °C (25.1 °F) in January to an average daily maximum of 30.4 °C (86.7 °F) in July. The average annual precipitation is approximately 136.6 cm (53.77 in). Prevailing wind directions at ORR tend to follow the orientation of the valley: upvalley, from west to southwest, or downvalley, from east to northeast. The average annual windspeed is approximately 2.0 m/s (4.4 mph) (NOAA 1994c:3). Additional information related to meteorology and climatology at ORR is presented in Appendix F.

Ambient Air Quality. The ORR is located in Anderson and Roane Counties in the eastern Tennessee and southwestern Virginia Interstate AQCR (#207). As of 1995, the areas within this AQCR were designated by EPA as in attainment (40 CFR 81.343) with respect to the NAAQS for criteria pollutants (40 CFR 50). Applicable NAAQS and Tennessee State ambient air quality standards are presented in Appendix F.

One PSD (40 CFR 52.21) Class I area can be found in the vicinity of ORR. This area, the Great Smoky Mountains National Park, is located approximately 48.3 km (30 mi) southeast of ORR. Since the creation of the PSD program in 1977, no PSD permits have been required for any emission source at ORR.

The primary emission sources of criteria pollutants are the steam plants at K–25, Y–12, and ORNL. Other emission sources include fugitive particulates from coal piles, the TSCA incinerator, other processes, vehicles, and temporary emissions from various construction activities (OR DOE 1987a:33-49). Appendix F presents emissions of criteria pollutants from ORR.

Table 3.6.3–1 presents the baseline ambient air concentration for criteria pollutants and other pollutants of concern at ORR. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. Major noise emission sources within ORR include various industrial facilities, equipment, and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most ORR industrial facilities are at a sufficient distance from the site boundary that noise levels at the boundary from these sources would not be measurable or would be barely distinguishable from background noise levels.

Sound-level measurements have been recorded at various locations within and near ORR in the process of testing sirens and preparing support documentation for the Atomic Vapor Laser Isotope Separation site (ORR 1991a:2; ORR 1991a:6). The acoustic environment along the ORR site boundary in rural areas and at nearby residences away from traffic noise is typical of a rural location, with the average DNL in the range of 35 to 50 dBA. Areas near the site within Oak Ridge are typical of a suburban area, with the average DNL in the range of 53 to 62 dBA (EPA 1974a:B-4,B-5). The primary source of noise at the site boundary and at residences located near roads is traffic. During peak hours, the plant traffic is a major contributor to traffic noise levels in the area.

The State of Tennessee has not established specific community noise standards applicable to ORR. The city of Oak Ridge has specific acceptable sound levels at property lines (Appendix F).

Table 3.6.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Oak Ridge Reservation, 1992

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000[b]	5
	1-hour	40,000[b]	11
Lead	Calendar Quarter	1.5[b]	0.05[c]
Nitrogen dioxide	Annual	100[b]	3
Ozone	1-hour	235[b]	[d]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	1
	24-hour	150[b]	2
Sulfur dioxide	Annual	80[b]	2
	24-hour	365[b]	32
	3-hour	1,300[b]	80
Mandated by the State of Tennessee			
Total suspended particulates	24-hour	150[e]	2[f]
Gaseous fluoride (as hydrogen fluoride)	30-day	1.2[e]	0.2
	7-day	1.6[e]	0.3
	24-hour	2.9[e]	0.6[g]
	12-hour	3.7[e]	0.6[g]
	8-hour	250[e]	0.6
Hazardous and Other Toxic Compounds			
1,1,1-Trichloroethane	8-hour	[h]	[d]
Acetic Acid	8-hour	[h]	<0.01
Chlorine	8-hour	150[e]	4.1
Hydrogen chloride	8-hour	750[e]	57.0
Mercury	8-hour	5[e]	0.06[i]
Nitric acid	8-hour	[h]	78.0
Sulfuric acid	8-hour	100[e]	20.0

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.
[b] Federal and State standard.
[c] Value is maximum for 24-hour period.
[d] Data not available from source document.
[e] State standard.
[f] Based on stack emissions of particulate matter only.
[g] 8-hour concentration was used.
[h] No State standard for indicated averaging time.
[i] Annual average (monitored value).

Note: Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

Source: 40 CFR 50; OR DOE 1993a; TN DEC 1994a; TN DHE 1991a.

3.6.4 WATER RESOURCES

Surface Water. The major surface water body in the immediate vicinity of ORR is the Clinch River, which borders the site to the south and west. There are four major sub-drainage basins on ORR that flow into the Clinch River and are affected by site operations: Poplar Creek, East Fork Poplar Creek, Bear Creek, and White Oak Creek. Several smaller drainage basins, including Ish Creek, Grassy Creek, Bearden Creek, McCoy Branch, Kerr Hollow Branch, and Raccoon Creek drain directly to the Clinch River. Each drainage basin takes the name of the major stream flowing through the area. Within each basin are a number of small tributaries. The natural surface water bodies in the vicinity of ORR are shown on Figure 3.6.4–1.

The three major facilities at ORR each affect different basins of the Clinch River. Drainage from Y–12 enters both Bear Creek and East Fork Poplar Creek; K–25 drains predominantly into Poplar Creek; and ORNL drains into the White Oak Creek drainage basin.

The Clinch River and connected waterways supply all raw water for ORR. The Clinch River has an average flow rate of 132 m^3/s (4,647 ft^3/s) as measured at the downstream side of Melton Hill Dam at mile 23.1 (OR USGS 1986a:161). The average flow rate of Grassy, Ish, and Bear Creeks in the ORR area are 0.08 m^3/s (2.8 ft^3/s), 0.05 m^3/s (1.8 ft^3/s), and 0.11 m^3/s (3.9 ft^3/s), respectively. The average flow rate at East Fork Poplar Creek is 1.46 m^3/s (51.4 ft^3/s). Y–12 uses approximately 7,530 million l/yr (2 billion gal/yr) of water, and ORR uses 14,210 million l/yr (3,754 million gal/yr). The ORR water supply system, which includes the DOE treatment facility and the K–25 treatment facility, has a capacity of 121.5 million l/day (32.1 million gal/day).

The Clinch River water levels in the vicinity of ORR are regulated by a system of dams operated by the TVA. Melton Hill Dam controls the flow of the Clinch River along the northeast and southeast sides of ORR. Watts Bar Dam, on the Tennessee River near the lower end of the Clinch River, controls the flow of the Clinch River along the southwest side of ORR.

The TVA has conducted flood studies along the Clinch River, Bear Creek, and East Fork Poplar Creek (OR TVA 1991a:1). Portions of Y–12 lie within the 100- and 500-year floodplains of East Fork Poplar Creek (ORNL 1995d). Studies have not been performed to delineate the 100- or 500-year floodplain boundaries of Grassy, Ish, and Bear Creeks in the western half of the facility (OR TVA 1991a:1). A site-specific assessment would be required before constructing any new facility at ORR.

Surface Water Quality. The streams and creeks of Tennessee are classified by the Tennessee Department of Environmental Conservation (TDEC) and defined in the State of Tennessee Water Quality Standards. Classifications are based on water quality, designated uses, and resident aquatic biota. The Clinch River is the only surface water body on ORR classified for domestic water supply. Streams at ORR are classified for fish, aquatic life, and livestock watering; irrigation; recreation; and wildlife. White Oak Creek and Melton Branch are the only streams not classified for irrigation. Portions of Poplar Creek, East Fork Poplar Creek, and Melton Branch are not classified for recreation.

Both routine and NPDES-required surface water monitoring programs (over 225 sites) are performed at Y–12 to assess the impacts of the plant effluents upon natural receiving water and to estimate the impacts of these effluents on human health and the environment. At Y–12, Bear Creek, McCoy Branch, Rogers Quarry, and East Fork Poplar Creek receive effluent from treated sanitary wastewater, industrial discharges, cooling water blowdown, stormwater, surface water runoff, and groundwater. The chemical water quality of Bear Creek has been affected by the infiltration of contaminated groundwater. Contaminants included high concentrations of dissolved salts, several metals, chlorinated solvents, and PCBs. DOE is currently involved with remediation of East Fork Poplar Creek under CERCLA, because the creek was contaminated by past releases from Y–12. Significant cleanup activities are required onsite and offsite. Contaminants present in East Fork Poplar Creek included mercury, organics, PCBs, and radionuclides (OR DOE 1994d:5-9).

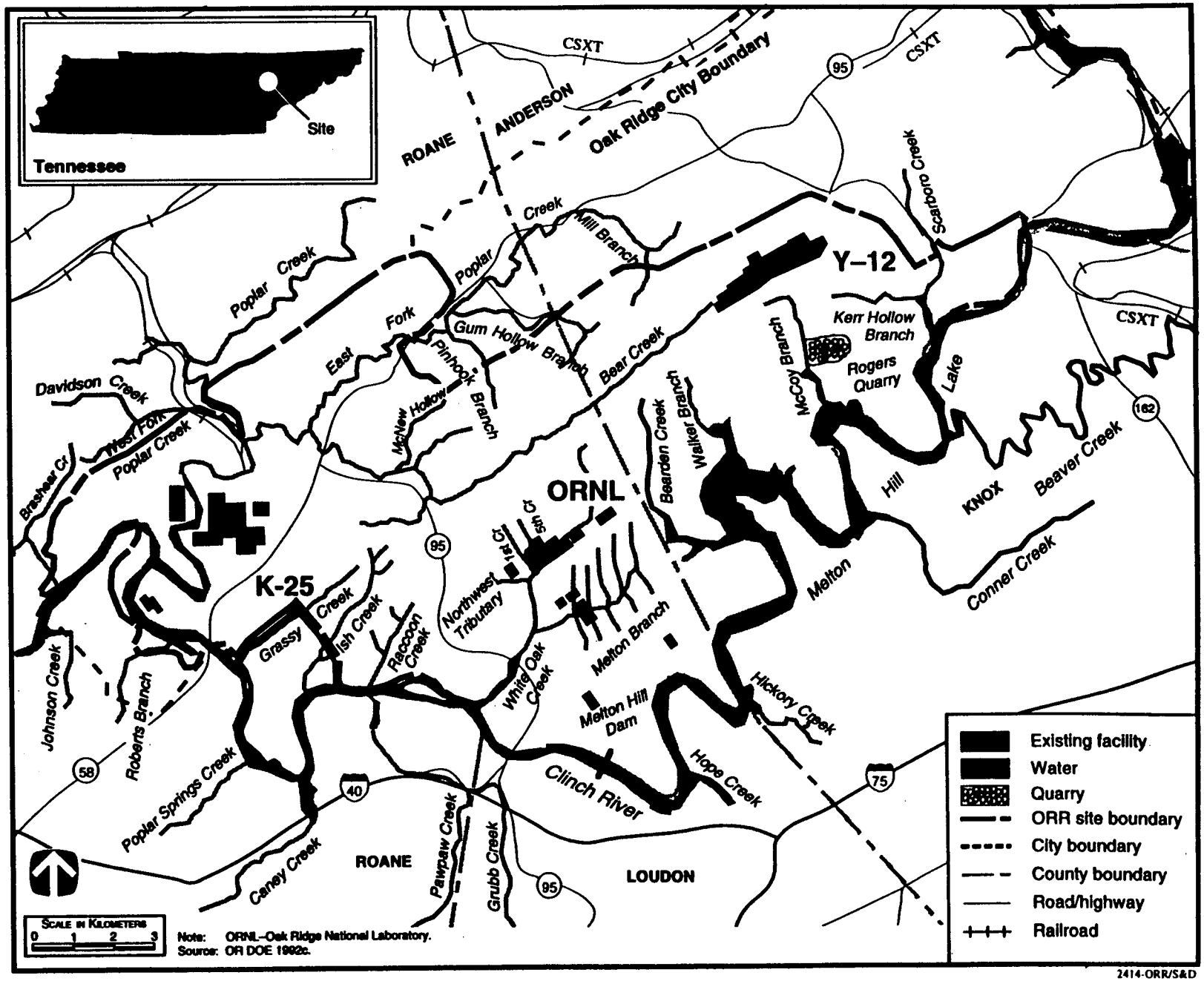


Figure 3.6.4–1. Surface Water Features at Oak Ridge Reservation.

Wastewater treatment facilities are located throughout ORR. At Y–12, there are six treatment facilities with NPDES-permitted discharge points to East Fork Poplar Creek. Y–12 also has a permit to discharge wastewater to the Oak Ridge Treatment Facility. At ORNL, there are three NPDES-permitted wastewater treatment facilities discharging into White Oak Creek basin. K–25 operates one sanitary sewage system discharging to Poplar Creek.

There are 455 NPDES-permitted outfalls associated with the three major facilities at ORR; many of these are stormwater outfalls. Approximately 57,000 NPDES laboratory analyses were completed in 1993, with a compliance rate of over 99 percent. Most excursions were associated with precipitation runoff (OR DOE 1994c:2-13). One Notice of Violation was issued by TDEC in 1993 for exceeding permit limits for total suspended solids at three outfalls at ORNL. An action plan was prepared addressing projects to mitigate the potential for future violations.

As shown in Table 3.6.4–1, maximum concentrations of all parameters except nitrate and manganese were within the various comparison water quality criteria where the Clinch River leaves ORR. Monitoring data from this sampling site were compared with data from the Melton Hill Dam sampling site, located upstream of all ORR discharges and therefore are representative of background water quality. The concentrations downstream of ORR discharges were lower than concentrations upstream in all cases except gross beta and total suspended solids. Concentrations at Melton Hill Dam were within applicable water quality criteria.

Surface Water Rights and Permits. In Tennessee, the State's water rights laws are established in the *Water Quality Control Act.* In effect, the water rights are similar to riparian rights, in that the designated usages of a water body cannot be impaired. The only requirement to withdraw water from available supplies would be a U.S. Army COE permit to construct intake structures.

Groundwater. The ORR is located in an area of sedimentary rocks of widely varying hydrological character. However, because of the topographic relief and a decrease in bedrock fracture density with depth, groundwater flow is restricted primarily to shallow depths and groundwater discharges primarily to nearby surface waters within ORR. Depth to groundwater is generally 5 to 9 m (16 to 30 ft), but is as little as 1.5 m (5 ft) in the area of Bear Creek Valley near State Route 95. No Class I sole source aquifers lie beneath ORR. All aquifers are considered Class II (current and potential sources of drinking water).

Aquifers at ORR include a surficial soil and regolith unit and bedrock aquifers. The surficial aquifer consists of manmade fill, alluvium, and weathered bedrock. Bedrock aquifers occur in carbonates and low-yield sandstones, siltstones, and shales. Groundwater flow in the surficial aquifer is controlled by bedding planes, joints, fracture and/or solution cavity distribution and orientation in limestones that store and transmit relatively large volumes of water. Bedding-plane and strike-parallel fracture orientation give rise to preferential groundwater movement along strike direction (OR DOE 1992c:5-7). In the bedrock aquifer, essentially all groundwater occurs in fractures and in a few larger cavities within the formation. Enlarged fractures and cavities are the primary water producing and solute transport features and are supplied by seepage through fractures in the rock matrix, which outnumber the enlarged fractures and cavities, are interconnected, and provide the continuity for groundwater flow paths. Movement of groundwater through fractures and solution conduits in some of the carbonate aquifers is quite rapid even where gradients are not particularly steep.

Recharge occurs over most of the area but is most effective where overburdened soils are thin or permeable. In the area near Bear Creek Valley, recharge into the carbonate rocks is mainly along Chestnut Ridge (OR DOE 1992c:5-5). Groundwater generally flows from the recharge areas to the center of Bear Creek Valley and discharges into Bear Creek and its tributaries. Because of the abundance of surface water and its proximity to the points of use, very little groundwater is used at ORR. Only one water supply well exists on ORR; it provides a supplemental water supply to an aquatics laboratory during extended droughts.

Table 3.6.4–1. Summary of Clinch River Surface Water Quality Monitoring at Oak Ridge Reservation, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Water Body Concentration	
			High	Low
Alpha (gross)	pCi/l	15[b]	1.6	-0.14
Beta (gross)	pCi/l	50[c]	6.8	3.8
Cesium-137	pCi/l	120[d]	4.1	-2.4
Chemical oxygen demand	mg/l	NA	21	<5.0
Fluoride	mg/l	4.0[b], 2.0[e]	0.10	<0.10
Manganese	mg/l	0.05[e]	0.068	0.0031
Nitrate	mg/l	10.0[b]	10.0	1.5
pH	pH units	6.5-8.5[f]	8.2	7.8
Sodium	mg/l	NA	4.9	3.3
Sulfate	mg/l	250[e]	27	15
Suspended solids	mg/l	NA	29	<5.0
Technetium-99	pCi/l	4,000[d]	5.9	-0.54
Total dissolved solids	mg/l	500[e]	170	150
Tritium	pCi/l	80,000[d]	540	-570
Uranium, Total	mg/l	0.02[c]	0.0010	<0.00010

[a] For comparison purposes only.

[b] National Primary Drinking Water Regulations (40 CFR 141).

[c] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[d] DOE DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored location. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the background environmental level.

[e] National Secondary Drinking Water Regulations (40 CFR 143).

[f] Tennessee drinking water quality standards.

Note: Data from 1993 sampling event at Station CRK16, located on the Clinch River, downstream from ORR. NA=not applicable.

Source: OR DOE 1994f; TN DEC 1991a.

Groundwater Quality. Groundwater samples are collected quarterly from more than 1,000 monitoring wells throughout ORR. Groundwater samples collected from the monitoring wells are analyzed for a standard suite of parameters and constituents, including trace metals, volatile organic compounds, radioactive materials, and pH. Background groundwater quality at ORR is generally good in the near-surface aquifer zones and poor in the bedrock aquifer at depths greater than 305 m (1,000 ft) due to high total dissolved solids.

Groundwater in Bear Creek Valley near Y–12 and in the ORNL and K–25 areas has been contaminated by hazardous chemicals and radionuclides (mostly uranium) from weapons production process activities. The contaminated sites include past waste disposal sites, waste storage tanks, spill sites, and contaminated inactive facilities. The groundwater quality as indicated by groundwater contamination monitoring wells at ORR is summarized in Table 3.6.4–2.

Groundwater Availability, Use, and Rights. Industrial and drinking water supplies in the area are primarily taken from surface water sources. However, single-family wells are common in adjacent rural areas not served by the public water supply system (OR DOE 1992c:1-15). Most of the residential supply wells in the immediate area of ORR are south of the Clinch River. Most wells used for potable water are in the deeper principal carbonate

Table 3.6.4–2. Groundwater Quality Monitoring at Oak Ridge Reservation, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standard[a]	Existing Conditions[b]	
			High	Low
Alkalinity-CO_3	mg/l	NA	190	1
Alkalinity-HCO_3	mg/l	NA	540	2
Alpha (gross)	pCi/l	15[c]	490	-52
Aluminum	mg/l	0.05-0.2[d]	140	<0.019
Barium	mg/l	2.0[c]	33	0.0016
Beta (gross)	pCi/l	50[e]	11,000	-23
Boron	mg/l	NA	1.6	0.0041
Calcium	mg/l	NA	6,600	0.85
Chloride	mg/l	250[d]	3,900	0.1
Chromium	mg/l	0.1[c,f]	58	<0.0033
Copper	mg/l	1.0[d]	1.1	<0.0033
Fluoride	mg/l	2.0[d], 4.0[c]	6.0	<0.1
Iron	mg/l	0.3[d]	470	0.0050
Lead	mg/l	0.005[f]	1.7	<0.0012
Magnesium	mg/l	NA	430	0.019
Manganese	mg/l	0.05[d]	29	0.001
Nickel	mg/l	0.1[c]	5.8	<0.0042
Nitrate	mg/l	10.0[c]	5,500	0.2
pH	pH units	6.5-8.5[d]	12	4.5
Potassium	mg/l	NA	32	0.60
Sodium	mg/l	NA	2,100	0.23
Strontium-90	pCi/l	400[g]	7,600	-16
Sulfate	mg/l	250[d]	2,100	1.0
Total dissolved solids	mg/l	500[d]	26,000	32
Uranium-235	pCi/l	24[g]	200	-70
Uranium-238	pCi/l	24[g]	120	-18
Vanadium	mg/l	NA	1.1	<0.002
Zinc	mg/l	5.0[d]	3.8	0.0020

[a] For comparison purposes only.

[b] Data are from all wells on ORR.

[c] National Primary Drinking Water Regulations (40 CFR 141).

[d] National Secondary Drinking Water Regulations (40 CFR 143).

[e] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[f] Tennessee drinking water standards.

[g] DOE DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored location. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the background environmental level.

Note: NA=not applicable.

Source: OR DOE 1994f; TN DEC 1991a.

aquifers (up to 305 m [1,000 ft]), while the groundwater contamination at Y–12 is primarily found at depths up to 84 m (276 ft).

Groundwater rights in the State of Tennessee are traditionally associated with the Reasonable Use Doctrine (VDL 1990a:725). Under this doctrine, landowners can withdraw groundwater to the extent that they must exercise their rights reasonably in relation to the similar rights of others.

3.6.5 GEOLOGY AND SOILS

Geology. The ORR is located in the Valley and Ridge physiographic province of east-central Tennessee. The topography consists of alternating valleys and ridges that have a northeast-southwest trend, with most ORR facilities occupying the valleys; Y–12 is located in Bear Creek Valley between Pine and Chestnut Ridges. ORNL and K–25 are underlain primarily by calcareous siltstones and silty to clean limestones of the Chickamauga Group; Y–12 is underlain by the Conasauga Group, which is composed of shales, calcareous siltstones, and silty to clean limestones. Pine Ridge is underlain by the Rome Formations, which consist of sandstone with thin shale interbeds. Chestnut Ridge is underlain by the cherty dolostones of the Knox Group. The present topography of the valleys is a result of stream action preferentially eroding the softer shales and limestones; the ridges are composed of relatively more resistant sandstones and dolomites. No economically viable geologic resources have been identified at ORR.

Oak Ridge Reservation is underlain by many inactive faults formed during the Late Paleozoic Era. There is no evidence of capable faults, as defined in 10 CFR 100, Appendix A, in the immediate area of ORR. The nearest capable faults are located approximately 480 km (298 mi) northwest in the New Madrid fault zone (OR EG&G 1991a:3.6.2–6).

The Oak Ridge Reservation area is located at the boundary between Seismic Zones 1 and 2, indicating that minor to moderate damage could occur as a result of earthquakes (Figure 3.2.5–1). Since the New Madrid earthquakes of 1811–12, at least 27 other earthquakes with an MMI of III to VI have been felt in the Oak Ridge area (Table 3.2.5–1). The nearest seismic event occurred in 1930 approximately 8 km (5 mi) from ORR and had an MMI of V at the site (OR EG&G 1991a:3.6.2-1). The most recent significant earthquake (4.6 on the Richter scale) occurred on November 30, 1973 in Maryville, Tennessee, approximately 34 km (21 mi) southeast of ORR.

There is no volcanic hazard at ORR. The area has not experienced volcanic activity within the last 230 million years. Therefore, future volcanic activity is not anticipated.

Soils. Bear Creek Valley lies on well-drained to moderately well-drained soils underlain by shale, siltstone, and sandstone. Developed portions of the valley are designated as urban land. Soil erosion from past land uses has ranged from slight to severe. Erosion potential is very high in those areas with slopes greater than 25 percent and which have been eroded in the past. Erosion potential is lowest in nearly flat-lying permeable soils that have a loamy texture (ORNL 1988b:69). Additionally, wind erosion is slight, shrink-swell potential is low to moderate, and the soils are acceptable for standard construction techniques.

3.6.6 BIOLOGICAL RESOURCES

Terrestrial Resources. Plant communities at ORR are characteristic of the intermountain regions of central and southern Appalachia. Approximately 10 percent of ORR has been disturbed since it was withdrawn from public access; the remainder of the site has reverted to, or been planted with, natural vegetation (OR DOE 1989a:3-5). The vegetation of ORR has been categorized into seven plant communities (Figure 3.6.6–1).

Pine and pine-hardwood forest is the most extensive plant community on ORR. Important species of this community type include loblolly pine, shortleaf pine, and Virginia pine (ORNL 1987a:9). Another abundant plant community is the oak-hickory forest, which is commonly found on ridges throughout ORR. Northern hardwood forest and hemlock-white pine-hardwood forest are the least common forest community types on ORR. Forest resources on ORR are managed for maintaining multiple use of forest land and sustaining yield of quality timber products (OR DOE 1994e:2-113). Nine hundred eighty-three species, subspecies, and varieties of plants have been identified on ORR (OR NERP 1993b:2).

Animal species found on ORR include 26 amphibian, 33 reptile, 169 bird, and 39 mammal species (OR NERP nda:8-17). Animals commonly found on ORR include the American toad, eastern garter snake, Carolina chickadee, northern cardinal, white-footed mouse, and raccoon. Although the whitetail deer is the only species hunted onsite (OR DOE 1991c:4-6), other game animals are also present. Raptors, such as the northern harrier and great horned owl, and carnivores, such as the gray fox and mink, are ecologically important groups on ORR. A variety of migratory birds has been found at ORR. Migratory birds, as well as their nests and eggs, are protected by the *Migratory Bird Treaty Act*.

Vegetative communities in the area proposed for the consolidated Pu storage facility (which is also the assumed analysis site for immobilization facilities) are typical of ORR as a whole, with pine and pine-hardwood and oak-hickory forests being the predominant community types (Figure 3.6.6–1). Fauna of the proposed storage site would be similar to that found throughout ORR. The assumed site for the evolutionary LWR was originally dominated by pine and pine-hardwood forests. However, it was cleared for a previously proposed breeder reactor and thus, is presently in a highly disturbed state.

Wetlands. Wetlands on ORR include emergent, scrub and shrub, and forested wetlands associated with embayments of the Melton Hill and Watts Bar Lake, riparian areas bordering major streams and their tributaries, old farm ponds, and groundwater seeps. Well-developed communities of emergent wetland plants in the shallow embayments of the two reservoirs typically intergrade into forested wetland plant communities, which extend upstream through riparian areas associated with streams and their tributaries. Old farm ponds on ORR vary in size and support diverse plant communities and fauna. Although most riparian wetlands on ORR are forested, areas within utility rights-of-way, such as those in Bear Creek and Melton Valleys, support emergent wetland vegetation (OR NERP 1991a:4,18,26,41).

Within the vicinity of the site proposed for the consolidated Pu storage facility (which is also the assumed analysis site for immobilization facilities), most wetlands are forested and are located in riparian areas bordering headwater tributaries to Bear Creek, Grassy Creek, and Ish Creek (Figure 3.6.4-1). Forested wetlands also occupy several acres in the floodplain of Bear Creek as it flows through the area. Emergent wetlands are present where tributaries to Grassy Creek cross a power line paralleling Bear Creek Road.

Portions of the forested wetland in the Bear Creek floodplain located near the northern edge of the proposed consolidated Pu storage site are designated as an NERP Reference Area and Natural Area. This wetland area is uncommon because it is not subject to the changing water levels from the TVA dams, and it has a deep, organic substrate combined with a diversity of herbaceous plants. The springs, seeps, and old streambeds create a variety of habitats. This wetland supports a State-listed endangered plant species (tubercled rein-orchid). A portion of the Reference Area and the entire Natural Area have been designated as State Natural Areas (OR NERP

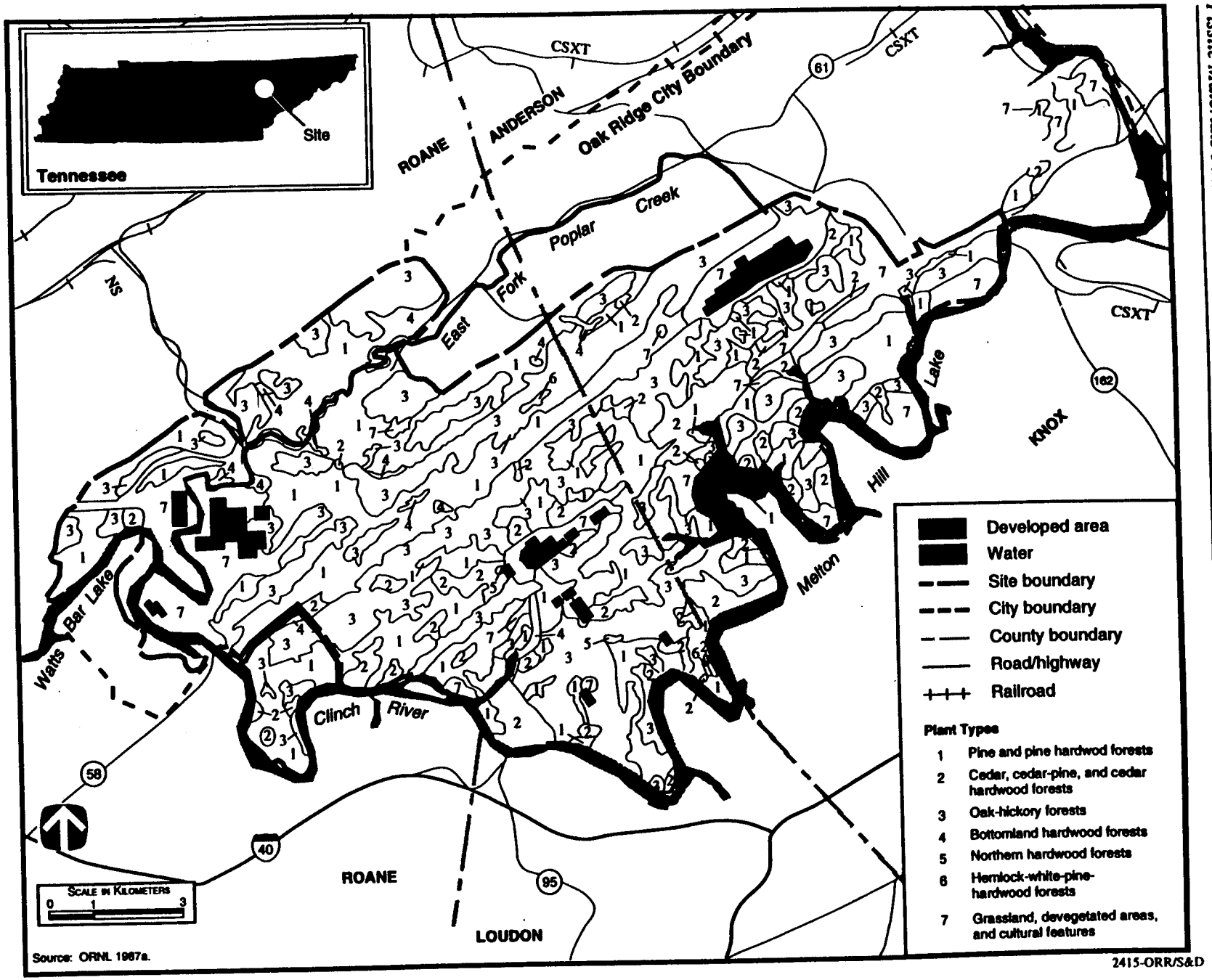


Figure 3.6.6–1. Distribution of Plant Communities at Oak Ridge Reservation.

1993a:13). The assumed location for the evolutionary LWR is highly disturbed and does not contain any wetlands.

Aquatic Resources. Aquatic habitat on or adjacent to ORR ranges from small, free-flowing streams in undisturbed watersheds to larger streams with altered flow patterns due to dam construction. These aquatic habitats include tailwaters, impoundments, reservoir embayments, and large and small perennial streams. Aquatic areas in ORR also include seasonal and intermittent streams.

Sixty-four fish species have been collected on or adjacent to ORR. The minnow family has the largest number of species and is numerically dominant in most streams (ORNL 1988c:0-43). Fish species representative of the Clinch River in the vicinity of ORR are shad, herring, common carp, catfish, bluegill, crappie, and freshwater drum (ORNL 1981b:138-149). The most important fish species taken commercially in the ORR area are common carp and catfish. Commercial fishing is permitted on the Clinch River downstream from Melton Hill Dam (TN WRA 1995a:1-5). Area recreational species consist of crappie, largemouth bass, sauger, sunfish, and catfish (TN DEC 1992e:1; TN WRA 1993a:1). Sport fishing is not permitted within ORR (TN WRA 1992a:1).

Fish species that have been recorded near the site of the proposed consolidated Pu storage facility (which is also the assumed analysis site for immobilization facilities) include 18 species in Bear Creek, 15 species in Grassy Creek, and 8 species in Ish Creek. Fish found in these streams include: blacknose dace, creek chub, shiner, Tennessee dace, banded sculpin, central stoneroller, bluntnose minnow, redbreast sunfish, and rock bass (OR DOE 1984a:3-30; ORNL 1988c:4-10; ORNL 1992c:4-5–4-7).

A NERP Aquatic Reference Area is located along Grassy Creek and its tributaries in the western portion of the proposed consolidated Pu storage site (OR NERP 1993a:16). Grassy Creek has a diverse assemblage of invertebrates and fish species for a stream its size. ORR uses Grassy Creek as a reference area for studies of other streams affected by site development. The assumed site for the evolutionary LWR is highly disturbed and does not contain any aquatic resources.

Threatened and Endangered Species. Eighty-four federally and State-listed threatened, endangered, and other special status species may be found on and in the vicinity of ORR (Table 3.6.6–1). Twenty-six of these species have records of occurrence on ORR or adjacent lakes. Seventeen of these are federally and/or State-listed as threatened or endangered, most of which are plant species located within NERP National Areas on ORR. Once a specific project site location has been determined, site surveys will verify the presence of special status species. No critical habitat for threatened or endangered species, as defined in the ESA (50 CFR 17.11; 50 CFR 17.12), exists on ORR or adjacent lakes.

The bald eagle is the only federally listed threatened or endangered species observed near ORR on Melton Hill and Watts Bar Lakes. The peregrine falcon may occur in the area as a rare migrant or winter visitor. [Text deleted.] State-listed threatened or endangered species observed on ORR include the osprey and fourteen plant species (Table 3.6.6–1).

No federally listed threatened and endangered species are known to occur in the proposed storage site (which is also the assumed analysis site for immobilization facilities). [Text deleted.] East Fork Poplar Creek, north of the proposed storage site, contains suitable habitat for the Indiana bat. ORR lies within the geographic range of the gray bat, but suitable caves for this species are not known to occur on or near the proposed storage site. Neither of these bat species was collected during a limited survey conducted in 1992 (OR TT 1993a:1). [Text deleted.]

A number of State-listed threatened and endangered species are known to occur in the vicinity of the proposed consolidated Pu storage facility site (ORNL 1987b:11,12). These include Cooper's hawk, sharp-shinned hawk, pink lady's-slippers, tubercled rein-orchid, purple fringeless orchid, American ginseng, and fen orchid (OR NERP 1993a:6). One species listed by the State as in need of management (the Tennessee dace) occurs on the proposed site. The Tennessee dace is an inhabitant of Bear Creek and its tributaries. This stream system, which

Table 3.6.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Oak Ridge Reservation

Common Name	Scientific Name	Status[a]	
		Federal	State
Mammals			
Alleghany woodrat	*Neotoma magister*	NL	D
Eastern cougar[b]	*Felis concolor couguar*	E	E
Eastern small-footed bat	*Myotis leibii*	NL	D
Gray bat[b]	*Myotis grisescens*	E	E
Indiana bat[b]	*Myotis sodalis*	E	E
Rafinesque's big-eared bat	*Plecotus rafinesquii*	NL	D
River otter	*Lutra canadensis*	NL	T
Smoky shrew	*Sorex fumeus*	NL	D
Southeastern shrew	*Sorex longirostris*	NL	D
Birds			
American peregrine falcon[b]	*Falco peregrinus anatum*	E	E
Appalachian Bewick's wren	*Thryomanes bewickii altus*	NL	T
Arctic peregrine falcon	*Falco peregrinus tundrius*	E(S/A)	E
Bachman's sparrow	*Aimophila aestivalis*	NL	E
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	T
Barn owl[d]	*Tyto alba*	NL	D
Cooper's hawk[d,e]	*Accipiter cooperii*	NL	D
Grasshopper sparrow	*Ammodramus savannarum*	NL	D
Northern harrier	*Circus cyaneus*	NL	D
Osprey[d]	*Pandion haliaetus*	NL	T
Red-cockaded woodpecker	*Picoides borealis*	E	E
Sharp-shinned hawk[d,e]	*Accipiter striatus*	NL	D
Swainson's warbler	*Limnothlypis swainsonii*	NL	D
Reptiles			
Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*	NL	D
Northern pine snake	*Pituophis melanoleucus melanoleucus*	NL	T
Amphibians			
[Text deleted.]			
Hellbender[d,e]	*Cryptobranchus alleganiensis*	NL	D
Tennessee cave salamander[f]	*Gyrinophilus palleucus*	NL	T
Fish			
Alabama shad	*Alosa alabamae*	NL	D
Amber darter[b]	*Percina antesella*	E	E
Blue sucker	*Cycleptus elongatus*	NL	T
Flame chub	*Hemitremia flammea*	NL	D
Frecklebelly madtom	*Noturus munitus*	NL	T
Highfin carpsucker	*Carpiodes velifer*	NL	D
Spotfin chub[b]	*Cyprinella monacha*	T	E
Tennessee dace[d,e]	*Phoxinus tennesseensis*	NL	D
Yellowfin madtom[b]	*Noturus flavipinnis*	T	E

Table 3.6.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Oak Ridge Reservation—Continued

Common Name	Scientific Name	Status[a] Federal	State
Invertebrates			
Alabama lampmussel[b]	*Lampsilis virescens*	E	E
Appalachian monkeyface pearlymussel[b]	*Quadrula sparsa*	E	E
Birdwing pearlymussel[b]	*Conradilla caelata*	E	E
Cumberland bean pearlymussel[b]	*Villosa trabalis*	E	E
Cumberland monkeyface pearlymussel[b]	*Quadrula intermedia*	E	E
Dromedary pearlymussel[b]	*Dromus dromas*	E	E
Fine-rayed pigtoe[b]	*Fusconaia cuneolus*	E	E
Green-blossom pearlymussel[b]	*Epioblasma torulosa gubernaculum*	E	E
Orange-footed pearlymussel[b]	*Plethobasus cooperianus*	E	E
Painted snake coiled forest snail	*Anguispira picta*	T	E
Pale lilliput pearlymussel[b]	*Toxolasma cylindrellus*	E	E
Pink mucket pearlymussel[b]	*Lampsilis abrupta*	E	E
Rough pigtoe[b]	*Pleurobema plenum*	E	E
Shiny pigtoe[b]	*Fusconaia cor*	E	E
Tan riffleshell[b]	*Epioblasma walkeri*	E	E
Tubercled-blossom pearlymussel[b]	*Epioblasma torulosa torulosa*	E	E
Turgid-blossom pearlymussel[b]	*Epioblasma turgidula*	E	E
White wartyback pearlymussel[b]	*Plethobasus cicatricosus*	E	E
Yellow-blossom pearlymussel[b]	*Epioblasma florentina florentina*	E	E
Plants			
American barberry	*Berberis canadensis*	NL	S
American ginseng[d,e]	*Panax quinquefolius*	NL	T
Appalachian bugbane[d]	*Cimicifuga rubifolia*	NL	T
Auriculate false-foxglove	*Tomanthera auriculata*	NL	E
Branching whitlowgrass	*Draba ramosissima*	NL	S
Butternut[d]	*Juglans cinerea*	NL	T
Canada (wild yellow) lily[d,e]	*Lilium canadense*	NL	T
Carey's saxifrage[d]	*Saxifraga careyana*	NL	S
Fen orchid[d,e]	*Liparis loeselii*	NL	E
Golden seal[d,e]	*Hydrastis canadensis*	NL	T
Gravid sedge[d,e]	*Carex gravida*	NL	S
Heartleaf meehania	*Meehania cordata*	NL	T
Heller's catfoot	*Gnaphalium helleri*	NL	S
Lesser ladies' tresses[d]	*Spiranthes ovalis*	NL	S
Michigan lily[d,e]	*Lilium michiganense*	NL	T
Mountain honeysuckle	*Lonicera dioica*	NL	S
Mountain witch alder[d]	*Fothergilla major*	NL	T
Northern bush honeysuckle[d]	*Diervilla lonicera*	NL	T
Nuttall waterweed[d]	*Elodea nuttallii*	NL	S
Pink lady's-slipper[d,e]	*Cypripedium acaule*	NL	E
Prairie goldenrod	*Solidago ptarmicoides*	NL	E
Purple fringeless orchid[d,e]	*Platanthera peramoena*	NL	T

Table 3.6.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Oak Ridge Reservation—Continued

Common Name	Scientific Name	Status[a]	
		Federal	State
Plants (continued)			
Slender blazing star	*Liatris cylindracea*	NL	E
Spreading false foxglove[d]	*Aureolaria patula*	NL	T
Swamp lousewort	*Pedicularis lanceolata*	NL	T
Tall larkspur[d]	*Delphinium exaltatum*	NL	E
Tennessee purple coneflower[b]	*Echinacea tennesseenis*	E	E
Tubercled rein-orchid[d,e]	*Platanthera flava var. herbiola*	NL	T
Virginia spiraea	*Spiraea virginiana*	T	E
Whorled mountainmint	*Pycnanthemum verticillatum*	NL	E-P

[a] Status codes: D=deemed in need of management; E=endangered; NL=not listed; P=possibly extirpated; S=species of special concern; S/A=protected under the similarity of appearances provision of the ESA; T=threatened.

[b] USFWS Recovery Plan exists for this species.

[c] Observed near ORR on Melton Hill and Watts Bar Lakes.

[d] Recent record of species occurrence on ORR.

[e] Species known to occur on or near proposed site for the New Pu Consolidated Storage Facility.

[f] Species collected on ORR in 1964.

Source: 50 CFR 17.11; 50 CFR 17.12; DOE 1995w; OR DOE 1990a; OR FWS 1992b; OR NERP 1993a; ORNL 1981a; ORNL 1984b; ORNL 1988c; TN DEC 1995a; TN DEC 1995b; TN DEC 1995c; TN DEC 1995d; TN WRC 1991a; TN WRC 1991b.

flows through the proposed site, is designated as a NERP Aquatic Natural Area. The habitat of this fish is protected by the State. Bear Creek is the site of life history studies of the Tennessee dace and may contain the greatest density of this species in the State (OR NERP 1993a:10,11). [Text deleted.]

The assumed location for the evolutionary LWR has been highly disturbed by land-clearing activities associated with the breeder reactor. It is unlikely that any species of special concern would reside on this site, although some listed birds and bats could use it to forage for food.

3.6.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. More than 20 cultural resources surveys have been conducted at ORR. About 90 percent of ORR has received at least some preliminary walkover or archival-level study, but less than 5 percent has been intensively surveyed. Most cultural resources studies have occurred along the Clinch River and adjacent tributaries. Prehistoric sites recorded at ORR include villages, burial mounds, camps, quarries, chipping stations, limited activity locations, and shell scatters. Over 45 prehistoric sites have been recorded at ORR to date. At least 13 prehistoric sites are considered potentially eligible for the NRHP, but most of these sites have not yet been evaluated. Site 40RE86 has been determined eligible for inclusion on the NRHP. Additional prehistoric sites may be identified in the unsurveyed portions of ORR. On May 6, 1994, a Programmatic Agreement concerning the management of historic and cultural properties at ORR was executed among the DOE Oak Ridge Operations Office, the Tennessee SHPO, and the Advisory Council on Historic Preservation. This agreement was administered to satisfy DOE's responsibilities regarding Sections 106 and 110 of the *National Historic Preservation Act* (NHPA), and requires DOE to develop a cultural resources management plan for ORR and to conduct cultural resources surveys as required.

Historic Resources. Several historic resources surveys have been conducted at ORR. Historic resources identified at ORR include both archaeological remains and standing structures. Documented log, wood frame, or fieldstone structures include cabins, barns, churches, gravehouses, springhouses, storage sheds, smokehouses, log cribs, privies, henhouses, and garages. Archaeological remains consist primarily of foundations, roads, and trash scatters. Sixty-nine pre-1942 cemeteries were located within the original ORR (OR Robinson 1950a:130). Today there are 32 known cemeteries within ORR because the size of the reservation has been reduced. More than 240 historic resources have been recorded at ORR, and 38 of those sites may be considered potentially NRHP-eligible. Freel's cabin and two church structures, George Jones Memorial Baptist Church and the New Bethel Baptist Church, are listed on the NRHP. These structures date from before the establishment of the Manhattan Project. NRHP sites associated with the Manhattan Project include the Graphite Reactor at ORNL, listed on the NRHP as a National Historic Landmark, and three traffic checkpoints, Bear Creek Road, Bethel Valley Road, and Oak Ridge Turnpike Checking Stations. Many other buildings and facilities at ORR are associated with the Manhattan Project and may be potentially eligible for the NRHP. Historic building surveys were completed during Fiscal Year 1994 at K–25 and ORNL. A similar survey was completed at Y–12, and the final document should be finished in Fiscal Year 1996. Based on this survey, approximately 100 additional buildings may be eligible for listing on the NRHP. Additional historic sites may be anticipated in the unsurveyed portions of ORR.

Native American Resources. The Overhill Cherokee occupied portions of the Tennessee, Hiwassee, Clinch, and Little Tennessee River Valley in the 1700s. Overhill Cherokee villages consisted of a large townhouse, a summer pavilion, and a plaza; residences had both summer and winter structures. Subsistence was based on hunting, gathering, and horticulture. The Cherokee were relocated to the Oklahoma territory in 1838; some Cherokee later returned to the area from Oklahoma. DOE has consulted with the Eastern Band of the Cherokee concerning activities at ORR. Resources that may be sensitive to Native American groups include remains of prehistoric and historic villages, ceremonial lodges, cemeteries, burials, and traditional plant gathering areas. Apart from prehistoric archaeological sites, no Native American resources have been identified to date at ORR.

Paleontological Resources. The majority of geological units with surface exposures at ORR contain paleontological materials. Paleontological materials consist primarily of invertebrate remains, and these assemblages have relatively low research potential.

3.6.8 SOCIOECONOMICS

Socioeconomic characteristics described for ORR include employment and regional economy, population and housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses 15 counties around ORR located in Tennessee (Table L.1–1). Statistics for population and housing, community services, and local transportation are presented for the ROI, a four-county area in which 90.8 percent of all ORR employees reside: Anderson County (29.5 percent), Knox County (41.3 percent), Loudon County (5.5 percent), and Roane County (13.8 percent). [Text deleted.] In 1995, ORR employed 18,010 persons.

Regional Economy Characteristics. Selected employment and regional economy statistics for the ORR REA are summarized in Figure 3.6.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 16.2 percent to the 1990 level of 412,803. The 1994 unemployment in the REA was 4.9 percent, which was about the same as the unemployment for Tennessee (4.8 percent). The region's per capita income of $17,652 in 1993 was approximately 4.3 percent less than the statewide per capita income of $18,439.

As shown in Figure 3.6.8–1, the composition of the REA economy parallels that of Tennessee. During 1993, the service sector constituted about 26 percent of the region's nonfarm private sector, while retail trade constituted 19 percent. Manufacturing represented about 18 percent of ORR REA employment. In Tennessee, the service sector comprised 26 percent of total employment, manufacturing 19 percent, and retail trade 17 percent.

Population and Housing. In 1994, the ROI population totaled 512,254. From 1980 to 1994, the ROI population grew by 10.4 percent, compared to 12.7 percent growth in Tennessee. Within the ROI, Loudon County experienced the greatest population increase, 22.9 percent, while Roane County's population increased by only 0.2 percent. Population and housing trends are summarized in Figure 3.6.8–2.

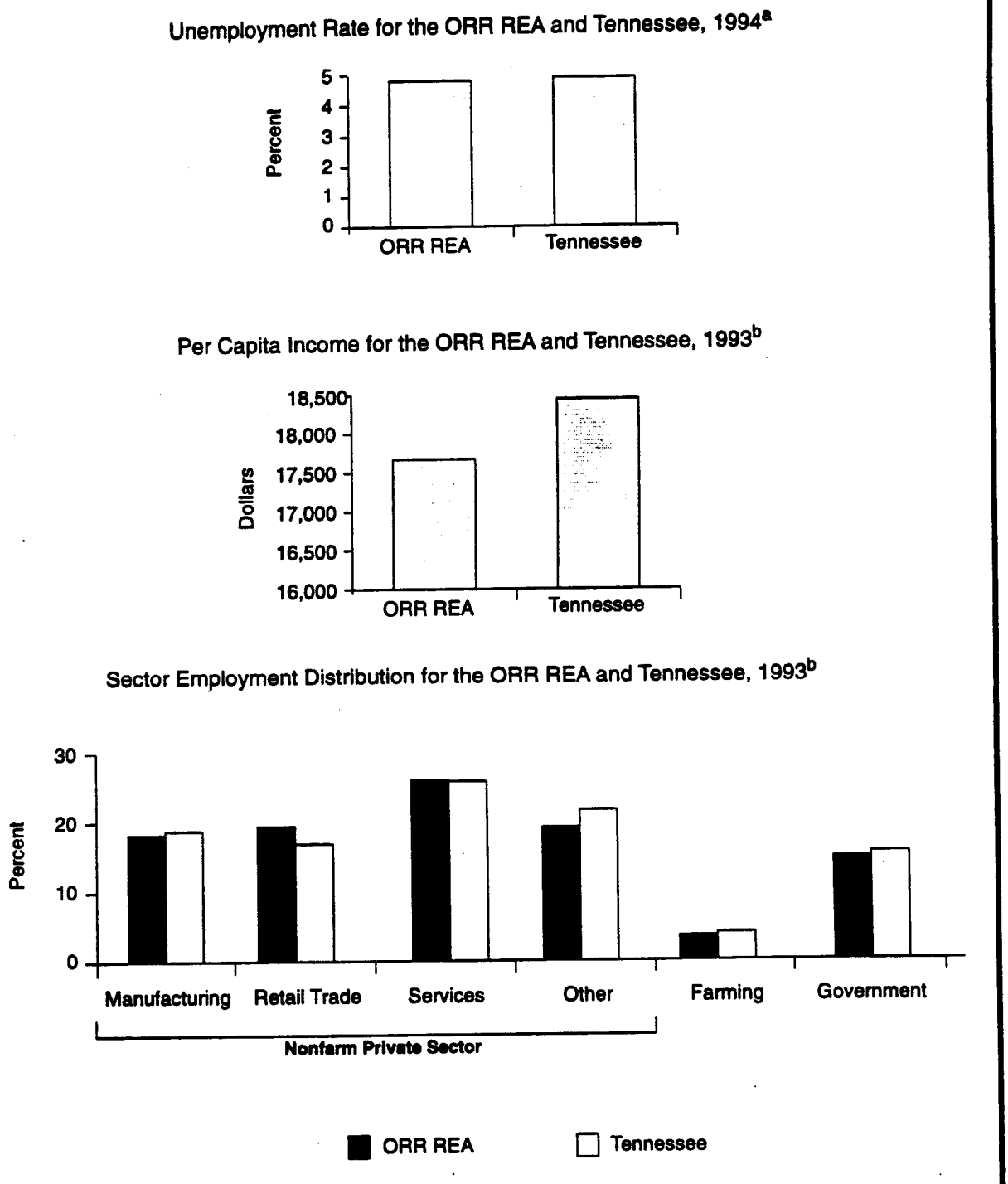
The 13.8-percent increase in the number of housing units between 1980 and 1990 for the ROI was nearly 2 percent less than the increase in the number of housing units for the entire State. The total number of housing units in the ROI for 1990 was 206,067. The 1990 ROI homeowner and renter vacancy rates were 1.7 and 8.5 percent, respectively. These rates were comparable to the statewide rates.

Community Services. Education, public safety, and health care characteristics were used to assess the level of community services in the ORR ROI. Figure 3.6.8–3 presents school district characteristics for the ORR ROI. Figure 3.6.8–4 summarizes public safety and health care services.

Education. In 1994, eight school districts provided public education services and facilities in the ORR ROI. As seen in Figure 3.6.8–3, these school districts operated at between 74.7-percent (Harriman School District) and 100-percent (Anderson, Knox, and Loudon Counties) capacity. The average student-to-teacher ratio for the ORR ROI in 1994 was 16.2:1. The Lenoir City School District had the highest ratio at 17.2:1.

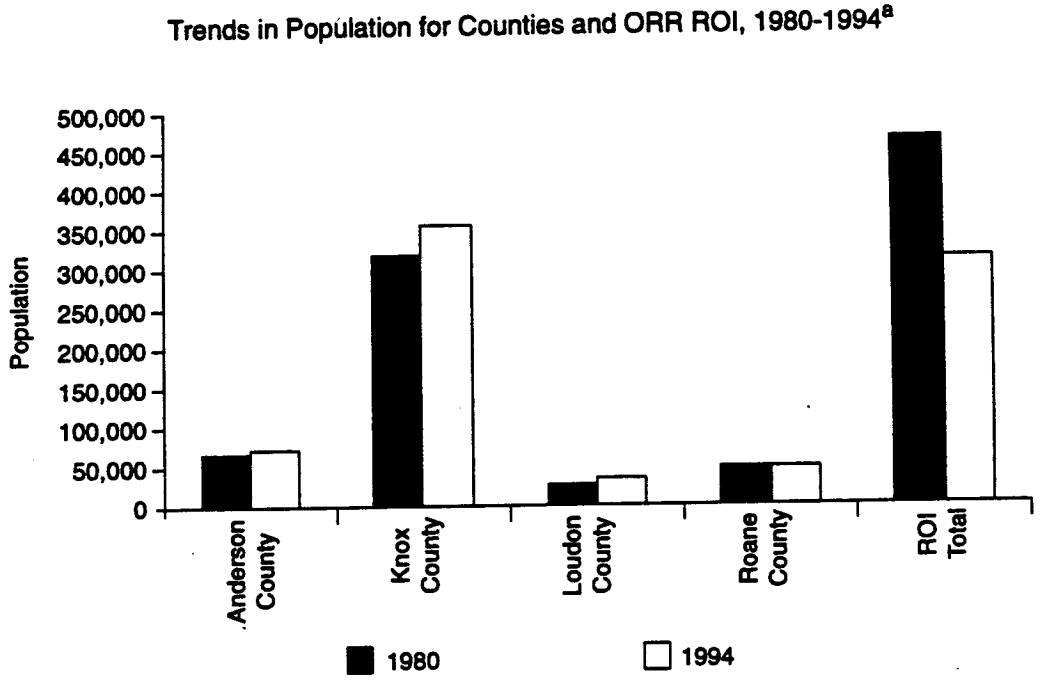
Public Safety. City, county, and State law enforcement agencies provided police protection to the residents of the ROI. In 1994, a total of 885 sworn police officers served the four-county area. The city of Knoxville employed the largest number of officers (337), while Anderson County had the highest officer-to-population ratio (3.7 sworn officers per 1,000 persons). The average ROI officer-to-population ratio was 1.7 officers per 1,000 persons. Figure 3.6.8–4 compares police force strengths across the ROI.

Fire protection services in the ORR ROI were provided by 1,120 paid and volunteer firefighters in 1995. The fire district with the highest firefighter-to-population ratio was located in the city of Kingston, 7.1 firefighters per 1,000 persons, as indicated in Figure 3.6.8–4. Knoxville employed the greatest number of firefighters (357). The average firefighter-to-population ratio in the ROI was 2.2 firefighters per 1,000 persons.



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.6.8–1. Employment and Local Economy for the Oak Ridge Reservation Regional Economic Area and the State of Tennessee.



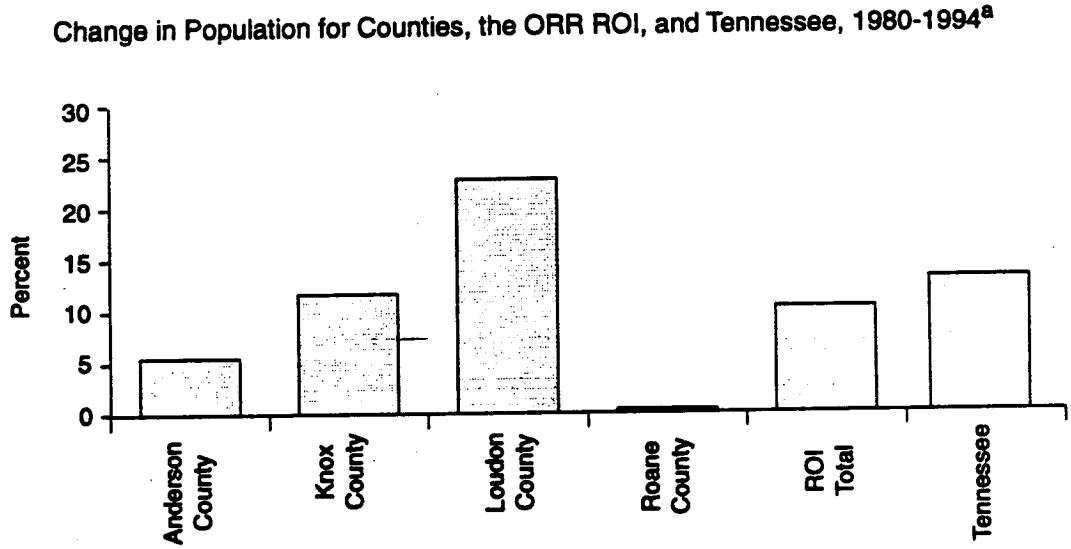
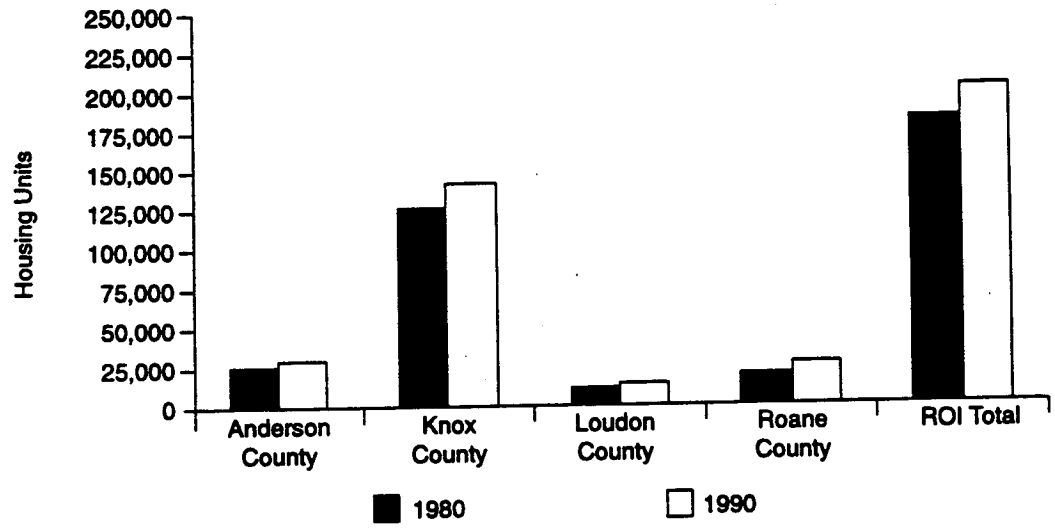
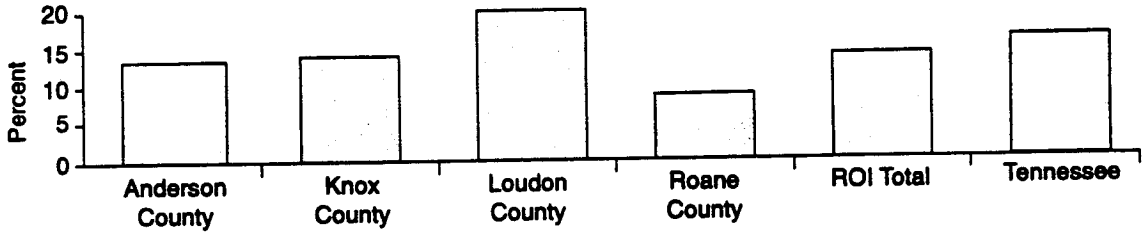


Figure 3.6.8–2. Population and Housing for the Oak Ridge Reservation Region of Influence and the State of Tennessee.

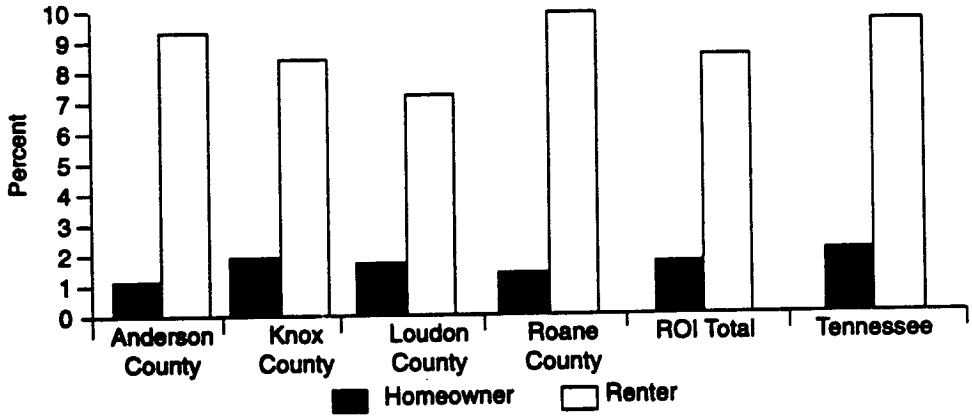
Trends in Housing for Counties and the ORR ROI, 1980-1990[b,c]



Change in Housing for Counties, the ORR ROI, and Tennessee, 1980-1990[b,c]



Homeowner and Renter Vacancy Rates for Counties, the ORR ROI, and Tennessee, 1990[c]



[a] Census 1983q; Census 1995a.
[b] Census 1982d.
[c] Census 1991c.

Figure 3.6.8–2. Population and Housing for the Oak Ridge Reservation Region of Influence and the State of Tennessee—Continued.

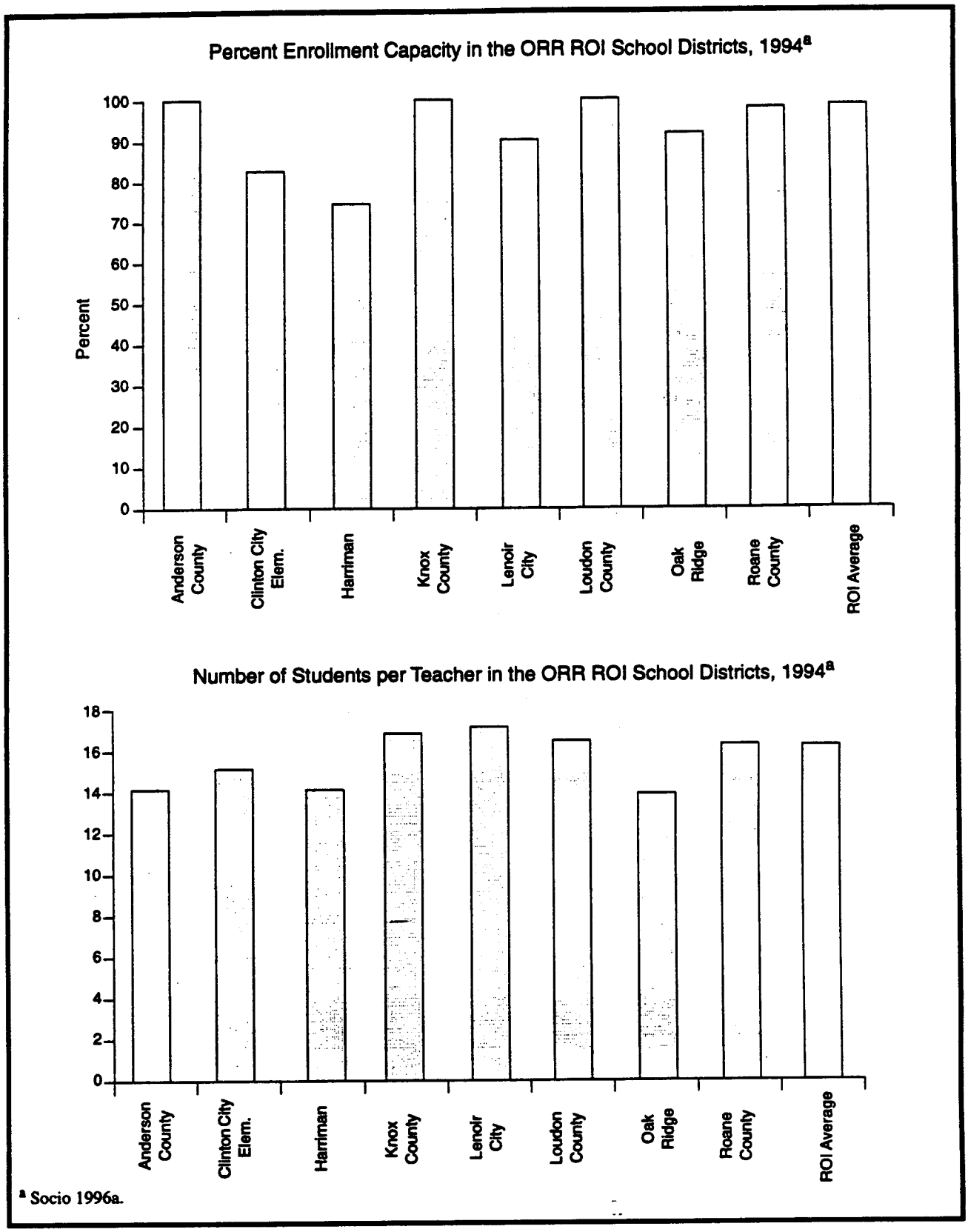
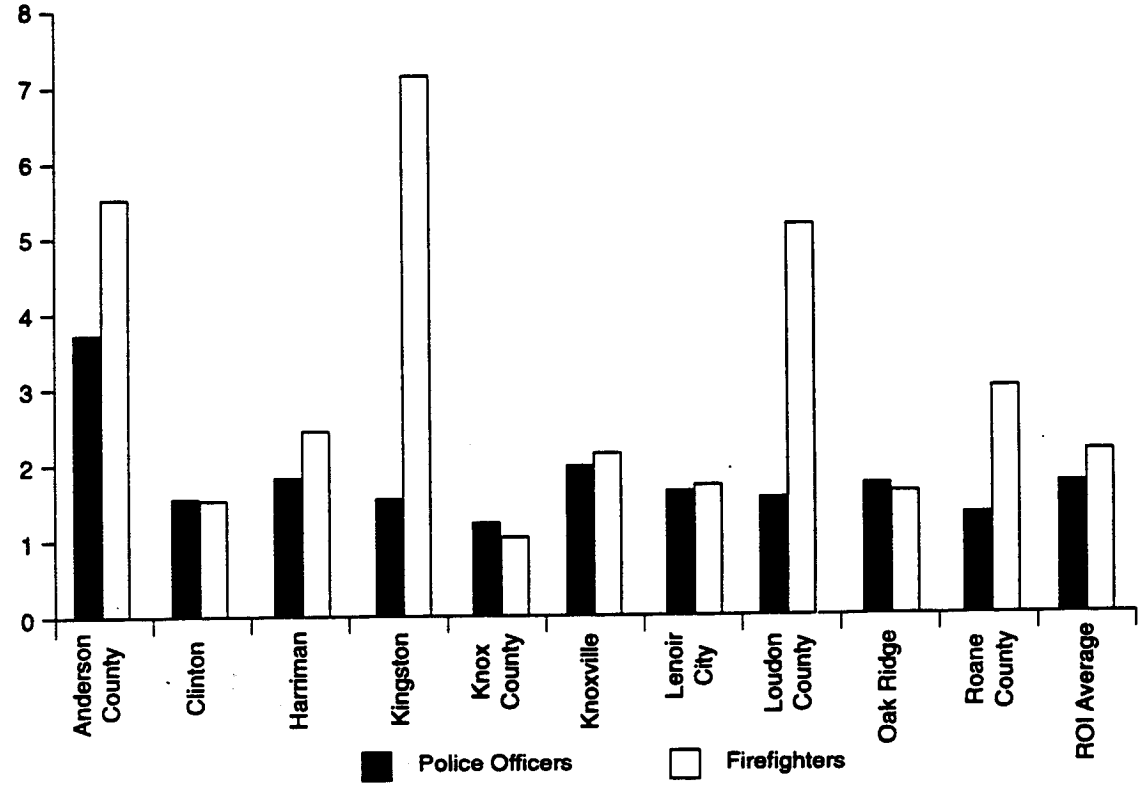
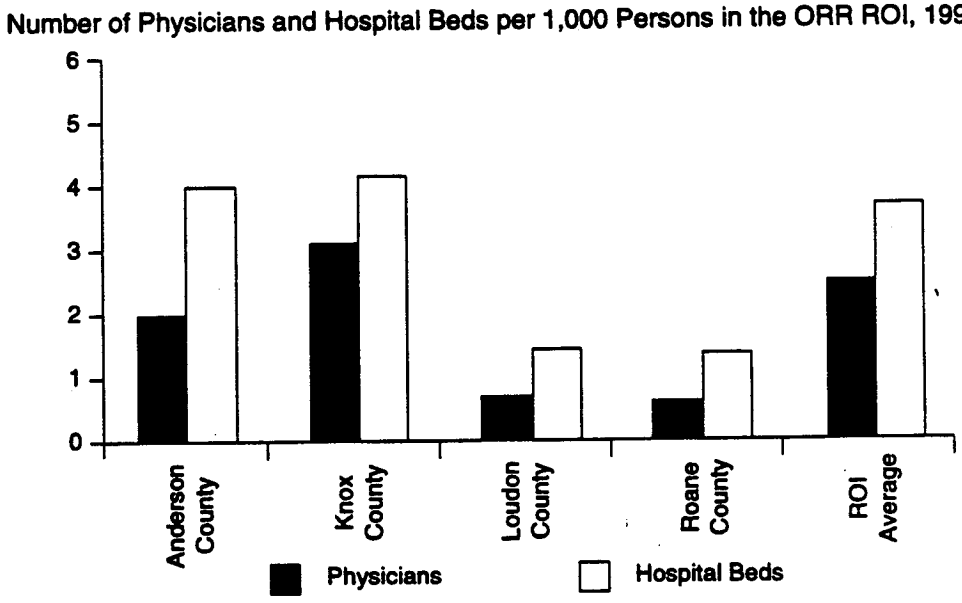


Figure 3.6.8–3. School District Characteristics for the Oak Ridge Reservation Region of Influence.



Note: Except for ROI cities, city sworn police officers and firefighters are included in the county totals.



[a] Census 1993b; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.6.8–4. Public Safety and Health Care Characteristics for the Oak Ridge Reservation Region of Influence.

Health Care. There were 10 hospitals serving the four-county ROI in 1994. Over 78 percent of the hospital beds capacity was located in six hospitals in Knox County. Figure 3.6.8–4 displays the hospital bed-to-population ratios for the ORR ROI counties. During 1994, all 10 hospitals operated at below capacity, with bed occupancy rates ranging from 32.0 percent in Loudon County to 65.3 percent in Anderson County.

There were 1,306 physicians in the ROI during 1994, with the majority (1,109) practicing in Knox County. Figure 3.6.8–4 shows that the physician-to-population ratios ranged from 0.6 physicians per 1,000 persons in Roane County to 3.1 physicians per 1,000 persons in Knox County. The average ROI physician-to-population ratio was 2.5 physicians per 1,000 persons.

Local Transportation. Interstates and State Routes provide access between ORR and metropolitan areas (see Figure 2.2.5-1 and Figure 2.2.5-2). The east-west highway, Interstate 40, located 3 km (2 mi) south of the reservation boundary, provides access to the cities of Nashville and Knoxville, Tennessee. The north-south highway, Interstate 75, is located 5 km (3 mi) east of ORR and serves as a major route to the south, passing through the cities of Chattanooga, Tennessee, and Atlanta, Georgia.

Vehicular access to ORR is provided by three State Routes. State Route 95 forms an interchange with Interstate 40 and enters the reservation from the south. State Route 58 enters the reservation from the west and passes just south of K–25. State Route 162 extends from Interstate 75 and Interstate 40 just west of Knoxville and provides eastern access to the ORR.

Within ORR, several routes are used to transfer traffic from the State Routes to the main plant areas. Bear Creek Road, located north of Y–12, flows in an east-west direction and connects Scarboro Road on the east end of the plant with State Route 95 and State Route 58. Bear Creek Road has restricted access around Y–12 and is not a public thoroughfare. Bethel Valley Road, a public roadway, extends from the east end of the ORR at State Route 62 to the west end at State Route 95. Blair Road provides access to K–25 from the north.

There are two current road improvement projects affecting access to ORR. The first is the construction of two box bridges on State Route 61 near Oak Ridge. The second is the repavement of State Route 62 from Tuskegee Drive to north of Union Valley Road. There are two planned road improvement projects that could affect access to ORR in the near future. The first is the reconstruction of State Route 9 in Lake City. The second is the construction of State Route 58 from Interstate 40 to State Route 95 in Oak Ridge (TN DOT 1995a:3).

Five road segments in the ROI could be affected by the storage and disposition alternatives. The first is I-275 from I-40 at Knoxville to I-75/640 at Knoxville. This segment operated at level of service D in 1995. The second is I-640 from I-75 at Knoxville to I-40. This segment operated at level of service D in 1995. The third is U.S. 70 from U.S. 321 to U.S. 11. This segment operated at level of service B in 1995. The fourth is Tennessee State Route 58 from Tennessee State Route 95 to I-40. The segment operated at level of service E in 1995. The fifth is Tennessee State Route 62 from Tennessee 95 at Oak Ridge to Tennessee State Route 170. This segment operated at level of service F in 1995.

Two main line branches provide rail service for ORR. The CSX Transportation line at Elza (just east of Oak Ridge) serves the Y–12 Plant and the Office of Science and Technological Information in east Oak Ridge. The Norfolk Southern main line from Blair provides easy access to K–25. The Clinch River has a barge facility located on the west end of ORR near K–25 and is occasionally used for the receipt of shipments that are too large or heavy to be transported by rail or truck. McGhee Tyson Airport, located 37 km (23 mi) from ORR, is the nearest airport serving the region with major carriers providing passenger and cargo service. A private airport, Atomic Airport, Inc., is the closest air transportation facility to Oak Ridge. Oak Ridge has a part-time public transportation system (ORR 1995a:7).

3.6.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of ORR are shown in Table 3.6.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to ORR operations.

Table 3.6.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Oak Ridge Reservation Operation

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic radiation	27
External terrestrial radiation	28
Internal terrestrial radiation	40
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fall out	<1
Air travel	1
Consumer and industrial products	10
Total	360

[a] OR DOE 1994c.

[b] NCRP 1987a.

Source: Value of radon is an average for the United States.

Releases of radionuclides to the environment from ORR operations provide another source of radiation exposure to individuals in the vicinity of ORR. Types and quantities of radionuclides released from operations in 1993 are listed in the *Oak Ridge Reservation Environmental Report for 1993* (ES/ESH-47). Doses to the public resulting from these releases and direct radiation are presented in Table 3.6.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1993 report were used in the development of the reference environment (No Action) radiological releases and resulting impacts at ORR in the year 2005 (Section 4.2.5.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from ORR operations in 1993 is estimated to be 1.5×10^{-6}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of ORR operations is less than 2 in 1 million. (Note that it takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Based on the same risk estimator, 0.014 excess fatal cancers are projected in the population living within 80 km (50 mi) of ORR from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national rate, the number of fatal cancers expected to occur during 1993 from all causes was 1,760 for the population living within 80 km (50 mi) of ORR. This number of expected fatal cancers is much higher than the estimated 0.014 fatal cancers that could result from ORR operations in 1993.

Table 3.6.9–2. Radiation Doses to the Public From Normal Oak Ridge Reservation Operation in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	1.4	4	0.60[b]	100	3.0[c]
Population within 80 km[d] (person-rem)	None	26	None	2.0	100	28.0
Average individual within 80 km[e] (mrem)	None	0.030	None	0.0023	None	0.032

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] These doses are mainly from drinking water and eating fish from the Clinch River section of Poplar Creek.

[c] This total dose includes 1 mrem/yr from direct radiation exposure to a cesium field near the Clinch River.

[d] In 1993, this population was approximately 880,000.

[e] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: OR DOE 1994c.

Oak Ridge Reservation workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.6.9–3 presents the average worker, maximally exposed worker, and cumulative worker dose to ORR workers from operations in 1992. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to ORR workers from normal operations in 1992 is estimated to be 0.027.

Table 3.6.9–3. Radiation Doses to Workers From Normal Oak Ridge Reservation Operation in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	4.0
Maximally exposed worker (mrem)	5,000	2,000
Total workers[b] (person-rem)	ALARA	68

[a] DOE's goal is to maintain radiological exposures as low as reasonably achievable.

[b] The number of badged workers in 1992 was approximately 17,150.

Source: 10 CFR 835; DOE 1993n:7.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Oak Ridge Reservation Environmental Report for 1993* (ES/ESH-47). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in the same report.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain

hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface waters during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in previous sections of this PEIS, particularly Section 3.6.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements) contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations via inhalation of air containing hazardous chemicals released to the atmosphere by ORR operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.6.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to ORR workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. ORR workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements (DOE O 440.1) ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at ORR are expected to be substantially better than required by the standards.

Health Effects Studies. Two epidemiologic studies were conducted to determine whether ORR contributed to any excess cancers in communities surrounding the facility. One study found no excess cancer mortality in the population living in counties surrounding ORR when compared to the control populations located in other nearby counties and elsewhere in the United States. The other found slight excess cancer incidences of several types in the counties near ORR, but none of the excess risks were statistically significant.

A pilot study on mercury contamination conducted by the Tennessee Department of Health and Environment showed no difference in urine or hair mercury levels between individuals with potentially high mercury exposures compared to those with little potential for exposure. However, soil analysis showed that the mercury in soil was inorganic, which decreases the likelihood of bioaccumulation and health effects. Studies are continuing on the long-term effects of exposure to mercury and other hazardous chemicals.

More epidemiologic studies have been conducted to assess the health effect of the population working at ORR than any other site reviewed for this document. Excess cancer mortalities have been reported and linked to specific job categories, age, and length of employment, as well as to the levels of exposure to radiation. For a more detailed description of the studies reviewed and the findings, refer to Section M.4.6.

Accident History. There have been no accidents with a measurable impact on offsite population during nearly 50 years of Y–12 operations at ORR. The most noteworthy accident in Y–12 history was a 1958 criticality accident. The impact from this accident resulted in temporary radiation sickness for a few ORR employees. In 1989, there was a one-time accidental release of xylene into the ORR sewer system with no offsite impacts.

Accidental releases of anhydrous hydrogen fluoride occurred in 1986, 1988, and 1992, with little onsite and negligible offsite impacts. The hydrogen fluoride system where these accidents occurred is being modified to reduce the probability of future releases and to minimize the potential consequences if a release does occur (ORR 1992a:6).

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

The Department has overall responsibility for emergency planning and operations at ORR. However, DOE has delegated primary authority for event response to the operating contractor. Although the contractor's primary response is onsite, the contractor does provide offsite assistance if requested under the terms of existing mutual aid agreements. If a hazardous materials event with offsite impacts occurs at a DOE ORR facility, elected officials and local governments are responsible for the State's response efforts. The Governor's Executive Order No. 4 established the Tennessee Emergency Management Agency as the agency responsible for coordinating State emergency services. When a hazardous materials event occurring at DOE facilities is beyond the capability of local government, and assistance is requested, the Tennessee Emergency Management Agency Director may direct State agencies to provide assistance to the local governments. To accomplish this task and ensure prompt initiation of emergency response actions, the Director may cause the State Emergency Operations Center and Field Coordination Center to be activated. City or county officials may activate local Emergency Operations Centers in accordance with existing emergency plans.

3.6.10 WASTE MANAGEMENT

This section outlines the major environmental regulatory structure and ongoing waste management activities for ORR. A more detailed discussion of the ongoing waste management operations is provided in Section E.2.5. Tables 3.6.10–1 (Y–12), 3.6.10–2 (ORNL), and 3.6.10–3 (K–25) present a summary of waste management activities at ORR for 1994.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations at ORR. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed-upon milestones.

The EPA placed ORR on the NPL on November 21, 1989. DOE, EPA Region IV, and the TDEC completed a Federal Facility Agreement effective January 1, 1992. This agreement coordinates ORR inactive site assessment and remedial action. Portions of the Federal Facility Agreement are applicable to operating waste management systems. Existing actions are conducted under RCRA and applicable State laws, which minimize duplication, expedite response actions, and achieve a comprehensive remediation of the site. ORR generates and manages spent nuclear fuel and the following waste categories: TRU, low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. The ORR generates and manages a relatively small quantity of spent nuclear fuel. The only operating reactor is the ORNL High-Flux Isotope Reactor, which is used to produce isotopes for medical and industrial applications, neutron scattering experiments, and various materials irradiation experiments. ORR has also received some offsite shipments of reactor irradiated nuclear material. Most of the fuel and irradiated nuclear material is stored in numerous buildings and hot cells at ORNL and one building at Y–12. Some of the fuel still remains in the core of the inactive research reactors. Irradiated fuel and its associated fission products are stored in dry wells at ORNL in Solid Waste Storage Area-5N. A small amount of irradiated spent nuclear fuel is stored in wells and trenches in Solid Waste Storage Areas-5S and -6. The interim management of the spent nuclear fuel will be in accordance with the ROD published in the *Federal Register* (60 FR 28680) on June 1, 1995, for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F) as amended on March 8, 1996 (61 FR 9441).

High-Level Waste. The ORR does not generate or manage HLW.

Transuranic Waste. The ORNL is the only generator of TRU waste at ORR. Solid TRU waste consisting of filters, paper, metals, and other items was generated at ORNL through laboratory, pilot plant, and reactor operations. This includes both contact-handled and remote-handled TRU waste contaminated with lead and, in some cases, mercury. Contact-handled waste is TRU waste that contains mainly Pu, which emits alpha particles and low-energy photons. The packaging is designed to provide sufficient containment and shielding to minimize personnel exposure. Remote-handled TRU waste contains activation materials and fission products that decay and emit beta and gamma radiation on the surface of the packaging that exceeds 200 mrem/hr.

As of December 31, 1994, approximately 1,360 m^3 (1,790 yd^3) of TRU wastes were in retrievable drum storage. The amount of remote-handled waste was about 1,420 m^3 (1,860 yd^3) (OR LMES 1996a:4-4b). Current activities center around certification of contact-handled waste, planning/designing of a repackaging and certification facility for remote-handled wastes, and planning for shipment of wastes to a suitable repository that can provide for the disposal of TRU wastes.

Low-Level Waste. Solid LLW, consisting primarily of radioactively-contaminated construction debris, wood, paper, asbestos, trapping media, personnel protection equipment, process equipment, and radioactive materials

Table 3.6.10–1. Spent Nuclear Fuel and Waste Management Activities at Oak Ridge Reservation, Y–12 Plant

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent Nuclear Fuel	None	NA	NA	Storage vaults[a]	4[b]	None-Ship to INEL or SRS	NA
Low-Level							
Liquid	898	Activated sludge	12,900[c]	Stored onsite	Included in liquid mixed LLW	NA	NA
Solid	5,230[d]	Stabilization and compaction, incineration and smelting by commercial vendor	19,300[e]	Stored onsite at Y–12 or K–25	16,200[f]	None—stored pending availability of offsite disposal or planned onsite LLW disposal facilities	NA
Mixed Low-Level							
Liquid	1,390	Neutralization, activated sludge, oxidation, adsorption, and incineration at K–25	12,300[g]	Tanks and drums	2,660[h]	NA	NA
Solid	306	Incineration at K–25 or offsite commercial vendors	NA	Staged for shipment	11,700[i]	Offsite	NA
Hazardous							
Liquid	9,450	Managed as mixed LLW	30,300[j]	Tanks	751[k]	Offsite	NA
Solid	Included in hazardous liquid[l]	None	NA	Staged for shipment	170[m]	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	2,460 m^3/day[n]	Offsite[o]	5,300 m^3/day	None	NA	Offsite	NA
Solid	41,700[p]	Compaction	41,700[q]	None	NA	Industrial and Sanitary Landfill V, offsite at municipal site	1,100,000[r]

Table 3.6.10–1. Spent Nuclear Fuel and Waste Management Activities at Oak Ridge Reservation, Y–12 Plant—Continued

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Other)							
Liquid	228,000[s]	Evaporation, neutralization, and precipitation	251,000[t]	None	NA	Offsite-NPDES outfall	NA
Solid	Included in solid sanitary	None	NA	None	NA	Construction Demolition Landfill VI	119,000[r]

[a] Building 9720-5.

[b] Based on conversion factor of 52 kg/m^3(DOE 1995kk). [Text deleted.]

[c] West End Treatment Facility and Central Pollution Control Facility.

[d] Includes 2,500 m^3 of contaminated scrap metal.

[e] Waste Feed Preparation Facility and the Uranium Chip Oxidizer Facility (design feed rate).

[f] Includes the Depleted Uranium Oxide Storage Vaults, Above Grade Storage Facility, salvage yard, Sludge Basin and the Containerized Waste Storage Area.

[g] Includes Waste Coolant Processing Facility, Acid Waste Neutralization and Recovery Facility, Cyanide Treatment Facility, and Groundwater Treatment Facility. The West End Treatment Facility, the Plating Rinsewater Treatment Facility, and the Central Pollution Control Facility can process mixed waste and LLW.

[h] OD7, OD8, OD9, and OD10, Liquid Storage Facility, 9212 Tank Farm, and Building 9720-9 (western half).

[i] RCRA and PCB Container Storage Area (9720-58), Container Storage Facility (Bldg. 9720-12), PCB Drum Storage Facility (9404-7), Buildings (9201-4, 9206, and 9212), and the West End Tank Farm.

[j] Plating Rinsewater Treatment Facility and Stream Plant Wastewater Treatment Facility.

[k] Building 9720-9 (eastern half).

[l] Currently, all RCRA-hazardous wastes are stored at the Y–12 plant or the K–25 Site awaiting further disposal.

[m] RCRA Storage and Staging Area (Bldg. 9720-31).

[n] Storm runoff does not include sewage waste.

[o] Oak Ridge Sewage Treatment Plant.

[p] Includes trash, debris, scrap metal, treatment residue, and classified waste.

[q] The 1994 generation rate was used as an estimate for the capacity of the Building 9720-25 Baler Facility.

[r] Serves all three sites. Value provided is design capacity. Projected utilization is 39,600 m^3/yr for Industrial and Sanitary Landfill V and 27,500 m^3/yr for Construction Demolition Landfill VI.

[s] Includes industrial wastes such as oils and solvents, liquid waste and wastewater from Y–12 Plant operations, contractors and waste management.

[t] Approximate Central Pollution Control Facility, West End Treatment Facility, and Steam Plant Wastewater Treatment Facility NPDES permit annual discharge volume limits for East Fork Poplar Creek.

Note: NA=not applicable.

Source: DOE 1994d; DOE 1994n; DOE 1995gg; DOE 1995kk; OR DOE 1992c; OR DOE 1995g; OR LMES 1996a; OR MMES 1995c; ORR 1993a:4.

Table 3.6.10–2. Spent Nuclear Fuel and Waste Management Activities at Oak Ridge National Laboratory

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent Nuclear Fuel	2[a]	None	NA	Pools	53[b]	None-Ship to INEL or SRS	NA
Transuranic (Solid)							
Contact handled	103[c]	None	NA	Staged for shipment[d]	1,760	None, WIPP or alternate facility in future	NA
Remote handled	64	None	NA	Staged for shipment[e]	856	None, WIPP or alternate facility in future	NA
Low-Level							
Liquid	2,070	Ion exchange, filtration, evaporation, and solidification	390,000[f]	Stored onsite in tanks	3,230[g]	NA	NA
Solid	1,640[h]	Compaction (compaction, incineration and smelting by commercial vendor)	11,300[i]	Stored onsite	7,850[j]	Onsite	3,590[k]
Mixed Low-Level							
Liquid	Included in solid mixed LLW[l]	Incineration at K–25	Offsite	Tank and drums	393[m]	None	NA
Solid	92[n]	Incineration at K–25 or offsite commercial vendors	Offsite	Staged for shipment	Include in liquid mixed LLW	Offsite	NA
Hazardous							
Liquid	23,800[o]	Neutralization/ sedimentation and evaporation, treat offsite[p]	Included in nonhazardous (other) liquid capacity	Staged for shipment	Included in solid hazardous	Offsite	NA
Solid	55[p]	Open-burning[q], treat offsite	Variable	Staged for shipment	130[r]	Storage/incineration (K–25) and landfill (Y–12)	NA

Table 3.6.10–2. Spent Nuclear Fuel and Waste Management Activities at Oak Ridge National Laboratory—Continued

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Sanitary)							
Liquid	360,000	Extended aeration-activated sludge treatment	414,000[s]	None	NA	NPDES outfall	NA
Solid	4,820	None[t]	NA	None	NA	Y–12 landfill, offsite to municipal site	See Table 3.6.10–1
Nonhazardous (Other)							
Liquid	718,000[u]	Neutralization, precipitation, and filtration	1,510,000[v]	None	NA	Offsite	NA
Solid	Included in solid sanitary	None	NA	None	NA	Y–12 landfill and SWSA 6 burial	Included in sanitary

[a] The HFIR research reactor generates 12 fuel assemblies per year (9.4 kg U-235 per assembly). Based on conversion factor of 52 kg/m^3 (DOE 1995kk).
[b] Includes 820 kg of available spent fuel capacity at the HFIR pool (43% full). Reracking of positions under way. Based on conversion factor of 52 kg/m^3, and the size of all fuel elements is assumed to be the same (DOE 1995kk).
[c] Does not include 8 m^3 of mixed TRU waste.
[d] Stored in various buildings (Bldg. 7826, 7834, 7842, 7878, 7879, and 7934).
[e] Stored in tanks, bunkers, and earthen trenches (Bldg. 7855 and SWSA 5N trenches).
[f] Process Waste Treatment Plant, Melton Valley Low-Level Waste Immobilization Facility and Liquid Low-Level Waste Evaporation Facility.
[g] Liquid LLW System.
[h] Includes radioactive scrap metal.
[i] Waste Compaction Facility (Bldg. 7831).
[j] As of June 30, 1995.
[k] Interim Waste Management Facility.
[l] May include 19 m^3 of mixed waste oil treated at TSCA incinerator in 1994.
[m] Buildings 7654, 7507W, 7823 and Tank 7830a.
[n] Includes waste oils, organic wastes, carcinogenic wastes, mercury-contaminated solid wastes, solvents, corrosives, poisons, and other process wastes.
[o] Projected Steam Plant regenerate in 1994 (may be coal yard runoff).
[p] Includes PCB and asbestos. May include some liquid hazardous waste.
[q] The Chemical Detonation Facility treats small amounts of hazardous waste that would be dangerous to transport offsite. Explosives such as aged picric acid are detonated in this facility.
[r] Hazardous Waste Storage Facility (Bldg. 7652 Part B permit - 57,200 l and Bldg. 7507 Part A permit - 31,200 l), and Buildings 7651 and 7653.
[s] Sanitary Waste Water Treatment Facility design capacity.
[t] Loaded in boxes and stored at Interim Waste Management Facility.
[u] May include coal yard runoff which is hazardous waste.
[v] Nonradiological Wastewater Treatment Facility.

Note: NA=not applicable.

DOE 1995ee; DOE 1995kk; OR DOE 1993b; OR DOE 1995e; OR LMES 1996a; OR MMES 1995c.

Table 3.6.10–3. Waste Management Activities at Oak Ridge Reservation, K–25 Site

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3/yr)
Low-Level							
Liquid	55	Incineration	15,700[a]	Stored onsite	Included in solid LLW[b]	NA	NA
Solid	4,480[c]	Compaction/ incineration and smelting by commercial vendor	Offsite	Stored onsite	44,000[d]	None–stored pending availability of offsite disposal or planned onsite LLW disposal facilities	NA
Mixed Low-Level							
Liquid	148,000[e]	Neutralization and incineration	221,000[f]	Stored onsite	97,000[g]	NA	NA
Solid	222[h]	Incineration or offsite by commercial vendors	Offsite[i]	Stored onsite	120,000[j]	Offsite	1,130[k]
Hazardous							
Liquid	Included in liquid mixed low-level[l]	Treated as mixed LLW	Included in liquid mixed LLW	Treated as mixed LLW	Included in liquid mixed LLW	Offsite	NA
Solid	743[m]	Treated as mixed LLW	Offsite[n]	Treated as mixed LLW	Included in solid mixed LLW	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	416,000	Extended aeration	829,000 - sewage[o]	None	NA	NPDES outfall	NA
Solid	2,950[p]	None	NA	None	NA	Oak Ridge landfill (offsite)	NA

Table 3.6.10–3. Waste Management Activities at Oak Ridge Reservation, K–25 Site—Continued

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3/yr)
Nonhazardous (Other)							
Liquid	69,300[q]	Neutralization settling; and filtration	221,000[r]	None	NA	NPDES outfall	NA
Solid	Included in solid sanitary	None	NA	Stockpiled at scrap yard	Unspecified capacity	Y–12 landfill and metal sold to public	See Table 3.6.10–1

[a] TSCA Incinerator (K-1435). Also treats mixed waste.
[b] Liquid LLW stored in Building K–25 vaults.
[c] Includes 103 m^3 of contaminated scrap metal.
[d] Based on solid LLW stored in Building K–25, outside areas, K-1313A, and K-33.
[e] Includes TSCA waste waters and density assumption is equal to 1 kg/l.
[f] Central Neutralization Facility permitted operating capacity.
[g] Includes current permitted container (solid/sludges/liquid wastes) and tank (liquids) storage capacity.
[h] Includes contaminated asbestos/beryllium oxide (BeO), RCRA and state regulated waste, and may include some PCB-tainted waste.
[i] Sludge Fixation Facility may be used after engineering problems are solved.
[j] Total current permitted waste pile unit storage capacity.
[k] Waste sent to commercial vendor in 1994.
[l] Hydrogen softener blowdown from the steam plant.
[m] Managed as mixed waste.
[n] Sludge Fixation Facility may be used after engineering problems are solved
[o] Sewage treatment plant capacity (Bldg. K-1203).
[p] Includes waste shipped to Y–12 Sanitary Landfill.
[q] Includes nonhazardous Steam Plant waste water.
[r] Central Neutralization Facility permitted capacity.

Note: NA=not applicable.
Source: DOE 1995gg; OR DOE 1993a; OR LMES 1996a; ORR 1993a:4.

removed from liquid and airborne discharges, is generated at ORR. ORNL operates the only LLW disposal facility at ORR. This disposal facility only accepts LLW generated at ORNL. Solid LLW is being stored at K–25 and Y–12 for future disposal. Contaminated scrap metal is stored above ground at the K-770 scrap metal facility and the Y–12 old salvage yard until further disposal methods are evaluated.

The management of LLW at ORR has been affected by three recent events: declines in ORR disposal capacity, changes in regulatory and operational conditions, and evolution of the radioactive waste disposal-class concept. The previous strategy classified LLW according to its isotopic content, concentration, and the performance of a disposal facility. In some instances, these classifications are used to describe the type of LLW or a disposal technology. For example, L-I refers to low concentration LLW or a landfill disposal facility, while L-II refers to low to moderate concentration LLW or a tumulus disposal facility. A revised classification system has been proposed. Exempt LLW would have contaminant levels sufficiently low to be disposed of in a sanitary or industrial landfill with State concurrence. Disposable LLW would be suitable for disposal on the ORR as determined by facility performance assessments. Offsite LLW would be that LLW which would not meet the criteria of exempt or disposable. The long-range strategy is to rely on the combination of onsite and offsite facilities. Plans for a replacement onsite disposal facility will continue to be pursued with the most likely candidate site for a tumulus disposal facility being Bear Creek Valley. That portion of the LLW that cannot be disposed of onsite consistent with DOE Order 5820.2A, *Radioactive Waste Management*, will be stored until disposal offsite becomes available.

Mixed Low-Level Waste. The RCRA mixed, radioactive land disposal restricted waste is in storage at Y–12, K–25, and ORNL. Because prolonged storage of these wastes exceeded the one-year limit imposed by RCRA, ORR entered into a Federal Facility Compliance Agreement (FFCA) for RCRA Land Disposal Restriction wastes with EPA on June 12, 1992. This agreement was terminated with issuance of the TDEC Commissioner's Order, effective October 1, 1995, which requires DOE to comply with the Site Treatment Plan prepared by ORR. The plan contains milestones and target dates for DOE to characterize and treat its inventory of mixed wastes at ORR.

Sludges contaminated with low-level radioactivity are generated by settling and scrubbing operations, and in the past were stored in K-1407-B and 1407-C ponds at K–25. Sludges have been removed from these ponds and a portion has been fixed in concrete at the K-1419 Sludge Treatment Facility and stored at the K-33 Building. The concreted sludges are being shipped offsite for disposal. The raw sludges are stored in the in the K–1065 building pending further treatment. Mixed waste sludges are also generated at Y–12 in the treatment of nitrate waste from purification and recycling of uranium and in the treatment of plating shop waste.

The primary facility generator of liquid mixed waste is the K-1435 TSCA Incinerator from the wet scrubber blowdown. This waste is currently being treated at the Central Neutralization Facility, which provides pH adjustment and chemical precipitation. Treated effluents are discharged through an NPDES outfall. The contaminated sludges are stored at K–25 as mixed waste.

The K–25 TSCA incinerator has a design capacity to incinerate 909 kg/hr (2,000 lb/hr) of mixed liquid waste and up to 455 kg/hr (1,000 lb/hr) of solids and sludge (91 kg/hr [200 lb/hr] maximum sludge content) (ORR 1993a:2). The TSCA incinerator is capable of incineration of both TSCA- and RCRA-mixed wastes. DOE guidance currently does not allow incineration of solids/sludges. Because of permit limits (TSCA, RCRA, State of Tennessee), the incinerator is not running at full capacity. In 1994, approximately 2,590 m^3 (683,000 gals) of mixed liquid waste was incinerated (OR LMES 1996a:7-6).

Uranium wastes contaminated with PCBs (that is, mixed wastes) are being stored in excess of the 1-year limit imposed by TSCA because of the lack of treatment and disposal capacities. DOE and EPA have signed an FFCA, effective February 20, 1992, to bring K–25 associated with the Uranium Enrichment Program into compliance with TSCA regulations for use, storage, and disposal of PCBs. It also addressed the approximately 10,000 pieces of nonradioactive PCB-containing dielectric equipment associated with the shutdown of diffusion

plant operations. An additional FFCA related to TSCA compliance is currently being discussed by DOE and EPA for ORR.

Hazardous Waste. The RCRA-regulated waste are generated by ORR in laboratory research, electroplating operations, painting operations, descaling, demineralizer regeneration, and photographic processes. Certain other wastes (for example, spent photographic processing solutions) are processed onsite into a nonhazardous state. Those wastes that are safe to transport and have been certified as having no radioactivity added are shipped offsite to RCRA-permitted commercial treatment and disposal facilities. Small amounts of reactive chemical explosives that would be dangerous to transport offsite, such as aged picric acid, are processed onsite in the Chemical Detonation Facility at ORNL.

Nonhazardous Waste. Nonhazardous wastes are generated from ORR maintenance and utilities. For example, the steam plant produces nonhazardous sludge. Scrap metals are discarded from maintenance and renovation activities and are recycled when appropriate. Construction and demolition projects also produce nonhazardous industrial wastes. All nonradioactive medical wastes are autoclaved to render them noninfectious and are sent to the Y–12 Sanitary Landfill. Remedial action projects also produce wastes requiring proper management. The State of Tennessee permitted landfill (Construction Demolition Landfill VI) receives nonhazardous industrial materials such as fly ash and construction debris. Asbestos and general refuse are managed in Industrial and Sanitary Landfill V located at Y–12.

3.7 SAVANNAH RIVER SITE

The SRS is located approximately 19 km (12 mi) south of Aiken, South Carolina (see Figure 2.2.6–1). First established in 1950, SRS has been involved for more than 40 years in tritium operations and other nuclear material production. Today the site includes 16 major production, service, research, and development areas, not all of which are currently in operation.

There are more than 3,000 facilities at SRS, including 740 buildings with 511,000 m^2 (5,500,000 ft^2) of floor area. Major nuclear facilities at SRS include fuel and Pu storage facilities and target fabrication facilities, nuclear material production reactors, chemical separations plants, a uranium fuel processing area, liquid HLW tank farms, a waste vitrification facility, and the Savannah River Technology Center. SRS processes nuclear materials into forms suitable for continued safe storage, use, or transportation to other DOE sites. In accordance with the ROD for the *F-Canyon Plutonium Solutions Environmental Impact Statement* (60 FR 9824), and the *Environmental Impact Statement, Interim Management of Nuclear Materials* (60 FR 65300 and 61 FR 6633) Pu solutions have been stabilized and targets have been dissolved and processed in the F-Canyon. A second supplemental ROD announcing DOE's decision for the stabilization of Pu-239 solutions by conversion to metal at F-Canyon and the FB-Line was published September 13, 1996 (61 FR 48474). Tritium recycling facilities at SRS empty tritium from expired reservoirs, purify it to eliminate the helium decay product, and fill replacement reservoirs with specification tritium for nuclear stockpile weapons. Filled reservoirs are delivered to Pantex for weapons assembly and directly to DoD to replace expired reservoirs. Historically, DOE has produced tritium at SRS, but has not produced any since 1988.

Department of Energy Activities. The current missions at SRS are shown in Table 3.7–1. [Text deleted.] In the past, the SRS complex produced nuclear materials. The complex consisted of various Pu storage facilities, five reactors (the C-, K-, L-, P-, and R-Reactors) (all inactive), a fuel and target fabrication plant, two chemical separation plants, a tritium-target processing facility, a heavy water rework facility, and waste management facilities. The K-Reactor (the last operational reactor) has been shut down with no planned provision for restart. SRS is still conducting tritium recycling operations in support of stockpile requirements using retired weapons as the tritium supply source. The Separations Facilities, and the F- and H-Canyons, are planned to be used through the year 2002 to complete DOE's commitment to the DNFSB regarding stabilization of site inventories of legacy nuclear materials.

The DOE Office of Environmental Management is pursuing a 30-year plan to achieve full compliance with all applicable laws, regulations, and agreements to treat, store, and dispose of existing wastes; reduce generation of new wastes; clean up inactive waste sites; remediate contaminated groundwater; and dispose of surplus facilities.

The Savannah River Technology Center provides technical support to all DOE operations at SRS. In this role, it provides process engineering development to reduce costs, waste generation, and radiation exposure. SRS has an expanding mission to transfer unique technologies developed at the site to industry. SRS is also an active participant in the Strategic Environmental R&D Program formulated to develop technologies to mitigate environmental hazards at DoD and DOE sites.

Non-Department of Energy Activities. Non-DOE facilities and operations at SRS include the Savannah River Forest Station, the Savannah River Ecology Laboratory, and the Institute of Archaeology and Anthropology. The Savannah River Forest Station is an administrative unit of the U.S. Forest Service, which provides timber management, research support, soil and water protection, wildlife management, secondary roads management, and fire management to DOE. The Savannah River Forest Station manages 62,300 ha (154,000 acres), comprising approximately 80 percent of the site area. It has been responsible for reforestation and manages an active timber business. The Savannah River Forest Station assists with the development and updating of sitewide land use and provides continual support with site layout and vegetative management. It also assists in long-term wildlife management and soil rehabilitation projects.

Table 3.7–1. Current Missions at Savannah River Site

Mission	Description	Sponsor
Pu storage	Maintain F-Area Pu storage facilities	Assistant Secretary for Environmental Management
Tritium recycling	Operate H-Area tritium facilities	Assistant Secretary for Defense Programs
Stabilize targets, spent nuclear fuels, and other nuclear materials	Operate F- and H-Canyons	Assistant Secretary for Environmental Management
Waste management	Operate waste processing facilities	Assistant Secretary for Environmental Management
Environmental monitoring and restoration	Operate remediation facilities	Assistant Secretary for Environmental Management
Research and development	Savannah River Technology Center technical support of DP, EM, and Nuclear Energy programs	Assistant Secretary for Defense Programs; Assistant Secretary for Environmental Management; Office of Nuclear Energy
Other non-DOE missions	Various, as described in text	Various

Source: SRS 1995a:2.

The Savannah River Ecology Laboratory is operated for DOE by the Institute of Ecology of the University of Georgia. It has established a center of ecological field research where faculty, staff, and students perform interdisciplinary field research and provide an understanding of the impact of energy technologies on the ecosystems of the southeastern United States. This information is communicated to the scientific community, government agencies, and the general public. In addition to Savannah River Ecology Laboratory studies, the Institute of Archaeology and Anthropology is operated by the University of South Carolina to survey the archaeological resources of SRS. These surveys are used by DOE when planning new facility additions or modifications, and are used as reference documents by site management.

3.7.1 LAND RESOURCES

Land Use. The SRS occupies approximately 80,130 ha (198,000 acres) in portions of Aiken, Barnwell, and Allendale Counties in southwestern South Carolina, approximately 40 km (25 mi) southeast of Augusta, Georgia (SR DOE 1995e:5-11). All of the land within SRS is owned by the Federal Government and is administered, managed, and controlled by DOE.

Existing Land Use. Generalized existing land uses at SRS and in the vicinity are shown in Figure 3.7.1–1. SRS land use can be grouped into three major categories: forest/undeveloped, water, and developed facility locations. Forest/undeveloped lands (for example, open fields and pine or hardwood forests) make up approximately 58,500 ha (144,500 acres) or 73 percent; water (for example, wetlands, streams, and lakes) comprising approximately 17,600 ha (43,500 acres) or 22 percent; and developed facility (for example, production and support areas, roads, and utility corridors) accounts for approximately 4,000 ha (9,900 acres) or 5 percent of the total land area of SRS. A forest management program has been in effect at SRS since 1952, when it was formed through an interagency agreement between DOE, then the AEC, and the U.S. Forest Service (WSRC 1993a:317). The majority of the woodlands area is in revenue producing, managed timber production. Soil map units that meet the soil requirements for prime farmland soils exist on SRS. However, U.S. Department of Agriculture, Natural Resources Conservation Service does not identify these lands as prime farmland due to the nature of site use (that is, the lands are not available for the production of food or fiber) (SR USDA 1995a:1).

In 1972, DOE designated the entire SRS as a NERP. The NERP is used by the national scientific community to study the impact of human activities on the cypress swamp and southeastern pine and hardwood forest ecosystems (DOE 1985a:1).

Land use bordering SRS is primarily forest and agricultural, although there is a substantial amount of open water and nonforested wetland along the Savannah River Valley. Incorporated and industrial areas are the only other significant land uses in the vicinity. There is a small amount of urban and residential development bordering SRS. The closest residences include several located to the west, north, and northeast that are within 61 m (200 ft) of the site boundary.

Land-Use Planning. Through Act 489, as amended in 1994, the State of South Carolina requires local jurisdictions (that is, counties and cities) to undertake comprehensive planning. Regional-level planning also occurs within the State, with the State divided into 10 planning districts guided by regional advisory councils. The councils provide technical planning assistance to local jurisdictions at their request. SRS is located within the counties of Aiken, Allendale, and Barnwell, which together constitute part of the Lower Savannah River Council of Governments (SR RCG 1995a:1).

Visual Resources. The SRS landscape is characterized by wetlands and upland hills. The vegetation is composed of bottomland hardwood forests, scrub oak and pine woodlands, and wetland forests. DOE facilities are scattered throughout SRS and are brightly lit at night. The developed areas and utility corridors (transmission lines and aboveground pipelines) of SRS are consistent with a BLM VRM Class 5 designation. The remainder of SRS generally ranges from VRM Class 3 to Class 4 designation.

The viewshed consists mainly of agricultural and heavily forested land, with some limited residential and industrial areas. Views are limited by rolling terrain, normally hazy atmospheric conditions, and heavy vegetation. DOE facilities are generally not visible from offsite. The only areas with visual sensitivity levels that are presently impacted by DOE facilities are the view corridors of State Highway 125 and SRS Road 1. The few other areas that have views of SRS facilities are quite distant (8 km [5 mi] or more) and have low visual sensitivity levels.

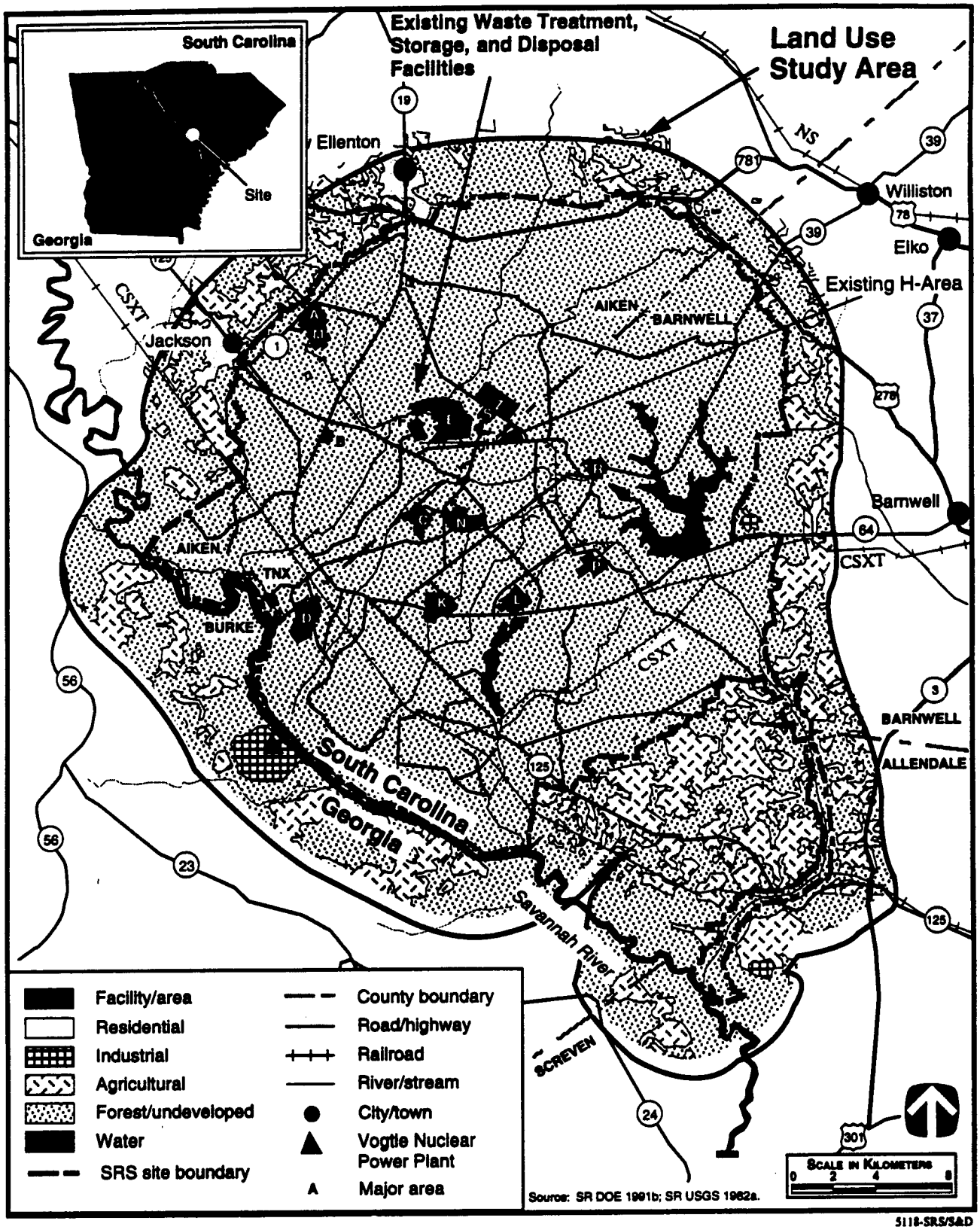


Figure 3.7.1–1. Generalized Land Use at Savannah River Site and Vicinity.

3.7.2 SITE INFRASTRUCTURE

Baseline Characteristics. The SRS contains extensive production, service, and research facilities. Not all of these facilities are in operation or needed today. To support current missions and functions, an extensive infrastructure exists, as shown in Table 3.7.2–1. Pu is currently stored in two vaults within the FB-line and three vaults in the 235-F Facility. Under No Action, APSF will be constructed to provide consolidated storage of all SRS nuclear materials. The road infrastructure is used for extensive intrasite transportation requirements. The railroad infrastructure is used to support large volume deliveries of coal and oversized structural components. SRS does not have a connection to the local natural gas lines.

Table 3.7.2–1. Savannah River Site Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	230	230
Railroads (km)	103	103
Electrical		
Energy consumption (MWh/yr)	659,000	1,672,000
Peak load (MWe)	130	330
Fuel		
Natural gas (m^3/yr)	0	0
Oil (l/yr)	28,400,000	28,400,000
Coal (t/yr)	210,000	244,000
Steam (kg/hr)	748,440,000	748,440,000

Source: SRS 1993a:3.

The electrical power infrastructure is of critical importance to the proposed actions involving construction of new facilities. The sub-regional electrical power pool area in which SRS is located and from which it draws its power is the Virginia-Carolina Sub-Region, a part of the Southeastern Electric Reliability Council. SRS draws its electrical power predominately from coal-fired plants and from 17 nuclear-powered generating plants. Characteristics of this power pool are given in Table 3.7.2–2.

Table 3.7.2–2. Virginia-Carolinas Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	50%
Nuclear	36%
Hydro/geothermal	2%
Oil/gas	3%
Other[b]	8%
Total Annual Production	272,155,000 MWh
Total Annual Load	284,556,000 MWh
Energy Imported Annually[c]	13,846,000 MWh
Generating Capacity	61,932 MWe
Peak Demand	55,477 MWe
Capacity Margin[d]	10,443 MWe

[a] Percentages do not total 100 percent due to rounding.

[b] Includes power from nonutility sources only.

[c] Energy imported is not the difference of production and load due to negative net pumped storage.

[d] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

3.7.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The SRS region has a temperate climate with short, mild winters and long, humid summers. Throughout the year, the climate is frequently affected by warm and moist maritime air masses. The average annual temperature at SRS is 17.3 °C (63.2 °F); temperatures vary from an average daily minimum of 0.0 °C (32 °F) in January to an average daily maximum of 33.2 °C (91.7 °F) in July. The average annual precipitation at SRS is 113.4 cm (44.66 in). Precipitation is distributed fairly evenly throughout the year, with the highest precipitation in summer and the lowest in autumn. There is no predominant wind direction at SRS. The average annual windspeed at Augusta NWS Station is 2.9 m/s (6.5 mph) (NOAA 1994c:3). Additional information related to meteorology and climatology at SRS is presented in Appendix F.

Ambient Air Quality. The SRS is located near the center of the Augusta-Aiken Interstate AQCR #53. As of 1995, the areas within SRS and its surrounding counties were in attainment with respect to the NAAQS for criteria pollutants (40 CFR 50; 40 CFR 81.311; 40 CFR 81.341). Applicable NAAQS and the ambient air quality standards for South Carolina and Georgia are presented in Appendix F.

Since the creation of the PSD program in 1977, PSD permits have not been required for any new SRS emission sources, nor have modifications been required to existing permits. There are no known PSD Class I areas within 100 km (62 mi) of SRS.

The emissions inventory for sources at SRS for criteria pollutants are presented in Appendix F. Historically, the primary emission sources of criteria air pollutants at SRS have been the nine coal-burning and four fuel oil-burning boilers that produce steam and electricity (A-, D-, H-, K-, and P-Areas), the fuel and target fabrication facilities (M-Area), and processing facilities (F- and H-Areas). Other emissions and sources include fugitive particulates from coal piles and coal-processing facilities, vehicles, and temporary emissions from various construction-related activities.

Hazardous and toxic air pollutant standards have been adopted by the South Carolina Department of Health and Environmental Control. (No ambient standards for hazardous and toxic air pollutants have been proposed or established by the State of Georgia.) The annual emission rates of hazardous and toxic air pollutants from existing SRS facilities during 1990 are listed in Appendix F.

Table 3.7.3–1 presents the baseline ambient air concentration for criteria pollutants and other pollutants of concern at SRS. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. Major noise sources at SRS are primarily located in developed or active areas and include various industrial facilities, equipment, and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Major noise emission sources outside of these active areas consist primarily of vehicles and rail operations. Existing SRS-related noise sources of importance to the public are those related to transportation of people and materials to and from the site, including trucks, private vehicles, helicopters, and trains.

Traffic from SRS operations is an important contributor to noise levels along site access highways through the nearby towns of New Ellenton, Jackson, and Aiken. Noise measurements recorded during 1989 and 1990 along State Route 125 in the town of Jackson at a point about 15 m (50 ft) from the roadway indicate that the 1-hour equivalent sound level from traffic ranged from 48 to 72 dBA. The estimated DNL average along this route was 66 dBA for summer and 69 dBA for winter. Similarly, noise measurements along State Route 19 in the town of New Ellenton at a point about 15 m (50 ft) from the roadway indicate that the 1-hour equivalent sound level from traffic ranged from 53 to 71 dBA. The estimated average DNL along this route was 68 dBA for summer and 67 dBA for winter (SR NUS 1990a:Appendices C and D).

Table 3.7.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Savannah River Site, 1990

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000[b]	22
	1-hour	40,000[b]	171
Lead	Calendar Quarter	1.5[b]	0.0004
Nitrogen dioxide	Annual	100[b]	5.7
Ozone	1-hour	235[b]	c
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	3.0
	24-hour	150[b]	50.6
Sulfur dioxide	Annual	80[b]	14.5
	24-hour	365[b]	196
	3-hour	1,300[b]	823
Mandated by the State of South Carolina			
Total suspended particulates	Annual	75[d]	12.6
Gaseous fluorides	30-day	0.8[d]	0.09
	7-day	1.6[d]	0.39
	24-hour	2.9[d]	1.04
	12-hour	3.7[d]	1.99
Hazardous and Other Toxic Compounds			
3,3-Dichlorobenzidine	24-hour	0.15[d]	0.002
Acrolein	24-hour	1.25[d]	0.016
Benzene	24-hour	150.00[d]	31.711
Bis (chloromethyl) ether	24-hour	0.03[d]	0.002
Cadmium oxide	24-hour	0.25[d]	0.021
Chlorine	24-hour	75.00[d]	7.630
Chloroform	24-hour	250.00[d]	4.957
Cobalt	24-hour	0.25[d]	0.206
Formic acid	24-hour	225.00[d]	2.420
Manganese	24-hour	25.00[d]	0.821
Mercury	24-hour	0.25[d]	0.014
Nickel	24-hour	0.50[d]	0.271
Nitric acid	24-hour	125.00[d]	50.960
Parathion	24-hour	0.50[d]	0.007
Phosphoric acid	24-hour	25.00[d]	0.462

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Federal and State standard.

[c] Data not available from source document.

[d] State standard.

Note: Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

Source: 40 CFR 50; SC DHEC 1991a; SC DHEC 1992b; SR DOE 1995b.

Most industrial facilities at SRS are at a sufficient distance from the site boundary that noise levels at the boundary from these sources would not be measurable or would be barely distinguishable from background noise levels.

The States of Georgia and South Carolina, and the counties in which SRS is located, have not established any noise regulations that specify acceptable community noise levels, with the exception of a provision in the Aiken County Zoning and Development Standards Ordinance which limits daytime and nighttime noise by frequency band (Appendix F).

3.7.4 WATER RESOURCES

Surface Water. The most prominent hydrologic feature at SRS is the Savannah River, bordering the site for 32 km (19.9 mi) to the southwest. Six major streams flow through SRS to the Savannah River: Upper Three Runs Creek, Beaver Dam Creek, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs Creek. Upper Three Runs has two tributaries, Tims Branch and Tinker Creek; Pen Branch has one tributary, Indian Grave Branch; and Steel Creek has one tributary, Meyers Branch. These surface water features are shown in Figure 3.7.4–1.

The SRS withdraws surface water from the Savannah River mainly for industrial cooling water purposes. A small quantity is also removed for drinking water supplies. Total water withdrawn from the Savannah River is currently 140,438 million l/yr (37,100 million gal/yr). Most of the water withdrawn is returned to the Savannah River through its onsite tributaries. Streams, especially Fourmile Branch, that received discharges from reactors in the past are still recovering from scouring or erosion impacts. The average flow rate of the Savannah River is 283 m^3/s (9,990 ft^3/s). The lowest recorded flow rate, 183 m^3/s (6,500 ft^3/s), occurred during a drought period from 1985 to 1988 (SR DOE 1990a:3-18). The minimum flow of Fourmile Branch is 0.16 m^3/s (5.8 ft^3/s).

The Savannah River also supplies potable water to several municipalities (SR DOE 1995e:3-8). Upstream from SRS, the Savannah River supplies domestic and industrial water needs to Augusta, Georgia; and North Augusta, South Carolina. The river also receives sewage treatment plant effluent from Augusta, Georgia; North Augusta, Aiken, and Horse Creek Valley, South Carolina; and, as described above, from a variety of SRS operations via onsite stream discharges. Approximately 203 km (126 mi) downstream from SRS, the river supplies domestic and industrial water needs for the Cherokee Hill Water Treatment Plant at Port Wentworth, Georgia, and for Beaufort and Jasper Counties in South Carolina.

There are two manmade water bodies on SRS: L-Lake, which discharges to Steel Creek; and Par Pond, which empties into Lower Three Runs Creek. Naturally-occurring surface water bodies include approximately 190 Carolina bays scattered throughout the site. Carolina bays are closed depressions that may hold water. There are no direct discharges to the bays, but some do receive stormwater runoff.

Average annual treated sanitary discharge volume from SRS to the Savannah River is approximately 700 million l/yr (185 million gal/yr), which is approximately 50 percent of the new centralized sanitary wastewater treatment facility capacity. Wastewater from the treatment plant is discharged to Fourmile Branch.

The proposed facilities are to be located outside of the 100-year floodplain. Sitewide information concerning 500-year floodplains at SRS is not available, but site-specific 500-year floodplain assessments would be completed prior to modifications and/or construction of individual project proposals.

Surface Water Quality. In the vicinity of SRS, the Savannah River and onsite streams are classified as fresh water suitable for the following: primary and secondary contact recreation; a source of drinking water, after conventional treatment in accordance with the requirements of the South Carolina Department of Health and Environmental Control; fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora; and industrial and agricultural uses (SC DHEC 1992a:29). Table 3.7.4–1 lists the surface water monitoring results for 1993 for the Savannah River downstream of SRS. The only parameters that exceeded Federal or State water quality criteria were aluminum, manganese, and turbidity.

In addition to water quality monitoring, SRS conducts monitoring to ensure compliance with NPDES permit limits. SRS has two NPDES permits for industrial wastewater discharge that cover 81 outfalls as part of the permit requirements and 1 general stormwater discharge permit that covers 48 outfalls. SRS collects and analyzes water from these outfalls to ensure compliance with NPDES permit limits. Of the 8,000 analyses performed at the industrial outfalls in 1993, 10 exceeded permit limits, for a compliance rate of 99.9 percent. Noncompliances were noted mainly for pH and total suspended solids with one noncompliance each for oil and

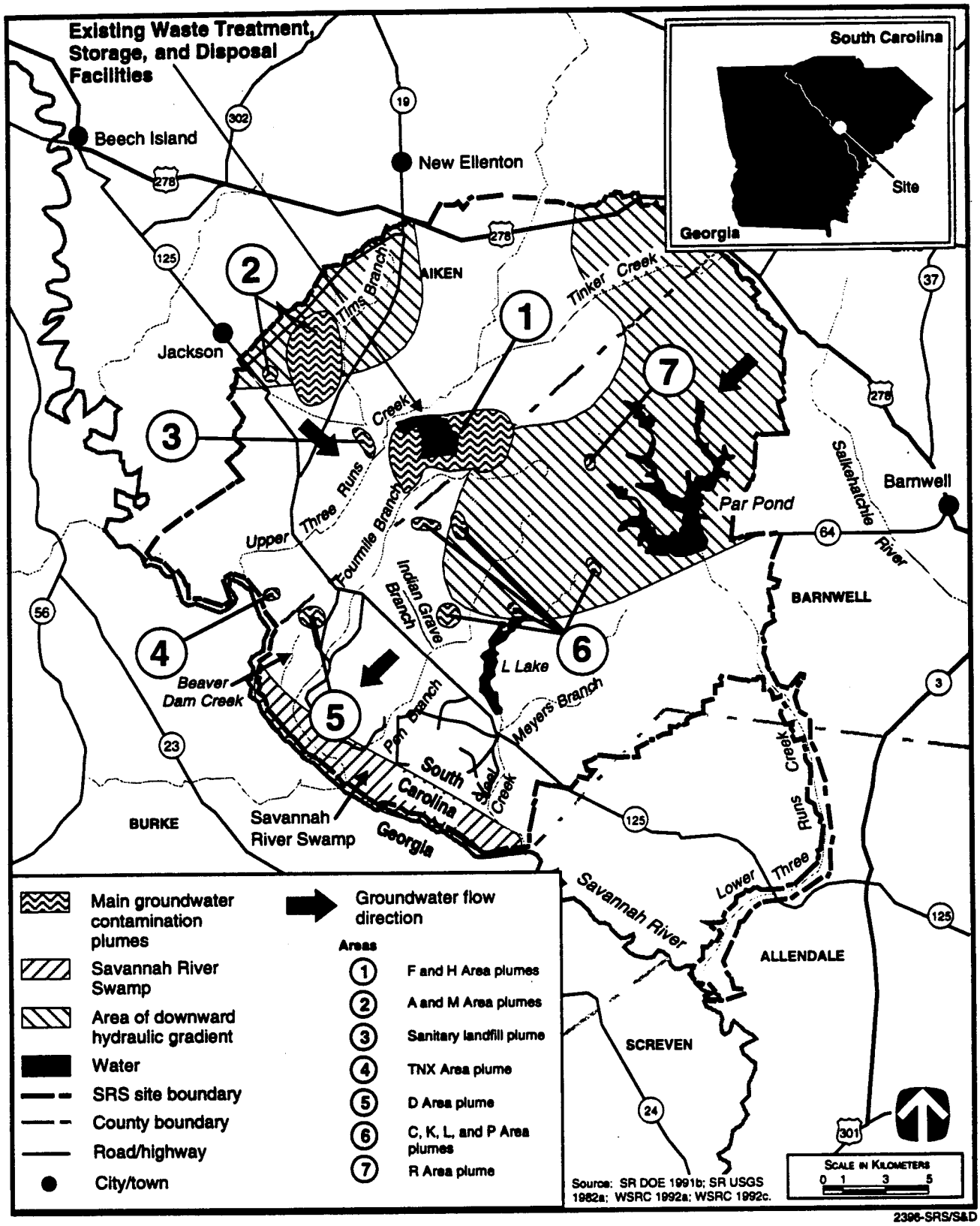


Figure 3.7.4–1. Surface Water Features and Groundwater Contamination Areas at Savannah River Site.

Table 3.7.4–1. Summary of Surface Water Quality Monitoring at Savannah River Site, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Water Body Concentration	
			High	Low
Alkalinity	mg/l	NA	24	13
Alpha (gross)	pCi/l	15[b]	0.51	-0.2
Aluminum	mg/l	0.05 to 0.2[c]	0.838	0.182
Ammonia (nitrogen)	mg/l	NA	0.11	0.02
Beta (gross)	pCi/l	50[d]	3.41	0.9
Calcium	mg/l	NA	5.09	3.25
Chemical oxygen demand	mg/l	NA	<dL	<dL
Chromium	mg/l	0.1[b,e]	<dL	<dL
[Text deleted.]				
Dissolved oxygen	mg/l	>5.0[e]	10.5	6.2
Iron	mg/l	0.3[c]	1.15	0.516
Lead	mg/l	0.015[b]	0.003	<dL
Magnesium	mg/l	NA	1.34	1.11
Manganese	mg/l	0.05[c]	0.064	0.04
Nitrogen (as NO_2/NO_3)	mg/l	NA	0.31	0.18
pH	pH units	6.5 to 8.5[c]	6.8	6.0
Phosphate	mg/l	NA	<dL	<dL
Plutonium-238	pCi/l	1.6[f]	0.001	-0.001
Plutonium-239	pCi/l	1.2[f]	0.001	0.0009
Sodium	mg/l	NA	12.7	5.28
Strontium-90	pCi/l	400[f]	0.24	0.0017
Sulfate	mg/l	250[c]	9	4
Suspended solids	mg/l	NA	16	5
Temperature	°C	<32.2[e]	25.7	9.1
Total dissolved solids	mg/l	500[c]	90	49
Tritium	pCi/l	80,000[f]	5,690	-147
Turbidity	turbidity unit	1 to 5[e]	28	3.6
Zinc	mg/l	5.0[c]	0.012	<dL

[a] For comparison purposes only.

[b] National Primary Drinking Water Regulations (40 CFR 141).

[c] National Secondary Drinking Water Regulations (40 CFR 143).

[d] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[e] South Carolina State water quality criteria.

[f] DOE's DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose equivalent of 100 mrem/yr; however, because the drinking water maximum contaminant level is based on 4 mrem/yr, the number listed is 4 percent of the DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored location. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the background environmental level.

Note: All nonradiological data from station R-10, downstream of SRS; all radiological data from station R-3B (below Vogtle); NA=not applicable; dL=detection limit.

Source: WSRC 1994d; WSRC 1994f.

grease and biological oxygen demand (WSRC 1994d:116). In all cases, either corrective actions or an administrative review were taken to prevent future noncompliances.

Surface Water Rights and Permits. Surface water rights for the Savannah River are determined by the Doctrine of Riparian Rights. Under this doctrine, users of water must not adversely effect the quantity or quality of water available for downstream users.

Groundwater. Several aquifer system naming schemes have been used at SRS. For this document, the most shallow aquifer will be referred to as the water table aquifer. This aquifer is supported by the leaky "Green Clay" aquitard, which confines the Congaree Aquifer. Below the Congaree Aquifer is the leaky Ellenton aquitard, which contains the Cretaceous (also known as the Tuscaloosa) aquifer. In general at SRS, groundwater in the water table aquifer flows downward to the Congaree Aquifer or discharges to nearby streams that intersect the water table. Flow in the Congaree Aquifer is downward to the Cretaceous Aquifer or horizontal to Upper Three Runs Creek or the Savannah River, depending on the location at SRS. Groundwater in the Cretaceous Aquifer discharges predominantly along the Savannah River. However, Upper Three Runs Creek also receives groundwater from the Cretaceous Aquifer. This flow creates an upward gradient between the Cretaceous and Congaree Aquifer over a significant portion of SRS (Figure 3.7.4–1).

The Cretaceous Aquifer is an abundant and important water resource for the SRS region. Some of the local cities (Aiken, for example) also obtain groundwater from the Cretaceous, but most of the rural population in the SRS region draws water from either the Congaree or water table aquifer. All groundwater at SRS is classified by the EPA as a Class II water source (current and potential source of drinking water). Depth to groundwater ranges from at or very near the ground surface (near streams) to approximately 46 m (151 ft). In 1993, SRS withdrew 13,247 million l/yr (3,500 million gal/yr) of groundwater in support of site operations.

Groundwater Quality. Groundwater quality data have been obtained from SRS monitoring wells for the past several years. Groundwater quality at SRS ranges from excellent (soft and slightly acidic) to below EPA drinking water standards for several constituents in the vicinity of some waste sites. The Cretaceous Aquifer is generally unaffected except for a small portion of the A-Area where trichloroethylene has been detected. The Congaree Aquifer is contaminated with trichloroethylene in much of the A- and M-Areas, with trichloroethylene and also some low levels of tritium in the General Separations Area. The water table aquifer is contaminated with solvents, metals, and low levels of radionuclides at several waste sites and facilities at SRS (Figure 3.7.4–1). All contaminated groundwater at SRS discharges to streams on the SRS or the Savannah River. Groundwater quality monitoring data is presented in Table 3.7.4–2.

Groundwater Availability, Use, and Rights. Groundwater is a domestic, municipal, and industrial water source throughout the Upper Coastal Plain. Most municipal and industrial water supplies in Aiken County are from the Cretaceous Aquifer. Domestic water supplies are primarily from the Congaree Aquifer and the water table. In Barnwell and Allendale Counties, the Congaree Aquifer supplies some municipal users. Groundwater production from these wells is approximately 13,247 million l/yr (3,500 million gal/yr), which is similar to the volume pumped for industrial and municipal production within 16 km (9.9 mi) of the site.

Groundwater rights in South Carolina are traditionally associated with absolute ownership rule. Originating in English common law doctrine, the owners of land overlying a groundwater resource are allowed to withdraw from their wells all the water they desire (VDL 1990a:725); however, the *Water Use Reporting and Coordination Act* requires all users of 379,000 l/day (100,000 gal/day) or more per day (138.3 million l/yr [36.5 million gal/yr]) of water to report their withdrawal rates to the South Carolina Water Resources Commission. SRS groundwater use exceeds this amount, and, consequently, its withdrawal rates are reported to the commission.

Table 3.7.4–2. Groundwater Quality Monitoring at Savannah River Site, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Existing Conditions	
			High	Low
Alpha (gross)	pCi/l	15[b]	77.61	0.96
Barium	mg/l	2.0[b]	0.09	0.0017
Beta (gross)	pCi/l	50[c]	75.88	1.00
Chloride	mg/l	250[d]	14.69	1.3
Iron	mg/l	0.3[d]	75.0	0.004
Lead	mg/l	0.015[b]	0.05	0.0015
Manganese	mg/l	0.05[d]	0.038	0.0018
Nitrate	mg/l	10[b]	2.37	0.03
pH	pH units	6.5-8.5[d]	11.6	4.7
[Text deleted.]				
Sulfate	mg/l	250[d]	118.1	0.5
Total dissolved solids	mg/l	500[d]	1,879.4	5.8
Total organic halogens	mg/l	NA	0.84	0.0025
Total phosphates	mg/l	NA	4.7	0.023
Total radium	pCi/l	5.0[c]	0.52	0.00628
Tritium	pCi/l	80,000[e]	1,162,810	350

[a] For comparison only.

[b] National Primary Drinking Water Regulations (40 CFR 141).

[c] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[d] National Secondary Drinking Water Regulations (40 CFR 143).

[e] DOE's DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.

Note: NA=not applicable.

Source: SRS 1995a:6.

3.7.5 GEOLOGY AND SOILS

Geology. The SRS is located in the Aiken Plateau portion of the Upper Atlantic Coastal Plain approximately 32 km (20 mi) east of the Fall Line, a major physiographic and structural feature that separates the Piedmont and Coastal Plain physiographic provinces, in southeastern South Carolina. The plateau is highly dissected, with narrow, steep-sided valleys separated by broad, flat areas.

Coastal Plain sediments underlying SRS consist of sandy clays and clayey sands, although occasional beds of clean sand, gravel, clay, or carbonate occur. The Coastal Plain sediments overlie a basement complex composed of Paleozoic crystalline and Triassic sedimentary formations of the Dunbarton Basin.

Small and discontinious thin calcareous sand zones, potentially subject to dissolution by water, have been located in some parts of SRS. If dissolution occurs in these zones, potential underground subsidence resulting in settling of the ground surface could occur. No settling as a result of dissolution of these zones has been identified. No economically viable geologic resources have been identified at SRS.

In the immediate region of SRS, there are no known capable faults as defined by 10 CFR 100, Appendix A. Several faults have been identified from subsurface mapping and seismic surveys within the Paleozoic and Triassic basement beneath SRS. The largest of these is the Pen Branch fault. However, there is no evidence of movement within the last 38 million years along this fault (DOE 1991c:4-108).

The SRS is located within Seismic Zone 2, indicating moderate damage could occur as a result of earthquakes (Figure 3.2.5–1). Since 1985, three earthquakes, all of Richter magnitude 3.2 or less, have occurred in the immediate area of SRS (Table 3.2.5–1). None of these earthquakes produced any damage at SRS. Historically, two large earthquakes have occurred within 300 km (186 mi) of SRS. The largest of these, the Charleston earthquake of 1886, had an estimated Richter magnitude ranging from 6.5 to 7.5. Earthquakes capable of producing structural damage to buildings are not likely to occur in the vicinity of SRS (SR DOE 1995e:3-4). There is no volcanic hazard at SRS; the area has not experienced volcanic activity within the last 230 million years.

Soils. The soils at SRS are primarily sands and sandy loams. The somewhat excessively drained soils have a thick, sandy surface layer that extends to a depth of 2 m (6.6 ft) or more in some areas (SR USDA 1990a:17-25). Many of the soils are subject to erosion, flooding, ponding, and cutbank caving. The soils at SRS are considered acceptable for standard construction techniques.

3.7.6 BIOLOGICAL RESOURCES

Terrestrial Resources. Most of SRS has remained undeveloped since it was established in 1950. Only about 5 percent of the site is occupied by DOE facilities. Five major plant communities have been identified at SRS (Figure 3.7.6–1). Of these, the largest is the loblolly, longleaf, slash pine community, which covers approximately 65 percent of the site. This community type, as well as upland hardwood-scrub oak, occurs primarily in upland areas. Swamp forests and bottomland hardwood forests are found along the Savannah River and the numerous streams that traverse SRS. More than 1,300 species and variations of vascular plants have been identified on the site (DOE 1992e:4-126,4-128).

Because of the variety of plant communities on the site, as well as the region's mild climate, SRS supports a diversity and abundance of wildlife, including 43 amphibian, 58 reptile, 213 bird, and 54 mammal species. Common species at SRS include the slimy salamander, eastern box turtle, Carolina chickadee, common crow, eastern cottontail, and gray fox (DOE 1992e:4-128; WSRC 1993b:3-5,3-39). A number of game animals are found on SRS, but only the whitetail deer and feral hog are hunted onsite (DOE 1992e:4-128). Raptors, such as the Cooper's hawk and black vulture, and carnivores, such as the gray fox and raccoon, are ecologically important groups on SRS. A variety of migratory birds have been found at SRS. Migratory birds, as well as their nests and eggs, are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Four of the five major plant communities at SRS are found on the proposed collocated storage site (Figure 3.7.6–1). The most common of these plant communities is the loblolly-longleaf-slash pine, followed by upland hardwood-scrub oak, pine/hardwood, and bottomland hardwood. Although not shown on Figure 3.7.6–1, cleared fields are also common on the proposed site. A 5.5 ha (13.6 acres) NERP oak-hickory forest set-aside area, which has an unusual composition of flora, is located near the northwest corner of the proposed site (SR DOE 1991b:4.3,4.26). Although specific studies of plant and animal communities found on the proposed collocated storage site have not been conducted, the occurrence of species on the site is expected to be the same as found in similar habitats elsewhere on SRS.

Ecological studies of the assumed analysis site for the MOX fuel fabrication facility have not been conducted, but the site is located within an area that primarily contains the loblolly, longleaf, and slash pine forest type (Figure 3.7.6–1). Some bottomland hardwood forest is located along the drainages that feed Par Pond. Wildlife species found in the area of the assumed site would be expected to be similar to those found in similar habitat throughout SRS.

The assumed analysis site for the evolutionary LWR is located in an area that is classified as loblolly, longleaf, and slash pine forest (Figure 3.7.6–1). Previous studies of the site area determined that pine plantations were the predominant plant cover. Other vegetation types present include old-field, bottomland hardwood forest, mixed forest, upland deciduous forest, grassland (under powerline rights-of-way), and emergent wetland. The assumed site has not been surveyed to determine the presence and abundance of wildlife (DOE 1992e:4-128). Animals present would be expected to be similar to those found in similar habitat throughout SRS.

Wetlands. The SRS contains approximately 19,800 ha (49,000 acres) of wetlands, most of which are associated with floodplains, streams, and impoundments (DOE 1992e:4-128). Wetlands on the site may be divided into the following categories: bottomland hardwoods, cypress-tupelo, scrub-shrub, emergent, and open water (WSRC 1993b:4-6). The most extensive wetland type on SRS is swamp forest associated with the Savannah River floodplain. Approximately 3,800 ha (9,390 acres) of these wetlands are found on SRS. Past releases of cooling water effluent into site streams and the Savannah River Swamp have resulted in shifts in plant community composition. Changes have included the replacement of bald cypress by scrub-shrub and emergent vegetation in the swamp and reduction in bottomland forests along streams (DOE 1992e:4-128; WSRC 1989e:3-4).

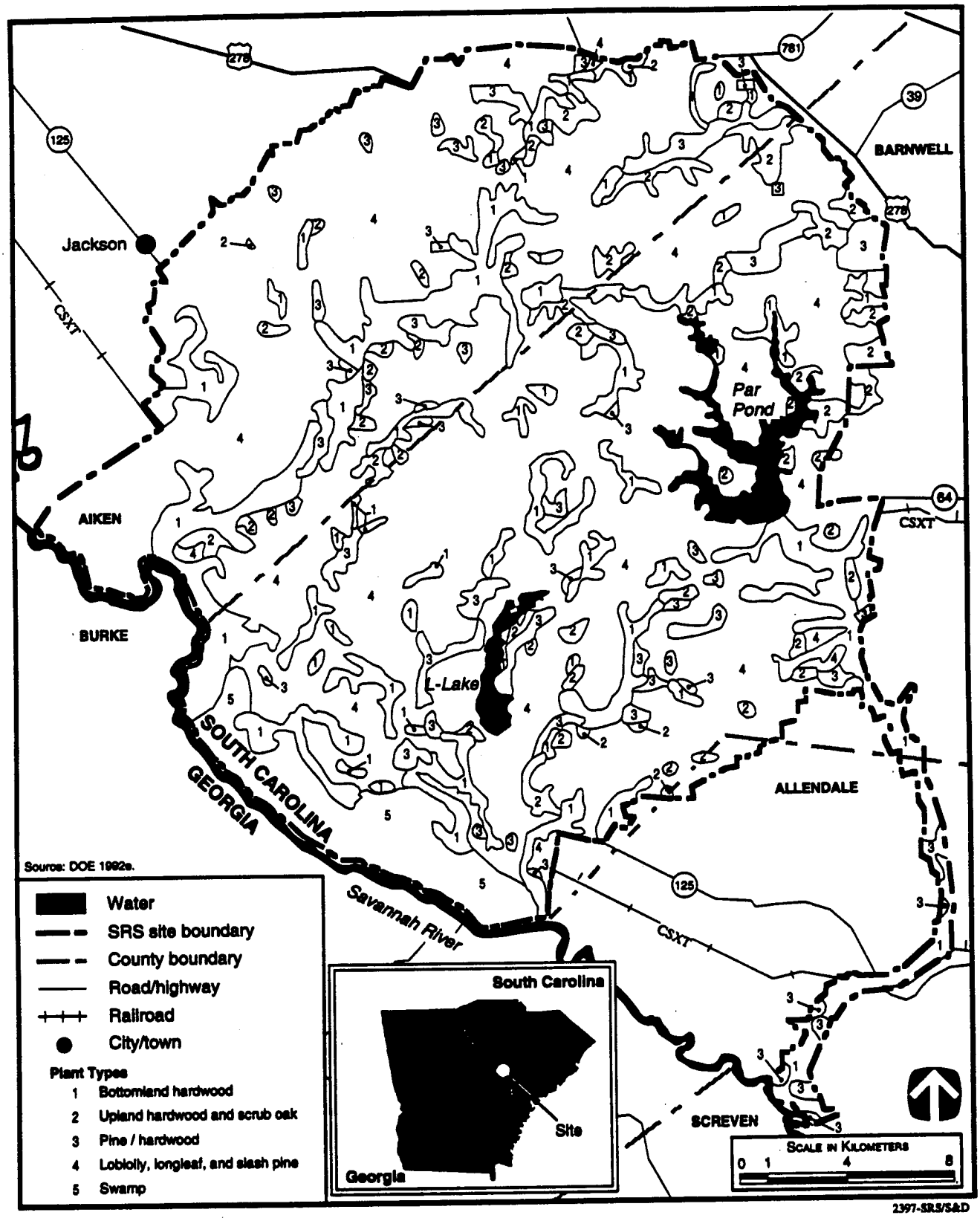


Figure 3.7.6–1. Distribution of Plant Communities at Savannah River Site.

Carolina bays, a type of wetland unique to the southeastern United States, are also found on SRS. Approximately 190 Carolina bays have been identified on the site. These natural shallow depressions occur on interstream areas of SRS and range from lakes to shallow marshes, herbaceous bogs, shrub bogs, or swamp forests (SR NERP 1989a:9).

Wetlands found on the proposed collocated storage site include bottomland hardwoods and three Carolina bays. Bottomland hardwood areas occur along tributaries to Upper Three Runs Creek. The three Carolina bays on the proposed site are typical of the smaller bays found on the SRS (SR DOE 1991b:4.3). All show evidence of previous draining and agricultural use. The larger of the bays is about 1 ha (2.5 acres) in size and is surrounded by oaks and sweet gum. Jurisdictional wetlands subject to COE regulation have not been delineated on this site using the U.S. Army COE *Wetlands Delineation Manual* (Y-87-1).

Wetlands found within the assumed analysis site for the MOX fuel fabrication facility include bottomland hardwoods associated with drainages that feed Par Pond. There are no Carolina bays located on the site. Par Pond, located to the east of the assumed site, supports a well-developed wetland community along its shores. The suitability of habitat in Par Pond for wetland vegetation is indicated by the extensive development of wetland vegetation on the lake and the spread of wetland vegetation from its shore into the lake (DOE 1992e:4-130).

The assumed analysis site for the evolutionary LWR contains a number of wetland areas. Several wetlands are associated with intermittent tributaries to Pen Branch and Fourmile Branch. Isolated wetlands are also found in the site area. Rainbow Bay, a 2.4-ha (5.9-acre) Carolina bay, occurs in the northeastern portion of the assumed site. Other isolated wetlands in the site area are upland depressions. Unlike Rainbow Bay, these wetlands do not have standing water for long periods of time (DOE 1992e:4-129).

Aquatic Resources. Aquatic habitat on SRS includes manmade ponds, Carolina bays, reservoirs, and the Savannah River and its tributaries. There are more than 50 manmade impoundments located throughout the site that support populations of bass and sunfish (SR DOE 1982a:4-22; SRS 1992a:8). Fewer than 20 Carolina bays have permanent fish populations. Species present in these bays include redfin pickerel, mud sunfish, lake chubsucker, and mosquitofish (SR NERP 1983a:40–42; SR NERP 1989a:37). Par Pond and L-Lake support similar fish populations including largemouth bass, black crappie, and various species of pan fish (DOE 1992e:4-131; SRS 1992a:8). Sport and commercial fishing is not allowed on the SRS site (DOE 1992e:4-132).

The Savannah River is used for both commercial and sport fishing. Important commercial species are American shad, hickory shad, and striped bass, all of which are anadromous. The most important warm-water game fish found in the Savannah River are bass, pickerel, crappie, bream, and catfish (SR DOE 1982a:4-28). In the past, water intake structures for C- and K-Reactors and the D-Area powerhouse caused annual estimated entrainment of approximately 10 percent of the fish eggs and larvae passing the intake canals during the spawning season. In addition, estimated impingement losses were approximately 7,600 fish per year (SR DOE 1987b:3-31,C-61).

Aquatic habitat in the vicinity of the proposed storage facility site consists of Upper Three Runs Creek and its tributaries and three Carolina bays (see Figure 3.7.4–1). Streams in the vicinity of the proposed site support largemouth bass, black crappie, and various species of pan fish. Upper Three Runs Creek has never received thermal effluents, but has received industrial pollutants from Tim's Branch. The creek has a rich fauna and is minimally affected by pollutants (SR NERP 1983a:11,13). Upper Three Runs Creek may also be an important spawning area for the blueback herring, and may be seasonally important as a nursery habitat for a number of important Savannah River species, including American shad, blueback herring, and striped bass (SR DOE 1982a:4-28). Information concerning aquatic resources in the three Carolina bays on the proposed site is unavailable (SR DOE 1991b:4.3).

Aquatic resources in the vicinity of the assumed analysis site for the MOX fuel fabrication facility area include Par Pond, precooling ponds 2 and 5, as well as the canal that connects these three water bodies. Also present are a number of drainages that feed Par Pond. Par Pond drains into Lower Three Runs Creek. A total of 30 species of fish, including chubsucker, largemouth bass, bluegill, and black crappie, have been recorded in Par Pond (DOE 1992e:4-131). The same species have been recorded in Lower Three Runs Creek (WSRC 1993b:15-64). During operation of P-Reactor, heated effluent was discharged into an arm of Par Pond (Pond C) via the above-mentioned canal and precooling ponds. Since the shutdown of the P-Reactor, the precooling ponds and Pond C have undergone substantial recovery (DOE 1992e:4-131).

The principal aquatic resources in the vicinity of the assumed analysis site for the evolutionary LWR include Fourmile Branch, Par Branch, and Rainbow Bay. Rainbow Bay does not contain standing water year-round. In the past, Fourmile Branch and Pen Branch have received thermal effluents from C- and K-Reactors, respectively. During reactor operations, fish populations in warmed portions of the streams were greatly reduced, with the mosquitofish being the most abundant species. With the cessation of reactor operation, a more diverse fish population has recolonized both streams (WSRC 1993b:12-44,13-42). Above the reactor outfalls, both Fourmile Branch and Pen Branch are small streams that have been relatively unaffected by past SRS operation. The dominant fish in the un-heated upper reaches of Pen Branch include sunfish, bullheads, and chubsuckers (SR DOE 1987b:3-51); species composition of the upper portion of Fourmile Branch would be expected to be similar.

Threatened and Endangered Species. Sixty-one federally and State-listed threatened, endangered, and other special status species may be found on and in the vicinity of SRS (Table 3.7.6–1). Fifty-seven of these species have records of occurrence on SRS, twelve of which are federally or State-listed as threatened or endangered. Once specific project locations have been determined, site surveys will verify the presence of special status species. No critical habitat for threatened or endangered species, as defined in ESA (50 CFR 17.11; 50 CFR 17.12), exists on SRS.

The smooth coneflower is the only endangered plant species found on SRS. Two colonies exist on SRS, but suitable habitat for this species occurs throughout the site. Bald eagles nest near Par Pond and L-Lake and forage on these reservoirs. Wood storks forage in the Savannah River Swamp and the lower reaches of Steel Creek, Pen Branch, Beaver Dam Creek, and Fourmile Branch. Red-cockaded woodpeckers inhabit open pine forests with mature trees (older than 70 years for nesting and 30 years for foraging). Peregrine falcons have been reported in the past as rare winter visitors on SRS. The American alligator is a common inhabitant of Par Pond, Beaver Dam Creek, and the Savannah River Swamp. The shortnose sturgeon spawns in the Savannah River both up and downstream of SRS. This fish has not been collected in the tributaries of the Savannah River that drain SRS, but sturgeon ichthyoplankton have been collected in the river near SRS (SR DOE 1995b:3-44). The Kirtland's warbler is a migrant species which historically occurred on SRS. The State-listed Rafinesque's big-eared bat, common ground dove, and Appalachian Bewick's wren have also been observed on SRS.

There are no federally listed threatened and endangered species known to occur on the proposed storage facility site, but several may exist in the general vicinity. Active bald eagle nests are located about 13.7 km (8.5 mi) southwest of the proposed site in an area of Pen Branch and approximately 12.1 km (7.5 mi) southeast of the site just south of Par Pond. Wood storks have been observed near the Fourmile Branch delta (WSRC 1993b:21-42,21-43) about 21 km (13 mi) from the proposed site. Although suitable forage habitat for the red-cockaded woodpecker exists on the proposed storage facility site, the closest colony is located approximately 4.8 km (3 mi) away. Occurrences of the American alligator are all located about 6.4 km (4 mi) or more from the site (WSRC 1993b:21-11,21-32,21-41,21-42,21-43). The shortnose sturgeon spawns in the Savannah River upstream of SRS, and larvae of this species have been collected in or near the water intake canals on the river. However, entrainment or impingement of this species at SRS water intake structures has not been documented (DOE 1992e:4-132). The smooth coneflower has not been recorded in affected areas but could be found on the proposed site. Several State special status species have also been found in the proposed storage site area.

Table 3.7.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Savannah River Site

Common Name	Scientific Name	Status[a]	
		Federal	State
Mammals			
Meadow vole	*Microtus pennsylvanicus*	NL	SC
Rafinesque's big-eared bat[b]	*Plecotus rafinesquii*	NL	SE
Southern Appalachian eastern woodrat[b]	*Neotoma floridana haematoreia*	NL	SC
Spotted skunk[b]	*Spilogale putorius*	NL	SC
Star-nosed mole[b]	*Condylura cristata parva*	NL	SC
Swamp rabbit	*Sylvilagus aquaticus*	NL	SC
Birds			
American peregrine falcon[b,c]	*Falco peregrinus anatum*	E	SE
American swallow-tailed kite	*Elanoides forficatus*	NL	SE
Appalachian Bewick's wren[b]	*Thryomanes bewickii altus*	NL	ST
Arctic peregrine falcon[b]	*Falco peregrinus tundrius*	E (S/A)	ST
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	SE
Barn owl[b]	*Tyto alba*	NL	SC
Common ground dove[b]	*Columbina passerina*	NL	ST
Cooper's hawk[b]	*Accipiter cooperii*	NL	SC
Kirtland's warbler[b]	*Dendroica kirtlandii*	E	SE
[Text deleted.]			
Mississippi kite[b]	*Ictinia mississippiensis*	NL	SC
Red-cockaded woodpecker[b,c]	*Picoides borealis*	E	SE
Red-headed woodpecker[b]	*Melanerpes erythrocephalus*	NL	SC
Swainson's warbler[b]	*Limnothlypis swainsonii*	NL	SC
Wood stork[b,d]	*Mycteria americana*	E	SE
Reptiles			
American alligator[b]	*Alligator mississippiensis*	T (S/A)	NL
Carolina swamp snake[b]	*Seminatrix pygaea*	NL	SC
Eastern coral snake[b]	*Micrurus fulvius fulvius*	NL	SC
Green water snake[b]	*Nerodia cyclopion*	NL	SC
[Text deleted.]			
Spotted turtle[b]	*Clemmys guttata*	NL	SC
Amphibians			
Carolina crawfish frog[b]	*Rana areolata capito*	NL	SC
Eastern bird-voiced treefrog[b]	*Hyla avivoca ogechiensis*	NL	SC
Eastern tiger salamander[b,d]	*Ambystoma tigrinum tigrinum*	NL	SC
Northern cricket frog[b]	*Acris crepitans crepitans*	NL	SC
Pickerel frog[b,d]	*Rana palustris*	NL	SC
Upland chorus frog[b]	*Pseudacris triseriata feriarum*	NL	SC

Table 3.7.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Savannah River Site—Continued

Common Name	Scientific Name	Status[a]	
		Federal	State
Fish			
[Text deleted.]			
Shortnose sturgeon[b,c,d]	*Acipenser brevirostrum*	E	SE
Invertebrates			
Brother spike mussel	*Elliptio fraterna*	NL	E
Plants			
[Text deleted.]			
Beak-rush[b,d]	*Rhynchospora inundata*	NL	SC
Beak-rush[b,d]	*Rhynchospora tracyi*	NL	SC
Bog spice bush[b]	*Lindera subcoriacea*	NL	RC
[Text deleted.]			
Cypress stump sedge[b,d]	*Carex decomposita*	NL	SC
Durand's white oak[b]	*Quercus durandii*	NL	SC
Dwarf bladderwort[b]	*Utricularia olivacea*	NL	SC
Dwarf burhead[b]	*Echinodorus parvulus*	NL	SC
Elliott's croton[b]	*Croton elliottii*	NL	SC
Few-fruited sedge[b]	*Carex oligocarpa*	NL	SC
Florida bladderwort[b]	*Utricularia floridana*	NL	SC
Florida false loosestrife[b]	*Ludwigia spathulata*	NL	SC
Gaura[b]	*Gaura biennis*	NL	SC
Green-fringed orchid[b,d]	*Platanthera lacera*	NL	SC
Leafy pondweed[b]	*Potamogeton foliosus*	NL	SC
Loose water-milfoil[b]	*Myriophyllum laxum*	NL	RC
Milk-pea[b]	*Astragalus villosus*	NL	SC
Nailwort[b,d]	*Paronychia americana*	NL	SC
Nestronia[b]	*Nestronia umbellula*	NL	SC
Nutmeg hickory[b]	*Carya myristiciformis*	NL	RC
Oconee azalea[b]	*Rhododendron flammeum*	NL	SC
Pink tickseed[b]	*Coreopsis rosea*	NL	RC
Quill-leaved swamp potato[b]	*Sagittaria isoetiformis*	NL	SC
Sandhill lily[b]	*Nolina georgiana*	NL	SC
Smooth coneflower[b]	*Echinacea laevigata*	E	SE
Trepocarpus[b]	*Trepocarpus aethusae*	NL	SC
Wild water-celery[b]	*Vallisneria americana*	NL	SC
Yellow cress[b]	*Rorippa sessiliflora*	NL	SC
Yellow wild indigo[b]	*Baptisia lanceolata*	NL	SC

[a] Status codes: E=endangered; NL=not listed; RC=regional of concern (unofficial plants only); S/A=protected under the similarity of appearance provision of the ESA; SC=State of concern; SE=State endangered (official state list-animals only); ST=State threatened (official State list-animals only); and T=threatened.

[b] Species occurrence recorded on SRS.

[c] USFWS Recovery Plan exists for this species.

[d] Species known to occur on Upper Three Runs Creek downstream from the proposed site for the new consolidated storage facility or in areas affected by the project.

Source: 50 CFR 17.11; 50 CFR 17.12; DOE 1992e; SC WD 1995a; SR NERP 1990b; WSRC 1993b.

A population of nailwort has been found within the central portion of the site and the green-fringed orchid has been collected in an area adjacent to the site (SR NERP 1990b:64-65).

Bald eagles have been seen on numerous occasions in the vicinity of Par Pond, and an eagle nest is located about 5.6 km (3.5 mi) southeast of the assumed analysis site for the MOX fuel fabrication facility. Although suitable forage habitat for the red-cockaded woodpecker exists in the site area, the nearest known red-cockaded colony is located about 8 km (5 mi) to the southeast. The American alligator is also a common inhabitant of Par Pond, located less than 1.6 km (1 mi) from the assumed site (WSRC 1993b:21-11,21-26,21-32).

There are no federally listed threatened and endangered species known to occur on the assumed analysis site for the evolutionary LWR, but several may exist in the general vicinity. Bald eagles have been observed at several locations on SRS, particularly in the vicinity of Par Pond and L-Lake. Active bald eagle nests are located 8 km (5 mi) southwest of the site in the area of Pen Branch and 11.3 km (7 mi) southeast of the site just south of Par Pond (WSRC 1993b:21-26). Although suitable forage habitat for the red-cockaded woodpecker exists on the assumed analysis site for the evolutionary LWR, the closest colony is located 11.3 km (7 mi) away. The American alligator is a common inhabitant of Par Pond, Beaver Dam Creek, and the Savannah River swamp, all located 8 km (5 mi) or more from the assumed site (WSRC 1993b:21-11,21-32,21-41,21-43). The federally listed smooth purple coneflower has not been recorded in the site but could be present. [Text deleted.] Several State special status species have also been found near Rainbow Bay, including the Cooper's hawk, two species of beak-rush, Florida false loosestrife, and green-fringed orchid.

3.7.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric resources at SRS consist of villages, base camps, limited activity sites, quarries, and workshops. An extensive archaeological survey program began at SRS in 1974 and includes numerous field studies such as reconnaissance surveys, shovel test transects, and intensive site testing and excavation. More than 60 percent of SRS has received some level of cultural resources evaluation. More than 800 prehistoric sites have been identified, some of which may fall within the locations of the proposed storage facilities. Fewer than 8 percent of these sites have been evaluated for NRHP eligibility. To date 67 prehistoric and historic sites are considered potentially eligible for listing on the NRHP.

A Programmatic Agreement was signed by the DOE Savannah River Operations Office, the South Carolina SHPO, and the Advisory Council on Historic Preservation on August 24, 1990. Its purpose is to ensure that appropriate measures are taken to inventory, evaluate, protect, and enhance archaeological sites on SRS. In addition, an Archaeological Resource Management Plan for SRS is in place.

Historic Resources. Types of historic sites include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farming dikes, dams, cattle pens, ferry locations, towns, churches, schools, cemeteries, commercial building locations, and roads. Approximately 400 historic sites or sites with historic components have been identified within SRS, some of which may fall within the locations of the proposed storage facilities. To date, approximately 10 percent have been evaluated for NRHP eligibility.

Most historic structures were demolished during the initial establishment of SRS in 1950. Two 1951 buildings are currently in use. SRS has been involved in tritium operations and other nuclear material production for more than 40 years. Therefore, some of the facilities at SRS may be eligible for listing on the NRHP.

Native American Resources. Native American groups with traditional ties to the area include the Apalachee, Cherokee, Chickasaw, Creek, Shawnee, Westo, and Yuchi. At different times, each of these groups was encouraged by the English to settle in the area to provide protection from the French, Spanish, or other Native American groups. Main villages of both the Cherokee and Creek were located southwest and northwest of SRS, but both groups may have used the area for hunting and gathering activities. During the early 1800s, most of the remaining Native Americans residing in the region were relocated to the Oklahoma territory.

Native American resources in the region include remains of villages or townsites, ceremonial lodges, burials, cemeteries, and areas containing traditional plants used for religious ceremonies. Literature reviews and consultations with Native American representatives reveal that there are some concerns related to the *American Indian Religious Freedom Act* within the central Savannah River valley, including some sensitive Native American resources and several plants traditionally used in ceremonies (SR DOE 1991e:19,21).

Paleontological Resources. Paleontological materials at SRS include fossil plants, numerous invertebrate fossils, deposits of giant oysters (*Crassostrea gigantissima*), mollusks, and bryozoa. All paleontological materials from SRS are marine invertebrate deposits and, with the exception of the giant oysters, are relatively widespread common fossils; therefore the assemblages have low research potential.

3.7.8 SOCIOECONOMICS

Socioeconomic characteristics addressed at SRS include employment and regional economy, population and housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses 15 counties around SRS located in Georgia and South Carolina (Table L.1–1). Statistics for population and housing, community services, and local transportation are presented for the ROI, a six-county area in which 90.1 percent of all SRS employees reside: Aiken County (51.9 percent), Allendale County (1.1 percent), Bamberg County (1.7 percent), and Barnwell County (7.3 percent) in South Carolina and Columbia County (10.6 percent) and Richmond County (17.5 percent) in Georgia (Table L.1–7). In 1993, SRS employed 23,351 persons which decreased to 16,562 persons in 1996.

Regional Economy Characteristics. Selected employment and regional economy statistics for the SRS REA are summarized in Figure 3.7.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 21.4 percent to the 1990 level of 248,239. The 1994 unemployment in the REA was 6.7 percent, which was approximately 0.4 and 1.5 percent higher than the unemployment for South Carolina and Georgia, respectively. The region's per capita income of $17,212 in 1993 was approximately 2.1 percent greater than South Carolina's per capita income of $16,861 and 10.6 percent lower than Georgia's per capita income of $19,249.

In 1993, the percentage of total employment involving the private sector activity of retail trade in the REA (16 percent) was comparable to the statewide economies of South Carolina and Georgia, as shown in Figure 3.7.8–1. Service employment in the region (22 percent of total employment) represented a 3-percent smaller share of the total employment in the region than in Georgia but was similar to that of South Carolina. The manufacturing sector in the region (21 percent) represented a 1- and 6-percent greater share of the total employment than in South Carolina (20 percent) and Georgia (15 percent), respectively.

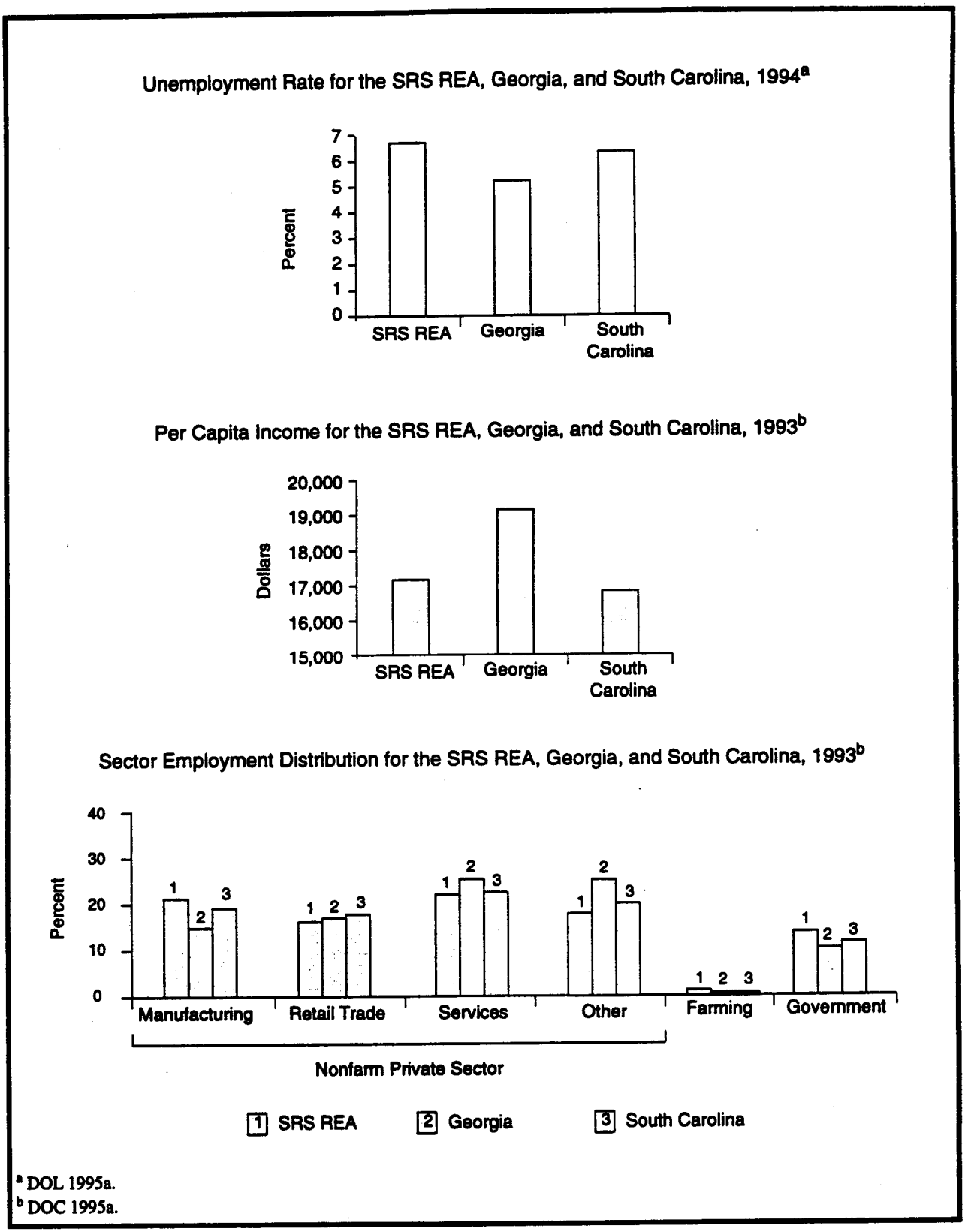
Population and Housing. In 1994, the ROI population totaled 457,812. From 1980 to 1994, the ROI population grew by 21.7 percent, compared to 29.1 percent in Georgia and 17.4 percent in South Carolina. Within the ROI, Columbia County experienced the largest increase, 99.2 percent, while Bamberg County's population decreased 7.8 percent. Population and housing trends are summarized in Figure 3.7.8–2.

The increase in number of housing units in the ROI between 1980 and 1990, 23.8 percent, was similar to the increase in South Carolina, but approximately 6 percent less than the increase in Georgia. The total number of housing units for 1990 was 168,803. The 1990 homeowner vacancy rate for the ROI, 2.2 percent, was comparable to the statewide rates for South Carolina and Georgia. The renter vacancy rate for the ROI counties, nearly 10 percent, was approximately 2 percent less than the renter vacancy rates for both States.

Community Services. Education, public safety, and health care characteristics were used to assess the level of community service in the SRS ROI. Figure 3.7.8–3 presents school district characteristics for the SRS ROI. Figure 3.7.8–4 presents public safety and health care characteristics.

Education. In 1994, nine school districts provided public education services and facilities in the SRS ROI. As shown in Figure 3.7.8–3, these school districts operated at between 58.7-percent (Allendale County) and 100-percent (Columbia County School District) capacity. The average student-to-teacher ratio for the SRS ROI in 1994 was 17.5:1. The Aiken County School District had the highest ratio at 19:1.

Public Safety. City, county, and State law enforcement agencies provided police protection to the residents in the ROI. In 1994, a total of 954 sworn police officers were serving the six-county ROI. Richmond County employed the greatest number of sworn police officers (325), while the city of Augusta, Georgia had the highest officer-to-population ratios (3.9 sworn officers per 1,000 persons). The average ROI officer-to-population ratio was 2.1 officers per 1,000 persons. Figure 3.7.8–4 compares police force strengths across the ROI.



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.7.8–1. Employment and Local Economy for the Savannah River Site Regional Economic Area and the States of Georgia and South Carolina.

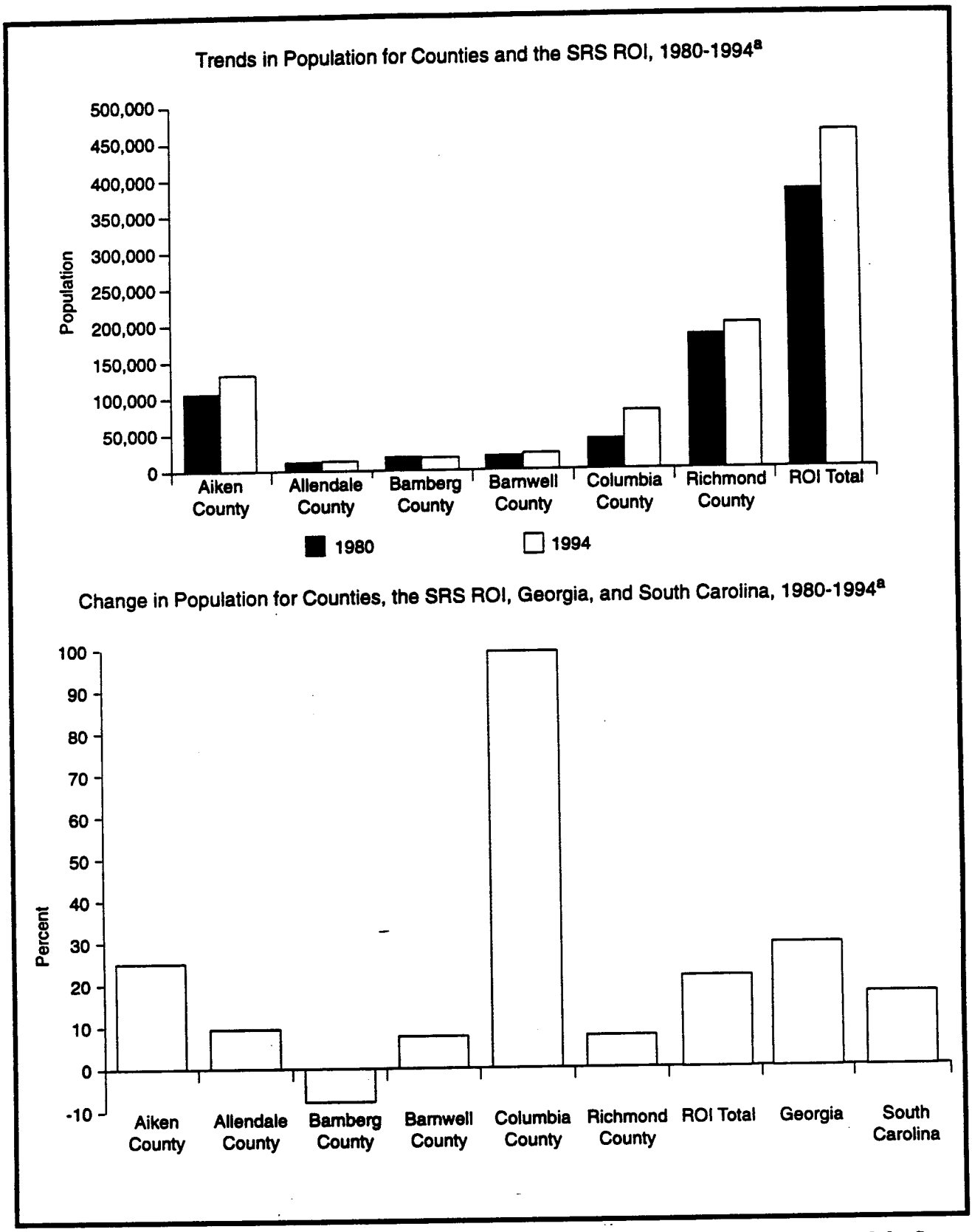
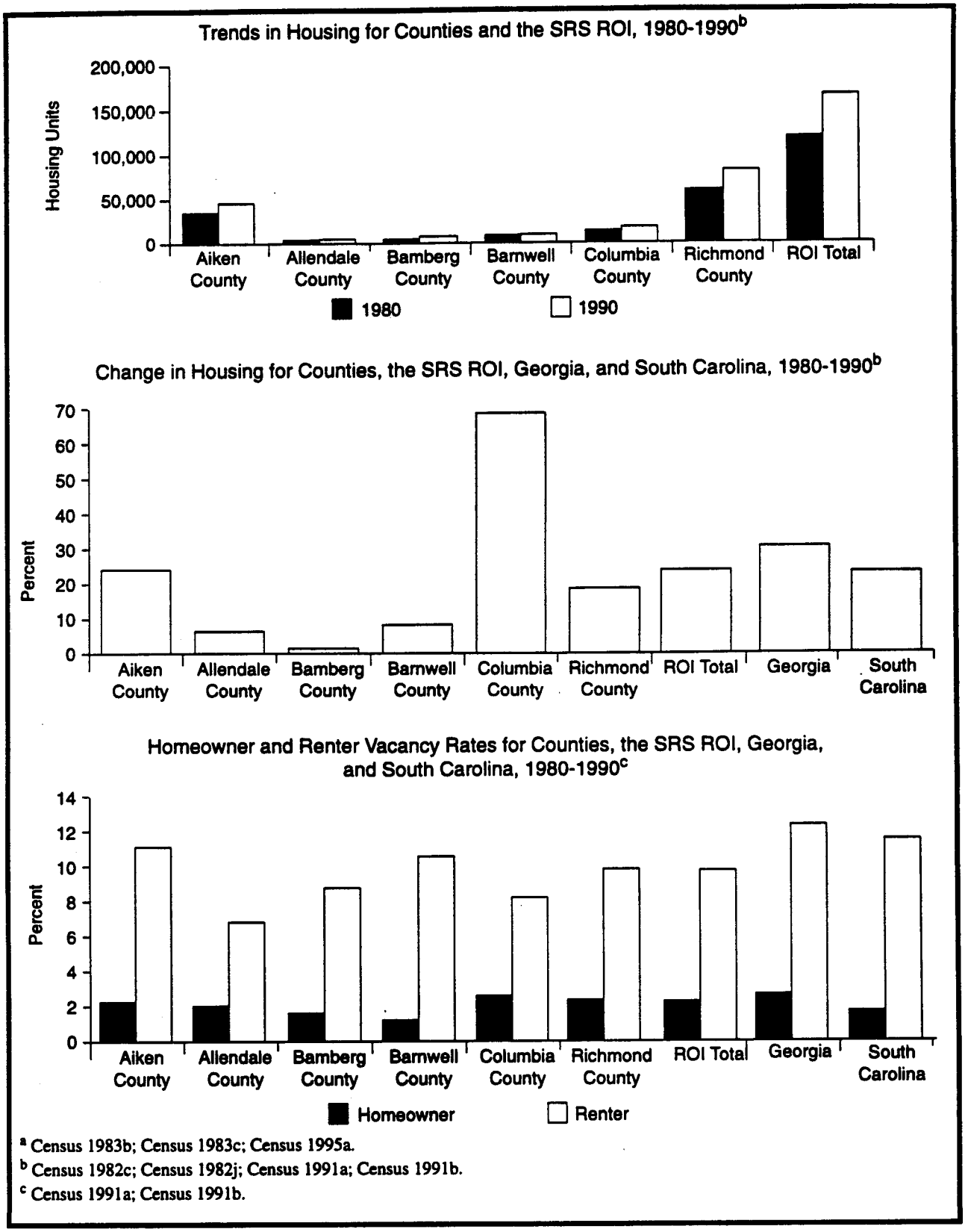
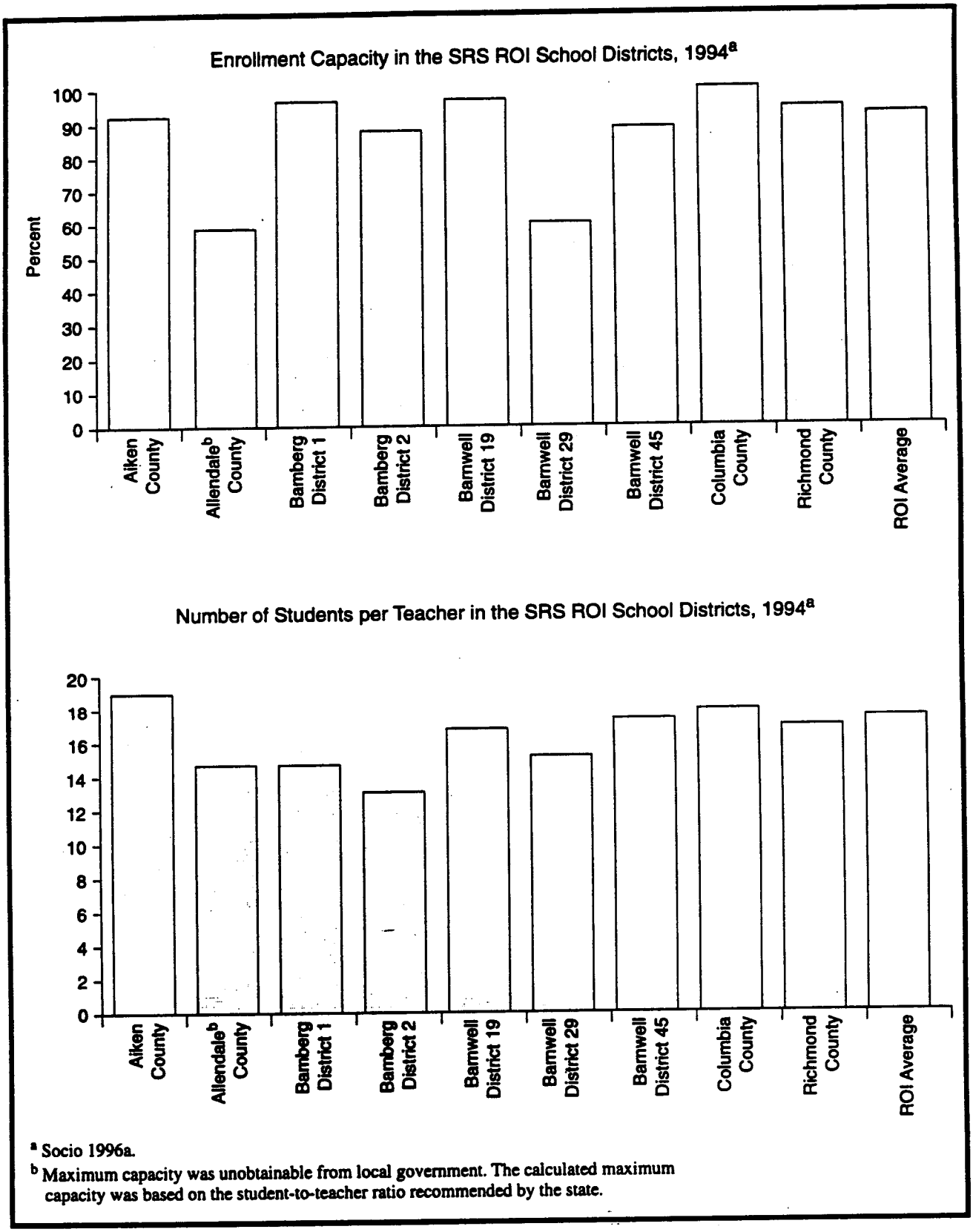


Figure 3.7.8–2. Population and Housing for the Savannah River Site Region of Influence and the States of Georgia and South Carolina.



[a] Census 1983b; Census 1983c; Census 1995a.
[b] Census 1982c; Census 1982j; Census 1991a; Census 1991b.
[c] Census 1991a; Census 1991b.

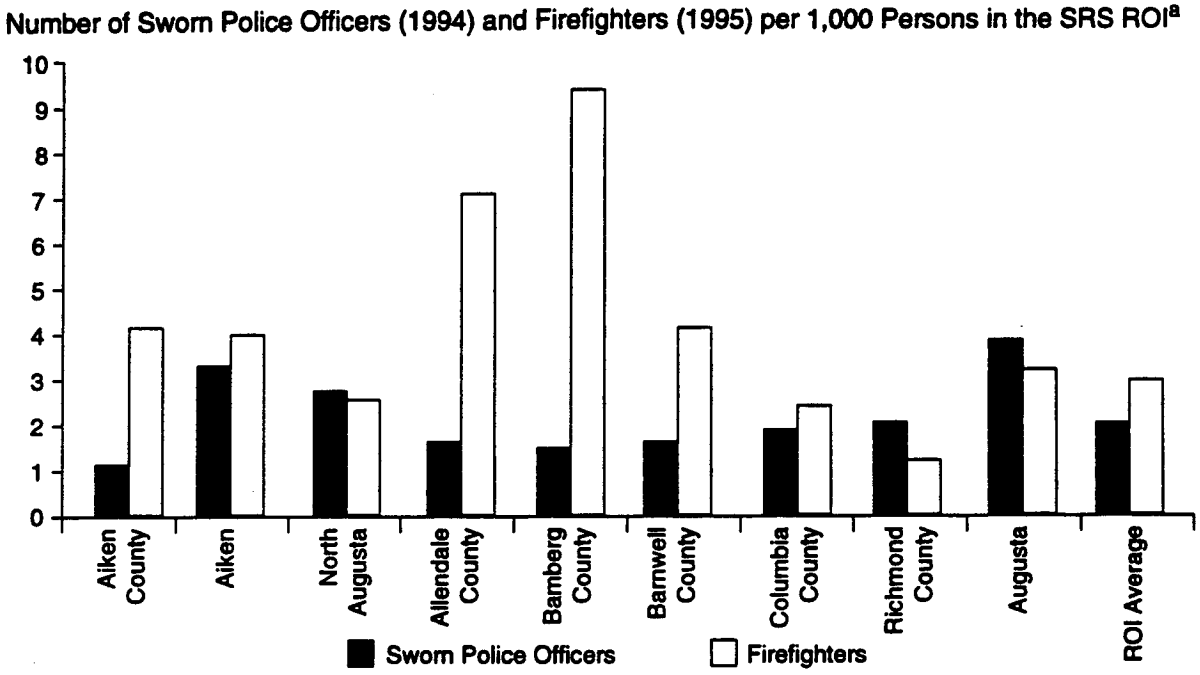
Figure 3.7.8–2. Population and Housing for the Savannah River Site Region of Influence and the States of Georgia and South Carolina—Continued.



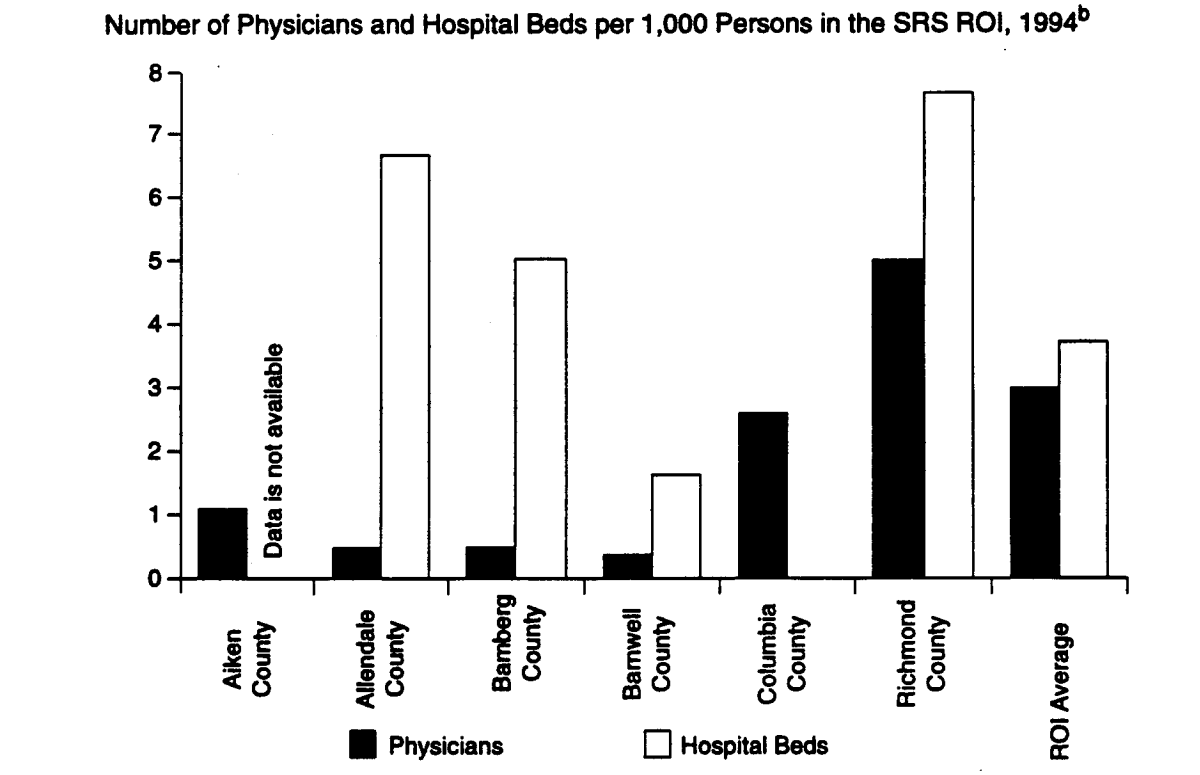
[a] Socio 1996a.

[b] Maximum capacity was unobtainable from local government. The calculated maximum capacity was based on the student-to-teacher ratio recommended by the state.

Figure 3.7.8–3. School District Characteristics for the Savannah River Site Region of Influence.



Note: Except for ROI cities, city sworn police officers and firefighters are included in the county totals.



[a] Census 1993c; Census 1993e; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b; DOJ 1995a; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.7.8–4. Public Safety and Health Care Characteristics for the Savannah River Site Region of Influence.

Fire protection services in the SRS ROI were provided by 1,363 paid and volunteer firefighters in 1995. The fire district with the highest firefighter-to-population ratio was located in Bamberg County, 9.3 firefighters per 1,000 persons, as indicated in Figure 3.7.8–4. Aiken County employed the greatest number of firefighters (375). The average firefighter-to-population ratio in the ROI was 3.0 firefighters per 1,000 persons.

Health Care. There were eight hospitals serving the six-county ROI in 1994. Figure 3.7.8–4 displays the hospital bed-to-population ratios for the SRS ROI counties. During 1994, all hospitals were operating below capacity, with hospital occupancy rates ranging from 45.7 percent in Barnwell County to 73.8 percent in Bamberg County.

In 1994, a total of 1,360 physicians served the ROI, with the majority (985) located in Richmond County. Figure 3.7.8–4 shows that the physician-to-population ratios for the ROI ranged from 0.4 physicians per 1,000 persons in Barnwell County to 5.0 physicians per 1,000 persons in Richmond County. The average ROI physician-to-population ratio was 3.0 physicians per 1,000 persons.

Local Transportation. The SRS is served by more than 322 km (200 mi) of primary roads and more than 1,609 km (1,000 mi) of unpaved secondary roads (see Figure 2.2.6–1 and Figure 2.2.6–2). The primary highways used by SRS commuters are State Routes 19, 64, and 125. There are no current or planned road improvements that would affect SRS.

Two road segments in the ROI could be affected by the storage and disposition alternatives. The first is South Carolina State Route 19 from U.S. 1/78 at Aiken to U.S. 278. This segment operated at level of service E in 1995. The second is South Carolina State Route 230 from U.S. 25 Business at North Augusta to U.S. 1/25/78/278. This segment operated at level of service E in 1995.

There is no public transportation to SRS (SR DOT 1995a:1). Rail service in the ROI is provided by the Norfolk Southern Corporation and CSX Transportation. SRS is provided rail access via Robbins Station on the CSX Transportation line. In addition, SRS maintains 101 km (63 mi) of onsite track for internal uses (DOE 1993j:4-60).

Waterborne transportation is available via the Savannah River. Currently, the Savannah River is used primarily for recreation (DOE 1993j:4-60). SRS has no commercial docking facilities, but it has a boat ramp that has accepted large transport barge shipments (SRS 1995a:9.)

Columbia Metropolitan Airport in the city of Columbia, South Carolina and Bush Field in the city of Augusta, Georgia, receive jet air passenger and cargo service from both national and local carriers. Numerous smaller private airports are located in the ROI.

3.7.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of SRS are shown in Table 3.7.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to SRS operations.

Table 3.7.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Savannah River Site Operation

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic and cosmogenic radiation	29
External radiation	29
Internal terrestrial radiation	40
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	363

[a] WSRC 1994d.
[b] NCRP 1987a.
Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from SRS operations provide another source of radiation exposure to individuals in the vicinity of SRS. Types and quantities of radionuclides released from SRS operations in 1993 are listed in the *Savannah River Site Environmental Report* for 1993 (WSRC-TR-94-075). The doses to the public resulting from these releases are presented in Table 3.7.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1993 report were used in the development of the reference environment (No Action) radiological releases and resulting impacts at SRS in the year 2005 (Section 4.2.6.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from SRS operations in 1993 is estimated to be 1.6×10^{-7}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of SRS operations is less than 2 in 10 million. (Note that it takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Based on the same risk estimator, 0.011 excess fatal cancers are projected in the population living within 80 km (50 mi) of SRS from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national mortality rate, the number of fatal cancers from all causes expected during 1993 in the population living within 80 km (50 mi) of SRS was 1,240. This number of expected fatal cancers is much higher than the estimated 0.011 fatal cancers that could result from SRS operations in 1993.

Table 3.7.9–2. Radiation Doses to the Public From Normal Savannah River Site Operation in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual[b]	Standard[a]	Actual
Maximally exposed individual (mrem)	10	0.18	4	0.14	100	0.32
Population within 80 km[c] (person-rem)	None	20.0	None	1.5	100	21.5
Average individual within 80 km[d] (mrem)	None	0.032	None	0.0022	None	0.034

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] The actual dose value given in the column under liquid releases conservatively includes all water pathways, not just the drinking water pathway. The population dose includes contributions to Savannah River users downstream of SRS to the Atlantic Ocean.

[c] In 1993, this population was approximately 620,100. For liquid releases, an additional 65,000 water users in Port Wentworth, Georgia and Beaufort, South Carolina (approximately 160 km downstream) are included in the assessment.

[d] Obtained by dividing the population dose by the number of people living within 80 km of the site for atmospheric releases; for liquid releases the number of people includes water users who live more than 80 km downstream of the site.

Source: WSRC 1994d.

The SRS workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.7.9–3 presents the average worker, maximally exposed worker, and cumulative worker dose to SRS workers from operations in 1992. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to SRS workers from normal operations in 1992 is estimated to be 0.14.

Table 3.7.9–3. Radiation Doses to Workers From Normal Savannah River Site Operation in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	17.9
Maximally exposed worker (mrem)	5,000	3,000
Total workers[b] (person-rem)	ALARA	350

[a] DOE's goal is to maintain radiological exposures as low as reasonably achievable.

[b] The number of badged workers in 1992 was approximately 19,500.

Source: 10 CFR 835, DOE 1993n:7.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Savannah River Site Environmental Report* for 1993 (WSRC-TR-94-075).

The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in this reference.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface waters during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.7.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements), contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at SRS via inhalation of air containing hazardous chemicals released to the atmosphere by SRS operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water, or direct exposure, are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.7.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to SRS workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a detailed estimation and summation of these impacts. However, the workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. SRS workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at SRS are expected to be substantially better than required by the standards.

Health Effects Studies. Only one published epidemiological study on the general population in communities surrounding SRS has been conducted. No evidence of excess cancer mortality, congenital anomalies, birth defects, early infancy deaths, strokes, or cardiovascular deaths was reported. An excess in leukemia deaths has been reported among hourly workers at SRS; no other health effects for workers were reported in the literature and reports reviewed. For a more detailed description of the studies reviewed and the findings, refer to Section M.4.7.

Accident History. Between 1974 and 1988, there were 13 inadvertent tritium releases from the tritium facilities at SRS. These releases have been traced to aging equipment in the tritium processing facility and are one of the reasons for the construction of a Replacement Tritium Facility at SRS. A detailed description and study of these incidents and their consequences to the offsite population has been documented by SRS. The most significant were in 1981, 1984, and 1985 when 32,934, 43,800, and 19,403 Ci of tritiated water vapor, respectively, were released (WSRC 1991a:41). In the period 1989 through 1992 there were 20 inadvertent releases, all with little or no offsite dose consequences. The largest of these recent releases occurred in 1992 when 12,000 Ci of tritium were released (WSRC 1993a:260).

In 1993, an inadvertent release of Pu-238 and Pu-239 took place. Westinghouse Savannah River Company (WSRC) emergency response models estimated a hypothetical exposure of 0.0019 mrem at the site boundary (WSRC 1994d:182).

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

The Emergency Preparedness Facility at SRS provides overall direction and control for onsite responses to emergencies and coordinates with Federal, State, and local agencies and officials on the technical aspects of the emergency.

The SRS Emergency Operations Facility consists of several centers, described below, that provide distinct emergency response support functions:

- The SRS Operations Center coordinates the initial response to all SRS emergencies and is equipped to function as the heart of SRS's emergency response communications network.
- The Technical Support Center provides command and control of emergency response activities for the affected facility or operational area.
- The Emergency Operations Center provides command and control of emergency response activities for SRS locations outside of the affected area.
- The Security Management Center coordinates activities relating to the security and safeguarding of materials by providing security staff in the affected area and contractor management in the Emergency Operations Center.
- The Dose Assessment Center is responsible for assessing the health and environmental consequences of any airborne or aqueous releases of radioactivity or toxic chemicals and recommends onsite and offsite protective actions to other centers.

3.7.10 WASTE MANAGEMENT

This section outlines the major environmental regulatory structure and ongoing waste management activities for SRS. A more detailed discussion of the ongoing waste management operations is provided in Section E.2.6. Table 3.7.10–1 presents a summary of waste management activities at SRS for 1993.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations at SRS. The DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed-upon milestones.

The EPA has placed SRS on the NPL and has identified approximately 150 potential operable units. In accordance with CERCLA, DOE entered into an FFCA with the EPA and the State of South Carolina, effective January 15, 1993, to coordinate cleanup activities at SRS under one comprehensive strategy. The FFCA combines the RCRA Facility Investigation Program Plan (under RCRA) with a CERCLA cleanup program entitled the RCRA Facility Investigation/Remedial Investigation Program Plan.

The Savannah River Site has an aggressive waste minimization program in progress to vastly improve the operation of existing and planned liquid and solid waste generating, treatment, and storage facilities. A disciplined approach to these activities is being developed based on technology and experience from the commercial nuclear industry. This approach already has significantly reduced the generation of TRU waste (48 percent), LLW (13 percent), mixed waste (96 percent), and hazardous waste (58 percent) (DOE 1993e:I-18). SRS generates and manages spent nuclear fuel and the following waste categories: high-level, TRU, low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. With the shutdown of the production reactors at SRS, no new spent nuclear fuel is expected to be generated from existing SRS operations. Future receipt and management of spent nuclear fuel at SRS will be made in accordance with the ROD published in the *Federal Register* (60 FR 28680) on June 1, 1995, and amended on March 8, 1996 (61 FR 9441) for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F), and the ROD (61 FR 25092) for the EIS on the *Proposed Policy for the Acceptance of U.S. Origin Foreign Research Reactor Spent Nuclear Fuel* (DOE/EIS-0218F).

High-Level Waste. Liquid HLW at SRS is made up of many waste streams generated during the recovery and purification of TRU products and unburned fissile material from spent reactor fuel elements. These wastes are separated by waste form, radionuclide, and heat content before their transfer to underground storage tanks in the F- and H-Area tank farms. Processes used routinely to treat liquid HLW are separation, evaporation, and ion exchange. Evaporation produces a Cs-contaminated condensate. Cesium is removed from the condensate resulting in a LLW stream that is treated in the ETF. The remaining HLW stream salts are precipitated, and some can be decontaminated. The decontaminated salt solution is sent with residues from the ETF to the Defense Waste Processing Z-Area Saltstone Facility where it is mixed with a blend of cement, flyash, and blast furnace slag to form grout. The grout is pumped into disposal vaults where it hardens for permanent disposal as solid LLW. The remaining high-level salt and sludge is permanently immobilized as a glass solid cast in stainless steel containers at the DWPF Vitrification Plant. The stainless-steel containers are decontaminated to DOT standards, welded closed, and temporarily stored onsite for eventual transport to and disposal in a permanent Federal repository. Future HLW generation could result from the processing and stabilization of spent fuel for long-term storage as a result of 60 FR 28680, and from remediation or materials recovery activities performed in the F- and H-Canyons.

Table 3.7.10–1. Spent Nuclear Fuel and Waste Management Activities at Savannah River Site

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent Nuclear Fuel	None	Stabilization[a]	None[a]	Pools	Sized to current inventory	None–High-Level Waste Program in the future	NA
High-Level							
Liquid	1,561	Settle,separate, evaporate	53,700[b]	F- & H- Area Tank Farm	133,000[c]	NA[d]	NA
Solid	None	Vitrification[e]	None	Air Cooled Shielded Facility	2,286 canisters[f]	None–High-Level Waste Program in the future	NA
Transuranic							
Liquid	None	NA	NA	NA	NA	NA	NA
Solid	391	None	None	Pads, buildings	14,600[g]	None–WIPP or alternate facility in the future	None
Low-Level							
Liquid	None	Absorption, evaporation, filtration, neutralization, saltstone	503,000[h]	Ponds, tanks-awaiting processing	NA	NA	NA
Solid	14,100	Compaction	3,980[i]	NA	NA	Burial vaults and trenches	2,578,000[j]
Mixed Low-Level							
Liquid	115	Stabilization, adsorption, neutralization, precipitation, filtration, ion exchange, evaporation	511,000[k]	RCRA permit Bldgs. E, 600, 700, M-Area Liquid Effluent Treatment Facility	11,500[l]	None	None
Solid	18	None	NA	RCRA permit Bldg. 600	1,990[m]	None	None
Hazardous							
Liquid	None	None	None	DOT containers	Included in solid	Offsite	NA
Solid	74[n]	None	None	DOT containers	2,618[o]	Offsite	NA

Table 3.7.10–1. Spent Nuclear Fuel and Waste Management Activities at Savannah River Site—Continued

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Sanitary)							
Liquid	700,000[p]	Filter, settle, strip	1,451,000[q]	Flowing ponds	NA	Permitted discharge	Varies by each permitted outfall
Solid	6,670	Compaction	Expandable, as required	NA	NA	Landfill (onsite and offsite)	Expandable, as required
Nonhazardous (Other)							
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	NA	Included in sanitary	Included in sanitary
Solid	Included in sanitary	Included in sanitary	Included in sanitary	NA	NA	Included in sanitary	Included in sanitary

[a] Some fuel will be processed in the F- and H-Canyons in accordance with the Final Environmental Impact Statement, *Interim Management of Nuclear Materials*.
[b] SRTC ion exchange, evaporators.
[c] F- and H-Area Tank Farms.
[d] Treatment removes the high level constituents (salt and sludge) from the liquids. The salt and sludge are vitrified.
[e] DWPF started operation in 1995.
[f] Defense Waste Processing Facility.
[g] TRU storage pads.
[h] Includes F- and H-Area Effluent Treatment Facility.
[i] Onsite compactors.
[j] Saltstone vaults, E-Area vaults, slit trenches.
[k] Includes F- and H-Area Effluent Treatment Facility, M-Area Effluent Treatment Facility, and Savannah River Technology Center Ion-exchange Treatment.
[l] Hazardous Waste Storage Facility, mixed waste storage buildings, Process Waste Interim Treatment, DWPF organic waste storage tank, burial ground storage tank, SRTC mixed waste storage.
[m] Hazardous Waste Storage Facility, mixed waste storage buildings.
[n] SRS generated 64.93 t of RCRA-regulated and 8.90 t TSCA-regulated hazardous wastes; thus, the sum is approximately 74 t. Assuming a density of 1,000 kg/m^3, a volume of 74 m^3 was calculated.
[o] Pads and buildings in B-, M-, and N-Areas.
[p] 1991 data.
[q] Centralized Sanitary Wastewater Treatment Facility.
Note: NA=not applicable.
Source: DOE 1995kk; SR DOE 1993c; SR DOE 1994b; SR DOE 1994c; SR DOE 1995b; SR DOE 1995c; SR MMES 1993a; SRS 1995a:2; WSRC 1995a.

Transuranic Waste. Under the FFCA on RCRA, LDRs signed by EPA and DOE on March 13, 1991, SRS is required to prepare TRU waste for shipment. SRS will begin discussions with the South Carolina Department of Health and Environmental Control on alternative treatment options in January 1998 if the Secretary of Energy does not decide to operate WIPP by that time. If a delayed opening date for WIPP is determined, DOE will propose modifications to the *SRS Site Treatment Plan* for approval by the State of South Carolina. Status of the WIPP readiness schedule will be included in the updates. Certified TRU waste is stored on TRU waste storage pads until it can be shipped to an approved TRU waste disposal facility. Should additional treatment be necessary for disposal, SRS would develop the appropriate treatment capability. All TRU waste currently generated is stored in containers on aboveground pads.

The Experimental TRU Waste Assay and Certification Facility began operations in 1986 to certify newly generated TRU waste. It since has been shut down. A new TRU waste characterization and certification facility is planned, and would provide extensive containerized waste processing certification capabilities. The facility is needed to prepare TRU waste for treatment and to certify TRU waste for disposal at WIPP. Drums that can be certified for shipment to WIPP are placed in interim storage on concrete pads in E-Area. Buried and stored waste containing concentrations of TRU nuclides between 10 and 100 nanocuries (nCi)/g (referred to as alpha-contaminated LLW or alpha waste) is managed like TRU waste because its physical and chemical properties are similar, and because similar procedures will be used to determine its final disposition. Because all of the TRU waste placed on the aboveground pads prior to January 1990 is suspected of having hazardous constituents, a RCRA Part B permit application has been submitted for the TRU waste storage pads and the Experimental TRU Waste Assay Certification Facility. The waste is currently being stored under RCRA interim status.

Low-Level Waste. The bulk of liquid LLW is aqueous process waste, including effluent cooling water, decontaminated salt solutions, purge water, water from storage basins for irradiated reactor fuel or target elements, distillate from the evaporation of process waste streams, and surface water runoff from areas where there is a potential for radioactive contamination. Liquids are processed to remove and solidify the radioactive constituents and to release the balance of the liquids to permitted discharge points within standards established by the regulatory permit. Solid LLW includes operating plant and laboratory waste, contaminated equipment, reactor and reactor-fuel hardware, spent lithium-aluminum targets, and spent deionizer resin from reactor coolant treatment. Solid LLW is separated by radiation levels into low and intermediate categories. Solid LLW that radiates less than 200 mrem/hr at 5 cm (1.97 in) from the unshielded container is considered low-activity waste. If it radiates greater than 200 mrem/hr at 5 cm (1.97 in), it is considered intermediate-activity waste. Intermediate-activity tritium waste is intermediate-activity waste with greater than 10 Ci of tritium per container. The disposal mode for solid LLW is disposal in earthen trenches and concrete vaults. Saltstone generated in the solidification of decontaminated salts extracted from HLW is disposed of as LLW in separate vaults. Saltstone is the highest volume of solid LLW disposed of at SRS. Disposal facilities are projected to meet solid LLW storage/requirements and to include LLW from offsite DOE facilities for the next 20 years.

Mixed Low-Level Waste. The FFCA signed by EPA and DOE on March 13, 1991, addresses SRS compliance with RCRA LDRs pertaining to past, ongoing, and future generation of mixed LLW (mostly solvents, dioxin, and California list wastes contaminated with tritium). SRS is allowed to continue to operate, generate, and store mixed wastes subject to LDRs; in return, SRS will report to EPA the characterization of all solid waste streams disposed of in land disposal units at SRS and has submitted its waste minimization plan to EPA for review. Schedules for measures to provide compliance through construction of the Consolidated Incineration Facility and the Hazardous Waste and Mixed Waste Storage Facility are included in the FFCA.

The Consolidated Incineration Facility will treat mixed LLW and hazardous waste. The Hazardous Waste and Mixed Waste Disposal Vaults are scheduled to be available in 2002. Mixed waste is currently placed in interim storage in the E-Area Solid Waste Disposal Facility and in two buildings in G-Area. These RCRA-permitted facilities will be used until completion of the Consolidated Incineration Facility and the Hazardous Waste and Mixed Waste Storage Facility. The FFCA requires DOE facilities storing mixed waste to develop site-specific

treatment plans and to submit the plans for approval. The FFCA formed the basis for the *SRS Proposed Site Treatment Plan.*

Hazardous Waste. Lead, mercury, cadmium, 1,1,1-trichloroethane, leaded oil, trichlorotrifluoroethane, benzene, and paint solvents are typical hazardous wastes generated at SRS. All hazardous wastes are stored onsite in DOT-approved containers in RCRA-permitted facilities in three RCRA-permitted hazardous waste storage buildings and on three interim status storage pads in the B- and N-Areas. Most of the waste is shipped offsite to commercial RCRA-permitted treatment and disposal facilities using DOT-certified transporters. Eight to nine percent of the hazardous waste (organic liquids, sludge and debris) will be incinerated in the Consolidated Incineration Facility. Hazardous chemicals are stripped from aqueous liquids collected during groundwater monitoring in the M-Area Stripper, and the treated wastewater is discharged in accordance with discharge limits of appropriate NPDES permits.

Nonhazardous Waste. In 1994, the centralization and upgrading of the sanitary wastewater collection and treatment systems at Savannah River were completed. The program included the replacement of 14 aging treatment facilities (out of 20) scattered across the site with a new 3,975 m^3/day (1.05 million gal/day) central treatment facility and connecting them with a new 29-km (18-mi) primary sanitary collection system. The collection system intercepts wastewater at points prior to discharge into old sanitary wastewater treatment facilities. The new central treatment facility treats sanitary wastewater by the extended aeration activated sludge process utilizing the oxidation ditch method. The treatment facility separates the wastewater into two forms, clarified effluent and sludge. The liquid effluent is further treated by non-chemical methods of ultraviolet light disinfection to meet NPDES discharge limitations. The sludge goes through a volume reduction process to reduce pathogen levels to meet proposed land application criteria (40 CFR 503). The remaining existing sanitary wastewater treatment facilities are being upgraded as necessary to meet demands by replacing existing chlorination treatment systems with non-chemical ultraviolet light disinfection systems to meet NPDES limitations. SRS-generated municipal solid waste is sent to a permitted offsite disposal facility. DOE is evaluating a proposal to participate in an interagency effort to establish a regional solid waste management center at SRS (DOE/EA-0989, DOE/EA-1079).

3.8 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Rocky Flats Environmental Technology Site was established in 1952 by the AEC and is located in rural northern Jefferson County, Colorado, 26 km (16 mi) northwest of downtown Denver and about 19 km (12 mi) south of Boulder. Once a remote site, RFETS is now adjacent to a large and growing metropolitan area that includes the communities of Boulder, Arvada, Westminster, Broomfield, and Golden. The Rocky Flats Industrial Area occupies approximately 155 ha (384 acres) in the middle of the site. The remaining 2,495 ha (6,165 acres) form a buffer zone around the active part of RFETS. The buffer zone provides a distance of more than 1.6 km (1 mi) between the developed portion of the site and any public road or private property.

The RFETS mission is to transition from a production-dominated site to an environmental restoration, cleanup, and waste management-dominated site. The contingency status of buildings that could have been used to manufacture new Pu components has been removed. The site will retain a Pu storage mission pending decisions and actions regarding long-term Pu storage and disposition based on this PEIS. The DOE property boundaries for the site are illustrated in Figure 2.2.7–1. The locations of major Pu facilities at RFETS are shown in Figure 2.2.7–2. Current activities at RFETS are all related to DOE activities. RFETS missions are listed in Table 3.8–1.

Table 3.8–1. Current Missions at Rocky Flats Environmental Technology Site

Mission	Description	Sponsor
Interim Pu storage	Maintain Buildings 371, 559, 707, 776/777, and 771 for interim Pu storage, with eventual consolidation into a single facility.	Assistant Secretary for Environmental Management
RFETS environmental restoration and waste management	As buildings are released from DP control, decontaminate and decommission; remove all Pu and other toxic and/or hazardous materials; prepare Pu wastes for final transport to long-term storage facility.	Assistant Secretary for Environmental Management

Source: RFETS 1995a:1.

Department of Energy Activities. With the January 1992 Presidential decision to cancel W88 warhead production, there are currently no weapons-related Pu operations scheduled for RFETS. The site will continue its Pu storage function, employing existing buildings for nonsurplus and surplus Pu materials. Pu component fabrication and production support activities have been permanently stopped; any such future activities would take place at other DOE sites. Other RFETS DOE activities that have been relocated under the nonnuclear manufacturing consolidation include the following:

- Manufacturing, fabrication, and repair support for the safe secure tractors, trailers, and railcars of the DOE transportation safeguards activities
- Fabrication of nuclear weapon component and assembly training devices, used by both DOE and the DoD
- Reservoir production that involves fabricating, assembling, testing, inspecting, and shipping of gas reservoir assemblies
- Metrology services
- Nuclear-grade steel

The expected reduction in stockpile requirements would have allowed Pu recovered from retired weapons to be recycled for all new production needs. Current stockpile projections anticipate that larger quantities of Pu will

be returned from weapon disassembly activities. Consequently, all existing residues, wastes, and Pu oxides do not need to be reprocessed for future weapon production at this time. These materials would only be processed to the extent necessary to ensure their stability for long-term monitored, retrievable storage or transport off the RFETS site in a Pu metal or oxide form. Selection of disposition options for residues would be based on minimizing waste disposal costs.

The current RFETS long-term mission is to prepare Pu processing and fabrication facilities for D&D with final disposition by EM. The Pu storage mission involves materials designated as either strategic reserve for current or anticipated program needs, surplus that can be converted to stable metal or oxide forms for storage and transport, or residue that is destined for disposal as waste. Pu storage capabilities would be maintained in Buildings 371, 707, 771, 776/777, and 559, with eventual consolidation into a single facility.

While preparing for PEIS ROD implementation, this interim period without Pu processing will permit operating selected RFETS Pu processing facilities to support the environmental restoration mission. Individual buildings and facilities will be D&D in accordance with EM plans.

The primary mission of RFETS was to produce components for nuclear weapons from materials such as Pu, uranium, beryllium, and various alloys of stainless steel. Production was stopped in 1989, and up until that time plant operations and purposes were kept secret, with little mission and management information given to the public. The site was off-limits to the general public. In 1992, the plant's production of nuclear weapon components was officially discontinued with the end of the Cold War.

Rocky Flats Environmental Technology Site now has a new mission focusing on environmental restoration, waste management, management of special nuclear materials onsite (one of which is Pu), D&D of facilities, and economic development. Although the site remains off-limits to the general public due to health and safety considerations, DOE now provides extensive information to the public concerning management and operations and works closely with the public on many issues related to RFETS.

Non-Department of Energy Activities. The RFETS has no non-DOE activities at this time.

3.8.1 LAND RESOURCES

Land Use. The 2,650-ha (6,550-acre) RFETS is located in northern Jefferson County, Colorado, approximately 26 km (16 mi) northwest of downtown Denver. All land within RFETS is owned by the Federal Government and is administered, managed, and controlled by DOE.

Existing Land Use. Generalized land uses within RFETS and the immediate vicinity are shown in Figure 3.8.1–1. Land uses surrounding the site are primarily open space, industrial, and rural residential and agricultural (grazing and hay production) (RF EG&G 1993a:2-1). RFETS contains two major categories of land use: industrial and undeveloped. Production facilities occupy approximately 155 ha (384 acres), or 6 percent of the site, and are centrally located on the site (RF DOE 1994a:2). The approximately 2,495 ha (6,165 acres) that remains is utilized as a security buffer zone while most of this area is open space (undeveloped); however, there are several other uses, including approximately 8 ha (20 acres) of production support facilities, approximately 45 ha (111 acres) of sanitary waste disposal, and 211 ha (523 acres) of aggregate and clay mining. No prime farmland exists onsite. There are no public recreation facilities onsite.

Land-Use Planning. Planning does not occur at the state level within Colorado, however, regional planning within the RFETS vicinity occurs through advisory Denver Regional Council of Governments (DRCOG). RFETS is located within Jefferson County, one of six counties that compromise the DRCOG. Jefferson County does not currently have a countywide comprehensive plan, however, the county has adopted community plans. Community plans function as land-use plans for specific areas of the county and their recommendations are used for making and granting future land-use decisions. The North Plains Community Plan designates RFETS as a "Special Use Area." The zoning resolution for Jefferson County classifies RFETS land with the following zoning districts: agricultural, industrial, and special use.

Visual Resources. The RFETS lays amid a landscape that is mostly grazing land with low hills and ridges. Construction and operation of the DOE facilities has heavily disturbed the character of the landscape. The most dominant features of the site include two large stacks and a water tank. The existing facilities are separated from public roads by the open land in the buffer area. The Rocky Mountains start to rise approximately 3.2 km (2 mi) to the west of RFETS. Because access to the site is limited to authorized personnel, public visual access is limited to views from the outside (RF EG&G 1993a:3-22). The facilities are brightly lit at night and are highly visible from many areas within a 4.8- to 8-km (3- to 5-mi) radius of the site. The area within the central developed area is consistent with a VRM Class 5 designation. The remainder of the site ranges from VRM Class 3 to Class 4.

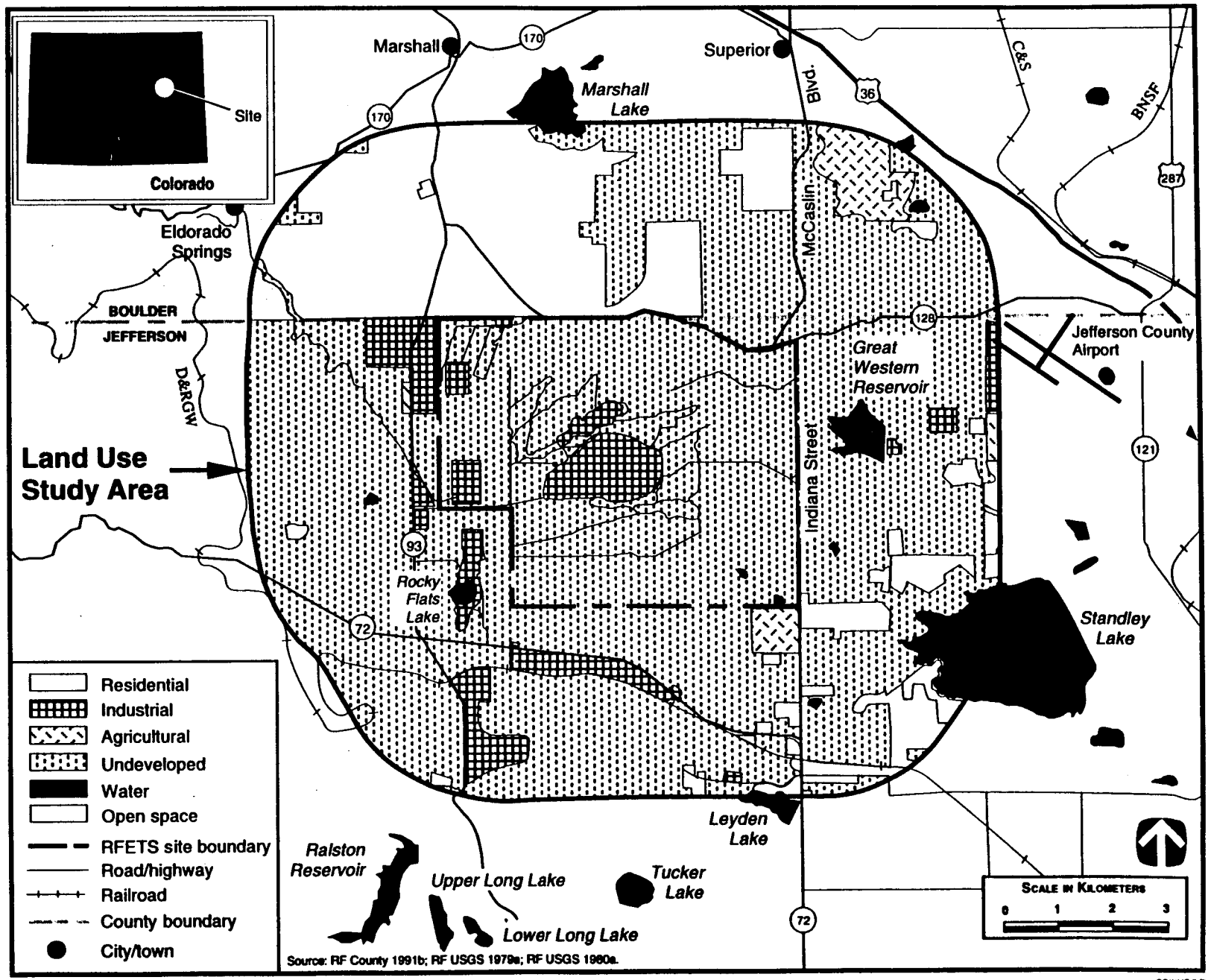


Figure 3.8.1–1. Generalized Land Use at Rocky Flats Environmental Technology Siteand Vicinity.

3.8.2 SITE INFRASTRUCTURE

Baseline Characteristics. Activities at RFETS are concentrated in facilities in the middle of the site. To support these activities, an extensive infrastructure exists. Baseline site infrastructure characteristics are shown in Table 3.8.2–1.

Table 3.8.2–1. Rocky Flats Environmental Technology Site Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	40	40
Railroads (km)	5	5
Electrical		
Energy consumption (MWh/yr)	184,000	184,000
Peak Load (MWe)	26	26
Fuel		
Natural gas (m^3/yr)	18,600,000	18,600,000
Oil (l/yr)	8,140,000	8,140,000
Coal (t/yr)	0	0
Steam (kg/hr)	41,000	41,000

Source: RFETS 1995a:1.

Two-lane county and State highways circumvent the site and include State Route 93 to the west, State Route 128 to the north, and Indiana Street to the east. No roads exist along the southern boundary and no public access roads traverse the site. RFETS has controlled access gates to the east and west with a paved road running through the middle of the site connecting Route 93 to Indiana Street. The site also has numerous dirt firebreak and access roads for management. Nuclear wastes from RFETS are transported by truck primarily along the interstate highway system. Nuclear shipments are restricted to off-peak periods when traffic activity is low.

Normal and alternate power is supplied from the Public Service Company of Colorado through two electrical switching stations. Currently, one station (to the north of the site) is used for primary services, and the other (just outside the west gate) is used to supply a small portion of the western side of the site and as backup electrical power. Emergency diesel generators provide backup power capabilities should normal and alternate power be lost. The sub-regional electric power pool from which RFETS draws its power is the Rocky Mountain Power Area. Capabilities of this power pool are summarized in Table 3.8.2–2.

The site is connected to a Public Service Company natural gas line. The line passes through the site and continues west to serve residential customers in the Coal Creek canyon area.

There are two methods by which the site acquires water; the method used at any particular time is at the discretion of the Denver Water Board. The preferred supply comes from a diversionary canal between Gross and Ralston Reservoirs. The canal passes the site between the west gate and Route 93, and provides gravity-fed flow to a holding pond, also to the west of the site. The second method involves pumping water directly from Ralston Reservoir to the holding pond, overcoming more than 300 ft of head pressure.

Table 3.8.2–2. Rocky Mountain Area Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel	
Coal	71%
Nuclear	0%
Hydro/geothermal	15%
Oil/gas	5%
Other[a]	9%
Total Annual Production	52,781,000 MWh
Total Annual Load	49,936,000 MWh
Energy Exported Annually[b]	2,753,000 MWh
Generating Capacity	10,691 MWe
Peak Demand	7,861 MWe
Capacity Margin[c]	2,357 MWe

[a] Includes power from both utility and nonutility sources.

[b] Energy exported is not the difference of production and load due to negative net pumped storage.

[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

The locations of buildings at RFETS are shown in Figure 2.2.7–2; the buildings that play a role in the site EA's proposed Category I and II special nuclear material consolidation and interim storage program are highlighted. Buildings 371 and 707 would play the most active role in the proposed site-specific action while Buildings 771, 776/777, 779, and 991 would perform consolidation support functions. The remainder of this section provides a description of these buildings. With the exception of Building 371, all of the buildings were built to commercial industrial standards. Building 371 was built to strict nuclear design standards.

Building 371 currently stores Category I and II special nuclear material and is proposed to be the primary special nuclear material consolidation and interim storage facility until long-term storage and disposition actions are decided and implemented. Portions of the RFETS Pu residues, TRU waste, and RCRA waste inventories currently are stored in Building 371. The four-level facility has approximately 17,300 m^2 (186,000 ft^2) of floor space and contains six Pu storage vaults and vault-type rooms. The stacker/retriever moves radioactive materials between the central storage vault and the input and output stations. In addition to this transport capability, the central storage vault was designed for storage of Category I and II special nuclear material.

Building 707 is a two-story facility with 6,897 m^2 (74,240 ft^2) per floor. A single-story portion with 1,724 m^2 (18,560 ft^2) composes the east side of the building. The building contains 10 modules in which various manufacturing activities have taken place in the past. Building 707 is connected directly, through other buildings or by tunnels, to Buildings 776/777, 771, 778, and 779.

Building 771 is a two-level facility with approximately 14,000 m^2 (151,000 ft^2) of floor space and stores Pu that requires stabilization. The building is connected by a tunnel to Building 776/777, which is directly connected to Buildings 779 and 707. The tunnel between Buildings 771 and 776 is concrete-lined and is equipped with a HEPA filtration ventilation system.

Building 776/777 is a two-story facility with approximately 14,500 m^2 (156,200 ft^2) of floor space and contains special nuclear material that requires stabilization. The building is connected to Building 779 by an enclosed hallway, to Building 771 by tunnel, and to Building 707 via Building 778.

Building 779 is a research and development facility originally built to support production and recovery processes. The facility was completed in 1965, and the external structure was subsequently improved to withstand an earthquake of 6.0 on the Richter scale.

Building 991 was built in 1952 and is used primarily for shipping special nuclear material and other certified product materials (including nonnuclear materials). The facility and its associated underground tunnels and vaults are also used for storing special nuclear material and other certified product materials.

3.8.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The RFETS region is characterized as a dry climate, middle-latitude steppe, with mild, sunny, semiarid conditions and few temperature extremes. The average annual temperature at RFETS is 10.2 °C (50.3 °F); temperatures vary from an average daily minimum of -8.8 °C (16.1 °F) in January to an average daily maximum of 31.2 °C (88.2 °F) in July. The average annual precipitation at RFETS is 39.1 cm (15.4 in). The average annual windspeed at Denver National Weather Service Station is 3.8 m/s (8.6 mph) (NOAA 1994a:3). Additional information related to meteorology and climatology at RFETS is presented in Appendix F.

Ambient Air Quality. The RFETS is located within the Metropolitan Denver Intrastate AQCR #36. This AQCR is designated nonattainment with respect to the NAAQS for PM_{10}, O_3, and CO, and listed as attainment for SO_2 and NO_2 (40 CFR 81.306). The PM_{10} standard is exceeded primarily due to fugitive dust. Vehicular traffic is a major contributor to the high concentrations of O_3 and CO in the region. Applicable NAAQS and the ambient air quality standards for Colorado are presented in Appendix F.

Since the creation of the PSD program in 1977, PSD permits have not been required for any new RFETS emission sources. There are several PSD (40 CFR 52.21) Class I areas near RFETS. The closest, Rocky Mountain National Park, is located approximately 46 km (30 mi) northwest of RFETS.

The emissions inventory from sources at RFETS is presented in Appendix F. Historically the principal sources of criteria pollutants at RFETS are the steam plant boilers. Minor combustion sources include various small boilers and diesel generators. Other sources of criteria pollutants include coating operations and particulate matter from various manufacturing operations.

National hazardous and toxic air pollutant standards have not been adopted by the State of Colorado Department of Public Health and Environment. The annual emission rates of hazardous/toxic air pollutants from existing RFETS facilities for the period 1991 through 1993 are listed in Appendix F.

Table 3.8.3–1 presents the baseline ambient air concentration for criteria pollutants and other pollutants of concern at RFETS. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. Major noise sources at RFETS include various facilities, equipment, and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). No sound-level measurements have been made around RFETS to determine background sound levels. Most RFETS industrial facilities are at a sufficient distance from the site boundary to make noise levels at the boundary from these sources barely distinguishable from background noise.

The acoustic environment along the RFETS boundary and at nearby residences away from traffic noise is typical of a rural location or quiet suburban residential area, with DNL in the range of 35 to 52 dBA (EPA 1974a:B-4). Traffic is the primary source of noise at the site boundary and at nearby residences. Plant traffic contributes little to overall traffic noise. However, traffic noise is expected to dominate sound levels along major roads in the area. Except for the prohibition of nuisance noise, neither the State of Colorado nor its local governments have established environmental noise standards applicable to RFETS.

Table 3.8.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Rocky Flats Environmental Technology Site, 1991-1994

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	Baseline Concentration[b] ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000[c]	145
	1-hour	40,000[c]	534
Lead	Calendar Quarter	1.5[c]	[d]
	30-day	1.5[e]	[d]
Nitrogen dioxide	Annual	100[c]	4.14
Ozone	1-hour	160[e]	[f]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[c]	0.235
	24-hour	150[c]	17.4
Sulfur dioxide	Annual	80[c]	0.295
	24-hour	365[c]	21.8
	3-hour	700[e]	64.6
Mandated by the State of Colorado			
Hydrogen sulfide	1-hour	142[e]	<0.01
Total suspended particulates	Annual	75[e]	0.284
	24-hour	150[e]	21.0
Hazardous and Other Toxic Compounds			
1,1,2-Trichloro-1,2,2 Trifluoroethane	Annual	[g]	0.01
Carbon tetrachloride	Annual	[g]	0.01
Dioctyl phthalate	Annual	[g]	<0.01
Methylene chloride	Annual	[g]	<0.01
Nitric acid	Annual	[g]	<0.01
Trichloroethane	Annual	[g]	<0.01

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.
[b] Modeled concentration based on permit data.
[c] Federal and State standard.
[d] Data not available from the source document.
[e] State standard.
[f] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.
[g] No State standard for indicated averaging time.
Source: 40 CFR 50; CO DPHE 1994a; RFETS 1995a:1.

3.8.4 WATER RESOURCES

Surface Water. The main surface water features at RFETS are Walnut Creek, North Walnut Creek, South Walnut Creek, and Woman Creek (Figure 3.8.4–1). The streams at RFETS are considered part of the Big Dry Creek drainage basin, although Big Dry Creek is not directly affected by RFETS activities. Rock Creek flows through the northwestern portion of the site and is physically separate from the operational plant complex; as such, Rock Creek is unaffected by site activities. Rock Creek has been maintained in an undisturbed condition since 1952.

The RFETS lies on the divide between Walnut Creek and Woman Creek drainage basins. North Walnut Creek and South Walnut Creek drain the central and northern areas of RFETS, and Woman Creek drains the southern areas. The confluence of South and North Walnut Creeks forms Walnut Creek. Walnut Creek flows downstream from RFETS and empties into the Broomfield Diversion Ditch. The Broomfield Diversion Ditch routes water around the Great Western Reservoir, which is a public water supply, then into Big Dry Creek, and eventually into the South Platte River.

Woman Creek flows east across the southern portion of RFETS into Standley Lake, which provides irrigation storage and municipal water for surrounding communities. Woman Creek may also be diverted into Mower Reservoir which also flows into Standley Lake. Standley Lake flows into Big Dry Creek, which flows into the South Platte River.

All natural surface water flow on RFETS occurs in ephemeral channels that flow only as a result of precipitation, discharge of site effluents, surface seeps, or release of water from storage areas west of the site to supplement water supplies in the Great Western Reservoir or Standley Lake. On North Walnut Creek, South Walnut Creek, and Woman Creek, a series of unlined ponds serve to impound waters from the site. Along North Walnut Creek, the ponds are numbered A–1 through A–4; on South Walnut Creek, the ponds are numbered B–1 through B–5; and on Woman Creek, the ponds are numbered C–1 and C–2. Pond C–2 is off channel from Woman Creek and does not receive direct flow. Flow into Pond C–2 is from runoff into South Interception Ditch and then into Pond C–2.

Wastewater from industrial processes is treated at a treatment plant that is isolated from other sources and does not discharge to surface water features. Existing sanitary wastewater generation is estimated at approximately 150 million l/yr (39.6 million gal/yr). Sanitary wastewater is treated and discharged to Pond B–3. Stormwater runoff from the plant is conveyed in storm sewers that discharge to creeks on the undeveloped portion of the site. Discharges from Ponds A–3, A–4, B–3, B–5 and C–2 are monitored under the NPDES-permit program.

Terminal ponds (A–4, B–5, and C–2) are designed to capture the flow from a 100-year storm if maintained at less than 10 percent of capacity. However, RFETS has been unable to maintain the 10-percent capacity limit due to the treatment of large quantities of water and delays in receiving approval for certain discharges.

The primary source of flood potential at RFETS is from flash flooding in seasonal streams. Of these, Woman Creek and North and South Walnut Creek drain the part of the site occupied by plant facilities. A recent study evaluating flooding potential at RFETS indicated that even in the most extreme circumstances it is unlikely that flows on Woman Creek could pose a hazard to facilities. The stream is at least 24 m (79 ft) below the elevation of structures in proximity to the stream (LLNL 1988a:3-1). Because evidence suggested that Walnut Creek may be subject to excessive flows during periods of high rainfall and runoff, a probabilitic flood analysis was performed. The 500-year floodplain of Walnut Creek corresponds to an elevation of approximately 1,806 m (5,925 ft). The majority of RFETS facilities are located between elevations of 1,814 and 1,844 m (5,952 and 6,050 ft) mean sea level. Therefore, these facilities lie outside the 500-year floodplain.

The RFETS does not withdraw any water from streams on or near the site. All water for the plant is obtained from surface waters from the city of Denver via the South Boulder Diversion Canal from the South Boulder Creek and

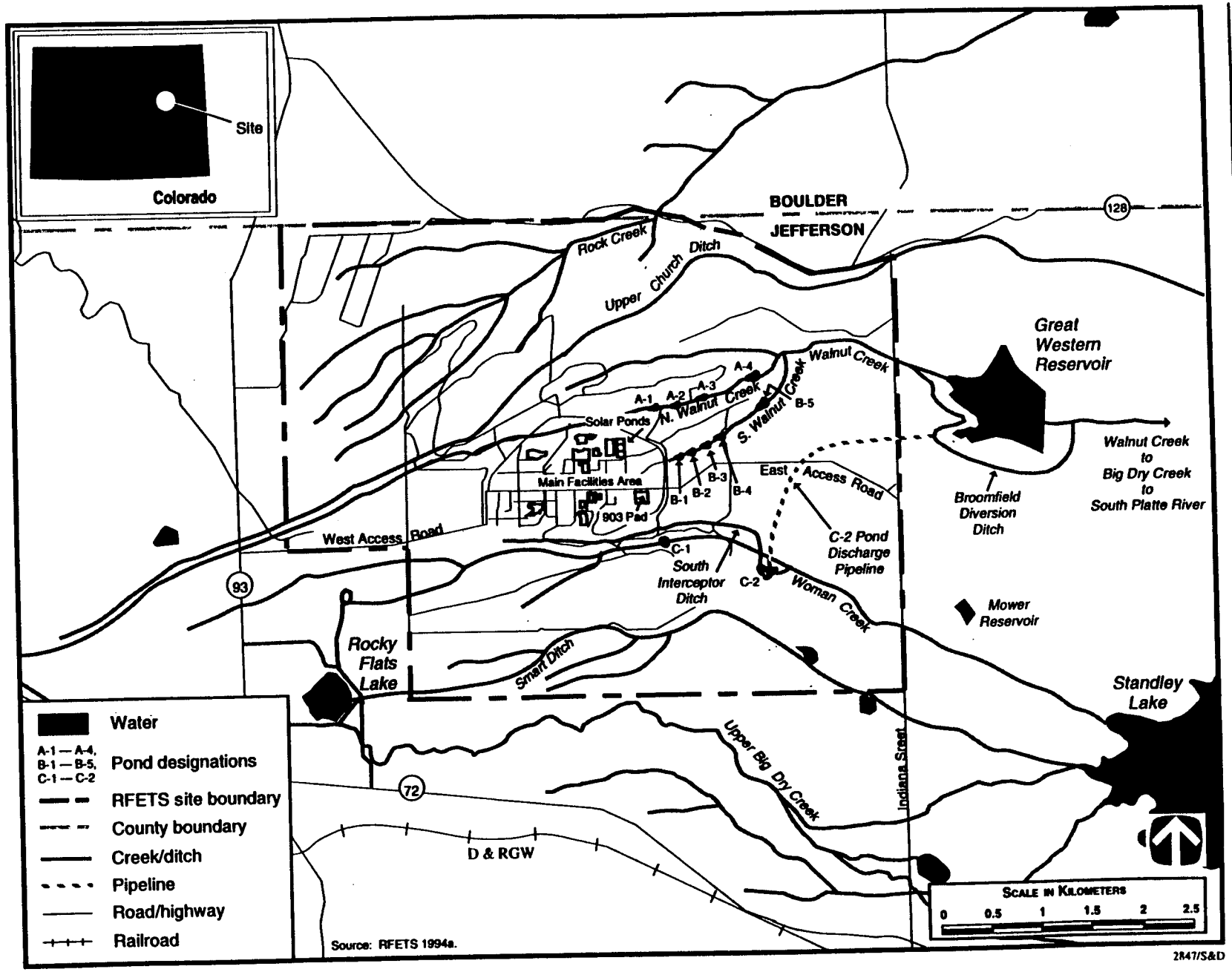


Figure 3.8.4–1. Surface Water Features at Rocky Flats Environmental Technology Site

Ralston Reservoir. The water supply contract with the city and county of Denver through the Denver Water Board is for an unguaranteed supply of up to 5.7 million l/day (1.5 million gal/day). The current average water consumption is approximately 485 million l/yr (128 million gal/yr). Raw water is stored in a 5.7 million l (1.5 million gal) storage pond west of the plant.

Surface Water Quality. The water from Woman Creek, North Walnut Creek, and South Walnut Creek flows into ponds that restrict offsite discharges and allow water testing and, if necessary, treatment to meet water quality standards. A treatment facility is located at Pond A–4. Water from Pond B–5 is transferred to Pond A–4. Treatment consists of filtration and carbon absorption to reduce potential radionuclides and organic chemical contaminants. With concurrence from the Colorado Department of Health, water is released from Pond A–4 to Walnut Creek, and from Pond C–2 to the Broomfield Diversion Ditch, or in an emergency, to Ponds A–4 or B–5.

Discharges from Ponds A–4 and B–5 enter Walnut Creek and are diverted around the Great Western Reservoir by the Broomfield Diversion Ditch. Water is discharged untreated from Pond C–2 through a 2,438 m (7,999 ft) pipeline into the Broomfield Diversion Ditch and around the Great Western Reservoir. The release of untreated discharge from Pond C–2 has been approved by EPA because sampling indicates that the discharge meets all Woman Creek standards except for gross beta. The gross beta standards for Walnut Creek, the eventual destination of the piped discharge are higher, and no standard is exceeded.

An unlined surface water control pond exists immediately downstream and downgradient of the landfill and current waste disposal operations at the eastern end of the landfill. The landfill is considered a hazardous waste management landfill due to past disposal of some materials that may now qualify as regulated hazardous wastes. The landfill pond routinely exceeds the RFETS standard for strontium and has exceeded standards for copper, iron, lithium, manganese, mercury, nickel, Pu, and zinc. The landfill pond does not discharge to natural surface waters.

Water quality monitoring results for Walnut Creek and Woman Creek are presented in Table 3.8.4–1. These results indicate that concentrations were less than the water quality criteria listed. No Notices of Violations were received by RFETS in 1993 for NPDES limitations.

Surface Water Rights and Permits. Surface water rights are not an issue at RFETS because RFETS facilities do not withdraw surface water for use. As previously mentioned, the water supply contract with the city and county of Denver is for an unguaranteed supply of up to 5.7 million l/day (1.5 million gal/day).

Groundwater. Two nonhydraulically connected groundwater systems are present at RFETS. The upper unit exists as an unconfined aquifer and the lower unit as a confined aquifer. The contact separating the two units is identified as the base of the weathered zone.

The unconfined aquifer at RFETS is primarily unconsolidated alluvial material. The average depth to the water table in the unconsolidated surficial deposits range from about 21 m (70 ft) at the western boundary of RFETS to less than 3 m (10 ft) in the industrial area. Seeps are common along stream drainage. Groundwater flow direction is generally toward the east. Recharge to the unconfined aquifer occurs from infiltration of precipitation and as seepage from ditches, creeks, and ponds. In addition, retention ponds along South Walnut and Woman Creeks probably recharge this unit.

In the confined aquifer, groundwater is in the sandstone lenses below most of the plant. Flow within the sandstones is assumed to be from west to east. In some places, the sandstones are in contact with the alluvium so that the unit is part of the unconfined system at those places. Recharge to the sandstones occurs where they are in direct contact with the alluvium and valley fill of the upper aquifer or by leakage through claystones in contact with alluvium. The sandstone units discharge along the South Platte River, about 47 km (29 mi) east of RFETS.

Table 3.8.4–1. Summary of Surface Water Quality Monitoring at Rocky Flats Environmental Technology Site, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Existing Water Body Concentration	
			Average	Maximum
Receiving Water: Walnut Creek				
Alpha (gross)	pCi/l	11[b]	2.4	2.9
Americium-241	pCi/l	0.05[b]	0.001	0.013
Beryllium	mg/l	0.004[c]	<0.001	<0.001
Beta (gross)	pCi/l	19[b]	2.0	3.0
Copper	mg/l	1.0[d]	0.008	0.010
Lead	mg/l	0.015[c]	<0.002	<0.047
Plutonium-239/240	pCi/l	1.2[e]	0.002	0.024
Total dissolved solids	mg/l	500[d]	325	350
Tritium	pCi/l	500[b]	0	250
Uranium-233/234	pCi/l	10[b]	0.65	1.00
Uranium-238	pCi/l	10[b]	0.69	1.17
Receiving Water: Woman Creek				
Americium-241	pCi/l	0.05[b]	0.017	0.017
Beryllium	mg/l	0.004[c]	<0.001	<0.001
Copper	mg/l	1.0[d]	0.004	0.004
Lead	mg/l	0.015[c]	<0.050	<0.050
Plutonium-239/240	pCi/l	1.2[e]	0.010	0.010
Total dissolved solids	mg/l	500[d]	328	328
Tritium	pCi/l	500[b]	67	110
Uranium-233/234	pCi/l	5[b]	2.74	2.74
Uranium-235	pCi/l	5[b]	0.08	0.08
Uranium-238	pCi/l	5[b]	2.32	2.32

[a] For comparison purposes only, except for parameters that have Colorado State Water Quality Standards. [Text deleted.]

[b] Colorado State Water Quality Standards, specific for Walnut and Woman Creeks.

[c] National Primary Drinking Water Regulations (40 CFR 141).

[d] National Secondary Drinking Water Regulations (40 CFR 143).

[e] DOE DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.

Source: RFETS 1994a.

Groundwater Quality. Groundwater monitoring has been conducted at RFETS since 1960. By the end of 1994, about 300 wells were monitored for the purpose of determining groundwater quality and to determine the distribution of contaminant constituents in groundwater at RFETS. Groundwater quality in uncontaminated portions in surficial materials (alluvium, colluvium, valley fill, and weathered bedrock) is relatively good and can be classified as calcium bicarbonate water. The unweathered bedrock groundwater system can be distinguished from the surficial system by relatively higher sodium and sulfate content. Background groundwater quality for the upper and lower hydrostratigraphic units beneath RFETS is summarized in Table 3.8.4–2.

The unconfined aquifer contains both radiological and nonradiological contaminants. To date, the understanding of the hydrogeologic relationships indicate that there are no known bedrock pathways through which

Table 3.8.4–2. Groundwater Quality Monitoring at Rocky Flats Environmental Technology Site, 1994

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Existing Conditions	
			Upper Hydrostatic Unit	Lower Hydrostatic Unit
Alpha (gross)	pCi/l	15[b]	8.354	3.127
Americium-241	pCi/l	1.2[c]	0.011	0.028
Beryllium	mg/l	0.004[b]	0.00222	0.00204
Beta (gross)	pCi/l	50[d]	4.892	3.234
Cadmium	mg/l	0.005[b]	0.00245	0.00240
Cesium-137	pCi/l	120[c]	0.420	0.217
Chloride	mg/l	250[e]	12.8	100.108
Copper	mg/l	1.0[e]	0.01085	0.00970
Lead	mg/l	0.015[b]	0.00855	0.00272
pH	pH Units	6.5-8.5[e]	7.14	7.85
Radium-226	pCi/l	5[b]	0.258	1.723
Strontium-89/90	pCi/l	800[c]/400[c]	0.338	0.473
Sulfate	mg/l	250[e]	86.230	123.943
Total dissolved solids	mg/l	500[e]	354.151	545.138
Tritium	pCi/l	80,000[c]	101.702	56.881
Uranium-233/234	pCi/l	20[c]	6.914	1.643
Uranium-235	pCi/l	24[c]	0.195	0.033
Uranium-238	pCi/l	24[c]	4.832	0.768

[a] For comparison purposes only.
[b] National Primary Drinking Water Regulations (40 CFR 141).
[c] DOE DCG for Water (DOE Order 5400.5). DCG values are based on a committed effective dose of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG.
[d] Proposed National Drinking Water Regulations; Radionuclides (56 FR 33050).
[e] National Secondary Drinking Water Regulations (40 CFR 143).
Source: RFETS 1995a:3.

groundwater contamination can directly leave RFETS and migrate into the confined aquifer system offsite (RFETS 1994a:123).

There are five principle areas where groundwater has been affected by plant activities at RFETS (Figure 3.8.4–2). The first plume is associated with the solar evaporation ponds, which were used to store radioactive/hazardous waste. The main contamination from this plume surrounds 207A and 207B ponds. Groundwater flow data across the solar evaporation ponds area diverges along two flow paths. One flow path is northeasterly toward North Walnut Creek and the other is southeasterly toward South Walnut Creek. Groundwater quality data from 1993 indicate that the solar ponds contributed nitrate/nitrite, sodium, TDSs, fluoride, bicarbonate, sulfate, dissolved radionuclides, several dissolved metals, and VOCs to the groundwater in surficial material and weathered bedrock immediately north, east, and southeast of the ponds (RFETS 1994a:130). The radionuclides include tritium, Pu-239, -240, Americium-241, and U-233,-234, -235, and -238.

The second plume, the 903 Pad, Mound, and Trench plume, is located in the southeastern-central portion of RFETS. The 903 Pad and Mound areas were historically used for storage and burial, respectively, of radioactively contaminated wastes. The plume located in the upper hydrostratigraphic unit is contaminated with

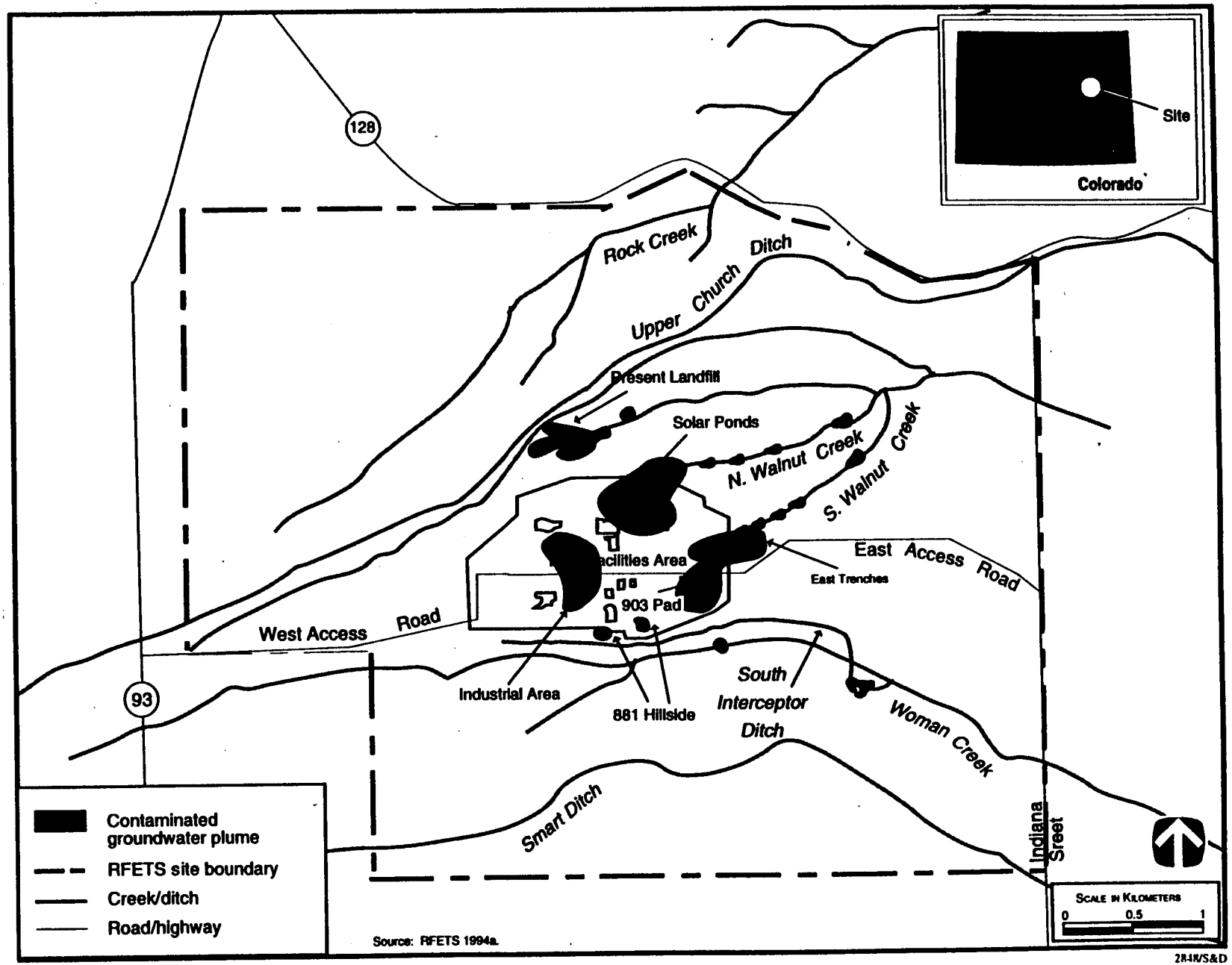


Figure 3.8.4–2. Groundwater Contamination Areas at Rocky Flats Environmental Technology Site.

VOCs, inorganics, dissolved metals, and some radionuclides (RFETS 1994a:127). The plume does not lie beneath buildings that house DOE activities.

The third plume is associated with the present landfill and is located at the western end of an unnamed drainage channel which discharges to North Walnut Creek. [Text deleted.] The plume contains inorganic analytes, dissolved metals, dissolved radionuclides, and VOCs, as well as nitrate and nitrite above standard levels (RFETS 1994a:136). The plume does not lie beneath buildings that house DOE activities.

The fourth plume is the 881 Hillside plume, located in the south-central portion of RFETS in the shallow groundwater system. Based on the most recently completed Phase III remedial investigation, VOCs (that is, carbon tetrachloride, perchloroethylene, and trichloroethylene) pose the most public health risk (RFETS 1994a:127). This area was used for the storage of drums containing cleaning solvents from 1967 to 1972. The plume also contains elevated levels of total dissolved solids, metals (nickel, Sr, selenium, zinc, and copper), and uranium. The plume does not lie beneath any buildings housing DOE activities.

The fifth plume is associated with the Western Industrial Area, with primary contamination occurring in the western portion of the RFETS buffer zone. Within and adjacent to the Western Industrial Area, groundwater quality has been impacted by carbon tetrachloride, tetrachloroethene, and trichloroethene. This plume does not lie beneath buildings that house DOE activities.

Groundwater Availability, Use, and Rights. Currently, no groundwater is used for potable purposes by the facility. However, approximately 10.6 million l/yr (2.8 million gal/yr) of groundwater is withdrawn from the site as part of the environmental restoration program, for contaminant removal.

In general, the rights to groundwater resources in Colorado are unrelated to ownership of the land under which those groundwater resources are located. However, for the Denver Basin aquifers, which include the lower aquifers at the RFETS, the right to groundwater resources derives from land ownership as long as the water is not tributary to any surface water supplies.

3.8.5 GEOLOGY AND SOILS

Geology. The RFETS is located on the western edge of the Colorado Piedmont section of the Great Plains physiographic province. The site is located on the west flank of the Denver Basin, an extensive sedimentary basin bordered on the west by the base of the Colorado Front Range. The site is located on a geomorphic surface comprised of a gravel-capped pediment surface identified as the Rocky Flats alluvial surface.

The surficial geology at RFETS consists of Quaternary alluvial, colluvial, eolian, and landslide deposits that range in thickness from several centimeters to over 30.5 m (100 ft). The most important unit is the Rocky Flats Alluvium, which consists of poorly sorted deposits of sand, gravel, and cobbles in a clay matrix that thins from west to east across the site (RF DOE 1985a:21). The Arapahoe Formation (Cretaceous-age), which immediately underlies the Rocky Flats Alluvium at RFETS, is approximately 0 to 36.5 m (0 to 120 ft) thick and consists of fluvial claystones with interbedded lenticular sandstones and siltstones (RF DOE 1985a:20; RF EG&G 1994a:G-1,G-2).

The RFETS lies in Seismic Zone 1, indicating minor damage could occur as a result of earthquakes (Figure 3.2.5–1). Occasional earthquakes with MMI of V to VI occur in Colorado. No major faults cut the Arapahoe Formation or overlying alluvium in the vicinity of RFETS (RF DOE 1985a:20). The Livingston fault, located approximately 5 km (3 mi) to the west, and the Golden fault, located approximately 8 km (5 mi) to the south, are the mountain-front faults closest to the facility. Neither fault is recognized as a capable fault according to 10 CFR 100, Appendix A. No other capable faults are present in the immediate vicinity of RFETS. There are no known areas of active volcanism in the Denver Basin.

Landslides and other mass earth movements are present as shallow features where slopes are steep. Nearly all of the site, however, has slopes averaging only 2 percent. Slopes may be greater than 2 percent along the sides of washes.

Soils. The RFETS is underlain mainly by soils of the Denver-Kutch and Flatirons-Velscamp soil associations. Erosion potential of the Denver-Kutch soil is low to moderate and shrink-swell potential is moderate to high. The Flatirons-Velscamp soil does not pose an erosion hazard, and its shrink-swell potential is low to moderate.

3.8.6 BIOLOGICAL RESOURCES

Terrestrial Resources. The RFETS is located at an elevation of 1,829 m (6,000 ft) above sea level, at the approximate elevation where plains grassland vegetation meets lower montane forest (RF DOE 1980a:2-93). Plant facilities occupy about 6 percent of the total site area. Vegetative communities on RFETS have been divided into four basic types; those within the central portion of the site are shown on Figure 3.8.6–1. Plant communities include grassland, marshland, woodland, and shrubland. Grassland is the most common community onsite, with mesic and zeric grasslands being the predominant subtypes. Marshland occurs along several creeks that traverse the site. Woodlands and shrublands are not common communities on RFETS. Habitats that are considered important to wildlife (especially waterfowl and passerine birds) include riparian zones along creeks and trees on south facing slopes (RFP 1992b:3). A total of 362 species of vascular plants have been identified on the site (RF DOE 1991i:23).

It appears that vegetation is recovering from the grazing that occurred before Government acquisition of the land. Recent studies have indicated that plant succession has progressed since the 1970s. Most areas formerly mapped as annual weed communities now qualify as perennial grassland. Indicator species for perennial grassland such as western wheatgrass and Canada bluegrass have increased in abundance and now dominate over much of the site (RF DOE 1991i:4).

Animals identified on the RFETS include 4 amphibian, 8 reptile, 167 bird, and 36 mammal species (RF DOE 1995a:2). Common animals of the site include the common bullsnake, prairie rattlesnake, western meadowlark, mourning dove, coyote, and mule deer (RF DOE 1991i:4,5,23,24). A variety of game animals occur on the site; however, hunting is not permitted. Numerous raptors, such as the red-tailed hawk and rough-legged hawk, and carnivores, such as the coyote and long-tailed weasel, are found on RFETS. Migratory birds and their nests and eggs are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Wetlands. Rocky Flats Environmental Technology Site contains a variety of wetlands including intermittent streams, ditches, ponds, and hillside seeps. Most wetlands that occur onsite are found along ephemeral streams and are classified on NWI maps as palustrine. There are several manmade wetlands on the site including vegetated sections of ditches, such as the South Interceptor Ditch, the A, B, and C-series ponds, and the landfill pond. Wetlands also occur at various locations around the site that are fed by drains and stormwater from paved areas and other surface runoff (RFP 1991c:4). Numerous seeps are scattered on the hillsides of the site. Vegetation typical of wetlands at RFETS includes sandbar willow, American watercress, plains cottonwood, broad-leaf cattail, and bulrush. In total there are about 43 ha (107 acres) of aerial wetlands and 25.9 km (16.1 mi) of narrow wetlands along streambeds within RFETS (RF DOE 1990b:18,19,22).

Aquatic Resources. Aquatic habitat on RFETS consists of ephemeral streams, ditches, ponds, and springs. Four streams flow within the site boundaries; North Walnut Creek, South Walnut Creek, Woman Creek, and Rock Creek (Figure 3.8.4-1). Each of these streams supports a series of on-channel retention reservoirs or ponds which collect surface water runoff and wastewater. North and South Walnut Creek, which are located in the northeast portion of the site, flow eastward offsite and into Great Western Reservoir. Fathead minnows are found in these streams. There are three holding ponds along North Walnut Creek and four ponds along South Walnut Creek. These ponds support crayfish and various other macroinvertebrates; fathead minnows are found in at least one of the ponds (RF DOE 1980a:2-96).

Woman Creek, which is located in the southern portion of the site, flows eastward offsite and into Standley Lake. Seven species of fish have been identified in Woman Creek and include several minnows, largemouth bass, green sunfish, and the white sucker (RF DOE 1991b:4). Redside dace and bluegill occur in holding ponds located along Woman Creek (RF DOE 1980a:2-97).

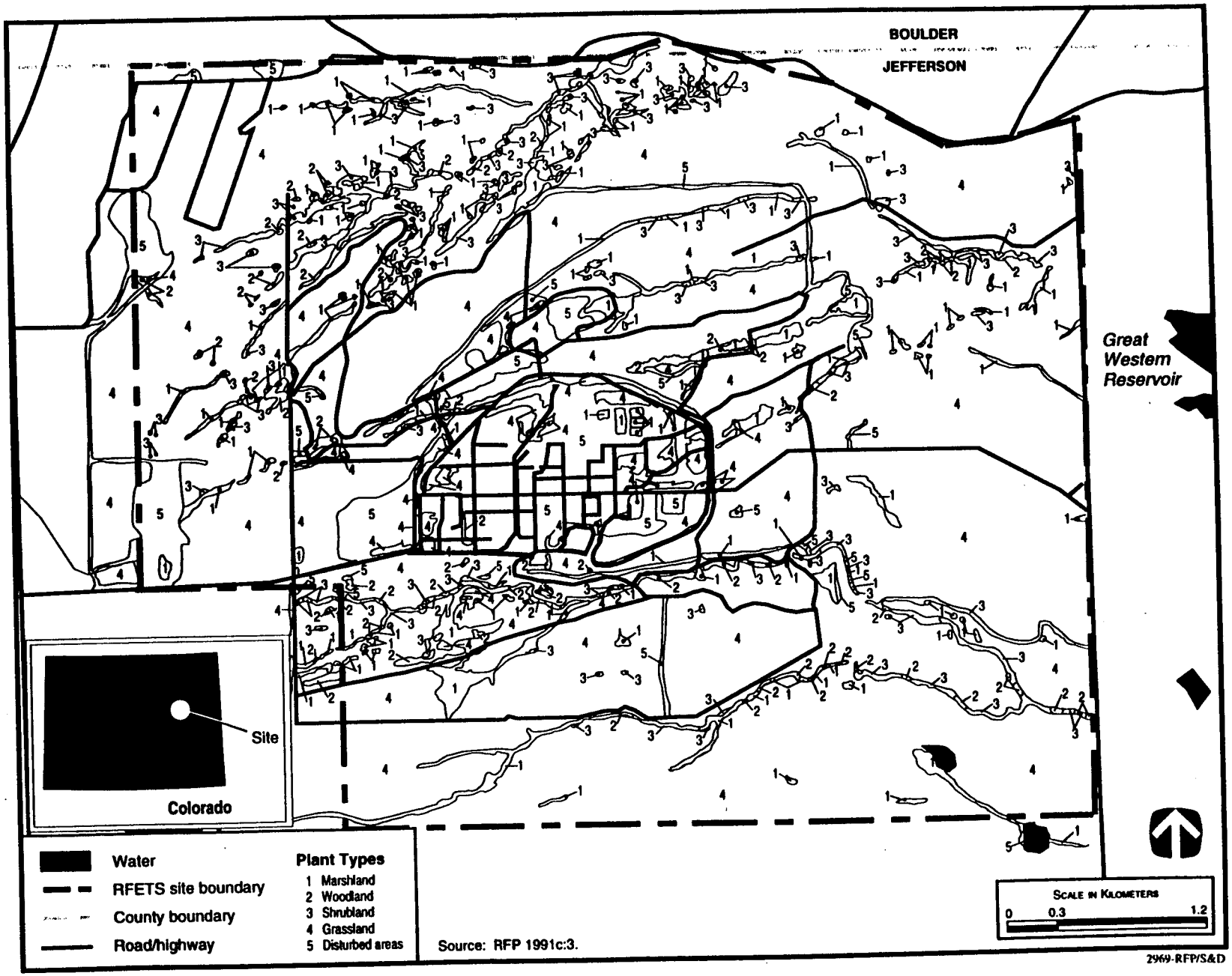


Figure 3.8.6–1. Distribution of Plant Communities at Rocky Flats Environmental Technology Site.

Rock Creek is located in the northwest portion of the site and is unlikely to support a large number of fish. However, Lindsay Pond, located on Rock Creek, does provide habitat for redside dace and largemouth bass (RF DOE 1980a:2-96).

Ditches located on RFETS convey stormwater runoff to holding ponds. These ditches do not support any fish populations. There are several permanent and temporary ponds located throughout the site, and a number of springs are found in the southwest portion of the site. Information is not available on the aquatic organisms found in these habitats (RFP 1992b:4).

Threatened and Endangered Species. The 35 federally and State-listed threatened, endangered, and other special-status species that may be found on or in the vicinity of the RFETS area are listed in Table 3.8.6–1. Twelve of these species have been observed on or in close proximity to the site. Potential suitable habitat for the remaining 23 species exists on RFETS. No critical habitat for threatened or endangered species, as defined in the ESA (50 CFR 17.11; 50 CFR 17.12), exists on RFETS.

Table 3.8.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Rocky Flats Environmental Technology Site

Common Name	Scientific Name	Status[a]	
		Federal	State
Mammals			
[Text deleted.]			
Preble's meadow jumping mouse[b]	*Zapus hudsonius preblei*	NL	SC
[Text deleted.]			
Spotted bat	*Euderma maculatum*	NL	U
Swift fox	*Vulpes velox*	C	U
Birds			
American peregrine falcon[b,c]	*Falco peregrinus anatum*	E	T
American white pelican[b]	*Pelecanus erythrorhynchos*	NL	SC
Arctic peregrine falcon[c]	*Falco peregrinus tundrius*	E (S/A)	T
[Text deleted.]			
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	T
Barrow's goldeneye	*Bucephala islandica*	NL	SC
[Text deleted.]			
Black-throated gray warbler[b]	*Dendroica nigrescens*	NL	SC
Blue grosbeak[b]	*Guiraca caerulea*	NL	SC
Ferruginous hawk[b]	*Buteo regalis*	NL	SC
Greater sandhill crane[b]	*Grus canadensis tibida*	NL	T
Least tern[c]	*Sterna antillarum*	E	E
[Text deleted.]			
Long-billed curlew[b]	*Numenius americanus*	NL	SC
Mountain plover	*Charadrius montanus*	C	SC
[Text deleted.]			
Piping plover[c]	*Charadrius melodus*	T	T
Plains sharp-tailed grouse	*Tympanuchus phasianellus jamesi*	NL	E
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	NL
Western burrowing owl[b]	*Athene cunicularia hypugea*	NL	U

Table 3.8.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Rocky Flats Environmental Technology Site—Continued

Common Name	Scientific Name	Status[a]	
		Federal	State
Western snowy plover	*Charadrius alexandrinus nivosus*	NL	SC
White-faced ibis	*Plegadis chihi*	NL	U
Whooping crane[c]	*Grus americana*	E	E
[Text deleted.]			
Fish			
Common shiner	*Notropis comutus*	NL	SC
[Text deleted.]			
Stonecat	*Noturus flavus*	NL	SC
Plants			
Adder's mouth orchid	*Malaxis brachypoda*	NL	SC
Bell's twinpod	*Physaria bellii*	NL	SC
Black spleenwort	*Aspelenium adiantum-nigrum*	NL	SC
Colorado butterfly plant	*Guara neomexicana coloradensis*	C	SC
Forktip three-awn[b]	*Aristida basiramea*	NL	SC
Gay-feather	*Liatris ligulistylus*	NL	SC
Sedge[b]	*Carex oreocharis*	NL	SC
Toothcup	*Rotala ramosior*	NL	SC
Tulip gentian	*Eustoma grandiflora*	NL	SC
Ute ladies'-tresses	*Spiranthes diluvialis*	T	SC
Yellow stargrass	*Hypoxis hirsuta*	NL	SC

[a] Status codes: C=Federal candidate; E=endangered; NL=not listed; S/A=protected under the similarity of appearance provision of the *Endangered Species Act*; SC=State species of concern; T=threatened; U=State undetermined species.

[b] Species observed on RFETS.

[c] USFWS Recovery Plan exists for this species.

Source: 50 CFR 17.11; 50 CFR 17.12; CO NHP 1994a; RF DOE 1995d.

Three federally listed threatened or endangered species (the bald eagle, peregrine falcon [both subspecies], and Ute ladies'-tresses) occur or are likely to occur on the RFETS site. Bald eagles have been observed flying over and occasionally foraging on RFETS and are known to roost at Standley Lake and Great Western Reservoir, approximately 1.8 km (1.1 mi) and less than 0.5 km (0.3 mi), respectively, from the site. Peregrine falcons have been observed flying over and hunting onsite. Two historical nest sites are within 16 km (10 mi) of the site. Ute ladies'-tresses are known to occur approximately 12.9 km (8 mi) north of the site in Boulder County (RF DOE 1995a:2,3). Suitable habitat exists on RFETS for this species, but no specimens were found during site surveys. Although the complex of prairie dog towns on the site provides suitable habitat for the endangered black-footed ferret, occurrence of the ferret is highly unlikely (RF DOE 1991j:5), and the area has been cleared of the requirement for verifying surveys.

[Text deleted.] The State-listed greater sandhill crane and several other special status species have been observed on RFETS. Continued site surveys may determine the occurrence of other special status species listed in Table 3.8.6–1.

3.8.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Three surface examination surveys have been conducted at RFETS resulting in complete coverage of the undisturbed portions of the facility (RF EG&G 1991a:3-2). No prehistoric sites were identified. However, two sites with rock alignments and four isolated cairns were recorded and are most likely prehistoric sites. The two sites have not been evaluated to determine their NRHP eligibility, and these sites are considered potentially NRHP eligible pending additional work. The four isolated features are not considered NRHP eligible. DOE is currently preparing a cultural resources management plan for RFETS to ensure compliance with Sections 106 and 110 of the NHPA.

Historic Resources. Thirty-five historic sites have been identified at RFETS. All undisturbed portions of RFETS have been intensively surveyed. Most of the historic resources in the area are archaeological sites or standing structures associated with ranching or transportation routes. Historic site types in the vicinity include trails, railroad grades, homesteads, cattle camps, line shacks, ranch complexes, irrigation ditches, stock ponds, and windmills. Historic sites recorded at RFETS include a railroad grade, stock ponds and tanks, irrigation ditches, corrals, a fence, a dump, a spring house, and homesteads. None of the historic sites or features have been recommended as eligible for the NRHP. There are 123 buildings at RFETS associated with the Cold War mission. Of these, 64 are considered potentially eligible for listing on the NRHP as contributing elements to the Rocky Flats Plant Historic District (RF DOE 1995a:26).

Native American Resources. Several Native American groups, including the Plains Apache, Comanche, Ute, Arapaho, and Cheyenne, historically occupied or traversed the foothills around RFETS. Tribal locations have been estimated for the Protohistoric and Historic periods. The Plains Apache occupied the region east of the Rockies prior to 1700. By 1750, the Ute and Comanche were in the area. The Ute moved back into the mountains and the Comanche were located on the Plains by 1820. From 1820 through 1870, the Cheyenne and Arapaho groups were using the area. All of these groups were highly mobile hunters and gatherers whose primary subsistence was based on bison procurement and seasonal plant gathering.

Important sites, such as burial or vision quest locations, may be of concern to Native American groups. Several unidentified rock features and alignments that have been recorded on RFETS may also be of concern to Native American groups. Consultation with the Comanche, Cheyenne, Arapaho, Southern Ute, Mountain Ute, and Apache tribes has been initiated by DOE. Important Native American resources may be identified through consultation with potentially affected groups.

Paleontological Resources. Surface geology at RFETS includes Rocky Flats alluvium and Arapahoe sandstone. The Arapahoe sandstone consists of claystone, silty claystones, and sandstones, and is not fossiliferous. Arapahoe sandstone outcrops occur along the edges of Walnut and Woman Creeks. The rest of RFETS is covered by Rocky Flats alluvium, which consists of gravely clays, sands, and gravels. No paleontological materials have been recovered from the RFETS alluvium, and it is considered nonfossiliferous.

3.8.8 SOCIOECONOMICS

Socioeconomic characteristics described for RFETS include employment and regional economy, population and housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses 49 counties around RFETS located in Colorado, Nebraska, and Kansas (Table L.1–1). Statistics for the remaining socioeconomic characteristics are presented for the ROI, a five-county area (located in Colorado) in which 90.6 percent of all RFETS employees reside: Adams County (20 percent), Arapahoe County (3.6 percent), Boulder County (25.6 percent), Denver County (6.2 percent), and Jefferson County (35.2 percent) (Table L.1–8). In 1995, RFETS employed 4,435 persons.

Regional Economy Characteristics. Selected employment and regional economy statistics for the RFETS REA are summarized in Figure 3.8.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 39.9 percent to the 1990 level of 1,868,628. The 1994 unemployment in the REA was 4.1 percent, which parallels the unemployment for Colorado. The unemployment for Kansas is about 1 percent higher than that of the REA and Nebraska is about 1 percent lower than the REA unemployment rate. The region's per capita income of $21,958 in 1993 was approximately 2 percent greater than Colorado's per capita income of $21,498. Kansas' per capita income ($19,849) was 9.6 percent lower than the region's, and Nebraska's per capita income ($19,673) was 10.4 percent lower.

As shown in Figure 3.8.8–1, the composition of the REA economy was similar to that of the statewide economy of Colorado. During 1993, the services sector constituted over 31 percent of the region's total employment followed by retail trade (about 17 percent) and manufacturing (about 9 percent). For Colorado, the service sector accounted for slightly over 30 percent of the total employment, while retail trade accounted for 17 percent and manufacturing, 8 percent. Kansas and Nebraska parallel each other, with the service sector representing 25 and 26 percent of total employment, retail trade representing 17 percent for both States, and manufacturing representing 12 and 10 percent, respectively.

Population and Housing. In 1994, the ROI population totaled 1,957,797. From 1980 to 1994, the ROI population grew by 22.9 percent, compared to 26.5 percent for Colorado. Within the ROI, Arapahoe County experienced the greatest population increase, 51.2 percent, while Denver County's population increased by only 0.2 percent. Population and housing trends are summarized in Figure 3.8.8–2.

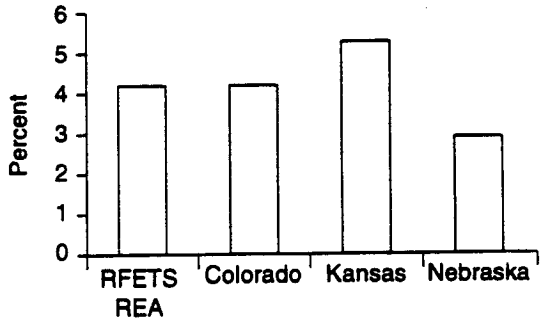
The increase in number of housing units in the ROI between 1980 and 1990, 22.5 percent, was about 1 percent less than the increase in Colorado housing units. The total number of housing units in the ROI for 1990 was 788,480. The 1990 ROI homeowner and renter vacancy rates, 3.2 and 11.7 percent, respectively, were similar to those in Colorado.

Community Services. Education, public safety, and health care characteristics were used to assess the level of community service in the RFETS ROI. Figure 3.8.8–3 presents school district characteristics for the RFETS ROI. Figure 3.8.8–4 summarizes public safety and health care services.

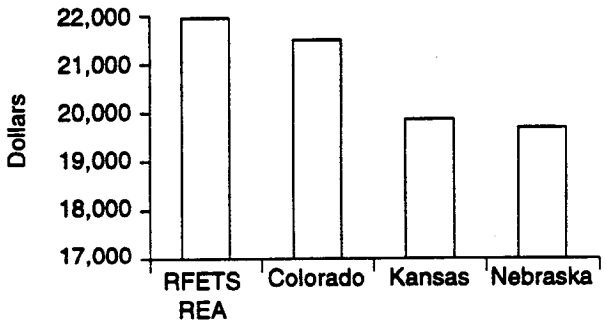
Education. In 1994, 18 school districts provided public education services and facilities in the RFETS ROI. As seen in Figure 3.8.8–3, these school districts operated at between 67.5-percent (Denver County School District) and 102.5-percent (Byers School District) capacity. The average student-to-teacher ratio for the RFETS ROI in 1994 was 19:1. The Jefferson County School District had the highest ratio at 23.7:1.

Public Safety. City, county, and State law enforcement agencies provided police protection to the residents of the ROI. In 1994, a total of 3,811 sworn police officers were serving the five-county ROI. The city of Denver employed the largest number of officers (1,378) and had the highest officer-to-population ratio (2.8 sworn officers per 1,000 persons). The average ROI officer-to-population ratio was 2.0 officers per 1,000 persons. Figure 3.8.8–4 compares police force strengths across the ROI.

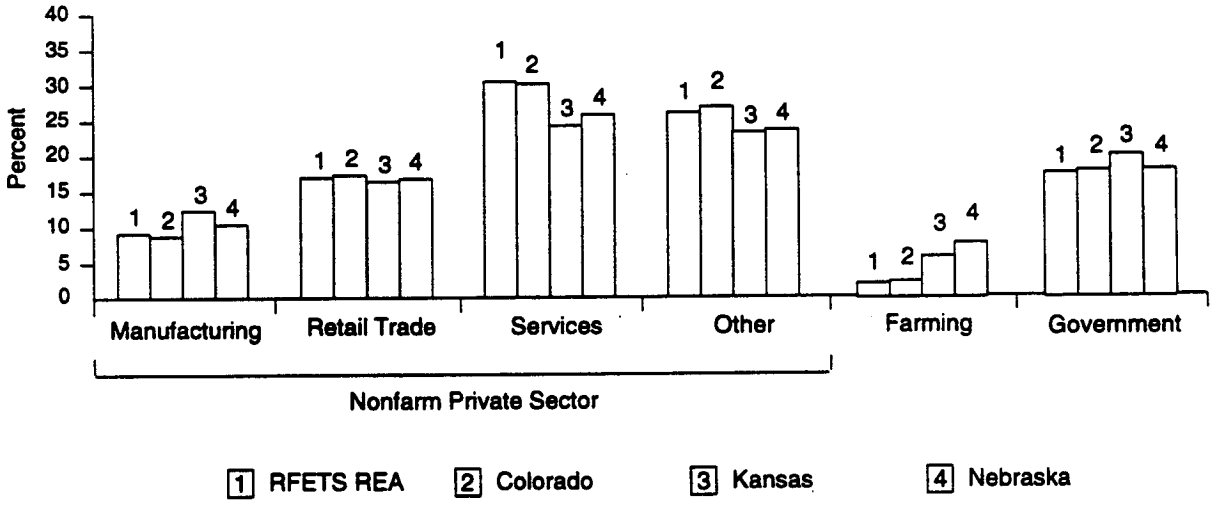
Unemployment Rate for the RFETS REA, Colorado, Kansas, and Nebraska, 1994[a]



Per Capita Income for the RFETS REA, Colorado, Kansas, and Nebraska, 1993[b]



Sector Employment Distribution for the RFETS REA, Colorado, Kansas, and Nebraska, 1993[b]



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.8.8–1. Employment and Local Economy for the Rocky Flats Environmental Technology Site Regional Economic Area and the States of Colorado, Kansas, and Nebraska.

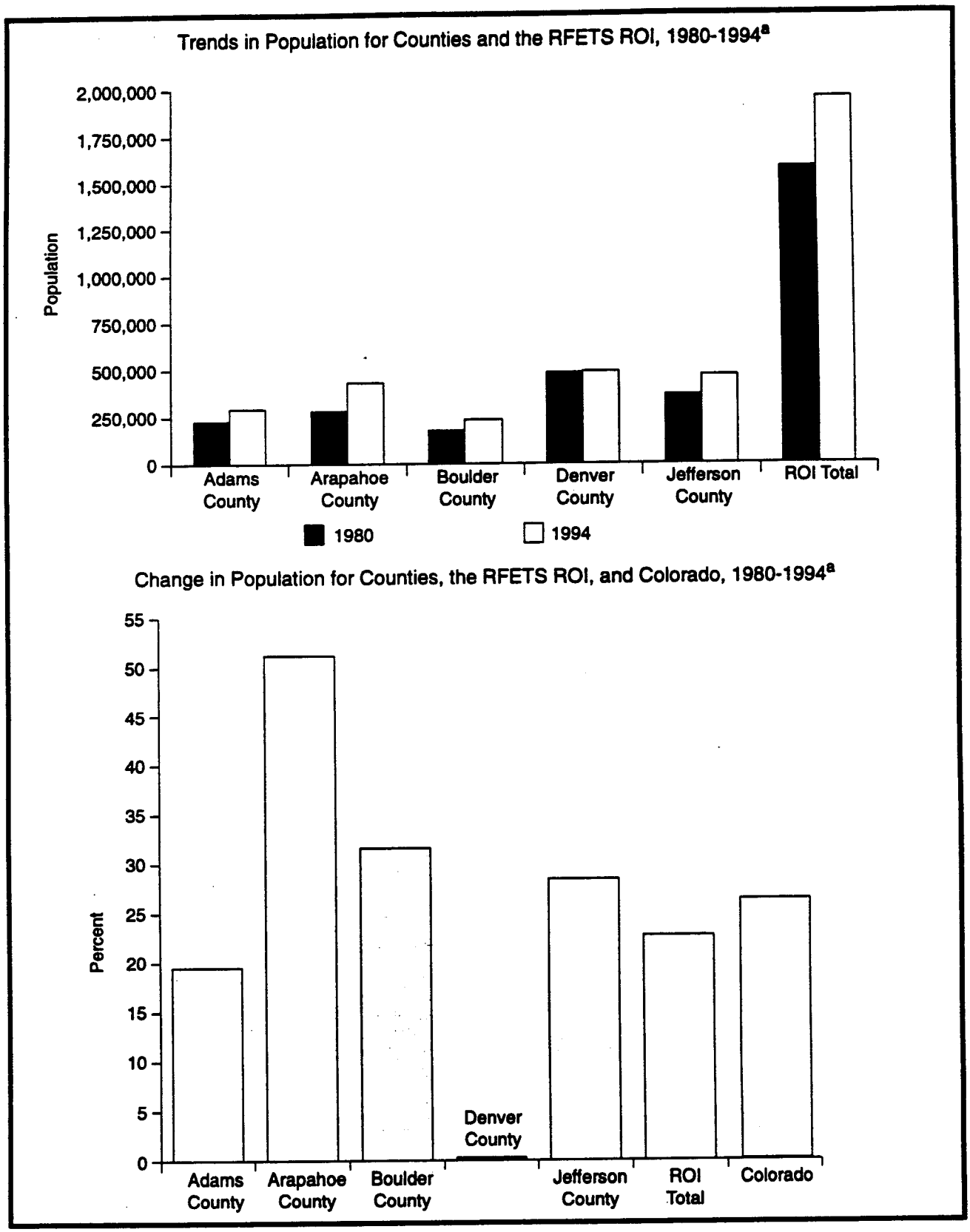
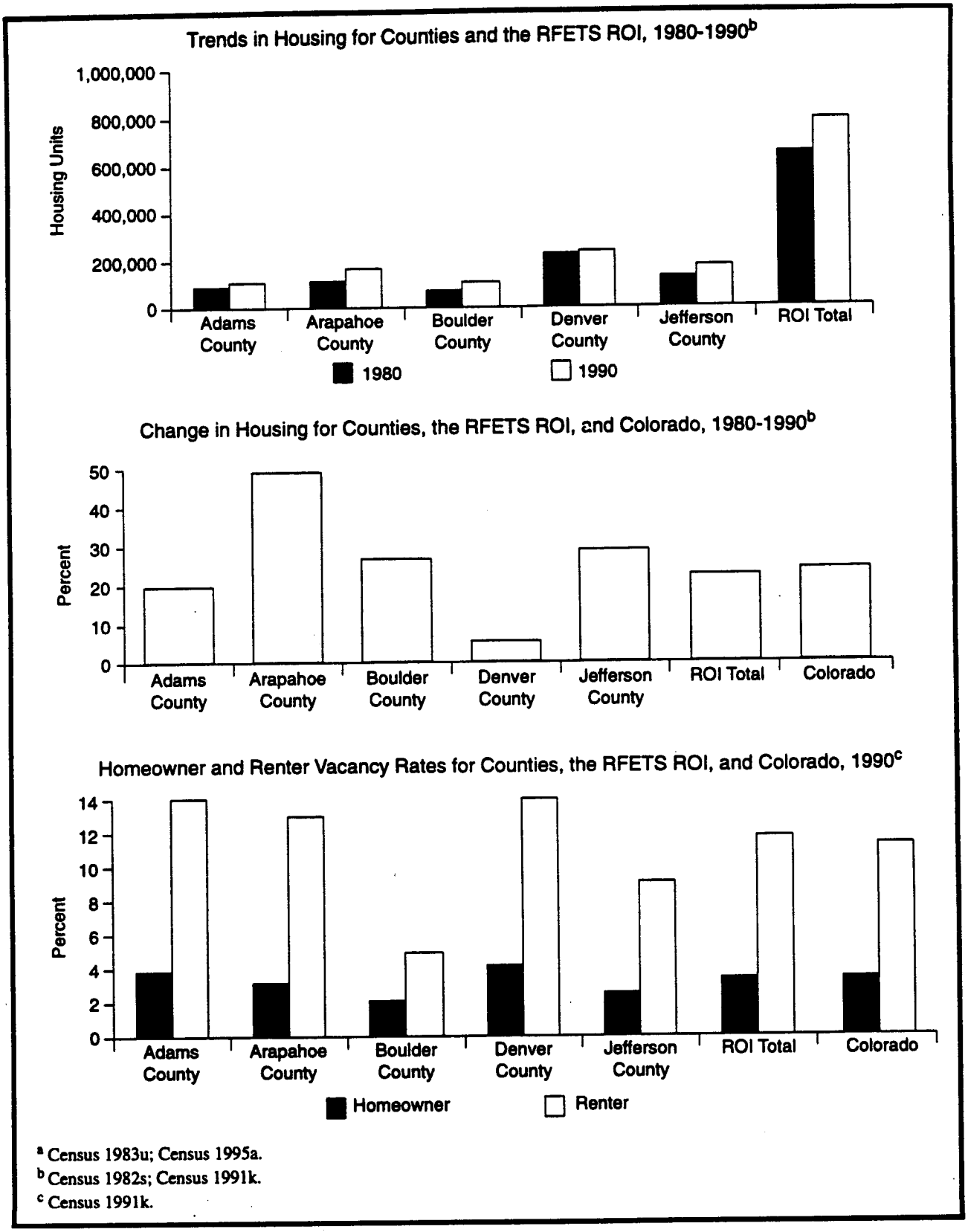


Figure 3.8.8–2. Population and Housing for the Rocky Flats Environmental Technology Site Region of Influence and the State of Colorado.



[a] Census 1983u; Census 1995a.
[b] Census 1982s; Census 1991k.
[c] Census 1991k.

Figure 3.8.8–2. Population and Housing for the Rocky Flats Environmental Technology Site Region of Influence and the State of Colorado—Continued.

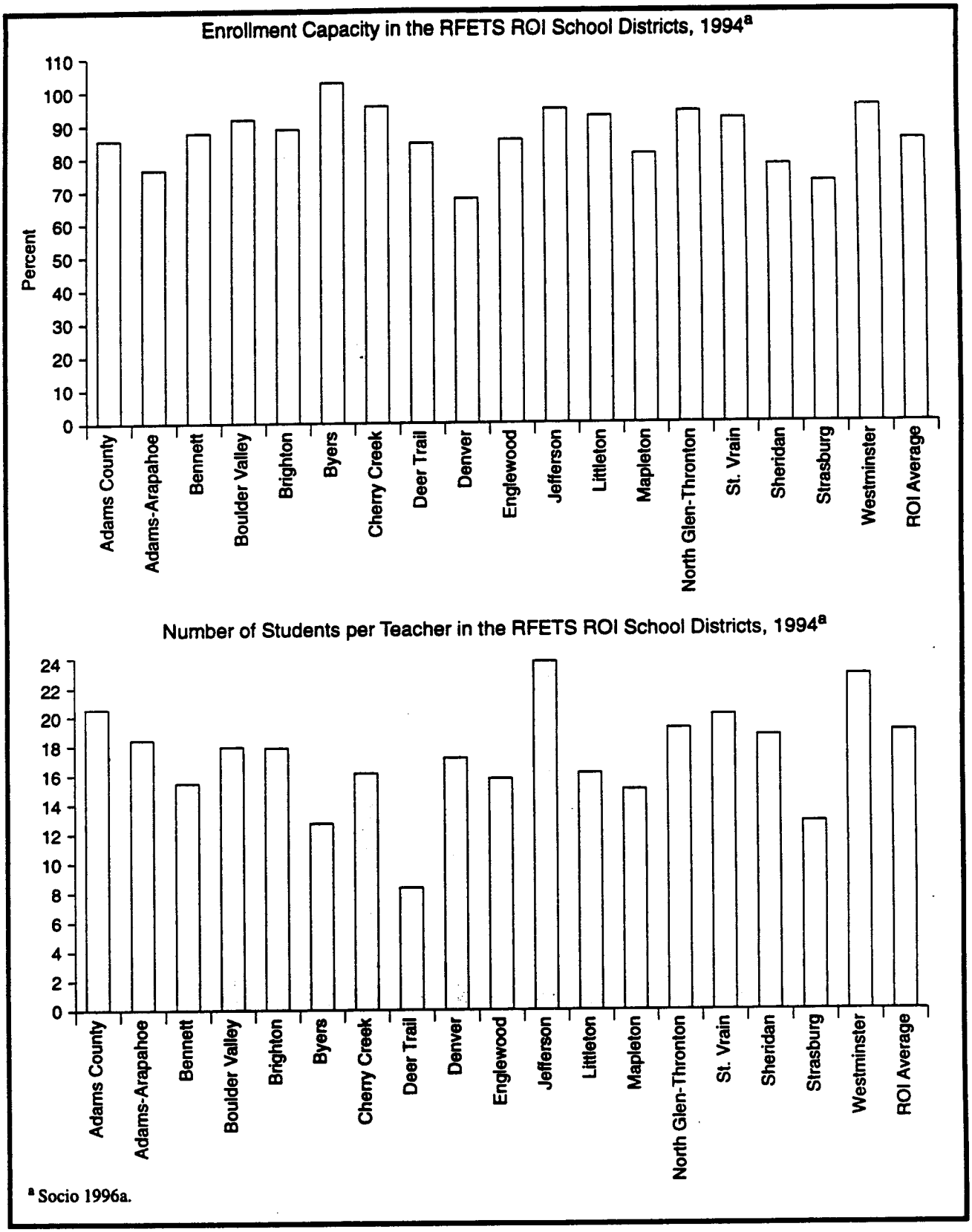
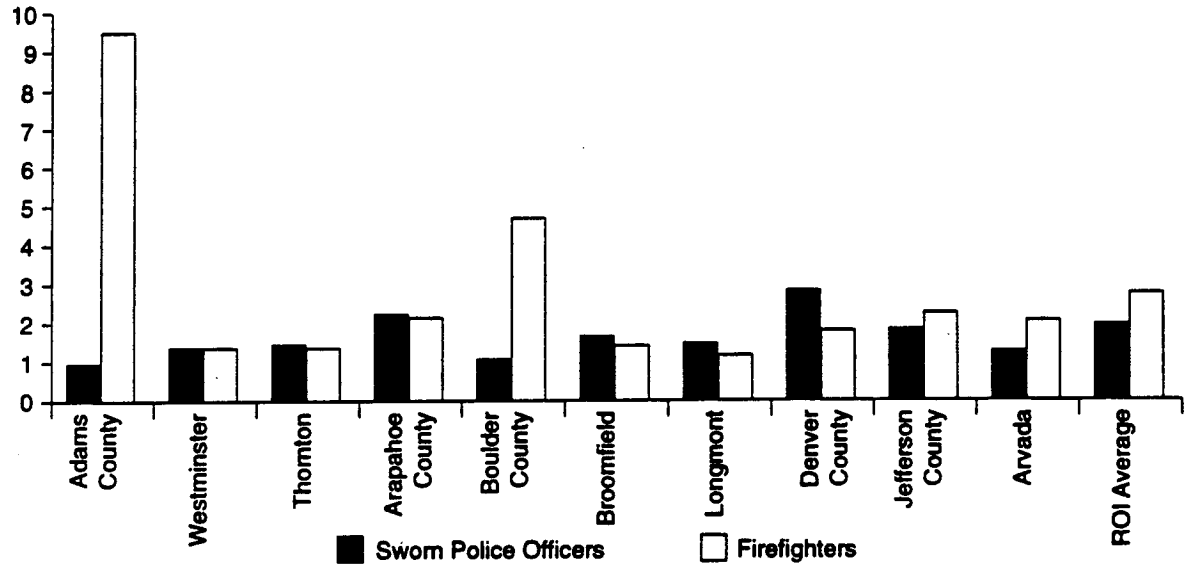
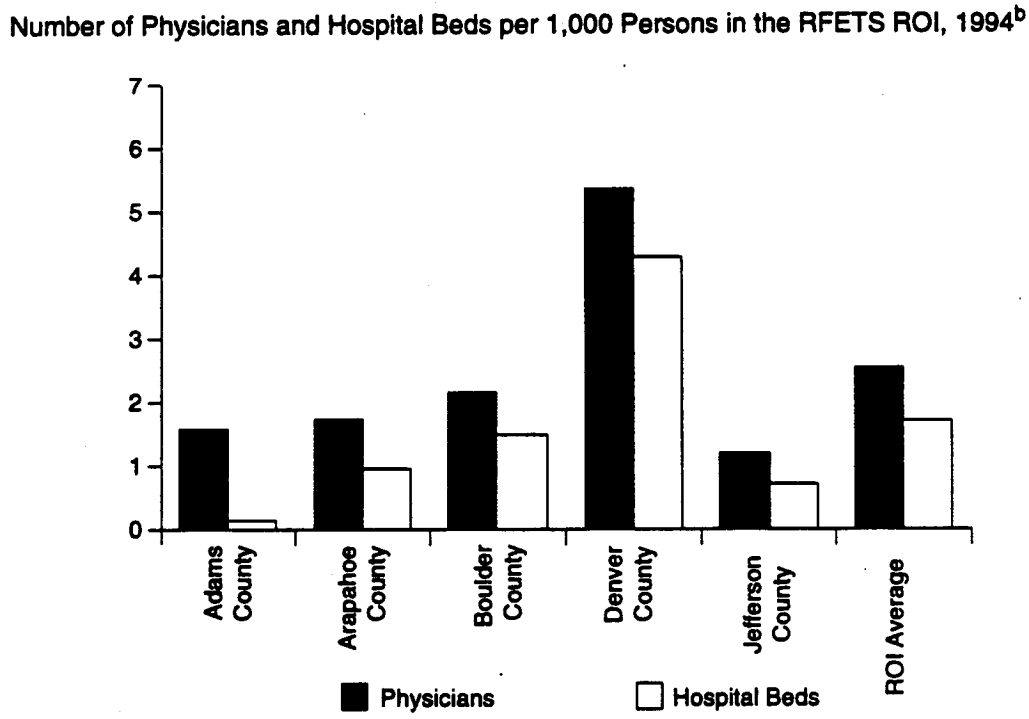


Figure 3.8.8–3. School District Characteristics for the Rocky Flats Environmental Technology Site Region of Influence.



Note: Except for ROI cities, sworn police officers and firefighters are included in county totals.



[a] Census 1993v; Census 1995a; CO DIS 1994a; DOC 1994j; DOC 1996a; DOC 1996b; DOJ 1995a; Socio 1996a.

[b] AHA 1995a; AMA 1995a; Census 1995a.

Note: The following fire departments were not included in the analysis because data was unavailable; Lefthand Fire District, Pinewood Springs Fire Protection District, Sugarloaf Fire District, and Sunshine Fire District.

Figure 3.8.8–4. Public Safety and Health Care Characteristics for the Rocky Flats Environmental Technology Site Region of Influence.

Fire protection services in the RFETS ROI were provided by 5,408 paid and volunteer firefighters in 1995. The fire district with the highest firefighter-to-population ratio was Adams County, with 9.5 firefighters per 1,000 persons, as indicated in Figure 3.8.8–4. Adams County also employed the greatest number of firefighters (1,396). The average firefighter-to-population ratio in the ROI was 2.7 firefighters per 1,000 persons.

Health Care. There were 19 hospitals serving the five-county ROI in 1994. Over 64 percent of the hospital bed capacity was located in 9 hospitals in the city of Denver. Figure 3.8.8–4 displays the hospital bed-to-population ratios for the RFETS ROI counties. During 1994, all 19 hospitals operated at below capacity, with bed occupancy rates ranging from 22.4 percent in Adams County to 60.2 percent in Denver County.

There were 5,017 physicians in the ROI during 1994, with the majority (2,649) practicing in Denver County. Figure 3.8.8–4 shows that the physician-to-population ratio ranged from 1.2 physicians per 1,000 persons in Jefferson County to 5.4 physicians per 1,000 persons in Denver County. The average ROI physician-to-population ratio was 2.6 physicians per 1,000 persons.

Local Transportation. Vehicular access to RFETS is provided by Colorado State Route 93 to the west and Jefferson County Road 17 (Indiana Street) to the east (see Figure 2.2.7–1 and Figure 2.2.7–2).

Road improvements for segments providing access to RFETS include bridge replacement and reconstruction along Colorado State Route 93 prior to the year 2000. There are no current road improvements that would affect access to RFETS. There is no public transportation to RFETS (RFETS 1995a:4).

Major railroads in the ROI include the Denver and Rio Grande Western Railroad; the Burlington Northern and Santa Fe Railroad; and the Union Pacific Railroad. A single-track spur from the Denver and Rio Grande Western Railroad mainline accesses RFETS from the west. No navigable waterways within the ROI are capable of accommodating waterborne transportation of material shipments to RFETS (DOE 1993j:4-190,4-191). The Denver International Airport, which began operations in 1995, provides passenger and cargo service in the ROI on national and international carriers.

3.8.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of RFETS are shown in Table 3.8.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to RFETS operations.

Table 3.8.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Rocky Flats Environmental Technology Site Operation

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic and cosmogenic radiation	51
External terrestrial radiation	63
Internal terrestrial radiation	39
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	418

[a] RFETS 1994a.
[b] NCRP 1987a.
Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from RFETS operations provide another source of radiation exposure to individuals in the vicinity of RFETS. Types and quantities of radionuclides released from RFETS operations in 1993 are listed in the *Site Environmental Report for 1993* (RFP-ENV-93). The doses to the public resulting from these releases are presented in Table 3.8.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The doses given in the 1993 report were assumed to be representative of the reference environment (No Action) doses from RFETS operations in the year 2005 (Section 4.2.7.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases and resulting impacts from RFETS operations in 1993 is estimated to be 2.4×10^{-7}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of RFETS operations is about 2 in 10 million. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Based on the same risk estimator, 5.0×10^{-5} excess fatal cancers are projected in the population living within 80 km (50 mi) of RFETS from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national mortality rate, the number of fatal cancers from all causes expected during 1993 in the population living within 80 km (50 mi) of RFETS was 4,400. This number of expected fatal cancers is much higher than the estimated 5×10^{-5} fatal cancers that could result from RFETS operations in 1993.

Table 3.8.9–2. Radiation Doses to the Public From Normal Rocky Flats Environmental Technology Site Operation in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	0.13	4	0.35	100	0.48
Population within 80 km[b] (person-rem)	None	0.1	None	0[c]	100	0.1
Average individual within 80 km[d] (mrem)	None	4.5×10^{-5}	None	0[c]	None	4.5×10^{-5}

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] In 1993, this population was approximately 2,200,000.

[c] Although the maximally exposed individual receives a dose, no population groups are exposed to any liquid pathways.

[d] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: RFETS 1994a.

The RFETS workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.8.9–3 presents the average worker, maximally exposed worker, and cumulative worker dose to RFETS workers from operations in 1992. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to RFETS workers from normal operations in 1992 is estimated to be 0.32.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Site Environmental Report for 1993* (RFP-ENV-93). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in this reference.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface waters during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.8.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements), contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at RFETS via inhalation of air containing hazardous chemicals released to the atmosphere by RFETS operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

Table 3.8.9–3. Radiation Doses to Workers From Normal Rocky Flats Environmental Technology Site Operation in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	122
Maximally exposed worker (mrem)	5,000	>10,000[b]
Total workers[c] (person-rem)	ALARA	800

[a] DOE's goal is to maintain radiological exposures as low as reasonably achievable.

[b] Three workers received doses that exceeded the standard. Only one worker received a dose greater than 10,000 mrem.

[c] The number of badged workers in 1992 was approximately 6,550.

Source: 10 CFR 835, DOE 1993n:7.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.8.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to RFETS workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a detailed estimation and summation of these impacts. However, the workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. RFETS workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operational processes, ensures that these standards are not exceeded. Additionally, DOE requirements (DOE O 440.1) ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at RFETS are expected to be substantially better than required by the standards.

Health Effects Studies. Several epidemiologic studies have been conducted on communities surrounding RFETS. The studies of surrounding populations have found no substantiated evidence of increased risk of cancers related directly to RFETS. Mixed findings have been reported from studies of workers, with some studies reporting increases in risk of some cancers, others finding no associations, and one reporting a significant deficit in numbers of lung cancers. For a more detailed description of the study findings reviewed, refer to Section M.4.8.

Accident History. A review of recent RFETS annual environmental and accident reports indicates that there have been no radiological or chemical releases that resulted in impacts to workers, members of the public, or the environment. The review was performed to support the affected environment presentation in the *Nonnuclear Consolidation Environmental Assessment* published in June 1993 (DOE/EA-0792).

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

The RFETS has comprehensive emergency plans that provide guidance and procedures that are designed to protect life and property within the facility, the health and welfare of surrounding metropolitan communities, and the defense interests of the nation during any credible emergency situation. Mutual assistance and coordination with Federal, State, and local agencies is ensured on a cooperative basis.

The DOE Rocky Flats Area Office Manager coordinates activities for emergencies affecting offsite personnel or property and is responsible for communication with the supporting Federal, State, and local agencies. The DOE Rocky Flats Area Office Manager may obtain further assistance through the Interagency Radiological Assistance Plan, which provides that each of the signatory Federal agencies will assist one another in the event of a major emergency involving radioactivity.

The Rocky Flats Emergency Plan expresses the philosophy that RFETS be as self-sufficient as possible in handling onsite emergency situations. Assistance may be requested from outside sources through written agreements with St. Anthony Hospital, St. Luke's Hospital, University of Colorado, Jefferson County Sheriff's Office, and the Federal Bureau of Investigation.

In the event of an offsite emergency, the *Rocky Flats Radiological Assistance Plan* interfaces with the *DOE Radiological Assistance Plan*, the *Interagency Radiological Assistance Plan*, and the Joint Nuclear Accident Coordinating Center through the DOE Rocky Flats Area Office at Rocky Flats. Also, in the event of an incident at RFETS involving the release of radioactive material that may endanger the health and safety of the general public, the *Colorado Radiological Emergency Response Plan* would be activated.

3.8.10 WASTE MANAGEMENT

This section outlines the major environmental compliance program and ongoing waste management activities for RFETS. Table 3.8.10–1 presents a summary of waste management activities at RFETS for 1995.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations at RFETS. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed-upon milestones.

The focus of the RFETS mission is on environmental restoration and possible economic development. The legal framework establishing the scope and schedule for projects in the environmental restoration program is the Interagency Agreement. The agreement integrates the actions required under the authority and jurisdiction of CERCLA and RCRA. Therefore, the investigative phase at each operable unit is referred to as a RCRA Facility Investigation/Remedial Investigation, and the selection of remedial alternatives is referred to as a Corrective Measures Study/Feasibility Study. The primary objective of the environmental restoration program is to assess and clean up RFETS in compliance with applicable environmental laws and regulations. The approach being taken is to reduce health risk and accelerate cleanup.

There have been, 177 contaminated sites previously identified and prioritized that are located both on RFETS and offsite. These sites were grouped into 16 operable units according to location and type of contamination. Per the new Cleanup Agreement, dated July 19, 1996, DOE, the State of Colorado, and EPA have proposed defining the existing 16 operable units into 7. The primary benefit of consolidating operable units is the reduced process and administrative requirements. The resulting cost saving can then be applied to environmental remediation or other higher priority tasks at RFETS.

Waste disposal activities include the shipment of saltcrete to an offsite commercial facility for disposal, LLW for shipment to NTS and Hanford; the preparation, transportation, and disposal of hazardous and other regulated wastes by commercial vendors; and the disposal of sanitary waste in the onsite landfill. RFETS manages the following waste categories: TRU, low-level, hazardous, mixed, and nonhazardous. A discussion of the waste management operations associated with each of these waste categories follows.

Spent Nuclear Fuel. The RFETS does not generate or manage spent nuclear fuel.

High-Level Waste. The RFETS does not generate or manage HLW.

Transuranic Waste. Transuranic waste at RFETS was generated as a result of Pu operations and its supporting functions such as Pu metal purification. TRU and mixed TRU waste generated at RFETS before 1970 was shipped to INEL and disposed of underground. After 1970, this waste was shipped to INEL for interim storage until a permanent disposal facility became available. As a result of delays in opening WIPP in Carlsbad, New Mexico, the Governor of the State of Idaho placed a moratorium on out-of-State waste shipments to INEL in October 1988, forcing RFETS to store TRU and mixed TRU waste onsite. However, this storage was found to violate RCRA storage provisions and led to several interim agreements.

Storage of TRU and mixed TRU wastes at RFETS is governed by the provisions of the Colorado Department of Health Settlement Agreement and Compliance Order on Consent, Number 89-07-10-01, related to mixed wastes, that was signed on July 14, 1989. The Order required RFETS to submit a Part A Permit Application for all its interim status mixed TRU and mixed LLW storage and treatment units. The Order also granted interim status to all mixed TRU waste units, except unit 60, included in applications filed by July 1, 1988. It also granted interim status to units used for storage and treatment of hazardous and mixed LLW identified in an August 2, 1988, Part A Application.

Table 3.8.10–1. Waste Management Activities at Rocky Flats Environmental Technology Site

Waste Category	1995 Generation[a] (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity
Transuranic							
Liquid	<1	Solidification	Included in liquid mixed LLW	None	NA	NA	NA
Solid	54	Compaction	Included in solid mixed LLW	Drums on pads	1,500[b]	None - WIPP or alternate facility in the future	NA
Transuranic (Mixed)							
Liquid	<1	Solidification	Included in liquid mixed LLW	None	NA	NA	NA
Solid	23	Compaction	Included in solid mixed LLW	Drums on pads	1,300[c]	None - WIPP or alternate facility in the future	NA
Low-Level							
Liquid	4	Evaporation and Solidification	Included in liquid mixed LLW	Staged	105[d]	NA	NA
Solid	752	None	None	Staged	4,540[d]	Offsite - DOE	NA
Hazardous							
Liquid	2	Neutralization & Precipitation	None	Staged in DOT containers	Included in solid hazardous waste	Offsite	NA
Solid	24	None	None	Staged in DOT containers	263[e]	Offsite	NA
Mixed (Low-Level)							
Liquid	165	Solidification	47,700[f]	Staged for treatment	Included in solid mixed LLW	None	NA
Solid	676	None	7,100[g,h]	DOT containers	13,600[i]	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	457,600[j]	Sedimentation	568,000	None	NA	Surface water	NA
Solid	11,400	None	None	None	NA	Onsite landfill	Expandable

Table 3.8.10–1. Waste Management Activities at Rocky Flats Environmental Technology Site—Continued

Waste Category	1995 Generation[a] (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity
Nonhazardous (Other)							
Liquid	Included in liquid sanitary	Sedimentation	Included in sanitary	None	NA	Included in sanitary	Included in sanitary
Solid	73	None	None	None	NA	Included in sanitary	Included in sanitary

[a] Values per *RFETS Comprehensive Waste Management Plan*
[Text deleted.]
[b] Value taken from *Draft Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste.*
[Text deleted.]
[c] Value taken from *RFETS Proposed Site Treatment Plan* dated March 1995 and is based on the sum of the current mixed-TRU storage and the expected 20-year generation.
[Text deleted.]
[d] Cumulative volume of LLW stored at the end of 1993 as per a memorandum from McGlochlin, EG&G to Reece, DOE on updated information for nonnuclear consolidation EA.
[Text deleted.]
[e] Value based on the 1991 Waste Storage Inventory Report and the memorandum from McGlochlin, EG&G to Reece, DOE on updated information for nonnuclear consolidation EA.
[f] Based on the operating capacities of Buildings 374 and 774 as described in the 1995 Mixed Waste Inventory Report.
[g] Based on the operating capacities of Building 776 as described in the 1995 Mixed Waste Inventory Report.
[h] Value calculated using the conversion ratio of 1,500 kg/m^3.
[i] Value taken from *RFETS Proposed Site Treatment Plan* dated March 1995 and is based on the mixed-LLW in storage at RFETS.
[j] Value taken from *1993 RFETS Site Environmental Report* and Reflects Annual Discharge From Main Collection Pond 68 (Pond A-4).
Note: NA=not applicable.
Source: DOE 1995cc; DOE 1995gg; RF DOE 1995b; RF DOE 1995c; RF EG&G 1992e; RFETS 1995a:1; RFETS 1995a:2; RFP 1993a:1.

Finally, the order set total capacity limit for interim status container storage for mixed TRU waste at 1,220 m^3 (1,601 yd^3) (RF DOH 1989b:7), yet a capacity exists for 1,500 m^3 (1,960 yd^3). The *Federal Facility Compliance Act* of 1992 requires DOE to develop site-specific mixed waste treatment plans and to submit the plans to EPA or the authorized State for approval. The final proposed plan was published in March, 1995.

As a temporary solution to the 1,220 m^3 (1,601 yd^3) limit, the Supercompaction and Repackaging Facility in Building 776 is used to compact and package solid TRU and mixed TRU wastes generated during various site operations. This facility processes both soft, combustible waste (such as paper and plastic) and hard, noncombustible waste (such as metal and glass). Supercompaction and Repackaging Facility equipment is contained in a single, large glovebox. The Supercompaction and Repackaging Facility allows repackaging operations to be performed inside the glovebox, reducing exposure to workers. An overall 5-to-1 volume reduction of waste by this facility is being achieved.

Residues at RFETS are Pu recovery byproducts (for example, salts and contaminated materials) that were determined to contain enough Pu to justify further processing for recovery. In the past, DOE has not considered residues at RFETS to be a waste form. Events at RFETS have led to the classification of these Pu residues as waste. A very limited quantity of the Pu residues at RFETS are considered to be mixed waste based upon a court judgement. These mixed residues have been managed under a series of compliance orders, agreements, settlements, and judicial orders.

The need to treat mixed TRU waste is being assessed as part of the WIPP test phase. If the no-migration exemption for WIPP is granted, mixed TRU wastes going to WIPP would only need to meet hazardous substance transportation requirements and WIPP WAC before shipment. If not approved, then treatment of mixed TRU waste would be required under 40 CFR 191 (disposal standards) to remove or reduce to acceptable levels the land disposal restriction constituents in the waste before shipment and disposal.

Low-Level Waste. The baler located in Building 889 processes solid LLW (soft combustibles) generated outside the PA. The baler is also being evaluated for volume-reducing beryllium and mixed LLW generated outside the PA, but some or all of the following improvements will be required in order to meet the following applicable requirements: equipment must be upgraded and rearranged; ventilation must be upgraded; and building modifications must be made to meet safety requirements.

Mixed Low-Level Waste. A great deal of the solid radioactive waste at RFETS consists of mixed LLW. Mixed LLW shipments to NTS were suspended in May 1990 when the RCRA LDR went into effect. In order to transport and receive wastes, NTS has to meet certain regulatory requirements. They must be either adequately characterized or treated to prove that hazardous constituents in these wastes are below treatment standards.

The Department and EPA entered into an FFCA for LDR wastes on May 20, 1991. This agreement requires DOE to submit the following: a Comprehensive Treatment and Management Plan addressing treatment proposed for RFETS nonresidue mixed wastes so as to come into compliance with the treatment and storage requirements of RCRA; a Waste Minimization Plan identifying process changes proposed to minimize or eliminate wastes; and an Annual Progress Report evaluating Rocky Flats' progress in achieving compliance with the RCRA LDR.

Negotiations began in June 1992 for a new agreement (FFCA). However, the intervening FFCA and its requirement for a site treatment plan compliance order will most likely obviate the need for an FFCA. Pending any new agreement, DOE will continue to manage its mixed waste compliance program in accordance with the existing FFCA. For example, the Waste Minimization Program Plan, Waste Stream and Residue Identification and Characterization Report, and the Annual Progress Report continue to be updated and submitted on an annual basis. However, because the FFCA gives the State primacy in approval of the site treatment plan and issuance of a compliance order, Colorado Department of Health is now considered the lead regulatory agency in regard to the DOE mixed waste compliance program. Current plans call for the disposal of saltcrete at Envirocare of

Utah. Disposal of saltcrete is planned in a proposed RCRA Subtitle C disposal cell. The remaining mixed LLW will either be disposed of at commercial facilities or at NTS.

Residues are process byproducts that contain radioactive materials in concentrations greater than the economic discard limit, and were destined for recycle to recover the radioactive materials. Those residues that contain hazardous constituents are undergoing characterization to determine how to comply with RCRA and court orders. DOE is presently determining how and where to store those residues it decides to retain. It is planned to remove all mixed residues by 1999.

The Department and the State signed the Residue Compliance Agreement and Consent Order on November 3, 1989, which requires DOE to submit a plan for removing all mixed residue inventory at RFETS by January 1, 1999. Also, the U.S. District Court, Colorado, issued a Judgment and Order on August 13, 1991, which declared that RFETS mixed residues were hazardous materials and must be managed in accordance with RCRA and further ordered that DOE must obtain a permit for the mixed residues currently stored without a RCRA permit. If no such permit is obtained, RFETS may not continue operations which generate hazardous or mixed waste, save certain limited exceptions.

The plan for removal of mixed residues from RFETS contains four primary ways of dealing with these residues: ship as waste or product, remove the RCRA characteristic, remove actinides and ship the resultant wastes, and remove stored solutions (RF DOE 1992a:8). All of the Pu-bearing residues in the backlog will undergo inspection and segregation so that the particular process path to be used can be identified or verified.

[Text deleted.]

Hazardous Waste. Treatment of hazardous wastes at RFETS is limited to organic liquid wastes. Hazardous wastes are shipped to various RCRA-permitted, commercial vendors for disposal. In 1991, DOE and the Colorado Department of Health agreed on radioactivity limits for waste garage oils; this waste form is now being shipped to a commercial vendor for recycle.

Nonhazardous Waste. The DOE and EPA agreed to, and signed on March 25, 1991, an *Federal Facility Compliance Act* for the NPDES program. The agreement requires the following actions:

- Upgrade the sewage treatment plant and change sewer sludge and spray irrigation management practices
- Enhance groundwater monitoring for the sewage sludge drying beds
- Prepare a compliance plan describing those actions necessary for the RFETS to remain in compliance with the NPDES permit
- Submit to EPA a variety of new reports and studies describing the status of compliance

The sanitary landfill on RFETS accepts all solid nonhazardous wastes. Liquid nonhazardous waste is treated and released to surface waters.

3.9 LOS ALAMOS NATIONAL LABORATORY

Los Alamos National Laboratory was established in 1943 as a nuclear weapons design laboratory and was formerly known as the Los Alamos Scientific Laboratory. Its facilities are located in north central New Mexico about 40 km (25 mi) northwest of Santa Fe. Figure 2.2.8–1 indicates the regional location of LANL and Figure 2.2.8–2 shows the locations of the technical areas which contain the major facilities within the site boundaries. LANL is owned by DOE and operated by the University of California under contract to DOE.

The central mission of LANL has evolved from developing the first atomic bomb during World War II to developing nuclear weapons for deterrence during the Cold War. With the recent easing of international tensions, the central mission of LANL has been redefined to one of developing a multidisciplinary science and technology research facility that is engaged in a variety of programs for DOE and other Government agencies and applying this expertise to the Nation's security and well being. Current missions at LANL are listed in Table 3.9–1.

Table 3.9–1. Current Missions at Los Alamos National Laboratory

Mission	Description	Sponsor
Nuclear weapons	Stockpile stewardship and management, materials support, fissile materials disposition	Assistant Secretary for Defense Programs
Environmental management	Environmental restoration, waste management, pollution prevention, technology development	Assistant Secretary for Environmental Management
Nonproliferation and international security	Nonproliferation and verification R&D, nuclear safeguards and security, arms control and nonproliferation, intelligence	Office of Intelligence and National Security
Energy research	Nuclear physics, biological and environmental research, basic energy sciences, magnetic fusion, high energy physics	Office of Energy Research
Energy technology	Enhanced energy production, improved energy efficiency, environmental consequences, medical radioisotope production	Assistant Secretary for Energy Efficiency and Renewable Energy; Assistant Secretary for Fossil Energy; Offices of Nuclear Energy and Civilian Radioactive Waste Management
Work for others	Conventional weapons technology, modeling and simulation, beams and sensors, high performance computing	DoD, NRC, other Federal and non-Federal entities.

Source: LANL 1995b:1.

Department of Energy Activities. The major DOE program activities at LANL include defense, environmental management, nonproliferation and international security, and energy research and technology. These programs, as well as others at LANL, are interdependent and have considerable overlap. Defense programs address nuclear weapons technology, nuclear materials and reconfiguration technology, and programs conducted by the Los Alamos Neutron Scattering Center (LANSCE) and Energy Research Program Office. Environmental management programs are primarily focused on restoration activities and attaining and maintaining compliance with all Federal and State regulations and permits for waste management. The nonproliferation and international security programs respond to the scientific and technological needs to assure the effective reduction in the proliferation of nuclear weapons, the means to deliver them, and to ensure U.S. and international security.

Energy research and technology programs principally address basic science and technology issues that contribute significantly to defense, national security, industrial competitiveness, and energy resources.

The Nuclear Weapons Technology Program is the principal defense program at LANL and is devoted to providing technology stewardship for the nuclear stockpile. Important aspects of stockpile stewardship at LANL include stockpile surveillance, surety, and aboveground experiments, all of which help in the absence of underground nuclear testing. The Nuclear Materials and Stockpile Management (NMSM) Program addresses a wide spectrum of activities in nuclear materials handling, processing, and fabrication in support of the DOE objectives of reducing the nuclear danger and addressing cleanup issues across the DOE complex. Two major interfaces for NMSM are the stockpile support and reconfiguration/nuclear materials management programs. LANL continues to support DOE's stockpile evaluation and pit rebuild efforts. Stockpile evaluation is currently focused on surveillance of milliwatt radioisotopic thermoelectric generators, surveillance of selected gas systems, and the pit surveillance effort, which was formerly conducted at RFETS.

The LANSCE and L/ER conduct several programs in the areas of science and technology that contribute to a wide spectrum of fundamental and strategic research. In addition to research activities, L/ER programs operate a major user facility for neutron research and applications supporting research by DP users, among others.

Environmental Management Program activities at LANL consist of environmental restoration, waste management, pollution prevention, independent technical assessments and environmental technology development. The major environmental management effort at LANL is assessing and remediating over 2,000 sites that may have been contaminated over the past 50 years and have been designated for corrective action investigations. One component of the environmental restoration program is the D&D of sites and facilities such as nuclear reactors and surplus contaminated facilities. Waste management activities are directed at attaining and maintaining compliance with all regulations and permits.

The Nonproliferation and International Security Program was created at LANL to develop and apply the science and technology capabilities needed to deter, detect, and respond to proliferation of weapons of mass destruction and thereby to help ensure U.S. and international security. Those LANL programs to control and prevent the proliferation of nuclear weapons throughout the world that are funded within the nuclear weapons research, development, and technology program are focused primarily on nuclear counterproliferation and emergency response issues.

In addition to the neutron research and applications at LANSCE, other related energy research includes nuclear and high energy physics, basic energy sciences, biological and environmental research, and fusion energy. Energy technology programs at LANL include energy production, energy utilization, and the environmental consequences of energy production and utilization. Energy production programs are funded by the Assistant Secretary for Defense Programs as well as the other DOE energy-source-specific program offices. The type of effort performed for the Assistant Secretary for Defense Programs is in the area of nuclear safety review work for both reactor and nonreactor facilities.

Non-Department of Energy Activities. Non-DOE activities at LANL include support to DoD, NRC, other Federal agencies (National Aeronautics and Space Administration, National Institutes of Health, NOAA, National Science Foundation, and others), and various other institutions and industries. For DoD and branches of the military, LANL provides support in the areas of conventional weapons technology; modeling and simulation; beams and sensors; high performance computing; and advanced concepts in structures and materials, nonlethal technologies, unmanned aerial vehicles, missiles, micromachines, and other state-of-the-art technological applications.

3.9.1 LAND RESOURCES

Land Use. The LANL is located in north-central New Mexico, 97 km (60 mi) north-northeast of Albuquerque, 40 km (25 mi) northwest of Santa Fe, and 32 km (20 mi) southwest of Española in Los Alamos and Santa Fe Counties. The associated communities of Los Alamos and White Rock are in Los Alamos County. The 11,300-ha (28,000-acre) LANL site and adjacent communities are situated on the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep canyons that run from the Jemez Mountains on the west toward the Rio Grande Valley on the east. Mesa tops range in elevation from approximately 2,400 m (7,800 ft) on the west to about 1,900 m (6,200 ft) on the east (LANL 1994a:II-1,II-2).

Existing Land Use. The developed acreage of LANL consists of 30 active TAs. These TAs consist of laboratory facilities and support infrastructure. They account for only a small portion of the total land area at LANL. Most of LANL is undeveloped to provide security, safety, and expansion possibilities for future mission requirements. There are no agricultural activities present at LANL, nor are there any prime farmlands. In 1977, DOE designated LANL as a NERP, which is used by the national scientific community as an outdoor laboratory to study the impacts of human activities on the pinyon-juniper woodland ecosystems (DOE 1985a:3,21).

Most developments within Los Alamos County are confined to mesa tops. Generalized land uses are shown in Figure 3.9.1–1. The surrounding land is largely undeveloped with large tracts north, west, and south of the LANL site administered by the U.S. Forest Service (Santa Fe National Forest), the National Park Service (Bandelier National Monument), and Los Alamos County. The San Ildefonso Pueblo borders the LANL site to the east (LANL 1994a:II-1,II-2). The closest offsite residences to LANL are approximately 3 m (10 ft) from the northern boundary.

Land-Use Planning. The *Site Development Plan Annual Update 1993* Master Plan designates TA-55 as Special Nuclear Material Research and Development. The *Site-Wide Environmental Impact Statement for Los Alamos National Laboratory* (LANL Site-Wide EIS) is currently being prepared and analyzes four future alternatives for LANL's operation over the next 5 to 10 years. An analysis of future operation, facilities, and buffer zones would be anticipated to be included (LANL 1996e:4).

Land-use planning occurs at the local level in New Mexico, with counties and cities preparing future land-use plans called comprehensive plans or general plans. Los Alamos County has a comprehensive plan and a development code that contains zoning. However, LANL is autonomous from a planning perspective and therefore, is not addressed in the county plan and code (NM County 1996a:1). The *Santa Fe County General Plan* land-use designations are based on groundwater protection goals. Therefore, the Plan designates LANL as "Agricultural and Residential" (NM County 1996a:2).

Visual Resources. Development and operation of DOE facilities has disturbed the character of the landscape in their respective areas. The DOE facilities are generally brightly lit at night and highly visible from nearby viewpoints, and are visible from as far away as southeast Santa Fe (approximately 48 km [30 mi]). The developed areas of LANL are consistent with a VRM Class 5 designation. The remainder of LANL ranges from VRM Class 3 to Class 4 designation.

Offsite viewpoints affected by DOE facilities are primarily associated with the Los Alamos townsite and New Mexico State Highways 4, 501, and 502. On a clear day, views can exceed 80 km (50 mi). Topographic relief and heavy vegetation provide significant visual screening of LANL facilities, especially from mid- and long-distance viewpoints.

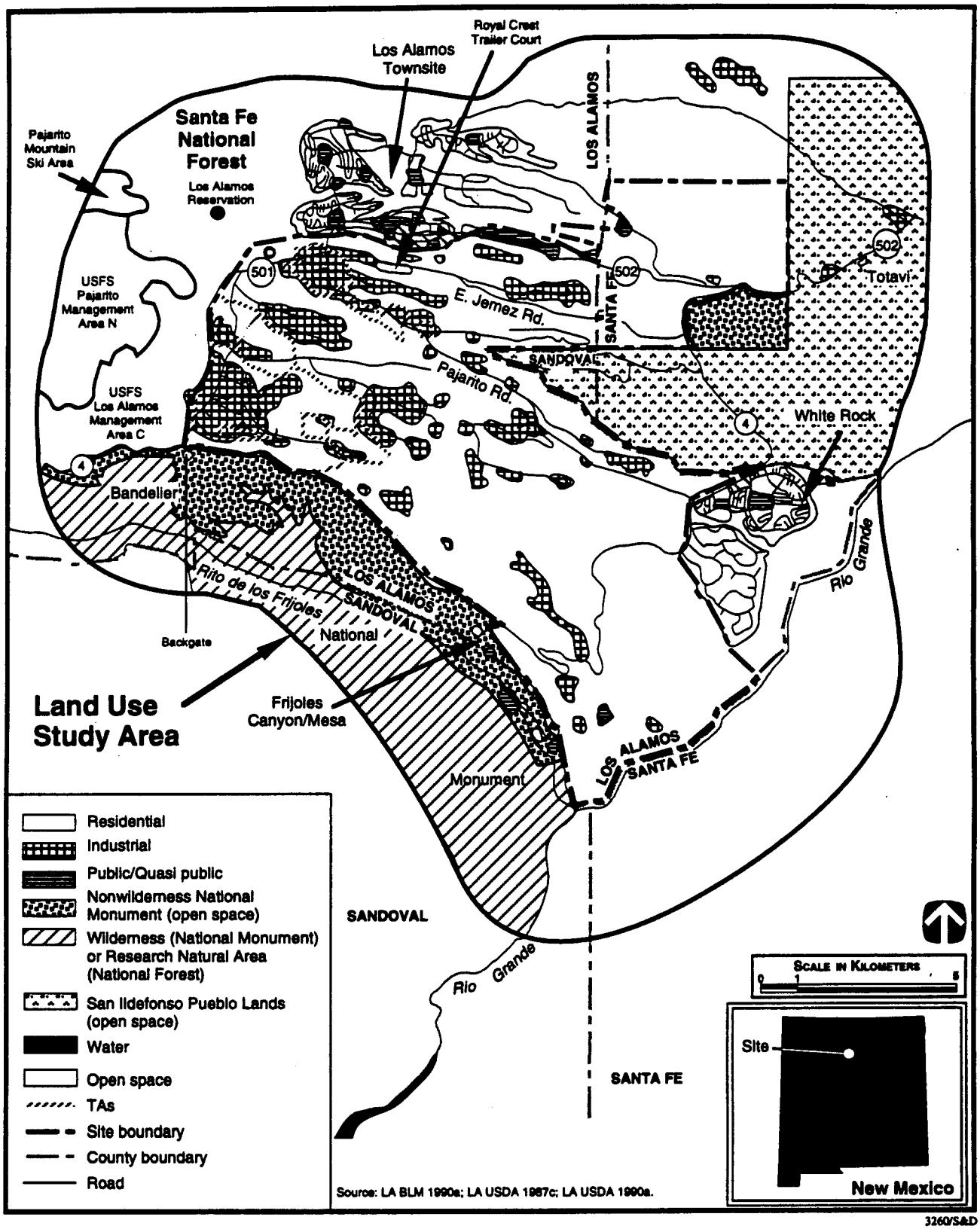


Figure 3.9.1–1. Generalized Land Use at Los Alamos National Laboratory and Vicinity.

3.9.2 SITE INFRASTRUCTURE

Baseline Characteristics. Section 3.9 describes the current LANL missions. Baseline characteristics are shown in Table 3.9.2–1.

Table 3.9.2–1. Los Alamos National Laboratory Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	137	137
Railroads (km)	0	0
Electrical		
Energy consumption (MWh/yr)	381,425	500,000
Peak load (MWe)	87	100
Fuel		
Natural gas (m^3/yr)	43,414,560	103,368,000
Oil (l/yr)	0[a]	0[a]
Coal (t/yr)	0	0
Steam (kg/hr)	33,554	234,000

[a] Oil is stored as a backup fuel source for natural gas.

Source: LANL 1990b; LANL 1995b:1.

The major existing highways that serve LANL are depicted on Figure 2.2.8–1. LANL is served by an extensive system of roads and parking facilities. Roadways are aligned with the predominant topography of east/west canyons and mesas. Cross-canyon travel is limited to the Los Alamos Canyon Bridge, West Road, and State Route 4 to the southeast. There are approximately 137 km (85 mi) of paved roads and 113 km (70 mi) of dirt or gravel roads and fire lanes. All materials shipped from locations outside LANL are first received or shuttled through TA-3. The nearest rail service is in Santa Fe, approximately 40 km (25 mi), southeast of LANL.

Locally, LANL is supplied with electricity by a Los Alamos County/DOE power pool. It also has a 20 MWe gas-fired generating plant in TA-3. Electricity is transmitted to the site and the County over two 115 kV lines, one from Santa Fe (Norton Generating Station) and one from Albuquerque (Reeves Generating Station). These lines enter LANL near TA-5 (Eastern Technical Area substation). Electricity is distributed throughout the site via 13.2 kV lines. The 115 kV system includes a loop that ties substations at TAs -3, -5, and -53 together. This looping ensures a power supply throughout LANL should outages occur in any major line. The total annual power consumption is considerably below the transmission capacity of the system. The sub-regional electric power pool from which LANL draws its power is the Arizona-New Mexico Power Area. Capabilities of this power pool are summarized in Table 3.9.2–2.

Table 3.9.2–2. Arizona-New Mexico Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	57%
Nuclear	24%
Hydro/geothermal	4%
Oil/gas	15%
Other[b]	0.3%
Total Annual Production	79,491,000 MWh
Total Annual Load	83,794,000 MWh
Energy Imported Annually[c]	4,325,000 MWh
Generating Capacity	17,023 MWe
Peak Demand	15,679 MWe
Capacity Margin[d]	3,081 MWe

[a] Percentages do not total 100 percent due to rounding.
[b] Includes power from both utility and nonutility sources.
[c] Energy imported is not the difference of production and load due to negative net pumped storage.
[d] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.
Source: NERC 1993a.

Natural gas is supplied to LANL from the San Juan Basin in northwest New Mexico. The lines are owned by DOE but operated and maintained by the Gas Company of New Mexico under contract to DOE. LANL depends on natural gas for most space heating requirements. Gas-fired forced air furnaces, hot water boilers, and steam boilers are some of the equipment used. Natural gas is distributed to buildings directly, or to three central steam plants (TAs -3, -16, and -21), and a standby plant for fueling the heating system. All plants also maintain reserves of fuel oil.

Water for LANL and adjacent areas (including Los Alamos townsite, White Rock, and Bandelier National Monument) primarily comes from three DOE-owned well fields and surface water from the Jemez Mountains. The system depends on gravity flow for distribution from high elevation terminal storage facilities.

Plutonium is stored in approximately 9,400 packages at 24 facilities within LANL. More than 90 percent of LANL's Pu inventory is located in 7,700 packages stored at the TA-55 facility. Research at the TA-55 facility includes Pu recovery processes, Pu metal fabrication, Pu-238 general purpose heat source and radioisotope thermoelectric generator production, and advanced fuel fabrication. Renovation of the Nuclear Materials and Storage Facility at TA-55 has been proposed to correct design and construction deficiencies that have prevented the use of this facility and to ensure that the facility can be operated safely and effectively. Operation of this facility would provide a centralized capability for consolidation and intermediate and long-term storage for LANL nuclear material inventories.

Plutonium analytical operations are conducted in the TA-3 CMR Building (SM-29), which has laboratories, hot cells, a waste assay facility and a vault. The Los Alamos Critical Experiments Facility, remotely located in TA-18, uses Pu in nuclear criticality experiments. These experiments generate insignificant quantities of fission and activitation products. The critical assemblies are in buildings called kivas. Pu in metal and oxide forms is stored in vaults in each kiva and also in the Hillside Vault. There are also 21 other technical areas that store small quantities of Pu materials.

3.9.3 AIR QUALITY AND NOISE

Meteorology and Climatology. Los Alamos has a semiarid, temperate mountain climate. The climate averages for atmospheric variables such as temperature, pressure, moisture, and precipitation are based on observations made at the TA-59 LANL weather station from 1961 through 1993. The meteorological conditions described here are representative of conditions on the Pajarito Plateau at an elevation of approximately 2,250 m (7,400 ft) above sea level (LANL 1995s:II-8). In July, the average daily high temperature is 27.2 °C (81 °F), and the average nighttime low temperature is 12.8 °C (55 °F). The average January daily high is 4.4 °C (40 °F), and the average nighttime low is -8.3 °C (17 °F). The highest recorded temperature is 35 °C (95 °F), and the lowest recorded temperature is -27.8 °C (-18 °F). The large daily range in temperature of approximately 13 °C (23 °F) results from the site's relatively high elevation and dry, clear atmosphere, which allows high insolation during the day and rapid radiative losses at night (LANL 1995s:II-8). Additional information related to meteorology and climatology at LANL is presented in Appendix F.

The average annual precipitation is 47.6 cm (18.7 in) but is quite variable from year to year. The lowest recorded annual precipitation is 17.3 cm (6.8 in), and the highest is 77.1 cm (30.3 in). The maximum precipitation recorded for a 24-hour period is 8.8 cm (3.5 in) (LANL 1995s:II-11). Because of the eastward slope of the terrain, there is a large east-to-west gradient in precipitation across the plateau. White Rock often receives about 13 cm (5 in) less annual precipitation than the TA-59 weather station, and the eastern flanks of the Jemez Mountains often receive about 13 cm (5 in) more (LANL 1994a:II-11).

Los Alamos winds are generally light, averaging 2.8 m/s (6.3 mph). Strong winds are most frequent during the spring when peak gusts often exceed 22 m/s (50 mph). The highest recorded wind gust was 34.4 m/s (77 mph). The semiarid climate promotes strong surface heating by day and strong radiative cooling by night. Because the terrain is complex, heating and cooling rates are uneven over the LANL area, which results in local thermally generated winds (LANL 1995s:II-11).

Ambient Air Quality. The LANL is located within the New Mexico Intrastate AQCR 157. None of the areas within LANL and its surrounding counties are designated as nonattainment areas with respect to any of the NAAQS (40 CFR 81.332). A nonattainment area is an area that has air quality worse than designated by NAAQS for one or more criteria pollutants. Applicable NAAQS and New Mexico State ambient air quality standards are presented in Appendix F.

The criteria pollutants—NO_2, CO, hydrocarbons, PM_{10}, and SO_2—make up approximately 79 percent of the stationary source emissions at LANL. The source of these criteria pollutants is combustion in power plants, steam plants, asphalt plants, and local space heaters. Toxic and other hazardous pollutants represent the remaining 21 percent of emissions from stationary sources at LANL. These emissions are generated by equipment surface cleaning, coating processes, and acid baths, and include gases, vapors, metal dusts, and miscellaneous emissions, such as wood dust, hazardous gases, and plastics (LANL 1994a:VI-1,VI-3).

One PSD Class I Area, the Bandelier National Monument's Wilderness Study Area, borders LANL to the south. To date, LANL has not been subject to PSD requirements (LANL 1993b:III-20).

Ambient concentration limits for hazardous/toxic air pollutants (to be used by the State as one of the criteria in evaluating construction permit applications for a new emission source) have been approved by the New Mexico Environmental Improvement Board. The estimated 2005 No Action annual emission rates from LANL facilities are listed in Table F.1.2.9–1. Estimates of maximum ground-level concentrations at or beyond the LANL boundary are listed in Table 3.9.3–1. Concentrations of criteria and hazardous/toxic air pollutants are in compliance with applicable guidelines and regulations. The hazardous/toxic air pollutant limits are one-hundredth of the recognized occupational exposure levels (for example, 8-hour time-weighted threshold limit values).

Table 3.9.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Los Alamos National Laboratory, 1990 and 1992

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	7,689[a]	115
	1-hour	11,578[a]	630
Lead	Calendar quarter	1.5[b]	<0.01
Nitrogen dioxide	Annual	73[a]	3.8
	24-hour	145[a]	[c]
Ozone	1-hour	235[b]	[d]
Particulate matter less than or equal to 10 microns in diameter[e]	Annual	50[b]	8
	24-hour	150[b]	21
Sulfur dioxide	Annual	40[a]	1.3
	24-hour	202[a]	[c]
	3-hour	1,300[b]	[c]
Mandated by the State of New Mexico			
Hydrogen sulfide	1-hour	11[a]	[c]
Total reduced sulfur	30-minute	3[a]	[c]
Total suspended particulate[e]	Annual	60[a]	8
	30-day	90[a]	<21
	7-day	110[a]	<21
	24-hour	150[a]	21
Hazardous and Other Toxic Compounds[f]			
Acetic acid	8-hour	250[a]	2.87
Ammonia	8-hour	180[a]	4.27
2-Butoxyethanol	8-hour	1,200[a]	0.66
Chlorine	8-hour	[g]	0.07
Chloroform	8-hour	500[a]	2.92
Ethyl acetate	8-hour	14,000[a]	0.49
Ethylene glycol	8-hour	[g]	0.39
Formaldehyde	8-hour	15[a]	0.27
Heavy metals	8-hour	[g]	0.62
Heptane (n-heptane)	8-hour	[g]	10.12
Hexane (n-hexane)	8-hour	[g]	0.41
Hydrogen chloride	8-hour	[g]	3.41
Hydrogen fluoride	8-hour	[g]	1.29
Isopropyl alcohol	8-hour	9,800[a]	2.88
Kerosene	8-hour	[g]	1.42
Methyl alcohol	8-hour	[g]	3.14
Methyl ethyl ketone	8-hour	[g]	9.95
Methylene chloride	8-hour	[g]	5.90
Nickel	8-hour	10[a]	0.30
Nitric acid	8-hour	50[a]	3.53

Table 3.9.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Los Alamos National Laboratory, 1990 and 1992—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Hazardous and Other Toxic Compounds[f] (Continued)			
Nitrogen oxide	8-hour	[g]	2.29
Nonmethane hydrocarbons	8-hour	[g]	15.83
Propane sultone	8-hour	400[a]	1.12
Stoddard solvent	8-hour	5,250[a]	1.41
Toluene	8-hour	[g]	13.2
1,1,2-Trichloroethane	8-hour	[g]	4.95
Trichloroethylene	8-hour	[g]	1.12
Tungsten (as W)	8-hour	50[a]	0.60
VM&P Naphtha	8-hour	13,500[a]	3.27
Welding fumes	8-hour	[g]	2.8
Xylene	8-hour	[g]	9.41

[a] State standard. The conversion from ppm to $\mu g/m^3$ for the ambient air quality standard is calculated with the corrections for temperature (530 °Rankine) and pressure (elevation) 2,255 m mean sea level.

[b] Federal standard.

[c] No monitoring data available; baseline concentrations assumed less than applicable standard.

[d] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[e] It is assumed that all particulate matter concentrations are total suspended particulate concentrations.

[f] Compounds listed are the major pollutants (11.34 kg/yr or more) of concern.

[g] No standard.

Source: 40 CFR 50; DOE 1995hh; LANL 1993b; LANL 1994a; NM EIB 1995a; NM EIB 1996a.

Table 3.9.3–1 presents the baseline ambient air concentrations for criteria pollutants for 1992 and other pollutants of concern for 1990 at LANL. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. The major noise sources at LANL include various facilities, equipment, and machines (for example, cooling towers, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, vehicles, pistol and rifle firing range, and explosives detonation). No LANL environmental noise survey data are available. At the LANL boundary, away from most of the industrial facilities, noise from most of these sources is barely distinguishable from background noise levels.

Impulsive noise from explosive testing can be heard occasionally in Los Alamos Townsite, White Rock Communities, and Bandelier National Monument. The acoustic environment along the LANL boundary away from traffic noise, although not measured, is expected to be that of a rural location with typical DNL levels in the range of 35 to 50 dBA (EPA 1974a:B-4). Traffic is the primary source of noise at the site boundary and residences near roads. The acoustic environment in the town of Los Alamos is similarly expected to be that of a suburban location with typical DNL in the range of 53 to 62 dBA (EPA 1974a:B-5).

The State of New Mexico has not established specific numeric environmental noise standards applicable to LANL. Los Alamos County has adopted a noise ordinance that specifies maximum sound levels in residential areas. (This ordinance is discussed in Appendix F.) Although the maximum levels specified by the ordinance

and the EPA guideline may be exceeded occasionally at the LANL boundary, this is expected to be attributable to traffic noise and not to sources at LANL; the ordinance does not apply to traffic noise.

3.9.4 WATER RESOURCES

Surface Water. The Rio Grande is the major surface water feature in north-central New Mexico. All surface water drainage and groundwater discharge from the Pajarito Plateau ultimately arrives at the Rio Grande. The Rio Grande at Otowi, just east of Los Alamos, has a drainage area of 37,037 km^2 (14,300 mi^2) in southern Colorado and northern New Mexico.

The major canyons that contain reaches of ephemeral streams within LANL are Pajarito, Water, Ancho, and Chaquehui Canyons (Figure 3.9.4–1). Ephemeral streams in the lower portions of Ancho and Chaquehui Canyons extend to the Rio Grande without being depleted. In lower Water Canyon, the ephemeral stream is very short and does not extend to the Rio Grande. In Pajarito Canyon, Homestead Spring feeds an ephemeral stream 3.2- to 4.8-km (2- to 3-mi) long.

Springs between 2,408- and 2,713-m (7,900- and 8,900-ft) elevation on the eastern slope of the Jemez Mountains supply base flow throughout the year to the upper reaches of Cañon de Valle, Los Alamos, Pajarito, and Water Canyons. These springs discharge water perched in the Bandelier Tuff and Tschicoma Formation at rates from 0.0001 to 0.0085 m^3/s (0.0035 to 0.30 ft^3/s). The volume of flow from the springs is insufficient to maintain surface flow within more than the western third of the canyons before it is depleted by evaporation, transpiration, and infiltration (DOE 1995hh:4-26).

Eleven drainage areas, with a total area of 212 km^2 (82 mi^2) pass through the eastern boundary of LANL. Runoff from heavy thunderstorms and heavy snowmelt reaches the Rio Grande several times a year from some drainages. Los Alamos, Pajarito, and Water Canyons have drainage areas greater than 26 km^2 (10 mi^2). Pueblo Canyon has a drainage area of 21 km^2 (8 mi^2), while all others have less than 13 km^2 (5 mi^2). The overall flood risk to LANL is low because nearly all the structures are located on the mesa tops, from which runoff drains rapidly into the deep canyons (DOE 1995hh:4-76). No surface water is withdrawn at LANL for either drinking water or facility operations (DOE 1993j:4-76).

Los Alamos, Sandia, and Mortandad Canyons currently receive treated industrial or sanitary effluent. Pueblo Canyon does not receive LANL effluents. Surface waters in these canyons are not a source of municipal, industrial, or agricultural water supply. Several times during the year heavy precipitation or snowmelt would cause waters from several canyons to extend beyond LANL boundaries and reach the Rio Grande (LANL 1995s:II-7).

In Mortandad Canyon, no surface runoff to LANL's boundary has occurred since studies were initiated in 1960. Pueblo Canyon received both untreated and treated industrial effluents from 1944 to 1964. It currently receives treated sanitary effluents from Los Alamos County treatment plants in its upper and middle reaches (DOE 1993j:4-76).

Existing wastewater generation from LANL is approximately 693 million l/yr (183 million gal/yr) (DOE 1993j:4-76). Permitted effluent discharges at LANL emerge from 2 sanitary wastewater treatment facilities and 130 industrial outfalls. These outfalls include power plant discharges (1 outfall), boiler blowdown (2 outfalls), treated cooling water (38 outfalls), noncontact cooling wastewater (51 outfalls), radioactive waste treatment plant (1 outfall), HE wastewater (21 outfalls), photographic laboratory rinse wastewater (13 outfalls), printed circuit board process wastewater (1 outfall), and sanitary wastewater (2 outfalls) (LANL 1995s:D-3).

Surface Water Quality. The 1993 surface water quality monitoring results for the five onsite canyons are presented in Table 3.9.4–1. The overall compliance for sanitary and industrial discharges during 1993 was 100 percent and 99.1 percent, respectively.

Water Rights and Permits. Water rights in New Mexico fall under the Doctrine of Prior Appropriations. Under this doctrine, the user who first appropriated water for a beneficial use has priority to use available water supply

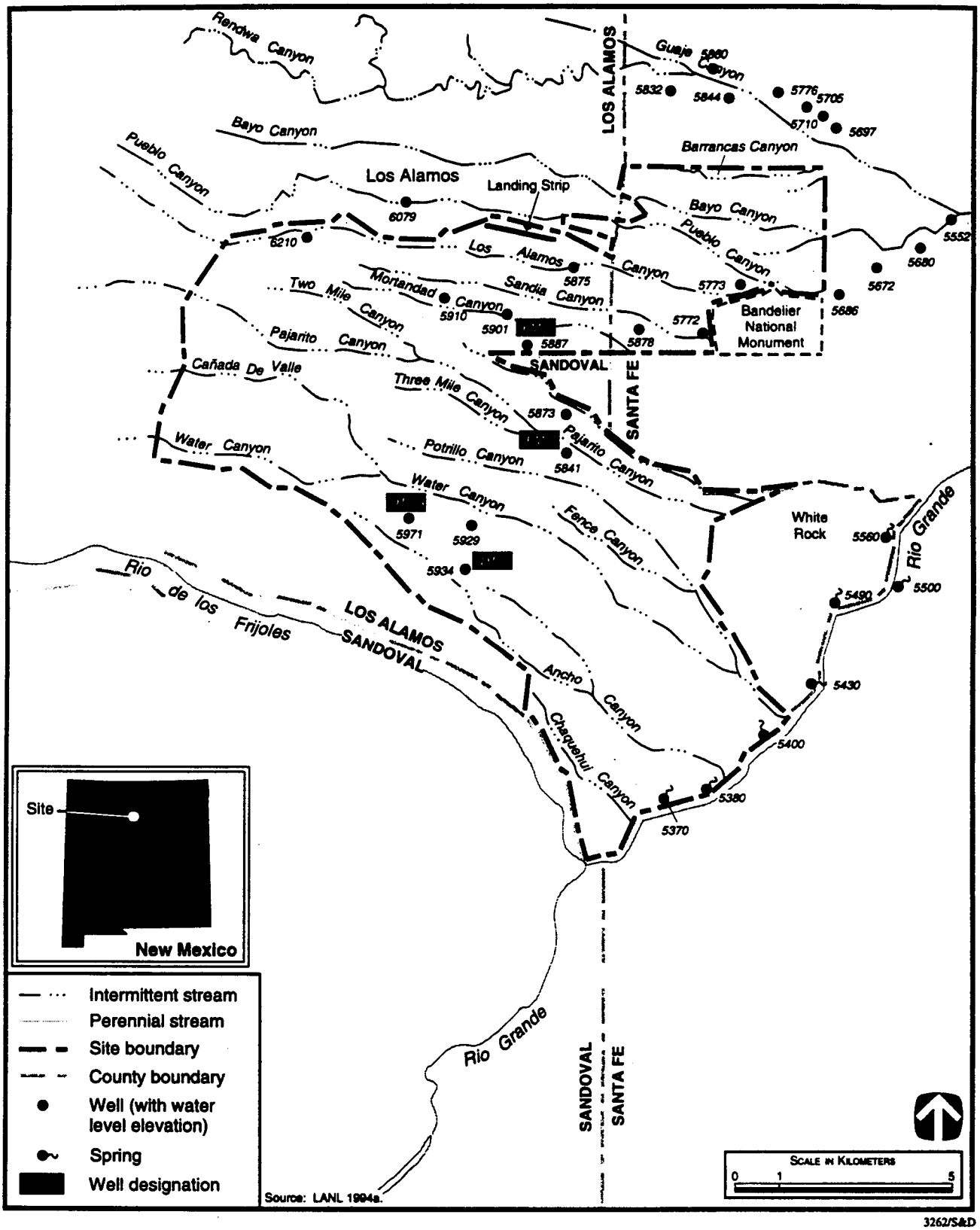


Figure 3.9.4–1. Surface Water Features at Los Alamos National Laboratory.

Table 3.9.4–1. Summary of Surface Water Quality Monitoring at Los Alamos National Laboratory, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Pajarito Canyon[b]	Pueblo Canyon[c]	Los Alamos Canyon[d]	Sandia Canyon[e]	Mortandad Canyon[f]
Bicarbonate	mg/l	NA	68	141	138	146	138
Calcium	mg/l	NA	28	.15	36	22	38
Carbonate	mg/l	NA	<5	<5	<5	<5	<5
Cesium-137	pCi/l	120[g]	1.0±1.5	2.3±1.3	3.0±1.3	3.0±1.2	NA
Chloride	mg/l	250[h]	58	34	111	70	9
Fluoride	mg/l	4.0[i],2.0[h]	0.1	0.4	0.7	0.9	0.6
Magnesium	mg/l	NA	7.1	2.6	2.5	4.6	3.5
Nitrate	mg/l	10.0[i]	0.04	4.53	<0.04	2.8	18
pH	pH units	6.8-8.5[h]	7.9	7.3	7.8	8.6	8.2
Phosphate	mg/l	NA	0	5.3	0.1	2.5	0.6
Plutonium-238	pCi/l	1.6[g]	-0.005±0.042	- 0.019±0.030	-0.036±0.030	0.004±0.030	748±0.058
Plutonium-239/240	pCi/l	1.2[g]	0.006±0.028	0.006±0.020	0.118±0.024	0.012±0.020	493±0.046
Potassium	mg/l	NA	5	N/A	7	N/A	5
Sodium	mg/l	NA	28	40	87	110	60
Strontium-90	pCi/l	400[g]	0±0.7	2.2±0.7	0±0	1.0±0.9	33.7±2.2
Sulfate	mg/l	250[h]	13	23	12	100	9
Total dissolved solids	mg/l	500[h]	228	404	356	558	302
Total hardness as $CaCO_3$	mg/l	NA	106	55	104	72	110
Tritium	pCi/l	80,000[g]	600±400	600±300	800±300	600±300	13,100±1,100
Uranium, Total	mg/l	0.02[j]	<0.2±0	<1.0±0	<1.0±0	<1.0±0	N/A

[a] For comparison purposes only.

[b] Mean of multiple samples.

[c] Surface water is monitored at two locations in Pueblo Canyon. The monitoring results presented are from Pueblo 3.

[d] Two locations are normally monitored in Los Alamos Canyon; however, one location was dry at the time of sampling. Results are reported for location DPS-1.

[e] Three locations are monitored in Sandia Canyon. The monitoring results presented are from the sampling location with the highest concentration of the given parameter.

[f] Only one location in Mortandad Canyon is sampled (GS-1).

[g] DOE DCG for drinking water (DOE Order 5400.5). Values are based on a committed effective dose of 100 mrem per year. However, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored concentrations. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the environmental level.

[h] National Secondary Drinking Water Regulations (40 CFR 143).

[i] National Primary Drinking Water Regulations (40 CFR 141).

[j] Proposed National Primary Drinking Water Regulation, Radionuclides (56 FR 33050).

Note: NA=not applicable; N/A=not analyzed.

Source: LANL 1995s.

over a user claiming rights at a later time. All natural water flowing in streams and water courses in New Mexico is considered to be public and subject to appropriation for beneficial use. Beneficial use is the basis, measure, and limit of the right to use water. No water right, therefore, may be granted or claimed for more than the amount that can be beneficially used. DOE owns combined surface and groundwater rights. These rights include the withdrawal of 6,835 million l/yr (1,806 million gal/yr) from a variety of wells and surface diversions under licenses RG–485 through RG–488, 1503, 1802, and 1802–B. DOE also owns a contract for 1,480 million l/yr (391 million gal/yr) of San Juan/Chama Diversion water.

Groundwater. Groundwater in the LANL area exists in three modes—in shallow alluvium in canyons, perched groundwater, and in the main aquifer. The main aquifer consists mostly of clastic sediments within the Santa Fe Group and the Puye Formation. Nearly all groundwater at LANL is obtained from deep wells that produce water from this aquifer. A minor amount of groundwater at LANL is obtained from springs. Most aquifers that lie beneath LANL, with the exception of perched zones, are considered Class II aquifers, having current sources of drinking water and other beneficial uses (DOE 1993j:4-77).

The Santa Fe Group consists of, in ascending order, the Tesuque Formation, Puye Conglomerate, and basaltic rocks of Chino Mesa. The Tesuque Formation contains thin, jointed, interbedded basalt flows that may yield large amounts of water. Some units have lower permeabilities that restrict the movement of water within the formation. The Puye Conglomerate overlies the Tesuque Formation and is highly permeable. When saturated, it yields large amounts of water to wells (LANL 1984a:3).

The depth to the top of the aquifer ranges from about 366 m (1,200 ft) on the west to about 183 m (600 ft) on the east. The total saturated thickness penetrated by production wells ranges up to approximately 518 m (1,700 ft). The most productive area lies in the central portion of the Pajarito Plateau and includes the Pajarito well field. The average drawdown for these wells is 12 m (39.4 ft). The rate of movement of water in the aquifer is approximately 12 to 29 m (39.4 to 95.1 ft) per year (LANL 1984a:7,8).

Groundwater Quality. Most of the wells in the Pajarito Plateau yield fresh water (TDSs less than 500 milligrams [mg]/l or parts per million [ppm]), although some wells east of the site have a higher total dissolved solids content (1,000 mg/l or more). The primary, secondary, and radiochemical groundwater quality, as measured from wells and springs in the main aquifer were below the DOE derived concentration guides or the New Mexico standards applicable to a DOE drinking water system (DOE 1993j:4-77). As shown in Table 3.9.4–2, parameters were below the applicable water quality criteria or standard in the main aquifer in 1993.

Groundwater Availability, Use and Rights. The LANL, the nearby communities of Los Alamos and White Rock, and Bandelier National Monument are entirely dependent on groundwater for their water supply. The water supply is primarily obtained from well fields. During 1993, total production from the wells for potable and nonpotable use was 5,519 million l/yr (1,458 million gal/yr) (LANL 1995r:4). LANL's water system had an average demand equal to about 81 percent of its current allotment of 6,800 million l/yr (1,800 million gal/yr).

Two wells have been drilled recently at LANL, one of which began pumping in the summer of 1992. The newer wells are expected to supplant the now abandoned Los Alamos field. Water is taken from depths of 245 to 550 m (804 to 1,805 ft).

Over the next 50 years, increases in water use may require one of the following: use of the 1,500 million l/yr (396 million gal/yr) San Juan-Chama water (releasing the water in exchange for excess pumping) and/or establishment of credit for return flow (DOE 1993j:4-79).

Table 3.9.4–2. Groundwater Quality Monitoring at Los Alamos National Laboratory, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[b]	1993 Existing Conditions[a] Test Well DT-9	Test Well DT-5A	Water Supply Well PM-5	Water Supply Well PM-2
Cesium-137	pCi/L	120[c]	2.1 (1.2)	2.3 (1.4)	0.2 (0.5)	1.4 (1.2)
Chloride	mg/L	250[d,e]	2	2	4	2
Fluoride	mg/L	2.0[e],4.0[f]	0.3	0.3	0.3	0.2
Nitrate	mg/L	10[f]	0.32	0.44	0.10	<0.04
pH	pH units	6.8-8.5[e]	8.2	8.0	7.6	8.2
Plutonium-238	pCi/L	1.6[c]	-0.014(0.030)	-0.014 (0.030)	<0.1 (0)	0.004 (0.030)
Plutonium-239/240	pCi/L	1.2[c]	0.008 (0.030)	0.032 (0.030)	0.03 (0.03)	0.127 (0.024)
Sulfate	mg/L	250[d]	3	3	3	4
Total dissolved solids	mg/L	500[d]	112	104	320	136
Tritium	pCi/L	80,000[c]	300 (300)	400 (300)	400 (300)	500 (300)
Uranium, Total	mg/L	0.02[g]	<2.0 (0)	<2.0 (0)	<1.0 (0)	<1.0 (0)

[a] All data come from groundwater from onsite stations. Samples were collected in 1993.

[b] For comparison purposes only.

[c] DOE DCG for drinking water (DOE Order 5400.5). Values are based on a committed effective dose of 100 mrem per year. However, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. All concentrations of radionucleotides are determined by subtracting the instrument background environmental levels from the monitored concentrations. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the environmental level.

[d] New Mexico State water quality criteria.

[e] National Secondary Drinking Water Regulations (40 CFR 143).

[f] National Primary Drinking Water Regulations (40 CFR 141).

[g] Proposed National Drinking Water Regulations, Radionuclides (56 FR 33050).

Note: Well locations are shown in Figure 3.9.4–1; Parentheses indicate standard error of the mean.

Source: LANL 1995s.

Based on No Action projections, the net growth in overall use is about 0.4 percent per year. Based on this growth rate, the present allotment would be fully used by about 2052. If San Juan-Chama water is added, the limit to the total available supply would be reached by about 2072.

3.9.5 GEOLOGY AND SOILS

Geology. The LANL is located on the Pajarito Plateau, which lies between the Jemez Mountains on the west and the Rio Grande River on the east. The surface of the plateau slopes gently eastward and is dissected by deep, southwest-trending canyons separated by long, narrow mesas. The Pajarito Plateau terminates along its eastern edge along the Puye Escarpment and White Rock Canyon.

The primary controlling feature in the region is the Rio Grande rift that begins in Northern Mexico, trends northwest across central New Mexico, and ends in central Colorado. The rift comprises a series of basins formed by faulting that are filled with sediments derived from highlands to the east and west as well as occasional lake deposits and lava flows. The rift basin in the Los Alamos and Santa Fe area is the Española Basin.

The Pajarito Plateau is capped by the Bandelier Tuff, which consists of a series of ash fall and ash flow tuff (LANL 1984a:6). The major portion of LANL is underlain by the Tshirege member of the Bandelier Tuff, a sequence of cliff-forming welded ash flows with ash fall basal units. The Bandelier Tuff is underlain by sedimentary and volcanic rocks of the Santa Fe Group, which includes the Tesuque Formation, Puye Conglomerate, and basaltic rocks of Chino Mesa (LANL 1984a:3-7).

The LANL lies within Seismic Zone 2 (Figure 3.2.5–1). The strongest earthquake in the last 100 years within an 80-km (50-mi) radius was estimated to have a Richter magnitude of 5.5 to 6 and a MMI of VII. Studies suggest that several faults have produced seismic events with Richter magnitudes of 6.5 to 7.8 in the last 500,000 years (LANL 1987c:ix). LANL operates a seismic hazards program that monitors seismicity through a seismic network and conducts studies in paleoseismology.

The Pajarito Fault system, part of which crosses the western boundary of LANL, is a major, active structural element of the Rio Grande rift. Recent studies have determined that faults within the Pajarito Fault system are capable in accordance with 10 CFR 100, Appendix A (LANL 1987c:ix). Major faults at LANL include the Pajarito, Water Canyon, Rendija Canyon, and Guaje Mountain Faults (Figure 3.9.5–1). The Pajarito Fault is thought to mark the active western boundary of the Española Basin and has evidence of multiple movement in the past 100,000 to 200,000 years. The Rendija Canyon and Guaje Mountain Faults are shorter and secondary to the Pajarito Fault and had movement approximately 8,000 to 9,000 years ago and 4,000 to 6,000 years ago, respectively (DOE 1995hh:4-19).

The 100-year earthquake at Los Alamos is regarded as having a Richter magnitude of 5, with an event of Richter magnitude 7 being the maximum credible earthquake. These values are currently used in design considerations at LANL (LANL 1987c:43,53,54,58).

Geological concerns associated with the LANL area include potential downslope movements in association with regional seismic activity. Although isolated rockfalls commonly occur from the canyon rims, landslides are an unlikely hazard at Los Alamos because of the dry climate, deep water table, and rock characteristics. Although the area has the potential for future volcanic eruptions, the periodicity and structural development of past eruptions indicate a very low probability of an event occurring within the next 1,000 years (LA DOE 1979a:3-17).

Soils. The LANL is underlain by soil types varying in texture from clay and clay loam to gravel. Over 95 percent of the soils are developed on acidic volcanic rocks (LANL 1978a:6,7). Because of the topographic relief of the Pajarito Plateau, rock outcrops occur on greater than 50 percent of the site area.

Water and wind erosion of these soils varies from slight to severe depending on slope, soil grain size, amount of disturbance, and degree of protection. Shrink-swell potential ranges from low to high, correlating with the amount of swelling clays present (LANL 1978a:80). The soils are acceptable for standard construction techniques.

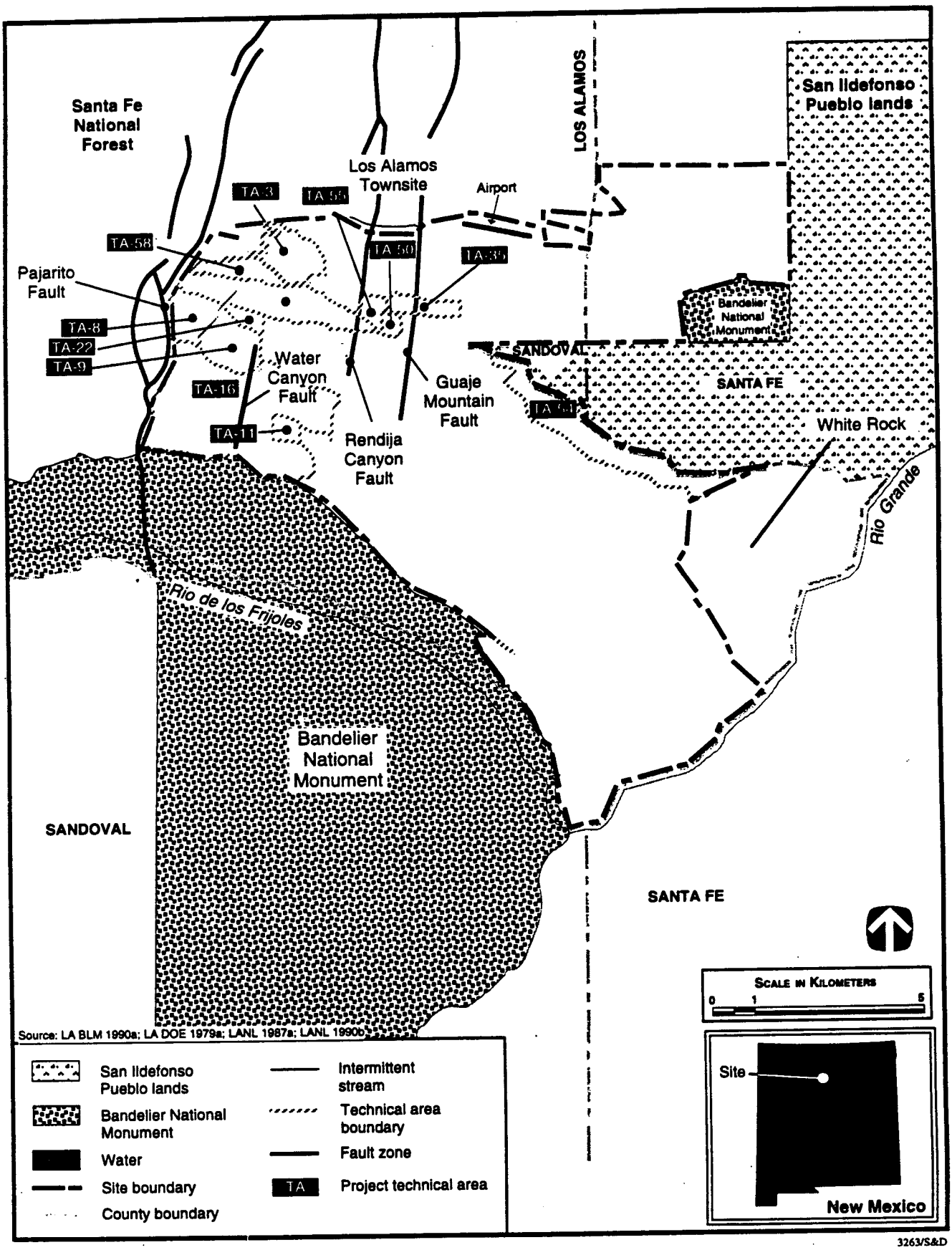


Figure 3.9.5–1. Major Fault Systems in the Los Alamos National Laboratory Region.

3.9.6 BIOLOGICAL RESOURCES

Terrestrial Resources. The LANL lies within the Colorado Plateau Province. Ecosystems within the laboratory site itself are quite diverse due partly to the 1,500-m (5,000-ft) elevational gradient from the Rio Grande River on the southeastern boundary to the Jemez Mountains, 20 km (12.4 mi) to the west, and to the many canyons with abrupt slope changes that dissect the site. Only a small portion of the total land area at LANL has been developed. The remaining land has been classified into seven major vegetative communities as shown in Figure 3.9.6–1.

Within LANL, the predominant community types are juniper grassland in the eastern one-third, pinyon-juniper in the central one-third, and ponderosa pine in the western one-third. The juniper-grassland community is found along the Rio Grande on the eastern border of the Pajarito Plateau and extends upward on the south-facing sides of the canyons at 1,700 to 1,900 m (5,600 to 6,200 ft). The pinyon-juniper community, generally found in the 1,900- to 2,100-m (6,200- to 6,900-ft) elevation range, includes large portions of the mesa tops and north-facing slopes at the lower elevations. The ponderosa pine community is found in the western portion of the plateau and on mesa tops in the 2,100- to 2,300-m (6,900- to 7,500-ft) elevation range. Coniferous trees are the dominant vegetation in the LANL environs, with pinyon pine and one-seed juniper predominate below 2,100 m (6,900 ft), and ponderosa pine and Douglas fir predominate above that elevation (DOE 1995hh:4-39–4-42). Almost 350 vascular plant species have been found, or are likely to be found, on LANL (LA DOE 1979a:3-39).

Terrestrial animal species that can be found on or near LANL include 1 amphibian, 9 reptile, 189 bird, and 45 mammal species (LA DOE 1979a:3-46, C-1–C-3). Undeveloped areas within LANL provide habitat for a diversity of terrestrial wildlife. Species lists have been compiled from observational data and published data, but the occurrence of some species has not been verified (DOE 1995hh:4-42). Among vertebrates, the collared lizard, eastern fence lizard, and whiptail lizard are some of the reptiles found at LANL. Typically, these are found at elevations between 1,910 and 2,134 m (6,265 and 7,000 ft). Bird species that nest in the area include the Mexican spotted owl, great-horned owl, and red-tailed hawk among the raptors, and Say's phoebe, lesser goldfinch, and American robin among other types. Overwintering species include the scrub jay, common raven, and house finch (DOE 1995hh:4-42). Migratory birds and their nests and eggs are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Some of the larger mammals at LANL are the black bear, coyote, and raccoon, while the smaller species include the Mexican woodrat, deer mouse, Abert's squirrel, and mountain cottontail (DOE 1995hh:4-42). The most important and prevalent big game species at LANL are mule deer and elk. LANL lands have traditionally been a transitional area for wintering elk and mule deer. More recently, these two species have been using LANL property on a year-round basis.

Throughout LANL's history, developments within various TAs have caused significant alterations in the terrain and the general landscape of the Pajarito Plateau. These alterations have resulted in significant changes in land use by most groups of wildlife species, particularly birds and larger mammals that have large seasonal and/or daily ranges. Certain projects required the segregation of large areas such as mesa tops, and, in some cases, project areas were secured by virtually impenetrable fences around their perimeters. These alterations have undoubtedly caused some species of wildlife, such as elk and deer, to alter their land-use patterns by cutting off or altering seasonal or daily travel corridors to wintering areas, breeding habitats, foraging habitats, and bedding areas, as well as other necessary habitats.

In 1980, elk were primarily using the southwestern portion of LANL. In addition, critical calving areas and important high-use areas were identified, all of which were primarily in the west and southwest part of LANL. Since 1980, the number of elk using LANL lands increased significantly. Studies of elk conducted from 1991 to 1993 revealed increased use of habitats north and northeast of previously documented high-use areas. There have also been recent concerns about increases in motor vehicle accidents involving elk and deer in the LANL

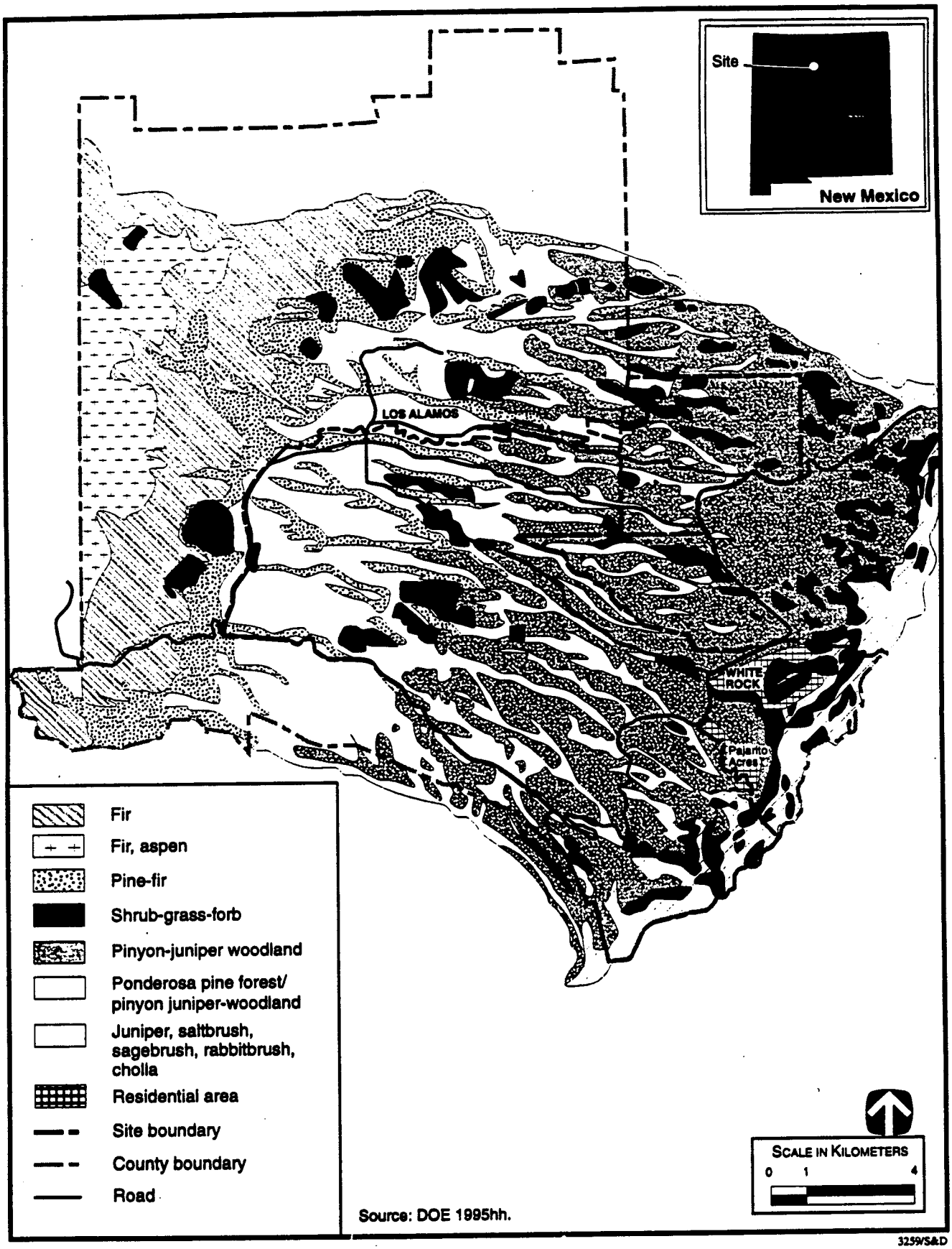


Figure 3.9.6–1. Distribution of Plant Communities at Los Alamos National Laboratory.

area. In general, however, little is known of habitat use patterns, population trends, and characteristics of elk on the Pajarito Plateau (DOE 1995hh:4-43).

Wetlands. National Wetland Inventory maps show that most LANL wetlands occur in canyons that drain to the Rio Grande River. Wetlands are found in most of the canyons on the laboratory site including Pueblo, Los Alamos, Sandia, Mortendad, Pajarito, Water, Ancho, Chaquchi, and White Rock (Rio Grande) Canyons. Wetlands have also developed in the vicinity of outfalls from LANL facilities. Most wetlands are classified as riverine intermittent, meaning they may contain flowing water part of the year and may contain pooled water or be dry the remainder of the year. Palustrine emergent and/or scrub-shrub wetlands are also indicated in sections of Pueblo, Los Alamos, Sandia, Pajarito, and Ancho Canyons. Most of the riverine and palustrine wetlands known to exist at LANL are designated as temporary or seasonal by the NWI maps.

Aquatic Resources. Aquatic habitats at LANL are limited to the Rio Grande and several springs and intermittent streams in the canyons. Some of these habitats currently receive NPDES-permitted wastewater discharges. The springs and streams at LANL do not support fish; however, many other aquatic species thrive in these waters (DOE 1995hh:4-43).

The Rio Grande is located along the southeastern property boundary and supports populations of common carp, chub, white sucker, and carpsucker. Game fish inhabiting the Rio Grande River in the vicinity of LANL include the channel catfish and brown trout (LANL 1992a:3).

Threatened and Endangered Species. Twenty federally or State-listed threatened, endangered, and other special status species may be found on and in the vicinity of LANL (Table 3.9.6–1). Four of these species have been observed on LANL. The federally listed species recorded onsite include the Mexican spotted owl, which has recently been observed nesting near TA-15 (two young were fledged from this nest during the 1995 breeding season) (DOE 1995hh:4-45), the bald eagle, which winters along the Rio Grande River, and peregrine falcon, which historically nested onsite and occasionally still forages there. The State-threatened Jemez Mountain salamander has also been observed onsite. LANL canyons provide suitable nesting, roosting, and foraging habitats for the Mexican spotted owl. No critical habitat for threatened or endangered species, as defined in ESA (50 CFR 17.11; 50 CFR 17.12), exists on LANL; however, critical habitat for the Mexican spotted owl has been designated in areas bordering the northern and western boundaries of LANL (60 FR 29914).

Table 3.9.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Los Alamos National Laboratory

Common Name	Scientific Name	Status[a]	
		Federal	State
Mammals			
New Mexican meadow jumping mouse	*Zapus hudsonius luteus*	NL	T
Spotted bat	*Euderma maculatum*	NL	T
Birds			
Baird's sparrow	*Ammodramus bairdii*	NL	T
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	T
Broad-billed hummingbird	*Cynanthus latirostris*	NL	T
Common black-hawk	*Beuteogallus anthracinus*	NL	T
Gray vireo	*Vireo vicinior*	NL	T
Mexican spotted owl[c]	*Strix occidentalis lucida*	T	NL
Peregrine falcon[b,c]	*Falcon peregrinus*	E (S/A)	E
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	T
Whooping crane[b]	*Grus americana*	E	E
Amphibians			
Jemez Mountain salamander[c]	*Plethodon neomexicanus*	NL	T
Fish			
Rio Grande silvery minnow	*Hybognathus amarus*	E	T
Invertebrates			
Say's pond snail	*Lymnaea caperata*	NL	E
Plants			
Checker lily	*Fritillaria atropurpurea*	NL	R
Giant helleborine orchid	*Epipactis gigantea*	NL	RS
Golden lady's slipper	*Cypripedium pubescens*	NL	E
Sandia alumroot	*Heuchera pulchella*	NL	RS
Santa Fe cholla	*Opuntia viridiflora*	NL	E
Wood lily	*Lilium philadelphicum var. andinum*	NL	E

[a] Status codes: E=endangered; NL=not listed; R=State rare plant review list; RS=State rare and sensitive plant species; S/A=protected under the similarity of appearances provision of the *Endangered Species Act*; T=threatened.

[b] USFWS Recovery Plan exists for this species.

[c] Species recorded on LANL.

Source: 50 CFR 17.11; 50 CFR17.12; DOE 1995hh; LANL 1996e:2; NM DGF 1990b; NM DGF 1995a; NM FRCD 1995a.

3.9.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric site types identified in the vicinity of LANL include large multiroom pueblos, field houses, talus houses, shrines, rock shelters, animal traps, hunting blinds, water control features, agricultural fields and terraces, quarries, rock art, trails, campsites, windbreaks, rock rings, and limited activity sites. Approximately 75 percent of LANL has been inventoried for cultural resources. Coverage for many inventories has been less than 100 percent; however, approximately 60 percent of LANL has received 100-percent coverage. More than 1,300 prehistoric sites have been recorded at LANL, and approximately 95 percent of these sites are considered eligible or potentially eligible for the NRHP. Two areas in the vicinity of LANL have been established as NRHP sites or districts: Bandelier National Monument (named as a monument in 1916) and Puye Cliffs Historical Ruins.

Historic Resources. Historic resources consist of homesteads, corrals, ditches, trash scatters, roads and trails, railroads, ranches, mines, remains of commercial ventures, and buildings associated with the Manhattan Project and the Cold War era. More than 80 historic resources have been recorded at LANL, and about 90 percent of the resources are considered eligible or potentially eligible for the NRHP.

The existing LANL facilities have been extensively modified and refurbished since 1943 when major construction occurred after World War II. The existing facilities are not likely to be considered NRHP eligible because they lack architectural integrity and may not be representative of a particular style. However, some of the facilities may be NRHP eligible based on their association with the broad historic theme of the Manhattan Project and initial nuclear production.

Portions of a number of TAs have been surveyed. NRHP-status buildings exist in TAs -3, -8, -9, -16 (74 individual buildings); TA-22 (TA-22-1); TA-28; and TA-55. Structures at the front and back gates are also eligible for the NRHP. Additional NRHP-eligible historic resources may exist in other TAs.

Native American Resources. Native Americans in the area with concerns include the six Tewa-speaking Pueblos of the northern Rio Grande Valley (San Ildefonso, San Juan, Santa Clara, Nambe, Tesuque, and Pojoaque), and the Cochiti and Jemez Pueblos.

Cultural resources are of special importance to Native Americans. These resources located on the LANL site may consist of prehistoric sites with ceremonial features such as kivas, village shrines, petroglyphs, or burials, or traditional cultural properties with no observable manmade features. Consultations by DOE with local Native Americans to identify any such cultural resources have been conducted in the past and are ongoing. An ethnographic study is currently being conducted to identify traditional cultural properties in the area as part of a sitewide EIS for LANL.

Paleontological Resources. The Pajarito Plateau consists primarily of Pleistocene volcanic tuffs and compacted pumice and ashfalls of the Bandelier Formation. None of the formations within LANL are known to be fossiliferous.

3.9.8 SOCIOECONOMICS

Socioeconomic characteristics addressed at LANL include employment and regional economy, population and housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses seven counties around LANL located in New Mexico (Table L.1–1). Statistics for population and housing, community services, and local transportation are presented for the ROI, a three-county area in which 88.1 percent of all LANL employees reside: Los Alamos County (48.3 percent), Rio Arriba County (20.8 percent), and Santa Fe County (19.0 percent) (Table L.1–9). More than half of the Los Alamos County employees reside in the unincorporated communities of Los Alamos and White Rock. In 1995, LANL employed 8,655 persons.

Regional Economy Characteristics. Selected employment and regional economy statistics for the LANL REA are summarized in Figure 3.9.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 34.1 percent to the 1990 level of 100,300. The 1994 unemployment rate in the REA was 6.2 percent, which was about the same as the unemployment in New Mexico (6.3 percent). The region's per capita income of $17,689 in 1993 was approximately 8.2 percent higher than New Mexico's per capita income of $16,346.

As shown in Figure 3.9.8–1, the REA and New Mexico have similar employment patterns. The service sector accounts for the largest share of employment in both the region (31.2 percent) and in New Mexico (28.3 percent). Retail trade employment was approximately the same for the region (18.2 percent) and New Mexico (18.1 percent). Manufacturing employment accounted for 4.0 percent of the total regional employment but 5.8 percent of the total State employment.

Population and Housing. In 1994, the ROI population totaled 166,788. From 1980 to 1994, the ROI population grew by 36.6 percent, compared to 26.9 percent for New Mexico. Within the ROI, Santa Fe County experienced the largest increase at 48.6 percent. Population and housing trends are summarized in Figure 3.9.8–2. The unincorporated communities of Los Alamos and White Rock in Los Alamos County are included in the county population and housing analysis.

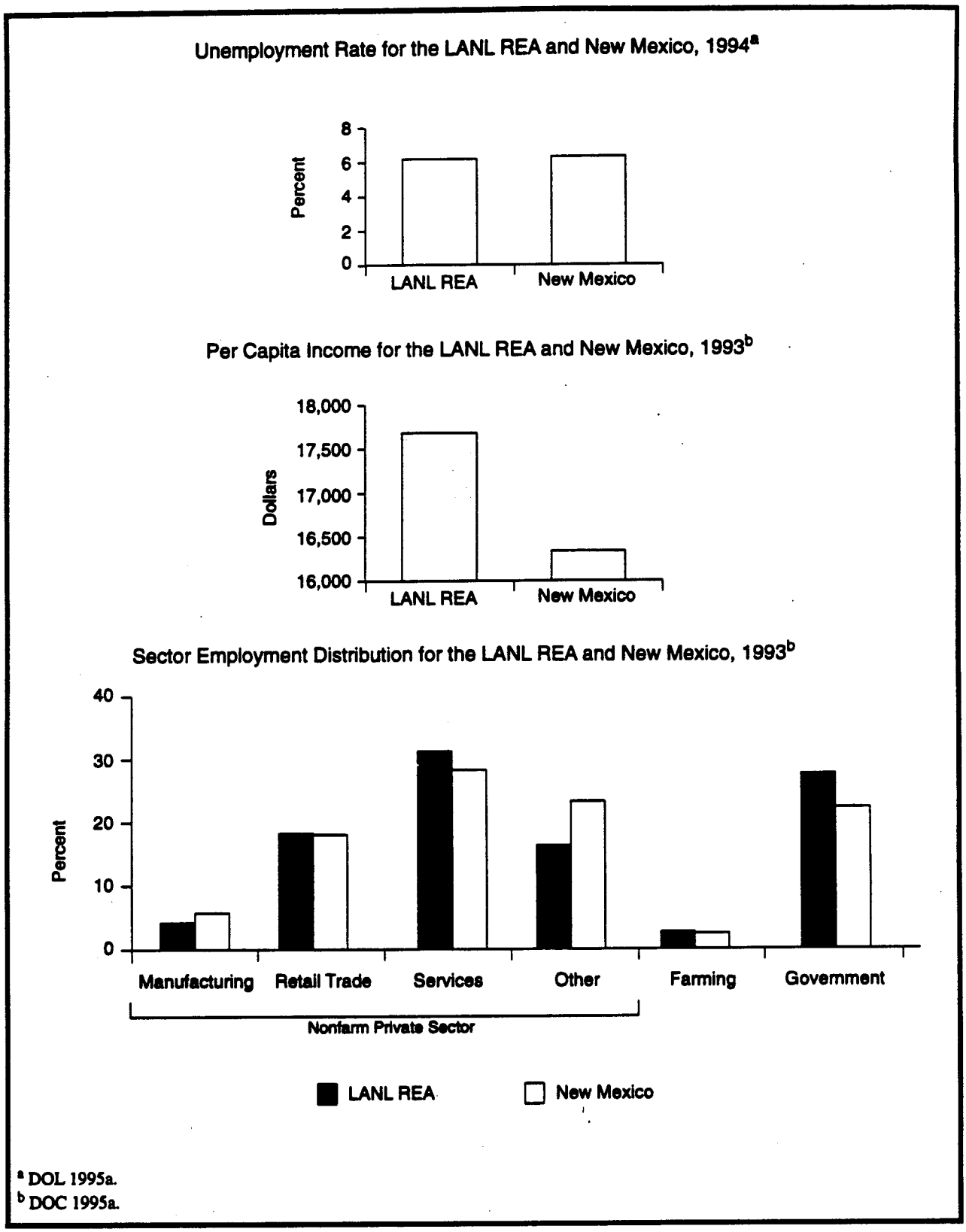
The 37.8-percent increase in the number of housing units between 1980 and 1990 for the ROI was much greater than the percent increase for New Mexico (24.5 percent). The total number of housing units for 1990 was 63,386. The 1990 homeowner vacancy rate in the ROI, 2.3 percent, was the same as New Mexico's homeowner vacancy rate. The rental vacancy rate for the ROI counties, 7.7 percent, was much less than New Mexico's rental vacancy rate (11.4 percent).

Community Services. Education, public safety, and health care characteristics were used to assess the level of community service in the LANL ROI. Figure 3.9.8–3 presents school district characteristics for the LANL ROI. Figure 3.9.8–4 presents public safety and health care characteristics.

Education. In 1994, seven school districts provided public education services and facilities in the LANL ROI. As shown in Figure 3.9.8–3, these school districts operated at between 57.4 percent (Chama Valley Independent School District) and 75.7 percent (Espanola Public School District) capacity. The average student-to-teacher ratio for the LANL ROI in 1994 was 17.3:1. The Espanola Public School District had the highest ratio at 18.9:1.

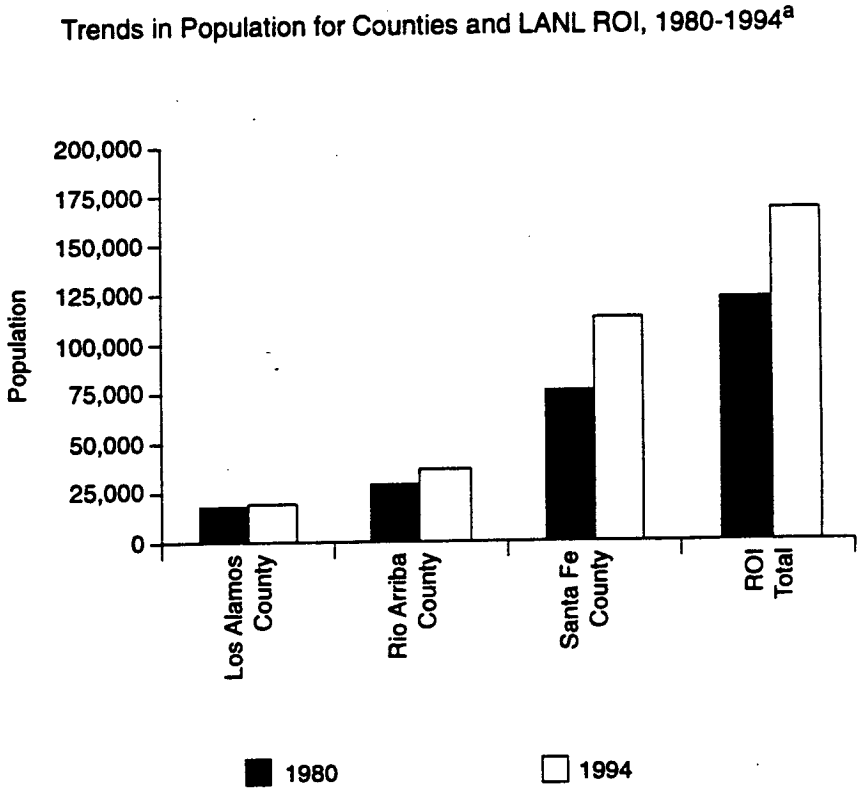
Public Safety. City, county, and State law enforcement agencies provided police protection to the residents in the ROI. In 1994, a total of 263 sworn police officers were serving the three-county ROI. The City of Santa Fe employed the greatest number of sworn police officers (104), while the City of Espanola had the highest officer-to-population ratios (2.5 sworn officers per 1,000 persons). The ROI average officer-to-population ratio was 1.6 officers per 1,000 persons. Figure 3.9.8–4 compares police force strengths across the ROI.

Fire protection services in the LANL ROI were provided by 800 paid and volunteer firefighters in 1995. The fire district with the highest firefighter-to-population ratio was located in Rio Arriba County, 10.2 firefighters per



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.9.8–1. Employment and Local Economy for the Los Alamos National Laboratory Regional Economic Area and the State of New Mexico.



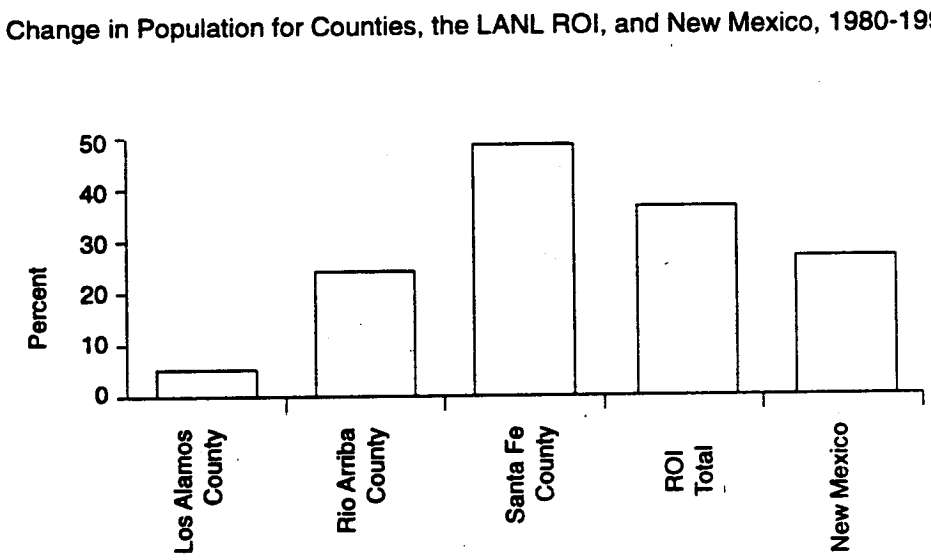
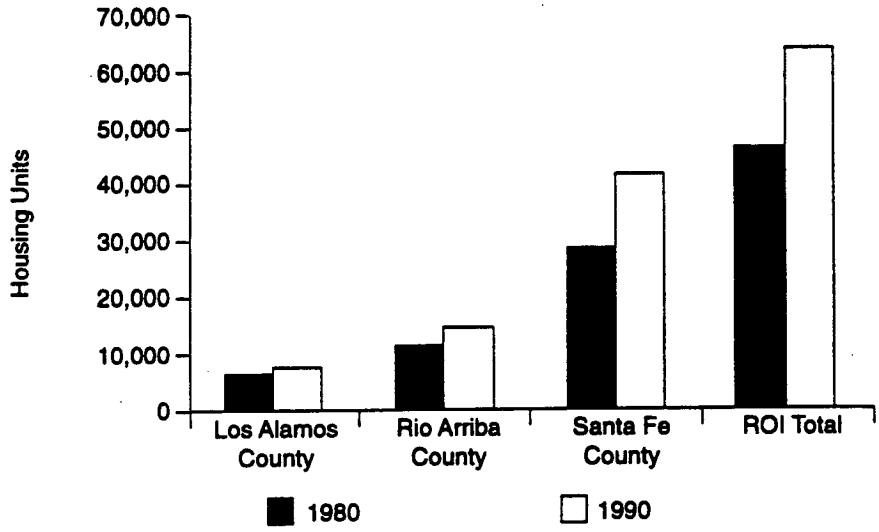
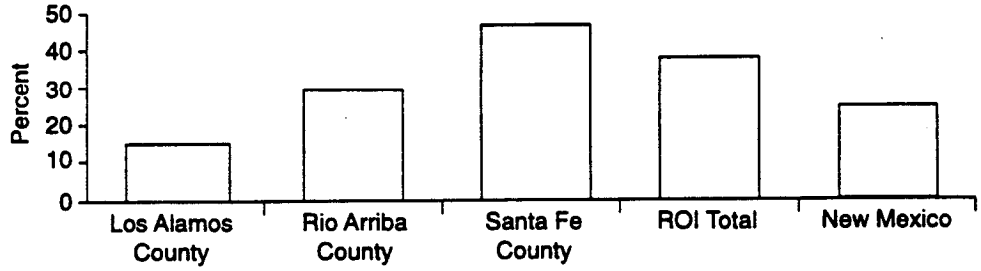


Figure 3.9.8–2. Population and Housing for the Los Alamos National Laboratory Region of Influence and the State of New Mexico.

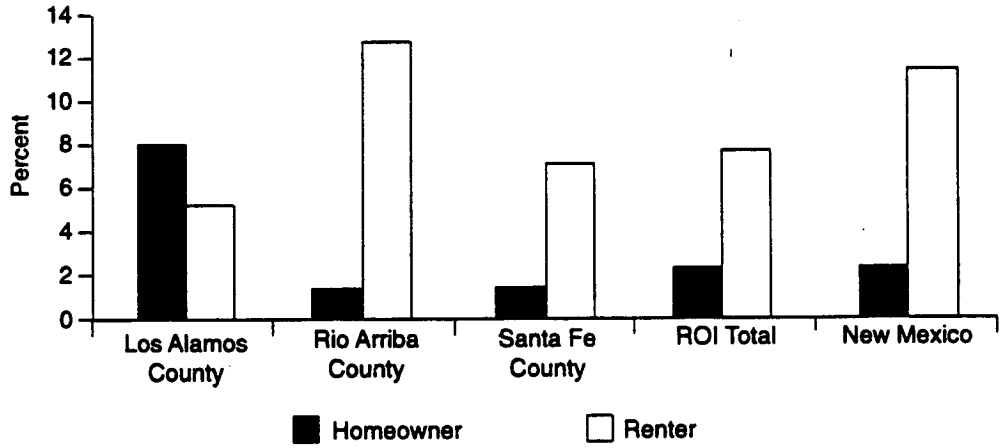
Trends in Housing for Counties and the LANL ROI, 1980-1990[b]



Change in Housing for Counties, the LANL ROI, and New Mexico, 1980-1990[b]



Homeowner and Renter Vacancy Rates for Counties, the LANL ROI, and New Mexico, 1990[c]



[a] Census 1983g; Census 1995a.
[b] Census 1982o; Census 1991h.
[c] Census 1991h.

Figure 3.9.8–2. Population and Housing for the Los Alamos National Laboratory Region of Influence and the State of New Mexico—Continued.

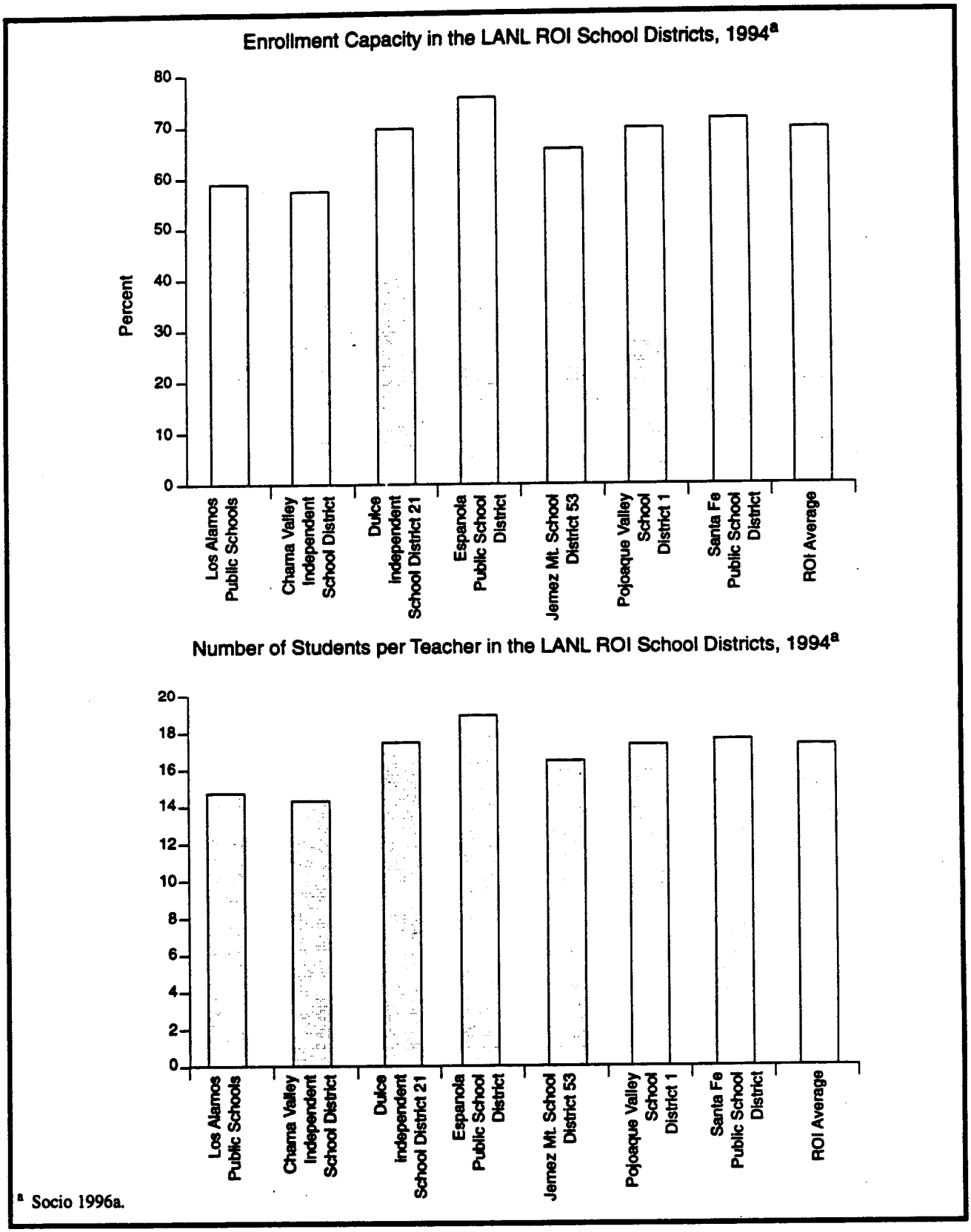
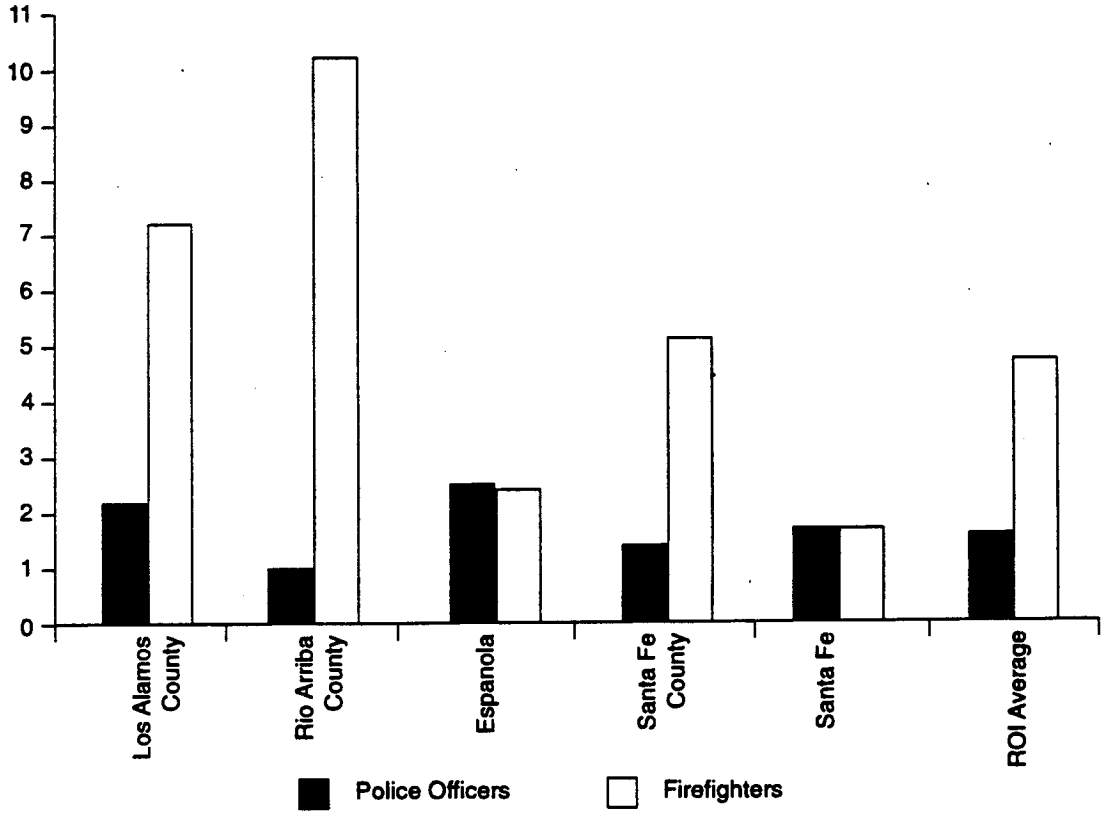


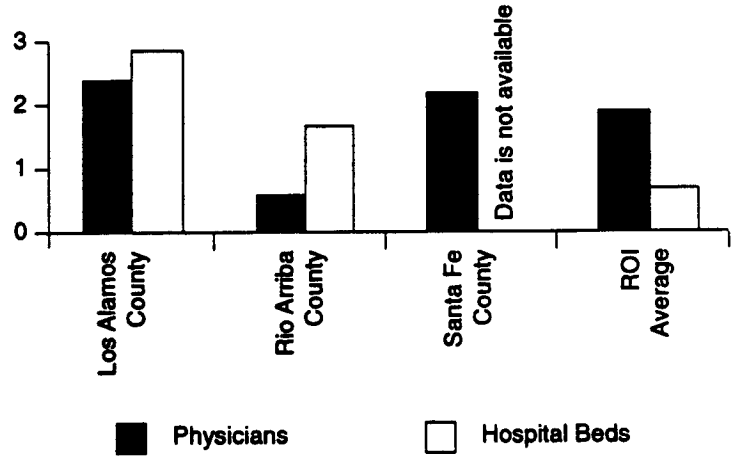
Figure 3.9.8–3. School District Characteristics for the Los Alamos National Laboratory Region of Influence.

Number of Sworn Police Officers (1994) and Firefighters (1995) per 1,000 Persons in the LANL ROI[a]



Note: Except for ROI cities, city sworn police officers and firefighters are included in the county totals.

Number of Physicians and Hospital Beds per 1,000 Persons in the LANL ROI, 1994[b]



[a] Census 1993m; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.9.8–4. Public Safety and Health Care Characteristics for the Los Alamos National Laboratory Region of Influence.

1,000 persons, as indicated in Figure 3.9.8–4. Rio Arriba County employed the greatest number of firefighters (276). The average firefighter-to-population ratio in the ROI was 4.7 firefighters per 1,000 persons.

Health Care. There were four hospitals serving the three-county ROI in 1994. Figure 3.9.8–4 displays the hospital bed-to-population ratios for the LANL ROI counties. During 1994, all hospitals were operating at below capacity, with hospital occupancy rates ranging from 28.3 percent in Los Alamos County to 31.1 percent in Rio Arriba County.

In 1994, a total of 311 physicians served the ROI, with the majority (244) located in Santa Fe County. Figure 3.9.8–4 shows that the physician-to-population ratio for the ROI ranged from 0.6 per 1,000 persons in Rio Arriba County to 2.4 per 1,000 persons in Los Alamos County. The ROI average physician-to-population ratio was 1.9 physicians per 1,000 persons.

Local Transportation. Regional transportation routes provide access to LANL (see Figure 2.2.8–1 and Figure 2.2.8–2 for maps of regional and local roads near LANL). Interstate 25 provides access to Denver, CO, to the north and Albuquerque, NM, to the south. Interstate 40 and Interstate 25 intersect at Albuquerque, NM. Interstate 40 provides access to Amarillo, TX, to the east and Flagstaff, AZ, to the west. U.S. 285 meets Interstate 25 at Santa Fe. U.S. 285 is to the east of LANL.

Vehicular access to LANL is provided by New Mexico Route 502 to the east and New Mexico Route 4 to the west. New Mexico Route 502 intersects U.S. 285 at Pojoaque, New Mexico. New Mexico Route 4 intersects New Mexico Route 44 at San Ysidro.

There are no current or planned (within 1 to 2 years) road improvement projects that would affect access to LANL (NM DOT 1995a:1). There is no public bus service at LANL. There is a non-profit bus service between White Rock, LANL, and Los Alamos (LA DOE 1995a:1.)

The only major railroad in the ROI is the Burlington Northern and Santa Fe. A spur of this railroad extends to Santa Fe, NM, from the south. There are no navigable waterways within the ROI that are capable of accommodating waterborne transportation of material shipments to LANL. The Albuquerque International Airport provides passenger and cargo service in the ROI on national and international carriers (DOT 1992a:7-214–7-217). There are other smaller airports in the ROI.

3.9.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of LANL are shown in Table 3.9.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to LANL operations.

Table 3.9.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Los Alamos National Laboratory Operation

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic radiation	48
External terrestrial radiation	44
Neutron cosmic radiation	10
Internal terrestrial radiation	40
Radon in homes (inhaled)	200
Other Background Radiation[a,b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	**407**

[a] LANL 1995s.
[b] NCRP 1987a.
Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from LANL operations provide another source of radiation exposure to individuals in the vicinity of LANL. Types and quantities of radionuclides released from LANL operations in 1993 are listed in *Environmental Surveillance at Los Alamos During 1993* (LA-12973-ENV). The doses to the public resulting from these releases are presented in Table 3.9.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The doses given in the 1993 report were assumed to be representative of the reference environment (No Action) doses from LANL operations in the year 2005 (Section 4.2.8.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases and resulting impacts from LANL operations in 1993 is estimated to be 3.3×10^{-6}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of LANL operations is about 3 in 1 million. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Based on the same risk estimator, 1.5×10^{-3} excess fatal cancers are projected in the population living within 80 km (50 mi) of LANL from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national mortality rate, the number of fatal cancers from all causes expected during 1993 in the population living within 80 km (50 mi)

Table 3.9.9–2. Radiation Doses to the Public From Normal Los Alamos National Laboratory Operation in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual[b]	Standard[a]	Actual
Maximally exposed individual (mrem)	10	5.7	4	0.8	100	6.5
Population within 80 km[c] (person-rem)	None	3.0	None	~0[d]	100	3.0
Average individual within 80 km[e] (mrem)	None	0.014	None	~0[d]	None	0.014

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] The actual dose values given in this column conservatively include all water pathways, not just the drinking water pathway.

[c] In 1993, this population was approximately 219,000.

[d] Although the maximally exposed individual receives a dose, no population groups are exposed to any liquid pathways.

[e] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: LANL 1995s.

of LANL was 438. This number of expected fatal cancers is much higher than the estimated 1.5×10^{-3} fatal cancers that could result from LANL operations in 1993.

The LANL workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.9.9–3 presents the average worker, maximally exposed worker, and cumulative worker dose to LANL workers from operations in 1992. Except for the dose to one worker, these doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to LANL workers from normal operations in 1992 is estimated to be 0.077.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Environmental Surveillance at Los Alamos During 1993* (LA-12973-ENV). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in this reference.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which can be ingested; and other environmental media with which people may come in contact (for example, soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in previous sections of this PEIS, particularly Sections 3.9.3 on air quality and 3.9.4 on water resources.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements) contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operation at LANL via inhalation of air containing hazardous chemicals released to the atmosphere from LANL operations. Risks to the public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Table 3.9.9–3. Radiation Doses to Workers From Normal Los Alamos National Laboratory Operation in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	34
Maximally exposed worker (mrem)	5,000	~7,000[b]
Total workers[c] (person-rem)	ALARA	194

[a] DOE's goal is to maintain radiological exposures as low as reasonably achievable.

[b] Only one worker exceeded the worker dose standard.

[c] The number of badged workers in 1992 was approximately 5,700.

Source: 10 CFR 835, DOE 1993n:7.

Baseline air emission concentrations for hazardous air pollutants and their applicable standards are presented in Section 3.9.3. These concentrations are estimates of the highest existing offsite concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations. Information about estimating health impacts is presented in Section M.3.

Exposure pathways to LANL workers during normal operation may include inhaling the workplace atmosphere, drinking LANL potable water and possible other contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. LANL workers are also protected by adherence to OSHA and EPA occupational standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Health Effects Studies. Recent epidemiological studies have been conducted in the communities surrounding LANL. Epidemiologic mortality and incidence studies assessing health effects in these communities have reported statistically significant elevated risks of melanoma, bladder cancers, and leukemia. Elevated risks of prostate, stomach, colon, rectum, lung, thyroid, and pancreatic cancers have also been reported in the total population, and elevated risks of breast and ovarian cancer incidence have been reported in females.

No statistically significant excess cancer was reported for male workers exposed to Pu. However, statistically significant excesses in kidney cancer and lymphomatic leukemia were observed in male workers exposed to external radiation (HP 1994a:577-588). An excess of death from suicides was reported among female radiation workers (LA Wiggs 1987a). More detailed descriptions of the studies reviewed and the findings are found in Section M.4.9.

Accident History. A review of recent LANL annual environmental and accident reports indicates that there have been no significant impacts to workers, the public, or the environment. This review was performed to provide an indication of the site's accident history. During the review period, from 1986 to 1990, site operations were much higher than in previous years and also higher than what is anticipated in the future.

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response. The LANL Emergency Preparedness Plan is designed to minimize or mitigate the impact of any emergency upon the health and safety of employees and the public.

3.9.10 WASTE MANAGEMENT

This section outlines the major environmental regulatory structure and waste management activities for LANL. Table 3.9.10–1 presents a summary of waste management activities at LANL for 1993.

The Department is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations of LANL. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in permits and negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed upon milestones.

The LANL is not listed on the NPL. As a function of obtaining a RCRA permit, however, the *Hazardous and Solid Waste Amendments* of 1984 mandate that permits for treatment, storage, and disposal facilities include provisions for corrective action to mitigate releases from solid and hazardous waste facilities in operation and to clean up contamination in areas designated as solid waste management units at LANL. By the end of 1995, over 60 of the approximately 2,100 potential release sites identified had been remediated, no further action was proposed for 575 sites, and 1,100 sites were slated for investigation or cleanup; for the remaining sites, action is still pending. All cleanup activities are expected to be completed by 2010 (LANL 1996e:1).

Through its research activities, LANL manages a small quantity of spent nuclear fuel and the following waste categories: TRU, low-level, mixed, hazardous, and nonhazardous wastes. Because there is no spent nuclear fuel or HLW associated with Pu storage at LANL, there is no discussion in this PEIS of spent nuclear fuel or HLW generation and management at LANL. A discussion of the waste management activities associated with each of these waste categories follows.

Spent Nuclear Fuel. Because there is no spent nuclear fuel associated with Pu storage at LANL, there is no discussion in this PEIS of spent nuclear fuel generation and management at LANL.

High Level Waste. Because there is no HLW associated with Pu storage at LANL, there is no discussion in this PEIS of HLW generation and management at LANL.

Transuranic Waste. The Plutonium Facility (TA-55) is the principal generator of liquid TRU wastes at LANL. Process acidic and caustic wastewaters, evaporator distillates from the nitrate recovery area, cooling water from gloveboxes, and wet vacuum seal water are the principal sources. Sludges that remain after treatment through filtration and residual evaporator bottoms are loaded into 208-l (55-gal) drums, solidified, and transported to Area G for storage. The liquid wastes remaining after filtration are transferred from TA-55 to the Radioactive Liquid Waste Treatment Facility (TA-50) by gravity drain in double-wall pipelines. After treatment at TA-50 through sedimentation, clarification, and flocculation, the residual radioactive sludge is loaded into drums, solidified, and transported to Area G for storage. Most of LANL's TRU waste is currently stored on asphalt pads. TRU wastes are currently being stored, until they can be shipped to WIPP if that facility can demonstrate compliance with the requirements of 40 CFR 191 and 40 CFR 268. Shipment of waste to WIPP also depends on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste. Should additional treatment be necessary for disposal at WIPP, LANL would develop the appropriate treatment to meet the WIPP WAC and package the wastes in accordance with DOE, NRC, and DOT requirements for transport to WIPP for disposal. LANL is presently upgrading TRU storage facilities to comply with RCRA requirements under the terms of a consent order with the State of New Mexico.

The LANL generates mixed TRU wastes. Newly generated mixed TRU wastes are identified, characterized, and stored in compliance with RCRA. The *Federal Facility Compliance Act* of 1992 requires DOE to provide specific information to EPA and the State of New Mexico on LANL's mixed TRU waste streams, treatment

Table 3.9.10–1. Waste Management Activities at Los Alamos National Laboratory

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Transuranic							
Liquid	0.1	Pretreatment at TA-50: neutralization, clariflocculation, filtration, precipitate, cement mixing	48,800	NA	NA	NA	NA
Solid	54	Volume reduction	1,080	Storage pads at TA-54, modified LLW burial pits and shafts	24,355	None: Federal repository in the future	None
Mixed Transuranic							
Liquid	None	See TRU	Included in TRU	NA	NA	NA	NA
Solid	255	See TRU	Included in TRU	NA	Included in TRU	See TRU	None
Low-Level							
Liquid	21,400	Chemical treatment and ion-exchange, solidification; and volume reduction (vial crusher)	45 m^3/hour	Chemical and Ion-Exchange Plant at TA-50 and the Chemical Plant at TA-21	663	Treated effluent is discharged to the environment. Residual sludge is solidified and disposed of at TA-54, Area G, as solid LLW	None
Solid	2,690	Compaction	76	TA-54 in Area G	Variable	Currently solid LLW goes to TA-54, Area G for burial. Continued construction at Area G under evaluation in site wide EIS	Estimated available capacity is 25,000 m^3
Mixed Low-Level							
Liquid	0	Neutralization, precipitation, oxidation, thermal treatment; solidification;volume reduction; liquid scintillation cocktail vials	Capabilities under development per site treatment plan	RCRA-permitted Bldgs. (not built yet) and interim status container storage areas	583	NA	None

Table 3.9.10–1. Waste Management Activities at Los Alamos National Laboratory—Continued

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Mixed Low-Level (continued)							
Solid	45	None	Capabilities under development per site treatment plan	RCRA-permitted Bldgs. (not built yet) and interim status container storage areas	583	Capabilities under development as per Site Treatment Plan for Mixed Wastes	None
Hazardous							
Liquid	273	Thermal treatment, treatment tanks, neutralization, precipitation, and evaporation	Varies depending on the waste stream	Thermal treatment TAs-14, -15, -16, -36, and -39 and storage and treatment TA-54, Area L	1,864	Offsite	NA
Solid	669[a]	Thermal treatment and flashpad	Varies depending on the waste stream	See above	See above	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	692,857	Filtration, settling, and stripping	1,060,063	NA	NA	Permitted discharge sanitary tile fields	2,271 m^3/day
Solid	5,453[b]	None	None	NA	NA	Offsite county landfill and onsite landfill Area J	NA
Nonhazardous (Other)							
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	NA	NA	Included in sanitary	Included in sanitary
Solid	Included in sanitary	None	None	NA	NA	Included in sanitary	NA

[a] Includes 84 t RCRA-regulated, 460 t State-regulated, and 124 t of TSCA-regulated solid hazardous wastes. Density of 1,500 kg/m^3 was used to convert to volume units.

[b] Density of 1,500 kg/m^3 was used to convert 8,180 t to cubic meters.

Note: NA=not applicable.

Source: LANL 1990a; LANL 1994b.

facilities, and technology development activities. This waste category covers a broad range of physical matrix categories for LANL. The Federal Facility Compliance Order for the Site Treatment Plan requires treatment of all mixed TRU waste not in compliance with LDR. This order is the implementation of the *Federal Facility Compliance Act* at LANL. The WIPP WAC specifies limiting parameters for waste containers, waste form, waste packaging, accompanying data, and miscellaneous requirements for packaging and RCRA. It is anticipated that some technology required for additional treatment of TRU wastes to attain additional treatment standards can be adapted from the technologies that must be brought online for mixed LLW. If DOE is successful in obtaining a no-migration petition for the disposal of mixed TRU wastes at WIPP, adherence with treatment standards under the land disposal restrictions would not be required.

Low-Level Waste. Both liquid and solid LLW are generated and managed by LANL. Liquid LLW is generated from many areas throughout LANL. There are two onsite wastewater treatment facilities used for treatment of aqueous LLW, one of which uses ion-exchange technology. As part of a new radioactive liquid waste treatment facility project, a facility for the solidification and subsequent volume reduction of the radioactive liquid waste treatment plant sludge containing Pu, americium, and other radionuclides is proposed, but not funded at LANL.

Solid LLW is generated from many areas throughout LANL. Solid LLW such as paper, plastic, glassware, and rags are separated into compactible and noncompactible materials by the waste generators. Compactible bales are banded, wrapped and sealed in plastic, and moved to Area G for disposal in landfill pits, located at TA-54 (Figure 2.2.8–2). LLW noncompactible items, such as large equipment and much of the D&D wastes, generally are not packaged but delivered to the burial site in covered or enclosed vehicles. Continued construction at Area G is dependent on decisions made in conjunction with the sitewide EIS being prepared by LANL.

Mixed Low-Level Waste. Mixed LLW includes solvents, pyrophoric substances, spray cans, scintillation vials, uranium-contaminated lithium hydride, miscellaneous reagent chemicals, vacuum pump oil contaminated with mercury, gas cylinders, and other contaminated material. It is stored at TA-54 Areas L and G. Currently, LANL does not dispose of mixed LLW. In accordance with the *Federal Facility Compliance Act*, LANL has developed a site treatment plan which covers management of all mixed waste at LANL. The State of New Mexico Environment Department issued a compliance order in the Site Treatment Plan for Mixed Waste in October 1995. The compliance order addresses land disposal restricted mixed waste. For mixed waste with identified treatment technologies, the plan provides a schedule for submitting permit applications, entering into contracts, initiating construction, conducting systems testing, starting operations, and processing mixed wastes. For mixed waste without an identified treatment technology, the plan includes a schedule for identifying and developing technologies, identifying the funding requirements for R&D, submitting treatability study notifications, and submitting R&D permit applications.

Mixed waste treatment skids are being designed to treat onsite hazardous and mixed waste streams that are not amenable to offsite treatment. Examples of the waste streams potentially amenable to skid treatment are reactive metals, plating wastes, acids, bases, ignitable liquids, spent solvents, and decontamination debris. Not all of the technologies to be included have been chosen. The mixed waste treatment skids would be housed in an existing LANL structure. An environmental restoration high-energy plasma technology is being tested as a technique for total destruction of mixed LLW that has been treated to land disposal restrictions standards. This technique will allow LANL to stay in compliance with the *Federal Facility Compliance Act*

Hazardous Waste. The LANL received a permit for treatment, storage, and disposal of hazardous waste under RCRA in November 1989, and for the *Hazardous and Solid Waste Amendments* of 1984 provisions from EPA on March 8, 1990. All hazardous waste treatment and storage facilities at LANL are either fully permitted or are operating under interim status, while other waste management facilities are being developed.

The LANL produces a wide variety of hazardous wastes. Small volumes of almost all wastes listed under 40 CFR 261 are generated as a result of a wide variety of ongoing research. HE waste is generated during the

processing and testing of various HE materials. All HE hazardous waste and potentially contaminated HE waste is picked up from the generating facility and treated by open detonation, open burning, or incineration at TAs -14, -15, -16, -36, and -39. Ash residue is then treated and, when its hazardous characteristic can be removed and it is determined that this residue does not contain radioactive constituents, it is disposed of onsite in the landfill, TA-54, Area J. The HE wastewater is treated by gravity settlement in a sump and discharged from NPDES-permitted outfalls. LANL is developing an HE wastewater treatment facility that will collect and treat these wastewaters with stepped filtration.

The LANL does not landfill RCRA-hazardous waste onsite, but contracts with certified transporters to deliver hazardous waste to commercial offsite RCRA-permitted treatment, storage, and disposal facilities. Before waste is sent offsite, the potential treatment or disposal facility is inspected by LANL personnel. Operating records and permits are also reviewed. LANL has an EPA Letter of Authorization allowing disposal of solid PCB-contaminated articles at the TA-54, Area G landfill. Other PCB waste and liquid PCB-contaminated articles are sent offsite to TSCA-regulated disposal facilities. Asbestos mixed waste is buried at TA-54, Area G. Asbestos waste is shipped offsite to an approved disposal site in accordance with TSCA and NESHAP regulations. Infectious wastes are managed according to State of New Mexico regulations.

Nonhazardous Waste. Solid sanitary wastes are generated routinely and include general facility refuse such as paper, cardboard, glass, wood, plastics, scrap, metal containers, dirt, and rubble. Solid sanitary wastes are segregated and recycled whenever possible. Trash is accumulated onsite in dumpsters, which are emptied on a regular basis by a commercial waste disposal firm and taken to the county sanitary landfill. The Los Alamos County landfill is located on property owned by DOE and is operated under a special-use permit. Approximately one-third of the solid sanitary waste disposed of at the county landfill originates from LANL. The Area J special waste landfill, which is operated by and is under the administrative control of LANL, receives only administratively controlled solid sanitary waste. Solid sanitary waste will be managed and disposed of at LANL until 2007, the year the existing sanitary landfill is expected to reach the end of its useful life. At that time, either a new landfill will have to be constructed or provisions made for offsite disposal.

A new sanitary wastewater treatment plant and collection system to replace 7 existing wastewater treatment facilities and 30 existing septic tanks has been completed. The new treatment plant will enable reuse of the treated wastewater for nondrinking water uses such as cooling and irrigation. The plant and collection system is designed to meet the requirements of LANL's existing Federal Facility Compliance Agreement and is expected to meet all of LANL's needs for the next 20 years.

3.10 DEEP BOREHOLE COMPLEX SITE (GENERIC)

Deep borehole-like waste storage facilities currently do not exist in the United States, and no actual sites for drilling a deep borehole have been proposed. Therefore, the approach to describing the environmental setting for the deep borehole is to provide a range of existing or probable environmental conditions. These conditions, to the extent possible, are determined from existing information about typical locations at either end of the range of conditions. It is assumed that these conditions, at either end of the range adequately represent the actual range of conditions. In developing a generic environmental baseline for the deep borehole site, a set of assumptions was used to help define where such a facility could be developed. The major assumptions were the following: (1) the site would be located within the contiguous United States in geologically stable Precambrian crystalline rocks; (2) the site would be located distant from international borders and any population centers; (3) the site would have reasonable access to water supplies, electrical power, and ground transportation; and (4) the site would be located so that surface waters could be sufficiently protected from construction activities and facility operations.

The optimum geographic location for a deep borehole site is an area far removed from major drainage, lakes, oceans, and areas of low population density. The topographic relief is minimal in order to provide a low differential head in groundwater. The area in the immediate vicinity of the deep borehole site is large enough to accommodate several drill sites, as previously described in Section 2.4.3, while avoiding steep surface water drainage gradients that would allow rapid distribution of contaminants in case of an accident.

The long-term performance of the deep borehole system depends primarily on the geologic system. Therefore, the most important factor that must be considered in the selection of an optimum borehole site is hydrologic isolation from the biosphere for geologic times. To achieve this degree of hydrologic isolation, the host rock must have very low matrix permeability. In addition, the locality should be in an area of low seismicity to indicate stable geology, where a possible return of glacial or pluvial climate will not cause a significant change in surface water or groundwater systems, and where there is no danger of exhumation by erosion.

An example of the low or completely undeveloped end of the range of existing conditions could be forests, grazing lands, agricultural areas, or federally owned land with almost no permanent facilities. Given the proper geologic and hydrologic conditions, and access to the transportation infrastructure, these types of areas could represent the undeveloped site in the range of environmental settings. Other locations that could be selected for a borehole site could be located in more developed areas. At the developed end of the range of environmental settings, a deep borehole site could resemble any one of the DOE sites previously described.

Should this alternative be selected, a siting study would be conducted, in addition to identifying site-specific environmental conditions and impacts in a tiered NEPA document.

3.10.1 LAND RESOURCES

The approach to defining the environmental setting for land resources is not site-specific. Consequently, a range of land-use and visual resources conditions that could exist at potential deep borehole complex site locations has been provided (see Table 3.10.1–1).

Table 3.10.1–1. Land Resources Attributes of the Generic Deep Borehole Complex Site

Land Use Attributes	
Land Area	2,000 - 20,000 ha
Land Ownership	Public or private
Existing Land Use	
Onsite	Undeveloped agricultural or industrial
Offsite	Undeveloped and/or agricultural
Land Use Compatibility	Likely
Plans, Policies, and Controls	
Jurisdiction	Federal, State, local
Enforcement	Lax to stringent
Conformance	Site-dependent
Visual Resource Attributes	
Landscape Character	
Site	Gentle relief
Viewshed	Undeveloped to agricultural
Visual Resource	
Sensitivity Level	Low to medium to high
Distance zones	Foreground, middleground, background, and seldom-seen
BLM VRM class	3 to 5
Degree of contrast	Weak to moderate

Source: LLNL 1996a.

Land Use. The potential site would require at least 2,000 ha (5,000 acres) of land area to accommodate the facility and buffer zone. The potential site could be located on public or private lands ranging up to 20,000 ha (49,420 acres). If the borehole site were located on privately-owned land, it would likely require the low to middle range of land area. If the site were located on publicly owned land (Federal, State, or local), the borehole could be part of a much larger site and could require the upper range of this land area. The range of site existing land uses would likely be undeveloped, agricultural, or industrial. Therefore, a change in site land use could occur. It is likely that land uses within the immediate vicinity of the site would range from undeveloped to agricultural (for example, cropland and grazing land) use. Due to the 1.6-km (1-mi) buffer zone surrounding the facility, it is likely that incompatibility, if any, with adjacent offsite land use would be minimized. Depending upon location, use, ownership, or management, the site could be subject to a variety of land-use plans, policies, and controls at the Federal, State, or local level. The existence and the stringency of these land-use plans, policies, and controls vary by jurisdiction. Regulations governing the type, density, and location of development are traditionally applied at the municipal (local) level through the comprehensive plan and its implementing mechanism, the zoning ordinance. Development of a privately owned site could require a change in the existing zoning classification. Development of a publicly owned site would likely conform to existing site development plans. If adjacent lands or lands that could be impacted by site development are designated as special status lands (for example, prime farmland, wild and scenic river, or wilderness study area), site development could be subject to additional controls.

Visual Resources. The complex would likely be constructed on a very small portion of the total site area. The immediate viewshed would likely range from undeveloped (for example, meadow and forest land) to agricultural lands. As discussed in Section 3.1.1, a visual resource inventory is comprised of three factors: scenic quality, distance zones, and sensitivity levels. Area sensitivity levels could range from low to high. Potential high visual sensitivity areas that could be impacted by the facilities include nearby public roadways, residential areas, and recreational/scenic areas with high user volumes. However, nearby public roadways predominately used by site workers could have a lower sensitivity level, while sensitivity levels would likely range from medium to high if nearby roads are traveled by the general public. The full range of distance zones could occur. Due to the mandatory 1.6-km (1-mi) buffer zone, it is probable that views of the facilities would predominately fall into the middleground zone. Therefore, it is likely that the degree of contrast would range from weak to moderate and that the overall visual character of the site would be consistent with a BLM VRM classification ranging from Class 3 to Class 5.

3.10.2 SITE INFRASTRUCTURE

Baseline Characteristics. The generic deep borehole site could have the baseline site infrastructure characteristics within the ranges shown in Table 3.10.2–1.

Table 3.10.2–1. Generic Deep Borehole Complex Site Baseline Characteristics

Characteristics	Site Availability
Transportation	
Roads (km)	0 to 60
Railroads (km)	0 to 20
Electrical	
Energy consumption (MWh/yr)	6,500 to 12,000
Peak load (MWe)	2 to 1,000
Fuel	
Natural gas (m^3/yr)	0 to 5,000,000
Oil (million l/yr)	0 to 100
Coal (t/yr)	0 to 200,000
Steam (kg/hr)	0 to 150,000

Source: HF DOE 1990e; INEL 1993a:5; NTS 1993a:4; OR LMES 1996i; PX 1995a:1; PX DOE 1995d; PX DOE 1996b; SRS 1993a:3.

The generic deep borehole site would be expected to be mostly open vacant land with a few widely scattered facilities. Any existing facilities would not likely be useful for the functions required in the deep borehole complex, but could possibly coexist with the developed borehole site.

The transportation infrastructure could be nonexistent on the site or could be well developed. However, the site would have reasonable access to transportation nodes with some new construction of access roads and railroad lines. There would be no surface water transportation in the vicinity.

Electricity, telecommunications, and other utilities may be available to the generic deep borehole site before development of the site. These utilities could be connected to the site or generated at the site, depending on the offsite availability. It is expected that the nearest electric utility company would be able to provide the modest borehole electricity requirements with little effect on the utility or sub-regional power pool. Typical ranges of capabilities of sub-regional power pools are shown in Table 3.10.2–2.

Natural gas, diesel, liquid propane fuel, and coal would be available from local utilities or suppliers either by pipelines or surface transportation to the borehole site.

Table 3.10.2–2. Generic Deep Borehole Complex Site Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	14 to 59%
Nuclear	0 to 39%
Hydro/geothermal	2 to 46%
Oil/gas	<1 to 32%
Other[b]	0 to 30%
Total Annual Production	107,607,000 to 272,155,000 MWh
Total Annual Load	104,621,000 to 293,262,000 MWh
Energy Exported Annually[c]	-45,400,000 to 6,359,000 MWh
Generating Capacity	24,870 to 61,932 MWe
Peak Demand	20,578 to 57,028 MWe
Capacity Margin[d]	4,064 to 13,655 MWe

[a] Percentages do not total 100 percent due to rounding.

[b] Includes power from both utility and nonutility sources.

[c] Energy exported is not the difference of production and load due to pumped storage.

[d] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

3.10.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The meteorological and climatological conditions for the generic deep borehole site include the range of extremes in ambient temperature, windspeed and direction, and precipitation exhibited over the United States. A generic deep borehole site could exhibit a wide diversity of climatology. Therefore, no further description of meteorology and climatology has been provided with respect to a generic deep borehole site.

Ambient Air Quality. Ambient air quality conditions for the generic deep borehole site include a wide range of pollutants and conditions. Some areas do not yet meet the ambient standards for certain pollutants. Areas with air quality better than the NAAQS are designated as being in attainment; areas with worse air quality are designated as nonattainment areas. Nonattainment areas could be less desirable for a deep borehole site since more restrictive requirements would apply for pollutants for which the area is nonattaining.

Noise. Specific existing noise sources and characteristics of a generic deep borehole site cannot be described. However, it is expected that such a site would be essentially rural in character and would have typically low background sound levels. Typical DNL in the range 35 to 50 dBA (EPA 1974a:B-4) can be expected for such a rural location where noise sources may include wind, insect activity, aircraft, and agricultural activity. An area that is essentially uninhabited can be expected to have lower sound levels, with the major sources of noise possibly including an occasional airplane and natural physical phenomena such as wind, rain, and wildlife activities.

3.10.4 WATER RESOURCES

Surface Water. Availability of water is location-specific and depends on the hydrology and constraints of the local area. The availability of water supplies can be characterized by precipitation. In areas where rainfall is abundant and population is dense, water supply is commonly obtained from local surface water reservoirs and shallow wells. In arid climates, water supply is commonly obtained from deep wells and manmade lakes created by damming major rivers. In humid climates, water supply is generally derived from surface water taken from major waterways. Local constraints include seasonal fluctuations in precipitation, with drought being an extreme example; consumption by other facilities using the same water supply; and State regulations, such as water appropriation permit requirements.

Water required for construction and operation activities may not be available to the generic deep borehole site before development of the site, depending on the site location. Water could be generated or delivered to the deep borehole site, either by pipelines or surface transportation, depending on the availability from offsite suppliers.

Surface water drainage areas could range in size from 0 to 3,200 km^2 (0 to 1,235 mi^2). Surface water resources discharge rates could range from 0 to 3,360 m^3/s (0 to 118,642 ft^3/s). Surface water reservoir storage capacity could range from 0 to 49 trillion l (0 to 13 trillion gal).

Site drainage of the generic deep borehole site must comply with the regulations of the local governing agency. The minimum design level for the Storm Water Management System is the 25-year, 6-hour storm, but potential effects of larger storms up to the 100-year, 6-hour storm would also be considered for site evaluation.

In the vicinity of the generic deep borehole site, surface water classifications could range from none (no surface water near the site) to fresh water suitable for fishing, swimming, and other primary and secondary contact recreation, and also as an existing or potential source of potable water.

The deep borehole site would be located in an area above the critical flood elevation (as determined from maps and site studies) of the potential flood source (river, dam, levee, precipitation). The deep borehole site surface facilities would be located in an area where the lowest floor of the structure, including subsurface floors, would be above the level of the 500-year floodplains. All facilities, including their basements, would be sited in an area above the 100-year floodplain.

Surface Water Quality. The quality of surface water across the nation is very diverse, affected by both natural processes and human activities. The natural quality of surface water is determined largely by the quality of its primary groundwater source, which is affected by the types of rocks through which the water moves and by various chemical processes. Absorption of atmospheric gases and assimilation of runoff and direct discharges further account for water quality differences throughout various potential generic deep borehole sites.

The range of surface water quality conditions that would be found at a generic deep borehole site is presented in Table 3.10.4–1. The amount of dissolved minerals in water (measured as dissolved solids) is a general indicator of overall inorganic water quality and, as shown in the table, could range from 10 to 174 mg/l (10 to 174 ppm). Iron and manganese could exceed water quality criteria. Nitrogen and phosphorus, which are major nutrients, contribute to the eutrophication of streams and lakes. Eutrophic waters are rich in nutrients that cause excessive growth of aquatic plants (for example, algae). Several forms of nitrogen are found in natural waters. Most common are the nitrate, nitrite, and ammonia ions. As shown in Table 3.10.4–1, nitrogen concentrations could range from 0 to approximately 2 mg/l (0 to 2 ppm), and phosphorus concentrations could range from 0 to 0.29 mg/l (0 to 0.29 ppm). The upper limits are more common in areas where there is considerable farming and soils are more likely to erode.

Table 3.10.4–1. Summary of Typical Surface Water Quality at the Generic Deep Borehole Complex Site

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Water Body Concentration	
			High	Low
Alkalinity	mg/l	NA	140	0
Alpha (gross)	pCi/l	15[b]	1.3	<0.4
Ammonia	mg/l	NA	0.25	0
Beta (gross)	pCi/l	50[c]	4.5	0.5
Calcium	mg/l	NA	9.9	0.8
Chloride	mg/l	250[d]	3.54	0.2
Chromium	mg/l	0.1[b]	0.04	0
Conductivity	µmhos/cm	NA	340	30
Dissolved oxygen	mg/l	>5.0[e]	14	6
Iron	mg/l	0.3[d]	1.5	0.02
Lead	mg/l	0.015[b]	0.013	0
Magnesium	mg/l	NA	9.3	0.5
Manganese	mg/l	0.05[d]	0.06	0
Nitrogen (as NO_2/NO_3)	mg/l	NA	2.13	0
pH	pH units	6.5-8.5[d]	8.5	6.3
Phosphorus	mg/l	NA	0.29	0
Sodium	mg/l	NA	20	0.7
Strontium-90	pCi/l	400[f]	0.33	0.01
Suspended solids	mg/l	NA	67	1
Temperature	°C	NA	35	0
Total dissolved solids	mg/l	500[d]	174	10
Uranium, Total	mg/l	0.02[c]	0.00019	0.00017
Zinc	mg/l	5.0[d]	0.6	0

[a] For comparison only.

[b] National Primary Drinking Water Regulations (40 CFR 141).

[c] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[d] National Secondary Drinking Water Regulations (40 CFR 143).

[e] Varies with pH and temperature.

[f] DOE DCG for water (DOE Order 5400.5). Values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. [Text deleted.]

Note: NA=not applicable; µmhos/cm=micromhos per centimeter.

Source: DOD 1993a.

Surface Water Rights and Permits. Surface water rights concerning the water body closest to the deep borehole site could range from not being an issue (because the site does not withdraw or discharge to a surface water body, or asserts its federally reserved water withdrawal rights), to impairment of designated uses.

Discharge of a pollutant to surface water requires a permit under the NPDES. NPDES permits include effluent limitations specifying the maximum concentrations of specific pollutants that may be present in discharge water.

Groundwater. Because of their characteristic remoteness, many government facilities use groundwater from onsite wells for their primary water supply. Groundwater could be used alone during construction and operations or could be mixed with either surface water or treated reclaimed wastewater.

The proposed deep borehole site could also be located in an area with undeveloped groundwater reserves, in underlying geologic strata, that are capable of providing an adequate supply of good quality water. Site-specific hydrogeologic data would be required to evaluate the groundwater availability.

The near-surface aquifer beneath the generic deep borehole site could occur under confined to unconfined conditions. Depth to groundwater could range from 1 to 200 m (3.3 to 656 ft). Recharge could occur primarily from rainfall and surface water seepage. Common ranges of hydraulic characteristics of aquifers are presented in Table 3.10.4–2.

Table 3.10.4–2. Common Ranges of Hydraulic Characteristics of Aquifers

Characteristic	Range of Conditions	
	Low	High
Transmissivity (l per day/m)	46	46,200,000
Hydraulic conductivity (l per day/m^3)	0.0008	7,500
Recharge rate (cm/yr)	0.0025	50.8
Well yield (l/minute)	38	75,700

Source: DOD 1993a.

Aquifer classification beneath the generic deep borehole site could range from a sole-source, federally protected, or EPA Class I aquifer (an aquifer which is required to supply 50 percent or more of the drinking water for that area and for which there are no reasonable available alternative sources should the aquifer become contaminated) to a Class III aquifer (an aquifer not considered a potential source of drinking water and of limited beneficial use because the salinity is greater than 10,000 mg/l (greater than 10,000 ppm) or the groundwater is otherwise contaminated beyond levels that can be removed using reasonable methods of public water supply treatment). Most aquifers found at government-operated facilities are Class II aquifers, which are current or potential sources of drinking water.

Groundwater Quality. Groundwater quality of the near-surface aquifer in the generic site area could range from good to poor. Groundwater that would occur at the emplacement zone depth would be brine. Characteristics of this water are high salinity (indicative of long-term isolation from the biosphere), low carbonate concentrations, slightly basic and reducing geochemistry, and low thermal gradient.

Groundwater Availability, Use, and Rights. Groundwater availability could range from not an issue (because the site does not withdraw groundwater) to critical groundwater overdraft and low surface water availability relative to demand. Critical is defined as more than 1,893 million l/day (500 million gal/day) of overdraft (VDL 1990a:725). Overdraft of groundwater occurs when water is withdrawn from sources that cannot be renewed or is withdrawn more quickly than it can be recharged.

Groundwater rights for a generic deep borehole site could range from absolute ownership rule to appropriation. Under the absolute ownership rule, the owners of land overlying a groundwater resource are allowed to withdraw unlimited water from their wells for whatever purpose they choose. Under the appropriation doctrine, all water is declared to be public and subject to appropriation on the basis of the "first in time, first in right" principle and control of the well use is usually accomplished by permits.

3.10.5 GEOLOGY AND SOILS

Geology. The deep borehole site could be located in a variety of geologic settings within the contiguous United States, provided the primary deep borehole site criterium, isolation from the biosphere, can be maintained for geologic times. Two key conditions for isolation from the biosphere would be geologic stability and the very low hydraulic efficiency of potential conduits (fractures, faults) to prevent pathways for transport of disposed materials to the surface.

Possible geologic terrains could range from interior basins to stable continental crust. Surficial material could range from desert sands to glacial tills. Coastal margins, volcanic zones, and seismically active zones are, by definition, unstable and would not represent optimal locations for the deep borehole site. The topography of the deep borehole site would range from flat to hilly; areas of high relief could result in large hydraulic head differences and deep circulation. Table 3.10.5–1 illustrates some of the principal advantages and disadvantages associated with the different types of candidate geologic media.

Soils. The deep borehole site may be located in areas where the predominant soil types range from clays to sands. These soils can range from poorly- to well-drained soils. Soil erosion from past land uses, if any, can range from slight to severe. The soil erosion potential can range from slight to severe in those areas with slopes greater than 25 percent and which have been eroded in the past. Wind erosion potential can range from low to high. The soils shrink-swell potential can range from low to severe.

Table 3.10.5–1. Attributes of Different Types of Geologic Media

Medium Type	Advantages	Disadvantages	Analysis
Plutonic/Metamorphic "Basement" Rocks (for example, granite)	Salinity increases with depth; fewer fractures at depth; mechanically strong, impermeable matrix; occurs in sufficiently thick sections; many locations with large areal extent.	Limited data on conditions at depth, may be structurally complex.	No disqualifiers, potential host rock.
Tuffs (consolidated volcanic ash)	High compressive strength; high sorptivity.	Columnar joints; fractures and cavities, water may induce geochemical changes; limited geologically old occurrences (fails tectonic stability test); vertical section discontinuous; may have insufficient depth.	Not suitable due to tectonic instability and vertical discontinuity.
Rock salt (evaporite)	Isolated from aquifers; low interstitial water content; self-healing fractures due to plasticity.	Interbedded rock layers in bedded salt could act as fluid conduits, brine pockets could migrate; drilling difficulties due to plasticity; holes may close before emplacement due to plastic flow; may not be thick enough; not as old as basement rock implying less stability; mobile salt (domes) are unstable.	Probably not suitable for borehole due to unfavorable mechanical properties.
Anhydrite (evaporite)	Chemically stable; little interstitial water; hydration induced swelling may reduce permeability.	Brittle and easily fractured; not self-healing; massive swelling during hydration causes fractures and borehole instability; may not be thick enough; not as old as basement rocks implying less stability; limited areal extent.	Probably not suitable due to unfavorable mechanical properties.
Sedimentary rocks (shales)	Low interstitial permeability; high sorptivity.	Flows plastically under high stresses, may lead to borehole instability; highly fractured; not as old as basement rocks implying less stability; vertically discontinuous; may have conductive interbeds.	Probably not suitable due to vertical discontinuity and vertical fractures.
Mafic lavas (flood basalts)	Low matrix permeability; high compressive strength.	Limited occurrences, may imply tectonic instability; vertically discontinuous; interbeds may be efficient transport routes.	Probably not suitable due to vertical discontinuity and implied tectonic instability.
Unconsolidated sediments (alluvium)	Moderate to high sorptive capacity; effective radionuclide barriers.	Geologically very young implying instability; high potential for erosion or continued tectonic movements; may not be thick enough; may be too conductive.	Unsuitable due to young age and implied tectonic instability.

Source: LLNL 1996i:1.

3.10.6 BIOLOGICAL RESOURCES

Terrestrial and Aquatic Resources

The description of terrestrial and aquatic resources has been divided into natural habitats and migratory birds. In each case, an overview of these resources is given for the area within which the generic deep borehole site may be sited.

Natural Habitats. The following description characterizes the principal vegetation types that could be found at a potential deep borehole site and is based on *Fundamentals of Ecology* and *The Study of Plant Communities: An Introduction to Plant Ecology* (Odum 1971a:377-403; Oosting 1956a:269-377). The principal vegetation types are defined by their climax vegetation (vegetation that develops following an extended time without major disturbance), a useful method of describing terrestrial resources, since vegetation types are comprised of similar groupings of flora and fauna. Although these vegetative types are a terrestrial resource classification system, the discussion of each addresses characteristic aquatic resources in the same geographical area.

Most areas have been subjected to substantial human disturbance over the past centuries, even though vegetation types are characterized by their climax vegetation. These areas now largely support successional vegetation, which can include grasses and forbs, shrubs and saplings, or forest cover comprising species other than those of the climax vegetation. Each vegetation type displays its own characteristic patterns of succession. Additionally, the boundary between any two is often a blend of characteristics from both types. The following principal vegetation types could be found at a generic deep borehole site.

Northern Coniferous Forest. Northern coniferous forest is common across much of Canada and Alaska, but within the type of area being considered for a deep borehole complex occurs only in the northern New England States. Climate is severe, with a short growing season and moderate precipitation. The principal evergreen species present in this forest include red spruce and balsam fir, which often form dense canopies under which little understory vegetation can grow. Paper birch, poplar, and aspen are common deciduous trees on disturbed sites. Animals found in northern coniferous forests within New England include moose, beaver, porcupine, boreal chickadee, red-breasted nuthatch, a variety of warblers, ring-necked snake, smooth green snake, green frog, and spotted salamander. Reptiles and amphibians are not as common in this vegetation type as in those that occur in more southerly latitudes. Aquatic habitat includes streams and lakes; bogs also commonly occur in the northern coniferous forest.

Hemlock-Hardwood Forest. Hemlock-hardwood forest is found in the northeastern and north-central part of the type of area under consideration for a deep borehole complex. This region is typified by long, cold winters and a short growing season. Although this is a northern forest type, it occurs at higher elevations along the Appalachian Mountains as far south as northern Georgia. Important tree species include hemlock, white pine, basswood, American elm, white ash, and red oak. Hemlock-hardwood forests support a diversity of animals, including red squirrel, snowshoe hare, ruffed grouse, pine siskin, and red crossbill. Reptiles and amphibians are not as numerous in this community type as in more temperate areas. The common garter snake, painted turtle, and chorus frog are found in hemlock-hardwood forests. Fast-moving streams occur within mountainous portions of this vegetation type, while lakes are common within those portions of the region that were glaciated.

Deciduous Forest. Deciduous forest occurs in most of the eastern third of the type of area under consideration for a deep borehole complex and is characterized by a moist, temperate, seasonal climate. The canopy of a deciduous forest is typically dominated by two or three species of trees. Common trees include oak, hickory, beech, and maple. A patchy to well-developed understory tree layer is found, and shrubs are common. The deciduous forest supports a variety of animal life, including the white-footed mouse, eastern gray squirrel, raccoon, gray fox, whitetail deer, black bear, wood thrush, ovenbird, downy woodpecker, worm-eating warbler, rat snake, eastern ribbon snake, American toad, and green frog. Streams and rivers are abundant in deciduous forest and include a number of major river systems, such as the Ohio.

Grassland. Grassland occurs in much of the central portion of the area under consideration. The climate is characterized by pronounced seasonality with respect to rainfall and temperature. Climax vegetation is characterized by grasses and other herbaceous plants, because there is insufficient rainfall to support forest communities. Because of the naturally fertile, nearly level soil, much of this vegetation type has been converted to farmland for producing grains and providing pasture for cattle. Fauna of grassland communities include the black-tailed prairie dog, thirteen-lined ground squirrel, horned lark, ring-necked pheasant, greater prairie chicken, prairie kingsnake, rat snake, western box turtle, chorus frog, and Great Plains toad. Playa lakes to the south and prairie pot holes to the north are important habitats for waterfowl and a number of other species of wildlife. Perennial and intermittent streams and small lakes characterize the aquatic resources of this vegetation type.

Desert. Desert occurs in much of the southwestern and western portion of the type of area under consideration for a deep borehole complex and is characterized by a scarcity of rainfall (less than 25 cm [9.8 in]) or rainfall that is very unevenly distributed. Vegetation is sparse and consists mainly of shrubs and rapidly growing annuals. During the short periods of rainfall, a large number of grasses and forbs briefly appear. Although the environment is harsh, the desert supports a variety of fauna, including the bighorn sheep, mule deer, black-tailed jackrabbit, mountain lion, coyote, javelina, golden eagle, greater roadrunner, Gambel's quail, desert tortoise, and various species of lizards and snakes. Aquatic resources are generally limited to intermittent streams and washes.

Rocky Mountain Forest. Rocky Mountain forest encompasses a number of vegetation types due to changes in environmental factors with altitude. This results in the zonation of plant communities, reflecting rapid altitude changes over short distances. A single mountainous area can feature four or five vegetation zones within a change of elevation of several thousand meters. The flora and fauna of each zone are often similar to those previously described (such as desert, grassland, deciduous forest, and northern coniferous forest). However, the zones are not always continuous nor are they always all present. Near the northern limits of this complex, the lower zones run out and the upper zones are found at relatively low altitudes. Southward, all zones are found at successively higher altitudes. Diverse freshwater aquatic habitats and species are associated with this vegetation complex.

Migratory Birds. Migratory birds include both waterfowl and the numerous other birds (for example, passerine species) that travel between breeding and wintering grounds. These species are dependent on the presence of adequate habitat along their migratory routes to provide both resting and feeding areas. The importance of these species has been recognized by the passage of the *Migratory Bird Treaty Act*. This act seeks to prevent the killing of migratory birds and the destruction of their eggs and nests.

Waterfowl. The four migratory waterfowl flyways (Pacific, Central, Mississippi, and Atlantic) represent some of the traditional routes for fall and spring migration of certain North American migratory waterfowl such as geese, swans, and cranes. While the Central and Mississippi flyways are entirely within the type of area being considered for a deep borehole complex, the Pacific and Atlantic flyways are only partially within the site area. To maintain migratory waterfowl populations, an adequate amount of open space, open water, and wetlands is necessary for foraging and refuge during migration. Wetlands also provide important breeding habitat for migratory waterfowl. Major breeding areas occur in the northern portion of the deep borehole site area. During the winter months, waterfowl migrate to the southern United States and Central America, where they congregate in wetland regions.

Other Migratory Birds. The flyways discussed above are a simplified method of describing migration paths used by certain types of waterfowl. Many other species of migratory birds follow different north-south routes across the type of area being considered for a deep borehole complex, often changing their migration paths from one year to the next. Typically, smaller birds such as rails, flycatchers, most sparrows, warblers, vireos, thrushes, and shorebirds migrate at night. Day migrants include large and small birds such as gulls, pelicans, hawks, swallows, nighthawks, and swifts (FWS 1979a:20,21,61).

Wetlands

Although wetlands occur across the entire type of area being considered for a deep borehole complex, they are most prevalent in the mid-Atlantic, southeast, south-central, and north-central portions of the site area. Major types of wetlands occurring in the site area include tidal salt marshes, freshwater marshes, northern peatlands, shrub swamps, and riparian forested wetlands. Wetlands serve important functions, including maintaining water quality, controlling floodwaters, stabilizing shorelines, and providing animal habitat and recreational uses such as hunting and fishing. Wetlands are also important in providing habitat for aquatic organisms and migratory birds, as well as for threatened and endangered plants and animals. Since it is difficult to protect surface waters and wetlands during construction drilling operations necessary for a deep borehole, wetlands typically would be avoided during selection of potential borehole drilling sites.

Threatened and Endangered Species

Threatened and endangered species could be present in each of the principal vegetation types discussed above. Over 750 threatened and endangered species occur in the United States (FWS 1995a:1-35). Endangered plants and animals often rely on sensitive environments such as wetlands for habitat. Critical habitats, geographical areas that are considered essential to the conservation of a species and that could require special management considerations or protection, can be designated and protected under the ESA. Protection of threatened and endangered species and their habitat is important for maintaining biodiversity, which is essential for full ecological functioning.

3.10.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric resources could be affected by the construction and operation of a deep borehole site. These resources may include objects, sites, or districts. Archaeological sites can include villages and campsites. Sites may yield artifacts such as stone tools and associated manufacturing debris and ceramic potsherds. Some sites may be eligible for inclusion on the NRHP.

Historic Resources. Historic resources that could be affected by construction and operation of a deep borehole site include subsurface remains of human occupation such as structural foundations of buildings, important paths or roads, and cemeteries. Some standing buildings such as commercial structures and residences may also be considered historic resources.

Native American Resources. Native American resources that could be affected by construction and operation of a deep borehole site may include sites, areas, and materials important to Native Americans for religious or heritage reasons. Sacred sites may include cemeteries, plant communities, mountains, paths, or geographical spaces that are socially identified and circumscribed. Some Native American groups could be affected and may need to be consulted if a specific site is chosen.

Paleontological Resources. Paleontological resources that could be affected by construction and operation may include fossil remains of extinct plants or animals, some rare. They can include poorly known fossil forms, well-preserved terrestrial vertebrates, unusual depositional contexts, assemblages that contain a variety of fossil forms, or deposits recovered from poorly studied regions or in unusual concentrations.

3.10.8 SOCIOECONOMICS

The generic deep borehole site could potentially affect the socioeconomic environment of an REA or an ROI. The characteristics of the REA, ROI, and communities are dependent upon geographic location. Employment and income in the economic area would be based upon industry interaction and linkages in the region. The anticipated residential distribution of project-related employees and their families would determine the ROI, and the ROI would contain all principal jurisdictions and school districts for community services likely to be affected by the proposed activity. Local transportation would consist of the existing principal road, air, and rail networks required to support the project activities.

Potential locations for a deep borehole have not been identified, so the affected environment cannot specifically be determined. The deep borehole complex would require a buffer zone of approximately 2,000 ha (4,900 acres). If the deep borehole complex were located in a largely uninhabited region, the majority of the workforce might choose to live in a more densely populated region and endure a longer commute to work. There is also the possibility of limited housing availability (and residential utilities), which could cause workers and their families to move to the more densely populated areas. It is also possible that the REA and the ROI could comprise uninhabited areas and small rural communities or contain different community types. The range of potential community types could be categorized as uninhabited regions, rural areas and small rural communities, and medium-size communities.

Uninhabited regions include unpopulated portions of the United States and Federal lands that have been set aside and are not developable. Economic activity in these regions is nonexistent. The primary issue is the availability and suitability of infrastructure and transportation networks to support the project activities.

Rural areas and small communities include areas or communities with populations of less than 50,000. These are small business centers that have a small workforce with little diversification of industries and employment. Public services, infrastructure, and transportation networks are generally limited, but capacities would vary with each location. These areas generally have small, specialized economies and relatively large basic sectors dependent on export activities.

Medium-size communities include areas with a city of at least 50,000 in population or an urbanized area of at least 50,000 with a total metropolitan population of 100,000. These communities usually operate as local or regional centers for economic activity. A local center usually has the largest community within a radius of approximately 80 km (50 mi); however, a larger regional or nationwide center is nearby for wholesaling, finance, and activities that do not involve the consumer directly. A regional center usually would be the largest community within a radius of 160 to 240 km (100 to 150 mi). The number of employment sectors is higher than in small communities, and economic relationships would exist between only a limited number of industries. Public services, transportation networks, and other infrastructures would tend to be more extensive than in smaller communities.

Communities of each category typically differ in terms of size and diversification. The vulnerability or susceptibility of a local community to changes in the economic base depends, in large part, on the strength of its economic base, as indicated by its number of employment sectors, its diversification of employment sectors, its pool of available labor, and its degree of inter-industry linkages. Inter-industry linkage is an economic relationship between two or more industries within the same market. A well developed network of mutually supporting diversified industries insulates a local economy from factors outside the region and contributes to a strong economic base. Communities with strong diversified economic bases are not affected by socioeconomic change as much as communities that have bases that rely on a single basic employment sector.

3.10.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of a generic deep borehole site are shown in Table 3.10.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose is expected to change as the population size changes. Background radiation doses are unrelated to any site operations that may exist at a potential deep borehole site.

Table 3.10.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Operation at the Generic Deep Borehole Complex Site

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic and cosmogenic radiation	27 to 39
External terrestrial radiation	28 to 59
Internal terrestrial radiation	39 to 40
Radon in homes (inhaled)[b]	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	359 to 403

[a] Based on annual reports for illustrative sites and EPA 1981b.
[b] NCRP 1987a.
Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from operations at generic deep borehole sites provide another source of radiation exposure to individuals in the vicinity of the sites. Types and quantities of radionuclides released from operations in 1993 at sites at developed locations that have current nuclear activities (refer to Sections 3.2.9 through 3.7.9), which could be typical of a generic deep borehole are listed in the 1993 annual environmental reports for those sites. The range of doses to the public resulting from these releases is presented in Table 3.10.9–2. The doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1993 reports were used in the development of the reference environments (No Action) radiological releases and resulting impacts in the year 2005 (Sections 4.3.3.1.9 and 4.3.3.2.2.9). For the generic deep borehole site that is not developed and has no current nuclear activities, there would be no radionuclide releases or doses in the past. For these sites, the No Action releases and doses in the year 2005 are assumed to be zero.

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from operations in 1993 at the generic deep borehole sites addressed in Sections 3.2.9 through 3.7.9 is estimated to range from 2.9×10^{-11} to 1.5×10^{-6}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of deep borehole site operations ranges from about 3 chances in 100 billion to less than 2 chances in 1 million. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Table 3.10.9–2. Radiation Doses to the Public From Normal Operation at the Generic Deep Borehole Complex Site in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	5.8×10^{-5} to 1.4	4	0 to 0.60[b]	100	5.8×10^{-5} to 3.0[c]
Population within 80 km[d] (person-rem)	None	1.4×10^{-4} to 26	None	0 to 2.0	100	1.4×10^{-4} to 28
Average individual within 80 km[e] (mrem)	None	5.0×10^{-7} to 0.030	None	0 to 0.0023	None	5.0×10^{-7} to 0.032

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order the 10 mrem/yr limit from airborne emission is required by the CAA, the 4 mrem/yr limit is required by the SWDA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268). If the potential total dose exceeds the value, it is required that the contractor operating the facility notify DOE.

[b] These doses are mainly from drinking water and eating fish.

[c] This total dose includes 1 mrem/yr from direct radiation exposure.

[d] In 1993, this population ranged from 21,750 to 880,000.

[e] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Note: Data from annual environmental reports for those illustrative sites discussed in Sections 3.2.9 through 3.7.9; all of these sites have nuclear activities. For potential sites having no nuclear activities, the doses would be zero.

Based on the same risk estimator, a range of 7×10^{-8} to 0.013 excess fatal cancers is projected in the populations living within 80 km (50 mi) of these same illustrative sites from normal operations in 1993. To place these numbers into perspective, they can be compared with the numbers of fatal cancers expected in these populations from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this mortality rate, the number of fatal cancers expected during 1993 from all causes ranged from 44 to 1,760 in the population living within 80 km (50 mi) of the borehole site. These numbers of expected fatal cancers are much higher than the estimated range of 7×10^{-8} to 0.013 of fatal cancers that could result from operations at generic deep borehole sites in 1993. The risks and numbers of expected fatal cancers from radiation from generic deep borehole sites that currently have no nuclear activities would be zero.

Site workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in the site facilities. Table 3.10.9–3 presents the range of the average worker, maximally exposed worker, and total cumulative worker dose to workers from operations in 1992 at a generic site at developed locations that presently have nuclear activities (Sections 3.2.9 through 3.7.9). These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of excess fatal cancers to workers from site operations in 1992 is estimated to range from 8.0×10^{-4} to 0.14. For generic deep borehole sites at undeveloped locations with no nuclear activities, the occupational radiological exposure would be zero.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the 1993 annual environmental reports for the active DOE sites, representative of developed locations. The concentrations of radioactivity in various environmental media (that is, air, water, and soil) in the regions of the sites (onsite and offsite) are also presented in these reports (see Sections 3.2.9 through 3.7.9).

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface waters during swimming and soil through direct contact or via the food pathway).

Table 3.10.9–3. Radiation Doses to Workers From Normal Operation at the Generic Deep Borehole Complex Site in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	2.6 to 27.3
Maximally exposed worker (mrem)	5,000	660 to 3,000
Total workers[b] (person-rem)	ALARA	2 to 350

[a] DOE's goal is to maintain radiological exposure as low as reasonably achievable.

[b] The number of badged workers in 1992 ranged from 780 to 19,500.

Source: 10 CFR 835; DOE 1993n:7.

The baseline data for assessing potential health impacts from the chemical environment are those presented in Sections 3.2.3 through 3.7.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (that is, air emissions and NPDES permit requirements) contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at the deep borehole site via inhalation of air containing hazardous chemicals released to the atmosphere by site operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Sections 3.2.3 through 3.7.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways for workers at a generic deep borehole site during normal operation may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Site workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operational processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at a generic deep borehole site are expected to be substantially better than required by the standards.

Health Effects Studies. Specific locations for the deep borehole complex must be designated before any reviews of epidemiologic studies in the areas can be conducted.

Accident History. Since there is no deep borehole site in operation, there is no site accident history.

Emergency Preparedness. The generic deep borehole site would have an emergency management program that could be activated in the event of an accident. The program would be compatible with all other Federal, State, and local plans and be thoroughly coordinated with all interested groups. The program would be modified, as necessary, to accommodate deep borehole operations.

3.10.10 WASTE MANAGEMENT

This section describes the range of waste management activities and regulatory framework that could exist at a generic deep borehole site. The volume of waste generated by existing DOE sites varies greatly. Existing DOE sites also have a wide range of capability in the "cradle-to-grave" management of the various categories of wastes. Sites such as INEL, Hanford, and SRS have an extensive onsite treatment, storage, and disposal capability for most waste categories. Whereas, sites such as Pantex have a limited treatment and storage capability, and with the exception of a landfill for construction debris, have no onsite disposal capability. For generic deep borehole sites that would not be on or near a DOE facility, it is highly unlikely that there would be any ongoing waste management activities, except for a possible sanitary wastewater treatment facility or sanitary landfill. There are no regulations that clearly pertain to the disposal of surplus Pu material into a deep borehole. However, the regulations that would govern the waste management activities in support of the deep borehole are well-defined. A general discussion follows to describe the range of waste management activities if a deep borehole were located on or near a DOE facility.

Spent Nuclear Fuel. There would be no spent nuclear fuel associated with a deep borehole site.

High-Level Waste. There would be no HLW associated with a deep borehole site.

Transuranic Waste. Transuranic wastes are unique to DOE. Most TRU waste exists in a solid form and is comprised of protective clothing, paper trash, rags, glass, miscellaneous tools, and equipment that have become contaminated with TRU radionuclides. Liquid TRU wastes are generated from the chemical processing for recovery of Pu or other TRU elements. TRU wastes are managed in accordance with DOE Order 5820.2A. TRU wastes are to be processed and packaged to meet the WIPP WAC or alternate treatment level and placed in interim storage while awaiting the availability of a Federal repository. Mixed TRU waste must also meet the requirements of RCRA as outlined in 40 CFR 260. The generation of TRU waste at DOE sites ranges from 0 to 638 m^3/yr (0 to 835 yd^3/yr) and from 0 to 225 m^3/yr (0 to 294 yd^3/yr) for mixed TRU (DOE 1994d:122,124).

Low-Level Waste. Low-level waste is generated at more than 30 different DOE sites and is disposed of at Hanford, NTS, INEL, ORR, SRS, and LANL. LLW is usually rags, papers, filters, tools, equipment, and discarded protective clothing contaminated with radionuclides. In accordance with DOE Order 5820.2A, LLW must be characterized with sufficient accuracy to permit proper segregation, treatment, storage, and disposal. Waste acceptance criteria are established for each LLW treatment, storage, and disposal facility. For the 30 sites that generate LLW, the generation ranged from a few cubic meters (few cubic yards) to 14,090 m^3/yr (18,430 yd^3/yr) (DOE 1994d:145). The average land usage factor for the six DOE LLW disposal facilities ranges from 3,400 to 29,700 m^3/ha (1,800 to 15,700 yd^3/acres) (DOE 1994d:141,152).

Mixed Low-Level Waste. Mixed LLW at DOE sites includes a variety of contaminated materials, including air filters, cleaning materials, engine oils and grease, paint residues, photographic materials, soils, building materials, and plant equipment being decommissioned. In accordance with the *Federal Facility Compliance Act* of 1992, each DOE site that generates, stores, or treats mixed LLW has developed a Site Treatment Plan. The Site Treatment Plan lays out the development of technologies and capacities needed to treat mixed LLW to the standards required by RCRA. With approval of the plans, the regulatory agency issued an order requiring compliance with the approved plan. For those DOE sites that generated mixed LLW in 1993, the generation ranged from less than 1 m^3 (1.3 yd^3) to 1,900 m^3 (2,485 yd^3) (DOE 1994d:241).

Hazardous Waste. Hazardous wastes generated by DOE facilities include solvent rags, analytical laboratory chemicals, photographic shop wastes, spent solvents, waste oil, and paint wastes. Hazardous wastes are managed in accordance with RCRA as outlined in 40 CFR 260. Most DOE sites ship their hazardous wastes offsite to commercial RCRA-permitted facilities under contract, using DOT-registered transporters.

Nonhazardous Waste. The DOE generates the same kinds of liquid and solid nonhazardous wastes that any industrial facility would generate. Liquid nonhazardous wastes may undergo a wastewater treatment process before discharge to a publicly owned treatment works or surface waters. Wastewater treatment processes may include a neutralization of acidic or basic wastewater or flocculation/clarification. These liquid wastes are regulated by the CWA and are treated and discharged in accordance with NPDES permits and other state and local guidelines. Solid nonhazardous wastes are disposed of in onsite sanitary landfills that are owned and operated by DOE or shipped offsite to municipal landfills for disposal. The operation and management of solid nonhazardous wastes are regulated under the provisions of RCRA, Subtitle D.

3.11 MIXED OXIDE FUEL FABRICATION SITE (GENERIC)

For the generic MOX fuel fabrication facility, the environmental baseline is representative of an existing reactor fuel fabrication facility currently operating in the contiguous United States. Nuclear fuel fabrication on a commercial scale in the United States is currently limited to five major nuclear fuel fabricators. The five existing reactor fuel fabrication sites that were used as the basis for creating the generic environment are the following:

- ABB–Combustion Engineering, Hematite, MO
- Framatome Commercial Nuclear Fuel Plant, Lynchburg, VA
- General Electric Nuclear Production Facility, Wilmington, NC
- Siemens Nuclear Power Corporation, Richland, WA
- Westinghouse Columbia Fuel Facility, Columbia, SC

The commercial nuclear fuel facilities are primarily engaged in the manufacture of fuel assemblies for commercial nuclear reactors, both BWRs and PWRs. In general, the operations consist of receiving LEU hexafluoride (UF_6); converting the UF_6 to produce UO_2 powder; and processing the UO_2 through pressing and sintering, fuel rod loading and sealing, and fuel assembly fabrication. The fabrication varies in both process and magnitude from site to site.

Currently, there are no commercial U.S. fuel fabrication facilities licensed to process MOX fuel. Processing of MOX fuel in commercial facilities would require licensing by the NRC. The NRC licensing application process includes compliance with site-specific NEPA requirements.

Department of Energy Activities. There are no major DOE activities at these commercial facilities.

Non-Department of Energy Activities. The range of primary missions of the commercial fuel fabrication facilities are as follows: one fabrication facility limits current operation to only loading fuel rods for PWRs; others provide a wide range of fuel fabrication for PWRs only or BWRs only; and one facility fabricates fuel for both BWRs and PWRs.

3.11.1 LAND RESOURCES

The approach to defining the generic MOX fuel fabrication site environmental setting for land resources is not site-specific. Consequently, a range of land use and visual resources conditions has been provided (see Table 3.11.1–1).

Table 3.11.1–1. Land Resources Attributes of the Generic Mixed Oxide Fuel Fabrication Site

Land Use Attributes	
Land Area	30 ha to 695 ha
Land Ownership	Public or Private
Percent of Site Area Developed	2 to 20 percent
Existing Land Use	
Onsite	Industrial; Undeveloped
Offsite	Forest land; Agriculture; Residential; Commercial; and/or Industrial
Land Use Compatibility	Likely
Plans, Policies, and Controls	
Jurisdiction	DOE; other Federal; State; local
Enforcement	Lax to stringent
Conformance	Likely
Visual Resource Attributes	
Landscape Character	
Site	Flat to gently rolling topography
Viewshed	Small to medium size urbanized area; surrounding agriculture; and/or forest
Visual Resource	
Sensitivity level	Low to medium to high
Distance zones	Foreground, middleground, background, and seldom-seen
BLM VRM class	4 to 5
Degree of contrast	Weak to moderate

Source: BW NRC 1976a; BW NRC 1983b; CE 1989a; GE 1989a; GE 1989b; GE 1989c; GE NRC 1984a; NRC 1981b; NRC 1982a; SPC 1992a; WEC 1975a.

Land Use. The land area requirement for a site would range from 30 ha to 695 ha (74 acres to 1717 acres). Plant facilities would be sited upon only a portion of the total site area, with the developed portion likely to range from 2 to 20 percent. The range of land uses for the undeveloped portion of the site would be grassland, forest, or swampland.

The location of a generic MOX fuel fabrication site would likely range in distance from less than 1 km to 5 km (0.6 mi to 3.1 mi) from the nearest community. Although a site could be located within a city corporate limit, it is more likely to be further from the closest city or metropolitan area, ranging between 6 and 56 km (3.7 and 34.8 mi) distant.

Land uses within the site vicinity would be described as rural, with forest land and agricultural uses predominating. The full range of land uses could include undeveloped uses such as forest and agriculture to developed uses such as residential, commercial, and industrial. The nearest residence would range from 200 to 800 m (656 to 2,625 ft) from the site boundary.

Depending on location, the site could be subject to a variety of land-use plans, policies, and controls at the Federal, State, and local level. The existence and stringency of these plans, policies, and controls could vary by jurisdiction. However, it is likely that site development would be in conformance with land-use plans, policies, and controls, and be compatible with adjacent land use.

Visual Resources. The visual environment of the site would likely be characterized by level to gently rolling topography. The site would be a developed area that contains facilities and activities, surrounded by undeveloped land. The viewshed would likely be rural with a low population density and with forested and agricultural uses predominating. Facilities would likely be visually unobtrusive due to site design, earthwork, and landscaping. The full range of sensitivity levels, and distance zones could occur (see Section 3.1.1 for discussion of visual resource inventory). Public viewpoints could include public access roadways, urbanized areas, and water-based recreational uses. It is likely that the degree of contrast would range from weak to moderate. The site would likely range from a Class 4 to Class 5 BLM VRM designation.

3.11.2 SITE INFRASTRUCTURE

Baseline Characteristics. The baseline characteristics for a generic MOX fuel fabrication site are provided in Table 3.11.2–1. Characteristics of a regional power pool to supply the generic MOX fuel fabrication site are given in Table 3.11.2–2.

Table 3.11.2–1. Generic Mixed Oxide Fuel Fabrication Site Baseline Characteristics

Characteristics	Site Availability
Transportation	
Roads (km)	3 to 9
Railroads (km)	0 to 4.3
Electrical	
Energy consumption (MWh/yr)	49,500 to 72,000
Peak load (MWe)	0.5 to 10
Fuel	
Natural gas (m^3/yr)	0 to 102,800,000
Oil (l/yr)	0 to 9,130,000
Coal (t/yr)	0 to 208,700
Steam (kg/hr)	0 to 11,000

Source: CFFF 1995a:1; GE 1995a:1; SPC 1995a:1.

Table 3.11.2–2. Generic Mixed Oxide Fuel Fabrication Site Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	14 to 59%
Nuclear	0 to 39%
Hydro/geothermal	2 to 46%
Oil/gas	<1 to 32%
Other[b]	0 to 30%
Total Annual Production	107,607,000 to 272,155,000 MWh
Total Annual Load	104,621,000 to 293,262,000 MWh
Energy Exported Annually	-45,400,000 to 6,359,000 MWh
Generating Capacity	24,870 to 61,932 MWe
Peak Demand	20,578 to 57,028 MWe
Capacity Margin[c]	4,064 to 13,655 MWe

[a] Percentage does not total 100 percent due to round-off error.

[b] Includes power from both utility and nonutility sources.

[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

3.11.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The meteorological and climatological conditions for potential generic MOX fuel fabrication sites in the United States include a wide range of extremes in ambient temperature, windspeed and direction, and precipitation. Therefore, no further description of meteorology and climatology has been provided with respect to a generic site.

Ambient Air Quality. Ambient air quality conditions at representative existing fuel fabrication sites in the United States include a wide range of pollutants and conditions. The existing commercial fuel fabrication sites are all expected to comply with the ambient air quality standards. None of these sites is located in a nonattainment area.

Noise. Specific existing noise sources and characteristics of a generic MOX fuel fabrication site cannot be described. However, it is expected that the area near such a site would be essentially rural in character and would have typically low background sound levels. Typical DNL in the range 35 to 50 dBA (EPA 1974a:B-4) can be expected for such a rural location where noise sources may include wind, insect activity, aircraft, and agricultural activity. Existing industrial noise sources and traffic noise at the site would result in higher background noise levels near the site and along site access routes.

3.11.4 WATER RESOURCES

Surface Water. Major surface water features in the generic MOX fuel fabrication site could range from none to a large navigable river. The average flow rate of these water bodies could range from 0 to 3,360 m^3/s (0 to 118,658 ft^3/s). Other surface water features could include small streams bordering the site with average flows ranging from comparable to the main surface water body's to negligible in comparison.

Stormwater control retention/drainage ponds could be present at the site. These ponds would probably discharge to the nearest surface water body, or to natural drainage channels. Portions of the site could be located within the 100-year floodplain.

Surface Water Quality. In the vicinity of the generic MOX fuel fabrication site, the surface water bodies could range from being classified as fresh water suitable for drinking water, contact recreation, and propagation of fish and aquatic life, to not suitable for drinking, bathing, or commercial shellfishing. The range of concentrations of typical surface water quality parameters that could be encountered at a generic site is the same as was presented in Table 3.10.4–1.

The generic commercial MOX fuel fabrication site would have an NPDES permit(s) that would dictate the acceptable levels of specific parameters in the liquid effluents that would be discharged to a nearby surface water body.

Surface Water Rights and Permits. Surface water rights concerning the water body near the generic MOX fuel fabrication site would involve non-impairment of designated uses.

Groundwater. The near-surface aquifer beneath the generic MOX fuel fabrication site would occur under unconfined conditions and could range in average thickness from 5 to more than 20 m (16.4 to more than 66 ft). Depth to groundwater could range from near the ground surface to more than 200 m (656 ft). The aquifer material could range from sand and gravel to saprolite, or highly weathered bedrock. In general, the generic MOX fuel fabrication site would obtain groundwater from a confined aquifer underlying the near-surface aquifer. The confined aquifer would have an abundant supply of good quality groundwater.

Recharge to the near-surface aquifer would be primarily from rainfall and would occur in areas located up to 10 km (6.25 mi) from the site. Groundwater flow would typically be from these recharge areas towards the major surface water feature.

In areas surrounding the generic MOX fuel fabrication site, groundwater would be used for domestic, agricultural, and industrial purposes. The classification of the aquifer would be a Class II aquifer (that is, currently being used or a potential source of drinking water).

Groundwater Quality. Groundwater quality of the near-surface aquifer in the site area would range from good to fair. The ranges of hydraulic characteristics of the aquifer are presented in Table 3.10.4–2.

Groundwater Availability, Use, and Rights. Groundwater rights concerning the aquifer(s) near the generic MOX fuel fabrication site could range from having potential for local restrictions on pumping to a reasonable use doctrine concerning neighboring landowners water availability.

3.11.5 GEOLOGY AND SOILS

Geology. The physiography of a generic MOX fuel fabrication site could range from a flat, nearly featureless plain to a highly dissected plain of arid to humid environments. Similarly, the area geology could range from alluvium to thick sequences of unconsolidated marine sediments, glaciofluvial material, and crystalline and sedimentary bedrock. These materials could range in age from Cenozoic to Precambrian (recent to over 600 million years).

A generic MOX fuel fabrication site could be located in Seismic Zones 1 to 3, which suggests there could be minor to major levels of damage in the event of an earthquake (Figure 3.2.5–1). [Text deleted.] The geologic terrain for Seismic Zones 1 through 3 of those areas considered for the generic MOX fuel fabrication site could have a history of seismic activity that ranges from low to severe. The nearest capable fault could be within 250 km (155 mi) of the generic MOX fuel fabrication site. The nearest local earthquake with a MMI of V could be within 170 km (106 mi) from a generic MOX fuel fabrication site (Table 3.2.5–1). The nearest epicenter from a damaging earthquake (MMI of VII or greater) could be approximately 170 km (106 mi) from a generic MOX fuel fabrication site.

Although the generic MOX fuel fabrication site is not located within a region of active volcanism, it could be located within approximately 164 km (102 mi) of a volcano.

Soils. The generic MOX fuel fabrication site could be located where the predominant soil types are loamy sands to loamy clays. These soils could range from poorly to excessively drained. The erosion potential could range from minor to severe in those areas with slopes greater than 25 percent and that have been eroded in the past. The soil's shrink-swell potential could range from minimal to severe, which is acceptable for standard construction techniques, depending upon the engineering controls employed. Wind erosion potential could range from minimal to severe.

3.11.6 BIOLOGICAL RESOURCES

The affected environment for the generic MOX fuel fabrication site is based on a review of biological conditions characteristic of several commercial reactor fuel fabrication facilities currently operating in the United States. Biological resources at a given site could vary from those typically associated with the principal vegetation type of the area due to a variety of factors, including previous disturbance by man. The principal vegetation types found within these representative environments include deciduous forest, southeastern evergreen forest, and grassland. With the exception of southeast evergreen forest, biological resources found within these vegetation types are discussed in Section 3.10.6.

Southeast Evergreen Forest. Southeast evergreen forest occurs along the Atlantic coastal plain from the mid-Atlantic States to Florida and along the northern Gulf Coast. The climate varies from distinct seasonal changes in the mid-Atlantic region to only minor seasonal variation in Florida and along the Gulf Coast. Pines, such as pitch, longleaf, and slash, are the dominant tree species within this vegetation type. Pine forests owe their origin and maintenance to their resistance to fire, which inhibits the growth of deciduous species. In the absence of fire, this forest type would be replaced by oak-hickory dominated forest. Animals associated with the southeast evergreen forest include the whitetail deer, opossum, gray fox, northern bobwhite, wild turkey, eastern bluebird, morning dove, eastern diamondback rattlesnake, American alligator and pine woods treefrog. Streams and rivers within this vegetation type are generally slow moving and are often bordered by forested swamps and bottomland hardwood forests.

3.11.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric resources may be affected by the construction and operation of the generic MOX fuel fabrication facility. These resources may include objects, sites, or features such as remains of storage pits, or hearths. Archaeological sites may include hunting and butchering sites and campsites. Sites may yield artifacts such as stone tools and associated manufacturing debris, and ceramic potsherds.

Historic Resources. Historic resources that could be affected by construction and operation may include subsurface remains of human occupation such as structural foundations of buildings, important paths or roads, and cemeteries. Some standing buildings such as commercial structures and residences also may be considered historic resources.

Native American Resources. Native American resources could be affected by construction and operation of this facility. Resources may include sites, areas, and materials important to Native Americans for religious or heritage reasons. Sacred sites may include cemeteries, plant communities, mountains, paths, or geographical spaces that are socially identified and circumscribed. Some Native American groups could be affected and would need to be consulted if a specific site is chosen.

Paleontological Resources. Paleontological resources could be affected. These resources may include fossil remains of extinct plants or animals, some rare. They can include poorly known fossil forms, well-preserved terrestrial vertebrates, unusual depositional contexts, assemblages that contain a variety of fossil forms, or deposits recovered from poorly studied regions or in unusual concentrations.

3.11.8 SOCIOECONOMICS

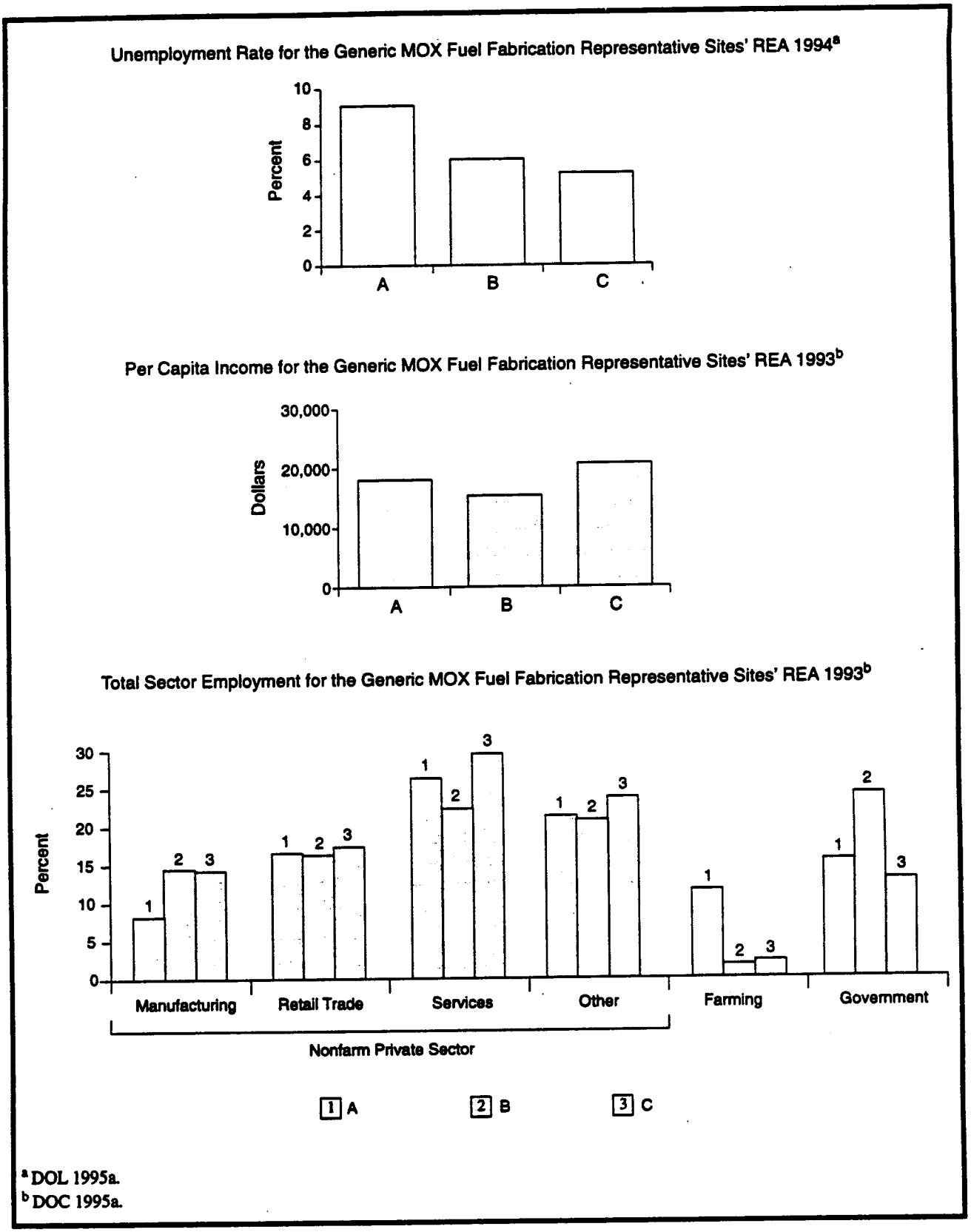
The generic MOX fuel fabrication site could potentially affect the socioeconomic environment of a given REA or ROI. The characteristics of the REA, ROI, and community are dependent upon geographic location. For employment and income, the economic area would be based upon industry interaction and linkages in the region. The anticipated residential distribution of project-related employees and their families would determine the ROI. This ROI would contain all principal jurisdictions and school districts likely to be affected by the proposed activity.

Because specific sites have not been proposed for the generic MOX fuel fabrication facility, representative sites have been used to describe the affected environment. Five existing facilities encompassing three location types were used as representative sites to develop a range of conditions for discussion in this section. Two of the sites, A and B, are located in medium communities located in urban areas. The third site, C, is a small community tied to a large metropolitan area. Medium-size communities and the vulnerability or susceptibility of a local community to changes in the economic base are characterized in Section 3.10.8.

Small communities tied to large metropolitan areas would be characterized by a rural ROI within a large metropolitan REA. The ROI would have attributes similar to rural areas and small rural communities. The population would normally be less than 50,000. There would be small business centers with a small work force and little local diversification of industries and employment. However, the large metropolitan area nearby should provide employment for a significant portion of the rural community's population. The resulting increase in tax base and diversification of employment would strengthen the community's economic base and allow for a higher level of community services than found in a more isolated rural area. Infrastructure and transportation networks would normally be more developed in the rural community linked to a large metropolitan area than in a more isolated community. This would be due, in part, to the requirement for good commuting routes to the large metropolitan area. The large metropolitan area to which the rural community is linked would have a population of at least 1 million. These communities would usually be independent centers of large-scale financial, wholesaling, and service activity. These areas would typically have high population densities and numerous employment centers. Economically supportive relationships between industries would be developed, and a large pool of labor would exist. Large and diverse metropolitan areas would provide a wide range of goods and services to local residents.

Socioeconomic characteristics described for the generic MOX fuel fabrication site include employment and local economy, population and housing, and local transportation. The communities of three typical sites were assessed. Site A, which had a 1992 population of 34,201 and a total urban population of more than 100,000, represents the smaller medium-size community being assessed; Site B, with a 1992 population of 98,832, represents the larger medium-size community being assessed. Site C was a small community whose population was incorporated into the population of the surrounding county. Site C was located approximately 16 km (10 mi) from a small community of 4,096 persons (1992 population) and about 64 km (40 mi) from a large metropolitan area of approximately 1.5 million persons. Statistics for employment and local economy were based on the REA for each site. Statistics for the remaining socioeconomic characteristics were based on the sites' ROIs.

Regional Economy Characteristics. Selected employment and regional economy statistics for each typical site's REA are discussed in this section and displayed in Figure 3.11.8–1. Between 1980 and 1990, the civilian labor force in the REA encompassing Site A increased 9.9 percent to the 1990 level of 254,800, and in Site B increased 19 percent to the 1990 level of 399,100. Site C had a 12.6 percent increase (the 1990 civilian labor force was 1,476,800). The 1994 unemployment for the REA encompassing Site A was 9.1 percent while Site B had unemployment of 6 percent. The unemployment for Site C was 5.3 percent. The 1993 per capita income was $18,501 and $16,832 for Sites A and B, respectively. Site C had a 1993 per capita income of $20,554.



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.11.8–1. Employment and Local Economy for the Generic Mixed Oxide Fuel Fabrication Representative Sites' Regional Economic Area.

Figure 3.11.8–1 displays the division of employment involving farming, nonfarm private sector, and government employment around each representative site. The portion of total REA employment involving farming was 12 percent at Site A and 2 percent at Site B. Government activities accounted for 15 and 24 percent of the total regional employment at sites for A and B, respectively. Employment involving manufacturing was 8 percent of the total employment in the region surrounding Site A and 14 percent in the region around Site B. Retail trade activities represented approximately 16 percent of the nonfarm private sector employment for Site A and Site B. Service activities represented a 26-percent share of this employment for Site A, and a 22 percent share at Site B.

For Site C, the portion of total employment involving farming and government activities was 2 percent and 13 percent, respectively. The nonfarm private sector activities of manufacturing and retail trade represented 14 percent and 17 percent, respectively, of the total regional employment. Employment in the service sector was 29 percent.

Population and Housing. Population and housing trends in the ROIs of the three typical communities are presented in Figure 3.11.8–2. The ROI population increases for Sites A and B between 1980 and 1994 were 19.8 percent (average annual increase of 1.3 percent) and 18.1 percent (average annual increase of 1.3 percent), respectively. The number of housing units, between 1980 and 1990, in the ROI increased 5.4 percent for Site A and 21.6 percent for Site B. The 1990 ROI homeowner vacancy rates were 1.3 percent for Site A and 1.9 percent for Site B, while the renter vacancy rates were 5.6 percent and 8.9 percent for Sites A and B, respectively.

The ROI surrounding Site C experienced a 5.2-percent (average annual increase of 0.4 percent) increase in population, between 1980 and 1994, and an 11.9-percent increase in the number of housing units between 1980 and 1990. The 1990 homeowner and renter vacancy rates were 1.8 and 9.1 percent, respectively.

Community Services and Local Transportation. These characteristics are dependent upon a geographic location. The ROI would determine all principal jurisdictions and school districts likely to be affected by the proposed activity. Local transportation would be the existing principal road, air, and rail networks required to support the project activities.

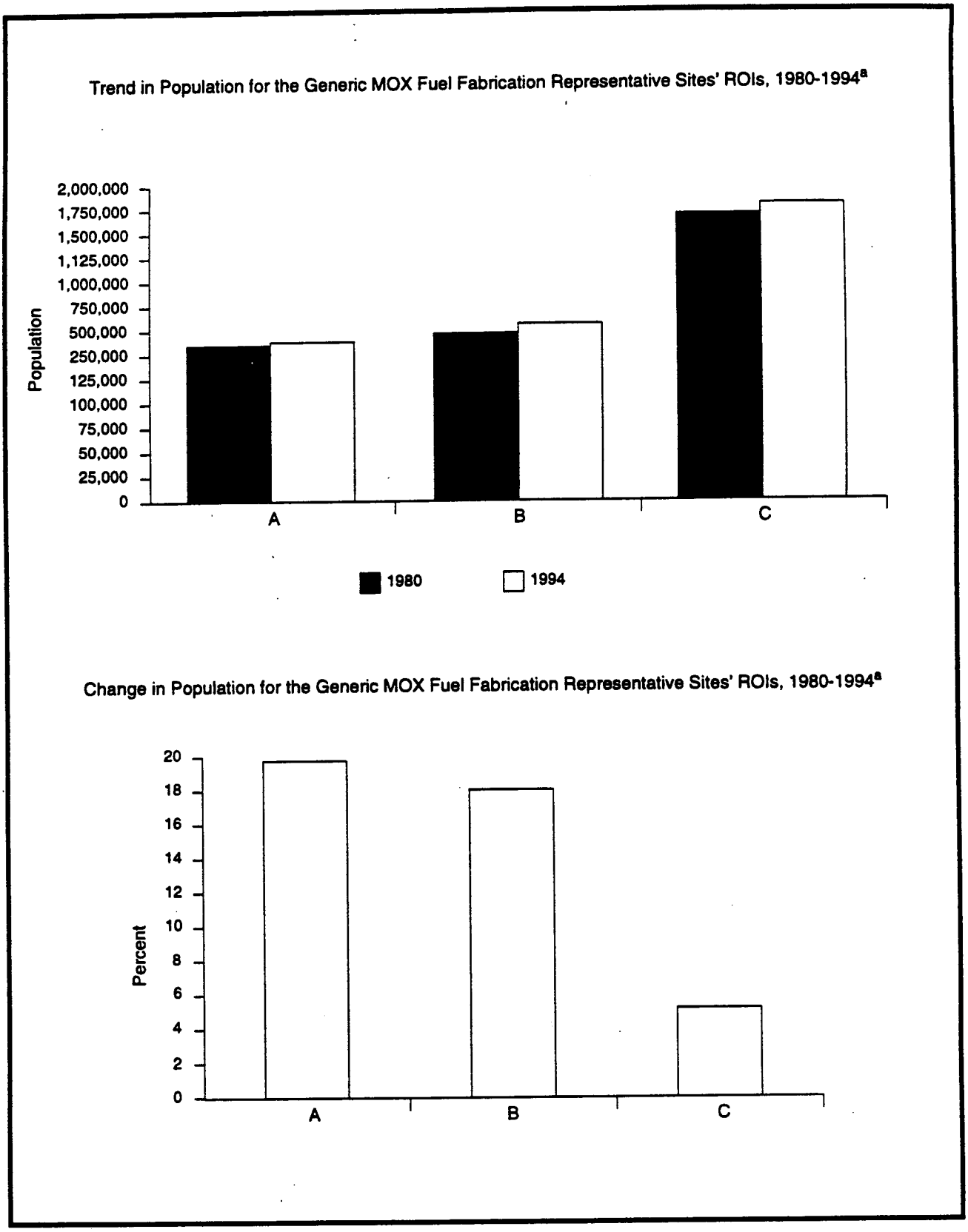
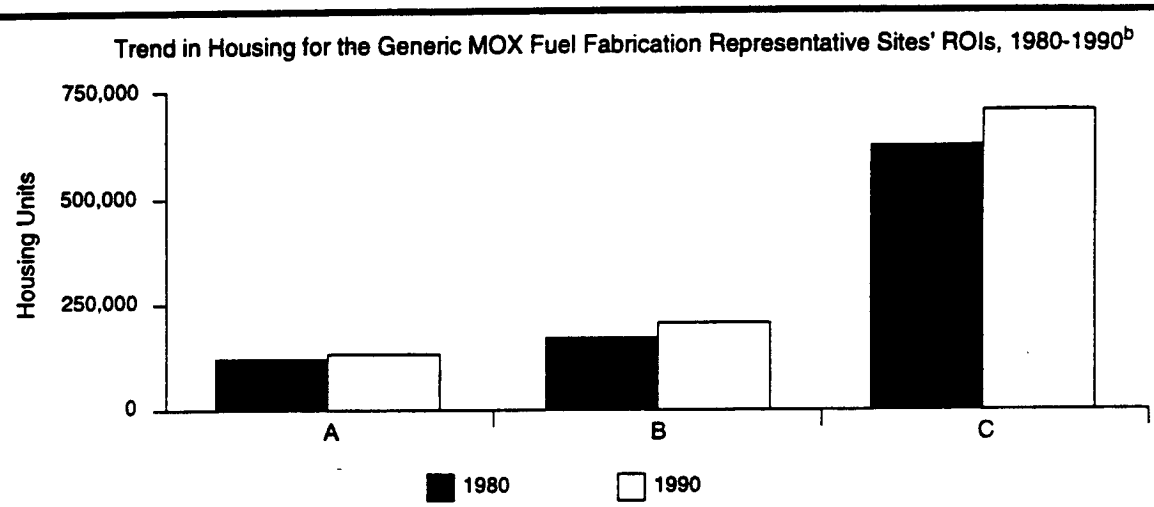
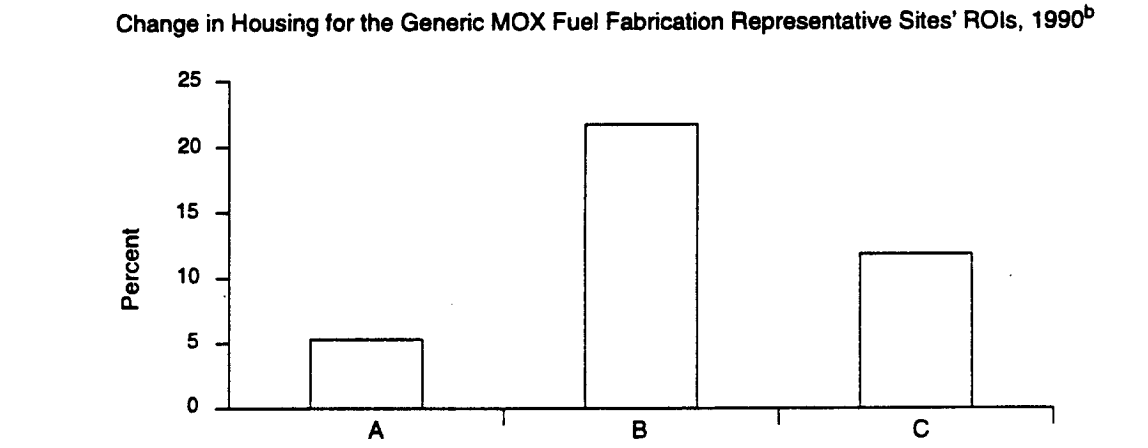
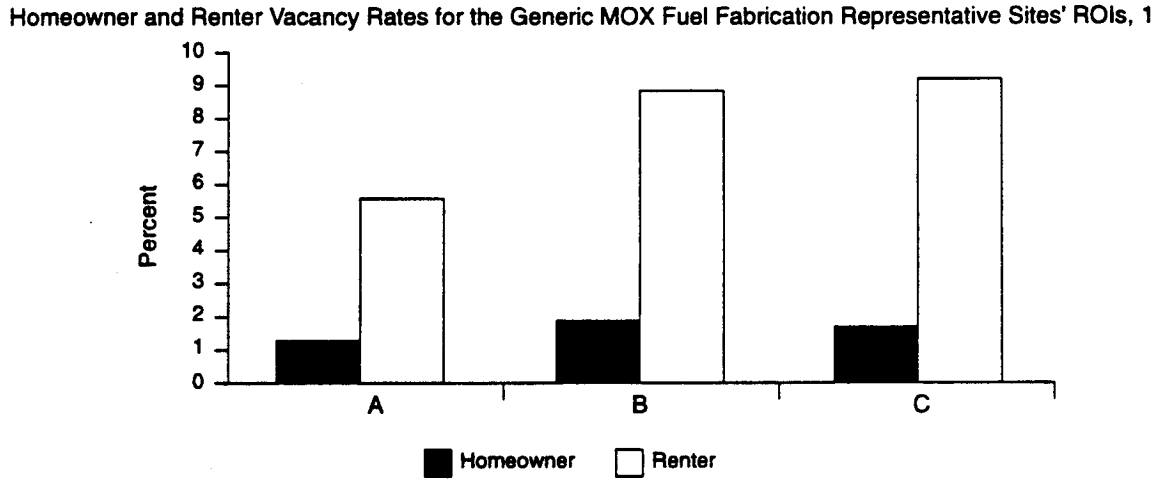


Figure 3.11.8–2. Population and Housing for the Generic Mixed Oxide Fuel Fabrication Representative Sites' Region of Influence.







[a] Census 1983b; Census 1983k; Census 1983m; Census 1995a.
[b] Census 1982c; Census 1982f; Census 1982r; Census 1991b; Census 1991d; Census 1991f.
[c] Census 1991b; Census 1991d; Census 1991f.

Figure 3.11.8–2. Population and Housing for the Generic Mixed Oxide Fuel Fabrication Representative Sites' Region of Influence—Continued.

3.11.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of representative background radiation exposure to individuals in the vicinity of a generic MOX fuel fabrication site are shown in Table 3.11.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to normal facility operation.

Table 3.11.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Operation at the Generic Mixed Oxide Fuel Fabrication Site

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation	
Cosmic and cosmogenic radiation[a,b]	27 to 28
External terrestrial radiation[a]	15 to 44
Internal terrestrial radiation[b]	39
Radon in homes (inhaled)[b]	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	346 to 376

[a] Based on information on cosmic and terrestrial radiation given in EPA 1981b.

[b] NCRP 1987a.

Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from normal facility operations provide another source of radiation exposure to individuals in the vicinity of a given site. For a range of existing conditions, types and quantities of radionuclides released from operations at a generic MOX fuel fabrication site is based on 1994 radiological effluent release reports for existing representative commercial fuel fabrication sites involved in the processing and fabrication of uranium ore into reactor fuel. The doses to the public resulting from these releases are presented in Table 3.11.9–2. These doses fall within radiological limits (40 CFR 61, 40 CFR 141, and 40 CFR 190) and are small in comparison to background radiation. The releases listed in the 1994 reports were used in the development of the reference environment's (No Action) radiological releases and resulting impacts at the generic MOX fuel fabrication sites in the year 2005 (Section 4.3.5.1.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from operations at the representative fuel fabrication sites in 1994 is estimated to range from 2.5×10^{-7} to 5.5×10^{-7}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of operations at the representative fuel fabrication site ranges from less than 3 in 10 million to less than 6 in 10 million. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Based on the same risk estimator, a range of 1.8×10^{-4} to 5.8×10^{-3} excess fatal cancers is projected in populations living within 80 km (50 mi) of the representative fuel fabrication sites from normal operations in 1994. To place these numbers into perspective, they can be compared with the numbers of fatal cancers expected in these

Table 3.11.9–2. Radiation Doses to the Public From Normal Operation at the Generic Mixed Oxide Fuel Fabrication Site in 1994 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	0.058 to 0.50	4	0.002 to 1.0	25	0.50 to 1.1
Population within 80 km[b] (person-rem)	None	0.30 to 11.1	None	0.050 to 0.48	None	0.35 to 11.6
Average individual within 80 km[c] (mrem)	None	5.7×10^{-4} to 0.013	None	9.5×10^{-5} to 5.7×10^{-4}	None	6.7×10^{-4} to 0.014

[a] The standards for individuals are given in 40 CFR 61, 40 CFR 141, and 40 CFR 190. As discussed in these regulations, the 10 mrem per year limit from airborne emissions is required by the CAA, the 4 mrem per year is required by the SDWA, and the total dose of 25 mrem per year is the limit from all pathways combined.

[b] In 1994, this population ranged from 525,000 to 848,000.

[c] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: BW 1995b:1; WEC 1975a; WEC 1995a:1.

populations from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was approximately 0.2 percent per year (Almanac 1993a:839). Based on this mortality rate, the number of fatal cancers expected to occur during 1994 from all causes ranged from 1,050 to 1,700 in the population living within 80 km (50 mi) of a fuel fabrication site. These numbers of expected fatal cancers are much higher than the estimated range of 1.8×10^{-4} to 5.8×10^{-3} fatal cancers that could result from operations at commercial fuel fabrication sites in 1994.

Site workers receive the same dose as the general public from background radiation but also receive an additional dose from working in the site facilities. Table 3.11.9–3 presents the range of the average worker, maximally exposed worker, and total cumulative worker dose from operations at the representative fuel fabrication sites in 1993. These doses fall within radiological regulatory limits (10 CFR 20). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of excess fatal cancers to workers from site operations in 1993 is estimated to range from 0.0028 to 0.039.

Table 3.11.9–3. Radiation Doses to Workers From Normal Operation at the Generic Mixed Oxide Fuel Fabrication Site in 1993 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	33 to 159
Maximally exposed worker (mrem)	5,000	<3,000
Total workers (person-rem)	ALARA	7.0 to 98

[a] NRC's goal is to maintain radiological exposure as low as reasonably achievable.

Source: 10 CFR 20; NRC 1995b.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the 1994 effluent release reports and environmental reports. The concentrations of radioactivity in various environmental media (including air, water, and soil) in the regions of the sites (onsite and offsite) are also presented in those reports.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface waters during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.11.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (that is, air emissions and NPDES permit requirements) contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at the fuel fabrication site via inhalation of air containing hazardous chemicals released to the atmosphere by site operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

A discussion of ambient air quality is given in Section 3.11.3. As stated in that section, air quality is expected to be in compliance with applicable standards. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways for workers at the fuel fabrication site during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Site workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operational processes ensures that these standards are not exceeded. Therefore, worker health conditions are expected to be substantially better than required by the standards.

Health Effects Studies. Specific locations for the MOX fuel fabrication facilities must be designated before any reviews of epidemiologic studies in the areas can be conducted.

Accident History. Domestic MOX fuel fabrication facilities do not presently exist. Consequently, there is no accident history available.

Emergency Preparedness. The generic MOX fuel fabrication site would develop an emergency management program which would be activated in the event of an accident. The program would be compatible with all other Federal, State, and local plans and is thoroughly coordinated with all interested groups. [Text deleted.]

3.11.10 WASTE MANAGEMENT

This section describes the range of waste management activities and the regulatory framework that exist at a generic fuel fabrication site in the United States. These commercial facilities would need to be licensed by NRC to handle Pu. To meet the requirements of their NRC license, the generic fuel fabrication site complies with Federal and State regulations of water, air, and land disposal in addition to facility permits. Agencies responsible for enforcement and inspection at a commercial nuclear fuel fabrication facility include the NRC, EPA, and the State's appropriate regulatory agencies. State agencies govern effluent discharge; nonhazardous waste disposal; hazardous waste treatment, storage, and disposal; underground storage tanks; incineration; and transport of hazardous waste.

A generic fuel fabrication site receives low-enriched UF_6 and/or UO_2 (made from natural or depleted uranium) as powder. The UO_2 powder is pressed into pellets, which are sintered, ground to final size, and loaded into fuel rods that are then fabricated into reactor fuel bundles. Wastes produced at this site are categorized as low-level, mixed low-level, hazardous, and nonhazardous. Activities at a generic fuel fabrication site that generate waste include uranium blending; pelleting; sintering; grinding; coating; fuel rod loading and inspection; scrap recovery; incineration of low-level radioactive, mixed low-level, hazardous, and nonhazardous wastes; recovery of zirconium and copper; waste compaction; and waste processing and research related to the recovery of uranium. Incoming materials to the site includes zircalloy tubing, UO_2, nitric acid, water, and natural gas. Exit streams from the site typically include product fuel elements and assemblies; recovered metals; and gaseous, liquid, and solid waste.

The low-level, mixed, hazardous, and nonhazardous wastes are treated to reduce either volume or toxicity for subsequent recycle, storage, or disposal. The quantity of waste and the characteristics of the waste would depend on the fabrication process and the method of treatment used. The following discussions describe the waste management practices that are used at a generic fuel fabrication site.

Spent Nuclear Fuel. The site does not generate or manage spent nuclear fuel.

High-Level Waste. The site does not generate or manage HLW.

Transuranic Waste. The site does not generate or manage TRU waste.

Low-Level Waste. The site produces both liquid and solid LLW; however, liquid LLW is processed for uranium scrap recovery and dried to solids before disposal. Liquid LLW is generated in uranium recovery and gaseous emissions cleanup operations. Many of the manufacturing operations are dry chemical reactions, thus minimizing the generation of liquid LLW. Manufacturing process liquid wastes include acid dissolution, washwater from the laundry and personnel stations, analytical laboratory liquids, and scrubber water from the acid treatment and incineration operations.

The liquid LLW generated can be treated using evaporation, filtration, centrifugation, or ion exchange in a liquid radioactive waste treatment facility. After the complete treatment process, final dried solids are produced that can either be incinerated for further uranium recovery or packaged for offsite disposal at a licensed LLW disposal facility. Liquid effluents from the process can be transferred to a retention tank system and ultimately released to a sanitary sewer or into the local river in accordance with the generic fuel fabrication site's NPDES permit.

Solid waste that is categorized as LLW results from uranium recovery, liquid waste management, and incineration; this waste includes paper, small pieces of equipment, sludge, and miscellaneous trash. Another form of solid LLW results from gaseous waste streams with measurable amounts of radioactive materials that are passed through HEPA filters. These filters are disposed of as LLW. The solid waste produced can be incinerated, and the remaining packaged for offsite disposal. A supercompactor can exist onsite that compacts

208-l (55-gal) drums containing LLW. At a generic fuel fabrication site, the total solid LLW volume is expected to be approximately 41 m^3/yr (54 yd^3/yr).

Mixed Low-Level Waste. The generic fuel fabrication site could processes uranium-containing material using distillation. The sludge bottoms from this process are categorized as mixed LLW. The mixed waste is packaged and stored onsite at a dedicated facility until disposal becomes feasible. The volume of mixed waste generated annually at a generic fuel fabrication site is estimated to be 2 m^3/yr (2.6 yd^3/yr).

Hazardous Waste. Liquid hazardous wastes generated at a generic fuel fabrication site results from acid pickling, metals cleaning, and emissions control operations. Solid hazardous wastes are generated through the liquid hazardous waste treatment operations. The primary treatment methods that are used for liquid hazardous wastes are advanced wastewater treatment, lagoons, precipitation, and retention tanks pending discharge to the local river or sewer system in accordance with the site's NPDES permit. Sludges from these processes are recycled or packaged and shipped offsite for treatment and disposal.

Nonhazardous Waste. Liquid sanitary waste is processed at a generic fuel fabrication site. The primary treatment methods for this waste include sanitary treatment, aeration, and chlorination. As with the other treatment processes for liquid waste, the effluent is ultimately discharged into the local river or sewer system in accordance with the site's NPDES permit. Solid nonhazardous waste at the generic fuel fabrication site includes miscellaneous trash and paper, classified paper, and scrap zirconium and copper. Miscellaneous trash is sorted and packaged for onsite or offsite disposal.

3.12 EXISTING LIGHT WATER REACTOR SITE (GENERIC)

Currently in operation are 110 commercial nuclear power reactors located at 72 sites in 32 of the contiguous United States. Of these, 58 sites are located east of the Mississippi River. Most of this nuclear capacity is located in the Northeast (New England States, New York, and Pennsylvania), the Midwest (Illinois, Michigan, and Wisconsin), and the Southeast (the Carolinas, Georgia, Florida, and Alabama). No commercial nuclear power plants are located in Alaska or Hawaii. Approximately half of these 72 sites contain 2 or 3 nuclear units per site. Typically, nuclear power plant sites are located on, and are situated near, flat-to-rolling countryside in wooded or agricultural areas. More than 50 percent of the sites have 80 km (50 mi) population densities of less than 77 persons per km^2 (200 persons per mi^2), and over 80 percent have 80 km (50 mi) densities of less than 193 persons per km^2 (500 persons per mi^2). Site areas range from 34 to 12,000 ha (84 to 30,000 acres). Almost 60 percent of the plant sites encompass 200 to 800 ha (500 to 2,000 acres). Larger land-use areas associated with plant cooling systems include reservoirs, artificial lakes, and buffer areas. Because it is beyond the scope of this PEIS to analyze all of them, the environmental baseline for the existing LWR was developed as a generic environmental site description that is representative of an existing reactor site located somewhere in the contiguous United States.

A sample of reactors from across the United States was compiled in order to generate generic operating characteristics for a commercial LWR, since no specific site or reactor has been selected. The sample was studied in detail to determine valid, applicable characteristics that could be used to describe a generic reactor using MOX fuel. The sample sites would not be an exhaustive list of potential sites but are used to define the generic affected operational and environmental characteristics. The sample includes eight operating high power (greater than 1,200 MWe) PWRs and four BWRs built after 1975. Characteristics of these 12 were felt to be representative of both reactor types, since none of the 12 experienced any unusual operating conditions over the operating period reviewed. Where possible, data was averaged for the 5-year period to smooth out unusually low or high values due to shutdowns for reasons other than normal refueling or maintenance activities.

Data for each reactor characteristic were taken from calendar years 1988 to 1992 (ORNL 1995b:A-5). Entries for all 12 plants were used to determine an average for each operational characteristic (for example, waste generated).

For determining the environmental setting (for example, land area) of the generic reactor site, a second set of 10 reactors at 5 existing commercial reactor sites located across the United States were selected. These sites were as follows:

- Byron #1 and #2, IL
- Catawba #1 and #2, SC
- LaSalle #1 and #2, IL
- Palo Verde #1, #2, and #3, AZ
- WNP #2, WA

3.12.1 LAND RESOURCES

The approach to defining the environmental setting for land resources is not site specific. Consequently, a range of land use and visual resources conditions for a generic existing LWR site has been provided (see Table 3.12.1–1).

Table 3.12.1–1. Land Resources Attributes of the Generic Existing Light Water Reactor Site

Land Use Attributes	
Land Area	419 ha to 1,640 ha[a]
Land Ownership	Public or private
Percent of Site Area Developed	
With cooling towers	3 to 9 percent
With cooling lakes	67 to 76 percent
Existing Land Use	
Onsite	Industrial; Undeveloped
Offsite	Forest land; Agriculture; Residential; Commercial; and/or Industrial
Land Use Compatibility	Likely
Plans, Policies, and Controls	
Jurisdiction	DOE; Other Federal; State; local
Enforcement	Lax to stringent
Conformance	Likely
Visual Resource Attributes	
Landscape Character	
Site	Flat to gently rolling topography; adjacent to large water body
Viewshed	Small to medium size urbanized area; surrounding agriculture; and/or forest
Visual Resource	
Sensitivity level	Low to medium to high
Distance zones	Foreground, middleground, background, and seldom-seen
BLM VRM class	5 (developed area)
Degree of contrast	NA (existing)

[a] Land area already dedicated.
Note: NA=not applicable.
Source: NRC 1982b.

Land Use. The land area requirement for a generic existing LWR site could range from 419 to 1,640 ha (1,035 to 4,050 acres). However, this land area has already been dedicated; additional land area is not required. Plant facilities would probably be sited on 3 to 9 percent of the total site area. For sites that utilize cooling ponds instead of cooling towers, facilities could occupy a larger percentage of total site area (67 to 76 percent). The site could contain multiple (ranging from one to three) nuclear units. The area of the site not utilized for facilities and activities would be left undeveloped, and the range of land uses would likely be forested land, open space, or reserve/refuge.

The location of a generic existing LWR site would range between 3 to 55 km (2 to 34 mi) from the nearest city. The site would likely be further from the closest metropolitan area, up to 80 km (50 mi) distant. The site would be located adjacent to a large water body, such as a lake or river. Land use in the site vicinity could range from

agricultural or forest uses to developed land uses such as residential, commercial, or industrial. The nearest residence to a generic existing LWR site would range from 1 to 6.5 km (0.6 to 4 mi) distant.

As this is an existing condition, site development would be in conformance with land-use plans, policies, and controls. Likewise, land-use incompatibility would not be an issue.

Visual Resources. The visual environment of a generic existing LWR site would likely be characterized by flat to gently rolling topography adjacent to a large water body. The site would be a developed area that contains facilities and activities, encompassed by an undeveloped buffer area. The viewshed would likely include a small- to medium-sized urbanized area with surrounding forest and agricultural use. Depending on topography, atmospheric conditions, vegetation, and distance, the facilities of a generic existing LWR site could be visible from adjacent viewpoints. Stack plumes from cooling towers could be visible under most meteorological conditions. Median visible plume lengths would usually range from less than 500 m (1,640 ft) in summer to 1000 m (3,280 ft) in winter (NRC 1981a:5-6,5-7). The facilities would be brightly lit at night. The range of public viewpoints could include public access roadways, urbanized areas, and recreation/scenic areas with high user volumes. The full range of sensitivity levels, and distance zones would occur (see Section 3.1.1 for discussion of visual resource inventory). Since the site would be adjacent to a large water body, it would be likely that distance zones would range from foreground to middleground. The developed areas of a generic existing LWR site would likely be consistent with a BLM VRM classification Class 5.

3.12.2 SITE INFRASTRUCTURE

Baseline Characteristics. Extensive infrastructures exist to support individual reactor sites as shown by the range of values displayed in Table 3.12.2–1. Approximately one-half of the 72 reactor sites in the United States contain two or three nuclear units. Larger land-use areas associated with plant cooling systems include reservoirs, artificial lakes, and buffer areas. Road infrastructure is needed for personnel access and intersite transportation requirements. Railroad infrastructure is required to support shipments of fuels, spent fuels, and outsized structural components among other items. Some sites are situated on navigable waters.

The reactor sites are located in a regional electric power pool made up of its parent utilities and a number of subregions. These power pools draw their electrical power from a variety of generating sources, as shown in Table 3.12.2–2.

Table 3.12.2–1. Generic Existing Light Water Reactor Site Baseline Characteristics

Characteristics	Site Availability
Transportation	
Roads (km)	5 to 20
Railroads (km)	0 to 12
Electrical	
Energy consumption (MWh /yr)	700,000 to 1,100,000
Peak load (MWe)	96 to 140
Fuel	
Oil (l/yr)	approximately 757,000

Source: ORNL 1995b.

Table 3.12.2–2. Generic Existing Light Water Reactor Site Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	14 to 59%
Nuclear	0 to 39%
Hydro/geothermal	2 to 46%
Oil/gas	<1 to 32%
Other[b]	0 to 30%
Total Annual Production	107,607,000 to 272,155,000 MWh
Total Annual Load	104,621,000 to 293,262,000 MWh
Energy Exported Annually	-45,400,000 to 6,359,000 MWh
Generating Capacity	24,870 to 61,932 MWe
Peak Demand	20,578 to 57,028 MWe
Capacity Margin[c]	4,064 to 13,655 MWe

[a] Does not total 100 percent due to range at power pools used to estimate the generic site.

[b] Includes power from both utility and nonutility sources.

[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

3.12.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The meteorological and climatological conditions at the representative existing LWR sites in the United States include a wide range of extremes in ambient temperature, wind speed and direction, and precipitation. Therefore, no further description of meteorology and climatology has been provided with respect to a generic site.

Ambient Air Quality. Ambient air quality conditions at the representative existing LWR sites in the United States include a wide range of pollutants and conditions. Table 3.12.3–1 presents the baseline ambient air concentrations for criteria pollutants at a representative existing LWR site. As show in this table, the existing LWR site is expected to comply with the ambient air quality standards. Some of the existing LWR sites evaluated are located near or within nonattainment areas for PM_{10}, O_3, and CO.

Table 3.12.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at the Generic Existing Light Water Reactor Site

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000	<0.01
	1-hour	40,000	<0.01
Lead	Calendar Quarter	1.5	[b]
Nitrogen dioxide	Annual	100	0.05
Ozone	1-hour	235	[c]
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01
	24-hour	150	0.015
Sulfur dioxide	Annual	80	0.04
	24-hour	365	0.15
	3-hour	1,300	0.35
Hazardous and Other Toxic Compounds			
No sources indicated			

[a] The Federal standards are presented.

[b] No sources indicated.

[c] Ozone, as a criteria pollutant, is not directly emitted nor monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

Source: 40 CFR 50; TVA 1974b.

Noise. Specific existing noise sources and characteristics of a generic existing LWR site cannot be described. However, it is expected that the area near such a site would be essentially rural in character and would have typically low background sound levels. Typical DNL in the range 35 to 50 dBA can be expected for such a rural location (EPA 1974a:B-4) where noise sources may include wind, insect activity, aircraft, and agricultural activity. Existing industrial noise sources and traffic noise at the site would result in higher background noise levels near the site and along site access routes.

3.12.4 WATER RESOURCES

Surface Water. Major surface water features in the generic existing LWR site area could range from a large navigable river to a large lake. The average flow rate of these water bodies could range from 28 to 3,360 m^3/s (989 to 118,658 ft^3/s). Other surface water features could include large ponds and/or small streams bordering the site.

Stormwater control retention/drainage ponds could be present at the site. These ponds would probably discharge to the nearest large surface water body.

Surface Water Quality. In the vicinity of the generic existing LWR site, the surface water bodies could range from being unclassified to classified as fresh water suitable for public and food processing water supply. The range of concentrations of typical surface water quality parameters that could be encountered at generic sites was presented in Table 3.10.4–1. High nutrient loads, low dissolved oxygen, and moderately high bacteria count could be encountered in the nearby large surface water body.

The generic existing LWR site would have an NPDES permit(s) that would dictate the acceptable levels of specific parameters in the liquid effluents that would be discharged to a nearby surface water body.

Surface Water Rights and Permits. Surface water rights concerning the large water body near the existing LWR site would involve non-impairment of designated uses.

Groundwater. The near-surface aquifer beneath the generic existing LWR site would occur under unconfined conditions and could range in average thickness from approximately 5 to 55 m (16 to 180 ft). Depth to groundwater could range from near the ground surface to 12 m (39 ft). The aquifer material could range from glacial drift to saprolite. In general, the generic existing LWR site would obtain groundwater from a confined aquifer underlying the near-surface aquifer. The confined aquifer would have an abundant supply of groundwater, although groundwater levels could be declining in the area. Water quality could range from good to fair.

Recharge to the near-surface aquifer would be primarily from rainfall and would occur in areas located from near the site to more than 16 km (10 mi) away from the site. Groundwater flow would typically be from these recharge areas towards the major surface water feature.

In areas surrounding the typical generic existing LWR site, groundwater would be used for domestic, industrial, agricultural, and municipal supply purposes. The classification of the aquifer beneath the site would be a Class II aquifer (that is, currently being used or a potential source of drinking water).

Groundwater Quality. Groundwater quality of the near-surface aquifer in the site area would range from good to fair. The range of hydraulic characteristics of the groundwater that might be encountered is presented in Table 3.10.4–2.

Groundwater Availability, Use, and Rights. Groundwater rights concerning the aquifer(s) near the generic existing LWR site could range from having potential for local restrictions on pumping to a reasonable use doctrine concerning neighboring landowners water availability.

3.12.5 GEOLOGY AND SOILS

Geology. The physiography of an existing LWR site could range from a flat nearly featureless plain to a highly dissected plain of arid to humid environments. The geology could range from alluvium to thick sequences of unconsolidated marine sediments, glaciofluvial material, and crystalline and sedimentary bedrock. These materials could range in age from Cenozoic to Precambrian (recent to over 600 million years).

The existing LWR sites could be located in Seismic Zones 0 to 2, which suggests there could be no to moderate levels of damage in the event of an earthquake (Figure 3.2.5–1). The geologic settings for Seismic Zones 0 to 2 considered for the existing LWR sites have histories of seismic activity that range from low to high. The location of the nearest capable fault could range from within the site boundaries to 350 km (217 mi) away from existing LWR sites. The nearest known epicenter of a damaging earthquake (MMI of VII or greater [Table 3.2.5–1]) could be approximately 350 km (217 mi) from existing LWR sites.

The existing LWR sites are not located within a region of active volcanism; however, an existing LWR site could be located within 164 km (102 mi) of a volcano.

Soils. The existing LWR sites could be located where the predominant soil types are loamy clays to gravel silty loams. These soils range from moderate to well drained soils. The erosion potential could range from minor to severe in those areas with slopes greater than 25 percent and which have been eroded in the past. The soils shrink-swell potential could range from low to severe, which is acceptable for standard construction techniques, depending upon the engineering controls employed. Wind erosion potential ranges from minor to severe.

3.12.6 BIOLOGICAL RESOURCES

Generic existing LWR sites are located within a number of the principal vegetation types. Vegetation types characteristic of the representative generic existing LWR sites used for this analysis include deciduous forest, grassland, desert, and southeast evergreen forest. Biological resources found within these vegetation types are described in Section 3.10.6 and 3.11.6. At a given site, biological resources could vary from those typically associated with the principal vegetation type of the area due to a variety of factors, including previous disturbance by man.

3.12.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric resources in the vicinity of the existing LWR site may include sites, districts, or isolated artifacts. Archaeological sites may represent occupation during the Archaic through later prehistoric periods and can include hunting and butchering sites, cemeteries, campsites, and tool manufacturing areas. They may yield artifacts such as stone tools and associated manufacturing debris, and ceramic potsherds. Some sites may have been determined eligible for inclusion on the NRHP by the SHPO. Prehistoric resources are most likely to be affected by ground disturbance. No impacts to prehistoric resources are anticipated because this alternative does not involve new facility construction.

Historic Resources. Historic resources may include cemeteries, remains of commercial or residential structures, or standing structures. Some sites may be eligible for inclusion on the NRHP.

Native American Resources. To date, no Native American resources have been identified at the generic existing LWR site, but they may exist. Such resources can include cemeteries, geological or geographic elements (such as mountains or creeks), certain species of animals or plants, architectural structures (such as pueblos), battlefields, or trails. Such resources are objects or areas that are important to Native American groups for religious or historical reasons. There also may be visual impacts to Native American resources.

Paleontological Resources. To date, no paleontological resources have been identified at the generic existing LWR site. However, some fossil-bearing strata may exist that contain rare fossils or fossil assemblages.

3.12.8 SOCIOECONOMICS

The generic existing LWR site could potentially affect the socioeconomic environment of a given REA or ROI. The characteristics of the REA, ROI, and community are dependent upon geographic location. For employment and income, the economic area would be based upon industry interaction and linkages in the region. The anticipated residential distribution of project-related employees and their families would determine the ROI. This ROI would contain all principal jurisdictions and school districts likely to be affected by the proposed activity.

Because specific commercial LWR sites have not been proposed for burning MOX fuel, representative sites have been used to describe the affected environment. Five existing reactors encompassing four location types were used as representative sites to develop a range of conditions for discussion in this section. The first two communities, Sites A and B, are small communities tied to large metropolitan areas. Site C is a medium-size community near a large metropolitan area. The fourth site, Site D, is a medium-size community located in an urbanized area.

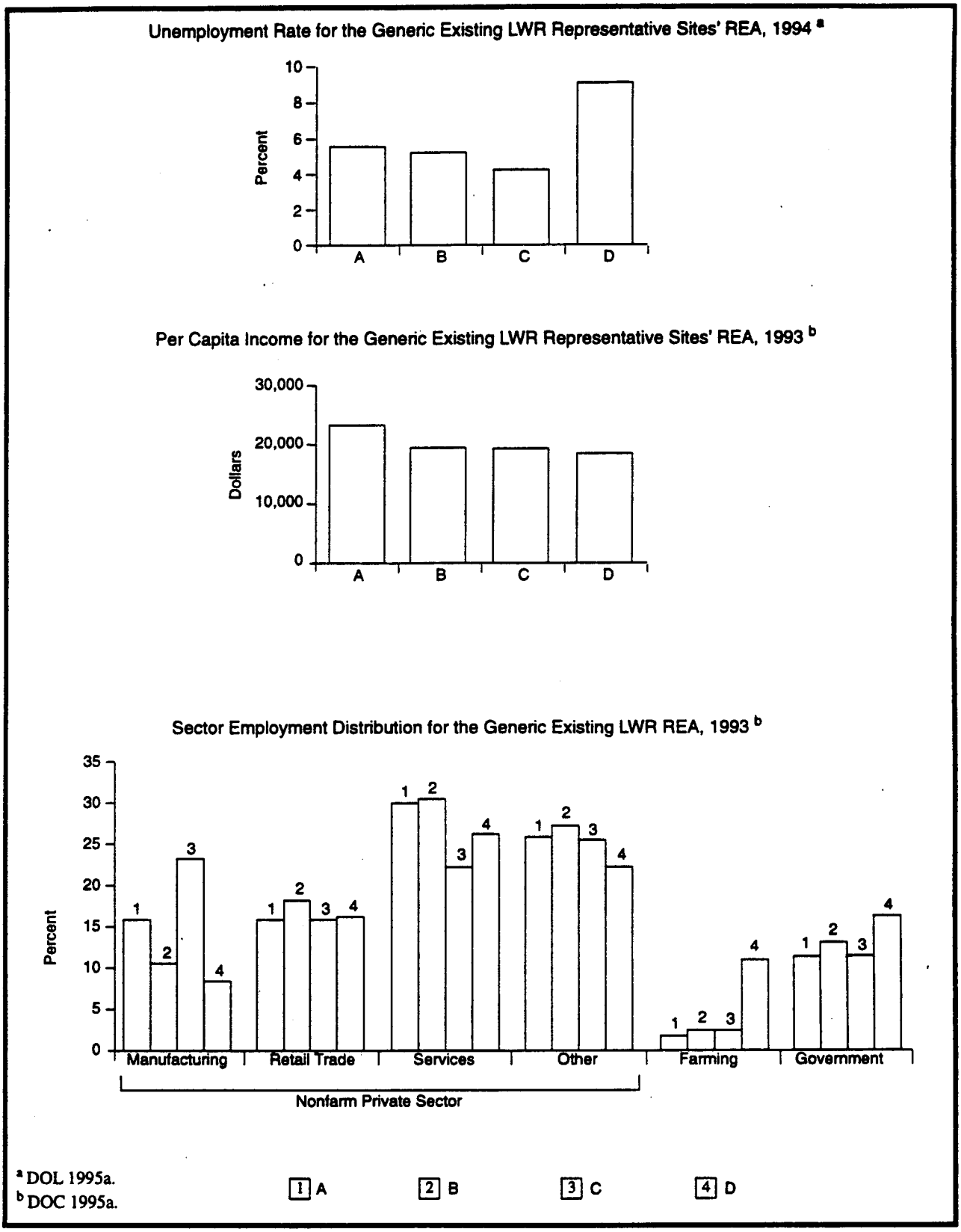
Small communities were characterized in Section 3.11.8. Medium-size communities and the vulnerability or susceptibility of a local community to changes in the economic base were described in Section 3.10.8. However, the specific communities discussed in this section are different from those discussed in Section 3.11.8.

Socioeconomic characteristics described for the generic existing LWR site include employment and local economy, population and housing, and local transportation. Site A, which had a 1992 population of 2,604, was located about 160 km (100 mi) from a large metropolitan area. Site B, with a 1992 population of 5,236, was located approximately 8 km (5 mi) from a small community and approximately 64 km (40 mi) from a large metropolitan area. Site C, with a 1992 population of 44,384, was located approximately 16 km (10 mi) from a medium-size community and approximately 48 km (29.8 mi) from a large metropolitan area. Site D, a medium-size community, had a 1992 population of 34,201 and a total urban population of more than 100,000. Statistics for employment and local economy were based on the REA for each site. Statistics for the remaining socioeconomic characteristics were based on the sites' ROIs.

Regional Economy Characteristics. Employment and regional economy statistics for each representative site's REA are discussed in this section and displayed in Figure 3.12.8–1. Between 1980 and 1990, the civilian labor force in the REA encompassing Site A increased 7.7 percent to the 1990 level of 4,811,800, and for Site B increased 49.6 percent to the 1990 level of 1,162,300. The civilian labor force for Site C, located near a large metropolitan area, increased 21.9 percent to the 1990 level of 862,500. The civilian labor force for Site D, located in an urbanized area, increased 9.9 percent to 254,800 persons. The 1994 unemployment rates in the two small communities' (A and B) REAs were 5.6 percent and 5.2 percent, respectively. Sites C and D had unemployment of 4.3 percent and 9.1 percent, respectively. The 1993 per capita incomes were $23,634 at Site A and $19,497 at Site B. Sites C and D had per capita incomes of $19,489 and $18,501, respectively.

Figure 3.12.8–1 displays the division of employment involving farming, nonfarming, and government sectors for each typical site. For the two small representative communities, the portions of total employment involving farming in the REAs were about 1 percent. Governmental activities for Sites A and B represented about 12 percent and 14 percent, respectively. Manufacturing was 16 percent of the total employment for site A and 10 percent for site B. Retail trade accounted for 16 percent and 18 percent of the total sector employment for Sites A and B, respectively. Service activities represented a 30-percent share of the total employment for Sites A and B.

For Sites C and D, the portion of total employment was about 1 percent and 12 percent for farming and 11 and 15 percent for governmental activities, respectively. The nonfarm private sector activities of retail trade and services were 16 and 22 percent of total employment, respectively, for Site C and 16 and 26 percent,



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.12.8–1. Employment and Local Economy for the Generic Existing Light Water Reactor Representative Sites' Regional Economic Area.

respectively, for Site D. Employments for manufacturing were 23 and 8 percent of total employment for Sites C and D, respectively.

Population and Housing. Population and housing trends in the representative ROIs are presented in Figure 3.12.8–2. The ROI population increase for the two small communities, A and B, between 1980 and 1994 were 6.4 (average annual increase of 0.5 percent) and 54.6 (average annual increase of 3.9 percent) percent, respectively. The number of housing units in the ROI increased 8.9 percent for Site A and 55.8 percent for Site B between 1980 and 1990. The 1990 ROI homeowner vacancy rates were 1.1 and 3.9 percent, while the renter vacancy rates were 5.9 and 16.4 percent for Sites A and B, respectively.

The ROIs surrounding Sites C and D experienced an 31.8-percent (average annual increase of 2.3 percent) and 19.8-percent (average annual increase of 1.4 percent) increase in population, between 1980 and 1994, and a 32.7- and 5.4-percent increase, respectively, in the number of housing units between 1980 and 1990. The 1990 homeowner and renter vacancy rates were 2.0 and 8.9 percent for Site C and 1.3 and 5.6 percent for Site D.

Community Services and Local Transportation. These characteristics are dependent upon a geographic location. The ROI would determine all principal jurisdictions and school districts likely to be affected by the proposed activity. Local transportation would be the existing principal road, air, and rail networks required to support the project activities.

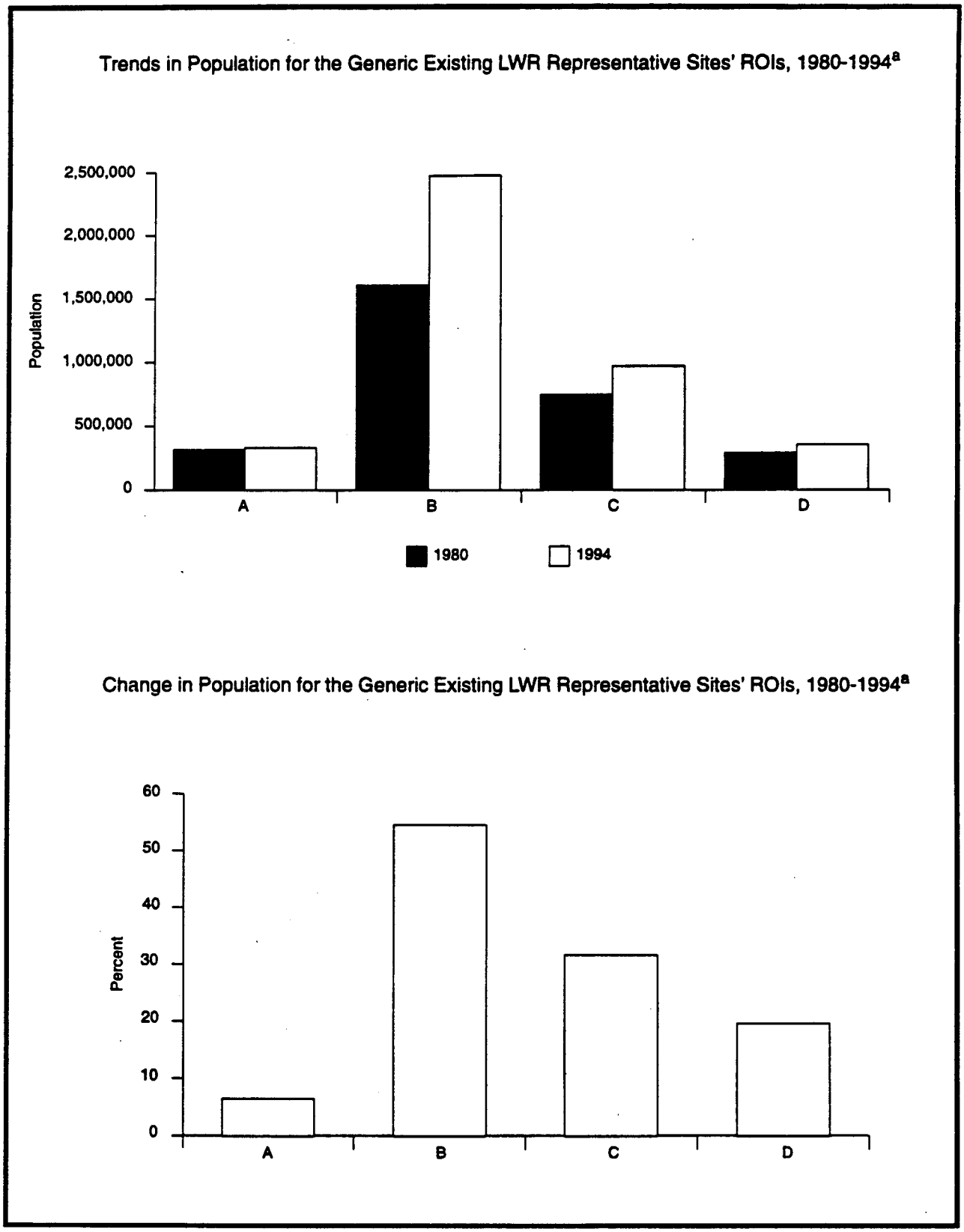
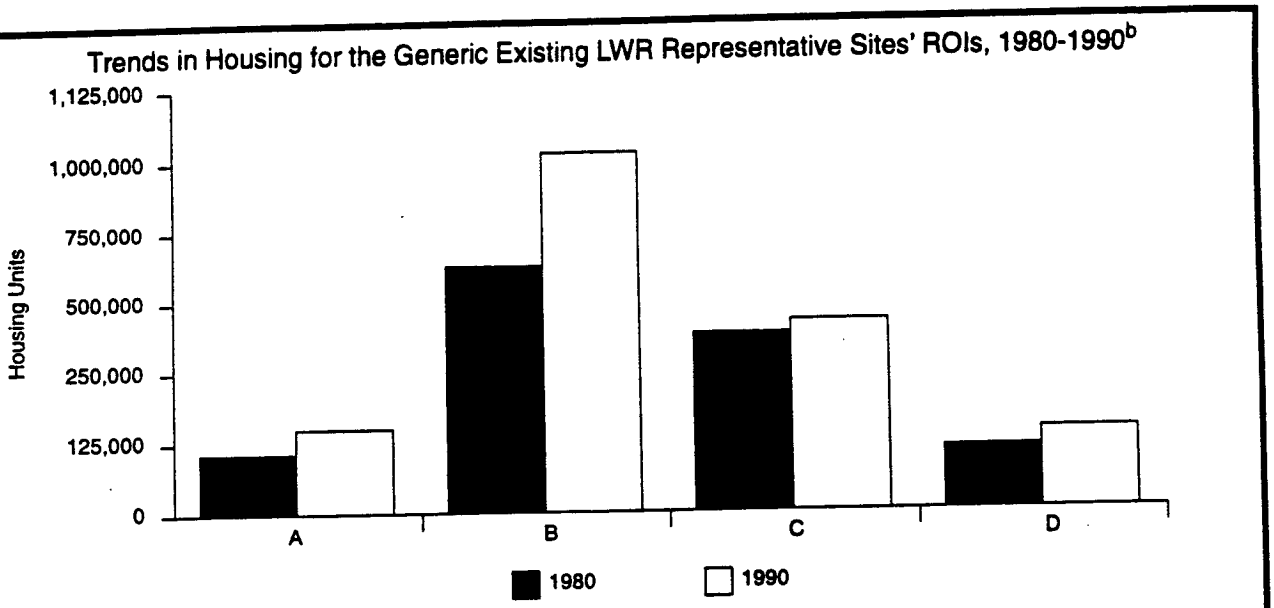
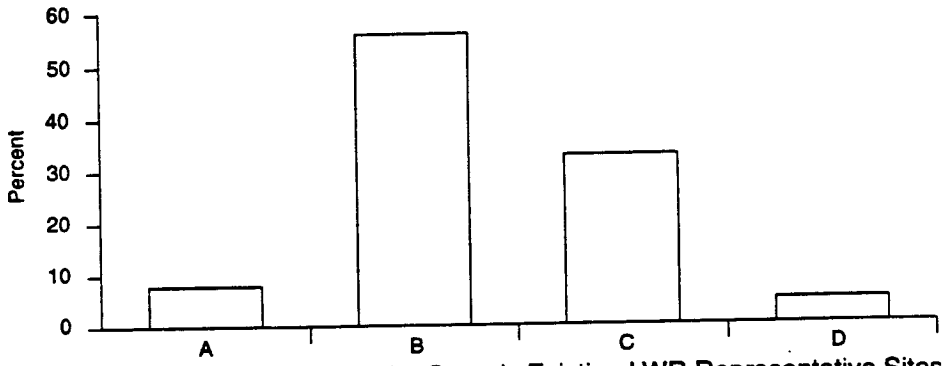
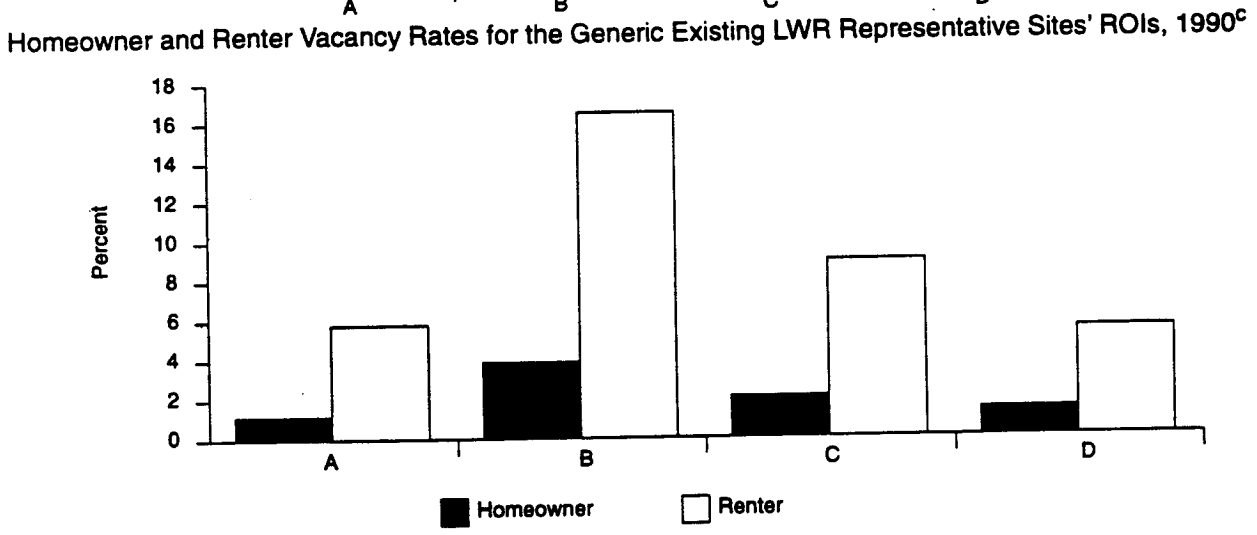


Figure 3.12.8–2. Population and Housing for the Generic Existing Light Water Reactor Representative Sites' Region of Influence.







[a] Census 1983b; Census 1983f; Census 1983k; Census 1983m; Census 1995a.

[b] Census 1982c; Census 1982e; Census 1982m; Census 1982r; Census 1991b; Census 1991d; Census 1991q; Census 1991r.

[c] Census 1991b; Census 1991c; Census 1991d; Census 1991q.

Figure 3.12.8–2. Population and Housing for the Generic Existing Light Water Reactor Representative Sites' Region of Influence—Continued.

3.12.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of the generic existing LWR site are shown on Table 3.12.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population size changes as the population size changes. Background radiation doses are unrelated to LWR site operations.

Table 3.12.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Operation at the Generic Existing Light Water Reactor Site

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation	
Cosmic radiation[a]	27 to 29
Cosmogenic radiation[b]	1
External terrestrial radiation[a]	29 to 30
Internal terrestrial radiation[b]	39
Radon in homes (inhaled)[b]	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	361 to 364

[a] Based on information given in EPA 1981b.
[b] NCRP 1987a.
Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from generic existing LWR site operations provide another source of radiation exposure to individuals in the vicinity of generic existing LWR sites. Types and quantities of radionuclides released from generic existing LWR site operations in 1994 are listed in the 1994 radiological effluent release reports for the reference sites. The doses to the public resulting from these releases are presented in Table 3.12.9–2. These doses fall within radiological guidelines and limits (10 CFR 50, Appendix I and 40 CFR 190) and are small in comparison to background radiation.

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from operations at the generic existing LWR site in 1994 is estimated to range from 3.9×10^{-9} to 7.0×10^{-7}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of LWR site operations ranges from about 4 in 1 billion to 7 in 10 million. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Based on the same risk estimator, a range of 1.0×10^{-5} to 6.7×10^{-3} excess fatal cancers is projected in the population living within 80 km (50 mi) of the generic existing LWR site from normal operations in 1994. To place these numbers into perspective, they can be compared with the numbers of fatal cancers expected in these populations from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a: 839). Based on this mortality rate, the number of fatal cancers expected during 1994 from all causes in the population living within 80 km (50 mi) of the generic existing LWR site

Table 3.12.9–2. Radiation Doses to the Public From Normal Operation at the Generic Existing Light Water Reactor Site in 1994 (Committed Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the General Public	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual[b]
Maximally exposed individual (mrem)	5	1.3×10^{-3} to 1.10	3 per reactor	0 to 0.29	25	7.8×10^{-3} to 1.39
Population within 80 km[c] (person-rem)	None	0.016 to 13.3	None	0 to 1.28	None	0.020 to 13.3
Average individual within 80 km (mrem)[d]	None	6.3×10^{-5} to 6.8×10^{-3}	None	0 to 8.9×10^{-4}	None	7.9×10^{-5} to 6.8×10^{-3}

[a] The standards for individuals are given in 10 CFR 50 Appendix I and 40 CFR 190. As discussed in Appendix I of 10 CFR 50, the 5 mrem/yr value is an airborne emission guideline and the 3 mrem/yr per reactor value is a liquid release guideline. Meeting these guideline values serves as a numerical demonstration that doses are as low as is reasonably achievable. The total dose of 25 mrem/yr is the limit from all pathways combined as given in 40 CFR 190.

[b] Totals cannot be obtained by summing the atmospheric and liquid release components since these component entries can be for different reactor sites.

[c] This population ranges from 252,000 to 1,960,000.

[d] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: HNUS 1996a.

ranged from 505 to 3,920. These numbers of expected fatal cancers are much higher than the estimated range of 1.0×10^{-5} to 6.7×10^{-3} fatal cancers that could result from operations at the generic existing LWR site in 1994.

At the generic existing LWR site, workers receive the same dose as the general public from background radiation but also receive an additional dose from working at the site. Table 3.12.9–3 presents the range of the average worker, maximally exposed worker, and total worker dose from operations at the generic existing LWR site in 1993. These doses fall within radiological regulatory limits (10 CFR 20). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of excess fatal cancers to generic existing LWR site workers from operations in 1993 is estimated to range from 0.16 to 0.34.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the reference sites' environmental reports and environmental monitoring reports. The concentrations of radioactivity in various environmental media (including air, water, and soil) in the regions of the generic existing LWR site (onsite and offsite) are also presented in those documents.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface waters during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.12.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements) contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at generic existing LWR sites via inhalation of air containing hazardous chemicals released to the atmosphere by site operations. Risks to public health from other

Table 3.12.9–3. Doses to Workers From Normal Operation at the Generic Existing Light Water Reactor Site in 1993 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	114 to 322
Maximally exposed worker (mrem)	5,000	2,000 to 3,000
Total workers[b] (person-rem)	ALARA	396 to 854

[a] NRC's goal is to maintain radiological exposure as low as reasonably achievable.

[b] The number of badged workers in 1993 ranged from 2,650 to 4,370.

Source: 10 CFR 20; NRC 1995b.

possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

A discussion of ambient air quality is included in Section 3.12.3. As stated in that section, air quality is expected to be are in compliance with applicable standards. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways for generic existing LWR site workers during normal operation may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. Occupational exposure varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. At the generic existing LWR site, workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operational processes, ensures that these standards are not exceeded. Worker health conditions at the generic existing LWR site are expected to be substantially better than required by the standards.

Health Effects Studies. Specific locations for the generic existing LWR must be designated before any reviews of epidemiologic studies in the areas can be conducted.

Accident History. Commercial LWR's that utilize uranium fuel have been in operation in the United States for many years. Accident information for these reactors, where applicable, can be found in documentation available from the NRC. Estimates of potential accidents and their consequences can also be found in safety analysis reports and probabilistic risk assessments prepared by the reactor owners and filed with the NRC. There are no domestic commercial reactors that utilize MOX fuel and consequently there is no information available regarding England accident history for MOX fueled reactors.

Emergency Preparedness. The generic existing LWR site has an emergency management program that would be activated in the event of an accident. The programs are compatible with the other Federal, State, and local plans and are thoroughly coordinated with all interested groups. Programs would be modified, if necessary, to accommodate MOX fueled reactor operations.

3.12.10 WASTE MANAGEMENT

Because of the increased disposal costs for LLW, utility companies have undertaken major volume reduction and waste minimization efforts. These efforts include segregation, decontamination, minimizing the exposure of materials and tools to the contaminated environment, and sorting. Compaction, consolidation, and the monitoring of waste streams to reduce the volume of LLW requiring storage and to lessen the exposure of routine equipment to the reactor environment have been the most effective volume reduction strategies. Between 1981 and 1985 there was a 48-percent decrease in LLW volumes from commercial pressurized LWRs. Current industry-wide volume reduction practices include ultra-high pressure compaction of waste drums, incineration of waste oils and resins, mobile thin-film evaporation, waste crystallization, and asphalt solidification of resins and sludges (NRC 1996b:6-40).

Nuclear power plants currently operating typically have waste minimization programs in place to minimize both the volume and cost impact of waste generation. In existing operating plants, a number of the design considerations that affect the plant waste streams are already in place, and improvements in waste management are continually being implemented. Waste minimization steps include more economical use of disposables or elimination of disposables in favor of recyclables. Process improvements aimed at more efficient use of ion exchange resins and reductions of waste streams from the waste processes are being implemented. In general, wastes generated by operating plants have been decreasing in recent years. The amount of waste generation is reported by each utility on a quarterly basis. Table 3.12.10–1 provides a range of waste volumes based on site-specific data from existing representative LWRs.

Spent Nuclear Fuel. After removal from the reactor, spent nuclear fuel is stored in racks in pools to isolate it from the environment and to allow the fuel rods to cool. Current plans call for spent nuclear fuel to be ultimately disposed of in a deep-geological repository. Because of the delay in siting the repository and interim monitored retrievable storage facilities, utility companies have been faced with the rapid filling of their spent fuel pools. The utility companies have been expanding pool storage, building above-ground dry storage, using longer fuel burnup to reduce the amount of spent fuel requiring interim storage, and shipping the spent nuclear fuel to other plants (NRC 1996b:6-70). When moved to another location, spent nuclear fuel is shipped in casks that are designed to withstand severe transportation accidents and are resistant to small-arms fire and HE detonations (NRC 1996b:6-34).

The average number of spent nuclear fuel assemblies discharged ranges from 64 to 88 for the 8 PWR and 187 to 191 for the 4 BWR existing plants used in the analysis. Licensed spent fuel pool storage capacity (number of assemblies) ranges from 756 to 1,542 for the 8 PWR plants, and 2,040 to 4,020 for the 4 BWR plants.

High-Level Waste. The generic existing LWR would not generate or manage HLW.

Transuranic Waste. The generic existing LWR would not generate or manage TRU waste.

Low-Level Waste. Liquid LLW generated in pressurized LWRs could be classified as either clean waste, dirty waste, turbine building floor drain water, or steam generator blowdown. Clean wastes come from equipment leaks and drains, certain valve and pump seal leakoffs not collected in the reactor coolant drain tank, and other aerated leakage sources. Primary coolant is also considered a clean waste. Liquid wastes collected in the containment building sump, auxiliary building sumps and drains, laboratory drains, sample station drains, and other miscellaneous floor drains are termed dirty wastes because of their moderate conductivity. Clean and dirty wastes will have variable radioactivity content. Detergent wastes, which consist of laundry wastes and personnel and equipment decontamination wastes, normally have a low radioactivity content. Turbine building floor drain water usually exhibits high conductivity with low radionuclide content. Depending on the amount of primary-to-secondary leakage, steam generator blowdown could have relatively high concentrations of radionuclides. The chemical and radionuclide content of the waste would determine the type and degree of treatment before

Table 3.12.10–1. Existing Light Water Reactor Site Waste Management Characteristics

Characteristic	BWR Range	BWR Average	PWR Range	PWR Average	All Plants Average	All Plants Low	All Plants High
LLW shipped (m^3/yr)	367.21 to 936.25	572.61	57.04 to 636.85	178.22	309.69	57.04	936.25
Number LLW shipments/year	39.50 to 108.25	62.84	6.00 to 31.00	16.17	31.73	6.00	108.25
Stored mixed waste/ 1000 MWe (m^3/yr)	Not reported	Not reported	Not reported	Not reported	101.90	Not reported	Not reported
Licensed spent fuel pool storage capacity (number of assemblies)	2,040 to 4,020	3,176	756 to 1,542	1,214	1,868	756	4,020
Average number of assemblies discharged	187 to 191	190	64 to 88	72	111	64	191

Source: ORNL 1995b.

storage for reuse or discharge to the environment. Operating plants have steadily increased the degree of processing, storing, and recycling of liquid radioactive waste (NRC 1996b:2-5).

Solid LLW is generated by the removal of radionuclides from the liquid radioactive waste streams, the filtration of airborne gaseous emissions, and the removal of contaminated material from various reactor areas. The concentrated liquids, filter sludges, waste oils, and other liquid sources are segregated by type, flushed to storage tanks, stabilized for packaging in a solid form by dewatering, and slurried into 0.2 m^3 (0.3 yd^3) steel drums. Other solid LLW consists of spent HEPA filters and wastes from plant modifications and routine maintenance activities such as contaminated protective clothing, paper, rags, glassware, compactible and noncompactible trash, and non-fuel irradiated reactor components and equipment. Tools and other material exposed to the reactor environment would also be considered solid LLW. Compactible solid LLW is taken to an offsite or onsite volume reduction facility before disposal. Solid LLW is stored in shielded prefabricated steel buildings or other facilities until suitable for disposal at an approved LLW disposal facility (NRC 1991a:2-15).

Low-level waste from BWRs primarily consists of concentrated waste from the reactor water cleanup and condensate demineralizer systems and waste generated during maintenance activities (for example, protective clothing, replaced equipment, and so forth). The average annual (1988 to 1992) volume of LLW shipped from a typical BWR unit ranges from 367 to 936 m^3/yr (480 to 1,224 yd^3/yr). The average annual (1988 to 1992) volume of LLW shipped from a typical PWR unit ranges from 57 to 637 m^3/yr (75 to 833 yd^3/yr). For 1993 and 1994, the per-unit volume of waste for all domestic BWRs has fallen to less than 200 m^3/yr, 18 percent under the 1995 industry goal of 245 m^3/yr. The average number of LLW shipments/year from a typical BWR unit ranges from 40 to 108. The average number of LLW shipments/year from a typical PWR unit ranges from 6 to 31. For 1993 and 1994, the per-unit volume of waste for all domestic PWRs has fallen to less than 50 m^3/yr (65.4 yd^3/yr), 45 percent under the 1995 industry goal of 110 m^3/yr (144 yd^3/yr) (ORNL 1995b:B-8).

Mixed Low-Level Waste. Mixed waste generated by a nuclear power plant covers a broad spectrum of waste types. The vast majority of mixed waste in storage at nuclear plants is chlorinated fluorocarbons and waste oil. Mixed LLW is stored onsite until treatment and disposal is available at an offsite RCRA-permitted facility. Because of the occupational exposure from testing radioactive wastes to determine if they are chemically hazardous, the utilities have been looking at ways to eliminate, or at least minimize, the generation of mixed wastes. These efforts include removing and separating hazardous constituents from radioactive streams by remote methods; minimizing the use of solvents exposed to the reactor environment; relying on substitute processes; and recycling and reusing cleaning materials, resins, and waste oils (NRC 1996b:6-66). Stored mixed LLW/1,000 MWe averages 102 m^3/yr (133 yd^3/yr) for all 12 existing plants studied.

Hazardous Waste. Hazardous wastes are generated from nonradioactive materials such as wipes contaminated with oils, lubricants, and cleaning solvents that are used outside the reactor environment. Hazardous wastes are packaged and shipped to offsite RCRA-permitted treatment and disposal facilities.

Nonhazardous Waste. Nonhazardous wastes include boiler blowdown, water treatment wastes, boiler metal cleaning wastes, floor and yard drain wastes, stormwater runoff, and sewage wastes. Depending on the design of the individual reactor, other small volumes of wastewater are released from other plant systems or combined with the cooling water discharges. Sanitary wastes that cannot be processed by onsite waste treatment systems are collected by independent contractors and trucked to offsite treatment facilities (NRC 1996b:6-86).

3.13 PARTIALLY COMPLETED REACTOR SITE

For this PEIS, the approach used to define the environmental setting for a partially completed reactor site was to use data from a representative site. Consequently, the environmental resource/issue areas are described in a general sense; not for a specific site.

The representative site used in this case is the partially completed Bellefonte Nuclear Plant, located in northeast Alabama along the Tennessee River. Principal structures include two reactor containment buildings, a turbine building, an auxiliary building, a condenser circulating water pumping station, two diesel generator buildings, a river intake pumping station, natural draft cooling towers, a transformer yard, 500-kV and 161-kV switchyards, and a sewage treatment facility.

3.13.1 LAND RESOURCES

For the partially completed reactor site, the representative environmental setting attributes for land use and visual resources are shown in Table 3.13.1–1.

Table 3.13.1–1. Land Resources Attributes of the Partially Completed Reactor Site

Land Use Attributes	
Land Area	600 ha[a]
Land Ownership	Public
Existing Land Use	
Onsite	Industrial
Offsite	Predominately forest and agricultural use; some urban/developed
Land Use Compatibility	Likely
Plans, Policies, and Controls	
Jurisdiction	DOE; other Federal; State; local
Enforcement	Lax to stringent
Conformance	Likely
Visual Resource Attributes	
Landscape Character	
Site	Flat valley; adjacent to large water body
Viewshed	Urban-industrial nodes; low-density residential; agricultural; and forest
Visual Resource	
Sensitivity Level	High
Distance Zones	Foreground, middleground, background, and seldom-seen
BLM VRM Class	5 (developed land)
Degree of Contrast	Weak to none

[a] Land area already dedicated.

Source: TVA 1974a; TVA 1974b; TVA 1995b:1.

Land Use. The partially completed reactor site consists of approximately 600 ha (1,500 acres) of land. However, this land area has already been dedicated; additional land area is not required to complete construction. Land use within the ROI is comprised of predominately forest and agricultural use, with some urban and developed land. Many communities adjacent to the site have corporate limits far exceeding actual developed areas and could accommodate additional development. The nearest town is located approximately 5 km (3 mi) from the site.

Completion of site development for industrial purposes would conform with the proposed land use of the site and its vicinity (urban and industrial development) as designated by the appropriate governmental plans, policies, and controls, and be compatible with adjacent land uses.

Visual Resources. The visual landscape of the partially completed reactor site is characterized by a flat valley adjacent to a reservoir and a river. The visual landscape of the site reflects that of an industrialized facility. The viewshed includes hilly land with urban-industrial nodes surrounded by low-density residential development scattered among agricultural uses and forest lands.

As discussed in Section 3.1.1, a visual resource inventory is composed of three factors: VRM classification, distance zones, and sensitivity levels. Distance zones with viewpoints include foreground, middleground,

background, and seldom-seen. Due to the site location adjacent to a large body of water, the immediate vicinity is likely to be subject to high user volumes associated with recreational use. Because of the proximity to urban development and a high-use recreational area, it is likely that the facilities would be visible from viewpoints with high sensitivity levels. However, since the partially completed reactor site represents an existing condition, contrasts created by new development are considered weak to none. The developed areas of the site are consistent with a VRM classification Class 5.

3.13.2 SITE INFRASTRUCTURE

Baseline Characteristics. The partially completed reactor site has the infrastructure shown in Table 3.13.2–1. The road infrastructure would be needed primarily for personnel access to the site. The railroad infrastructure is required for spent fuel shipments and oversized structural components. The site is situated on a navigable river with a small docking facility to accommodate barge traffic.

Table 3.13.2–1. Partially Completed Reactor Site Baseline Characteristics

Characteristics	Site Availability
Transportation	
Roads (km)	8
Railroads (km)	6
Electrical	
Energy consumption (MWh/yr)	1,100,000
Peak load (MWe)	140
Fuel	
Oil (l/yr)	757,000

Source: LLNL 1996g.

The sub-regional electric power pool for the site has the characteristics depicted in Table 3.13.2–2.

Table 3.13.2–2. Partially Completed Reactor Site Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	49%
Nuclear	39%
Hydro/geothermal	11%
Oil/gas	<1%
Other[b]	0%
Total Annual Production	159,842,000 MWh
Total Annual Load	156,987,000 MWh
Energy Exported Annually[c]	2,407,000 MWh
Generating Capacity	33,370 MWe
Peak Demand	28,127 MWe
Capacity Margin[d]	4,550 MWe

[a] Percentage does not total 100 percent due to rounding.

[b] Includes power from both utility and nonutility sources.

[c] Energy exported is not the difference of production and load due to system losses and pumped storage.

[d] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

3.13.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The climate at the representative partially completed reactor site and the surrounding region is characterized as temperate, with warm, humid summers and cool, variable winds. The average annual temperature is 15.7 °C (60.3 °F); average daily temperatures range from a minimum of -1.6 °C (29.2 °F) in January to a maximum of 31.7 °C (89.0 °F) in July (NOAA 1994c:3). The average annual precipitation is approximately 145.3 cm (57.2 in). Higher frequencies of winds are from the southeast, southwest, and northwest (TVA 1974b:1.2-7).

Ambient Air Quality. Ambient air quality conditions at the representative partially completed reactor site were reviewed. The site is located in an area that has been designated attainment with the NAAQS. There is no PSD Class I areas in the vicinity of the site. The site is expected to comply with the ambient air quality standards.

Noise. [Text deleted.] The area near the representative partially completed reactor site is rural in character and is expected to have typically low background sound levels. Typical DNL in the range of 35 to 50 dBA could be expected for such a rural location (EPA 1974a:B-4) where noise sources would include wind, insect activity, aircraft, and agricultural activity.

3.13.4 WATER RESOURCES

Surface Water. Major surface water features at the partially completed reactor site include a large navigable river that has been dammed to create a reservoir with a surface area of about 275 km^2 (106 mi^2) and a total volume of water of approximately 1.2 trillion l (317 billion gal). Average flow at the site is approximately 89 billion liters/day (23.5 billion gal/day). Other surface water features include small streams bordering the site.

Stormwater control retention/drainage ponds are present at the facility. These ponds discharge into the reservoir via Town Creek.

Surface Water Quality. The surface water body in the vicinity of the partially completed reactor site is classified as fresh water suitable for the following: primary and secondary contact recreation; a source of drinking water, after conventional treatment in accordance with State and local requirements; fishing and the survival and propagation of a balanced indigenous aquatic community of flora and fauna; and industrial and agricultural uses. The range of concentrations of typical surface water quality parameters at the site are presented in Table 3.10.4–1.

Surface Water Rights and Permits. Surface water rights concerning the large water body near the partially completed reactor site involve non-impairment of designated uses.

Groundwater. The near-surface aquifer beneath the site occurs under unconfined conditions. Typical aquifer material is highly weathered sedimentary bedrock overlying slightly fractured bedrock with no evidence of major solution channels.

Although the reservoir near the site supplies most of the potable water to nearby users, both private and public uses of groundwater occur in areas surrounding the site. The classification of the aquifer beneath the site is a Class II aquifer, that is, currently being used, or a potential source of drinking water.

Groundwater Quality. Groundwater quality of the near-surface aquifer at the site ranges from good to fair. The range of hydraulic characteristics of the groundwater that might be encountered at the partially completed reactor site is presented in Table 3.10.4–2.

Groundwater Availability, Use, and Rights. Groundwater rights concerning the aquifer(s) near the partially completed reactor site would be associated with the reasonable use doctrine. Under this doctrine, landowners can withdraw groundwater to the extent that they must exercise their rights in accordance with the similar rights of others.

3.13.5 GEOLOGY AND SOILS

Geology. The partially completed reactor site is defined as being located in a flat valley surrounded by an area consisting of alternating valleys and hills. This area could be underlain by rocks composed of dolomite, limestone, and shale of Paleozoic age (225 to 600 million years).

The partially completed reactor site is located in Seismic Zone 1, which suggests there could be minor levels of damage in the event of an earthquake (Figure 3.2.5–1). The nearest potential earthquake with an MMI of V could be located within approximately 8 km (5 mi) from the partially completed LWR site (Table 3.2.5–1). The nearest known epicenter of a damaging earthquake (MMI of VII or greater) could be approximately 80 km (50 mi) from the partially completed reactor site. The partially completed LWR facility is not located in a volcanically active region.

Soils. The partially completed reactor site is located where the predominant soil types range from loamy clays to loamy sands. These soils range from poorly to well drained soils. The erosion potential could range from minor to severe in those areas with slopes greater than 25 percent and that have been eroded in the past. The soil's shrink-swell potential could range from low to severe, which is acceptable for standard construction techniques, depending upon the engineering controls employed. Wind erosion potential could range from minor to severe.

3.13.6 BIOLOGICAL RESOURCES

The representative partially completed reactor site is located within the deciduous forest vegetation type. Biological resources found within this vegetation type are discussed in Section 3.10.6. At a given site, biological resources could vary from those typically associated with the principal vegetation type identified above due to a variety of factors, including previous disturbance by man.

3.13.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric resources at the representative partially completed reactor site may include sites, districts, or isolated artifacts. Archaeological sites located at the generic site may represent occupation during the Archaic, Woodland, or Mississippian periods, and could include hunting and butchering sites and short occupation campsites, or long-term occupation sites with remains of structures, hearths, and storage pits. They may yield artifacts such as stone tools and associated manufacturing debris, and ceramic potsherds. Some sites may have been determined eligible for inclusion on the NRHP by the SHPO.

Historic Resources. Historic resources may include cemeteries, remains of residential or commercial structures, standing structures, or roads. Some sites may be eligible for inclusion on the NRHP, and some may be listed with the SHPO.

Native American Resources. Native American resources may exist at the site. These resources can include objects, areas, or natural resources that are important to Native American groups for religious or historical reasons. Such resources can include cemeteries, geological or geographical elements such as mountains or creeks, certain species of animals or plants, or trails. There could also be visual impacts to Native American resources.

Paleontological Resources. To date no paleontological resources have been identified for the partially completed reactor site. The site is located on limestone formations. These formations can be fossil-bearing, so some paleontological resources may exist within the site boundaries.

3.13.8 SOCIOECONOMICS

Operation of the representative partially completed reactor site could potentially affect the socioeconomic environment of a given REA or ROI. The characteristics of the REA, ROI, and community depend upon geographic location. For employment and income, the economic area would be based upon industry interaction and linkages in the region. The anticipated residential distribution of project-related employees and their families would determine the ROI. This ROI would contain all principal jurisdictions and school districts for community services likely to be affected by the proposed activity. Local transportation would be the existing principal road, air, and rail networks required to support the project activities.

The representative site is located in a small community approximately 104 km (64.6 mi) from an urbanized area. Statistics for employment and regional economy are presented for the REA that encompasses 12 counties around the representative site. Statistics for the remaining socioeconomic characteristics are presented for the ROI, a three-county area (Counties A, B, and C) surrounding the site.

Regional Economy Characteristics. Selected employment and regional economy statistics for the representative site's REA are given in Figure 3.13.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 20.3 percent to the 1990 level of 430,100. The 1994 unemployment in the REA was 6.1 percent, which was approximately equal to unemployment for the representative State (6.0 percent). The per capita income in 1993 was $17,796, which was similar to the State's per capita income of $17,129.

As shown in Figure 3.13.8–1, farming represented 4 percent and governmental activities 18 percent of the total employment within the site's REA. This compares with the State rates of 3 and 18 percent for farming and government employment, respectively. Nonfarm private sector activities of manufacturing, retail trade, and services were 24, 16, and 21 percent, respectively, of the total regional employment for the representative site's REA. These were slightly different than the representative State's percentages for manufacturing (18 percent), retail trade (16 percent), and services (23 percent).

Population and Housing. Population in the ROI increased 20.9 percent from 1980 to 1994, compared to 8.3 percent in the representative State. The number of housing units increased 25.9 percent between 1980 and 1990, which was approximately 10 percent greater than the increase in the number of housing units for the entire State. The 1990 ROI homeowner vacancy rate, 1.9 percent, and the rental vacancy rate, 9.2 percent, were similar to those experienced in the representative State. Population and housing trends are summarized in Figure 3.13.8–2.

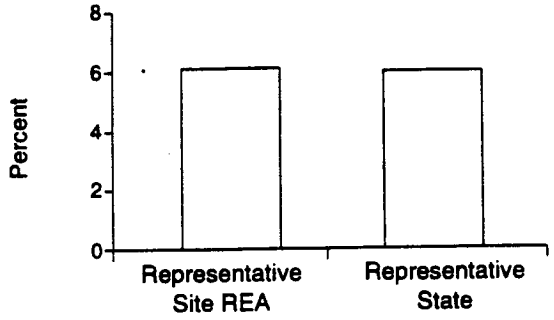
Community Services. Education, public safety, and health care characteristics were used to assess the level of community service in the representative ROI. These characteristics are summarized in Figures 3.13.8–3 and 3.13.8–4.

Education. In 1994, six school districts provided public education services and facilities in the representative ROI. As seen in Figure 3.13.8–3, these school districts operated between 69.7-percent and 100-percent capacity. The average student-to-teacher ratio for the ROI was 15.5:1.

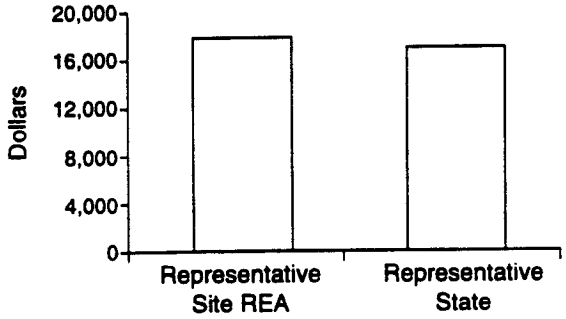
Public Safety. City, county, and State law enforcement agencies provided police protection to the residents in the ROI. In 1994, a total of 546 sworn police officers were serving the three-county ROI. The average officer-to-population ratio in the ROI was 1.5 officers per 1,000 persons. Figure 3.13.8–4 compares police force strengths across the ROI.

Fire protection services in the representative ROI were provided by 1,490 paid and volunteer firefighters in 1995. The average firefighter-to-population ratio in the ROI was 4.1 firefighters per 1,000 persons, as indicated in Figure 3.13.8–4.

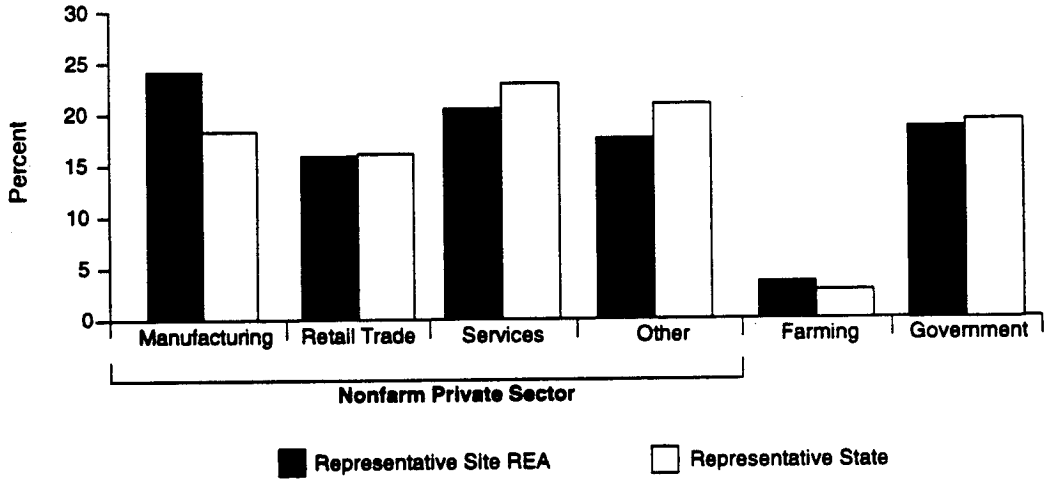
Unemployment Rate for the Representative Site REA and Representative State, 1994[a]



Per Capita Income for the Representative Site REA and Representative State, 1993[b]



Total Sector Employment for the Representative Site REA and Representative State, 1993[b]



[a] DOL 1995a.
[b] DOC 1995a.

Figure 3.13.8–1. Employment and Local Economy for the Representative Partially Completed Reactor Site Regional Economic Area and the Representative State.

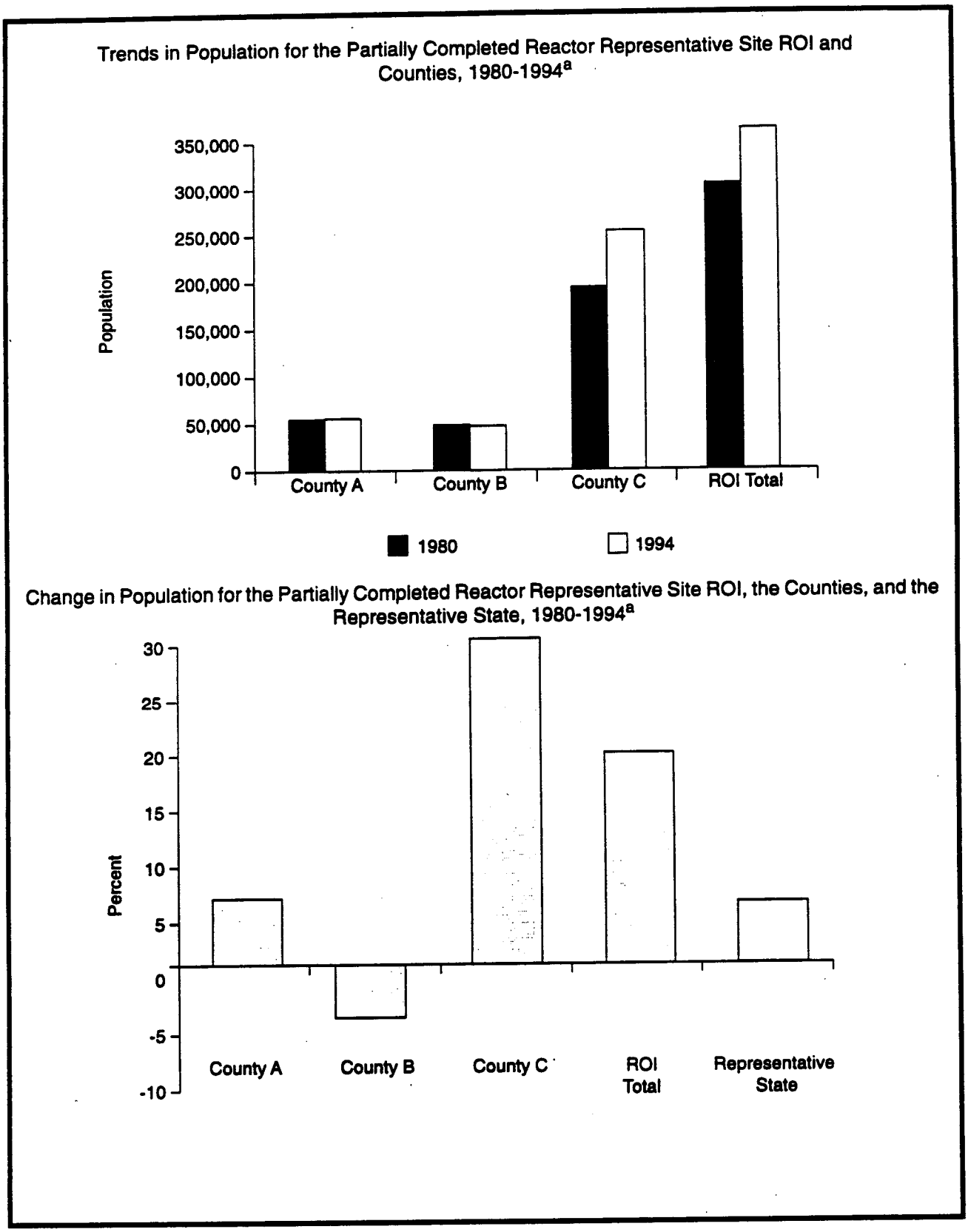
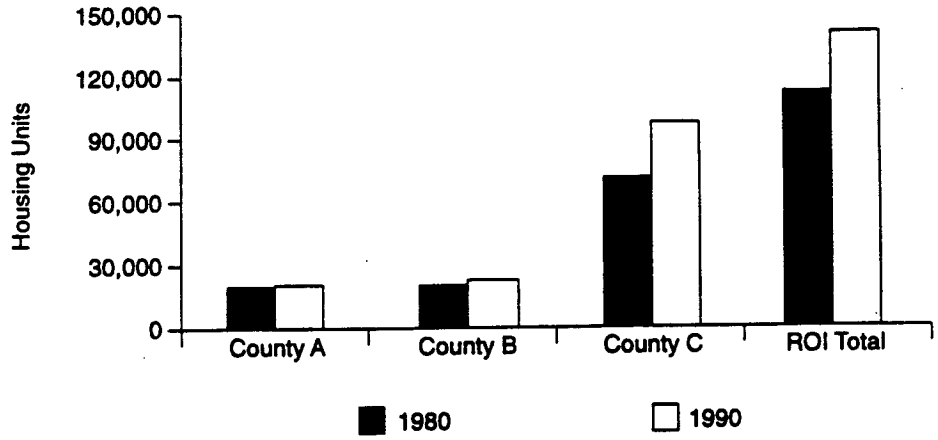
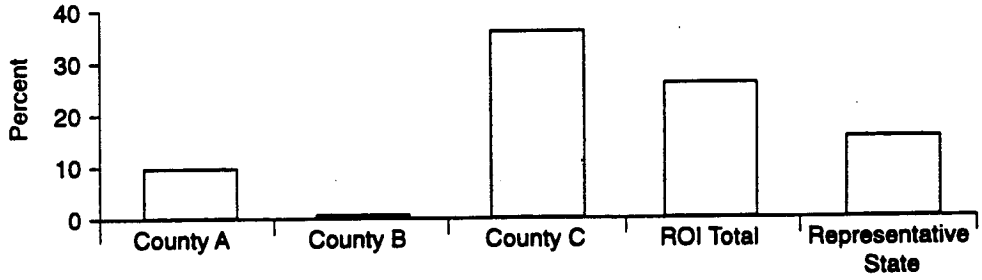


Figure 3.13.8–2. Population and Housing for the Representative Partially Completed Reactor Site Region of Influence and the Representative State.

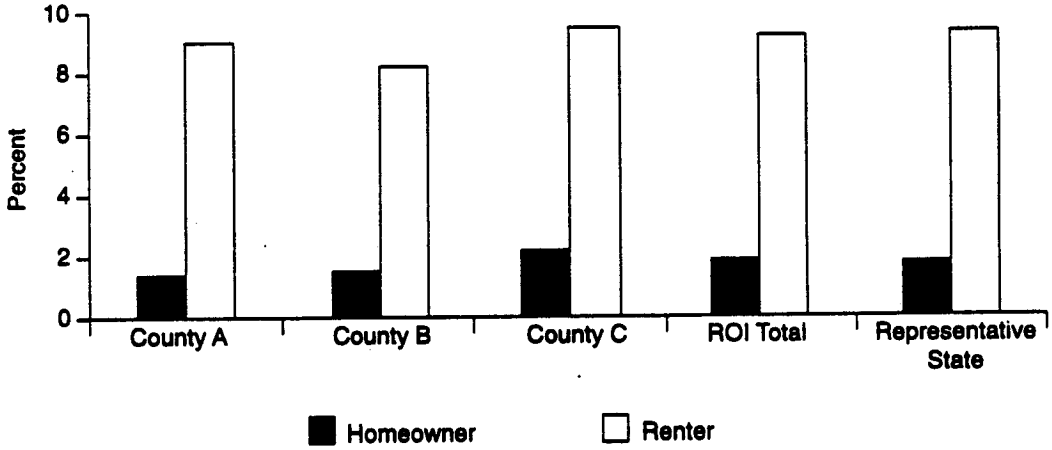
Trends in Housing for the Partially Completed Reactor Representative Site ROI and Counties, 1980-1990[b]



Change in Housing for the Partially Completed Reactor Representative Site ROI, the Counties, and the Representative State, 1980-1990[b]

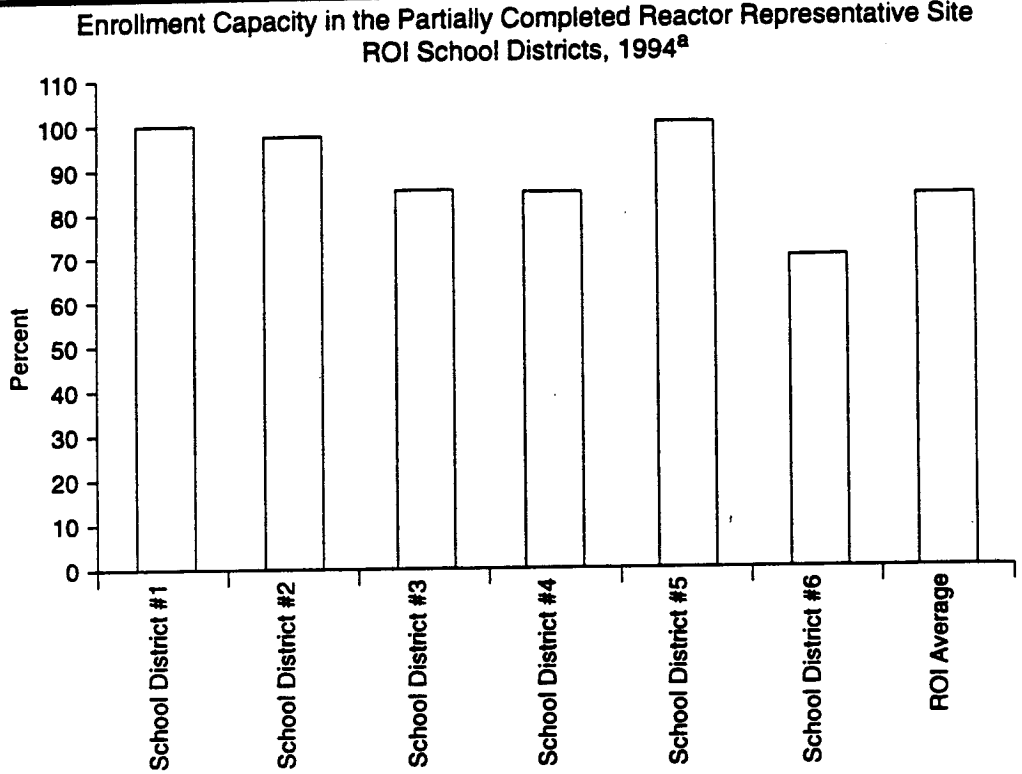


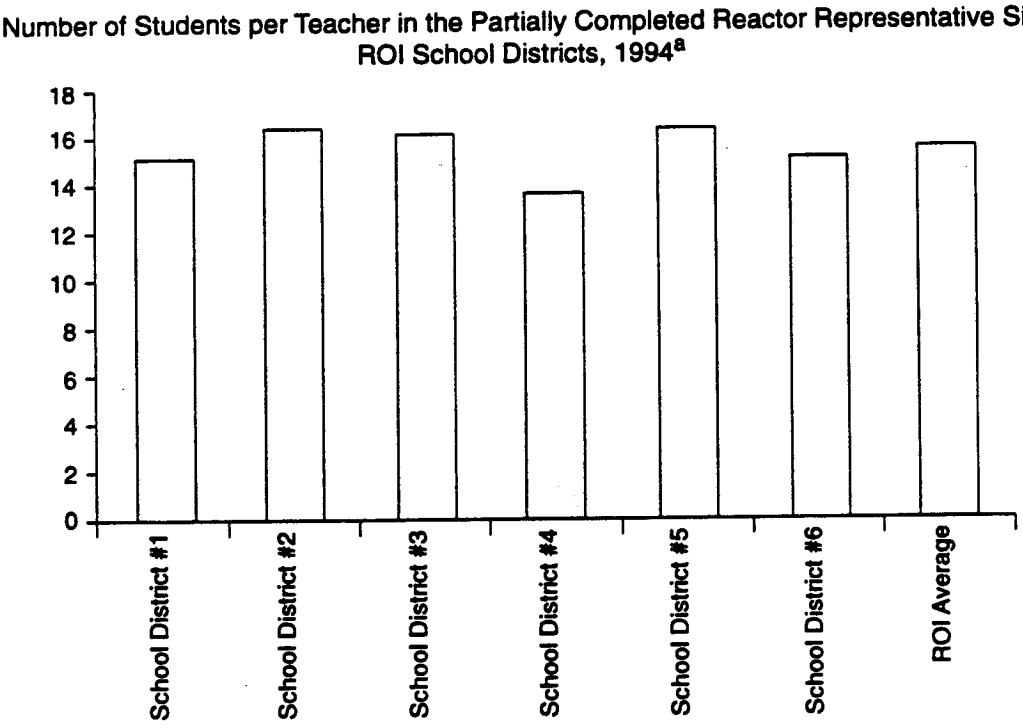
Homeowner and Renter Vacancy for the Partially Completed Reactor Representative Site ROI, the Counties, and the Representative State, 1990[c]



[a] Census 1983j; Census 1995a.
[b] Census 1982q; Census 1991p.
[c] Census 1991p.

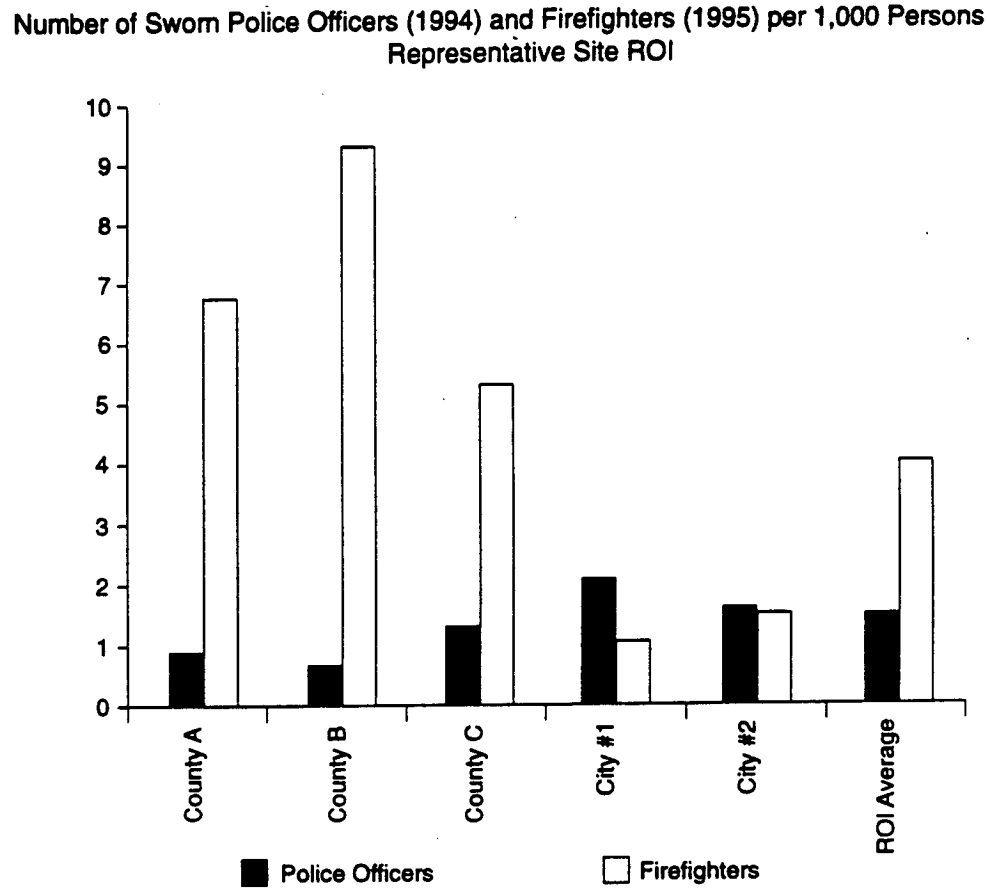
Figure 3.13.8–2. Population and Housing for the Representative Partially Completed Reactor Site Region of Influence and the Representative State—Continued.



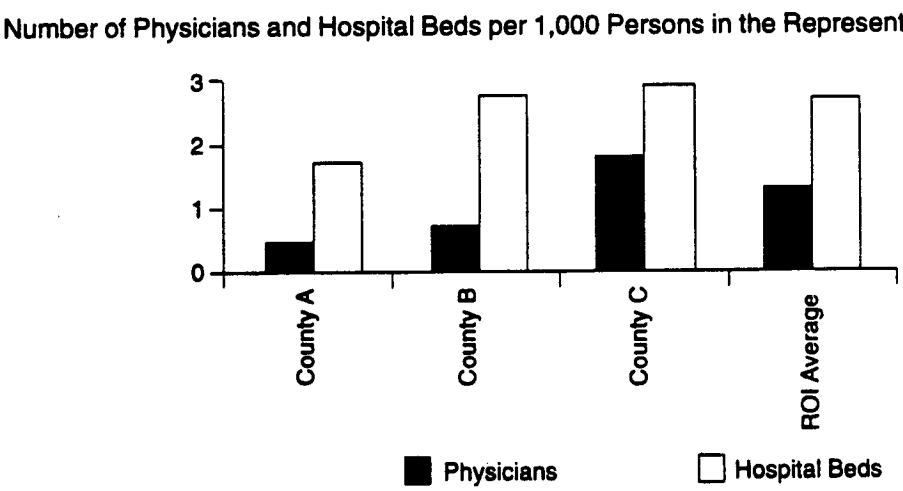


[a]Socio 1996a.

Figure 3.13.8–3. School District Characteristics for the Representative Partially Completed Reactor Site Region of Influence.



Note: Except for ROI cities, city sworn police officers and firefighters are included in county totals.



[a] Census 1993p; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b; DOJ 1995a; Socio 1996a.
[b] AHA 1995a; AMA 1995a; Census 1995a.

Figure 3.13.8–4. Public Safety and Health Care Characteristics for the Representative Partially Completed Reactor Site Region of Influence.

Health Care. Seven hospitals served the three-county ROI, with all operating below capacity. Figure 3.13.8–4 displays the hospital bed-to-population ratios for the ROI counties. The average ROI hospital occupancy rate was 58.9 percent in 1994, and a total of 525 physicians served the ROI. The average physician-to-population ratio for the ROI was 1.4 per 1,000 persons.

Local Transportation. Local transportation consists of the existing principal road, air, and rail networks required to support the project activities. Transportation networks in the smaller communities would generally be limited. However, due to its proximity to an urbanized area, the transportation networks at the representative site would be more extensive than in a more secluded community.

3.13.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of the representative partially completed reactor site (and to any onsite workers) are shown on Table 3.13.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes.

Table 3.13.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Operation at the Partially Completed Reactor Site

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation	
Cosmic radiation[a]	28
External terrestrial radiation[a]	29
Internal terrestrial radiation[b]	39
Radon in homes (inhaled)[b]	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	361

[a] Derived from information given in EPA 1981b.

[b] NCRP 1987a.

Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from an operational nuclear reactor site would provide another source of radiation exposure to members of the public. However, because the partially completed reactor has never operated, releases of radionuclides from it, and the resulting doses and health effects, are taken to equal zero for the existing conditions.

Similarly, the nonoperational status of the reactor precludes exposure of workers to radioactivity. The associated doses and health effects to workers are also taken to equal zero for the existing conditions.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface waters during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.13.3.

Health Effects Studies. Specific locations for the partially completed reactor must be designated before any reviews of epidemiologic studies in the areas can be conducted.

Accident History. Since the reactor has never operated at the site, there is no site accident history.

Emergency Preparedness. Sites that are licensed by the NRC must have an emergency management program that would be activated in the event of an accident. The program must be compatible with all other Federal, State, and local plans and be thoroughly coordinated with all interested groups. The program would have to be developed and approved before operation of the completed reactor.

3.13.10 WASTE MANAGEMENT

This section addresses the management of wastes associated with a representative partially completed reactor site. Because construction of the reactors at the site has been deferred, the only activities currently at the site are maintenance and limited engineering design work.

Spent Nuclear Fuel. No spent nuclear fuel is currently generated by this facility.

High-Level Waste. No HLW is currently generated by this facility.

Transuranic Waste. No TRU waste is currently generated by this facility.

Low-Level Waste. No LLW is currently generated by this facility.

Mixed Low-Level Waste. No mixed LLW is currently generated by this facility.

Hazardous Waste. The representative partially completed reactor is considered a small quantity hazardous waste generator (less than 100 kg/month [220 lb/month]) as defined in 40 CFR 261.5. Hazardous wastes currently generated from maintenance activities include Pb, spent solvents, and used oils. Approximately 454 kg (1,000 lbs) per year is currently generated. Hazardous wastes are packaged and shipped offsite to the TVA hazardous waste storage facility at Muscle Shoals, Alabama. Once sufficient quantities have accumulated, the hazardous wastes are shipped to commercial RCRA-permitted treatment and disposal facilities.

Nonhazardous Waste. Liquid sanitary wastewater from the representative partially completed reactor site is sent to the Hollywood sewer system and eventually treated at the Hollywood Sanitary Treatment Plant. Solid nonhazardous wastes such as desiccants and normal housekeeping trash is collected in dumpsters and transported offsite to a permitted landfill by a commercial contractor. Large desiccants are packaged in drums and transported to a permitted landfill by the commercial contractor.

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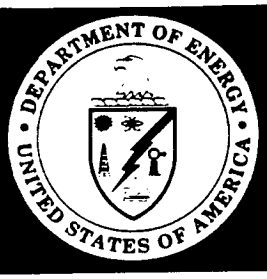

Office of
Fissile Materials Disposition

United States Department of Energy

Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Volume II - Part A

December 1996

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ABSTRACT: This document analyzes the potential environmental consequences of alternatives for the long-term storage (up to 50 years), including storage until disposition, and disposition of weapons-usable fissile materials from U.S. nuclear weapon dismantlements under the responsibility of the DOE. Long-term storage of nonsurplus inventories of weapons-usable plutonium (Pu) and highly enriched uranium (HEU) are required for national defense purposes, while the disposition of surplus weapons-usable Pu is necessary in order to implement our national nonproliferation policy. In addition to the No Action Alternative, this PEIS assesses three storage alternatives (that is, upgrade at multiple sites, consolidation of Pu, and collocation of Pu and HEU) at six DOE candidate sites located across the country. These sites are Hanford Site, Nevada Test Site, Idaho National Engineering Laboratory, Pantex Plant, Oak Ridge Reservation, and Savannah River Site. Although they are not candidate sites for storage, Rocky Flats Environmental Technology Site (RFETS) and Los Alamos National Laboratory are assessed for the No Action Alternative. For the disposition of surplus Pu, three alternative categories (that is, deep borehole, immobilization, and reactor) with nine primary alternatives are assessed at several DOE and representative sites for analysis purposes. Evaluations of impacts on site infrastructure, water resources, air quality and noise, socioeconomics, waste management, public and occupational health and safety, and environmental justice are included in the assessment. The intersite transportation of nuclear and hazardous materials is also assessed. DOE's Preferred Alternative is identified in this Final PEIS. The Preferred Alternative for storage is a combination of No Action and Upgrade Alternatives for the various DOE sites, and phaseout of Pu storage at RFETS. The Preferred Alternative for disposition of surplus Pu is to pursue a disposition strategy involving a combination of immobilization and reactor alternatives, including vitrification, ceramic immobilization, and existing reactors.

PUBLIC INVOLVEMENT: The DOE issued a Draft PEIS on March 8, 1996, and held a formal public comment period on the Draft through June 7, 1996. In preparing the Final PEIS, DOE considered comments received via mail, fax, electronic bulletin board (Internet), and transcripts of messages recorded by telephone. In addition, comments and concerns were recorded by notetakers during interactive public meetings held during March and April 1996 in Denver, CO, Las Vegas, NV, Oak Ridge, TN, Richland, WA, Idaho Falls, ID, Washington, DC, Amarillo, TX, and North Augusta, SC. Comments received and DOE's responses to those comments are found in Volume IV of the Final PEIS.

DOE/EIS-0229

Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Volume II - Part A

United States Department of Energy
Office of Fissile Materials Disposition

December 1996

FOREWORD

This is the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (PEIS), prepared by the U.S. Department of Energy, Office of Fissile Materials Disposition. The document is composed of four volumes and a separate Summary. Changes made since the Draft PEIS are shown by change bar notation (vertical lines adjacent to the changes) in this Final PEIS for both text and tables. Deletion of one or more sentences is indicated by the phrase "Text deleted." in brackets. This Final PEIS includes the Preferred Alternative, which is a combination of alternatives. The Preferred Alternative is described in Section 1.6 and Chapter 2 of Volume I, and analyzed in Chapter 4 of Volume II. For all the alternatives, including the Preferred Alternative, a comparison of alternatives is presented in Section 2.5 of Volume I and a summary of impacts is presented in Section 4.6 of Volume II (Part B). Information from these sections is also presented in the Summary.

Volume I contains Chapters 1 through 3 of the PEIS. Chapter 1 includes a description of the history and background of the fissile materials disposition program, the purpose of and need for the proposed action, a summary of changes made to the Draft PEIS, and the Preferred Alternative. Chapter 2 gives a description of the proposed long-term storage and disposition alternatives, a description of how the alternatives were selected and why others were eliminated from further consideration, and a comparison of the alternatives in terms of their potential environmental impacts. Chapter 3 describes the affected environment at candidate long-term storage locations, and at sites and environmental settings for the disposition alternatives.

Volume II (Parts A and B) contains Chapters 4 through 10 of the PEIS. Chapter 4 describes the potential environmental impacts resulting from construction and operation of the proposed long-term storage and disposition alternatives, including the Preferred Alternative. Also contained in this chapter are intersite transportation impacts, a discussion of environmental justice issues, cumulative impacts due to the implementation of the proposed alternatives in addition to other actions at a site, avoided environmental impacts, and a summary of impacts. Chapter 5 provides a list of references used in the preparation of this document. Chapter 6 provides an index to the main text of the PEIS. Chapter 7 is a glossary of key terms used in the document. Chapter 8 is a list of preparers. Chapter 9 lists government agencies and organizations contacted during the preparation of this PEIS. Chapter 10 provides a distribution list for the document.

Volume III contains the appendices to this PEIS. Appendix A contains the fact sheet on the President's *Nonproliferation and Export Control Policy*, and the Joint Statement Between the United States and Russia on Nonproliferation. Appendix B provides specifications for key buildings within each facility complex analyzed in this PEIS. Appendix C describes requirements for construction and operation of the various facilities required to accomplish the storage and disposition activities essential to the alternatives described in this PEIS. Appendix D provides information on overall water usage for the storage and disposition facilities discussed in this PEIS. Appendix E gives a general overview of the Department of Energy (DOE) environmental restoration and waste management program, baseline waste management at DOE sites, and project-specific waste management activities associated with the proposed long-term storage and disposition alternatives. Appendix F provides detailed data supporting the air quality and noise analyses. Appendix G describes the methodology used for intersite transportation risk analysis and provides a summary of hazardous materials shipped to and from DOE sites, plus information on shipping containers. Appendix H evaluates various plutonium waste forms for potential disposal in a high-level waste repository. Appendix I describes operations of a Canadian Deuterium Uranium Reactor. Appendix J identifies the compliance requirements associated with the Proposed Action, as specified by the major Federal and State environmental, safety, and health statutes, regulations, and orders. Appendix K lists the scientific names of common nonthreatened and nonendangered animal and plant species identified in Chapters 3 and 4. Appendix L includes the supporting data used for assessing the No Action

Alternative in the socioeconomics sections of this PEIS. Appendix M presents detailed information on the potential health risks associated with releases of radioactivity and hazardous chemicals from the proposed storage and disposition alternatives during normal operations and from postulated accidents. Appendix N describes different concepts for, and provides cost and benefit information on, the multipurpose reactor. Appendix O provides a description of facilities and operations for a can-in-canister approach to plutonium immobilization at the Savannah River Site in South Carolina. Appendix P describes the potential environmental impacts of using the Manzano Weapons Storage Area in New Mexico for the long-term storage of plutonium pits. Appendix Q identifies the potential health impacts from the storage of Rocky Flats Environmental Technology Site plutonium pits at the Pantex Plant in Texas. Appendix R discusses the aircraft crash and radioactive release probabilities for proposed storage and disposition facilities at Pantex Plant in Texas. A separate Classified Appendix was also prepared, which provides detailed analysis results for intersite transportation risks based on classified inventories of materials stored at DOE sites.

Volume IV (Parts A and B) is the Comment Response Document. It contains an overview of the public comment process, the comments received on the Draft PEIS during the public review period, and the DOE responses to those comments, including identifying changes made to the Draft PEIS in response to public comments.

The Summary provides a brief overview of the PEIS. It includes the purpose of and need for the Proposed Action, a description of the storage and disposition alternatives including the Preferred Alternative, and the potential environmental impacts resulting from these alternatives.

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LIST OF ACRONYMS AND ABBREVIATIONS

AADT	Average Annual Daily Traffic
ACEC	Area of Critical Environmental Concern
ACGIH	American Conference of Governmental Industrial Hygienists
AEA	*Atomic Energy Act*
AEC	Atomic Energy Commission
AGV	automated guided vehicle
ALARA	as low as reasonably achievable
ALE	Arid Lands Ecology Reserve
ANL-W	Argonne National Laboratory-West
APSF	Actinide Packaging and Storage Facility
AQCR	Air Quality Control Region
ARA	Auxiliary Reactor Area
ARIES	Advanced Recovery and Integrated Extraction System
BEA	Bureau of Economic Analysis
BEIR	biological effects of ionizing radiation
BLM	Bureau of Land Management
BOP	balance-of-plant
BPA	Bonneville Power Administration
BWR	boiling water reactor
CAA	*Clean Air Act*
CANDU	Canadian deuterium uranium
CAS	Chemical Abstracts Service
CCDF	complimentary cumulative distribution function
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
CI	confidence interval
CIC	can-in-canister
CLUP	Comprehensive Land-Use Plan
CMR	Chemistry and Metallurgy Research

COE	Corps of Engineers
Complex	Nuclear Weapons Complex
CRD	Comment Response Document
CRT	Cargo Restraint Transporters
CWA	*Clean Water Act*
D&D	decontamination and decommissioning
DAF	Device Assembly Facility
DCG	derived concentration guide
DHLW	defense high-level waste
DNB	departure of nucleate boiling
DNFSB	Defense Nuclear Facilities Safety Board
DNL	day and night average sound levels
DNWR	Desert National Wildlife Range
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DP	Office of Defense Programs
DRCOG	Denver Regional Council of Governments
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EBR	Experimental Breeder Reactor
EDNA	Environmental Design for Noise Abatement
EIA	Energy Information Administration
EIS	environmental impact statement
EM	Office of Environmental Management
EPA	Environmental Protection Agency
ERR	excess relative risk
ES&H	Office of Environment, Safety, and Health
ESA	*Endangered Species Act*
ETF	effluent treatment facility
FAIR	Forest, Agriculture, Industry, and Research
FCF	Fuel Cycle Facility
FEMA	Federal Emergency Management Agency
FFCA	Federal Facility Compliance Agreement
FFTF	Fast Flux Test Facility

FLPMA	*Federal Land Planning Management Act*
FMEF	Fuels and Materials Examination Facility
FMF	Fuel Manufacturing Facility
FONSI	Finding of No Significant Impact
FR	Federal Register
FSAR	Final Safety Analysis Report
GBZ	Glass-bonded zeolite
GESMO	Generic Environmental Statement on Mixed Oxide
GIS	Geographical Information System
GMA	*Growth Management Act*
GMODS	Glass Material Oxidation Dissolution System
HAD	hazard analysis document
Hanford	Hanford Site
HE	high explosives
HEAST	Health Effects Summary Table
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HEU EIS	*Disposition of Surplus Highly Enriched Uranium Environmental Impact Statement*
HFEF	Hot Fuel Examination Facility
HI	Hazard Index
HLW	high-level waste
HQ	Hazard Quotient
HRA EIS	*Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan*
HVAC	Heating Ventilation and Air Conditioning
HWR	Heavy Water Reactor
IAEA	International Atomic Energy Agency
ICPP	Idaho Chemical Processing Plant
ICRP	International Commission of Radiological Protection
INEL	Idaho National Engineering Laboratory
IRIS	Integrated Risk Information System
ISCST2	Industrial Source Complex Short-Term Model Version 2
ISO	International Standards Organization
IWG	Interagency Working Group
K-25	K-25 Site

L/ER	Energy Research Program Office
LA	Limited Area
LAA	Limited Access Area
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Scattering Center
LCF	latent cancer fatalities
LDR	Land Disposal Restriction
LEU	low-enriched uranium
LIGO	Laser Interferometer Gravitational-Wave Observatory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LOB	Laboratory Office Building
LWR	Light Water Reactor
MAA	Material Access Area
MACCS	Melcor Accident Consequence Code System
MC&A	Material Control and Accountability
MD	Office of Fissile Materials Disposition
MEI	maximally exposed individual
MHR	Modular Helium Reactor
MMI	Modified Mercalli Intensity
MOX	mixed oxide
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAGPRA	*Native American Graves Protection and Repatriation Act*
NAS	National Academy of Sciences
NCDC	National Climatic Data Center
NCRP	National Commission of Radiological Protection
NEIC	National Earthquake Information Center
NEPA	*National Environmental Policy Act*
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFS	Nuclear Fuel Services Fuel Fabrication Plant
NHPA	*National Historic Preservation Act*
NIOSH	National Institute of Occupational Safety and Health
NMSF	Nuclear Material Storage Facility

NMSM	Nuclear Materials and Stockpile Management
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NRHP	National Register of Historic Places
NTS	Nevada Test Site
NTS EIS	*Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*
NWI	National Wetlands Inventory
NWPA	*Nuclear Waste Policy Act*
NWS	National Weather Service
OCRWM	Office of Civilian Radioactive Waste Management
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PA	Protected Area
Pantex	Pantex Plant
Pantex EIS	*Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*
PBF	Power Burst Facility
PCV	Primary Containment Vessel
PEIS	programmatic environmental impact statement
PEL	Permissible Exposure Level
PFP	Plutonium Finishing Plant
PFP EIS	*Plutonium Finishing Plant Stabilization Environmental Impact Statement*
PIDAS	Perimeter Intrusion Detection and Alarm System
PNNL	Pacific Northwest National Laboratory
PPA	Property Protection Area
PRA	probabilistic risk assessment
PSAR	Preliminary Safety Analysis Report
PSD	Prevention of Significant Deterioration

PUREX	Plutonium-Uranium Extraction Plant
PWR	pressurized water reactor
R&D	Research and Development
RCRA	*Resource Conservation and Recovery Act*
REA	regional economic area
RIA	reactivity insertion accident
RFETS	Rocky Flats Environmental Technology Site
RIMS II	Regional Input-Output Modeling System
RL	Richland Operations Office
ROD	Record of Decision
ROI	region of influence
RSWF	Radioactive Scrap and Waste Facility
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SAR	Safety Analysis Report
SARA	*Superfund Amendments and Reauthorization Act*
sd	standard deviation
SDWA	*Safe Drinking Water Act*
SEB	Security Equipment Building
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SISMP	Site Integrated Stabilization and Management Plan
SMR	Standardized Mortality Ratio
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SRR	standardize rate ratio
SRS	Savannah River Site
Stockpile Stewardship and Management PEIS	*Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*
Storage and Disposition PEIS	*Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement*
SST	safe secure trailer
START	Strategic Arms Reduction Talks

TA	Technical Area
TAN	Test Area North
TCLP	toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environmental Conservation
TDS	total dissolved solids
TI	transport index
TLV	Threshold Limit Values
TNRCC	Texas Natural Resources Conservation Commission
TRA	Test Reactor Area
TRU	transuranic
TSCA	*Toxic Substance Control Act*
TSD	Transportation Safeguards Division
TSP	total suspended particulates
TSR PEIS	*Tritium Supply and Recycling Programmatic Environmental Impact Statement*
TVA	Tennessee Valley Authority
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Survey
VOC	volatile organic compound
VRM	Visual Resource Management
WAC	Waste Acceptance Criteria
Waste Management PEIS	*Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*
WIPP	Waste Isolation Pilot Plant
WMIS	Waste Management Information System
WNP	Washington Nuclear Power
WPPSS	Washington Public Power Supply System
WSA	Weapons Storage Area
WSCC	Western Systems Coordinating Council
WSCF	Waste Sampling and Characterization Facility
Y–12	Y–12 Plant
Y–12 EA	*Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Level at the Y–12 Plant, Oak Ridge, Tennessee*
YMSCO	Yucca Mountain Site Characterization Office
ZPPR	Zero Power Physics Reactor

CHEMICALS AND UNITS OF MEASURE

°C	degrees Celsius
Ci	curie
cm	centimeter
CO	carbon monoxide
CO_2	carbon dioxide
Co-60	cobalt-60
Cs	cesium
Cs-137	cesium-137
CsCl	cesium chloride
Cu	copper
dB	decibel
dBA	decibel A-weighted
°F	degrees Fahrenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
g	gram
G	gravitational acceleration
gal	gallon
Gd	gadolinium
GWd	gigawatt-days
ha	hectare
H_2	hydrogen
HF	hydrogen fluoride
HNO_3	nitric acid
hr	hour
I-129	iodine-129
in	inch
k_{eff}	effective neutron multiplication factor
kg	kilogram
km	kilometer
km^2	square kilometer

Kr	krypton
kV	kilovolt
l	liter
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
mCi	millicurie
mg	milligram
mi	mile
mi^2	square miles
min	minute
mph	miles per hour
mrem	millirem (one thousandth of a rem)
MW	megawatt
MWe	megawatt electric
N_2	nitrogen
nCi	nanocurie (one-billionth of a Curie)
Ni	nickel
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
oz	ounce
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocurie (one-trillionth of a Curie)
PM_{10}	particulate matter less than or equal to 10 microns
ppm	parts per million
Pu	plutonium
PuCl	plutonium chloride
PuO_2	plutonium dioxide
rad	radiation absorbed dose
rem	roentgen equivalent man
RfC	Reference Concentration
RfD	Reference Dose

s	second
SO_2	sulfur dioxide
Sr-90	strontium-90
t	metric ton
Tc-99	technetium-99
ton	short ton
U	uranium
U-233	uranium-233
U-234	uranium-234
U-235	uranium-235
U-236	uranium-236
U-238	uranium-238
UF_6	uranium hexafluoride
UNH	uranyl nitrate hexahydrate
UO_2	uranium dioxide
U_3O_8	triuranium octaoxide
VOC	volatile organic compound
yd	yard
yr	year
μg	microgram (one-millionth of a gram)

METRIC CONVERSION CHART

To Convert Into Metric			To Convert Out of Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor
exa-	E	$1\,000\,000\,000\,000\,000\,000 = 10^{18}$
peta-	P	$1\,000\,000\,000\,000\,000 = 10^{15}$
tera-	T	$1\,000\,000\,000\,000 = 10^{12}$
giga-	G	$1\,000\,000\,000 = 10^{9}$
mega-	M	$1\,000\,000 = 10^{6}$
kilo-	k	$1\,000 = 10^{3}$
hecto-	h	$100 = 10^{2}$
deka-	da	$10 = 10^{1}$
deci-	d	$0.1 = 10^{-1}$
centi-	c	$0.01 = 10^{-2}$
milli-	m	$0.001 = 10^{-3}$
micro-	μ	$0.000\,001 = 10^{-6}$
nano-	n	$0.000\,000\,001 = 10^{-9}$
pico-	p	$0.000\,000\,000\,001 = 10^{-12}$
femto-	f	$0.000\,000\,000\,000\,001 = 10^{-15}$
atto-	a	$0.000\,000\,000\,000\,000\,001 = 10^{-18}$

Chapter 4
Environmental Consequences

The potential environmental consequences resulting from the proposed weapons-usable fissile materials storage alternatives, the Pu disposition alternatives, and the No Action Alternative are described in this chapter for each of the sites, environmental settings, and resource/issue areas described in Section 3.0. The impact methodology applied for each of these resource/issue areas is described in Section 4.1. In addition, descriptions of methodologies applied and the resulting environmental consequences for intersite transportation and environmental justice are found in Sections 4.4 and 4.5, respectively.

Section 4.2 describes the environmental consequences associated with the No Action Alternative and the long-term storage alternatives. Table 4–1 identifies the pages within the document where environmental consequences of the alternatives are analyzed for each of the sites. [Text deleted.] Environmental impacts of each long-term storage alternative and the No Action Alternative are analyzed for each of the six candidate storage sites to allow (1) the comparison of impacts by sites for each alternative and (2) the comparison of impacts by alternatives for each site. As a result, decisions can be made to select a single storage alternative for all sites, or a combination of different alternatives for different sites.

Table 4–1. Key to Locating Information on Environmental Consequences and Mitigation Measures for Storage Alternatives by Page Number[a]

	Sites							
Alternatives	**Hanford**	**NTS**	**INEL**	**Pantex**	**ORR**	**SRS**	**RFETS**	**LANL**
No Action Alternative	4–23	4–83	4–131	4–182	4–240	4–291	4–343	4–363
Preferred Alternative	4–859	4–859	4–859	4–859	4–859	4–859	4–859	4–859
Upgrade at Multiple Sites Alternative	4–23	NA	4–131	4–182	4–240	4–291	NA	NA
Consolidation of Pu Alternative	4–23	4–83	4–131	4–182	NA[b]	4–291	NA	NA
Collocation of Pu and HEU Alternative	4–23	4–83	4–131	4–182	4–240	4–291	NA	NA

[a] See also Sections 4.4 (Intersite Transportation) and 4.5 (Environmental Justice).

[b] Consolidated Pu storage at ORR would create an HEU collocation condition and is analyzed as part of the Collocation Alternative.

Note: NA=alternative does not apply at the site.

For the Pu disposition alternatives analyzed in Section 4.3, specific site characteristics, as well as generic representative environmental settings, have been used in this PEIS for analyzing the potential environmental impacts of disposition technology alternatives. Six DOE sites and other generic and specific sites were used for assessing the environmental impacts of various disposition technologies and strategies. The locations of the new facilities considered for the various disposition technologies are representative and for analysis purposes only. Table 4–2 identifies the locations in this document where the disposition alternatives and common activities, and sites and environmental settings, have been analyzed. Since the disposition decision to be made encompasses the programmatic strategy and technology or technology mix that would be employed for disposition of the various forms of surplus weapons-usable Pu materials, generic cumulative environmental impact analysis of locating more than one disposition facility at a single site is described in Sections 4.6 and 4.7. Site-specific analysis would be made in follow-on tiered NEPA documentation.

Although analyzed individually, both pit disassembly/conversion and Pu conversion are front-end processes common to all of the disposition alternatives (except No Action). MOX fuel fabrication is a common activity to all of the reactor alternatives. In addition to a potential new MOX fuel fabrication facility that would be built in the United States, the Existing LWR Alternative initially could include MOX fuel fabrication abroad on an interim basis.

Table 4–2. Key to Locating Information on Environmental Consequences and Mitigation Measures for Disposition Alternatives by Page Number

Alternatives and Common Activities	Analysis Sites and Environmental Settings						
	Hanford	NTS	INEL	Pantex	ORR	SRS	Generic
Preferred Alternative	4–859	NA	4–859	4–859	NA	4–859	NA
Common Activities							
Pit Disassembly/Conversion Facility	4–383	4–383	4–383	4–383	4–383	4–383	NA
Pu Conversion Facility	4–427	4–427	4–427	4–427	4–427	4–427	NA
Deep Borehole Category							
Direct Disposition Alternative	NA	NA	NA	NA	NA	NA	4–474
Immobilized Disposition Alternative							
Ceramic Immobilization Facility (for Borehole)	4–496	4–496	4–496	4–496	4–496	4–496	NA
Deep Borehole Complex	NA	NA	NA	NA	NA	NA	4–543
Immobilization Category							
Vitrification Alternative	4–561	4–561	4–561	4–561	4–561	4–561	NA
Ceramic Immobilization Alternative	4–605	4–605	4–605	4–605	4–605	4–605	NA
Electrometallurgical Treatment Alternative[a]	NA	NA	4–657	NA	NA	NA	NA
Reactor Category and Common Activities							
MOX Fuel Fabrication							
New Domestic Facility	4–673	4–673	4–673	4–673	4–673	4–673	4–673
Existing European Facility	NA	NA	NA	NA	NA	NA	NA
Existing LWR Alternative	NA	NA	NA	NA	NA	NA	4–720
Partially Completed LWR Alternative	NA	NA	NA	NA	NA	NA	4–735
Evolutionary LWR Alternative	4–749	4–749	4–749	4–749	4–749	4–749	NA
CANDU Reactor Alternative[b]	NA	NA	NA	NA	NA	NA	4–809

[a] INEL is a representative site for the Electrometallurgical Treatment Alternative. If this alternative is selected, any of the six DOE sites could be used and subsequent NEPA documents would be prepared, as appropriate.

[b] Activities in Canada are not fully analyzed in this PEIS but are discussed in Section 4.3.5.5 and Appendix I.

Note: NA=not applicable.

For the ocean transportation of fissile materials associated with the European MOX fuel fabrication option, the intersite transportation section (Section 4.4) analyzes potential impacts to the global commons, pursuant to Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*. Although actions proposed in other countries are not analyzed in this PEIS, changes in CANDU reactor operations due to the use of MOX fuel are described in Appendix I.

As noted in Section 2.4, the final disposal of immobilized forms and domestically produced spent fuel for some disposition alternatives would be accomplished by sending the materials to a geologic repository pursuant to NWPA.[1] Since a repository site has not yet been recommended by the President and approved by Congress, this PEIS does not analyze impacts to a repository. Such a geologic repository, if approved under the provisions of the NWPA, would serve primarily as the disposal site for commercial and DOE-owned spent nuclear fuel and HLW. This impact analysis would be done in a separate EIS for the repository. Operation issues regarding the repository, however, are described in Appendix H.

A summary of the environmental consequences for all the proposed storage and disposition alternatives and the preferred alternative is presented in Section 4.6. Cumulative impacts associated with the alternatives are described in Section 4.7. Sections 4.8 through 4.11 provide descriptions of the following with regard to the alternatives: unavoidable adverse environmental impacts, avoided environmental impacts, relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity, and irreversible and irretrievable commitment of resources. Section 4.12 provides energy requirements and conservation potential of the various alternatives and mitigation measures.

4.1 METHODS FOR ASSESSING ENVIRONMENTAL IMPACTS

The environmental impact assessment methodologies discussed in this section address the full range of natural and human resource and issue areas pertinent to the sites considered for constructing and operating weapons-usable fissile materials storage and disposition alternatives. These resource/issue areas are land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, and waste management. A summary of major Federal and State environmental, safety, and health statutes, regulations, and orders applicable to the various resource/issue areas is provided in Appendix J.

As part of the impact assessment process, mitigation measures are identified that could be used to reduce and minimize potential impacts. Because these mitigation measures vary from site to site, some mitigation strategies may need to be addressed in subsequent site-specific environmental documents and/or through agency coordination, as required.

4.1.1 LAND RESOURCES

The land resources analysis assesses land use and visual resources for the defined ROI. The ROI for land use includes land within 3.2 km (2 mi) of a given candidate site; the ROI for visual resources includes those lands within the affected viewshed of the proposed action. Land resources impacts are analyzed within the context of NEPA and other related Federal legislation and executive orders. Land-use impacts associated with site-specific alternatives are compared to existing land-use patterns and densities, and to land-use plans, policies, and controls. Visual resource impacts are associated with changes in the existing landscape character that could result from the proposed action. Land resources impacts associated with alternatives for which site-specific locations have not been identified are assessed generically. For example, based on technology descriptions and site infrastructure requirements, likely land resources impacts are characterized for a range of land-use and

[1] Under the NWPA, NRC may determine by rule that highly radioactive material requires permanent isolation as HLW in a geologic repository. Such a determination or legislative clarification may be required in order for the immobilized forms generated by the Immobilization Alternatives to be disposed of in a repository pursuant to NWPA.

visual resources conditions that could support the specific technology. The No Action Alternative is based on the most current site development and facility utilization plans.

Land Use. The land-use analysis estimates the magnitude and extent of potential impacts to current land-use patterns and densities due to the implementation of the alternative under consideration. The impact analysis identifies the amount of land disturbed during construction and used during operation; the total amount of land required; and potential changes in land use and conflicts with land-use plans, policies, and controls. Potential impacts to special status lands, including prime farmland, are emphasized. Possible conflict with any related legislation or regulation is assessed since major regulatory conflicts could conceivably impede or prevent implementation. Conflicts with State and local land-use plans, policies, and controls could result in potential impacts. Conflicts with site development and facility utilization plans could result in potential impacts.

For storage alternatives, the Storage and Disposition PEIS identifies the land area required for operation as the area occupied by the footprint of each building and nonbuilding support areas. In conjunction with paved road, parking areas, graveled areas, and any land graded and cleared of vegetation, they constitute the total land area requirements. Of the land required during operation, the "disturbed area" is the land that was not in use and was previously undisturbed natural habitat. Previously disturbed areas, include graveled areas and any land previously graded and cleared of vegetation. All areas within the existing perimeter intrusion detection boundaries are classified as already disturbed areas. The construction laydown area accommodates material and equipment storage, and provides limited onsite fabrication areas and temporary construction buildings to support construction activities. The criteria for determining disturbed and undisturbed land area during construction is the same as for operation. Therefore, facilities or construction laydown areas proposed to be situated entirely on previously disturbed land area would not create any newly disturbed area.

Visual Resources. The visual resources analysis identifies and evaluates the magnitude and extent of potential changes to the visual environment that could result from implementation of the proposed alternative. Visual resources assessments are based on the BLM VRM methodology. The existing landscape at each analysis site was assigned a VRM classification as defined in Section 3.1.1, ranging from 1 (pristine areas including designated wilderness and wild and scenic rivers) to 5 (areas where the natural character of the landscape no longer exists). Important objectives of visual resources analysis are the identification of the degree of contrast between the proposed action and the existing landscape, the location and sensitivity levels of viewpoints accessible to the public, and the visibility of the proposed action from the viewpoints. Sensitivity levels of viewpoints are based on the number and concerns of the observers. The distance from a viewpoint to the affected area and atmospheric conditions are also taken into consideration because distance and haze can diminish the degree of contrast and visibility.

The Storage and Disposition PEIS does not include a complete and detailed VRM assessment for each disposition alternative because design plans are not available. An assessment of visual impacts is performed using the degree of visual contrast between the proposed facilities or activities and the existing landscape character as seen from viewpoints accessible to the public, such as public roadways, recreation areas, special status lands, and residential areas. Sensitivity levels of the viewpoints and visibility of the affected area from those viewpoints are also taken into consideration. The reduction of assigned VRM classification could result if the affected area could be seen from a viewpoint with a high sensitivity level.

4.1.2 SITE INFRASTRUCTURE

Site infrastructure impacts are assessed by overlaying the support requirements of the various alternatives on the projected site infrastructure capacities. These impact assessments focus on electrical power requirements, road networks, rail interfaces, and fuel requirements. Projection of electricity availability, site development plans, and other DOE mid- and long-range planning documents are utilized to describe existing site infrastructure conditions. Tables are presented depicting additional infrastructure requirements estimated for each alternative. Data for these comparison tables were obtained from detailed data input reports describing each potential facility that would be required under the various alternative actions. Design mitigation considerations that might reduce infrastructure demand are identified, where possible, on a site-by-site basis.

Under some Pu disposition alternatives, specific analysis sites are not identified. As a result, no planning documents are available to provide descriptions of the site infrastructure or to establish a detailed baseline from which environmental consequences can be estimated. For these cases, generic environmental baselines were developed to define conditions for analysis purposes. Site infrastructure impacts are assessed by analyzing the specific facilities and activities associated with the alternative that are necessary to locate new missions at the unspecified sites. As stated above, tables are presented to depict the additional infrastructure requirements for each alternative as a result of the new missions. Impact assessments focus on the additional electrical power, road networks, rail interfaces, and fuel required to perform the new missions located at the unspecified sites.

Detailed assessments of the availability of electric power for the various storage and disposition facilities' electrical power requirements in the year 2005 timeframe are not considered practical. Electric utilities would not be expected to reliably project how they would meet the needs of these facilities (that is, whether by new power generation, power imports, or demand-side management). Therefore, the basis for this PEIS assessment is the supply and demand projections of the U.S. electric utilities published annually by the North American Electric Reliability Council.

For purposes of analysis, electricity generation is based on the assumption that electricity would be supplied by the power pool currently supplying the facility in question by using a mix of fuels and generating sources representative of those projected. These data are used to determine whether there would be enough reserve margin within a particular power pool to accommodate electrical requirements or if additional power is required. A detailed analysis, based on the proportional contributions from each fuel source, would be conducted in site-specific NEPA documents, as appropriate.

Four of the Pu disposition alternative technologies, specifically the existing LWR, evolutionary LWR, partially completed LWR, and CANDU reactor, have the ability to produce electricity while using Pu as MOX fuel. The environmental effects of this steam production are included in the analysis of the basic technologies since design of these reactors includes steam turbines to generate electricity. Selection of either of two alternatives, the partially completed LWR or the evolutionary LWR, would result in additional power line construction to distribute electricity to the power grid. The environmental impacts of this additional power line construction for these two alternative actions are not addressed in this PEIS but would be assessed in tiered, site-specific NEPA documents should either be chosen for implementation.

4.1.3 AIR QUALITY AND NOISE

Air Quality. Potential effects on the environment associated with air pollutant emissions from normal operations for each alternative are evaluated, and effects of construction emissions are discussed. The assessment of air quality impacts requires identification of applicable criteria for assessing impacts, the development of emission inventories, and the estimation of air pollutant concentrations. The assessment of impacts is based on the estimated concentrations, data on the existing environment, and the assessment criteria. Human health effects due to air pollutant emissions are discussed in the Public and Occupational Health and Safety sections and include consideration of airborne radioactive chemical releases and from accidents initiated by natural phenomenon (for example, tornadoes).

The assessment of potential impacts to air quality is based upon comparison of effects of each alternative with applicable State, local, or NAAQS. Assessment criteria for air pollutants include the EPA primary and secondary ambient air quality standards for criteria pollutants, specified in 40 CFR 50, and ambient standards established by each State. The more stringent of either the EPA or State standards serve as the assessment criteria. The assessment criteria for hazardous or toxic pollutants include guidelines or standards adopted or proposed by each State. Hazardous and toxic air pollutants include those listed in Title III of the 1990 CAA Amendments, in the NESHAP, in 40 CFR 61, and in standards or guidelines proposed or adopted by the respective states.

Certain hazardous pollutants for specific industrial processes are regulated by NESHAPs. No sources to which NESHAPs apply have been identified for the alternatives being evaluated except for sources of beryllium which are discussed in the health effects sections. Some of the sites have existing NESHAPs sources for which emissions are quantified under the No Action alternative.

No Action concentrations of pollutants were determined by modeling site emissions. Site-specific emissions are modeled in accordance with the guidelines presented in the EPA's *Guidelines on Air Quality Models*. The EPA recommended Industrial Source Complex Short Term Model, Version 2 (ISCST2) was selected as the most appropriate model to perform the air dispersion modeling analysis because it is designed to support the EPA regulatory modeling program and is capable of handling multiple sources, including different source types. The air quality modeling analysis performed for the sites is a "screening level" analysis incorporating conservative assumptions applied to each of the sites so that the impacts associated with the respective alternatives could be compared among the sites. The "highest-high" concentration for each pollutant and averaging time is selected for comparison to the applicable assessment criteria, instead of the less conservative EPA-recommended "highest-high" and "highest second-highest" concentration for longer-term and short-term averaging times, respectively. The concentrations evaluated are the maximum occurring at or beyond the site boundary or public access road and include the contribution from the alternative and the baseline concentration. Concentrations presented for each alternative include the criteria pollutants CO, Pb, NO_2, PM_{10}, SO_2; pollutants for which there are State-mandated standards; and hazardous and other toxic pollutants that are emitted for the specific alternative. Appendix F contains additional information on the ISCST2 model.

Ozone is a secondary pollutant formed in the atmosphere and is not directly emitted as a pollutant from the candidate sites. The primary pollutants contributing to ozone formation are NO_x and VOCs. The formation of ozone in the atmosphere is a regional issue and is contributed to by vehicular sources (mobile sources), natural sources, and stationary sources in a region. Ozone, as a criteria pollutant, was not evaluated for this programmatic evaluation since it is not directly emitted or monitored by the candidate sites, but NO_2 and VOC emissions were analyzed where applicable.

Additional assumptions incorporated into the air quality modeling at each site include: major source criteria pollutant emissions were modeled using actual source locations and stack parameters to determine environmental baseline and No Action criteria pollutant concentrations; toxic/hazardous pollutant emissions

and sources with incomplete source characteristic information were modeled from a single source centrally located within the complex of facilities on each site assuming a 10-m (33-ft) stack height, a stack diameter of 0.3 m (1 ft), stack exit temperature equal to ambient temperature, and a stack exit velocity equal to 0.03 m/s (0.1 ft/s).

Input data for the model representing site emission rates were provided by the individual sites. Air emissions data for each alternative, other than No Action, are based on preconceptual design reports. Onsite or representative NWS meteorological data are used to define the dispersion characteristics of the site. Actual terrain heights are used for those sites not considered "flat."

The environmental consequences of construction activities on air quality are also described. Source control measures are described that are commonly used to control air pollutant emissions from construction activities. The concentrations presented in this document are the highest concentrations predicted by the model to present conservative estimates of pollutant concentrations.

The CAA, as amended in 1990 (U.S.C. 7506(c)), requires Federal actions to conform with the host State's "State Implementation Plan" (SIP). A SIP provides for the implementation, maintenance, and enforcement of NAAQS for the six criteria pollutants (that is, SO_2, PM_{10}, CO, O_3, NO_2 and Pb). The SIP's purpose is to eliminate or reduce the severity and number of violations of NAAQS and to expedite the attainment of these standards. No department, agency, or instrumentality of the Federal Government shall engage in, support in any way, or provide financial assistance for, license or permit, or approve any activity that does not conform to an applicable implementation plan.

The final rule for *Determining Conformity of General Federal Actions to State or Federal Implementation Plans* was established by EPA in November 30, 1993 (58 FR 63214), and took effect on January 31, 1994 (40 CFR Parts 6, 51, and 93). This rule establishes the conformity criteria and procedures necessary to meet the CAA until the required conformity SIP revision by each State is approved by EPA. Criteria for determining conformity are specified in some detail in the final rule, but basically ensure that emissions of all criteria air pollutants and VOCs from the action are specifically identified and accounted for in the SIP's attainment or maintenance demonstration.

The EPA has striven to ensure that the new conformity procedures are consistent with NEPA. This way, Federal agencies can incorporate the new conformity procedures into their existing NEPA procedures.

The EPA has limited the Conformity Rule to "nonattainment" areas or those areas classified after November 15, 1990, as "maintenance" areas. An area is designated as nonattainment for a criteria pollutant if it does not meet national primary or secondary ambient air quality standards for the pollutant (or if the area contributes to the ambient air quality of a nearby area that does not meet national primary or secondary ambient air quality standards). A "maintenance" area is an area a State has redesignated from nonattainment to attainment; accordingly, the State must submit to EPA a plan for maintaining NAAQS as a revision to the SIP.

The candidate sites at Hanford, NTS, INEL, Pantex, ORR, and SRS are within existing attainment areas. Therefore, in regard to these criteria pollutants, the proposed storage and disposition action is not affected by the provisions of this rule.

Toxic air pollutants are addressed in both the Air Quality and Noise sections and the Public and Occupational Health and Safety sections for each of the potential sites. In the Air Quality sections, the maximum concentrations of toxic air pollutants at or beyond the site boundary are compared with the most stringent standard or guidance. VOCs are not addressed because there are no regulatory standards and because they are a secondary source of ozone. In addition, there is a wide variety of VOCs that could be emitted.

For the disposition facilities, the maximum concentrations of hazardous pollutants, including cleaning solvents and hydrocarbons, are also not addressed because there are no regulatory standards. There are a wide variety of cleaning solvents and hydrocarbons available. However, DOE would use cleaning solvents that would reduce the chemical exposure to the public and to workers to the maximum extent possible. Specific cleaning solvents would be identified and analyzed in detail in tiered NEPA documentation. In the Public and Occupational Health and Safety sections, a health risk is calculated based upon chemical concentration, toxicity, and PEL and RfC for non-cancer effects and a cancer risk based on the slope factor (cancer potency) of those compounds that are regulated or carcinogenic.

These differences in analytical method result in the presentation of pollutants that differ between the air quality analysis and public and occupational health analysis. In the air quality analysis, toxic pollutants with low emission rates and high toxicity will, in most cases, result in extremely low concentrations at or beyond the site boundary and are therefore not presented in the air quality analysis. On the other hand, these chemical pollutants may expose an onsite worker located 100 m (328 ft) from the emission source to an unacceptable risk and therefore are presented in the analysis, hence the type and form of data used to evaluate these two areas can and will be different and may require different data sources. For example, compliance to standards neither considers what health effects are expected nor the interaction between several chemicals that may cumulatively cause health responses even if they separately are at acceptable concentrations.

Noise. The acoustical environment both onsite and offsite may be affected during construction and operations of the proposed facilities. Construction and operation noise sources and the potential for onsite and offsite impacts are discussed. The discussion is based on information available on the potential types of noise sources and the location of the proposed facilities relative to the site boundary and noise-sensitive locations. Acoustics impacts are assessed on the basis of the potential degree of change in noise levels at sensitive receptors (for example, residences near the site boundary) with respect to ambient conditions. Most nontraffic noise sources associated with construction and operation of the proposed storage and disposition facilities are located at sufficient distances from offsite noise-sensitive receptors that the contribution to offsite noise levels is expected to be small. The analysis uses available information on the potential types of noise sources and the location of proposed alternative facilities relative to the site boundary and noise-sensitive locations.

4.1.4 WATER RESOURCES

The availability and quality of water resources (surface water and groundwater) and the presence of floodplains may play a significant role in the acceptability of sites for this program. Impacts to water resources at a site could affect surrounding communities as well as the proposed project. Important legislation that protects water resources includes the CWA, especially Sections 402 (NPDES) and 307(b) (Pretreatment Standards), and the SDWA. In addition, DOE regulations 10 CFR 1022, *Compliance with Floodplains/Wetlands Environmental Review Requirements*, which implement Executive Orders 11988 and 11990, require evaluation of the potential effects of their actions in floodplains and wetlands.

Water resources include both surface water and groundwater. The main issues related to water resources include the following: (1) whether there is sufficient water available for both the proposed alternative and local domestic consumption, (2) whether water quality will be degraded or further degraded, (3) whether proposed actions challenge legislative or regulatory compliance, and (4) whether actions are threatened by flooding.

Surface Water Availability. Impact assessment on water availability was analyzed by comparing the rates of water consumption and wastewater discharge during construction and operation of proposed long-term storage and disposition facilities to volumes or use rates for No Action water sources. For sites that obtain water from surface water sources, a comparison was performed for both No Action water use and stream flow. For each storage and disposition alternative, water-use rates for construction and operation activities at each site or for each technology under each option or alternative were taken from technical reports prepared for specialized alternatives. The water use at a site was the sum of water use for waste treatment, storage, or disposal operations. The existing water supply is evaluated to determine its capacity to support an increased demand by comparing a projected increase with the capacity of the supplier and with existing water rights, agreements, and allocations.

The analysis assumed that water for the proposed long-term storage and disposition activities would be withdrawn from the current water source at each site. The surface water, groundwater, or municipal water source is part of the water resources affected and described in Chapter 3. However, at Pantex, the city of Amarillo has offered the use of reclaimed wastewater from the Hollywood Road Waste Treatment Plant as a potential source of water when large water requirements are needed. Where surface water is the current source, surface flow data were also evaluated.

Domestic consumption of regional water supplies by the anticipated workforce is addressed to determine if the projected supply of public water might result in or intensify potential water shortages. The impact assessment methodology presented is applied for all alternatives, including No Action.

Surface Water Quality. The assessment of potential water quality impacts include the type (for example, wastewater effluent, or stormwater runoff, or cooling tower blowdown [rapid discharge of water from the cooling tower to the receiving water body]), rate, and concentrations of potential discharge constituents, including sediment loading. Water quality management practices employed at each site also are reviewed. Parameters with the potential to further degrade existing water quality, along with parameters that could violate existing NPDES permit limits, are identified.

During the construction period, impacts to surface water resources could occur from runoff and sedimentation as a result of site clearing. During operations, impacts to water resources could occur through increased runoff from buildings, parking lots, and cleared areas. These impacts would be proportional to the amount of land disturbed and would be minimized by application of standard management practices for stormwater runoff and erosion control.

During operations, stormwater runoff could be contaminated with materials deposited from airborne pollutants. Impacts from stormwater runoff are expected to be minor, but they are highly site-specific and would depend on the design, precipitation, topography, and surface water body.

Floodplains. Floodplains are identified from maps and existing environmental documents. Any facility operating within a 100-year floodplain, or a critical action within a 500-year floodplain, is analyzed for the environmental consequence to the floodplain. [Text deleted.]

If possible, no new storage or disposition facilities would be located in 100-year or 500-year floodplain areas identified from maps and existing environmental documents. The impacts of disposition activities on floodplains cannot be determined at this time because the specific locations of the disposition facilities for generic sites have not been selected. Therefore, the requirements of Executive Order 11988 *(Floodplain Management)* and 10 CFR 1022 *(Compliance with Floodplain/Wetland Environmental Review Requirements)* would be examined in follow-on NEPA documentation, as appropriate.

Groundwater Availability. Environmental impacts to groundwater availability and usage are determined by addressing the potential change in demand as a result of program activities during the construction and operation phases. Estimates of drawdowns in the affected aquifers, both onsite and offsite, are calculated. Instances are identified where groundwater use may exceed locally developed groundwater supplies. Existing water rights for the major water users, as well as contractual agreements for water supply to the sites from support communities, are summarized. Impacts associated with construction and operation withdrawals are described, including potential effects on existing areas of contaminated groundwater. Withdrawals of groundwater to supply water for the storage and disposition facilities could cause movement of existing groundwater contamination plumes. This could occur where water levels are lowered by withdrawals. If necessary, potential impacts on existing areas of contamination would be evaluated in detail in site-specific environmental documents.

Groundwater Quality. Potential groundwater quality impacts associated with pollutant discharges during construction and operation phases (for example, sanitary wastes) are examined. The results of the groundwater quality projections then are compared to Federal and State groundwater quality standards, effluent limitations, and safe drinking water standards to assess the impacts of each alternative.

4.1.5 GEOLOGY AND SOILS

The geology and soil resource impact analysis consists of an evaluation of the effects generated by the construction and operation of a proposed alternative on specific geologic and soil resource attributes. Construction activities represent the principal means by which an effect to the geologic resource (limiting access to mineral or energy resources) and the soil resource (increasing the potential for soil erosion) would occur. The impact analysis also considers the effects on these attributes resulting from other past, present, and reasonably foreseeable future site improvements within the defined ROI. The principal element in assessing the effect on the geologic and soil resource is the amount and location of land disturbed during construction of the alternative.

Key factors in the impact analysis of geologic and soil resources for the disposition alternatives focus on the amount of land disturbed during construction and operations. For the soil resource impact analysis, the climatic conditions at the sites are considered. Since these key factors varied only slightly for the disposition alternatives, the impact analysis is similar for all alternatives.

Geology. Impact analysis on the geologic resource by a proposed alternative involves the evaluation of potential effects to critical geologic resource attributes such as access to mineral and energy resources, destruction of unique geologic features, vibratory ground motion induced by seismic activity, subsidence induced by groundwater, and mass movement or ground shifting induced by the construction of facilities associated with an alternative. The impact analysis includes the analysis of large-scale geological conditions such as earthquakes, volcanism, geological resources, and sinkhole development. Human health effects from accidents initiated by natural phenomenon (for example, earthquakes) are discussed in the Public and Occupational Health and Safety sections. These conditions tend to affect broad expanses of land and are not typically restricted to smaller discrete areas of land. The analysis of these conditions is provided for the storage alternatives and also applies to the disposition alternatives as appropriate.

Soil. Impact analysis on the soil resource by a proposed alternative involves the evaluation of potential effects to specific soil attributes such as soil erosion and shrink-swell potential by construction activities. [Text deleted.] Affects to the soil resource occur to small, discrete areas of land. The impact analysis for the soil resource is provided for each alternative.

4.1.6 BIOLOGICAL RESOURCES

During construction of storage and disposition facilities, impacts to biological resources may result from land-clearing activities, erosion and sedimentation, human disturbance and noise, and dewatering of foundations. Operations may affect biological resources as a result of changes in land use, salt drift from cooling systems, emissions of radionuclides, water withdrawal, wastewater discharge, and human disturbance and noise. In general, potential impacts are assessed based on the degree to which various habitats or species could be affected by an alternative. Where appropriate, impacts are evaluated with respect to Federal and State protection regulations and standards. The ROI for site-specific alternatives includes the entire DOE site under consideration, while the ROI for non-site-specific alternatives includes conditions representing various regions of the United States within which the alternative could be located.

Terrestrial Resources. Impacts of project activities on terrestrial plant communities are evaluated by comparing data on site or regional vegetation communities to proposed land requirements for both construction and operation. The analysis of impacts to wildlife is based to a large extent on plant community loss or modification, which directly affects animal habitat. The loss of important or sensitive habitats and species is considered more important than the loss of a regionally abundant type. Where alternatives are associated with specific sites, the disturbance, displacement, or loss of wildlife is evaluated. Migratory birds are discussed in a broader sense where alternatives are not site-specific, since they encompass a wide geographic area. Alternatives that may cause salt deposition are identified. [Text deleted.] Impacts on biotic resources from the release of radionuclides would be expected to be less than that on the human population. Humans have generally been shown to be the most sensitive organism to radiation release (AEC 1968a:220; NAS 1972a:34); radiological effects on humans are addressed in the human health sections.

Wetlands. The potential direct loss of wetlands resulting from construction and operation of storage and disposition facilities is addressed in a similar fashion as for terrestrial plant communities, that is, by comparing data on site or regional wetlands to proposed land requirements. Sedimentation impacts are evaluated based on the proximity of wetlands to project areas and the knowledge that erosion and sedimentation controls will be required. Where alternatives are site-specific, impacts resulting from increased flows are evaluated based on a relative comparison of expected discharge rates with stream flow rates. Impacts resulting from the introduction of thermal and chemical pollution into a wetland system are addressed recognizing that effluents are required to meet Federal and State standards. DOE regulations concerning proposed actions in wetlands (10 CFR 1022) were also considered.

Aquatic Resources. Impacts to aquatic resources resulting from sedimentation, increased flows, and the introduction of waste heat and chemicals are evaluated as described for wetlands. Potential impacts from radionuclides are not addressed for the same reasons described for terrestrial resources. Where alternatives are site-specific, impingement and entrainment impacts are evaluated based on a relative comparison of stream flow and intake volumes, recognizing that when intake volumes represent a large percentage of stream flow, the possibility of impingement and entrainment impacts exists. Compliance with protective measures, such as the *Anadromous Fish Conservation Act* (Appendix J), are addressed, as appropriate.

Threatened and Endangered Species. Impacts on threatened and endangered species are determined in a manner similar to that described for terrestrial and aquatic resources because the sources of potential impacts are similar. A list of species potentially present on each site or in each region was developed using information obtained from the USFWS, National Marine Fisheries Service, and appropriate State agencies and site-specific reports. This list, along with consideration of site environmental and engineering data, is used to evaluate

whether the various alternatives could impact any threatened or endangered plant or animal (or its habitat). Consultations with USFWS and State agencies would be conducted at the site-specific level, as appropriate.

4.1.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

The cultural and paleontological resources impact analysis evaluates the potential effects of the construction and operation of a proposed alternative on prehistoric, historic, Native American, and paleontological resources. Appropriate information regarding cultural resources includes the possibility that NRHP-eligible sites or important Native American resources may be affected, as well as the procedures for successful completion of the NHPA Section 106 identification or mitigation process. Section 106 requires Federal agencies to take into account the effects of their activities and programs on NRHP-eligible properties. Section 106 procedures include identification of resources, evaluation for NRHP eligibility, assessment of project effects, preservation or mitigation of affected eligible resources, and coordination and consultation with the appropriate SHPO and the Advisory Council on Historic Preservation.

Compliance with the *American Indian Religious Freedom Act* and the *Native American Graves Protection and Repatriation Act* is also part of the regulatory process. These acts require that consultation with interested Native American groups be initiated as part of the compliance process.

Information collected to identify relevant cultural and paleontological resources includes the general prehistory and history of a region, results of previous cultural or paleontological resources surveys or studies within or near the affected project area, and identification of any resources eligible for or currently on the NRHP, or part of the National Natural Landmarks Program.

Impacts to prehistoric and historic resources are postulated if alternatives could substantially add to existing disturbance of resources in the project areas, could affect NRHP-eligible resources, or could cause loss or destruction of important scientific, cultural, or historic resources. Impacts to Native American resources are postulated if alternatives have the potential to affect sites important for their position in the Native American physical universe or religion, or to reduce access to traditional use areas, plant or animal communities, or sacred sites. Impacts to paleontological resources are postulated if alternatives could affect deposits with high research potential.

[Text deleted.] On a programmatic level specific detail on the types and locations of resources within the proposed project areas is not available for all locations, and the level of detail varies by facility or alternative. General information concerning site types and NRHP eligibility of those types in the region, however, is appropriate for the PEIS. At the site-specific level and depending on the alternative, more detailed information may be required including file investigations, Native American consultation, implementation of the DOE American Indian Policy, or predictive modeling to determine the types, numbers, locations, and NRHP eligibility or importance of cultural resources in the proposed project area.

4.1.8 SOCIOECONOMICS

The socioeconomic impact analysis assesses the environmental consequences of demographic and economic changes resulting from implementing a proposed alternative. Developing a new facility or adding new operations to an existing DOE or commercial facility may create new jobs. The creation of new jobs may affect the economy of the regional economic area and may place an increased demand on housing, community services, and local transportation within the ROI, if the local labor market is unable to meet the labor requirements. Therefore, this study assesses the potential impacts of each proposed alternative on these characteristics. The socioeconomic environment is defined for two geographic regions: the REA and the ROI. REAs are used to assess potential effects on the regional economy, and ROIs are used to assess effects that are more localized in political jurisdictions surrounding the sites.

The REA for each site encompasses a broad market that involves trade among and between regional industrial and service sectors and is characterized by strong economic linkages between the communities in the region. These linkages determine the nature and magnitude of multiplier effects of economic activity (purchases, earnings, and employment) at each site. REAs are defined by BEA and consist of an economic node that serves as the center of economic activity and the surrounding counties that are economically related and include the places of work and residences of the labor force.

Potential demographic impacts were assessed for the ROI, a smaller geographic area where the housing market and local community services would be the most affected. Site-specific ROIs were identified as those counties where approximately 90 percent of the current DOE and/or contractor employees reside. This residential distribution reflects existing commuting patterns and attractiveness of area communities for people employed at each site and is used to estimate the future distribution of in-migrating workers.

The following sections summarize the methodology used for assessing the potential socioeconomic impacts from the alternatives.

Baseline Comparisons. Data on the current socioeconomic conditions were compiled for each ROI and REA. The data were then projected out to the period of full operation for the alternatives based on population forecasts developed by BEA. These projections were compared with the estimates of project-related impacts.

Proposed project alternatives may require additional workers during the construction and operation phases. An analysis of the projected labor availability was performed to determine the number of workers that may in-migrate to the region to meet employment needs. In addition to jobs and income directly created by the proposed project alternatives, other jobs and income may be created indirectly within the REA. These indirect jobs and resulting income are measured by employing the most recent version of the Regional Input-Output Modeling System developed by the BEA.

Population increases due to in-migration of new workers and their families are estimated by the number of new workers and the national average household size. The national average is used because the new population would come from unknown locations outside the region.

The impact on community services is assessed by determining the increase in each community service required to maintain the level of service that currently exists within the ROI, such as student-to-teacher ratio, police officer-to-population ratio, and hospital capacity.

Local Transportation. Traffic impacts are modeled using a proprietary transportation model developed in accordance with the *Highway Capacity Manual* methodology for freeways, multilane roads, and two-lane roads. Average Annual Daily Traffic (AADT) volumes are projected for 1995 and the impact year using No Action population projections.

The AADT for impacts beyond the No Action alternative are calculated from the direct employment and direct in-migrating population associated with each alternative. Only roads in the vicinity of the site on which at least 5 percent of workers travel were modeled. It was assumed that any additional workers required for a proposed alternative would use the same roads as the current workforce.

Service flow, the maximum hourly rate at which vehicles can reasonably be expected to cross a point or uniform section of a lane during a given time period under current roadway and traffic conditions, is calculated for the road segments. Capacity of the road segments is calculated from the number of lanes and capacity per lane. The service flow equation is solved for the volume-to-capacity ratio.

Level of service is a measure describing operational conditions within a traffic stream. A level of service describes these conditions in terms of factors such as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety. The level of service designations range from A to F, with each level defined by a range of volume to capacity ratios. The level of service designations, given in Table 4.1.8–1, are based primarily on the *Highway Capacity Manual* Special Report 209.

Table 4.1.8–1. Level of Service Letter Designations and Definitions

Letter Designation	Operating Conditions	Level of Service Definition
A	Good	This is a condition of free flow, accompanied by low volumes and high speeds.
B	Good	This occurs in the zone of stable flow, with operating speeds beginning to be restricted somewhat by traffic conditions.
C	Good	This is still in the zone of stable flow, but speeds and maneuverability are more closely controlled by the higher volumes.
D	Below average	This level of service approaches unstable flow, with tolerable operating speeds maintained, though considerably affected by changes in operating conditions.
E	Maximum capacity	This cannot be described by speed alone, but represents operations at lower operating speeds, typically, but not always, in the neighborhood of 30 miles per hour, with volumes at or near the capacity of the highway.
F	Traffic jam	This describes a forced-flow operation at low speeds, where volumes are above capacity.

Source: National 1985a.

4.1.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

The scope of the public and occupational health and safety analysis includes a determination of effects on human health that result from exposures to ionizing radiation and hazardous chemicals. Storage and disposition alternatives addressed in this PEIS use a broad variety of processes involving both radioactive and chemical materials that can be hazardous to human health. The degree of hazard is directly related to the type and quantity of the particular radioactive or chemical material to which a person is exposed. The health effects that may be associated with radiation and chemical induction of cancer are determined by estimating the radiological and chemical doses to workers and the general public that result from these exposures. The risk from these doses is then converted to potential cancers. This is done for normal operations and postulated accident scenarios. Additionally, for hazardous chemicals, a Hazard Quotient (HQ) is calculated based on the exposure concentration of each chemical; the HQs are calculated for all known noncancer adverse effects. The HQs are then summed to obtain the Hazard Index (HI) for each operation at a given site. The HI is used as an indicator of safe exposure levels to avoid noncancer effects of an acute or chronic nature, and is independent of the cancer risk. More detailed information about the public and occupational health safety analysis for this PEIS is found in Appendix M.

Computer models and operational histories are used to predict the impacts on the health of workers and the public due to both normal operation and postulated accidents. The computer models include GENII and Melcor Accident Consequence Code System (MACCS) for airborne and liquid radioactive releases during normal operation and accident conditions, respectively; and ISCST2 for hazardous chemical releases.

Since direct chemical monitoring data on worker exposure is not available for specific operations, the onsite worker is assumed to receive the maximum exposure that any involved (the workers directly involved in the proposed facility) or noninvolved (the workers onsite but not directly involved in the proposed facility) onsite person will receive. OSHA-regulated levels (that is, the PEL) are applied to all hazardous chemicals that are released at the site. This includes both the process-specific releases as well as those that are a result of other site operations. All onsite exposures are assumed to occur at a distance of 100 m (330 ft) from a centralized point of release, which will yield a conservative concentration level for each chemical. The concentrations are derived through the ISCST 2 model recommended by EPA. The noncancer risks to the MEI of the public consist of HQs that compare chemical exposure levels to the RfC values published by EPA in the Integrated Risk Information System (IRIS). For the onsite worker, the HQ values are calculated by comparing the calculated chemical exposure levels to the PEL established by OSHA. The HI for either the MEI or the onsite worker is the sum of the HQs for every hazardous chemical analyzed. If the HIs are 1.0 or less, then the noncancer regulated levels for all hazardous chemicals have been met and no health effects are expected.

The lifetime cancer risk to the MEI and the onsite worker from exposure to a carcinogenic chemical can be derived from either of the two following ways. The calculated exposure dose in mg/kg of body weight is multiplied by that individual chemical's slope factor published in EPA's IRIS or the EPA's yearly published Health Effects Summary Tables (HEAST), or the exposure concentration in mg/m^3 is multiplied by unit risk (found in IRIS or HEAST) to give the lifetime cancer risk. Only carcinogenic chemicals will have slope factors and/or unit risk values. The cancer risk coming from all carcinogenic chemicals is derived by summing up the risks from all individual carcinogenic chemicals.

The chemical pollutant exposures to the public are considered to be for 24 hours a day, 52 weeks per year, and 70 years for a lifetime. The worker exposure is based on an 8-hour day and 52 weeks of 40 hours each (0.237 fractional year). The HI values and cancer risks are conservative because all emissions are assume to come from a centralized source term. The cancer risks to the noninvolved worker for each chemical are computed from the dose (converted from air concentrations) and the unit risk or slope factors to yield a probable risk. The risks are also conservative because a single point at or near the maximum onsite concentration is selected for exposure of the noninvolved facility worker. Actual risks are likely lower than estimated risks.

The HI is the sum of the HQs for every hazardous chemical analyzed, the HQ being the ratio of the actual (or calculated) concentration to the regulated concentration value. Even if OSHA PELs and EPA RfCs for several hazardous chemicals are met, but they affect the same target organ or tissue, they may be expected to collectively cause injury or ill health because their damage will be cumulative. Thus, an HI of much greater than 1.0 is meaningful because the sum of the effects has the same effect as that of a single hazardous chemical exceeding the OSHA PEL or the RfC. The HI and HQ are not regulated values, but serve to assess whether regulated values have been met and whether there is a potential for a detrimental health effect to occur.

Toxic air pollutants are addressed in the Air Quality and Noise sections and the Public and Occupational Health sections for each of the potential sites. In the Air Quality sections, the maximum concentration of toxic air pollutants at or beyond the site boundary are compared with a standard to determine compliance. In the Public and Occupational Health sections, a health risk is calculated based upon chemical concentration, toxicity, and PEL or RfC for noncancer effects and a cancer risk based on the slope factor (cancer potency) of those compounds which are regulated or carcinogens.

These differences in analytical method result in the presentation of pollutants that differ between the air quality analysis and public and occupational health analysis. In the air quality analysis, toxic pollutants with low emission rates and high toxicity will, in most cases, result in extremely low concentrations at or beyond the site boundary and are therefore not presented in the air quality analysis. On the other hand, these chemical pollutants may expose an onsite worker located 100 m (330 ft) from the emission source to an unacceptable risk, and therefore are presented in the analysis. Hence, the type and form of data used to evaluate these two areas can and will be different and may require different data sources.

The assessments use technology-specific releases of radioactivity and hazardous chemicals and site-specific factors such as meteorology, population distribution, agricultural production, and an assumed facility location on the site. Atmospheric dispersion modeling performed for the Air Quality section is also utilized to develop exposure concentrations in the evaluation of impacts to workers from hazardous chemicals.

A discussion of calculational uncertainties is included to provide an understanding of how the various steps of an impact analysis can lead to predictions different from those presented in this PEIS. However, efforts have been made in all assessments to choose conservative assumptions and parameters so that impacts are not underestimated. Further discussions of assessment methodologies, including values of parameters used in the various computer models, are presented in Appendix M.

Health Impacts on Plant Workers During Normal Operation. Because radiation workers are individually monitored, experiences from past and current operations that are similar to future operations are used to estimate the radiological doses to workers directly involved with fissile material storage and disposition activities. Doses are also determined for noninvolved workers (that is, workers who are onsite but not involved with the proposed storage and disposition activities).

Radiological doses are converted to health effects using appropriate health risk estimators. Health effects from chemicals are predicted by applying appropriate risk estimators to modeled concentrations. Radiological and chemical impacts are also compared with applicable regulatory compliance and guidance requirements. The health risk estimators and applicable standards are presented and discussed in detail in Appendix M.

Health Impacts on the Public During Normal Operation. Public health impacts could result from exposure to radioactive or hazardous chemical materials released during operation. The effect is the sum of internal exposure resulting from breathing air, eating food, and drinking water; and of external exposure from standing on contaminated ground, being exposed to the air, and being submerged in water.

Impacts to the MEI and to the population around each site are calculated. The differences in impacts among the various sites are the result of many site-specific factors including the distance to the site boundary, the population distribution, and meteorological dispersion.

Modeling is used to estimate the type and amount of material released and the associated radiological doses and chemical concentrations and doses. The predictive models used to calculate radiological doses have been found to give results that tend to be higher than if calculated by converting actual measured concentrations to doses. The radiological doses and the chemical doses and concentrations are converted to health effects using appropriate health risk estimators. Radiological doses, chemical concentrations, and health risks are compared with regulatory limits and, for perspective, with background levels in the vicinity of the site. The health risk estimators used in the assessments and the applicable regulatory standards are presented and discussed in detail in Appendix M.

Accident Analysis for Postulated Accident Scenarios. The relative consequences of postulated accidents are considered in the evaluation of each alternative. In evaluating the magnitude and consequences of each alternative, accident analysis is performed. The concepts used are analogous to a formal Probabilities Risk Assessment, which would be appropriate for a project-level analysis, although the accident analysis involves considerably less detail for programmatic decision-making. The accident analysis addresses only a spectrum of bounding accidents (high consequence, low probability) and a representative spectrum of possible operational accidents (low consequence but high probability of occurrence). The technical approach for the selection of accidents is consistent with the DOE Office of NEPA Oversight *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements* (May 1993) guidance that recommends consideration of two major categories of accidents: within design basis accidents (also referred to as evaluation basis accidents) and beyond design basis accidents (also referred to as beyond evaluation basis accidents).

For the purpose of this assessment, risk is defined as the mathematical product of the probability and consequence of an accident. The risk-contributing scenarios consider both evaluation basis and beyond evaluation basis accidents. The specific accidents consider the types of facilities. Examples of accidents include those resulting from operator errors, spills, criticalities, fire, explosions, airplane crashes, common-cause failures, severe weather, earthquakes, and transportation. Information on potential accidents includes those that have been postulated and analyzed for similar facilities. The risks of the various storage and disposition facilities are evaluated in terms of the incremental increase in risk from postulated accidents with respect to normal day-to-day risks to which the general population is exposed.

For each alternative, a number of evaluation basis and beyond evaluation basis accidents have been identified and are analyzed to define the accident consequences and risks. Evaluation basis accidents are generally in a frequency range of greater than 10^{-6} per year, while beyond evaluation basis accidents are generally in a frequency range of 10^{-7} to 10^{-6} per year. In some cases, accidents less than 10^{-7} are included in the set of beyond evaluation basis accidents when their impacts are relevant to decisionmaking.

Uncertainties. The sequence of analyses performed to generate the radiological and hazardous chemicals impacts estimates from normal operation and facility accidents include (1) selection of normal operational modes and accident scenarios and their probabilities, (2) estimation of source terms, (3) estimation of environmental transport and uptake of radionuclides and hazardous chemicals, (4) calculation of radiation and chemical doses to exposed individuals, and (5) estimation of health effects. There are uncertainties associated with each of these steps. Uncertainties exist in the way the physical systems being analyzed are represented by the computational models and in the data required to exercise the models (due to measurement errors, sampling errors, or natural variability).

Of particular interest are the uncertainties in the estimate of cancer deaths from exposure to radioactive materials. The numerical values of the health risk estimates used in this PEIS (refer to Appendix M) were

obtained by the practice of linear extrapolation from the nominal risk estimate for lifetime total cancer mortality at 10 rad. Other methods of extrapolation to the low-dose region could yield higher or lower estimates of cancer deaths. Studies of human populations exposed at low doses are inadequate to demonstrate the actual level of risk. There is scientific uncertainty about cancer risk in the low-dose region below the range of epidemiological observation, and the possibility of no risk or even health benefits (hormesis effects) cannot be excluded. Because the health risk estimators are multiplied by conservatively calculated radiological doses to predict fatal cancer risks, the fatal cancer values presented in this PEIS are expected to be overestimates.

The widely used algorithms for estimating the risk of latent cancers from radiation are based on high dose rates, and the impacts are then extrapolated to low rates by presumed linear response models. These models are known to overestimate the risk for low dose rates, and the actual risk may be zero.

For the purposes of presentation in this PEIS, the impacts calculated from the linear model are treated as an upper bound case, consistent with the widely used methodologies for quantifying radiogenic health impacts. This does not imply that health effects are expected. Moreover, in cases where the upper bound estimators predict a number of latent cancer deaths that is greater that 1, this does not imply that the latent cancer death(s) are identifiable to any individual.

Uncertainties are also introduced when accident analyses performed for similar existing facilities have been used as a major source of data. Although the radionuclide composition of source terms are reasonable estimates, there are uncertainties in the radionuclide inventory and release fractions that affect the estimated consequences. Accident frequencies for low probability sequences of events are always difficult to estimate, even for operating facilities, because there is little or no record of historical occurrences. For a new facility, such as a Pu storage facility or an LWR for Pu disposition, any use of accident frequencies that are estimated from similar existing facilities would tend to further compound the effects of uncertainties. There are also uncertainties attributed to information for designs that are in the conceptual stage.

In summary, the radiological and hazardous chemical impact estimates presented in this document were obtained by:

- Using the latest available data
- Considering the processes, events, and accidents reasonably foreseeable for the storage and disposition facilities described in this PEIS
- Making conservative assumptions when there is doubt about the exact nature of the processes and events taking place, such that the chance of underestimating health impacts is small.

4.1.10 WASTE MANAGEMENT

Waste management facilities that support the long-term storage or disposition of weapons-usable fissile materials would treat and package all waste generated in support of this activity into forms that enable long-term storage and/or disposal in accordance with the *Atomic Energy Act* (AEA), RCRA, and other applicable statutes as outlined in Section E.1.2. The preconceptual designs of the new facilities provide their own waste treatment capability and incorporate waste minimization and pollution prevention practices.

Since any changes in wastes volumes could have an impact on the existing and projected waste activities at DOE sites, the PEIS assesses the impacts on waste management from the waste streams generated by all alternatives, including the No Action Alternative. All alternatives would be required to fully comply with all current applicable regulations. The waste management assessment is very important to the overall DOE decisionmaking process and is being coordinated with EM, which evaluates alternatives for implementing an integrated waste management program. The Draft Waste Management PEIS (DOE/EIS-0200-D) focuses on waste management strategies required to treat, store, or dispose of existing wastes and wastes that will be generated in the future as a result of DOE operations. The Draft Waste Management PEIS also evaluates the environmental impacts of transporting wastes. [Text deleted.]

Waste management activities that would support the long-term storage or disposition of weapons-usable fissile materials program are assumed to be per current site practices and are contingent upon decisions to be made through the Waste Management PEIS. Any future waste management facilities that may be required to support the long-term storage or disposition of weapons-usable fissile materials program would be coordinated with any decisions resulting from the Waste Management PEIS and any respective site-specific NEPA documentation. For example, depending on decisions in the waste-type-specific RODs for the Waste Management PEIS and in subsequent waste-type-specific RODs and NEPA documents, wastes could be treated and disposed of onsite or at regionalized or centralized DOE sites.

The construction and operation of facilities to support the storage and disposition of weapons-usable fissile material program would generate spent nuclear fuel and several types of wastes, depending on the alternative. [Text deleted.] Construction wastes would be similar to those generated by any construction project of comparable scale. Spent nuclear fuel and the following waste categories are analyzed: TRU, mixed TRU, low-level, mixed low-level, hazardous, and nonhazardous. This PEIS also analyzes the management and onsite storage of wastes and spent nuclear fuel, until DOE either disposes of the wastes or places them in long-term retrievable storage. To provide a framework for addressing the impacts of waste management, descriptive information is presented on waste management activities anticipated for each DOE site and for each storage or disposition alternative. Operational waste generation and effluent data are estimated and vary according to the storage or disposition technology and site. These estimates have included waste minimization provisions. The impact assessment compares the projected waste type and waste volume generation from the various disposition facilities at each site with that of the No Action Alternative. Impacts are assessed in the context of existing site practices for treatment, storage, and disposal, including current Federal, State, and local regulations and agreements.

The number of TRU waste shipments to WIPP (depending on decisions from the Supplemental EIS for the disposal phase of WIPP) was estimated by using data in the *Comparative Study of Waste Isolation Pilot Plant Transportation Alternatives* (DOE/WIPP 93-058). From this report, the PEIS uses 8.7 m^3 (11.4 yd^3) per truck shipment, 17.5 m^3 (22.9 yd^3) per regular train shipment, and 52.4 m^3 (68.6 yd^3) per dedicated train shipment (rail shipment may not be applicable at all sites). DOE sites used in the analysis (with the exception of Pantex) either have, or have planned, an onsite LLW disposal facility. As discussed in Section E.1.4, land-usage factors for the disposal of LLW were developed from data in the DOE Integrated Data Base Program for each existing DOE LLW disposal facility (Hanford, INEL, NTS, and SRS). For the proposed Class II LLW disposal facility at ORR, a 3,300 m^3/ha (1,700 yd^3/acre) usage factor was assumed (OR DOE 1995e:1). For the purposes of this

PEIS, it was assumed that all LLW generated at Pantex would be shipped to NTS per current practice. The number of additional shipments required to transport LLW from the site to a DOE LLW disposal facility is estimated. A typical shipment was assumed to consist of eighty 208-l (55-gal) drums, which results in a total shipment volume of approximately 16.6 m^3 (21.7 yd^3). The risks associated with additional shipments are addressed as part of the intersite transportation assessment.

Under some PEIS alternatives, specific candidate sites are not identified. As a result, no planning or environmental documents are available to provide descriptions of the waste management activities or to establish a detailed baseline from which environmental consequences can be estimated. For these cases, generic environmental baselines are presented to define conditions. Waste management impacts are assessed by analyzing the specific waste management facilities and activities associated with the alternative that are necessary to locate new missions at the unspecified sites.

4.2 NO ACTION ALTERNATIVE AND LONG-TERM STORAGE ALTERNATIVES

This section describes the potential environmental consequences of the No Action Alternative and of constructing and operating various long-term storage alternatives. A key for locating information on the storage alternatives and candidate sites analyzed is shown in Table 4–1. Included in the analysis of each site is storage phaseout. The phaseout of Pu storage at Hanford, INEL, Pantex, SRS, RFETS, and LANL, and HEU storage at ORR, is a common activity associated with both storage and disposition when the storage requirements for these fissile materials are eliminated at a particular site. The impact analysis in this section is organized by site.

4.2.1 HANFORD SITE

A listing of the proposed long-term storage alternatives, subalternatives, and related actions, including the No Action Alternative, at Hanford is provided below. The potential impacts of implementing these alternatives and related actions at Hanford are described in the following sections: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, and waste management. The specific long-term storage alternatives proposed for Hanford are the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative.

Preferred Alternative

No Action Alternative:

Continue to store Hanford Pu material within the scope of this PEIS in the PFP in stabilized form pursuant to DNFSB Recommendation 94-1.

Proposed Storage Activities at Hanford Site

- **No Action Alternative (Preferred Alternative):** Continue to store Hanford Pu material within the scope of this PEIS in the PFP in stabilized form pursuant to DNFSB Recommendation 94-1.
- **Upgrade Alternative:** There are two subalternatives under this storage alternative.
  - ***Upgrade Without RFETS Pu or LANL Pu Subalternative:*** Two options to accommodate Hanford Pu material: Modify selected areas of FMEF in 400 Area; or construct a new facility in 200 West Area.
  - ***Upgrade With All or Some RFETS Pu and LANL Pu Subalternative:*** Two options to accommodate Hanford, RFETS and LANL Pu material: Increase modification of selected areas of the FMEF in 400 Area; or construct a larger new facility in 200 West Area.

Proposed Storage Activities at Hanford Site—Continued

- **Consolidation Alternative:** Construct a new facility adjacent to 200 East Area to accommodate all Pu material within the scope of this PEIS.
- **Collocation Alternative:** Construct a new facility adjacent to 200 East Area to accommodate all Pu and HEU material within the scope of this PEIS.
- **Subalternatives Not Including Strategic Reserve and Weapons Research and Development Materials:** Facility and other resource requirements would be smaller than the Upgrade With All or Some RFETS Pu and LANL Pu subalternatives, the Consolidation Alternative, and the Collocation Alternative.
- **Phaseout:** Hanford Pu material within the scope of this PEIS would be moved out of Hanford to the Consolidation or Collocation site (located at another DOE site) or to disposition (for surplus Pu).

4.2.1.1 Land Resources

Preferred Alternative: No Action Alternative

Under this alternative, Pu storage would continue at the current interim storage location in stabilized form at the PFP pursuant to DNFSB Recommendation 94-1 and the Record of Decision for the *Plutonium Finishing Plant Stabilization Environmental Impact Statement* (PFP EIS). The ongoing (no new action) activities conform with present and future land-use plans, policies, and controls. Therefore, no impacts on land resources would be anticipated at Hanford beyond the effects of existing activities and future activities that are independent of the proposed action.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

Part of the existing FMEF, located in the 400 Area of Hanford, would be converted into a Pu storage facility. The modified FMEF would house the Pu storage vault and all the functions needed to support storage. No new land disturbance would occur during construction nor would additional land not previously disturbed be used during operations.

Land Use. Modifying the FMEF for Pu storage would conform with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the CLUP Process. According to the *Hanford Site Development Plan*, 400 Area land use is identified as reactor operations, which can include other operational uses such as material storage (HF DOE 1993c:13,14). Since this option would involve the modification of an existing facility, construction would occur completely within an existing, but not operating, protected area and would use the same areas previously disturbed during original construction (for example, laydown areas). During operation, the entire previously disturbed protected area (6.25 ha [15.45 acres]) would be required. In addition, there could be dedicated areas outside the fence (for example, parking lot). Other Hanford land uses or special status lands will not be affected. As discussed in Section 4.2.1.8, no in-migration of workers would be required during the construction and only a small increase in population would occur during operation. There would be no change to the region's housing market during construction and an insignificant effect during operation. Therefore, no indirect impacts to the offsite land use would be anticipated.

Construction and operation would be compatible with State and local (Benton, Franklin, and Grant Counties and the city of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. This alternative would not result in new land disturbance or new structures, so the existing landscape would remain virtually unchanged. No impacts to visual resources caused by construction and operation would occur. The appearance of the upgraded facilities would remain consistent with the industrialized landscape character and the current VRM Class 5 designation of the developed areas of Hanford.

Construct New 200 West Area Facility for Plutonium Storage

The new Pu storage facility would be a two-level facility that would be located on vacant land within the 200 West Area northwest of the 234-5Z building. No new land disturbance would occur during construction nor would additional land not previously disturbed be used during operations.

Land Use. Construction of a new facility for Pu storage would conform with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the CLUP Process. According to the *Hanford Site Development Plan*, 200 Area land use is identified as waste operations, which includes radioactive material management and storage (HF DOE 1993c:13,14). Although existing land use would change from unused to developed land, the proposal would be consistent with land-use plans and construction and operation would occur completely within an existing protected area and would not involve new disturbed land. During operation, the entire 10.5 ha (26 acres) protected area would be required. In addition, there could be dedicated area outside the fence (for example, parking lot). Other Hanford land uses or special status lands would not be affected. As discussed in Section 4.2.1.8, workforce requirements for construction and operation would be the same as modification of the FMEF. Therefore, no offsite land use would be indirectly affected. [Text deleted.]

Construction and operation would be compatible with State and local (Benton, Franklin, and Grant Counties and the city of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] The appearance of the proposed facility would be consistent with the existing industrialized landscape character, and the current VRM Class 5 designation of the 200 West Area would remain. Because of the existing industrial character of the 200 West Area and the distance to any sensitive viewpoints, no visual impacts would occur.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

This option would modify selected areas of the existing FMEF for Pu storage. Although the additional interior area needed to accommodate the RFETS and LANL material would slightly increase footprint, the facility would still be contained within the existing protected area. Therefore, land area requirements during modification and operations would be equal to the Upgrade Without RFETS or LANL Pu Subalternative. Potential impacts to land resources would be the same as the Upgrade Without RFETS Pu or LANL Pu Subalternative.

Construct New 200 West Area Facility for Plutonium Storage

A new facility to accommodate Hanford, RFETS, and LANL Pu material would be constructed in the 200 West Area. Land area requirements during construction and operations would be equal to that of the Upgrade Without RFETS Pu or LANL Pu Subalternative. Therefore, potential impacts to land resources would be similar to the Upgrade Without RFETS Pu or LANL Pu Subalternative.

Consolidation Alternative

Construct New Plutonium Storage Facility

Under this alternative, all Pu within the scope of this PEIS would be stored at a new storage facility to be constructed at Hanford west of the 200 East Area. The potential facility location has been improved with a railroad spur and utility line (HF 1996a:1). The alternative would disturb 58.5 ha (144 acres) of land area during construction of which 56 ha (138 acres) would be used during operations. A buffer zone would be provided between operations and the Hanford site boundary. Pu storage in existing DOE storage facilities would be phased out.

Land Use. Construction and operation of a new consolidated facility for Pu storage would conform with existing and future land use as described in the current *Hanford Site Development Plan* and in the CLUP Process. The *Hanford Site Development Plan*, identifies land use in the 200 Area as waste operations, which includes radioactive material management and storage (HF DOE 1993c:13,14). Although existing land use would change from undeveloped to industrial, this alternative conforms with land-use plans. As discussed in Section 4.2.1.8, no in-migration of workers would be required during the construction phase, and only a small in-migration would occur during operations, with no effect on the housing sector. Therefore, no indirect offsite land-use effects would occur. Compatibility with the use of special status lands, and consistency with State and local land-use plans, policies, and controls would be similar to the Construct New 200 West Area Facility for Pu Storage option of the Upgrade Alternative.

Visual Resources. The appearance of the proposed action would be consistent with the industrial landscape character and current VRM Class 5 designation of the 200 Area. Potential impacts to visual resources would be similar to the Construct New 200 West Area Facility for Pu Storage option of the Upgrade Alternative.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

All HEU within the scope of the PEIS would be stored at a new storage facility at Hanford collocated with the Pu storage facility. The facilities would be located west of the 200 East Area. The potential facility location has been improved with a railroad spur and utility line (HF 1996a:1). The facilities would disturb 89.5 ha (221 acres) of land area during construction of which 87 ha (215 acres) would be used during operations. A buffer zone would be provided between the facilities and the Hanford site boundary. Pu storage in existing facilities at Hanford would be phased out.

Land Use. Construction and operation of new collocated facilities would conform with existing and future land-use plans as described in the current *Hanford Site Development Plan* and in the CLUP Process. The *Hanford Site Development Plan* identifies land use in the 200 Area as waste operations, which includes radioactive material management and storage (HF DOE 1993c:13,14). Vacant land would be used. As discussed in Section 4.2.1.8, no in-migration would occur during construction. A small number of workers are projected to in-migrate during operation. Projected housing vacancies would be sufficient to accommodate this growth. Therefore, no indirect impacts to offsite land uses would be anticipated. Compatibility with the use of special status lands, and consistency with land-use plans, policies, and controls, would be similar to the Construct New 200 West Area Facility for Pu Storage option of the Upgrade Alternative.

Visual Resources. The appearance of the proposed action would be consistent with the industrial landscape character and current VRM Class 5 designation of the 200 Area. Potential impacts to visual resources would be similar to the Construct New 200 West Area Facility for Pu Storage option.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, land effects during construction and operation would be almost the same in extent and magnitude to the No Action Alternative, Upgrade with All or Some RFETS Pu and LANL Pu Subalternative, Consolidation Alternative, and Collocation Alternative because the facility would be almost the same. However, because the smaller quantity of material would require smaller facilities, it is likely that less land area would be disturbed during construction and used during, operations. [Text deleted.]

Phaseout

No new construction or upgrade of existing facilities would occur under the phaseout of the Pu mission. Hanford Pu would be moved out of Hanford to the Consolidation or Collocation site or to disposition. Therefore, no impacts to land resources would be anticipated at Hanford beyond the effects of existing activities and future activities that are independent of the proposed action.

[Text deleted.]

4.2.1.2 Site Infrastructure

For selected site infrastructure parameters, Table 4.2.1.2–1 shows the site availability, projected usage under No Action, and projected usage associated with each storage alternative at Hanford, including phaseout of the Pu storage mission. Adequate infrastructure is available to accommodate all long-term storage alternatives. In addition, there is adequate space for any new facilities required to support the various storage alternatives.

Preferred Alternative: No Action Alternative

The infrastructure currently in place at Hanford is capable of handling all anticipated missions and functions associated with the No Action Alternative. However, certain actions could result in changes to the site infrastructure under No Action. Some of these actions are described below. Since the PFP processing facilities (234-5Z) were designed and constructed in 1947, it is reasonably foreseeable that upgrades of the PFP and support services/utilities could be required to complete stabilization and packaging activities for the current inventory of weapons-usable Pu. These activities are described in the *Hanford Site Integrated Stabilization Management Plan* (SISMP). In addition, glovebox-scale processing and a new packaging capability are required to implement the DOE-STD-3013-94 storage standard in SISMP timeframes.

In the PFP-EIS, DOE has assessed impacts of activities required at Hanford to remove and stabilize readily retrievable Pu residues in the nonstorage portions of the PFP (that is, 234-5Z processing facility) while its current material storage capability is maintained. The actions resulting from the PFP-EIS could affect certain site infrastructure parameters. Hanford will continue to evaluate low-assay, non-weapons usable, Pu materials currently in storage for potential treatment, packaging, and disposal as TRU waste to WIPP to avoid unnecessary costs, handling, and personnel exposure. [Text deleted.]

There could be additional changes to Hanford's site infrastructure under No Action resulting from construction of safe, environmentally sound, and economic, dry interim storage of the K-East Basin (105-KE Basin) spent fuel. The Hanford SISMP outlines plans to remove the spent nuclear fuel from the 105-KE Basin by December 1999. Such removal will resolve the safety and environmental concerns identified in DNFSB Recommendation 94-1 that are associated with the deteriorating spent fuel in the 105-KE Basin and would occur under No Action.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium subalternatives

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

Modifying selected areas of the FMEF to accommodate long-term storage of existing quantities of Pu at Hanford would not affect the site infrastructure. Data for construction are presented in Appendix C. Operations impacts to the Hanford infrastructure under this option would be minimal. This is because the FMEF is a fully capable nuclear materials facility with the required infrastructure, including access roads, in place. All infrastructure requirements for this subalternatives are within site capacities.

Construct New 200 West Area Facility for Plutonium Storage

Constructing a new storage facility to accommodate long-term storage of existing quantities of Pu at Hanford would not impact the site infrastructure. Data for construction are presented in Appendix C. Operations impacts to the Hanford infrastructure under this subalternatives would be minimal. [Text deleted.] As shown in Table 4.2.1.2–1, less than 5 km (3 mi) of roads would need to be constructed. All other infrastructure requirements are within site capacities.

Table 4.2.1.2–1. Site Infrastructure Changes Required for Operation at Hanford Site (Annual)—No Action (2005) and Storage Alternatives

Alternative	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
No Action							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage	420	204	345,500	58	9,334,800	21,039,531	0
Upgrade (without RFETS or LANL Pu material)							
Modify FMEF							
Projected usage with upgrade facility	420	204	365,500	63	9,338,740	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0	0	0
New Pu Storage Facility							
Projected usage with upgrade facility	425	204	365,500	63	9,338,740	21,039,531	0
Amount required in excess to site availability	<5	0	0	0	0	0	0
Upgrade (with RFETS and LANL Pu material)							
Modify FMEF							
Projected usage with upgrade facility	420	204	366,650	63	9,338, 740	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0	0	0
New Pu Storage Facility							
Projected usage with upgrade facility	425	204	366,650	63	9,338,740	21,039,531	0
Amount required in excess to site availability	<5	0	0	0	0	0	0
Consolidation							
Projected usage with consolidated facility	425	204	416,500	67	9,372,800	21,039,531	0
Amount required in excess to site availability	<5	0	0	0	0	0	0
Collocation							
Projected usage with collocated facilities	425	204	437,500	76	9,372,800	21,039,531	0
Amount required in excess to site availability	<5	0	0	0	0	0	0
Phaseout							
Projected usage with storage phaseout	420	204	345,500	58	9,334,800	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0	0	0

Source: DOE 1996e; DOE 1996f; HF 1995a:1; HF DOE 1996a.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium subalternatives

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

Construction to modify selected areas of the FMEF to accommodate existing quantities of Pu plus material relocated from RFETS and LANL would not impact the site infrastructure. Data for construction are presented in Appendix C. Operations impacts under this option would also be minimal. Requirements are within site capacities and would not impact the site infrastructure.

Since impacts associated with this option for storing all of the RFETS Pu and LANL Pu material at Hanford are minimal, storing only a portion of the RFETS Pu and LANL Pu material at Hanford would result in minimal impacts to the site infrastructures as well. Additional annual electrical energy requirements would be proportionately less than that required for storage of the full amount of RFETS Pu and LANL Pu material.

Construct New 200 West Area Facility for Plutonium Storage

Constructing a new storage facility to accommodate existing quantities of Pu plus material relocated from RFETS and LANL would not impact the site infrastructure. Data for construction are presented in Appendix C. Operations impacts under this option would also be minimal. Requirements are within site capacities and would not impact the site infrastructure. Less than 5 km (3 mi) of access road would need to be constructed.

Since impacts associated with this option for storing all of the RFETS Pu and LANL Pu material at Hanford are minimal, storing only a portion of the RFETS Pu and LANL Pu material at Hanford would result in minimal impacts to the site infrastructures as well. Additional annual electrical energy requirements would be proportionately less than that required for storage of the full amount of RFETS Pu and LANL Pu material.

Consolidation Alternative

Construct New Plutonium Storage Facility

The site infrastructure impacts of constructing a consolidated Pu storage facility at Hanford would be minimal. Data for this construction are located in Appendix C. The site infrastructure impacts of operating a consolidated Pu storage facility at Hanford are shown in Table 4.2.1.2–1. The Hanford site infrastructure would be fully capable of supporting the operations of such a new facility without major modifications to the existing site infrastructure and utility resource requirements. Less than 5 km (3 mi) of access road would need to be constructed.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

The site infrastructure impacts of constructing consolidated Pu and collocated HEU storage facilities at Hanford would be minimal. Data for this construction are located in Appendix C. The site infrastructure impacts of operating consolidated Pu and collocated HEU storage facilities at Hanford are shown in Table 4.2.1.2–1. Hanford site infrastructure would be fully capable of supporting the operations of such new facilities without major modifications to the existing site infrastructure and utility resource requirements. Less than 5 km (3 mi) of access road would need to be constructed.

Subalternatives Not Including Strategic Reserve and Weapons Research and Development Materials

Since the existing Hanford site infrastructure would be fully capable of supporting construction/modification and operation of facilities for the Upgrade Alternative (both subalternatives), the Consolidation Alternative, and the Collocation Alternative, constructing and operating such facilities without including provisions for storage of strategic reserve and weapons R&D materials could be accommodated as well. Expected reductions in amounts of annual electrical energy requirements from those of the various storage alternatives for all the strategic reserve and weapons R&D materials are the only site infrastructure changes expected if this subalternatives is chosen because electric usage is dependent on the amount of material. [Text deleted.]

Phaseout

Phaseout of the Pu storage mission at Hanford would have no impact on the facilities and site infrastructure. While Pu storage operations would cease, the storage facilities would remain and utility service would continue at about the same usage level until D&D is accomplished.

4.2.1.3 Air Quality and Noise

Construction and operation activities associated with the No Action Alternative and the proposed storage alternatives would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts at Hanford, criteria and toxic/hazardous concentrations from the No Action Alternative and the proposed storage alternatives are compared with Federal and State standards and guidelines. Impacts to human health from radiological and chemical airborne emissions are described in Section 4.2.1.9.

In general, all of the proposed storage facilities would emit the same types of air pollutants during construction. It is expected emissions would not exceed Federal, State, or local air quality regulations. PM_{10} and TSP concentrations will be increased, especially during peak construction periods.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, and wind erosion of exposed ground surfaces
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

During operation, impacts from each of the individual storage facilities with respect to the concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Table 4.2.1.3–1 presents the estimated pollutant concentrations for each of the proposed storage alternatives, indicating little difference between alternatives with respect to impacts to air quality.

Emission rates attributed to operation of the proposed storage facilities are presented in Tables F.1.3–1 to F.1.3–3. [Text deleted.] Air pollutant emission sources associated with operations include the following:

- Operation of boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- Exhaust and road dust generated by vehicles delivering supplies and bringing employees to work
- Toxic/hazardous pollutant emissions from facility processes

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for each storage alternative are described separately. Supporting data for the air quality and noise analyses are presented in Appendix F.

AIR QUALITY

An analysis was conducted of the potential impacts on air quality from emissions from each of the storage alternatives described in Section 2.2.1.

Section 176 (c) of the 1990 CAA Amendments requires that all Federal actions conform with the applicable SIP. The EPA has implemented rules that establish the criteria and procedures governing the determination of conformity for all Federal actions in nonattainment and maintenance areas. These are discussed in Section 4.1.3. The attainment status of the area in which Hanford is located is discussed in Section 3.2.3. Since the area is considered to be an attainment area for the criteria pollutants, the proposed actions at this site do not require that a conformity analysis be performed.

Table 4.2.1.3–1. Estimated Operational Concentrations of Pollutants at Hanford Site and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Criteria Pollutants						
Carbon monoxide	8-hour	10,000[b]	0.08	0.09	0.17	0.17
	1-hour	40,000[b]	0.3	0.37	1.04	1.04
Lead	Calendar Quarter	1.5[b]	<0.01	<0.01	<0.01	<0.01
	24-hour	0.5[c]	<0.01	<0.01	<0.01	<0.01
Nitrogen dioxide	Annual	100[b]	0.03	0.03	0.04	0.04
Ozone	1-hour	235[b]	[d]	[d]	[d]	[d]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	<0.01	<0.01	<0.01	<0.01
	24-hour	150[b]	0.02	0.02	0.02	0.02
Sulfur dioxide	Annual	52[b]	<0.01	<0.01	<0.01	<0.01
	24-hour	260[b]	<0.01	<0.01	<0.01	0.01
	3-hour	1,300[b]	0.01	0.01	0.01	0.11
	1-hour	1,018[c]	0.02	0.02	0.22	0.22
	1-hour	655[c,e]	0.02	0.02	0.22	0.22
Mandated by Washington						
Total suspended particulates	Annual	60[c]	<0.01	<0.01	<0.01	<0.01
	24-hour	150[c]	0.02	0.02	0.02	0.02
Gaseous fluorides	30-day	0.8[c]	[f]	[f]	[f]	[f]
	7-day	1.7[c]	[f]	[f]	[f]	[f]
	24-hour	2.9[c]	[f]	[f]	[f]	[f]
	12-hour	3.7[c]	[f]	[f]	[f]	[f]
Hazardous and Other Toxic Compounds						
Ammonia	24-hour	100[c]	<0.01	<0.01	<0.01	<0.01
Chlorine	24-hour	5[c]	[f]	[f]	<0.01[g]	<0.01[g]

Table 4.2.1.3–1. Estimated Operational Concentrations of Pollutants at Hanford Site and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Hydrogen chloride	24-hour	7[c]	f	f	<0.01[g]	<0.01[g]
Hydrazine	Annual	0.0002[c]	f	f	<0.00001[g]	<0.00001[g]
Nitric acid	24-hour	17[c]	f	f	<0.01[g]	<0.01[g]
Phosphoric acid	24-hour	3.3[c]	f	f	<0.01[g]	<0.01[g]
Sulfuric acid	24-hour	3.3[c]	f	f	<0.01[g]	<0.01[g]

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Federal and State standard.

[c] State standard or guideline.

[d] Ozone, as a criteria pollutant, is not directly emitted or monitored by the candidate site. See Section 4.1.3 for a discussion of ozone-related issues.

[e] The standard is not to be exceeded more than twice in any seven consecutive days.

[f] No sources of this pollutant have been identified.

[g] The concentration represents the alternative contribution only.

Note: Concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from non-facility sources (for example, traffic).

Source: 40 CFR 50; DOE 1996e; DOE 1996f; HF 1995a:1; HF DOE 1996a; WA Ecology 1994a.

Preferred Alternative: No Action Alternative

This alternative utilizes estimated air emissions data from total site operations at Hanford assuming continuation of site missions as described in Section 3.2. These data reflect conservative estimates of criteria and toxic/hazardous emissions at Hanford. The emission rates for the criteria and toxic/hazardous pollutants for No Action are presented in Table F.1.2.2–1. Table 4.2.1.3–1 presents the No Action concentrations. Increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside of the scope of the PEIS) under the No Action Alternative. Concentrations of all other criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable Federal, State, and local ambient air quality standards.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

It is expected that pollutant concentrations will remain within applicable Federal and State ambient air quality standards during modification of the FMEF.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.1.3–1. Concentrations of air pollutants are expected to be the same with or without the RFETS or LANL material.

Construct New 200 West Area Facility for Plutonium Storage

In addition to the types of sources of emissions during construction associated with the No Action Alternative and the storage upgrade alternatives, fugitive dust resulting from the operation of a concrete batch plant would be an additional emission source associated with construction of a new facility.

Increased PM_{10} and TSP concentrations may occur during the peak construction period, and during dry and windy conditions. Appropriate control measures would be followed to minimize pollutant concentrations during construction. Concentrations of all pollutants at the site boundary or public access highways would remain within applicable Federal and State ambient air quality standards during construction.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.1.3–1. Concentrations of air pollutants are expected to be similar with or without the RFETS or LANL material since pollutant emissions are the result of combustion of fossil fuels for heating the facility.

Upgrade With All or Some Rocky Flats Environmental Technology Site and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

Air quality impacts for construction and operation for this option are expected to be similar to those previously described for modifying the FMEF.

Construct New 200 West Area Facility for Plutonium Storage

Air quality impacts for construction and operation for this option are expected to be similar to those previously described for the new Pu storage facility.

Consolidation Alternative

Construct New Plutonium Storage Facility

Air quality impacts for construction and operation for this option are expected to be similar to those for the options previously discussed for the Upgrade Alternative.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

The collocation of Pu and HEU materials facilities would be located in the same area as the consolidated Pu materials facilities and would have similar air quality impacts, with the following exceptions.

During operation, emissions would be slightly higher, as shown in Appendix F. Concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative and No Action are presented in Table 4.2.1.3–1.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Air quality impacts for construction and operation for this subalternative are expected to be similar to those previously described for the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. Since the same facility or a slightly smaller facility would be constructed or upgraded, the construction activities would be expected to have the same or less emissions. Storage of a smaller quantity of material would be expected to result in less emissions during operation of the facility as a result of reduced combustion emissions, laboratory operations, and other activities. [Text deleted.]

Phaseout

Phaseout of existing Pu inventories as a result of consolidating Pu at another site is expected to result in a small reduction in air pollutant concentrations from the No Action concentrations and would be in compliance with Federal and State standards. Some emissions may occur as a result of transporting materials from Hanford. Quantity of emissions is dependent on transportation mode.

NOISE

The location of the storage facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy construction equipment and increased traffic. Increased traffic would occur onsite and along offsite local and regional transportation routes used to bring construction material and workers to the site.

Preferred Alternative: No Action Alternative

Nontraffic noise sources associated with continued interim storage (No Action) and other ongoing missions are the same as described in Chapter 3. The continuation of operations at Hanford would result in no appreciable change in traffic noise and onsite operational noise sources from current levels. Nontraffic noise sources are

located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may be located close enough to onsite noise sensitive areas to result in impacts, such as disturbances of wildlife.

Upgrade, Consolidation, and Collocation Alternatives

Nontraffic noise sources associated with the storage alternatives would be similar to those for existing facilities as discussed in Chapter 3. Nontraffic, operational noise sources associated with the alternatives include new or existing equipment and machines (cooling systems, vents, motors, and material handling equipment). These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Noise impacts for construction and operations for this option are expected to be almost the same to those previously described for the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative because noise impacts are based on the use of the facility and not the size. [Text deleted.]

Phaseout

A reduction in noise levels associated with facility operations may result from the phaseout of storage facilities.

4.2.1.4 Water Resources

Construction and operation of the potential long-term storage facilities at Hanford would affect water resources. All facility options (in either the 400 or 200 Areas) are above the 100-year, 500-year, probable maximum flood (40,000 m^3/s [1.4 million ft^3/s]), flooding from dam failures, and flooding from a landslide resulting in river blockage. At Hanford, surface water resources, primarily the Columbia River, would be used to meet all construction and operation water requirements for facilities located in the vicinity of the 200 Area. The Columbia River has sufficient flow to support any of the alternatives. No construction- or operation-related impacts would exceed 1.1 percent of the Columbia River's average flow. Groundwater would be used to meet water requirements for facilities located in the 400 Area. During construction and operation of the facilities, treated wastewater would continue to be discharged in compliance with NPDES permit requirements, to infiltration ponds in the 200 Area, or nearby streams, or would be recycled at newly constructed wastewater treatment facilities. Stormwater runoff would be collected and treated, if necessary, before discharge to natural drainage channels in accordance with permit requirements. [Text deleted.]

Minimal impacts to groundwater are anticipated because no direct discharges would occur during construction and operation. Table 4.2.1.4–1 presents No Action water resources uses and discharges and the potential changes to water resources at Hanford resulting from the long-term storage alternatives.

Preferred Alternative: No Action Alternative

Surface Water. [Text deleted.] A description of the activities that would continue at Hanford is provided in Section 3.2. Under this alternative, surface water withdrawals from the Columbia River are not expected to increase from the current usage of 13,511 million l/yr (3,569 million gal/yr) by 2005. Treated wastewater discharged to infiltration/evaporation ponds is expected to remain at 246 million l/yr (65 million gal/yr). Under this alternative, current restoration programs would continue, and water quality is anticipated to improve.

Groundwater. Under this alternative, no additional impacts to groundwater resources are anticipated. Withdrawals from current operations in the 400 Area (195 million l/yr [51.6 million gal/yr]) are not anticipated to increase by 2005.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

Surface Water. There are no unique construction characteristics associated with water requirements and discharges from the modify FMEF option. Since the facilities are located in the 400 Area, no surface water would be withdrawn for any modification or operation activities. Groundwater from the unconfined aquifer would be used to meet water requirements. Since upgrades will take place in an existing facility, no impact to surface water would result from soil erosion of disturbed land and siltation of surface drainage channels during modifications. During operation, stormwater runoff would be collected and treated, if necessary, before discharge to natural drainage channels.

During modification of selected areas of the FMEF, sanitary wastewater (approximately 3.9 million l/yr [1.0 million gal/yr]) would be generated and discharged to the existing wastewater treatment systems at the 400 Area. This would cause a 1.6-percent increase in the effluent discharged at Hanford. During operation, wastewater would be discharged to infiltration/evaporation ponds. [Text deleted.]

Table 4.2.1.4–1. No Action and Potential Changes to Water Resources at Hanford Site—No Action (2005) and Storage Alternatives

Affected Resource Indicator	No Action	Upgrade				Consolidation	Collocation	Phaseout
		Without RFETS or LANL Pu Material		With RFETS and LANL Pu Material				
		Modify FMEF	New Storage Facility	Modify FMEF	New Storage Facility			
Water Source	Surface/ Ground	Ground	Surface	Ground	Surface	Surface	Surface	Surface
Construction								
Water Availability and Use								
Total water requirement (million l/yr)	NA[a]	5.0	5.0	7.8	7.8	85	105	0
Percent increase in projected water use[b]	NA[a]	2.6	0.04	4.0	0.06	0.6	0.8	0
Water Quality								
Total wastewater discharge (million l/yr)	NA[a]	3.9	3.9	5.9	5.9	7.7	12.5	0
Percent change in wastewater discharge[c]	NA[a]	1.6	1.6	3.0	0.04	3.1	5.1	0
Operation								
Water Availability and Use								
Total water requirement (million l/yr)	13,511/195	8.4	8.4	8.9	8.9	110	150	0
Percent increase in projected water use[d]	0/0	4.3	0.06	4.6	0.07	0.8	1.1	0
Water Quality								
Total wastewater discharge (million l/yr)	246	0	0	0	0	0	0	0
Percent change in wastewater discharge[e]	0	0	0	0	0	0	0	0
Floodplain								
Is action in 100-year floodplain?	NA	No	No	No	No	No	No	No

Table 4.2.1.4–1. No Action and Potential Changes to Water Resources at Hanford Site—No Action (2005) and Storage Alternatives—Continued

Affected Resource Indicator	No Action	Upgrade: Without RFETS or LANL Pu Material: Modify FMEF	Upgrade: Without RFETS or LANL Pu Material: New Storage Facility	Upgrade: With RFETS and LANL Pu Material: Modify FMEF	Upgrade: With RFETS and LANL Pu Material: New Storage Facility	Consolidation	Collocation	Phaseout
Is critical action in 500-year floodplain?	NA	No	No	No	No	No	No	No

[a] See operations section of table for No Action water data.

[b] Percent increases in water requirements for construction at Hanford are calculated by dividing No Action water requirements (13,511 million l/yr for surface water and 195 million l/yr for groundwater) with that for each storage alternative: Modify FMEF without RFETS or LANL Pu material (5.0 million l/yr), new Pu storage facility without RFETS or LANL Pu material (5.0 million l/yr), Modify FMEF with all RFETS and LANL Pu material (7.8 million l/yr), new Pu storage facility with all RFETS and LANL Pu material (7.8 million l/yr), new Pu storage facility (85 million l/yr), new Pu and HEU storage facility (105 million l/yr), and storage phaseout (0 l/yr).

[c] Percent changes in wastewater discharged during construction at Hanford are calculated by dividing No Action wastewater discharges (246 million l/yr) with that for each storage alternative: modify FMEF without RFETS or LANL Pu material (3.9 million l/yr), new Pu storage facility without RFETS or LANL Pu material (3.9 million l/yr), modify FMEF with all RFETS and LANL Pu material (5.9 million l/yr), new Pu storage facility with all RFETS and LANL Pu material (5.9 million l/yr), new Pu storage facility (7.7 million l/yr), new Pu and HEU storage facility (12.5 million l/yr), and storage phaseout (0 l/yr [0 gal/yr]).

[d] Percent increases in water requirements for operation at Hanford are calculated by dividing No Action water requirements (13,511 million l/yr for surface water and 195 million l/yr for groundwater) with that for each storage alternative: modify FMEF without RFETS or LANL material (8.4 million l/yr), new Pu storage facility without RFETS or LANL material (8.4 million l/yr), modify FMEF with all RFETS and LANL Pu material (8.8 million l/yr), new Pu storage facility with all RFETS and LANL Pu material (8.9 million l/yr), new Pu storage facility (110 million l/yr), new Pu and HEU storage facility (146 million l/yr), and storage phaseout (0 l/yr).

[e] Percent changes in wastewater discharged during operation at Hanford are calculated by dividing No Action wastewater discharges (246 million l/yr) with that for each storage alternative: modify FMEF without RFETS or LANL Pu material (0 million l/yr), new Pu storage facility without RFETS or LANL Pu material (0 million l/yr), modify FMEF with all RFETS and LANL Pu material (0 million l/yr), new Pu storage facility with all RFETS and LANL Pu material (0 million l/yr), new Pu storage facility (0 l/yr), new Pu and HEU storage facility (0 l/yr), and storage phaseout (0 l/yr).

Note: NA=not applicable. During operation of the new facilities, all wastewater will be recycled; construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations occur continuously.

Source: DOE 1996e; DOE 1996f; HF 1995a:1; HF DOE 1995e:1; HF DOE 1996a.

Fire sprinkler water and truck hose-down water would be collected in tanks, monitored for radioactivity, and if uncontaminated, discharged to storm drains that discharge to local drainage channels. If contaminated, this water would be treated as required.

The FMEF is located in the 400 Area above the floodplain from the probable maximum flood of 40,000 m^3/s (1.4 million ft^3/s), which is greater than the 500-year flood. The possibility of flooding from dam failures with a flood wave of 600,000 m^3/s (21 million ft^3/s) has been studied by the COE. In addition to the areas inundated by the probable maximum flood, the remainder of the 100 Area, the 300 Area, and nearly all of Richland, but not the 400 Area, would be flooded. A landslide resulting in river blockage downstream of the 400 Area, and flooding along the Columbia River during a river flood flow of 17,000 m^3/s (600,000 ft^3/s), would not inundate the FMEF. Additionally, it is unlikely that the landslide would be downstream.

Groundwater. During modification activities, the quantity of water required would be approximately 5.0 million l/yr (1.3 million gal/yr), which would represent a 2.6-percent increase over the projected No Action groundwater withdrawal (195 million l/yr [52 million gal/yr]). During operation, groundwater would be obtained from existing supply systems in the 400 Area. The total annual requirement for the modified FMEF would be 8.4 million l/yr (2.2 million gal/yr), which would represent a 4.3-percent increase over the projected groundwater withdrawal (195 million l/yr [52 million gal/yr]). It is not expected that these small increases would impact regional groundwater levels.

No wastewater would be discharged directly to groundwater, so groundwater quality would not be affected. However, some of the treated wastewater discharged to evaporation/percolation ponds would percolate downward into the groundwater. The water discharged to and from the ponds would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Similarly, some stormwater runoff and other discharges routed to storm drains could percolate into the subsurface. Storm sewer and storm drain discharges would be monitored under the NPDES stormwater regulations. No impacts to groundwater quality are expected.

Construct New 200 West Area Facility for Plutonium Storage

Surface Water. Because the new Hanford Pu storage facility would be located in the 200 West Area, surface water would be used to meet water requirements. During construction, approximately 5 million l/yr (1.3 million gal/yr) of water would be required. This represents a much less than 1-percent increase in the projected No Action surface water withdrawal. This additional withdrawal would not cause any impacts. During operation, approximately 8.4 million l/yr (2.2 million gal/yr) of water would be required. This represents a much less than 1-percent increase in the projected annual surface water withdrawal, and it would increase Hanford's total withdrawal from the Columbia River to less than 1.0×10^{-6} of the river's average minimum flow. This would not cause any impacts to surface water availability.

During construction of the new Hanford Pu storage facility, sanitary wastewater (approximately 3.9 million l/yr [1.0 million gal/yr]) would be generated and discharged to the existing wastewater treatment systems at the 200 West Area. This would cause a 1.6-percent increase in the effluent discharged at Hanford. During operation, treated wastewater would be discharged to evaporation/infiltration ponds. [Text deleted.] All discharges would be monitored to comply with discharge requirements. Makeup water for the closed-cycle cooling system would be recycled.

The new facility would be located in the 200 Area, which is above the 100-year, 500-year, probable maximum floods, flooding from dam failures, and flooding from a landslide resulting from river blockage.

Groundwater. Because surface water would be used during construction and operation, no impact on groundwater availability is anticipated. No wastewater would be discharged from the ponds directly to groundwater, so groundwater quality would not be affected. However, some of the treated wastewater discharged to evaporation/percolation ponds could percolate downward into the groundwater. The water would be monitored and would not be discharged until contaminant levels were within the limits specified in the NPDES permit. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates. Similarly, some stormwater runoff routed to storm drains could percolate into the subsurface. These discharges would be monitored under the NPDES stormwater regulations. No impacts to groundwater quality are expected.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

Modification activities would require 7.8 million l/yr (2.1 million gal/yr) of water, a 4.0-percent increase over the projected No Action water use. This is approximately 2.8 million l/yr (0.74 million gal/yr) of water more than that required for the Pu storage upgrade without RFETS Pu or LANL Pu material water requirements. During operations, 8.9 million l/yr (2.4 million gal/yr) of water would be required, a 4.6-percent increase over projected No Action water use. All other water requirements of the Pu storage upgrade with RFETS Pu and LANL Pu material are identical to the modified FMEF without RFETS Pu or LANL material.

Modifying FMEF to store RFETS Pu and LANL Pu material would increase water discharges by 5.9 million l/yr (1.6 million gal/yr) or 1.9 percent during construction activities over the projected No Action discharge. During operations, wastewater would be discharged to infiltration/evaporation ponds. All other wastewater requirements of the upgrade with RFETS Pu and LANL Pu material are similar to the modified FMEF without RFETS Pu or LANL Pu material.

Construct New 200 West Area Facility for Plutonium Storage

During construction, the facility would require 7.8 million l/yr (2.1 million gal/yr), a much less than 1-percent increase over projected No Action water use. All other water requirements of the new Pu storage upgrade with RFETS Pu and LANL Pu material are identical to the new Hanford Pu facility without RFETS Pu or LANL Pu material. During operations, 8.9 million l/yr (2.4 million gal/yr) of water would be required. This represents a less than 1-percent increase in surface water withdrawal.

Water resources impacts during construction and operation with RFETS Pu and LANL Pu material would increase water discharges by 5.9 million l/yr (1.6 million gal/yr) or 1.9 percent of the projected No Action discharge. During operations, wastewater would be discharged to infiltration/evaporation ponds. All other wastewater discharges of the upgrade with RFETS Pu and LANL Pu material are the same as previously discussed for the new Hanford Pu storage facility without RFETS Pu or LANL Pu material.

Consolidation Alternative

Construct New Plutonium Storage Facility

The new consolidated Pu storage facility would be located west of the 200 East Area of Hanford. Impacts associated with it are the same as those discussed above for the upgrade of the existing Pu storage area, with the following exceptions. The water requirements for construction and operation of this option are approximately 85 million l/yr (22.5 million gal/yr) and 110 million l/yr (29 million gal/yr), respectively. These additional requirements represent 0.6- and 0.8-percent increases, respectively, in the projected annual surface water withdrawals from the Columbia River and should not cause any impacts.

The quantity of sanitary wastewater generated during construction of this option would be approximately 7.7 million l/yr (2 million gal/yr). This represents a 3.1-percent increase in the projected annual wastewater effluent that would be discharged to evaporation/infiltration ponds. During operations, sanitary, utility, and process wastewaters would be recycled. No impacts to groundwater are expected from discharges. Groundwater would not be used for this alternative, so no impacts to groundwater availability or quality would be expected.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

These storage facilities would be located west of the 200 East Area of Hanford, and the impacts associated with them are the same as those discussed above, with the following exceptions. The water requirements for construction and operation of this option are greater, approximately 105 million l/yr (27.7 million gal/yr) and 150 million l/yr (39.6 million gal/yr), respectively. These additional requirements represent 0.8- and 1.1-percent increases, respectively, in the projected annual surface water withdrawals from the Columbia River and should not cause any impacts.

The quantity of sanitary wastewater generated during construction of this option would be approximately 12.5 million l/yr (3.3 million gal/yr). This represents a 5.1-percent increase in the projected annual wastewater effluent that would be discharged to evaporation/infiltration ponds. During operations, sanitary, utility, and process wastewater would be recycled at newly constructed wastewater treatment systems. No impacts are expected. Groundwater would not be used for this alternative. Therefore, no impacts to groundwater availability or quality would be expected.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Water resource impacts for construction and operation of this subalternative are expected to be slightly less than those for the Upgrade With All or Some RFETS Pu and LANL Pu, the Pu Consolidated, and the Pu and HEU Collocation Storage Alternatives at Hanford described previously because of the reduction in the amount of material. [Text deleted.]

Phaseout

Should the current Pu storage mission at Hanford be phased out, surface water withdrawals from the Columbia River and nonhazardous wastewater discharge to evaporation/percolation ponds would decrease by negligible quantities. No noticeable impacts would occur or be alleviated due to these decreases.

[Text deleted.]

4.2.1.5 Geology and Soils

Construction and operation of the alternatives at Hanford would have no effect on the geologic resources. A low seismic risk exists, but would be considered in the design of the proposed alternatives. The existing seismic risk does not preclude the safe construction and operation of the proposed alternative facilities. The facilities would be designed for earthquake-generated ground accelerations in accordance with DOE O 420.1, *Facility Safety*. Intensities of approximately V to VII on the MMI scale are possible in the general region. This could affect the integrity of poorly designed or nonreinforced structures, but should not affect newly designed facilities. Human health effects from accidents initiated by natural phenomenon (for example, earthquakes) are discussed in Section 4.2.1.9. A volcanic event of the Mt. St. Helens type could occur in the Cascade Mountain region to the west, resulting in a possible ashfall at Hanford. A recurrence of a similar event would not have an effect on the construction and operation of any of the proposed storage alternatives. It is highly unlikely that landslides, sinkhole development, or other nontectonic events would affect project activities. Slopes and underlying foundation materials are generally considered stable. Geologic resources at Hanford consist of crushed rock, sand, and gravel that have low economic value. New construction may increase the use of these materials; however, because large volumes of these materials are present, the impact is anticipated to be negligible.

Impacts to the geologic and soil resource occur during, or as a result of, ground-disturbing construction activities. Construction of the alternatives may involve ground disturbing activities that could affect the soil resources. The amount of land disturbed is specified below for each alternative. Impacts would depend on the specific soil units in the disturbed area, the extent of land disturbing activities, and the amount of soil disturbed. Control measures would be employed during construction activities to minimize soil erosion. [Text deleted.]

[Text deleted.]

Preferred Alternative: No Action Alternative

Under the No Action Alternative, DOE would continue current and ongoing activities at Hanford. There would be no ground-disturbing activities beyond those associated with existing and future site improvements. Because neither new construction nor the associated ground disturbance for potential soil erosion would occur, the No Action Alternative would have no effect on the geologic or soil resources at the site.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

No apparent direct or indirect effects on the geologic resources are anticipated because neither facility construction and operational activities nor site infrastructure improvements will limit access to potential geologic resources. Design of the facilities would preclude potential impacts by any potential hazardous geological conditions.

Construction activities will occur completely within FMEF protected area, using existing gravel areas for construction laydown. Modification of the existing FMEF for Pu storage may disturb as much as 6.3 ha (15.5 acres) from construction activities, which would affect the soil profile and lead to a possible increase in soil erosion as s result of stormwater runoff and wind action. Soil impacts during operation are expected to be minimal.

Construct New 200 West Area Facility for Plutonium Storage

No apparent direct or indirect effects on the geologic resource are anticipated because neither facility construction and operational activities nor site infrastructure improvements will limit access to potential geologic resources. Design of the facilities would preclude potential impacts by any potential hazardous geological conditions.

Construction activities will occur completely within PFP protected area and use existing gravel areas for construction laydown. Construction of the new Pu storage facility will involve ground-disturbing construction activities (approximately 10.5 ha [26 acres]) that will affect the soil profile and potentially cause a temporary increase in soil erosion. Construction activities (foundation preparation) and associated building construction laydown areas can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increases in wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-disturbing activities.

Net soil disturbance during operations would be considerably less than during construction because areas temporarily used for construction laydown would be restored. Although stormwater runoff and wind action could occur during operation, they are anticipated to be minimal. [Text deleted.]

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

The construction and operation land-use requirements to modify the FMEF are not affected by the inclusion of RFETS and LANL Pu material. Therefore, the impacts would be similar to those discussed for the modify FMEF without RFETS or LANL Pu material.

Construct New 200 West Area Facility for Plutonium Storage

The construction and operation land use requirements for the new Hanford Pu storage facility are not affected by the inclusion or exclusion of RFETS and LANL Pu material. Therefore, the impacts would be similar to those discussed for the new 200 West Area Pu storage facility without RFETS or LANL Pu material.

Consolidation Alternative

Construct New Plutonium Storage Facility

Construction of the new Pu storage facility will occur completely on previously undisturbed land as defined by Section 4.1.1 in a location west of the 200 East Area. Implementation of the Consolidation Alternative will involve ground-disturbing activities (58.5 ha [144 acres]) that will affect the soil profile and potentially cause a temporary increase in soil erosion. No apparent direct or indirect effects on the geologic resource are anticipated because neither facility construction and operational activities nor site infrastructure improvements will limit access to potential geologic resources. Analysis in this section is the same as that provided for the new 200 West Area Pu storage facility without RFETS or LANL Pu material.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction and operation effects on geologic and soil resources for the Collocation Alternative would be similar to those described for the Consolidation Alternative. However, additional soil impacts would be expected. Construction activities would occur completely on undisturbed land (west of the 200 East Area) as defined by Section 4.1.1 and involve approximately 89.5 ha (221 acres) of land disturbance for the new facilities, affecting the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil impacts during operation are expected to be minimal.

No apparent direct or indirect effects on the geologic resource are anticipated, because neither facility construction and operational activities nor site infrastructure improvements will restrict access to potential geologic resources.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Exclusion of strategic reserve and weapons R&D materials would give almost the same effects to the geologic and soil resources for the Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. By excluding these materials, the size of a facility would be similar, thus not changing the amount of land disturbed by construction activities. No effect to the geologic resource is anticipated as a result of this subalternative. [Text deleted.]

Phaseout

The phaseout of storage capacity would have no apparent effects on the geologic resources. However, phaseout could result in beneficial effects on the soils of the area. Hazardous, radioactive, and mixed waste sources would be eliminated from the area, thus decreasing the potential for future soil contamination.

[Text deleted.]

4.2.1.6 Biological Resources

Preferred Alternative: No Action Alternative

Under No Action, the Pu storage mission described in Section 2.2.1 would continue at Hanford. These activities would result in no appreciable change to current conditions of biological resources at Hanford as described in Section 3.2.6.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

Modifying selected areas of the FMEF within the 400 Area at Hanford would cause minimal disturbance to biological resources. This is because all activities would involve existing structures and would take place within an area that is currently disturbed. Noise associated with modifying the FMEF could cause some temporary disturbance to wildlife, but this impact would be minimal because animals living adjacent to the current facility have already adapted to its presence. Water withdrawal would be through wells and would involve relatively minor volumes, so wetlands and aquatic resources would not be affected. Wastewater would be discharged to evaporation/infiltration ponds. Since the upgrade would take place within a developed area, impacts to threatened and endangered species would not be expected.

Construct New 200 West Area Facility for Plutonium Storage

A new Pu storage facility would be constructed within the protected area of the PFP in the 200 West Area of Hanford. Although new construction would be involved in this option, it will take place within an area of the 200 West Area that is currently disturbed. Impacts to biological resources would be expected to be minimal and similar to those described above for the modification of the FMEF.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

Upgrading with all or some RFETS and LANL materials would not be expected to change impacts to biological resources from those described above for the modification of the FMEF.

Construct New 200 West Area Facility for Plutonium Storage

Upgrading with all or some RFETS and LANL materials would not be expected to change impacts to biological resources from those described above for the new Pu storage facility.

Consolidation Alternative

Construct New Plutonium Storage Facility

Under this alternative, Pu would be consolidated in a new storage facility located adjacent to the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the consolidated Pu storage facility would disturb 58.5 ha (144 acres) of terrestrial habitat, or about 0.04 percent of Hanford. This includes areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation within the proposed location would be destroyed during land-clearing operations. The project site falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the Pu storage facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources, which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the proposed location may not survive. The location would be surveyed as necessary for the nests of migrating birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the Pu storage facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas. Salt drift generated by mechanical draft cooling systems would be minimal, so impacts are not expected.

Wetlands. Construction and operation of the Pu storage facility would not affect wetlands since no wetlands exist near the proposed location. Due to the relatively small amount of water required during both construction and operation, existing intake structures would be used. It would not be necessary to disturb wetlands along the Columbia River. Construction- and operation-related discharges would be directed to evaporation ponds and, thus, would not impact wetlands. All wastewater discharges would be treated, as necessary, to meet NPDES permit requirements.

Aquatic Resources. Construction of a Pu storage facility at Hanford would not impact aquatic resources since there are no surface water bodies near the proposed location. Water requirements during both construction and operation would be met by existing site sources. Since new intake structures would not be required, direct disturbance of aquatic resources in the Columbia River would not occur. Water withdrawal during both construction and operation would represent a small percentage of the Columbia River's average flow and would have little effect on the flow of the river. Flow-related impacts to aquatic resources from impingement and entrainment impacts would be minimal and unlikely to affect fish populations in the Columbia River. In compliance with the *Anadromous Fish Conservation Act* (16 USC 757a et seq.), populations of anadromous fish species would be sustained, and their movement would be unobstructed by project construction and operation. All discharges would be to evaporation ponds, which would provide temporary aquatic habitat.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the Pu storage facility. However, this alternative would disturb 58.5 ha (144 acres) of sagebrush habitat. Sagebrush habitat is important nesting/breeding and foraging habitat for several State-listed and candidate species, such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would

be conducted as appropriate prior to construction to determine the presence of plant species or animal species in the area to be disturbed. Consultation with the USFWS and State agencies would be conducted at the site-specific level, as appropriate.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Under this alternative, Pu would be stored with HEU inventories in a new collocated storage facility located in the 200 East Area. Construction and operation of collocated storage facilities at Hanford would have similar, but somewhat greater, effects on biological resources as those described for the consolidated storage facility alone. Construction of the collocated storage alternative would disturb 89.5 ha (221 acres) of habitat.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve and weapons R&D materials would have almost the same effects to the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. The size of facility would be similar and would not result in the reduction of disturbed habitat and fewer facility modifications and the potential impacts to biological resources would be similar. [Text deleted.]

Phaseout

The phaseout of Pu storage facilities at Hanford is not expected to affect biological resources, although increased human activity could temporarily disturb some wildlife species in the vicinity of the site.

4.2.1.7 Cultural and Paleontological Resources

Preferred Alternative: No Action Alternative

Under this alternative, DOE would continue the existing and planned missions at Hanford, which include continued storage of Pu material in the PFP in stabilized forms pursuant to DNFSB Recommendation 94-1. All inventory and evaluation of cultural resources at Hanford is conducted within the framework of the *Hanford Cultural Resources Management Plan* (PNL-6942 UC-600, June 1989), which has been in place since 1989. Any impacts to cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate NHPA, *American Indian Religious Freedom Act*, and *Native American Graves Protection and Repatriation Act* regulatory compliance procedures.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

The FMEF is located in the 400 Area of Hanford in an existing protected area. This option involves only modification to selected areas of the existing facility. No new construction would be necessary. Because it was recently built, the FMEF itself is not NRHP eligible. The 400 Area has been surveyed, and no archaeological or historic resources were identified. Consequently, any land-disturbing activity associated with building modification (such as equipment staging areas and temporary roads) should not affect cultural resources. Similarly, operation does not involve increased activity or ground disturbance, so it would not result in impact.

Construct New 200 West Area Facility for Plutonium Storage

The new Pu storage facility would be constructed in the 200 West Area northwest of the PFP facility within the existing protected area. The total land required during construction and operation is 10.5 ha (26 acres). All land was previously disturbed, and there will be no construction on undisturbed land.

[Text deleted.]

A non-systematic archaeological survey was conducted across 50 percent of the 200 West Area. No prehistoric or historic resources were identified, except for the White Bluffs Freight Road, which was used during both prehistoric and historic times. This portion of the road is a noncontributing element of the NRHP-listed resource, and has been given a buffer zone to protect it from development. The road is outside the proposed construction area and will not be affected. Depending on siting, construction, and operation, the new facility may affect the functional and historic setting of the PFP, which is an NRHP-eligible property. The PFP was constructed between 1947 and 1949 and was used to produce Pu metal during the Cold War Era. Some scientifically valuable Pliocene and Pleistocene paleontological deposits may also exist in the areas to be excavated during construction; although this is unlikely as previous construction activities did not reveal these kinds of resources. Archaeological and paleontological resources would not be affected by facility operation because operation does not involve additional ground disturbance or increased activity.

To date, no Native American groups have identified any areas of special concern in proximity to the 200 Areas. [Text deleted.] Operation may result in reduced access to traditional hunting, fishing, and gathering areas, or visual and auditory intrusion into sacred spaces.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

The inclusion of RFETS and LANL material would not increase the total area requirement of the Upgrade Without RFETS or LANL Subalternative, therefore, no ground-breaking construction would be necessary. All materials could be accommodated within existing facilities. Consequently, construction and operation are not expected to affect cultural or paleontological resources.

Construct New 200 West Area Facility for Plutonium Storage

Total land disturbed by construction and operation would not increase with the inclusion of RFETS and LANL materials. Construction of a slightly larger Pu storage facility is not expected to have more of an effect on cultural or paleontological resources, as discussed under the new Pu storage facility option.

Consolidation Alternative

Construct New Plutonium Storage Facility

This alternative would involve the construction of a new facility west of the 200 East Area. During construction, 58.5 ha (144 acres) would be disturbed. The total land required for operation is 56 ha (138 acres). A 1.6-km (1 mi) reduced-access buffer zone exists and would be maintained around the facility. Pu storage in existing DOE storage facilities would be phased out.

The 200 areas have been surveyed, and no prehistoric or historic resources were identified. The area is previously disturbed. Some significant paleontological materials may occur within this acreage. The potential for impacts to paleontological resources is greatest during construction. Operation would not have an additional impact on resources, should any be identified during construction. As discussed under the new Hanford Pu storage facility upgrade option, Native American groups have not identified any resources in proximity to the 200 Areas. Additional consultation may be necessary for resource identification.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

This alternative would involve the construction of a new HEU storage facility to be collocated with a consolidated special nuclear material plant adjacent to the 200 East Area. Land required during operation would be 87 ha (215 acres). Construction of this facility is expected to disturb 89.5 ha (221 acres). A 1.6-km (1-mi) reduced-access buffer zone exists and would be maintained around the facility. Pu and HEU storage in existing facilities would be phased out. Potential for impacts to these resources would be similar to that discussed under the previous Consolidation Alternative.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, facility and other resource requirements will be almost the same as the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. Therefore, impacts to cultural and paleontological resources would be equal to those previously discussed. [Text deleted.]

Phaseout

Impacts to archaeological resources are not anticipated because phaseout is not expected to result in ground-breaking activity. Likewise, no impacts to paleontological remains are expected. It may affect, through alteration, if subsequently proposed, some NRHP-eligible historic structures at Hanford. Impacts to Native American resources are not expected.

[Text deleted.]

4.2.1.8 Socioeconomics

Preferred Alternative: No Action Alternative

Under this alternative, the existing storage facility would remain operational. No new employment or in-migration of workers would be required.

Regional Economy Characteristics. Total employment in the REA is projected to increase by about 1.3 percent annually between 1995 and 2000, reaching 322,000 in the latter year. Long-range projections indicate slower growth after the year 2000, when employment will increase by less than 1 percent annually and reach 446,300 in 2040. Unemployment in the REA was 9.1 percent in 1994 and is expected to remain at this level into the near future. Per capita income is projected to increase from approximately $18,996 in 1995 to $28,079 in 2040. Projections for the No Action Alternative are presented in Table L.1–10.

Population and Housing. Population in the ROI is projected to increase from approximately 384,700 in 1995 to 568,600 by 2040. The total number of housing units in the ROI is projected to increase from approximately 140,900 to 208,200 during the same period. Population and housing projections for the No Action Alternative are presented in Tables L.1–11 and L.1–12, respectively.

Community Services. Education, public safety, and health care characteristics are used to assess the level of community services in the Hanford ROI. School enrollments are projected to increase from 76,891 students in 1995 to 113,659 students by 2040. To maintain the current student-to-teacher ratio of 18.9:1, the number of teachers in the ROI would need to increase from 4,077 in 1995 to 6,023 in 2040. These projections are presented in Tables L.1–13 and L.1–14, respectively.

The projected numbers of sworn police officers and firefighters serving in ROI communities over the period 1995 to 2000 are shown in Tables L.1–15 and L.1–16, respectively. Under No Action, the number of sworn police officers is projected to increase from 503 in 1995 to 742 in 2040 to maintain the current service level of 1.6 officers per 1,000 persons. The number of firefighters in the ROI would need to increase from 1,544 in 1995 to 2,281 in 2040 to maintain the current level of service of 4.0 firefighters per 1,000 persons.

Hospital occupancy rates are based on current capacity. Hospital occupancy rates and the estimated number of practicing physicians serving the ROI population between 1995 and 2040 are presented in Tables L.1–17 and L.1–18, respectively. Hospital occupancy rates for the ROI are projected to increase from 51 percent in 1995 to 75 percent in 2040. To maintain the current physician-to-population ratio of 1.2 physicians per 1,000 persons, the total number of physicians in the ROI would need to increase from 472 in 1995 to 696 in 2040.

Local Transportation. The worker population at Hanford would not increase. Therefore, any increases in traffic or air traffic would be due to the projected growth in the area unrelated to DOE activities. [Text deleted.]

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

[Text deleted.] A total of 54 workers would be employed during peak construction of the modified facility. During the operational phase, 225 workers would be required. Projections indicate that there would be sufficient available labor in the REA to fill both direct and indirect jobs generated as a result of construction and all indirect jobs generated by operation of the modified facility. Some workers would in-migrate to fill a portion of the direct jobs generated during operations.

Regional Economy Characteristics. During peak construction, the project would add up to 108 (54 direct and 54 indirect) jobs to the regional economy. All of these new jobs would be filled by available labor force in the REA and unemployment would fall from the No Action level of 9.1 percent to 9.0 percent (Socio 1996a). Per capita income would remain virtually unchanged, increasing by much less than 1 percent over the No Action Alternative.

Operation of the facility without storage of RFETS or LANL material would generate a total of 759 jobs (225 direct and 534 indirect) in the REA. These additional jobs would reduce regional unemployment by much less than 1 percent from the No Action level. Per capita income would increase by much less than 1 percent in the year 2005, when the facility would become fully operational (Socio 1996a).

Population, Housing, and Community Services. During construction, all newly created jobs would be filled by the resident labor force. Therefore, there would be no change to the region's population, housing market, or demand for community services beyond the No Action projections. A small increase in population would occur during operation of the facility due to the in-migration of five workers. Accordingly, there would be an insignificant effect on the housing market and the demand for community services (Socio 1996a).

Local Transportation. During the peak construction period, 104 vehicle trips per day would be generated by workers involved in facility modification. This increase would not affect level of service on the road segments analyzed. During operations, the workers would generate 432 vehicles trips per day. This increase over the No Action level would not affect the level of service on the local road segments analyzed (Socio 1996a).

Construct New 200 West Area Facility for Plutonium Storage

Work force requirements for the construction and operation of the new Pu storage facility are the same as for modification of the FMEF. Therefore, the magnitude of socioeconomic impacts for this option would be the same as those discussed above for the FMEF.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

A peak of 77 workers would be employed to modify the facility to store all of the RFETS and LANL material. During the operational phase, 252 workers would be required. Projections indicate that there would be sufficient labor available in the REA to fill all direct and indirect jobs generated by construction and all indirect jobs generated by operation of the modified facility. Some workers would in-migrate to fill a portion of the direct jobs generated by operation.

Regional Economy Characteristics. During peak construction, the project would generate 154 jobs (77 direct and 77 indirect) in the regional economy. All of these new jobs would be filled by available labor within the REA. Unemployment would fall from the No Action level of 9.1 percent to 9.0 percent (Socio 1996a). Per capita income would remain virtually unchanged, increasing by much less than one percent over the No Action Alternative.

Operation of the facility would generate a total of 850 (252 direct and 598 indirect) jobs. Regional unemployment would be reduced slightly from the No Action projection of 9.1 percent to 8.9 percent. Per capita income would increase by much less than 1 percent (Socio 1996a).

Population, Housing, and Community Services. All jobs generated by construction would be filled by the resident labor force. Therefore, there would be no change to the region's population from the No Action projections. Accordingly, there would be minimal effects on the housing market or demand for community

services. A small increase in population would occur during operation of the facility due to the in-migration of eight workers. Such an increase would have an insignificant effect on the housing market and the demand for community services (Socio 1996a).

If only a portion of the RFETS or LANL materials were transferred to Hanford, between 225 and 252 workers would be required to operate the facility. The exact number of workers would depend on the amount of material that would actually reside at Hanford. The size of the construction workforce would be between 54 and 77 workers in the peak year of construction. Between 108 and 154 jobs (direct and indirect) would be generated during construction while between 759 and 850 jobs (direct and indirect) would be generated during operations. There would be no changes to the ROI population over the No Action projections during construction, but could be some in-migration during operations. In all cases, the socioeconomic impacts to the region would be slight.

Local Transportation. During the peak construction period, 148 vehicle trips per day would be generated by workers involved in facility modification. During operations, workers would generate 484 vehicle trips per day. These increases would not affect the level of service on the local road segments analyzed. (Socio 1996a).

Construct New 200 West Area Facility for Plutonium Storage

Workforce requirements for the construction and operation of the new Pu storage facility are the same as for the modification of the FMEF. Therefore, the magnitude of socioeconomic impacts for this option would be the same as those discussed above for the FMEF.

Consolidation Alternative

Construct New Plutonium Storage Facility

To consolidate storage of Pu that is currently stored at multiple DOE sites, a new storage facility would need to be constructed at Hanford. A few workers would in-migrate to fill a portion of the direct jobs created during the operation of the new facility.

Regional Economy Characteristics. Construction would involve over 1,000 workers on site and add a total of 2,129 jobs (1,064 direct and 1,065 indirect) to the REA during the peak period of activity, an increase of less than 1 percent over the No Action level. All of these jobs would be filled by available labor in the REA. Unemployment would drop from 9.1 percent to about 8.5 percent. Per capita income would increase by much less than 1 percent in the peak year of construction (Socio 1996a).

The operation of the facility would add a total of 1,495 jobs (443 direct and 1,052 indirect) to the regional economy, an increase of less than 1 percent over the No Action level. A small percentage of the direct workers would in-migrate to fill some specialized employment requirements. Operation workers would begin phasing in as construction nears completion. Unemployment would rise from 8.5 percent during peak construction to 8.7 percent during operation, but would remain lower than the No Action level of 9.1 percent. Per capita income would increase by much less than 1 percent over No Action (Socio 1996a).

Population, Housing, and Community Services. A small increase in population would occur during the operation phase due to the in-migration of 27 workers. Such an increase would have no effect on the housing sector and would have an insignificant effect on the demand for community services (Socio 1996a).

Local Transportation. During the peak construction period, workers would generate 2,043 vehicle trips per day. This increase would not affect the level of service on the local road segments analyzed. During operations, workers would generate 851 vehicles trips per day, and the increase to roadway traffic would be less than during construction (Socio 1996a).

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction of new storage facilities would be required in order to store Pu and HEU at Hanford. Workers would in-migrate to fill some of the direct jobs created during operation of the new storage facility. Construction employment would reach 1,076 during the peak period of activity. Operations would require 572 workers.

Regional Economy Characteristics. Construction of the new facility would generate a total of 2,153 jobs (1,076 direct and 1,077 indirect) during the peak construction year. The resident available labor force would be sufficient to fill all of the direct and indirect jobs created during the construction phase. Total employment in the REA would increase by less than 1 percent. Unemployment would decrease from 9.1 percent to 8.5 percent. Per capita income would increase by much less than 1 percent in the peak construction year (Socio 1996a).

Operation of the facility would produce a total of over 1,930 new jobs (572 direct and 1,358 indirect) within the REA. A majority of direct jobs and all of the indirect jobs generated would be filled by the resident labor force. Total employment in the REA would increase by less than 1 percent in the year 2005, when the facility would become fully operational. Operation workers would begin phasing in as construction nears completion. Unemployment would rise from 8.5 percent during peak construction to 8.6 percent during operation, but would remain lower than the No Action level of 9.1 percent. Per capita income is projected to increase by less than 1 percent (Socio 1996a).

Population and Housing. A small number of workers are projected to in-migrate during the operation period. The population increase would be negligible, and projected housing vacancies would be sufficient to accommodate the incremental population increase (Socio 1996a).

Community Services. The additional population would slightly increase demand for some community services. Worker in-migration would lead to an increase in ROI school enrollment by approximately 35 students during operation. In order to maintain the No Action student-to-teacher ratio, the number of teachers would have to increase by one (Socio 1996a). [Text deleted.]

In order to maintain the No Action level of service, two firefighters would need to be hired during the operational period. No additional police would be required to maintain the No Action level of service during the operational period (Socio 1996a).

The small population change would have a negligible effect on health services, increasing hospital occupancy by much less than 1 percent. The number of physicians in the ROI would be sufficient to maintain the No Action level of service.

Local Transportation. During the peak construction period, workers would generate 2,066 vehicle trips per day. This increase would not affect the level of service on the road segments analyzed. During operations, workers would generate 1,098 vehicles trips per day and the increase in roadway traffic would be less than during construction (Socio 1996a).

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

If strategic reserve and weapons R&D materials are not included in the storage requirements for Hanford, there would be a small reduction in worker requirements for construction and operation of the facility due to fewer workers being needed. Therefore, the socioeconomic effects would be less than under those alternatives that include storage of nonsurplus RFETS and LANL material for the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. [Text deleted.]

Phaseout

Phaseout of the existing Pu storage facility at Hanford would result in the loss of 675 total jobs (200 direct and 475 indirect) in the REA. The total direct and indirect employment loss would be much less than a 1 percent reduction in the projected regional employment levels for the year 2005, when the phaseout would be implemented.

In the longer term, some unemployed workers may migrate out of the REA to seek new employment opportunities. Even if all of these workers were to leave the REA with their families, population would decrease by much less than 1 percent compared to No Action. The impact on housing and community services, including health care, education, and public safety would not be substantial. For example, there could be a slight increase in housing vacancies or a decline in new housing construction and also a small decrease in demand for educational and health services (for example, teachers and physicians). These minor impacts would be further reduced if the storage mission is phased out over more than 1 year.

Phaseout of the existing Pu storage facilities at Hanford would reduce the number of vehicle trips per day by 384. There would be no significant traffic impact to the local road network.

4.2.1.9 Public and Occupational Health and Safety

The assessments of potential radiological and chemical impacts associated with the storage alternatives at Hanford are presented in this section. Summaries of radiological impacts from normal operations are presented in Tables 4.2.1.9–1 and 4.2.1.9–2 for the public and workers, respectively. Impacts from hazardous chemicals are presented in Table 4.2.1.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.2.1.9–4 through 4.2.1.9–7. Detailed results are presented in Appendix M.

Preferred Alternative: No Action Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from normal operations involving the Hanford sitewide missions, including interim storage of Pu. The impacts would be within applicable regulatory limits. For facility accidents, the risks and consequences are described in site safety documentation.

Normal Operation. The current mission at Hanford, where Pu is in interim storage, is described in Section 3.2. The site has identified those facilities that will continue to operate under the No Action Alternative, including interim Pu storage facilities and others, if any, that will become operational by 2005. Based on that information, the radiological and chemical releases to the environment in 2005 and beyond (future operation) were developed and used in the impact assessments. The resulting doses and potential health effects on the public and workers at Hanford are described below.

Under the No Action Alternative, Hanford would continue to store Pu-bearing materials in the storage vaults and approved vault-type rooms of the PFP. All Pu materials would be stabilized and repackaged, as necessary, to ensure safe storage. Activities supporting stabilization, repackaging, and storage of the Pu materials are identified and discussed in the *DNFSB Recommendation 94-1 Hanford Site Integrated Stabilization Management Plan* (VHC-EP-0853). This plan calls for transforming the Pu-bearing materials to a stable form that meets the DOE standard *Criteria for Safe Storage of Pu Metals and Oxides* (DOE-STD-3013-94) by 2002 for materials with greater than 50 percent Pu. Some PFP plant systems that are required to provide basic facility services would be upgraded for storage facility operations for the No Action Alternative.

Radiological Impacts. Under this alternative at Hanford, Table 4.2.1.9–1 presents the calculated annual dose to the average and MEI of the public, from total site operation, the projected fatal cancer risks to these individuals from 50 years of operation, the dose to the population within 80 km (50 mi) due to total site operation in the year 2030, and the projected number of fatal cancers in this population from 50 years of operation. The annual dose of 5.3×10^{-3} mrem to the MEI is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.3×10^{-7}. The annual dose of 1.6 person-rem to the population of 621,000 would be within the limit in proposed 10 CFR 834. The corresponding number of fatal cancers in this population from 50 years of operation would be 0.039. To put operational doses into perspective, comparisons with natural background radiation doses are included in the table. The doses and projected fatal cancers associated with the storage component of the No Action Alternative are included in Table 4.2.1.9–1. These are seen to be much lower than those from total site operations.

Under the No Action Alternative shown in Table 4.2.1.9–2, the annual average dose to a noninvolved (No Action) site worker and the annual dose to the noninvolved (No Action) total site workforce would be 31 mrem and 296 person-rem, respectively. The associated risk of fatal cancer to the average worker from 50 years of total site operations would be 6.0×10^{-4} and the projected number of fatal cancers from 50 years of total site operations would be 5.1.

The annual average dose to a worker involved in No Action storage operations would be 250 mrem/year, with a total involved No Action workforce dose of 49 person-rem. The increased risk of latent cancer fatality to the

Table 4.2.1.9–1. Potential Radiological Impacts to the Public During Normal Operation at Hanford Site—No Action and Storage Alternatives

Receptor	No Action		Upgrade		Consolidation		Collocation	
	Storage Facility	Total Site	Storage Facility[a]	Total Site[b]	Storage Facility	Total Site[b]	Storage Facility	Total Site[b]
Annual Dose to the Maximally Exposed Individual Member of the Public [c]								
Atmospheric release pathway (mrem)	4.1×10^{-4}	4.4×10^{-3}	1.8×10^{-6}	4.1×10^{-3}	2.5×10^{-6}	4.1×10^{-3}	2.5×10^{-6}	4.1×10^{-3}
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0
Total liquid release pathway (mrem)	0	9.5×10^{-4}	0	9.5×10^{-4}	0	9.5×10^{-4}	0	9.5×10^{-4}
Atmospheric and liquid release pathways combined (mrem)	4.1×10^{-4}	5.3×10^{-3}	1.8×10^{-6}	5.1×10^{-3}	2.5×10^{-6}	5.1×10^{-3}	2.5×10^{-6}	5.1×10^{-3}
Percent of natural background[d]	1.4×10^{-4}	1.8×10^{-3}	6.0×10^{-7}	1.7×10^{-3}	8.3×10^{-7}	1.7×10^{-3}	8.3×10^{-7}	1.7×10^{-3}
50-year fatal cancer risk	1.0×10^{-8}	1.3×10^{-7}	4.5×10^{-11}	1.3×10^{-7}	6.2×10^{-11}	1.3×10^{-7}	6.2×10^{-11}	1.3×10^{-7}
Population Dose Within 80 Kilometers for Year 2030 [e]								
Atmospheric release pathway (person-rem)	0.047	0.46	4.7×10^{-5}	0.41	1.1×10^{-4}	0.41	1.1×10^{-4}	0.41
Liquid release pathway (person-rem)	0	1.1	0	1.1	0	1.1	0	1.1
Atmospheric and liquid release pathways combined (person-rem)	0.047	1.6	4.7×10^{-5}	1.5	1.1×10^{-4}	1.5	1.1×10^{-4}	1.5
Percent of natural background[d]	2.5×10^{-5}	8.4×10^{-4}	2.5×10^{-8}	8.1×10^{-4}	5.9×10^{-8}	8.1×10^{-4}	5.9×10^{-8}	8.1×10^{-4}
50-year fatal cancers	1.2×10^{-3}	0.039	1.2×10^{-6}	0.038	2.8×10^{-6}	0.038	2.8×10^{-6}	0.038
Annual Dose to the Average Individual Within 80 Kilometers [f]								
Atmospheric and liquid release pathways combined (mrem)	7.6×10^{-5}	2.6×10^{-3}	7.6×10^{-8}	2.4×10^{-3}	1.8×10^{-7}	2.4×10^{-3}	1.8×10^{-7}	2.4×10^{-3}
50-year fatal cancer risk	1.9×10^{-9}	6.0×10^{-8}	1.9×10^{-12}	6.0×10^{-8}	4.4×10^{-12}	6.0×10^{-8}	4.4×10^{-12}	6.0×10^{-8}

[a] The radiological impacts associated with the new Hanford Pu storage facility are smaller than for the modified FMEF (refer to the text). The impacts from total site operations are virtually the same with operations of either of the two storage alternatives. The radiological impacts are calculated based on measured releases from facilities at Hanford, RFETS, and LANL.

[b] Includes impacts from No Action facilities. The location of the MEI may be different under No Action than for the other alternatives. Therefore, the impacts may not be directly additive.

[c] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by the NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[Text deleted.]

[d] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km in the year 2030 receives 186,400 person-rem.

[e] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[f] Obtained by dividing the population dose by the number of people projected to live within 80 km of Hanford in 2030 (621,000).

Source: Section M.2.

Table 4.2.1.9–2. Potential Radiological Impacts to Workers During Normal Operation at Hanford Site—Storage Alternatives

Receptor	No Action[a]	Upgrade[b]	Consolidation[b]	Collocation[b]
Involved Workforce[c]				
Average worker dose (mrem/yr)[d]	250	250	258	264
50-year risk of fatal cancer	5.0×10^{-3}	5.0×10^{-3}	5.2×10^{-3}	5.3×10^{-3}
Total dose (person-rem/yr)	46	52	24	25
50-year fatal cancers	0.92	1.0	0.48	0.50
Noninvolved Workforce[e]				
Average worker dose (mrem/yr)[d]	27	27	27	27
50-year risk of fatal cancer	5.5×10^{-4}	5.5×10^{-4}	5.5×10^{-4}	5.5×10^{-4}
Total dose (person-rem/yr)	250	250	250	250
50-year fatal cancers	5.1	5.1	5.1	5.1
Total Site Workforce[f]				
Dose (person-rem/yr)	296	302	274	275
50-year fatal cancers	5.9	6.0	5.5	5.5

[a] It is expected that for the No Action Alternative the number of involved workers and average dose would be the same as for the Upgrade Without RFETS Pu or LANL Pu Subalternative. Additional workers would be required for the Upgrade With RFETS Pu and LANL Pu Subalternative. Therefore, the total worker dose would increase accordingly.

[b] Under the Upgrade Alternative, 225 in-plant workers (of which 185 are badged with dosimeters to monitor radiation exposure) would be required to operate the storage facility, with an estimated additional 27 in-plant workers (22 badged) needed if Pu is transferred from the RFETS and LANL. The impacts given in the upgrade column include those associated with these additional workers. The number of involved badged workers for the Consolidation and Collocation Alternatives would be 92 and 95, respectively.

[c] The involved worker is associated with operations of the proposed action. The maximum dose to an involved worker will be kept below 500 mrem per year. Based on a review of worker doses associated with similar operations (Section M.2.3.2), an average worker dose of 250 mrem per year was conservatively assumed. However, an effective ALARA program will ensure that exposure will be reduced to that level which is as low as reasonably achievable.

[d] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the site must make reasonable attempts to maintain worker doses below this level.

[e] The noninvolved worker is onsite but not associated with operations of the proposed action. The projected number of noninvolved badged workers in 2005 and beyond is 9,300. The noninvolved workforce is equivalent to the No Action workforce.

[f] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Table 4.2.1.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation at Hanford Site—No Action and Storage Alternatives

	No Action	Upgrade		Consolidation		Collocation	
Receptor	Total Site[a]	Facility[b]	Total Site[a]	Facility[b]	Total Site[a]	Facility[b]	Total Site[a]
Maximally Exposed Individual (Public)							
Hazard Index[c]	6.2×10^{-5}	9.4×10^{-7}	6.3×10^{-5}	4.0×10^{-6}	6.6×10^{-5}	1.6×10^{-5}	7.8×10^{-5}
Cancer risk[d]	0	0	0	2.7×10^{-8}	2.7×10^{-8}	2.7×10^{-8}	2.7×10^{-8}
Worker Onsite							
Hazard Index[e]	4.0×10^{-3}	1.9×10^{-5}	4.0×10^{-3}	2.8×10^{-4}	4.3×10^{-3}	7.1×10^{-4}	4.7×10^{-3}
Cancer risk[f]	0	0	0	1.2×10^{-5}	1.2×10^{-5}	1.2×10^{-5}	1.2×10^{-5}

[a] Total=Sum of the No Action plus the contributions of the above activity.

[b] Facility=Contribution from the above activity only (for example, the amount of increase over the existing, No Action level at the site).

[c] Hazard index for MEI=Sum of Individual Hazard Quotients (Noncancerous health effects) for MEI.

[d] Cancer risk for MEI=(Emissions for 8-hr) x (0.286 [Converts concentrations to doses]) x (Slope Factor [SF]).

[e] Hazard index for workers=Sum of Individual Hazard Quotients (Noncancerous health effects) for workers.

[f] Cancer risk for workers=(Emissions for 8-hr) x (0.286 [Converts concentrations to doses]) x (0.237 [Fraction of year exposed]) x (0.571 [Fraction of lifetime working]) x (SF).

Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors, therefore the calculated risk value is 0.

Source: Section M.3, Tables M.3.4–1 through M.3.4–4.

average No Action worker from 50 years of operation would be 5.0×10^{-3}, and the projected number of latent fatal cancers to the No Action workforce from 50 years of operation would be 0.92.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public resulting from the normal operation under No Action at Hanford are presented in Table 4.2.1.9–3. The hazardous chemical impacts from current site operations represent the baseline site impacts for the various storage alternatives. The noncancerous health effects and the risk of cancer due to the total chemical exposures were estimated. Since the major releases due to normal operation at Hanford are expected to make up nearly all of the exposures to onsite workers and to the public in adjacent communities, contributions to the hazardous chemical concentrations from all other sources (for example, industrial operations) are considered negligible for purposes of risk calculations.

The HI to the MEI of the public at Hanford resulting from normal operation under the No Action Alternative is 6.2×10^{-5}, and the cancer risk from hazardous chemicals is zero (because no carcinogens are released from the hazardous chemicals used). The HI to the onsite worker is 4.0×10^{-3}, and the cancer risk is zero (because no carcinogens are released from the hazardous chemicals used).

Facility Accidents. Under the No Action Alternative, Pu would continue to be stored at Hanford in existing facilities. These facilities currently operate in accordance with DOE Orders which ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations will be minimized. The safety to workers and the public from accidents at existing facilities is also controlled by Technical Safety Requirements specified in detail in a Safety Analysis Report (SAR) or a Basis for Interim Operations document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities would cause a halt in operations until it can be established that worker and public safety has not been compromised.

The *Plutonium Finishing Plant Safely Analysis Report* (WHC-SD-CP-SAR-021) analyzes a wide spectrum of accidents that are primarily associated with processing rather than vault storage. This is because a release from a vault would require more severe accident conditions than are normally analyzed in an SAR. The accidents in

the SAR consist of potential process accidents such as fires, explosions, and criticality as well as an externally initiated aircraft crash and earthquake. An estimate of the effects of potential accidents in the existing storage vault at Hanford can be derived from similar storage accidents that have been postulated for an upgraded storage facility. A severe consequence, low frequency accident for storage under the No Action Alternative would be a beyond design basis earthquake. If this accident were to occur, there would be an estimated 0.12 latent cancer fatalities in the offsite population within 80 km (50 mi). The estimated frequency of the earthquake with sufficient damage to cause a release is approximately 1.0×10^{-7} per year, which corresponds to a risk of 1.2×10^{-8} latent cancer fatalities per year. For the MEI and noninvolved worker, there would be 1.7×10^{-5} and 2.2×10^{-3} latent cancer fatalities, respectively, if the accident occurred. The risks would be 1.7×10^{-12} and 2.2×10^{-10} latent cancer fatalities per year. A potentially more frequent accident is penetration of the PCV caused by corrosion. If this accident were to occur, the estimated number of cancer fatalities in the offsite population would be 1.3×10^{-3}. The estimated frequency of this accident is 6.4×10^{-3} per year, which corresponds to a risk of 8.3×10^{-5} cancer fatalities per year. For the MEI and noninvolved worker the corresponding impacts are 1.8×10^{-7} and 1.8×10^{-5} latent cancer fatalities, respectively, if the accident occurred. The risks would be 1.2×10^{-9} and 1.2×10^{-7} latent cancer fatalities per year.

Upgrade Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting either from normal operation or from accidents involved with the modified FMEF or a new storage facility at Hanford. The section describes the impacts from normal facility operations at Hanford, followed by a description of impacts from facility accidents.

During normal operation at Hanford, the operation of any of these Pu storage facilities would result in impacts that are within applicable regulatory limits.

[Text deleted.]

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

Normal Operation. There would be no radiological releases during the modification of the FMEF at Hanford. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable (ALARA). Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct exposures. The resulting doses and potential health effects on the public and workers at Hanford are described below.

Radiological Impacts. Doses to the public from storage would be expected to decrease from No Action for the Upgrade Alternative, as shown in Table 4.2.1.9–1. This is because the storage facility safety and design features would improve. The dose to the MEI of the public due to annual storage facility operation would be 1.8×10^{-6} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 4.5×10^{-11}. The impacts to the average individual would be less. As a result of storage facility operation in the year 2030, the population dose would be 4.7×10^{-5} person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 1.2×10^{-6}.

The dose to the MEI due to annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 5.1×10^{-3} mrem. From 50 years of operations, the

corresponding risk of fatal cancer to this individual would be $1.3x10^{-7}$. These values are presented in Table 4.2.1.9–1. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operations in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 1.5 person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 0.038.

Doses to onsite workers from normal operations are given in Table 4.2.1.9–2. Included are involved workers directly associated with the modified facility for Pu storage, workers who are not involved with the modified facility, and the entire workforce at Hanford. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the upgraded storage facilities at Hanford are presented in Table 4.2.1.9–3. The impacts from all site operations, including the upgraded storage facilities are also included in this table. Total site impacts, which include the No Action impact plus the facility are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI from the facility to the MEI of the public is $9.4x10^{-7}$, and the cancer risk from hazardous chemicals from the facility is zero (because no carcinogens are released from the hazardous chemicals used) as a result of operation of the upgraded storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the upgrade facility, would result in an HI of $6.3x10^{-5}$ and a cancer risk of zero (because no carcinogens are released) for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI from the facility to the onsite worker would be $1.9x10^{-5}$and the cancer risk from the facility is zero (because no carcinogens are released from the hazardous chemicals used) as a result of operation of the upgraded storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, provided exposures remain the same. The total site operation including the upgrade facility would result in an HI of $4.0x10^{-3}$ and a cancer risk of zero (because no carcinogens are released) for the worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. Modification of the existing Pu storage facilities at the Hanford site may change the existing risks of accidents to workers and the public. Under this action, the FMEF would be modified and would be in compliance with applicable DOE Orders and other regulations and standards. This may result in a reduction of risk compared to No Action.

A set of potential accidents have been postulated for upgraded storage at FMEF of existing Pu without LANL or RFETS Pu for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.1.9–4. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.12 at Hanford for the beyond design basis earthquake accident scenario with an estimated probability of $1.0x10^{-7}$ per year (for example, probability of severe earthquake occurring is estimated to be about $1.0x10^{-5}$, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be $6.1x10^{-7}$, $8.3x10^{-11}$, and $1.1x10^{-8}$, respectively. The maximum population 50-year facility lifetime risk would

be 4.2×10^{-4} (for example, one fatality in over 100,000 years) at Hanford for the PCV penetration by corrosion accident scenario with a probability of 6.4×10^{-3} per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 5.7×10^{-8} and 5.7×10^{-6}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.1.9–4.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Construct New 200 West Area Facility for Plutonium Storage

Normal Operation. There would be no radiological releases during the construction of new storage facilities at Hanford. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct exposures. The resulting doses and potential health effects to the public and workers at Hanford are described below.

Radiological Impacts. The doses and associated health risks to the public associated with this new storage facility are expected to be even smaller than those for the modified FMEF. Total site doses and resulting health risks would be virtually the same for both storage facilities. The doses and associated health risks to workers are assumed to be the same as for the modified FMEF (Table 4.2.1.9–2). This is because the operations would be similar and the amount of material handled would be the same.

Hazardous Chemical Impacts. Hazardous chemical emissions from the new Pu storage facility would be less than the emissions from the modified FMEF. The resultant health risks to the public and workers from hazardous chemical emissions associated with this new storage facility would be even smaller than those given in Table 4.2.1.9–3 for the modified FMEF.

Facility Accidents. A new Pu storage facility for continued storage of Pu would incorporate new safety features that should reduce the consequences and risks of accidents compared with No Action. The consequences and risks of accidents for this new facility would be bounded by the consequences and risks presented in Table 4.2.1.9–4 for the upgraded FMEF at Hanford.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Table 4.2.1.9–4. Upgrade Without Rocky Flats Environmental Technology Site or Los Alamos National Laboratory Material Alternative—Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	1.3×10^{-7}	4.4×10^{-6}	1.3×10^{-9}	4.4×10^{-8}	9.6×10^{-6}	3.2×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	7.7×10^{-9}	4.4×10^{-7}	7.7×10^{-11}	4.4×10^{-9}	5.6×10^{-7}	3.2×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	5.7×10^{-6}	1.8×10^{-5}	5.7×10^{-8}	1.8×10^{-7}	4.2×10^{-4}	1.3×10^{-3}	6.4×10^{-3}
Vault fire	5.8×10^{-9}	1.2×10^{-3}	4.6×10^{-11}	9.2×10^{-6}	3.4×10^{-7}	0.067	1.0×10^{-7}
Truck bay fire	3.1×10^{-9}	6.1×10^{-4}	3.1×10^{-11}	6.1×10^{-6}	2.2×10^{-7}	0.045	1.0×10^{-7}
Spontaneous combustion	3.1×10^{-11}	8.8×10^{-7}	3.1×10^{-13}	8.8×10^{-9}	2.2×10^{-9}	6.4×10^{-5}	7.0×10^{-7}
Explosion in the vault	7.2×10^{-10}	1.4×10^{-4}	7.2×10^{-12}	1.4×10^{-6}	5.3×10^{-8}	0.011	1.0×10^{-7}
Explosion outside of vault	3.3×10^{-11}	6.6×10^{-6}	3.3×10^{-13}	6.6×10^{-8}	2.4×10^{-9}	4.8×10^{-4}	1.0×10^{-7}
Nuclear criticality	2.1×10^{-11}	4.2×10^{-6}	1.6×10^{-13}	3.3×10^{-8}	1.8×10^{-10}	3.5×10^{-5}	1.0×10^{-7}
Beyond design basis earthquake	1.1×10^{-8}	2.2×10^{-3}	8.3×10^{-11}	1.7×10^{-5}	6.1×10^{-7}	0.12	1.0×10^{-7}
Expected risk[d]	5.8×10^{-6}	–	5.8×10^{-8}	–	4.3×10^{-4}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years in operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks for each accident over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using Table 4.2.1.9–6 data adjusted for existing inventory of Pu at Hanford.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

Normal Operation. As described for the Upgrade Without RFETS or LANL Pu, there would be no radiological releases during the modification of the FMEF at Hanford. Construction worker exposures to material potentially contaminated with radioactivity would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct exposures. The resulting doses and potential health effects on the public and workers at Hanford are described below.

Radiological Impacts. During normal operations, there would be only a negligible difference in radiological impacts if Pu from the RFETS and LANL is included in the upgrade storage alternative. Therefore, the impacts are essentially the same as presented in the previous section, which discusses the upgrade without RFETS or LANL Pu.

Hazardous Chemical Impacts. Hazardous chemicals associated with storage of Pu from RFETS and LANL does not measurably contribute to hazardous chemical emissions from the facility for this subalternative. Therefore resultant hazardous chemical impacts to the public and worker are essentially the same as presented in the previous section, which discusses the upgrade without RFETS or LANL Pu.

Facility Accidents. Upgrade of the existing Pu storage facilities at the Hanford site may change the existing risks of accidents to workers and the public. Under upgrade, all Pu storage facilities would be brought into compliance with applicable DOE Orders and other regulations and standards. This may result in a reduction of risk compared to No Action.

A set of potential accidents have been postulated for the RFETS and LANL Pu storage increment for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.1.9–5. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.12 at Hanford for the beyond design basis earthquake accident scenario with an estimated probability of 1.0×10^{-7} per year (for example, probability of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 6.2×10^{-7}, 8.5×10^{-11}, and 1.1×10^{-8}, respectively. The maximum population 50-year facility lifetime risk would be 4.3×10^{-4} (for example, on fatality in over 100,000 years) at Hanford for the PCV penetration by corrosion accident scenario with a probability of 6.6×10^{-3} per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 5.9×10^{-8} and 5.9×10^{-6}, respectively. Table 4.2.1.9–5 also shows the Combined Expected Risk for the upgraded storage of existing Pu, the RFETS Pu and the LANL Pu increment. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.1.9–5.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Construct New 200 West Area Facility for Plutonium Storage

Normal Operation. As described for the Upgrade Without RFETS or LANL Pu, there would be no radiological releases during the construction of the new 200 West Area Facility. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct exposures. The resulting doses and potential health effects to the public and workers at Hanford are described below.

Radiological Impacts. During normal operations, there would be only a negligible difference in radiological impacts if Pu from the RFETS and LANL is included in the upgrade storage alternative. Therefore, the impacts are essentially the same as presented in the previous section, which discusses the Upgrade Without RFETS or LANL Pu.

Table 4.2.1.9–5. Upgrade With Rocky Flats Environmental Technology Site and Los Alamos National Laboratory Material Alternative—Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	1.3×10^{-7}	4.4×10^{-6}	1.3×10^{-9}	4.4×10^{-8}	9.6×10^{-6}	3.2×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	7.7×10^{-9}	4.4×10^{-7}	7.7×10^{-11}	4.4×10^{-9}	5.6×10^{-7}	3.2×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	5.9×10^{-6}	1.8×10^{-5}	5.9×10^{-8}	1.8×10^{-7}	4.3×10^{-4}	1.3×10^{-3}	6.6×10^{-3}
Vault fire	5.9×10^{-9}	1.2×10^{-3}	4.7×10^{-11}	9.4×10^{-6}	3.5×10^{-7}	0.069	1.0×10^{-7}
Truck bay fire	3.1×10^{-9}	6.1×10^{-4}	3.1×10^{-11}	6.1×10^{-6}	2.2×10^{-7}	0.045	1.0×10^{-7}
Spontaneous combustion	3.1×10^{-11}	8.8×10^{-7}	3.1×10^{-13}	8.8×10^{-9}	2.2×10^{-9}	6.4×10^{-5}	7.0×10^{-7}
Explosion in the vault	7.4×10^{-10}	1.4×10^{-4}	7.4×10^{-12}	1.4×10^{-6}	5.4×10^{-8}	0.011	1.0×10^{-7}
Explosion outside of vault	3.3×10^{-11}	6.6×10^{-6}	3.3×10^{-13}	6.6×10^{-8}	2.4×10^{-9}	4.8×10^{-4}	1.0×10^{-7}
Nuclear criticality	2.1×10^{-11}	4.2×10^{-6}	1.6×10^{-13}	3.3×10^{-8}	1.8×10^{-10}	3.5×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	1.1×10^{-8}	2.3×10^{-3}	8.5×10^{-11}	1.7×10^{-5}	6.2×10^{-7}	0.12	1.0×10^{-7}
Expected risk[d]	6.0×10^{-6}	–	6.0×10^{-8}	–	4.3×10^{-4}	–	–
Combined expected risk[e]	1.2×10^{-5}	–	1.2×10^{-7}	–	8.6×10^{-4}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years in operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the incremental risk for storing the additional RFETS and LANL material for each accident over the 50-year lifetime of the facility.

[e] Combined expected risk for base case without RFETS or LANL Pu material plus RFETS and LANL Pu material increment.

Note: All values are mean values.

Source: Calculated using in Tables 4.2.1.9–6. Data adjusted for additional RFETS and LANL Pu.

Hazardous Chemical Impacts. Hazardous chemicals associated with storage of Pu from RFETS and LANL associated with building a new Pu facility are essentially the same as presented in the previous section, which discusses the upgrade without RFETS or LANL Pu. The resultant hazardous chemical impacts to the public and worker are essentially the same as presented in the previous section.

Facility Accidents. The new 200 West Area Facility constructed for continued storage of Pu would incorporate new safety features that should reduce the consequences and risks of accidents compared with No Action. The consequences and risks of accidents for this facility would be bounded by the consequences and risks presented in Table 4.2.1.9–5 for the Modify Existing FMEF for Pu Storage Subalternative at Hanford.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Consolidation Alternative

Construct New Plutonium Storage Facility

This section includes a description of radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involving the new consolidated Pu storage facility at Hanford.

[Text deleted.]

Normal Operation. There would be no radiological releases during the construction of a new consolidated Pu storage facility at Hanford. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct in-plant exposures. The resulting doses and potential health effects to the public and workers at Hanford are described below.

Radiological Impacts. Radiological impacts to the public resulting from the normal operation of the new consolidated Pu storage facility are presented in Table 4.2.1.9–1. The impacts from all site operations, including the new consolidated Pu storage facility, are also given in the table. To put operational doses into perspective, comparisons of operational doses with natural background radiation doses are included in the table.

The dose to the MEI due to annual storage facility operation would be 2.5×10^{-6} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 6.2×10^{-11}. As a result of storage plant operation in the year 2030, the population dose would be 1.1×10^{-4} person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 2.8×10^{-6}.

The dose to the MEI due to annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5 and would be 5.1×10^{-3} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.3×10^{-7}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 1.5 person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 0.038.

Doses to onsite workers from normal operations are given in Table 4.2.1.9–2. Included are involved workers directly associated with the new consolidated Pu storage facility, workers who are not involved with the new storage facility, and the entire workforce at Hanford. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the new consolidated Pu storage facility at Hanford are presented in Table 4.2.1.9–3. The impacts from all site operations, including the consolidated storage facility, are included in this table. Total site impacts, which include the No Action impact plus the added facility impact, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 4.0×10^{-6}, and the cancer risk is 2.7×10^{-8} as a result of operation of the new consolidated Pu storage facility in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, provided exposures remain the same. The total site operation including the upgrade facility would result in an HI of 6.6×10^{-5} and a cancer risk of 2.7×10^{-8} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 2.8×10^{-4}, and the cancer risk is 1.2×10^{-5} as a result of operation of the new consolidated Pu storage facility in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, provided exposures remain the same. The total site operation including the upgrade facility would result in an HI of 4.3×10^{-3} and a cancer risk of 1.2×10^{-5} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents for the consolidation of Pu alternative at Hanford for which there may be releases of Pu that may impact onsite workers and the offsite population has been postulated. The accident consequences and risks to a worker located 1,000 m (3,280 feet) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.1.9–6. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 1.2 at Hanford for the beyond design basis earthquake accident scenario with an estimated probability of 1.0×10^{-7} per year (that is, probability of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 6.1×10^{-6}, 8.3×10^{-10}, and 1.1×10^{-7}, respectively. The maximum population 50-year facility lifetime risk would be 4.2×10^{-3} (that is, one fatality in about 12,000 years) at Hanford for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 5.7×10^{-7} and 5.7×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.1.9–6.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

This section includes a description of radiological and hazardous chemical releases and the associated impacts resulting from either normal operation or accidents involved with the consolidation of Pu storage and collocation with HEU storage facilities at Hanford. This storage would take place in a new Pu and HEU storage facility.

Normal operation of the new collocated storage facility at Hanford would result in impacts that are within applicable regulatory limits.

[Text deleted.]

Normal Operation. There would be no radiological releases during the construction of a new collocated storage facility at Hanford. Construction worker exposures to materials potentially contaminated with radioactivity (for

Table 4.2.1.9–6. Consolidation Alternative Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality (per 50 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality (per 50 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatality[b]	Population to 80 km: Risk of Cancer Fatalities (per 50 yr)[a]	Population to 80 km: Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	1.3×10^{-7}	4.4×10^{-6}	1.3×10^{-9}	4.4×10^{-8}	9.6×10^{-6}	3.2×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	7.7×10^{-9}	4.4×10^{-7}	7.7×10^{-11}	4.4×10^{-9}	5.6×10^{-7}	3.2×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	5.7×10^{-5}	1.8×10^{-5}	5.7×10^{-7}	1.8×10^{-7}	4.2×10^{-3}	1.3×10^{-3}	0.064
Vault fire	5.8×10^{-8}	0.012	4.6×10^{-10}	9.2×10^{-5}	3.4×10^{-6}	0.67	1.0×10^{-7}
Truck bay fire	3.1×10^{-9}	6.1×10^{-4}	3.1×10^{-11}	6.1×10^{-6}	2.2×10^{-7}	0.045	1.0×10^{-7}
Spontaneous combustion	3.1×10^{-11}	8.8×10^{-7}	3.1×10^{-13}	8.8×10^{-9}	2.2×10^{-9}	6.4×10^{-5}	7.0×10^{-7}
Explosion in the vault	7.2×10^{-11}	1.4×10^{-3}	7.2×10^{-11}	1.4×10^{-5}	5.3×10^{-7}	0.11	1.0×10^{-7}
Explosion outside of vault	3.3×10^{-11}	6.6×10^{-6}	3.3×10^{-13}	6.6×10^{-8}	2.4×10^{-9}	4.8×10^{-4}	1.0×10^{-7}
Nuclear criticality	2.1×10^{-11}	4.2×10^{-6}	1.6×10^{-13}	3.3×10^{-8}	1.8×10^{-10}	3.5×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	1.1×10^{-7}	2.2×10^{-2}	8.3×10^{-10}	1.7×10^{-4}	6.1×10^{-6}	1.2	1.0×10^{-7}
Expected risk[d]	5.8×10^{-5}	–	5.8×10^{-7}	–	4.3×10^{-3}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks for each accident over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.1.1–5 and M.5.2.1.1–6 and the MACCS computer code.

example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the public resulting from the normal operation of the new collocated storage facility at Hanford are presented in Table 4.2.1.9–1. The impacts from all site operations, including the new storage facility, are also given in the table. To put operational doses into perspective, comparisons of operational doses with natural background radiation doses are included in the table.

The dose to the MEI of the public due to annual storage facility operation would be 2.5×10^{-6} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 6.2×10^{-11}. The impacts to the average individual would be less. As a result of storage facility operation in the year 2030, the population

dose would be $1.1x10^{-4}$ person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be $2.8x10^{-6}$.

The dose to the MEI of the public due to annual total site operations is within radiological limits and would be $5.1x10^{-3}$ mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be $1.3x10^{-7}$. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 1.5 person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 0.038.

Doses to onsite workers due to normal operations are given in Table 4.2.1.9–2. Included are involved workers directly associated with the new storage facility, workers who are not involved with the new storage facility, and the entire workforce at Hanford. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also worker rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the new consolidation of Pu storage and collocation with HEU storage facilities at Hanford are presented in Table 4.2.1.9–3. The impacts from all site operations, including the consolidation of Pu storage and collocation with HEU storage facilities, are also included in this table. Total site impacts, which include the No Action impact plus the added facility impacts, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is $1.6x10^{-5}$, and the cancer risk is $2.7x10^{-8}$ as a result of operation of the new consolidation of Pu storage and collocation with HEU storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the new facility, would result in an HI of $7.8x10^{-5}$ and a cancer risk of $2.7x10^{-8}$ for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker is $7.1x10^{-4}$, and the cancer risk is $1.2x10^{-5}$ as a result of operation of the new consolidation of Pu storage and collocation with HEU storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation including the new facility would result in an HI of $4.7x10^{-3}$ and a cancer risk of $1.2x10^{-5}$ for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents for collocation of Pu and HEU at Hanford for which there may be releases of Pu or HEU that may impact onsite workers and the offsite population has been postulated. The consequences and risks of potential accidents for Pu and HEU storage would be bounded by the impacts associated with the release of Pu. The accident consequences and risks to a worker located 1,000 m (3,280 feet) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.1.9–7. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 1.2 at Hanford for the beyond design basis earthquake accident scenario with an estimated probability of $1.0x10^{-7}$per year (that is, probability of severe earthquake occurring is estimated to be about $1.0x10^{-5}$, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be $6.1x10^{-6}$, $8.3x10^{-10}$, and $1.1x10^{-7}$, respectively. The maximum population 50-year facility lifetime risk would be $4.2x10^{-3}$ (that is, one fatality in about 12,000 years) at Hanford for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum

offsite individual and worker 50-year facility lifetime risks would be 5.7×10^{-7} and 5.7×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.1.9–7.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

If the strategic reserve and weapons R&D materials are not included, the incremental impacts to the public and to workers from the accident-free storage activities would be reduced in proportion to the decrease in the amount of material stored. The impacts from total site operations would decrease slightly. This subalternative applies to the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. The risks due to accidents would also tend to be lower.

Table 4.2.1.9–7. Collocation Alternative Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per year)
PCV puncture by forklift	1.3×10^{-7}	4.4×10^{-6}	1.3×10^{-9}	4.4×10^{-8}	9.6×10^{-6}	3.2×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	7.7×10^{-9}	4.4×10^{-7}	7.7×10^{-11}	4.4×10^{-9}	5.6×10^{-7}	3.2×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	5.7×10^{-5}	1.8×10^{-5}	5.7×10^{-7}	1.8×10^{-7}	4.2×10^{-3}	1.3×10^{-3}	0.064
Vault fire	5.8×10^{-8}	0.012	4.6×10^{-10}	9.2×10^{-5}	3.4×10^{-6}	0.67	1.0×10^{-7}
Truck bay fire	3.1×10^{-9}	6.1×10^{-4}	3.1×10^{-11}	6.1×10^{-6}	2.2×10^{-7}	0.045	1.0×10^{-7}
Spontaneous combustion	3.1×10^{-11}	8.8×10^{-7}	3.1×10^{-13}	8.8×10^{-9}	2.2×10^{-9}	6.4×10^{-5}	7.0×10^{-7}
Explosion in the vault	7.2×10^{-9}	1.4×10^{-3}	7.2×10^{-11}	1.4×10^{-5}	5.3×10^{-7}	0.11	1.0×10^{-7}
Explosion outside of vault	3.3×10^{-11}	6.6×10^{-6}	3.3×10^{-13}	6.6×10^{-8}	2.4×10^{-9}	4.8×10^{-4}	1.0×10^{-7}
Nuclear criticality	2.1×10^{-11}	4.2×10^{-6}	1.6×10^{-13}	3.3×10^{-8}	1.8×10^{-10}	3.5×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	1.1×10^{-7}	0.022	8.3×10^{-10}	1.7×10^{-4}	6.1×10^{-6}	1.2	1.0×10^{-7}
Expected risk[d]	5.8×10^{-5}	–	5.8×10^{-7}	–	4.3×10^{-3}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks for each accident over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code.

Phaseout

Normal Operation. A phaseout of existing Pu storage facilities at Hanford would reduce the impacts from radiological and chemical releases and exposures to levels slightly less than the No Action exposures. As shown in Table 4.2.1.9–1, the dose to the MEI from annual operation would be reduced by 4.1×10^{-4} mrem; the dose to the population would be reduced by 0.047 person-rem. The associated reductions in fatal cancer are included in the table. All workers involved in the transfer of the Pu would be monitored to assure that their doses remain within regulatory limits and ALARA.

Facility Accidents. The phaseout operation will be conducted in accordance with DOE Orders to ensure that the risk to the public of prompt fatalities due to accidents or of cancer fatalities due to operations will be minimized. For current operations in the facility that would be phased out, the safety of workers and the public from accidents is controlled by Technical Safety Requirements that are specified in SARs or Basis for Interim Operations documents that have been prepared for the facility. Prior to initiating phaseout, the potential for accidents that could affect workers and the public will be assessed and, if necessary, applicable existing safety documentation will be modified to ensure safety for workers and the public.

4.2.1.10 Waste Management

This section summarizes the impacts on waste management at Hanford under No Action, each of the long-term storage alternatives, and the phaseout of Pu storage. There is no spent nuclear fuel or HLW associated with Pu or HEU storage. Table 4.2.1.10–1 lists the projected sitewide waste generation rates and treatment, storage, disposal capacities under No Action for 2005. Projections for No Action were derived from the most recent available environmental data, with the assumption that operational requirements for waste generation in 2005 would be approximately equal to the 1993 generation volume. The projection does not include wastes from future, yet uncharacterized environmental restoration activities, such as content characterization and decommissioning of 149 single shell tanks, treating 28 double shell tanks, and removing over 500 buildings. The projections for No Action could change significantly depending on the decisions resulting from the PEIS on waste management being prepared by DOE. Table 4.2.1.10–2 provides the estimated incremental operational waste volumes projected to be generated at Hanford as a result of the various storage alternatives prior to treatment. Some of the waste values described in this section are different than the waste values in the table. For those values that differ (for example LLW), the table gives waste generated pre-treatment values and the text discusses post-treatment values (indicated as after treatment and volume reduction). The waste volumes generated from the various storage alternatives and the resultant waste effluent used for the waste impacts analysis can be found in Section E.3.1. Facilities that would support the storage of Pu and/or HEU would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated and disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous wastes would be treated and disposed of in accordance with current site practice.

Preferred Alternative: No Action Alternative

Under this alternative, high-level, TRU, low-level, mixed, hazardous, and nonhazardous wastes, and spent nuclear fuel would continue to be managed from the missions outlined in Section 3.2. Hanford no longer has a weapons production mission. Its focus is to decommission the reactors and site facilities, as well as cleanup approximately 1,450 km^2 (560 mi^2) of land. The impacts of the wastes generated as part of environmental restoration and D&D activities are addressed in the *Final Environmental Impact Statement: Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington* (DOE/EIS–0119F) and the *Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan* (DOE/EIS–0222D). Under No Action, Hanford would continue to store its inventory of Pu, and treat, store, and dispose of its legacy and newly generated wastes in current and planned facilities.

The Pu addressed in this PEIS is limited to materials currently stored within protected vaults and gloveboxes, and additional materials within process lines and process equipment within the PFP Complex in the 200 West Area. The PFP had been used to conduct Pu processing operations such as Pu purification, Pu recovery, oxide production, metal production, and parts fabrication. The PFP has also been used for receipt and large-scale storage of onsite and offsite Pu scrap and product materials. [Text deleted.] Modifications to the facilities will proceed following the ROD resulting from the PFP EIS (DOE/EIS-0244F) to meet current regulations and provide for interim storage. Maintenance, assay, packaging, and monitoring of the inventory would produce TRU, low-level, hazardous, and nonhazardous wastes. These wastes would be treated, stored, and disposed of in compliance with existing regulations.

Under No Action, the processing of legacy wastes would require new facilities, since the necessary treatment, storage, and disposal facilities either do not exist or are nearing capacity. Spent nuclear fuel would be managed in accordance with the amended ROD (61 FR 9441) from the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste*

Table 4.2.1.10–1. Projected Spent Nuclear Fuel and Waste Management Under No Action (2005) at Hanford Site

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent Nuclear Fuel	None[a]	Encapsulation	Planned	Reactor basins Non-Hanford production reactor spent fuel to be sent to INEL	2,133 t	To HLW Program	NA
High-Level							
Liquid	None[a]	Evaporation[b,c]	50,000	Tank farm	146,000[d]	NA	NA
Solid	None	NA	NA	NA	NA	To HLW Program	NA
Transuranic							
Liquid	None[a]	Included in HLW	Included in HLW	Tank farm	Included in HLW	NA	NA
Solid	271	None	NA	Containers on asphalt pads	15,370	WIPP or alternate facility–planned[e]	None
Mixed Transuranic							
Liquid	None[a]	Included in HLW	Included in HLW	Tank farm	Included in HLW	NA	NA
Solid	98	Included in TRU	Included in TRU	Containers on asphalt pads	15,370	WIPP or alternate facility–planned[e]	None
Low-Level							
Liquid	None	Evaporation, separation, solidification (vitrification)	Evaporator in service, new facilities planned	None	NA	NA	NA
Solid	3,390	Compaction	4,000[f]	Not stored	NA	Burial	902,900[g]

Table 4.2.1.10–1. Projected Spent Nuclear Fuel and Waste Management Under No Action (2005) at Hanford Site—Continued

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Mixed Low-Level							
Liquid	3,760	Evaporation, ion exchange[c]	50,000	Storage tanks, basins planned	446,500[h]	None	NA
Solid	1,505	None	NA	RCRA facility, retrievable	1,218,700	Landfill, LLW burial grounds 218-E-NN	Included in LLW
Hazardous							
Liquid	Included in solid	None	NA	RCRA building	Included in solid	Commercial[i]	NA
Solid	560	None	NA	RCRA building	127	Commercial[i]	NA
Nonhazardous (Sanitary)							
Liquid	414,000[j]	None	NA	None	NA	Septic tanks, french drains	Expandable
Solid	5,107	None	NA	None	NA	Richland Sanitary Landfill	Expandable
Nonhazardous (Other)							
Liquid	Included in sanitary	None	NA	None	NA	Percolation ponds, leachfields	Expandable
Solid	Included in sanitary	None	NA	None	NA	Landfill	Expandable

[a] No waste in this category is expected to be generated in 2005. Treatment and storage and/or disposal is expected to continue for waste generated from past activities.
[b] Vitrification planned.
[c] Assumes 242-A Evaporator as treatment method for liquid HLW, liquid TRU, and liquid mixed TRU.
[d] Consists of HLW and liquid TRU wastes in Double-Shell Tanks; Pu recovery and extraction aging waste. Includes 241-AN, 241-AP, 241-AW, 241-AY, 241-AZ, and 241-SY Tank Farms.
[e] Disposal at WIPP would depend in part on decisions pursuant to the *Waste Isolation Pilot Plant Disposal Phase Supplemental Environmental Impact Statement.*
[f] Compaction by LLW Compactor (213-W).
[g] Includes the LLW Burial Grounds (unit 218-E-NN) and Low-Level Mixed Waste Disposal Facility (Project-W-025).
[h] Assumes storage of liquid mixed LLW in tanks and planned basins.
[i] Offsite at RCRA facility.
[j] Estimate based on 14,586 employees, 30 gal per day per employee, and 250 days per year of operation.
Note: NA=not applicable.
Source: 61 FR 9441; DOE 1992f; DOE 1993a; DOE 1993h; HF 1993a:1; HF 1995a:1.

Table 4.2.1.10–2. Estimated Annual Generated Waste Volumes at Hanford Site—No Action (2005) and Net Incremental for Storage Alternatives

Category	No Action[a] (m^3)	Upgrade		Consolidation[b] (m^3)	Collocation[b] (m^3)	Phaseout (m^3)
		Without RFETS or LANL Material[b] (m^3)	With RFETS and LANL Material[b] (m^3)			
Transuranic						
Liquid	None	0	0	0.02[c]	0.02[c]	0
Solid	271	20	21	10	10	0
Mixed Transuranic						
Liquid	None	0	0	0	0	0
Solid	98	0	0	4	4	0
Low-Level						
Liquid	None	0.08[c]	0.08[c]	2[c]	2.1[c]	0
Solid	3,390	85	89	1,260	1,300	0
Mixed Low-Level						
Liquid	3,760	0	0	0.2	0.2	0
Solid	1,505	5	5	65	66	0
Hazardous						
Liquid	Included in solid	0.57	0.57	2	2	0
Solid	560	4	4	2	2	0
Nonhazardous (Sanitary)						
Liquid	414,000	8,330	8,780	110,000	146,000	0
Solid	5,107	917	967	1,140	1,760	0
Nonhazardous (Other)						
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	0
Solid	Included in sanitary	0	0	1,400[d]	2,200[d]	0

[a] The No Action waste volumes are from Table 4.2.1.10–1.

[b] Generated waste volumes for storage alternatives shown in this table are found in Section E.3.1 (Tables E.3.1.1–1, E.3.1.1–5, E.3.1.2–1, and E.3.1.3–1). Waste effluents (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in these tables.

[c] Liquid TRU and LLW would be treated and solidified prior to disposal.

[d] Recyclable wastes.

Management Programs Final Environmental Impact Statement (DOE/EIS-0203-F) and the ROD (61 FR 10736) from the follow-on tiered site-specific NEPA analysis, *Final Environmental Impact Statement on the Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, Richland, Washington* (DOE/EIS-0245). TRU waste already packaged to current planning-basis WIPP WAC would either be stored or have been shipped. In compliance with the *Federal Facility Compliance Act* of 1992, mixed waste would have been treated and disposed of according to the Hanford Tri-Party Agreement. Solid LLW would continue to be buried at the onsite low-level disposal facility.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

The modification of the FMEF or construction of a new storage facility for the continued storage of Pu would have a small impact on existing Hanford waste management activities. Construction waste volumes as presented in Table E.3.1.1–1 would have minimal impact on Hanford waste management activities. Waste generated during construction would consist of wastewater and solid nonhazardous and hazardous wastes. Nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous waste would be shipped offsite to commercial RCRA-permitted treatment and disposal facilities. Operational waste volumes as shown in Table 4.2.1.10–2 would increase slightly due to increased surveillance activities over No Action.

Approximately 20 m^3 (26 yd^3) of TRU waste from damaged PCVs and contaminated glovebox panels, windows, and gaskets would need to be treated and packaged to meet the current planning-basis WIPP WAC or alternative treatment level. While awaiting shipment to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), the TRU waste would be stored in above-grade storage facilities at the Hanford Central Waste Complex and the Transuranic Waste Storage and Assay Facility. Three additional truck shipments per year or, if applicable, two regular train shipments per year or one dedicated train shipment every 3 years, would be required to transport this waste to WIPP.

After treatment and volume reduction, approximately 42 m^3 (56 yd^3) of LLW from solidified liquid LLW (such as decontamination solutions), protective clothing, HEPA filters, glovebox gloves, and decontamination equipment and materials would require disposal in the 200 Area LLW Burial Grounds. Assuming a land usage of 3,400 m^3/ha (1,800 yd^3/acre), this would require 0.01 ha/yr (0.03 acre/yr) of LLW disposal area.

Contaminated shielding and cleaning materials would be the major contributors to the 5 m^3 (7 yd^3) of mixed LLW. This small amount of mixed LLW could be treated and disposed of in accordance with the Hanford Tri-Party Agreement through the use of existing and planned facilities.

The 0.57 m^3 (150 gal) of liquid hazardous waste such as lubricants, cleaning solvents, paint, and lube oil and 4 m^3 (5 yd^3) of solid hazardous waste such as lead packing, wipes, and solid materials contaminated with oils, lubricants, and cleaning solvents would have minimal impact on waste management activities at Hanford. The hazardous wastes would be packaged in DOT-approved containers and shipped offsite to commercial RCRA-permitted treatment and disposal facilities.

Approximately 8,330 m^3 (2,200,000 gal) of liquid nonhazardous waste to include sanitary, utility and process wastewaters, and cooling system blowdown would be processed using the 200 West Area Treatment Facility or one of the numerous septic tanks/subsurface disposal systems. Existing and planned liquid nonhazardous waste facilities are adequate. After volume reduction, approximately 459 m^3 (600 yd^3) of solid nonhazardous waste

such as clean non-Pu metals, packing materials, office trash, defective and damaged equipment, and industrial waste from utility and maintenance operations would be shipped to one of the onsite landfills.

Construct New 200 West Area Facility for Plutonium Storage

The construction and operation of a new storage facility for the continued storage of the current inventory of Pu would have a small impact on existing Hanford waste management activities. The impacts are identical to those identified in the preceding option of modifying the FMEF.

Upgrade With All or Some Rocky Flats Environmental Technology Site and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Fuels and Materials Examination Facility for Plutonium Storage

As shown in Table E.3.1.1–5 construction waste volumes would increase for the additional required construction. The types of operational waste are identical to those discussed earlier, but there would be a small increase in volume. Approximately 21 m^3 (27 yd^3) of TRU waste would be treated and packaged to meet the current planning-basis WIPP WAC or alternative treatment level. While awaiting shipment to WIPP (depending on decisions resulting from the supplemental PEIS noted earlier), the TRU and mixed TRU waste would be stored in above-grade storage facilities in the Hanford Central Waste Complex and the Transuranic Waste Storage and Assay Facility. Three additional truck shipments per year or, if applicable, two regular train shipments per year or one dedicated train shipment every 3 years, would be required to transport these wastes to WIPP.

After treatment and volume reduction, approximately 45 m^3 (59 yd^3) of LLW would require disposal in the 200 Area LLW Burial Grounds. Assuming a land usage of 3,400 m^3/ha (1,800 yd^3/acre), this would require 0.01 ha/yr (0.03 acre/yr) of LLW disposal area. The 5 m^3 (7 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the Hanford Tri-Party Agreement through the use of existing and planned facilities. The 0.57 m^3 (150 gal) of liquid hazardous wastes and 4 m^3 (5 yd^3) of solid hazardous wastes would have minimal impact on waste management activities at Hanford. The hazardous wastes would be packaged in DOT-approved containers and shipped offsite to commercial RCRA-permitted treatment and disposal facilities. Approximately 8,780 m^3 (2,320,000 gal) of liquid nonhazardous wastes to include sanitary, utility and process wastewaters, and cooling system blowdown would be processed using the 200 West Area Treatment Facility or one of the numerous septic tanks/subsurface disposal systems. Existing and planned liquid nonhazardous waste facilities are adequate. After volume reduction, approximately 483 m^3 (632 yd^3) of solid nonhazardous waste would require disposal at one of the onsite landfills.

Distributing the RFETS and LANL material to more than one site would reduce the operational waste volumes. The decrease would be proportional to the amount of material.

Construct New 200 West Area Facility for Plutonium Storage

The impacts of constructing and operating a new storage facility to include RFETS and LANL Pu would be identical to those identified in the preceding option of modifying the FMEF to include RFETS and LANL Pu.

Consolidation Alternative

Construct New Plutonium Storage Facility

Construction and operation of a consolidated Pu storage facility would have an impact on existing Hanford waste management activities, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater and solid nonhazardous

and hazardous wastes. The solid nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any was generated it would be managed in accordance with site practice and all applicable Federal and State regulations. The types of operational wastes from the consolidated Pu storage facility would be the same as those from the Upgrade Alternative, but the quantity would change.

After treatment and volume reduction of TRU waste, approximately 5 m^3 (7 yd^3) of TRU waste and 4 m^3 (5 yd^3) of mixed TRU waste from leaded gloves and windows and contaminated lead shielding would be treated and packaged to meet the current planning-basis WIPP WAC or alternative treatment level. While awaiting shipment to WIPP (depending on decisions resulting from the supplemental EIS noted earlier), the TRU and mixed TRU wastes would be stored in above-grade storage facilities in the Hanford Central Waste Complex and the TRU Waste Storage and Assay Facility. One additional truck shipments per year or, if applicable, one regular train shipment every 2 years or one dedicated train shipment every 6 years, would be required to transport these wastes to WIPP.

Following treatment and volume reduction, approximately 630 m^3 (824 yd^3) of LLW would require disposal in the 200 Area LLW Burial Grounds. Assuming a land usage of 3,400 m^3/ha (1,800 yd^3/acre), this would require approximately 0.2 ha/yr (0.5 acre/yr) of LLW disposal area. The 0.2 m^3 (50 gal) of liquid mixed LLW and 65 m^3 (85 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the Hanford Tri-Party Agreement through the use of existing and planned facilities. The 2 m^3 (476 gal) of liquid hazardous waste and 2 m^3 (3 yd^3) of solid hazardous waste would have minimal impact on waste management activities at Hanford. The hazardous wastes would be packaged in DOT-approved containers and shipped offsite to commercial RCRA-permitted treatment and disposal facilities. Approximately 110,000 m^3 (29,000,000 gal) of liquid nonhazardous waste would be treated and recycled by the consolidated facility. After volume reduction, 570 m^3 (746 yd^3) of solid nonhazardous waste would require disposal at one of the onsite landfills.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction and operation of a consolidated Pu storage facility collocated with HEU storage would have an impact on existing Hanford waste management activities, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater and solid nonhazardous and hazardous wastes. The solid nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any was generated it would be managed in accordance with site practice and all applicable Federal and State regulations. Since there is no TRU or mixed TRU wastes associated with HEU storage, the impacts from TRU and mixed TRU wastes are identical to those identified in the consolidated Pu storage alternative. The sources of waste are similar to those of the Pu storage facilities except the source of radioactive contamination from HEU storage is uranium.

Following treatment and volume reduction, approximately 630 m^3 (824 yd^3) of LLW contaminated with Pu and 20 m^3 (26 yd^3) of LLW contaminated with uranium would require disposal in the 200 Area LLW Burial Grounds. Assuming a land usage of 3,400 m^3/ha (1,800 yd^3/acre), this would require approximately 0.2 ha/yr (0.5 acre/yr) of LLW disposal area. The 0.2 m^3 (55 gal) of liquid mixed LLW and 66 m^3 (86 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the Hanford Tri-Party Agreement through the use of existing and planned facilities. The 2 m^3 (530 gal) of liquid hazardous waste and 2 m^3 (3 yd^3) of solid hazardous waste would have minimal impact on waste management activities at Hanford. The hazardous wastes would be packaged in DOT-approved containers and shipped offsite to commercial RCRA-permitted treatment and disposal facilities. The 146,000 m^3 (39,000,000 gal) of liquid nonhazardous waste would require construction

of sanitary, utility, and process wastewater treatment systems. After volume reduction 880 m^3 (1,150 yd^3) of solid nonhazardous wastes would require disposal at one of the onsite landfills.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve and weapons R&D materials would reduce the amount of operational waste volumes shown in Table 4.2.1.10–2 for the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. The decrease would be proportional to the amount of material excluded. [Text deleted.]

Phaseout

The phaseout of Pu storage would have no impact on Hanford waste management activities. The volume of waste would not decrease until the facilities in which Pu is stored were D&D.

4.2.2 NEVADA TEST SITE

A listing of the proposed long-term storage alternatives, subalternatives, and related actions, including the No Action Alternative, at NTS is provided below. The potential impacts of implementing these alternatives and related actions at NTS are described in the following sections: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, and waste management. The specific long-term storage alternatives proposed for NTS are the Consolidation Alternative and the Collocation Alternative.

Preferred Alternative

No Action Alternative:

There is no Pu or HEU storage mission currently at NTS; does not add Pu or HEU storage at NTS.

Proposed Storage Activities at Nevada Test Site

- **No Action Alternative (Preferred Alternative):** There is no Pu or HEU storage mission currently at NTS; does not add Pu or HEU storage at NTS.
- **Upgrade Alternative:** This storage alternative does not apply to NTS.
- **Consolidation Alternative:** Two options to accommodate all Pu material within the scope of this PEIS: Modify the existing network of tunnel drifts and construct a new material handling building at the P-Tunnel; or construct a new facility near DAF.
- **Collocation Alternative:** Two options to accommodate all Pu and HEU material within the scope of this PEIS: Modify the existing network of tunnel drifts and construct a larger new material handling building at the P-Tunnel; or construct a larger new facility near the DAF.
- **Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials:** Facility and other resource requirements would be smaller than the Consolidation Alternative and the Collocation Alternative.
- **Phaseout:** This storage activity does not apply to NTS.

4.2.2.1 Land Resources

Preferred Alternative: No Action Alternative

Neither Pu nor HEU is presently stored at NTS. Under the No Action Alternative, existing and planned missions at NTS would continue. The ongoing (no new action) activities would conform with present and future land-use plans, policies, and controls. No effects to land resources would be anticipated at NTS beyond those of existing and future activities that are independent of this action.

Consolidation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

This option would modify the existing P-Tunnel and construct a new material handling building in Area 12 to accommodate all Pu material within the scope of this PEIS. During construction, 29 ha (72 acres) of land area would be required of which 27 ha (68 acres) would be used during operation. Construction laydown area and the operating facility would be situated entirely on previously disturbed land and would not create any newly disturbed area. As a modification of an existing facility, the 1.6-km (1-mi) buffer zone is established.

Land Use. Utilization of the P-Tunnel in Area 12 would not conform with the master plan of the *Nevada Test Site Development Plan*, which designates the North area of NTS as an underground nuclear weapons test area (NT DOE 1995d:7). However, the P-Tunnel is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program materials disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (NTS EIS) (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). Should the Consolidation Alternative P-Tunnel option be selected, the Expanded Use Alternative of the NTS EIS could be used to revise the current *Nevada Test Site Development Plan*. With these changes, any required construction would be consistent with the land use plan. As discussed in Section 4.2.2.8, sufficient available labor exists within the region to fill the jobs created during construction and operations. There would be no increased demand for housing. Therefore, no indirect impacts on offsite land use would be anticipated.

Use of the P-Tunnel would not affect special status lands as shown in Figure 3.3.1–1. The buffer zone and security area associated with the long-term storage alternative would preclude development within the immediate area. However, the NTS EIS Expanded Use Alternative indicates that adequate land area is available at NTS for facility siting (NT DOE 1996c:3-14, 3-15). The proposal would not affect offsite grazing allotments. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, or controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning. Storage of Pu in the P-Tunnel could impact weapons effects testing ability. It is likely that the P-Tunnel be closed during testing, although it could be kept manned if appropriate safety considerations were met (NT DOE 1995e:1). However, the potential for impacts could be eliminated by test or tunnel design (NT DOE 1996f:1).

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the existing industrialized landscape character of Area 12 and the current VRM Class 5 designation. Although U.S. Route 95 is a heavily traveled public roadway, travelers are unable to view Area 12 facilities because of mountainous terrain and distance.

Construct New Plutonium Storage Facility

All Pu within the scope of this PEIS would be stored at a new storage facility to be constructed at NTS Area 6 near the DAF. The consolidated Pu storage plant at NTS would disturb 58.5 ha (144 acres) of land area during

construction of which 56 ha (138 acres) would be used during operation. A buffer zone would be provided between the facility and the NTS site boundary. Pu storage in existing storage facilities at other DOE sites would be phased out.

Land Use. Construction and operation of the Pu facility would convert undeveloped land in Area 6. The proposed action would not conform with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area (NT DOE 1995d:7). However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program materials disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). As discussed in Section 4.2.2.8, no in-migration of workers would be required during construction and operations. No increase in housing demand would be anticipated, with offsite land use not subject to indirect land-use impacts.

Construction and operation would not affect other land uses at NTS or special status lands. The buffer zone and security area associated with the long-term storage alternative would preclude development within the immediate area. However, the Expanded Use Alternative of the NTS EIS indicates that adequate land area is available at NTS for facility siting (NT DOE 1996c:3-14,3-15). The alternative would not affect offsite grazing allotments. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, or controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the alternative would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Collocation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Under this action, the existing P-Tunnel located in Area 12 is proposed to be utilized, and a new material handling building would be constructed at the P-Tunnel. Land disturbance would be 29 ha (72 acres) during construction of which 27 ha (68 acres) would be used during operations. Construction laydown area and the operating facility would be situated entirely on previously disturbed land and would not create any newly disturbed area. Effects to land resources during construction and operation would be similar to those of the new and modified P-Tunnel for the Consolidation Alternative. As discussed in Section 4.2.2.8, in-migration would occur only during the operation phase. Projected vacancies within the housing stock would be sufficient to accommodate the slight increase in demand. Therefore, no indirect effects to offsite land use would be anticipated.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

The new storage facility would be located on undisturbed land in Area 6 near the DAF and would disturb a land area of 89.5 ha (221 acres) during construction of which 87 ha (215 acres) would be used during operations. A buffer zone would be provided between operations and the NTS site boundary. Direct and indirect land resources effects would be similar to the Consolidation Alternative, new storage facility.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, land effects during construction and operation would be almost the same in extent and magnitude to the Consolidation Alternative and Collocation Alternative because the facility would be almost the

same. However, because the smaller quantity of material would require smaller facilities, it is likely that less land area would be disturbed during construction and used during operations. [Text deleted.]

[Text deleted.]

4.2.2.2 Site Infrastructure

Nevada Test Site had an extensive infrastructure to handle the underground test program. With the cessation of nuclear testing, many of the operations around the site have been terminated. However, the facilities remain in place and are considered to be available.

Preferred Alternative: No Action Alternative

The infrastructure currently in place at NTS is capable of handling all anticipated missions and functions associated with the No Action Alternative.

Consolidation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Construction to modify the P-Tunnel and construct a new material handling building to accommodate long-term storage of Pu at NTS would not impact the site infrastructure. Data for construction are presented in Appendix C. Operations impacts to NTS infrastructure under this option are in the areas of electrical energy and fuel requirements for the site. As shown in Table 4.2.2.2–1, additional electrical energy would be required to operate the facility. A small amount of oil would be required to operate the modified P-Tunnel for storage of Pu. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil could be procured through normal contractual means. The preconceptual facility design uses natural gas as a fuel source. The final facility design for NTS would be converted to an energy source already available at NTS. With this conversion from natural gas to oil, site infrastructure requirements are within site capacities.

Construct New Plutonium Storage Facility

Constructing a new storage facility to accommodate long-term storage of Pu at NTS would not affect the site infrastructure. Data for construction are presented in Appendix C. Operations impacts to NTS infrastructure under this option are in the area of fuel requirements. As shown in Table 4.2.2.2–1, a small amount of oil would be required to operate the new facility for storage of Pu. Since oil availability is governed by usage and not by storage capacity on site, the additional oil could be procured through normal contractual means. Adequate electrical energy is available from the regional power grid. The preconceptual facility design uses natural gas as a fuel source. The final facility design for NTS would be converted to an energy source already available at NTS. With this conversion from natural gas to oil, site infrastructure requirements are within site capacities.

Collocation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Construction to modify the P-Tunnel and construct a new material handling building to accommodate long-term storage of Pu and HEU at NTS would not affect site infrastructure. Data for construction are presented in Appendix C. Operations impacts to NTS infrastructure under this option are in the areas of electrical energy and fuel requirements for the site. As shown in Table 4.2.2.2–1, additional electrical energy would be required to operate the facility. A small amount of oil would be required to operate the modified P-Tunnel for storage of Pu and HEU. Since oil availability is governed by usage and not by storage capacity on site, the additional oil could be procured through normal contractual means. Adequate electrical energy is available from the regional power grid. The preconceptual facility design uses natural gas as a fuel source. The final facility design for NTS would be converted to an energy source already available at NTS. With this conversion from natural gas to another energy source, site infrastructure requirements are within site capacities.

Table 4.2.2.2–1. Site Infrastructure Changes Required for Operation at Nevada Test Site (Annual)—No Action (2005) and Storage Alternatives

Alternative	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
No Action							
Site availability	1100[a]	0	176,844	45	5,716,000	0	0
Projected usage	645	0	124,940	25	5,716,000	0	0
Consolidation							
Modify Existing Tunnel Drifts and Construct New Material Handling Building							
Projected usage with consolidated facility	650	0	196,940	35	5,754,000	3,200,000	0
Amount required in excess to site availability	0	0	20,096	0	38,000	3,200,000	0
New Pu Storage Facility							
Projected usage with consolidated facility	650	0	173,940	33	5,754,000	2,800,000	0
Amount required in excess to site availability	0	0	0	0	38,000	2,800,000	0
Collocation							
Modify Existing Tunnel Drifts and Construct New Material Handling Building							
Projected usage with consolidated and collocated upgrade facilities	650	0	213,940	38	5,754,000	3,600,000	0
Amount required in excess to site availability	0	0	37,096	0	38,000[b]	3,600,000[c]	0
New Pu and HEU Storage Facilities							
Projected usage with and new collocated facilities	650	0	189,940	36	5,754,000	3,200,000	0
Amount required in excess to site availability	0	0	13,096	0	38,000[b]	3,200,000[c]	0

[a] Includes paved and unpaved roads.

[b] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

[c] Facility would be adapted to use fuel oil instead of natural gas.

Note: Modified from NTS 1993a:4.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Constructing a new storage facility to accommodate long-term storage of Pu and HEU at NTS would not affect the site infrastructure. Data for construction are presented in Appendix C. Operations impacts to NTS infrastructure under this option are in the areas of electrical energy and fuel requirements. As shown in Table 4.2.2.2–1, additional electrical energy would be required to operate the facility. A small amount of oil would be required to operate the new facility for storage of Pu and HEU. Since oil availability is governed by usage and not by storage capacity on site, the additional oil could be procured through normal contractual means. Adequate electrical energy is available from the regional power grid. The preconceptual facility design uses natural gas as a fuel source. The final facility design for NTS would be converted to an energy source already available at NTS. With this conversion from natural gas to oil, site infrastructure requirements are within site capacities.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

With a change to the preconceptual facility designs that would allow use of a fuel source already in place at NTS, the existing site infrastructure would be fully capable of supporting construction/modification and operation of facilities for the Consolidation of Pu and Collocation of Pu and HEU Alternatives. With this change, constructing and operating such alternatives, without including provisions for storage of strategic reserve and weapons R&D materials could be accommodated as well. Expected reductions in annual electrical energy requirements from that of the various storage alternatives for all the nonsurplus materials are the only site infrastructure changes expected if this subalternative is chosen because electric usage is dependent on the amount of material. [Text deleted.]

4.2.2.3 Air Quality and Noise

Construction and operation activities associated with the No Action Alternative and the proposed storage alternatives would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts at NTS, criteria and toxic/hazardous concentrations from the No Action Alternative and the proposed storage alternatives are compared with Federal and State standards and guidelines. Impacts from radiological airborne emissions are described in Section 4.2.2.9.

In general, all of the proposed storage facilities would emit the same types of air pollutants during construction. It is expected emissions would not exceed Federal, State, or local air quality regulations. PM_{10} concentrations will be increased especially during peak construction periods.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, and wind erosion of exposed ground surfaces
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

During operation, impacts from each of the individual storage facilities with respect to the concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Table 4.2.2.3–1 presents the estimated pollutant concentrations for each of the storage alternatives, indicating little difference between alternatives with respect to impacts to air quality.

Emission rates attributed to operation of the proposed storage facilities are presented in Tables F.1.3–2 and F.1.3–3. [Text deleted.] Air pollutant emission sources associated with operations include the following:

- Operation of boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- Exhaust and road dust generated by vehicles delivering supplies and bringing employees to work
- Toxic/hazardous pollutant emissions from facility processes

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for each storage alternative are described separately. Supporting data for the air quality and noise analyses are presented in Appendix F.

AIR QUALITY

An analysis was conducted of the potential air quality impacts of emissions from each of the storage alternatives as described in Section 4.1.3.

Section 176 (c) of the 1990 CAA Amendments requires that all Federal actions conform with the applicable SIP. EPA has implemented rules that establish the criteria and procedures governing the determination of conformity for all Federal actions in nonattainment and maintenance areas. These are discussed in Section 4.1.3. The attainment status of the area in which NTS is located is discussed in Section 3.3.3. Since the area is considered to be an attainment area for the criteria pollutants, the proposed actions at this site do not require that a conformity analysis be performed.

Table 4.2.2.3–1. Estimated Operational Concentrations of Pollutants at Nevada Test Site and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Consolidation		Collocation	
				New Storage Facility ($\mu g/m^3$)	Modify P-Tunnel ($\mu g/m^3$)	New Storage Facilities ($\mu g/m^3$)	Modify P-Tunnel ($\mu g/m^3$)
Criteria Pollutants							
Carbon monoxide	8-hour	10,000[b]	2,290	2,290.29	2,290.54	2,290.33	2,290.60
	1-hour	40,000[b]	2,748	2,750.02	2,751.77	2,750.30	2,752.22
Lead	Calendar Quarter	1.5[b]	[c]	[c]	[c]	[c]	[c]
Nitrogen dioxide	Annual	100[b]	[c]	<0.01[d]	0.01[d]	<0.01[d]	0.01[d]
Ozone	1-hour	235[b]	[e]	[e]	[e]	[e]	[e]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	9.4	9.4	9.4	9.4	9.4
	24-hour	150[b]	106	106	106	106	106
Sulfur dioxide	Annual	80[b]	8.4	8.4	8.4	8.4	8.4
	24-hour	365[b]	94.6	94.6	94.6	94.6	94.6
	3-hour	1,300[b]	725	725	725	725	725
Mandated by Nevada							
Hydrogen sulfide	1-hour	112[f]	[c]	[c]	[c]	[c]	[c]

Table 4.2.2.3–1. Estimated Operational Concentrations of Pollutants at Nevada Test Site and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Consolidation: New Storage Facility ($\mu g/m^3$)	Consolidation: Modify P-Tunnel ($\mu g/m^3$)	Collocation: New Storage Facilities ($\mu g/m^3$)	Collocation: Modify P-Tunnel ($\mu g/m^3$)
Hazardous and Other Toxic Compounds							
Chlorine	8-hour	35.7[f]	[d]	<0.01[d]	<0.01[d]	<0.01[d]	<0.01[d]
Hydrogen chloride	8-hour	[g]	[d]	<0.01[d]	<0.01[d]	<0.01[d]	<0.01[d]
Hydrazine	8-hour	3.1[f]	[d]	<0.01[d]	<0.01[d]	<0.01[d]	<0.01[d]
Nitric acid	8-hour	123.8[f]	[d]	<0.01[d]	<0.01[d]	0.01[d]	<0.01[d]
Phosphoric acid	8-hour	23.8[f]	[d]	<0.01[d]	<0.01[d]	<0.01[d]	<0.01[d]
Sulfuric acid	8-hour	23.8[f]	[d]	<0.01[d]	<0.01[d]	<0.01[d]	<0.01[d]

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Federal and State standard.

[c] No sources of this pollutant have been identified.

[d] The concentration represents the alternative contribution only.

[e] Ozone, as a criteria pollutant is not directly emitted or monitored by the candidate site. See Section 4.1.3 for a discussion of ozone-related issues.

[f] State standard or guideline.

[g] Not Applicable.

Note: Concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from non-facility sources (for example, traffic).

Source: 40 CFR 50; DOE 1996e; DOE 1996f; NT DOE 1996a; NV DCNR 1992a; NV DCNR 1995a.

Preferred Alternative: No Action Alternative

This alternative utilizes estimated air emissions data from operations at NTS assuming continuation of site missions as described in Section 3.3. The emission rates for the criteria and toxic/hazardous pollutants for No Action are presented in Table F.1.2.3-1. Table 4.2.2.3–1 presents the No Action concentrations for the total site. Concentrations of all criteria and toxic/hazardous air pollutants at the site boundary are expected to remain within applicable Federal, State, and local ambient air quality standards.

Consolidation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

In addition to the sources of emissions during construction associated with the No Action Alternative, fugitive dust resulting from the operation of a concrete batch plant may be an additional emission source associated with a new facility.

Increases in PM_{10} concentrations may occur during the peak construction period for a new facility and during dry and windy conditions. Appropriate control measures would be followed to minimize pollutant concentrations during construction. Concentrations of all pollutants at the site boundary would remain within applicable Federal and State ambient air quality standards during construction.

During operation of the modified P-Tunnel, impacts with respect to the concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.2.3–1.

Construct New Plutonium Storage Facility

The new storage facility option would have air quality impacts similar to those of the modified P-Tunnel, with the following exceptions. During operation, emissions would be slightly lower, as shown in Appendix F. Impacts for the new storage facility option with respect to the concentrations of criteria pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this option for the storage alternative, plus the No Action concentrations, are presented in Table 4.2.2.3–1.

Collocation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

The P-Tunnel option would have slightly higher emissions than for the consolidation of Pu modified P-Tunnel, as shown in Appendix F. Impacts for this alternative are also expected to be in compliance with Federal, State, and local air quality regulations and guidelines. Estimated pollutant concentrations attributable to increased operations associated with this option for the storage alternative, plus the No Action concentrations, are presented in Table 4.2.2.3–1.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

The new storage facility option would be located in the same area as the consolidation of Pu new storage facility and would have similar air quality impacts with the following exceptions.

During operation, emissions would be slightly higher than for consolidation of Pu new storage facility option, as shown in Appendix F. Impacts for the new storage facilities option with respect to the concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this option for the storage alternative, plus the No Action concentrations, are presented in Table 4.2.2.3–1.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Air quality impacts for construction and operations for this subalternative are expected to be similar to those previously described for the Consolidation Alternative and the Collocation Alternative. [Text deleted.]

NOISE

The location of the storage facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy construction equipment and increased traffic. Increased traffic would occur onsite and along offsite local and regional transportation routes used to bring construction material and workers to the site.

Preferred Alternative: No Action Alternative

Nontraffic noise sources associated with continued interim storage and other ongoing missions would be the same as described in Chapter 3. The continuation of operations at NTS would result in no appreciable change in traffic noise and onsite operational noise sources from current levels. Nontraffic noise sources are located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may be located close enough to onsite noise sensitive areas to result in impacts, such as disturbance of wildlife.

Consolidation and Collocation Alternatives

Nontraffic, operational noise sources associated with the storage alternatives include existing or additional equipment and machines (cooling systems, vents, motors, and material handling equipment). These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Noise impacts for construction and operations for this option are expected to be almost the same as those previously described for the Consolidation Alternative and the Collocation Alternative because noise impacts are based on the use of the facility and not the size. [Text deleted.]

4.2.2.4 Water Resources

Construction and operation of the potential long-term storage facilities at NTS could affect water resources. All water required for construction and operation would be supplied from groundwater. The proposed facilities do not lie within areas historically prone to flooding. During construction, treated sanitary wastewater would be discharged to containment and sewage ponds, which would be built in accordance with applicable regulations to avoid impacts on groundwater. While the potential impacts to surface waters during the construction phase would be erosion and sedimentation, the relatively dry climate, along with the implementation of best management practices for stormwater runoff and erosion control, should preclude these potential impacts. No excess wastewater would be discharged to surface waters during the operation of the facilities, so no impacts to surface water quality are expected. Stormwater runoff would be collected and treated, if necessary, before discharge to natural drainage channels. [Text deleted.] Table 4.2.2.4–1 presents No Action water resources uses and discharges and the potential changes to water resources at NTS resulting from the long-term storage alternatives.

Preferred Alternative: No Action Alternative

Surface Water. A description of the activities that would continue at NTS is provided in Section 3.3.4. Under this alternative, no impacts to surface water resources are anticipated because there are no surface water withdrawals, offsite surface drainage system, or publicly owned treatment works. Treated wastewater discharged to evaporation/infiltration ponds is expected to continue at a rate of 82 million l/yr (21.7 million gal/yr). Contamination that has occurred from past practices and is limited to onsite areas would continue to be characterized and remediated.

Groundwater. Under this alternative, no additional impacts to groundwater availability or quality are anticipated. Baseline conditions and operations, described in Section 3.3 would continue at NTS. Current groundwater usage of 2,400 million l/yr (634 million gal/yr) is not anticipated to increase by the year 2005. Groundwater would continue to be withdrawn from local groundwater sources. No additional impacts to groundwater quality are anticipated since there are no direct discharges to groundwater.

Consolidation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Surface Water. No surface water would be withdrawn during construction or operation of the proposed facilities. Consequently, impacts to surface water availability and quality are not expected. Approximately 7.8 million l/yr (2.1 million gal/yr) of nonhazardous wastewater would be generated during construction and subsequently treated, and discharged to evaporation/infiltration ponds that would be designed to minimize seepage. No impacts to surface water from these discharges are expected, because wastewaters are not discharged to natural flowing surface water bodies.

[Text deleted.]

During operation, utility, process, and sanitary wastewater from the proposed facilities would be treated and recycled. Treated effluent would be monitored to comply with discharge permit limits. The extent to which treated effluent or stormwater would be recycled for reuse within the plant would be determined during site-specific studies.

[Text deleted.]

There have been no studies conducted to assess the 500-year floodplain at NTS. However, information on the location of the 500-year floodplain could be developed as part of the siting process. Studies of the 100-year

Table 4.2.2.4–1. No Action and Potential Changes to Water Resources at Nevada Test Site—No Action (2005) and Storage Alternatives

Affected Resource Indicator	No Action	Consolidation		Collocation	
		Modify P-Tunnel	New Storage Facility	Modify P-Tunnel	New Storage Facilities
Water Source	Ground	Ground	Ground	Ground	Ground
Construction					
Water Availability and Use					
Total water requirement (million l/yr)	NA[a]	35	85	35	104.7
Percent increase in projected water use[b]	NA[a]	1.5	3.5	1.5	4.4
Water Quality					
Wastewater discharge (million l/yr)	NA[a]	7.8	7.8	8.7	11.8
Percent change in wastewater discharge[c]	NA[a]	9.5	9.5	10.6	14.4
Operation					
Water Availability and Use					
Total water requirement (million l/yr)	2,400	130	110	190	150
Percent increase in projected water use[d]	0	5.4	4.6	7.9	6.3
Water Quality					
Total wastewater discharge (million l/yr)	82	0	0	0	0
Percent change in wastewater discharge[e]	0	0	0	0	0
Floodplain					
Is action in 100-year floodplain?	NA	No	No	No	No
Is critical action in 500-year floodplain?	NA	Unlikely	Unlikely	Unlikely	Unlikely

[a] See operations section of table for No Action water data.

[b] Percent increases in water requirements during construction at NTS are calculated by dividing No Action water requirements (2,400 million l/yr) with that for each storage option: modified P-Tunnel drift (35 million l/yr), new Pu storage facility (85 million l/yr), modify P-Tunnel drifts (35 million l/yr), and new Pu and HEU storage facility (104.7 million l/yr).

[c] Percent changes in wastewater discharged during construction at NTS are calculated by dividing No Action wastewater discharges (82 million l/yr) with that for each storage option: modified P-Tunnel drift (7.8 million l/yr), new Pu storage facility (7.8 million l/yr), modify P-Tunnel drifts (8.7 million l/yr), and new Pu and HEU storage facility (11.8 million l/yr).

[d] Percent increases in water requirements during operation at NTS are calculated by dividing No Action water requirements (2,400 million l/yr) with that for each storage option: modified P-Tunnel drift (130 million l/yr), New Pu storage facility (110 million l/yr), modify P-Tunnel drifts (190 million l/yr), and new Pu and HEU storage facility (150 million l/yr).

[e] Percent changes in wastewater discharged during operation at NTS are calculated by dividing No Action wastewater discharges (82 million l/yr) with that for each storage option: modified P-Tunnel drift (0 l/yr), new Pu storage facility (0 l/yr), modify P-Tunnel drifts (0 l/yr), and new Pu and HEU storage facility (0 l/yr).

Note: NA=not applicable.

Source: DOE 1996e; DOE 1996f; NT DOE 1996a; NTS 1993a:4.

floodplain showed it to be confined to the Jackass Flats and Frenchman Lake areas. The proposed site for the new Pu storage facilities is outside these areas. However, since NTS is in a region where most flooding occurs by locally intense thunderstorms that can create brief (less than 6 hours) flash floods, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater via the existing supply system. The Lower and Upper Carbonate, the Volcanic, and the Valley-Fill Aquifers are the source of water for operations at NTS. Groundwater required for construction (35 million l/yr [9 million gal/yr]) and operation (130 million l/yr [34.3 million gal/yr]) would represent a 1.5- and 5.4-percent maximum increase, respectively, over the projected No Action 2005 groundwater withdrawal, and 0.09- and 0.3-percent, respectively, of the minimum estimated annual recharge to the regional aquifer under the entire NTS. This is based on several studies conducted in recent years, which estimated recharge to be 38 to 57 billion l (10 to 15 billion gal). These amounts would also be within NTS's allotment and would not be expected to cause depletion of the aquifer. Groundwater required for both construction and operation and the percent increase in projected water use is shown in Table 4.2.2.4–1.

Construction and operation of the potential modified P-Tunnel drifts would not result in direct discharges to groundwater. Recycling of all treated wastewater is expected. However, if treated wastewater generated during construction was discharged to disposal ponds it could percolate downward into the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged until contaminant levels are within the limits specified. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates. Similarly, some stormwater runoff and other discharges routed to storm drains could percolate into the subsurface. These discharges would be monitored and no impacts to groundwater quality are expected.

Construct New Plutonium Storage Facility

Surface Water. There are no unique construction characteristics associated with water requirements and discharges from a new Pu storage facility. No surface water would be withdrawn for any construction or operation activities associated with any of the proposed facilities. Therefore, there would be no impacts to surface water availability. During the construction phase, approximately 7.8 million l/yr (2.1 million gal/yr) of nonhazardous wastewater would be generated. This treated wastewater would be discharged to evaporation/infiltration ponds. No impacts to surface water from these discharges are expected, because wastewaters are not discharged to natural flowing surface waterbodies.

[Text deleted.]

During operation, utility, process, and sanitary wastewater from the proposed facilities would be treated and recycled to the cooling tower and/or boiler. Cooling system blowdown is directed to the utility wastewater treatment facility and is also recycled for use as cooling tower makeup. Treated effluent would be monitored to comply with discharge permit limits. Floodplain issues are the same as described for the previous alternative.

[Text deleted.]

Groundwater. All water required for construction and operation would be supplied from groundwater via the existing supply system. Groundwater required for both construction and operation and the percent increase in projected water use are shown in Table 4.2.2.4–1 for operations at NTS.

Construction and operation water requirements for the proposed facilities (85 million l/yr [22.5 million gal/yr], and 110 million l/yr [30 million gal/yr]) represent approximately 0.2 and 0.3 percent of the minimum estimated annual recharge (38 billion l [10 billion gal]) to the regional aquifer under the entire NTS. As shown in Table 4.2.2.4–1, the quantities of water required for construction and operation of the proposed facilities

represent approximately 3.5- and 4.6-percent increases over the projected No Action groundwater usage. These small increases boost the total projected groundwater withdrawal to less than 7 percent of the estimated annual recharge; there should be no impact on groundwater availability.

Construction and operation of the proposed consolidated Pu storage facilities would not result in direct discharges to groundwater. Recycling of all treated wastewater is expected. However, if treated wastewater generated during construction was discharged to disposal ponds it could percolate downward into the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged until contaminant levels are within the limits specified. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates. Impacts to groundwater quality are therefore not expected.

Similarly, some stormwater runoff and other discharges routed to storm drains could percolate into the subsurface. These discharges would be monitored under the State of Nevada stormwater regulations and therefore no impacts to groundwater quality are expected.

Collocation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Surface Water. Under this alternative, modifying the P-Tunnel would increase water discharges by 10.6 percent over the projected No Action discharge during construction. During operations, wastewater would be recycled. All other wastewater requirements of the option would be similar to modifying P-Tunnel under the Consolidation Alternative.

Groundwater. During construction, the Pu and HEU storage upgrade using the P-Tunnel would require 35 million l/yr (9.2 million gal/yr) of groundwater, or a 1.5-percent increase over projected No Action water use. During operations, 190 million l/yr (50.2 million gal/yr) of water would be required, a 7.9-percent increase over the projected No Action water use, representing 0.5 percent of the minimum estimated recharge. All other water requirements of the option are identical to those discussed previously for modifying the P-Tunnel.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Since the new Pu and HEU collocated storage facilities would be located in the same area as the new Pu storage facility, the impacts associated with them are similar to those previously discussed for the Consolidation New Storage Facility Alternative, with the following exceptions. Sanitary wastewater quantities generated during construction would be greater than for the new storage facility option and are approximately 11.8 million l/yr (3.1 million gal/yr). These effluents would be discharged to evaporation/infiltration ponds under a State of Nevada permit. No impacts are expected. During operations, wastewater would be recycled. The groundwater requirements for construction of this option are greater than those for the previous option. This option would require approximately 104.7 million l/yr (27.7 million gal/yr) and 150 million l/yr (39.6 million gal/yr) for construction and operation, respectively. These additional requirements represent 4.4- and 6.3-percent increases, respectively, in the projected No Action groundwater withdrawals. These amounts increase the total projected site groundwater withdrawal to less than 7 percent of the estimated annual recharge; there should be no impact on groundwater availability.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Water resource impacts for construction and operation of this option are expected to be slightly less than those described for the Consolidation Alternative and the Collocation Alternative because of the reduction in the amount of material. [Text deleted.]

4.2.2.5 Geology and Soils

Construction and operation of the alternatives at NTS would have no effect on the geologic resources. A moderate seismic risk exists, but would be considered in the design of the proposed alternatives. The existing seismic risk does not preclude the safe construction and operation of the proposed alternative facilities. The facilities would be designed for earthquake-generated ground accelerations, in accordance with DOE O 420.1, *Facility Safety*. The Yucca and Carpet Bag faults are considered to be capable faults and represent a potential for ground rupture as a result of an earthquake. However, ground shaking is more likely in the areas of the proposed alternatives. Intensities of approximately VII on the MMI scale are possible at NTS. A peak ground acceleration of 0.67 g with a Richter magnitude of 6.7, has been estimated for the Cane Spring fault, with a recurrence interval of 10,000 to 30,000 years. This could affect the integrity of inadequately designed or nonreinforced structures but should not affect newly designed facilities. Human health effects form accidents initiated by natural phenomenon (for example, earthquakes) are discussed in Section 4.2.2.9. Volcanic activity is improbable during the life of the alternatives and is not anticipated to affect the construction and operation of the alternatives. The most likely risk to NTS is possible ash fall from the Long Valley, California area located approximately 214 km (150 mi) to the west-northwest. Lava extrusions from sources at NTS could recur but are unlikely. Precursors, such as shallow earthquakes, gas venting activity, and an increase in groundwater temperatures provide advance warning of most eruptions of this type; no such activity is currently indicated at NTS. It is unlikely that landslides, sinkhole development, or other nontectonic events would affect project activities. Slopes and underlying foundation materials are generally considered stable. Properties and conditions of the soils typical of NTS have no limitation on construction. Soils would be affected by construction and operations of a proposed alternative.

None of the sites has known economically viable geologic resources that would be affected by the construction and operations of an alternative. Except for the potential existence of gold, tungsten, and molybdenum at NTS, geologic resources consist of surficial sand, gravel, or clay deposits that have low economic value. New construction may increase the use of the materials, but because large volumes of these materials are present, consequently the impact is anticipated to be negligible.

Construction of the proposed alternative facilities may involve ground-disturbing activities that could affect the soil resource. The amount of land disturbed is specified below for each alternative. Impacts would depend on the specific soil units in the disturbed area, the extent of the land disturbing activities, and the amount of soil disturbed. Within NTS, the soil erosion potential is directly related to the amount of land disturbed because soil and climatic conditions are similar throughout the site. Control measures would be employed during construction to minimize soil erosion.

Preferred Alternative: No Action Alternative

[Text deleted.]

Impacts to geologic and soil resources occur during, or as a result of, ground-disturbing construction activities. Under the No Action Alternative, DOE would continue current and ongoing activities at NTS. There would be no ground-disturbing activities beyond those associated with existing and future site improvements. Because new construction and the associated ground disturbance for potential soil erosion would not occur, the No Action Alternative would have no effect on the geologic or soil resources at the site.

Consolidation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

No apparent direct or indirect effects on the geologic resource are anticipated, because neither facility construction and operational activities nor site infrastructure improvements will restrict access to potential geologic resources. Design of the facilities would ensure that they would not be affected by potentially hazardous geological conditions.

[Text deleted.] Construction activities will occur completely on previously disturbed land, as described in Section 4.2.2.1 and involve land disturbance of approximately 29 ha (72 acres) that will affect the soil profile and potentially cause a temporary increase in soil erosion. Soil disturbance would occur primarily from ground-disturbing construction activities (foundation preparation) and activities associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rainstorm wind velocities (increased velocities and durations increase potential erosion); the frequency and severity of storms; and the size, location, and duration of ground-disturbing activities.

Net soil disturbance during operations would be considerably less than during construction because areas temporarily used for construction laydown would be restored. Although stormwater runoff and wind action could occur during operation, it is anticipated to be minimal. [Text deleted.]

Construct New Plutonium Storage Facility

Construction and operation effects on geologic resources for the storage facility are the same as those described for the modified P-Tunnel. However, additional soil impacts would be expected from the construction of the storage facility which will occur completely on previously disturbed land as described in Section 4.2.2.1. Approximately 58.5 ha (144 acres) would be disturbed for construction of the new facility, affecting the soil profile and leading to a possible temporary increase in soil erosion as a result of stormwater runoff and wind action. Soil losses would depend on frequency of storms, wind velocity, and location of the facility with respect to drainage and wind patterns; slope, shape, and area of the tracts of ground disturbed; and the duration of time the soil is bare. Soil impacts during operation are expected to be minimal.

Collocation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Construction and operation effects on geological and soil resources for this alternative are the same as those discussed previously for the Consolidation Alternative using the modified P-Tunnel. Construction will occur completely on previously disturbed land, as described in Section 4.2.2.1, and involve land disturbance of approximately 29 ha (72 acres).

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

[Text deleted.] Additional soil impacts would be anticipated from the construction of the storage facilities which will occur completely on previously undisturbed land, as described in Section 4.2.2.1. Approximately 89.5 ha (221 acres) would be disturbed for construction of the Collocation Alternative, affecting the soil profile and leading to a possible temporary increase in soil erosion as a result of storm water runoff and wind action. Soil losses would depend on frequency of storms, wind velocity, and location of the facility with respect to drainage and wind patterns; slope, shape, and area of the tracts of ground disturbed; and the duration of time the soil is exposed. Soil impacts during operation are expected to be minimal.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Exclusion of strategic reserve and weapons R&D materials would give almost the same effects to the geologic and soil resources for the Consolidation Alternative and Collocation Alternative. By excluding these materials, the size of a facility would be similar, thus not changing the amount of land disturbed by construction activities. No effect to the geologic resource is anticipated as a result of this option. [Text deleted.]

[Text deleted.]

4.2.2.6 Biological Resources

Preferred Alternative: No Action Alternative

The missions described in Section 2.2.2 would continue at NTS. This would result in no changes to current conditions of biological resources at NTS as described in Section 3.3.6.

Consolidation Alternative

Consolidated storage facilities would be located in modified P-Tunnel drifts or in new facilities in the Frenchman Flat area.

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Terrestrial Resources. If consolidated storage facilities were located within the modified P-Tunnel area, existing and new facilities would be required at both the modified P-Tunnel site itself and the Area 12 Camp. Modification of existing structures would have minimal impact on terrestrial resources. New construction would also have minimal impact, because construction would take place within presently developed areas. The material handling facility, which is the principal structure to be built, would be located in an area on which excavated material from the modified P-Tunnel was deposited. Foundation preparation would require some additional soil, which would be imported from other as-yet-unspecified areas of NTS. If this material was excavated from a new borrow pit, terrestrial resources at the location could be affected. Construction and operation could result in disturbance to wildlife by noise and human activity, but impacts to wildlife would be minimal because animals would have already adjusted to ongoing activities.

Wetlands. Construction and operation of consolidated storage facilities would not affect wetlands since there are no wetlands in the vicinity of the modified P-Tunnel.

Aquatic Resources. Construction and operation of consolidated storage facilities would not affect aquatic resources since there are no permanent surface water bodies in the vicinity of the modified P-Tunnel.

Threatened and Endangered Species. Construction and operation of consolidated storage facilities would have minimal effect on threatened and endangered species in the modified P-Tunnel area since the habitat is already disturbed. The range of the federally listed threatened desert tortoise does not extend to the modified P-Tunnel area. Site surveys would be performed as necessary to determine the presence of special status species. Consultation with USFWS and State agencies would be conducted at the sit-specific levels, as appropriate.

Construct New Plutonium Storage Facility

Under this alternative, Pu would be consolidated in a new storage facility located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction of the consolidated Pu storage facility at NTS would result in the disturbance of 58.5 ha (144 acres) of terrestrial resources, or less than 0.02 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the proposed project area, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land-clearing operations. Creosote bush communities are well represented on NTS.

Construction of the Pu storage facility would affect animal populations. Less-mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby.

If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources, which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the proposed site may not survive. The site would be surveyed as necessary for the nests of migrating birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas. Impacts to vegetation from salt drift would not occur since dry cooling systems would be used.

Wetlands. Construction and operation of the Pu storage facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the Pu storage facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The desert tortoise is a federally listed threatened species that could be affected by construction of the Pu storage facility at NTS. Construction activities such as land-clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicular traffic is an additional hazard to the tortoise. Measures from previous projects at NTS designed to avoid impacts to the desert tortoise have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training; putting restrictions on vehicle speeds and off-road movement; conducting clearance surveys prior to surface disturbance; approving stop work authority if tortoises are found within work areas; removing tortoises from roadways and work areas; placing permanent and temporary tortoise-proof fencing around trenches, landfills, and treatment ponds; inspecting trenches; and having biologists present when heavy equipment is in use. The USFWS would be consulted, and similar USFWS recommendations would be implemented should NTS be selected as the location for the Pu storage facility.

[Text deleted.] Any listed plant species located within the construction area could be lost or affected during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the presence of these species in the area to be disturbed. Consultation with USFWS and State agencies would be conducted at the site-specific levels, as appropriate.

During facility operation, vehicular traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole are not expected to change due to operation of the Pu storage facility (Section 4.2.2.4), so impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Collocation Alternative

Under this alternative, consolidated Pu would be stored with HEU inventories in existing and new facilities in the modified P-Tunnel area or in a new collocated Pu storage facility sited at the same location as the consolidated storage facility.

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Impacts to biological resources from placing collocated storage facilities in modified P-Tunnel drifts would be similar to those described previously for consolidated storage facilities. This is because both facilities are of a similar size and both would be placed within developed portions of the P-Tunnel site and Area 12 Camp.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction and operation of a collocated storage facility at the Frenchman Flat area of NTS would have similar, but somewhat greater effects on biological resources as those described for the consolidated storage facility. Construction of the collocated storage alternative would disturb 89.5 ha (221 acres) of habitat.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve and weapons R&D materials would have almost the same effects to the Consolidation Alternative and the Collocation Alternative. The size of facility would be similar and would not result in the reduction of disturbed habitat and/or fewer facility modifications and thus lessen the potential impacts to biological resources would be similar. [Text deleted.]

4.2.2.7 Cultural and Paleontological Resources

Preferred Alternative: No Action Alternative

Under this alternative, DOE would continue the existing and planned missions at NTS. Management of NTS's cultural resources follows the Programmatic Agreement between DOE, the Nevada SHPO, and the Advisory Council on Historic Preservation. Any impacts to cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate NHPA, *American Indian Religious Freedom Act*, and *Native American Graves Protection and Repatriation Act* regulatory compliance procedures.

Consolidation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

The existing P-Tunnel is located in Area 12. Modification would result in ground disturbance of 29 ha (72 acres) on previously disturbed land. No new, undisturbed land would be used. The P-Tunnel is on Rainier Mesa, in Area 12. In 1990, DOE entered into a Programmatic Agreement with the Nevada SHPO and the Advisory Council on Historic Preservation that has resulted in an in-depth cultural resources study of 11 percent of Pahute and Rainier Mesas. Additional surveys would be completed prior to construction on any currently unexamined tracts. This area is rich in cultural resources, including many archaeological sites. Construction of the proposed facility may affect some potentially NRHP-eligible resources. Recorded prehistoric sites in the area include quarries, lithic workshops, campsites, and rock shelters. Historic site types include remains of ranches and mines. Operation would not have an additional impact on prehistoric or historic resources. Some paleontological resources may also be affected by land disturbance during construction. Operation would not result in additional impacts to those resources.

The CGTO is an alliance of Native American groups that have ties to the land at NTS. This alliance has in the past requested and been denied access to Rainier Mesa. Consequently, no important Native American resources have been identified there to date. Oral histories indicate that some resources, such as ancestral campsites, are located within Rainier Mesa (NT DOE 1996c:4-169). Additional Native American resources such as archaeological sites, traditionally used plant and animal species, and rock art may be affected by both the construction and operation of the proposed facility. Consultation with interested parties during the *American Indian Religious Freedom Act*, *Native American Graves Protection and Repatriation Act*, and NHPA compliance process may identify some of these resources.

Construct New Plutonium Storage Facility

The new Pu storage facility would be situated in the northern portion of Frenchman Flat in Area 6, near the DAF. The operational land requirement for the proposed facility is 56 ha (138 acres). Some new construction would be necessary. Land to be disturbed during construction totals 58.5 ha (144 acres). A 1.6-km (1-mi) reduced-access buffer zone would be created around the facility.

[Text deleted.] In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acres) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites that have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources.

Impacts to resources could occur during construction of the proposed facility. Operation would not result in additional impact as it does not involve ground disturbance or increased activity. In addition, construction (but not operation) may have some impact on Late Pleistocene paleontological resources, should any exist within the acreage to be disturbed.

The CGTO has conducted surveys over portions of Frenchman Flat. The area is known to contain at least 20 plant species of importance to Native Americans. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from the construction and operation of the proposed facility. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Collocation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handing Building at the P-Tunnel

Potential impacts under this option would be the same as the P-Tunnel discussion under the Consolidation Alternative.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction of the proposed Pu and HEU storage facility would disturb 89.5 ha (221 acres) of land; operation would require 87 ha (215 acres). A 1.6-km (1-mi) reduced-access buffer zone would be created around the facility. The proposed location is contained within Area 6 near the DAF. Impacts to cultural and paleontological resources would be similar to those discussed under the new storage facility option of the Consolidation Alternative.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, facility and other resource requirements will be almost the same as the Consolidation and Collocation Alternative. Therefore, impacts to cultural and paleontological resources would equal those previously discussed. [Text deleted.]

4.2.2.8 Socioeconomics

Preferred Alternative: No Action Alternative

Under this alternative, the existing storage facility would remain operational. No new employment or in-migration of workers would be required.

Regional Economy Characteristics. Total employment in the REA is projected to grow 3.4 percent annually between 1995 and 2000, reaching 686,800 in the latter year. Slower growth is projected after the year 2000, when employment will increase 2 percent annually and reach approximately 1,236,600 in 2040. Unemployment in the REA was 6.1 percent in 1994 and is expected to remain at this level into the near future. Per capita income is projected to increase from approximately $21,900 in 1995 to $46,134 in 2040. No Action projections are presented in Table L.1–19.

Population and Housing. Population in the ROI is projected to total 990,700 in 1995 and reach 2,087,000 by 2040. Over the same period, the total number of housing units in the ROI is projected to increase from 403,700 to 850,500. No Action projections for population and housing are presented in Tables L.1–20 and L.1–21, respectively.

Community Services. Education, public safety, and health care characteristics are used to assess the level of community services in the NTS ROI. School enrollments are projected to increase from approximately 165,630 students in 1995 to 348,920 students by 2040. In 1994, the student-to-teacher ratio was 19.6:1. To maintain this level of service, the number of teachers in the ROI would need to increase from 8,466 in 1995 to 17,833 in 2040. No Action projections are presented in Tables L.1–22 and L.1–23.

The projected number of sworn police officers and firefighters serving ROI communities during the period 1995 to 2040 is shown in Tables L.1–24 and L.1–25, respectively. Under No Action, the number of sworn police officers is projected to increase from 1,946 in 1995 to 4,101 in 2040 to maintain the current service level of 2.0 officers per 1,000 persons. The number of firefighters in the ROI is estimated to increase from 1,553 in 1995 to 3,271 in 2040 to maintain the current service level of 1.6 firefighters per 1,000 persons.

Hospital occupancy rates are based on current capacity. Projections of hospital occupancy rates and the number of practicing physicians serving the ROI population between 1995 and 2040 are presented in Tables L.1–26 and L.1–27, respectively. Without expansion of existing capacity, hospital occupancy rates for the ROI would increase from 62 percent in 1995 to over 100 percent in 2040. If the 1994 physician-to-population ratio of 1.3 physicians per 1,000 persons is to be maintained, the total number of physicians would need to increase from 1,276 in 1995 to 2,704 in 2040.

Local Transportation. The worker population at NTS would not increase and could decrease. Any increases in traffic would be due to the projected growth in the area unrelated to DOE activities. [Text deleted.]

Consolidation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Modification of the existing P-Tunnel at NTS to consolidate the storage of Pu would require 1,103 workers during the peak construction year and would generate over 2,100 jobs (direct and indirect) in the region. Operation of the facility would generate over 1,400 jobs (direct and indirect) in the region. Projections indicate that there would be sufficient labor available within the region to fill all direct and indirect jobs during both construction and operations.

Regional Economy Characteristics. A total of 2,139 (1,103 direct and 1,036 indirect) jobs would be created in the region during the construction of the facility. Employment in the region would increase by less than 1 percent, and the unemployment rate would fall from the No Action projection of 6.1 percent to 5.8 percent. Per capita income would increase by less than 1 percent (Socio 1996a).

Operation of the facility would generate a total of 1,406 jobs (527 direct and 879 indirect) in the region, increasing regional employment by less than 1 percent. Operation workers would begin phasing in as construction nears completion. Unemployment would rise from 5.8 percent during peak construction to 5.9 percent during operation but remain below the No Action level of 6.1 percent (Socio 1996a).

Population, Housing, and Community Services. All newly created jobs would be filled by the resident labor force. Therefore, there would be no change to the region's population from the No Action projections. Accordingly, there would be minimal impacts to the demand for housing or community services in the region as a result of the construction and operation of this facility (Socio 1996a).

Local Transportation. During the peak construction year, workers would generate 2,118 vehicle trips per day. During operations, workers would generate 1,012 vehicle trips per day. These increases would not affect the level of service on the local road segments analyzed (Socio 1996a).

Construct New Plutonium Storage Facility

Construction of a new facility for the consolidated storage of Pu at NTS would generate over 2,100 jobs (direct and indirect) within the REA. Operation would generate over 1,300 jobs (direct and indirect) in the region. Projections indicate that there would be sufficient available labor in the region to fill all of the direct and indirect jobs. [Text deleted.]

[Text deleted.]

Regional Economy Characteristics. During the construction period, the project would add a total of 2,122 (1,094 direct and 1,028 indirect) jobs to the regional economy that would be filled by the labor available within the region. The regional unemployment rate would decrease from 6.1 percent to 5.8 percent, while per capita income would increase minimally (much less than 1 percent) (Socio 1996a).

The consolidated storage facility at NTS would create 1,313 jobs (492 direct and 821 indirect) during full operation, increasing total employment in the REA by much less than 1 percent over the No Action projection. Available labor would fill all of the indirect positions. However, some workers would need to in-migrate to fill specialized direct employment requirements. Operation workers would begin phasing in as construction nears completion. Unemployment would rise from 5.8 percent during peak construction to 6.0 percent during operation but would remain below the No Action level of 6.1 percent. Per capita income would increase minimally (much less than 1 percent) (Socio 1996a).

Population, Housing, and Community Services. All newly created jobs would be filled by the resident labor force. Therefore, there would be no change to the region's population from the No Action projections. Accordingly, there would be minimal impact to the demand for housing or community services in the region as a result of the construction and operation of this facility. [Text deleted.]

[Text deleted.]

Local Transportation. Construction workers would generate a projected 2,100 vehicle trips per day during peak construction activity. During operations, workers would generate 945 vehicle trips per day. These increases would not affect the level of service on the local road segments analyzed (Socio 1996a).

Collocation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Modification of the existing P-Tunnel at NTS to consolidate the storage of all Pu and HEU would generate a total of over 2,500 jobs (direct and indirect) during the construction phase. Projections indicate that there would be sufficient labor available within the region to fill these positions. However, operations of the upgraded facility, which would generate over 1,700 total jobs (direct and indirect), would require some workers to relocate to the area to fill specialized employment requirements. Available labor within the REA would fill all of the indirect jobs created during the operation phase. The impacts on the region's economy, population, housing, community services, and local transportation are discussed below.

Regional Economy Characteristics. Modification of the existing P-Tunnel would require 1,297 workers during the peak construction year and would generate an additional 1,218 jobs in other industries within the REA. The available labor force within the region would be sufficient to fill all the direct and indirect jobs created. Employment in the REA would increase by less than 1 percent over No Action, and the unemployment rate would fall from the No Action projection of 6.1 percent to 5.8 percent. Per capita income would increase by less than 1 percent (Socio 1996a).

Operation of the facility would require 641 new employees and would generate an additional 1,069 indirect jobs within the REA. Available labor within the REA would fill all of the indirect positions, however, some workers would have to in-migrate to fill specialized direct employment requirements. Total employment and per capita income in the region would both increase by much less than 1 percent over No Action projections. Operation workers would begin phasing in as construction nears completion. Unemployment would rise from 5.8 percent during peak construction to 5.9 percent during operation but would remain below the No Action level of 6.1 percent (Socio 1996a).

Population and Housing. During full operation of the upgraded facility, in-migration is projected to increase population in the ROI by 73 over the No Action Alternative, a change of much less than 1 percent of total population. Projected vacancies in the housing stock would be sufficient to accommodate the slight increase in demand (Socio 1996a).

Community Services. Because there would be no in-migration associated with construction of the upgraded facility, and the population change resulting from operations is so small, the demand for community services would remain unchanged from No Action projections (Socio 1996a). [Text deleted.]

[Text deleted.]

Local Transportation. Construction workers would generate a projected 2,490 vehicle trips per day in the year 2001 (the peak construction year) under this alternative. Operation workers would generate 1,231 vehicle trips per day. These increases would not affect the level of service on the local road segments analyzed (Socio 1996a).

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction of a new facility to store all Pu and HEU would generate almost 2,200 jobs (direct and indirect) in the region. Operation of the facility would generate over 1,600 jobs. Projections indicate that workers would in-migrate to the REA to fill some of the direct jobs created during the operation of a new consolidated Pu and HEU storage facility at NTS. However, there would be sufficient available labor in the REA to fill both the

indirect jobs created during operation and all employment generated by the construction of the facility. The effects on the region's economy, population, housing, community services, and local transportation are discussed below.

Regional Economy Characteristics. Construction of the new consolidated Pu and HEU storage facility would generate 1,123 direct and 1,055 indirect jobs during peak construction at NTS. Total employment in the region would increase by less than 1 percent, and the unemployment rate would decrease from the No Action projection of 6.1 percent to 5.8 percent. Per capita income would increase by much less than 1 percent (Socio 1996a).

Operation of the proposed storage facilities would generate a total of 1,659 new jobs (622 direct and 1,037 indirect) in the REA, with some direct jobs filled by in-migrant workers. All of the indirect positions would be filled by available labor in the REA. Total employment in the region would increase by less than 1 percent over the No Action projection. Operation workers would begin phasing in as construction nears completion. Unemployment would rise from 5.8 percent during peak construction to 5.9 percent during operation but remain below the No Action level of 6.1 percent. Per capita income would increase much less than 1 percent (Socio 1996a).

Population and Housing. Although 22 workers would in-migrate to the REA during the operation phase of the proposed storage facilities, the resulting change to population would be less than a 1 percent increase over No Action. Projected housing vacancies would be sufficient to accommodate demand from the in-migrating population (Socio 1996a).

Community Services. Because there would be no in-migration associated with construction of the facility, and the population change from operations is so small, the demand for community services would remain unchanged from No Action projections (Socio 1996a).

[Text deleted.]

Local Transportation. Construction employees would generate 2,156 vehicle trips per day. Operation employees would generate an estimated 1,194 vehicle trips per day. These increases would not affect the level of service on the local road segments analyzed (Socio 1996a).

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

If strategic reserve and weapons R&D materials are not included in the storage requirements at NTS, there would be a small reduction in worker requirements for construction and operation of the facility. Therefore, the socioeconomic effects would be less than those options including strategic reserve and weapons R&D for the Consolidation Alternative and the Collocation Alternative. [Text deleted.]

4.2.2.9 Public and Occupational Health and Safety

The assessments of potential radiological and chemical impacts associated with the storage alternatives at NTS are presented in this section. Summaries of radiological impacts from normal operations are presented in Tables 4.2.2.9–1 and 4.2.2.9–2 for the public and workers, respectively. Impacts from hazardous chemicals are presented in Table 4.2.2.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.2.2.9–4 through 4.2.2.9–7. Detailed results are presented in Appendix M.

Preferred Alternative: No Action Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from normal operations involved with the sitewide NTS missions. The radiological and chemical source terms (releases) under the No Action Alternative are taken to be the same as for the existing baseline condition; the resulting impacts would be within applicable regulatory limits. For facility accidents, the risks and consequences are described in site safety documentation.

Normal Operation. The doses and potential health effects on the public and workers during normal operations are described below.

Radiological Impacts. The calculated annual dose to the average and maximally exposed members of the public from total site operation; the associated fatal cancer risks to these individuals from 50 years of operation; the dose to the population within 80 km (50 mi) from total site operation in the year 2030; and the projected number of fatal cancers in this population from 50 years of operation are presented in Table 4.2.2.9–1 under this alternative at NTS. The annual dose of 4.2×10^{-3} mrem to the MEI is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.0×10^{-7}. This activity would be included in a program to ensure that doses to the public are ALARA. The annual dose of 3.7×10^{-3} person-rem to the population would be within the limit in proposed 10 CFR 834. The corresponding number of fatal cancers in this population from 50 years of operation would be 9.3×10^{-5}. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

Under the No Action Alternative, as shown in Table 4.2.2.9–2, the annual average dose to a noninvolved (No Action) site worker and the annual dose to the noninvolved (No Action) total site workforce would be 5.0 mrem and 3.0 person-rem, respectively. The associated risk of fatal cancer to the average worker from 50 years of total site operations would be 1.0×10^{-4} and the projected number of fatal cancers among all workers from 50 years of total site operations would be 0.060.

Hazardous Chemical Impacts. There would be no hazardous chemical impacts shown in Table 4.2.2.9–3 on the public or to workers resulting from the normal operation under No Action at NTS because no hazardous or other carcinogens are released.

Facility Accidents. Under the No Action Alternative, facilities would continue to operate in accordance with DOE safety orders, which ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations will be minimized. The safety to workers and the public from accidents at existing facilities is also controlled by Technical Safety Requirements specified in detail in SARs or a Basis for Interim Operations document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities would cause a halt in operations until it can be established that worker and public safety has not been compromised.

Table 4.2.2.9–1. Potential Radiological Impacts to the Public During Normal Operation at Nevada Test Site—No Action and Storage Alternatives

	No Action	Consolidation				Collocation
		Modify P-Tunnel		New Storage Facility		
Receptor	Total Site	Facilities	Total Site[a]	Facility	Total Site[a]	
Annual Dose to the Maximally Exposed Individual Member of the Public[b]						
Atmospheric release pathway (mrem)	4.2×10^{-3}	5.6×10^{-6}	4.2×10^{-3}	1.3×10^{-6}	4.2×10^{-3}	c
Drinking water pathway (mrem)	0	0	0	0	0	c
Total liquid release pathway (mrem)	0	0	0	0	0	c
Atmospheric and liquid release pathways combined (mrem)	4.2×10^{-3}	5.6×10^{-6}	4.2×10^{-3}	1.3×10^{-6}	4.2×10^{-3}	c
Percent of natural background[d]	1.3×10^{-3}	1.8×10^{-6}	1.3×10^{-3}	4.2×10^{-7}	1.3×10^{-3}	c
50-year fatal cancer risk	1.0×10^{-7}	1.4×10^{-10}	1.0×10^{-7}	3.2×10^{-11}	1.0×10^{-7}	c
Population Dose Within 80 Kilometers for Year 2030[e]						
Atmospheric release pathway (person-rem)	3.7×10^{-3}	1.7×10^{-6}	3.7×10^{-3}	2.6×10^{-6}	3.7×10^{-3}	c
Total Liquid Release Pathway (person-rem)	0	0	0	0	0	c
Atmospheric and liquid release pathways combined (person-rem)	3.7×10^{-3}	1.7×10^{-6}	3.7×10^{-3}	2.6×10^{-6}	3.7×10^{-3}	c
Percent of natural background[d]	4.0×10^{-5}	1.8×10^{-8}	4.0×10^{-5}	2.8×10^{-8}	4.0×10^{-5}	c
50-year fatal cancers	9.3×10^{-5}	4.3×10^{-8}	9.3×10^{-5}	6.5×10^{-8}	9.3×10^{-5}	c
Annual Dose to the Average Individual Within 80 Kilometers[f]						
Atmospheric and liquid release pathways combined (mrem)	1.3×10^{-4}	5.8×10^{-8}	1.3×10^{-4}	8.8×10^{-8}	1.3×10^{-4}	c
50-year fatal cancer risk	3.1×10^{-9}	1.4×10^{-12}	3.1×10^{-9}	2.2×10^{-12}	3.1×10^{-9}	c

[a] Includes impacts from No Action (Baseline) facilities. The location of the MEI may be different under No Action than for the other alternatives. Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The impacts for both the new storage facility and the new and modified P-Tunnel Drifts under the Collocation of Pu Storage would be virtually the same as for these two options under the Consolidation of Pu Storage. This is because the HEU contributes a negligible dose to the public.

[d] The annual natural background radiation level at NTS is 313 mrem for the average individual; the population within 80 km in the year 2030 receives 9,190 person-rem.

[e] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[f] Obtained by dividing the population dose by the number of people projected to live within 80 km of NTS in 2030 (29,400).

Source: Section M.2.

Table 4.2.2.9–2. Potential Radiological Impacts to Workers During Normal Operation at Nevada Test Site—Storage Alternatives

Receptor	Consolidation		Collocation	
	Modify P-Tunnel	New Storage Facility	Modify P-Tunnel	New Storage Facility
Involved Workforce[a]				
Average worker dose (mrem/yr)[b]	262	258	262	264
50-year risk of fatal cancer	5.2×10^{-3}	5.2×10^{-3}	5.2×10^{-3}	5.3×10^{-3}
Total dose (person-rem/yr)	30	24	40	25
50-year fatal cancers	0.60	0.48	0.80	0.50
Noninvolved Workforce[c]				
Average worker dose (mrem/yr)[b]	5.0	5.0	5.0	5.0
50-year risk of fatal cancer	1.0×10^{-4}	1.0×10^{-4}	1.0×10^{-4}	1.0×10^{-4}
Total dose (person-rem/yr)	3.0	3.0	3.0	3.0
50-year fatal cancers	0.060	0.060	0.060	0.060
Total Site Workforce[d]				
Dose (person-rem/yr)	33	27	43	28
50-year fatal cancers	0.66	0.54	0.86	0.56

[a] The involved worker is a worker associated with operations of the proposed action. The number of involved badged workers for the consolidation and collocation alternatives using the New Storage Facility would be 92 and 95, respectively. For storage in P-Tunnel, the number of involved badged workers would be 113 for the consolidation alternative and 152 for the collocation alternative. The maximum dose to an involved worker would be kept below 500 mrem per year. An effective ALARA program will ensure that exposure will be reduced to that level which is as low as reasonably achievable.

[b] The radiological limit for an individual worker is 5000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the site must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The projected number of noninvolved badged workers in 2005, and beyond, is 619. The Noninvolved Workforce is equivalent to the No Action workforce.

[d] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: NT DOE 1996a and Section M.2.

Table 4.2.2.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation at Nevada Test Site—No Action and Storage Alternatives

		Consolidation				Collocation			
	No Action	Modify P-Tunnel		New Facility		Modify P-Tunnel		New Facilities	
Receptor	Total Site[a]	Facilities[b]	Total Site[a]	Facility[b]	Total Site[a]	Facility[b]	Total Site[a]	Facility[b]	Total Site[a]
Maximally Exposed Individual (Public)									
Hazard Index[c]	0	2.5×10^{-6}	2.5×10^{-6}	2.3×10^{-6}	2.3×10^{-6}	2.8×10^{-6}	2.8×10^{-6}	4.2×10^{-6}	4.2×10^{-6}
Cancer Risk[d]	0	4.1×10^{-9}	4.1×10^{-9}	4.1×10^{-9}	4.1×10^{-9}	4.1×10^{-9}	4.1×10^{-9}	4.1×10^{-9}	4.1×10^{-9}
Worker Onsite									
Hazard Index[e]	0	5.1×10^{-4}	5.1×10^{-4}	4.7×10^{-4}	4.7×10^{-4}	5.6×10^{-4}	5.6×10^{-4}	7.2×10^{-4}	7.2×10^{-4}
Cancer risk[f]	0	6.4×10^{-6}	6.4×10^{-6}	6.4×10^{-6}	6.4×10^{-6}	6.4×10^{-6}	6.4×10^{-6}	6.4×10^{-6}	6.4×10^{-6}

[a] Total=Sum of the No Action plus the contributions of the above activity.

[b] Contribution from the above activity only (for example, the amount of increase over the existing, No Action level at the site).

[c] Hazard Index for MEI=Sum of Individual Hazard Quotients (Noncancerous health effects) for MEI.

[d] Cancer Risk for MEI=(Emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (Slope Factor [SF]).

[e] Hazard Index for workers=Sum of Individual Hazard Quotients (Noncancerous health effects) for workers.

[f] Cancer risk for worker=(Emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [Fraction of year exposed]) x (0.571 [Fraction of lifetime working]) x (SF).

Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors, therefore the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4–5 through M.3.4–9.

Earthquakes offer the greatest threat from natural phenomena. Available seismology studies indicate that active faults such as the Mine Mountain Fault, the Carpetbag Fault, the Yucca Flat Fault, and the Cane Spring Fault in the NTS vicinity are capable of generating earthquakes of up to 0.85 g (PX DOE 1996b:5-16). NTS has a natural background seismicity. The Cane Springs Fault, located 5 to 8 km (3 to 5 mi) south-southeast of the DAF area, has been identified as the most significant feature from the standpoint of seismic risk. However, a large portion of seismic events occurring near NTS may have been aftershocks from past nuclear explosions. The proposed storage area in P-Tunnel is only a few hundred feet away from the site of some past nuclear explosions. Since the P-Tunnel has survived these explosions without noticeable degradation, it is not reasonably foreseeable that the proposed storage area would be damaged by an earthquake. However, if the P-Tunnel collapses, the impact forces could breach some containers. The collapse would also seal the containers inside the tunnel, resulting in no or minimal short-term releases to the environment. Thus, the consequences to the public and workers are considered negligible.

Consolidation Alternative

This section includes a description of radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the new material handling building and modified P-Tunnel drifts and with the new consolidated Pu storage facility at NTS.

Normal operation under either consolidated storage option would result in impacts that are within applicable regulatory limits.

[Text deleted.]

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Normal Operation. There would be no radiological releases during the construction of a new material handling building or from modifying P-Tunnel drifts at NTS. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment as well as direct in-plant exposures. The resulting doses and potential health effects to the public and workers at NTS are described below.

Radiological Impacts. The radiological impacts to the public resulting from the normal operation of the modified P-Tunnel and the associated handling building are given in Table 4.2.2.9–1. The dose to the MEI due to annual storage operation in the P-Tunnel drifts and handling building would be 5.6×10^{-6} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.4×10^{-10}. The impacts to the average individual would be less. As a result of storage operations in the year 2030, the population dose would be 1.7×10^{-6} person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 4.3×10^{-8}.

The dose to the MEI of the public due to annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 4.2×10^{-3} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.0×10^{-7}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population doses would all be within the limit in proposed 10 CFR 834 and would be 3.7×10^{-3} person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 9.3×10^{-5}.

Doses to onsite workers due to normal operations are given in Table 4.2.2.9–2. Included are involved workers directly associated with the new handling building and modified P-Tunnel drifts, workers who are not involved with the new building and modified P-Tunnel drifts, and the entire workforce at NTS. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. For the purposes of analyses only, this PEIS assumes that TRU and TRU mixed waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW and mixed LLW would be treated and disposed of in accordance with current site practice. Also, this analysis assumes that hazardous waste would be treated and disposed of in accordance with current site practice.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of consolidated storage in the P-Tunnel facility and the new handling building at NTS are presented in Table 4.2.2.9–3. The impacts from all site operations, including the upgraded storage facilities, are also included in this table. Total site impacts, which include the No Action impact plus the facility impact, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 2.5×10^{-6}, and the cancer risk is 4.1×10^{-9} as a result of operation of consolidated storage in the P-Tunnel facility and handling building in the year 2030. The total HI and cancer risk from hazardous chemicals would remain constant over 50 years of operation, provided exposures remain the same. The total site operation, including the consolidated facility, would result in an HI of 2.5×10^{-6} and a cancer risk of 4.1×10^{-9} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker at P-Tunnel is 5.1×10^{-4}, and the cancer risk is 6.4×10^{-6} as a result of operation of consolidated storage in the year 2030. The total HI and cancer risk would remain constant over 50 years of operation, provided exposures remain the same. The total operation, including the consolidated facility, would result in an HI of 5.1×10^{-4} and a cancer risk of 6.4×10^{-6} for the onsite worker. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents for modified P-Tunnel drifts for which there may be releases of Pu that may impact onsite workers and the offsite population has been postulated for the P-Tunnel. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.2.9–4. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 5.3×10^{-4} at NTS for the truck bay fire accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 2.7×10^{-9}, 3.6×10^{-10}, and 2.1×10^{-9}, respectively. The maximum population 50-year facility lifetime risk would be 5.1×10^{-5} (that is, one fatality in about 1,000,000 years) at NTS for the PCV Penetration by Corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 6.9×10^{-6} and 4.0×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.2.9–4.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Construct New Plutonium Storage Facility

Normal Operation. There would be no radiological releases during the construction of a new consolidated Pu storage facility at NTS. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment as well as direct in-plant exposures. The resulting doses and potential health effects on the public and workers at NTS are described below.

Radiological Impacts. Radiological impacts to the public resulting from the normal operation of the new consolidated Pu storage facility are presented in Table 4.2.2.9–1. The impacts from all site operations, including the new consolidated storage facility, are also given in the table. To put operational doses into perspective, comparisons with natural background radiation doses are included in the table.

The dose to the MEI due to annual storage facility operation would be 1.3×10^{-6} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 3.2×10^{-11}. The impacts to the average individual would be less. As a result of storage facility operation in the year 2030, the population dose would be 2.6×10^{-6} person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 6.5×10^{-8}.

The dose to the MEI due to annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 4.2×10^{-3} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.0×10^{-7}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 3.7×10^{-3} person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 9.3×10^{-5}.

Doses to onsite workers from normal operations are given in Table 4.2.2.9–2. Included are involved workers directly associated with the new consolidated Pu storage facility, workers who are not involved with the storage facility, and the entire workforce at NTS. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operations are included in the table.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the consolidated storage facilities at NTS are presented in Table 4.2.2.9–3. The impacts from all site operations, including the new consolidated storage facilities are also included in this table. Total site impacts, which include the No Action impact plus the facility are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 2.3×10^{-6}, and the cancer risk is 4.1×10^{-9} as a result of operation of the consolidated storage facilities in the year 2030. The HI and cancer risk from hazardous chemicals would remain

Table 4.2.2.9–4. Consolidation Alternative (P-Tunnel) Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift impact	8.8×10^{-8}	2.9×10^{-6}	1.5×10^{-8}	5.0×10^{-7}	1.1×10^{-7}	3.7×10^{-6}	6.0×10^{-4}
PCV breach by firearms discharge	5.2×10^{-9}	2.9×10^{-7}	8.8×10^{-10}	5.0×10^{-8}	6.5×10^{-9}	3.7×10^{-7}	3.5×10^{-4}
PCV penetration by corrosion	4.0×10^{-5}	1.3×10^{-5}	6.9×10^{-6}	2.2×10^{-6}	5.1×10^{-5}	1.6×10^{-5}	0.064
Truck bay fire	2.1×10^{-9}	4.2×10^{-4}	3.6×10^{-10}	7.2×10^{-5}	2.7×10^{-9}	5.3×10^{-4}	1.0×10^{-7}
Spontaneous combustion	2.1×10^{-11}	5.9×10^{-7}	3.5×10^{-12}	1.0×10^{-7}	2.6×10^{-11}	7.5×10^{-7}	1.0×10^{-7}
Explosion outside of vault	2.1×10^{-11}	4.2×10^{-6}	3.6×10^{-12}	7.1×10^{-7}	2.6×10^{-11}	5.3×10^{-6}	1.0×10^{-7}
Nuclear criticality	1.5×10^{-11}	3.1×10^{-6}	3.1×10^{-12}	6.1×10^{-7}	3.2×10^{-12}	6.4×10^{-7}	1.0×10^{-7}
Expected risk[d]	4.0×10^{-5}	–	6.9×10^{-6}	–	5.1×10^{-5}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the MEI) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the incident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks for each accident over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.8.1–3 and M.5.2.8.1–4 and the MACCS computer code

constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the consolidated facility, would result in an HI of 2.3×10^{-6} and a cancer risk of 4.1×10^{-9} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 4.7×10^{-4}, and the cancer risk is 6.4×10^{-6} as a result of operation of the consolidated storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the consolidated facility, would result in an HI of 4.7×10^{-4} and a cancer risk of 6.4×10^{-6} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents for consolidation of Pu in a new storage facility for which there may be releases of Pu that may impact onsite workers and the offsite population has been postulated. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.2.9–5. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.027 at NTS for the beyond design basis earthquake accident scenario with an estimated probability of 1.0×10^{-7} per year (that is, probability of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.4×10^{-7}, 1.3×10^{-9}, and 7.3×10^{-8}, respectively. The maximum population 50-year facility lifetime risk would be 9.4×10^{-5} (that is, one fatality in about 540,000 years) at NTS for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 9.1×10^{-7} and 3.9×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.2.9–5.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Collocation Alternative

This section includes a description of radiological and hazardous chemical releases and the associated impacts resulting from either normal operation or accidents involved with the consolidation of Pu storage and collocation with HEU storage facilities at NTS. This storage would take place in either the modified P-Tunnel drifts or in a new collocated Pu and HEU storage facility.

Normal operation under either the modified P-Tunnel option or the new collocated storage facility option at NTS would result in impacts that are within applicable regulatory limits.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. [Text deleted.] The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Table 4.2.2.9–5. Consolidation Alternative (New Storage Facility) Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	9.0×10^{-8}	3.0×10^{-6}	2.1×10^{-9}	7.0×10^{-8}	2.2×10^{-7}	7.2×10^{-6}	6.0×10^{-4}
PCV breach by firearms discharge	5.3×10^{-9}	3.0×10^{-7}	1.2×10^{-10}	7.0×10^{-9}	1.3×10^{-8}	7.2×10^{-7}	3.5×10^{-4}
PCV penetration by corrosion	3.9×10^{-5}	1.2×10^{-5}	9.1×10^{-7}	2.9×10^{-7}	9.4×10^{-5}	3.0×10^{-5}	0.064
Vault fire	3.8×10^{-8}	7.6×10^{-3}	7.3×10^{-10}	1.5×10^{-4}	7.6×10^{-8}	0.015	1.0×10^{-7}
Truck bay fire	2.1×10^{-9}	4.2×10^{-4}	4.9×10^{-11}	9.7×10^{-6}	5.1×10^{-9}	1.0×10^{-3}	1.0×10^{-7}
Spontaneous combustion	2.1×10^{-11}	6.0×10^{-7}	4.9×10^{-13}	1.4×10^{-8}	5.1×10^{-11}	1.5×10^{-6}	7.0×10^{-7}
Explosion in the vault	4.9×10^{-9}	9.9×10^{-4}	1.1×10^{-10}	2.3×10^{-5}	1.2×10^{-8}	2.4×10^{-3}	1.0×10^{-7}
Explosion outside of vault	2.3×10^{-11}	4.5×10^{-6}	5.2×10^{-13}	1.0×10^{-7}	5.4×10^{-11}	1.1×10^{-5}	1.0×10^{-7}
Nuclear criticality	1.5×10^{-11}	3.1×10^{-6}	3.3×10^{-13}	6.5×10^{-8}	3.5×10^{-12}	6.9×10^{-7}	1.0×10^{-7}
Beyond design basis earthquake	7.3×10^{-8}	0.015	1.3×10^{-9}	2.6×10^{-4}	1.4×10^{-7}	0.027	1.0×10^{-7}
Expected risk[d]	4.0×10^{-5}	–	9.2×10^{-7}	–	9.5×10^{-5}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks for each accident over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.1.1–5 and M.5.2.1.1–6 and the MACCS computer code.

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Normal Operation. There would be no radiological releases during the construction of a new, but larger (than for consolidation) material handling building or from modifying P-Tunnel drifts at NTS. Worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment as well as direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the public resulting from the normal operation of the modified P-Tunnel drifts and the associated handling building at NTS are included in the information presented in Table 4.2.2.9–1. The impacts from all site operations are also given in the table. To put operational doses into perspective, comparisons with natural background radiation doses are also included in the table. Similar information regarding radiological impacts to workers is given in Table 4.2.2.9–2. [Text deleted.]

The dose to the MEI due to annual storage operation in the P-Tunnel and handling building would be 5.6×10^{-6} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.4×10^{-10}.

The impacts to the average individual would be less. As a result of storage operations in the year 2030, the population dose would be 1.7×10^{-6} person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 4.3×10^{-8}.

The dose to the MEI due to annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 4.2×10^{-3} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.0×10^{-7}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 3.7×10^{-3} person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 9.3×10^{-5}.

Doses to onsite workers due to normal operations are given in Table 4.2.2.9–2. Included are involved workers directly associated with the modified P-Tunnel drifts and handling building, workers who are not involved with the modified P-Tunnel drifts and handling building, and the entire workforce at NTS. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the collocated storage facility in the P-Tunnel at NTS are presented in Table 4.2.2.9–3.

The HI to the MEI of the public is 2.8×10^{-6}, and the cancer risk is 4.1×10^{-9} as a result of operation of the collocated storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation in P-Tunnel would result in an HI of 2.8×10^{-6} and a cancer risk of 4.1×10^{-9} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker at P-Tunnel would be 5.6×10^{-4}, and the cancer risk is 6.4×10^{-6} as a result of operation of the collocated storage facility in the P-Tunnel at NTS in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation including the consolidated facility would result in an HI of 5.6×10^{-4} and a cancer risk of 6.4×10^{-6} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents for modified P-Tunnel and collocated Pu and HEU storage facilities for which there may be releases of Pu or uranium that may impact onsite workers and the offsite population has been postulated. The consequences and risks of potential accidents that release both Pu and HEU would be bounded by the impacts associated with Pu. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.2.9–6. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 5.3×10^{-4} at NTS for the truckbay fire accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 2.7×10^{-9}, 3.6×10^{-10}, and 2.1×10^{-9}, respectively. The maximum population 50-year facility lifetime risk would be 5.1×10^{-5} (that is, one fatality in about 1,000,000 years) at NTS for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 6.9×10^{-6} and 4.0×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.2.9–6.

Table 4.2.2.9–6. Collocation Alternative (P-Tunnel) Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift impact	8.8×10^{-8}	2.9×10^{-6}	1.5×10^{-8}	5.0×10^{-7}	1.1×10^{-7}	3.7×10^{-6}	6.0×10^{-4}
PCV breach by firearms discharge	5.2×10^{-9}	2.9×10^{-7}	8.8×10^{-10}	5.0×10^{-8}	6.5×10^{-9}	3.7×10^{-7}	3.5×10^{-4}
PCV penetration by corrosion	4.0×10^{-5}	1.3×10^{-5}	6.9×10^{-6}	2.2×10^{-6}	5.1×10^{-5}	1.6×10^{-5}	0.064
Truck bay fire	2.1×10^{-9}	4.2×10^{-4}	3.6×10^{-10}	7.2×10^{-5}	2.7×10^{-9}	5.3×10^{-4}	1.0×10^{-7}
Spontaneous combustion	2.1×10^{-11}	5.9×10^{-7}	3.5×10^{-12}	1.0×10^{-7}	2.6×10^{-11}	7.5×10^{-7}	1.0×10^{-7}
Explosion outside of vault	2.1×10^{-11}	4.2×10^{-6}	3.6×10^{-12}	7.1×10^{-7}	2.6×10^{-11}	5.3×10^{-6}	1.0×10^{-7}
Nuclear criticality	1.5×10^{-11}	3.1×10^{-6}	3.1×10^{-12}	6.1×10^{-7}	3.2×10^{-12}	6.4×10^{-7}	1.0×10^{-7}
Expected risk[d]	4.0×10^{-5}	–	6.9×10^{-6}	–	5.1×10^{-5}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the incident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks for each accident over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.8.1–3 and M.5.2.8.1–4 and the MACCS computer code.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Normal Operation. There would be no radiological releases during the construction of a new collocated storage facility at NTS. Worker exposures to material potentially contaminated with radioactivity would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment as well as direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the public resulting from the normal operation of the new collocated storage facility at NTS are included in the information presented in Table 4.2.2.9–1. The impacts from all site operations are also given in the table. To put operational doses into perspective, comparisons with natural background radiation doses are also included in the table. Similar information regarding radiological impacts to workers is given in Table 4.2.2.9–2. [Text deleted.]

The dose to the MEI from the annual storage operations in the new storage facility would be 1.3×10^{-6} mrem. For 50 years of operation, the corresponding risk of fatal cancer to this individual would be 3.2×10^{-11}. The impacts to the average individual would be less. As a result of storage operation in the year 2030, the population dose would be 2.6×10^{-6} person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 6.5×10^{-8}.

Doses and associated health risks to the public from total site operations are virtually the same whether storage is in the new storage facility or in the modified P-Tunnel drifts (Table 4.2.2.9–1). This is because the storage operations contribute negligibly to the total offsite doses.

Doses to onsite workers due to normal operations are given in Table 4.2.2.9–2. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the new consolidation of Pu storage and collocation with HEU storage facilities at NTS are presented in Table 4.2.2.9–3. The impacts from all site operations, including the consolidation of Pu storage and collocation with HEU storage facilities, are also included in this table. Total site impacts, which include the No Action impact plus the facility impacts, are provided. All analyses to support the values presented in this table are provided in Section M.3

The HI to the MEI of the public is 4.2×10^{-6}, and the cancer risk is 4.1×10^{-9} as a result of operation of the new consolidation of Pu storage and collocation with HEU storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the new facility, would result in an HI of 4.2×10^{-6} and a cancer risk of 4.1×10^{-9} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 7.2×10^{-4}, and the cancer risk is 6.4×10^{-6} as a result of operation of the new consolidation of Pu storage and collocation with HEU storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the new facility, would result in an HI of 7.2×10^{-4} and a cancer risk of 6.4×10^{-6} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents for a new storage facility for collocated Pu and HEU for which there may be releases of Pu or HEU that may impact onsite workers and the offsite population has been postulated. The consequences and risks of potential accidents that release both Pu and HEU would be bounded by the impacts associated with Pu. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.2.9–7. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.027 at NTS for the beyond design basis earthquake accident scenario with an estimated probability of 1.0×10^{-7} per year (that is, probability of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.4×10^{-7}, 1.3×10^{-9}, and 7.3×10^{-8}, respectively. The maximum population 50-year facility lifetime risk would be 9.4×10^{-5} (that is, one fatality in about 530,000 years) at NTS for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 9.1×10^{-7} and 3.9×10^{-5}, respectively. Appendix M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.2.9–7.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

If the strategic reserve and weapons R&D materials are not included, the impacts to the public and to workers from the accident-free storage activities would be reduced in proportion to the decrease in the amount of material stored. The impacts from total site operations would decrease slightly. The risks due to accidents would also tend to be lower.

Table 4.2.2.9–7. Collocation Alternative (New Plutonium and Highly Enriched Uranium Facilities) Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	9.0x10-8	$3.0x10^{-6}$	$2.1x10^{-9}$	$7.0x10^{-8}$	$2.2x10^{-7}$	$7.2x10^{-6}$	$6.0x10^{-4}$
PCV breach by firearms discharge	5.3x10-9	$3.0x10^{-7}$	$1.2x10^{-10}$	$7.0x10^{-9}$	$1.3x10^{-8}$	$7.2x10^{-7}$	$3.5x10^{-4}$
PCV penetration by corrosion	3.9x10-5	$1.2x10^{-5}$	$9.1x10^{-7}$	$2.9x10^{-7}$	$9.4x10^{-5}$	$3.0x10^{-5}$	0.064
Vault fire	3.8x10-8	$7.6x10^{-3}$	$7.3x10^{-10}$	$1.5x10^{-4}$	$7.6x10^{-8}$	0.015	$1.0x10^{-7}$
Truck bay fire	2.1x10-9	$4.2x10^{-4}$	$4.9x10^{-11}$	$9.7x10^{-6}$	$5.1x10^{-9}$	$1.0x10^{-3}$	$1.0x10^{-7}$
Spontaneous combustion	2.1x10-11	$6.0x10^{-7}$	$4.9x10^{-13}$	$1.4x10^{-8}$	$5.1x10^{-11}$	$1.5x10^{-6}$	$7.0x10^{-7}$
Explosion in the vault	4.9x10-9	$9.9x10^{-4}$	$1.1x10^{-10}$	$2.3x10^{-5}$	$1.2x10^{-8}$	$2.4x10^{-3}$	$1.0x10^{-7}$
Explosion outside the vault	2.3x10-11	$4.5x10^{-6}$	$5.2x10^{-13}$	$1.0x10^{-7}$	$5.4x10^{-11}$	$1.1x10^{-5}$	$1.0x10^{-7}$
Nuclear criticality	1.5x10-11	$3.1x10^{-6}$	$3.3x10^{-13}$	$6.5x10^{-8}$	$3.5x10^{-12}$	$6.9x10^{-7}$	$1.0x10^{-7}$
Beyond evaluation basis earthquake	7.3x10-8	0.014	$1.3x10^{-9}$	$2.6x10^{-4}$	$1.4x10^{-7}$	0.027	$1.0x10^{-7}$
Expected risk[d]	4.0x10-5	–	$9.2x10^{-7}$	–	$9.5x10^{-5}$	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code.

4.2.2.10 Waste Management

This section summarizes the impacts on waste management at NTS under No Action and for each of the long-term storage alternatives. There is no spent nuclear fuel or HLW associated with Pu or HEU storage. Table 4.2.2.10–1 lists the projected sitewide waste generation rates and treatment, storage, and disposal capacities under No Action for 2005. Projections for No Action were derived from the most recent applicable environmental data, with the appropriate adjustments made for those changing operational requirements where the volumes of wastes generated are identifiable. The projections do not include waste from future, yet uncharacterized, environmental restoration activities. The projections for No Action could change significantly depending on the decisions resulting from the Waste Management PEIS or the NTS Site-Wide EIS. Table 4.2.2.10–2 provides the estimated incremental operational waste volumes projected to be generated at NTS as a result of the various storage alternatives prior to treatment. Some of the waste values described in this section are different than the waste values in the table. For those values that differ (for example LLW), the table gives waste generated pre-treatment values and the text discusses post-treatment values (indicated as after treatment and volume reduction). The waste volumes generated from the various storage alternatives that were added to the No Action projection and the resultant waste effluent used for the waste impact analysis are shown in Section E.3.1. Facilities that would support the storage of Pu and/or HEU would treat and package all generated waste into forms that would enable staging and/or disposal in accordance with RCRA and other applicable statutes as outlined in Section E.1.2. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS and in subsequent RODs and NEPA documents, wastes could be treated and disposed of onsite or at regionalized or centralized DOE sites. For purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous wastes would be treated and disposed of in accordance with current site practice.

Preferred Alternative: No Action Alternative

Under this alternative, TRU, low-level, mixed, hazardous, and nonhazardous wastes would continue to be managed from the missions outlined in Section 3.3. The disposal of waste received from offsite would not involve treatment at NTS, since this waste must be treated, packaged, and certified to NTS WAC before being shipped to NTS for disposal. NTS has retrievable storage of TRU waste awaiting shipment to a Federal repository. Although there would be no generation of TRU waste onsite, mixed TRU waste from LLNL would continue to be stored at NTS. Solid mixed LLW would be stored and treated in accordance with the NTS Site Treatment Plan. Hazardous waste would be accumulated, then shipped offsite for treatment and disposal at commercial RCRA-permitted facilities. Nonhazardous and sanitary wastes would be treated and disposed of locally in facilities located within the separate activity areas onsite.

Consolidation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Construction and operation of a consolidated Pu storage facility using P-Tunnel would have an impact on existing NTS waste management activities, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous material or radioactive constituents is expected to be generated during construction. However, if any was generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

After treatment and volume reduction, approximately 5 m^3 (7 yd^3) of TRU waste and 4 m^3 (5 yd^3) of mixed TRU waste from leaded gloves, windows, and contaminated lead shielding would be treated and packaged to

Table 4.2.2.10–1. Projected Waste Management Under No Action (2005) at Nevada Test Site

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Mixed Transuranic	None	None	None	Containers on asphalt pads	1,208[a]	To WIPP or alternate facility	NA
Low-Level							
Liquid	Dependent on restoration activities	Not determined	None	None	NA	NA	NA
Solid	15,000[b]	None	None	None	NA	Shallow burial	650,000[c]
Mixed Low-Level							
Liquid	None	None	NA	None	NA	NA	NA
Solid	50[d]	None	NA	Containers on asphalt pads	Included in mixed TRU	Shallow land burial[e]	90,626[f]
Hazardous							
Liquid	Included in solid	Contracted offsite	None	RCRA-permitted pad	Included in solid	Contracted offsite	NA
Solid	212	Contracted offsite	None	RCRA-permitted pad	61.6[g]	Contracted offsite	NA
Nonhazardous (Sanitary)							
Liquid	Included in solid	Septic fields	As required	None	NA	Septic fields	As required
Solid	2,120	None	None	NA	NA	Landfill onsite	As required
Nonhazardous (Other)							
Liquid	Included in sanitary	Septic fields	As required	None	NA	Septic fields	As required
Solid	76,500	None	None	NA	NA	NA	As required

[a] TRU waste pad and cover building, Area 5. Storage area is 1,765 m^2. Volume estimate made assuming 50 percent of area is available due to aisle space and drums are stacked two high.
[b] Depending on ROD from the sitewide EIS, additional solid LLW could be received.
[c] Area 3 and 5. Additional acreage available for expansion.
[d] Depending on ROD from the sitewide EIS, additional mixed LLW could be generated from onsite environmental restoration activities and receipts from offsite for disposal.
[e] As required to meet RCRA requirements.
[f] Remaining capacity Pit 3, Area 5 RWMS.
[g] Total capacity for solid and liquid hazardous wastes stored at the Hazardous Waste Storage Unit in Area 5.
Source: NTS 1996a:1.

Table 4.2.2.10–2. Estimated Annual Generated Waste Volumes at Nevada Test Site—No Action (2005) and Net Incremental for Storage Alternatives

Category	No Action[a] (m^3)	Consolidation		Collocation	
		Modify P-Tunnel[b] (m^3)	New Facility[b] (m^3)	Modify P-Tunnel[b] (m^3)	New Facility[b] (m^3)
Transuranic					
Liquid	None	0.02[c]	0.02[c]	0.02[c]	0.02[c]
Solid	None	10	10	10	10
Mixed Transuranic					
Liquid	None	0	0	0	0
Solid	None	4	4	4	4
Low-Level					
Liquid	Dependent on restoration activities	2[c]	2[c]	2.1[c]	2.1[c]
Solid	15,000	1,260	1,260	1,300	1,300
Mixed Low-level					
Liquid	Included in solid	0.2	0.2	0.2	0.2
Solid	50	65	65	66	66
Hazardous					
Liquid	Included in solid	2	2	2	2
Solid	212	2	2	2	2
Nonhazardous (Sanitary)					
Liquid	Included in solid	135,000	114,000	189,000	153,000
Solid	2,120	1,620	1,500	1,960	1,900
Nonhazardous (Other)					
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary
Solid	76,500	2,000[d]	1,900[d]	2,500[d]	2,400[d]

[a] The No Action waste volumes are from Table 4.2.2.10–1.

[b] Incremental generated waste volumes for storage alternatives are found in Section E.3.1 (Tables E.3.1.2–2, E.3.1.2–3, E.3.1.3–2, and E.3.1.3–3). Waste effluents (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in these tables.

[c] Liquid TRU and LLW would be treated and solidified prior to disposal.

[d] Recyclable wastes.

meet the current planning-basis WIPP WAC or alternative treatment level. While awaiting shipment to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), the TRU and mixed TRU waste would be stored at the TRU Pad Waste Storage in Area 5. One additional truck shipment per year would be required to transport these wastes to WIPP.

Following treatment and volume reduction, approximately 630 m^3 (824 yd^3) of LLW from solidified liquid LLW (such as decontamination solutions), protective clothing, HEPA filters, glovebox gloves, and decontamination equipment and materials would require disposal in the Area 5 or Area 3 RWMS. Assuming a land usage of 6,000 m^3/ha (3,200 yd^3/acre), this would require approximately 0.1 ha/year (0.3 acres/year) of LLW disposal area. The 0.2 m^3 (50 gal) of liquid and 65 m^3 (85 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the NTS Site Treatment Plan through the use of existing and planned facilities. The 2 m^3 (476 gal) of liquid and 2 m^3 (3 yd^3) of solid hazardous wastes would have a minimal impact on waste management activities at NTS. Existing facilities at the Area 5 Hazardous Waste Storage Unit are adequate to stage the increase in hazardous waste while awaiting shipment to an offsite commercial RCRA-permitted treatment and disposal facility. New sanitary lagoons would be required to treat the 135,000 m^3 (35,600,000 gal) of nonhazardous liquid wastes. After volume reduction, 810 m^3 (1,060 yd^3) of solid nonhazardous waste would require disposal at one of the onsite landfills.

Construct New Plutonium Storage Facility

Construction and operation of a consolidated Pu storage facility would have an impact on existing waste management activities identical to that described above for the P-Tunnel facility, with the following exceptions. Construction of sanitary, utility, and process wastewater treatment systems would be required to treat approximately 114,000 m^3 (30,100,000 gal) of liquid nonhazardous waste. After volume reduction, 750 m^3 (981 yd^3) of solid nonhazardous waste would require disposal at one of the onsite facilities.

Collocation Alternative

Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel

Construction and operation of a consolidated Pu storage facility collocated with HEU storage using the P-Tunnel would have an impact on existing NTS waste management activities, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous material or radioactive constituents is expected to be generated during construction. However, if any was generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Since there is no TRU or mixed TRU wastes associated with HEU storage, the impacts from TRU and mixed TRU wastes are identical to those identified in the consolidated Pu storage alternative. The sources of waste are similar to those of the consolidated Pu storage facility, except the source of radioactive contamination from the HEU storage is uranium.

Following treatment and volume reduction, approximately 630 m^3 (824 yd^3) of LLW contaminated with Pu and 20 m^3 (26 yd^3) contaminated with uranium would require disposal in the Area 5 or Area 3 RWMS. Assuming a land usage of 6,000 m^3/ha (3,200 yd^3/acre), this would require approximately 0.1 ha/yr (0.3 acre/yr) of LLW disposal area. The 0.2 m^3 (55 gal) of liquid mixed LLW and 66 m^3 (86 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the NTS Site Treatment Plan through the use of existing and planned facilities. The 2 m^3 (528 gal) of liquid and 2 m^3 (3 yd^3) of solid hazardous wastes would have a minimal impact on waste management activities at NTS. Existing facilities at the Area 5 Hazardous Waste Accumulation Site

are adequate to stage the increase in hazardous waste while awaiting shipment to an offsite commercial RCRA-permitted treatment and disposal facility. New sanitary lagoons would be required to treat the 189,000 m^3 (49,900,000 gal) of liquid nonhazardous waste. After volume reduction, 980 m^3 (1,280 yd^3) of solid nonhazardous waste would require disposal at one of the onsite landfills.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction and operation of a consolidated Pu storage facility collocated with HEU storage would have an impact on existing NTS waste management activities identical to that described above for the modified P-Tunnel facility, with the following exceptions. Construction of sanitary, utility, and process wastewater treatment systems would be required to treat approximately 153,000 m^3 (40,500,000 gal) of nonhazardous waste. After volume reduction, 950 m^3 (1,240 yd^3) of solid nonhazardous waste would require disposal at one of the onsite landfills.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve or weapons R&D materials would reduce the amount of operational waste volumes shown in Table 4.2.2.10–2 for the Consolidation Alternative and the Collocation Alternative. The decrease would be proportional to the amount of material excluded. [Text deleted.]

4.2.3 IDAHO NATIONAL ENGINEERING LABORATORY

A listing of the proposed long-term storage alternatives, subalternatives, and related actions, including the No Action Alternative at INEL, is provided below. The potential impacts of implementing these alternatives and related actions at INEL are described for: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, and waste management. The specific long-term storage alternatives proposed for INEL are the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative.

Preferred Alternative

No Action Alternative:

Continue to store INEL Pu material within the scope of this PEIS at ANL-W in the ZPPR and FMF vaults and the ICPP in stabilized form pursuant to DNFSB Recommendation 94-1.

Proposed Storage Activities at Idaho National Engineering Laboratory

- **No Action Alternative (Preferred Alternative):** Continue to store INEL Pu material within the scope of this PEIS at ANL-W in the ZPPR and FMF vaults and the ICPP in stabilized form pursuant to DNFSB Recommendation 94-1.
- **Upgrade Alternative:** There are two subalternatives under this storage alternative.
  - ***Upgrade Without RFETS Pu or LANL Pu Subalternative*:** Modify the FMF and construct a new material handling building at ANL-W to accommodate INEL Pu material.
  - ***Upgrade With All or Some RFETS Pu and LANL Pu Subalternative*:** Modify the FMF and construct a larger new material handling building at ANL-W to accommodate INEL, RFETS, and LANL Pu material.
- **Consolidation Alternative:** Construct a new facility near the ICPP to accommodate all Pu material within the scope of this PEIS.
- **Collocation Alternative:** Construct a new facility near the ICPP to accommodate all Pu and HEU material within the scope of this PEIS.
- **Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials:** Facility and other resource requirements would be smaller than the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative.
- **Phaseout:** INEL Pu material within the scope of this PEIS would be moved out of ANL-W to the Consolidation or Collocation site (located at another DOE site) or to disposition (for surplus Pu).

4.2.3.1 Land Resources

Preferred Alternative: No Action Alternative

Under this alternative, Pu storage would continue at the current interim storage locations at the ICPP and at ANL-W in the ZPPR and FMF vaults in stabilized form pursuant to DNFSB Recommendation 94-1. The ongoing (no new action) activities conform with present and future land-use plans, policies, and controls. Therefore, no effects to land use or visual resources would be anticipated at INEL beyond those of existing and future activities that are independent of the proposed action.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

Long-term storage of the existing inventory of INEL Pu material would be accommodated at ANL-W on the INEL site. The proposed facility would be a modification of the FMF on the ANL-W and construction of a new material handling building. Construction laydown area and the operating facility would be situated on previously disturbed land entirely within an upgraded protected area of ANL-W totalling approximately 9 ha (22 acres) and would not create any newly disturbed area. A buffer zone exists between ANL-W operations and the INEL site boundary. [Text deleted.]

Land Use. Upgrading existing storage facilities and constructing a new material handling building at ANL-W would have no direct land-use effect during construction or operations. Existing land use would not change and would conform with site development and facility utilization plans. As discussed in Section 4.2.3.8, no in-migration of workers would be required during the construction and operation phases. No indirect effects to offsite land use would be anticipated.

Construction and operation would not affect other land uses at INEL or special status lands. Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation of the facilities would be compatible with the industrial landscape character of ANL-W. The current VRM Class 5 designation of ANL-W would not change.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

The FMF would be modified, and a material handling building would be constructed at ANL-W to accommodate INEL, RFETS, and LANL Pu material. Land area requirements during construction and operations would be equal to the Upgrade Without RFETS Pu or LANL Pu Subalternative (that is, protected area). Direct and indirect effects on land resources during construction and operations would be similar to the Upgrade Alternative, Upgrade Without RFETS Pu or LANL Pu Subalternative.

Consolidation Alternative

Construct New Plutonium Storage Facility

All the Pu within the scope of the PEIS would be stored at a new storage facility to be constructed at INEL within the Prime Development Zone of the Sitewide Area near the ICPP. Land disturbance would be 58.5 ha (144 acres) during construction of which 56 ha (138 acres) would be used during operations. A buffer zone would be provided between operations and the INEL site boundary. Pu storage in existing DOE storage facilities would be phased out.

Land Use. Consolidating the storage of Pu at INEL would be situated on undisturbed land. However, the proposed site is within designated prime development land pursuant to the current *Idaho National Engineering Laboratory Site Development Plan* (IN DOE 1994d:8-4) although existing land use would change. As discussed in Section 4.2.3.8, expected vacancies and historic housing construction rates indicate that sufficient housing would be available to accommodate the estimated in-migration of workers during the construction and operational phases. Therefore, indirect effects to offsite land use would not be anticipated.

Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site. Construction and operation would not affect other land uses at INEL or special status lands. No onsite grazing permits would be affected. No prime farmlands exist onsite.

Visual Resources. [Text deleted.] Construction and operation would be compatible with the industrial character of INEL's developed areas, which consist of large industrial facilities and stack plumes. The current VRM Class 5 designation of the proposed site would not change.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

All the Pu and HEU within the scope of this PEIS would be collocated at a primary new storage plant at INEL, on undisturbed land in the Prime Development Zone of the Sitewide Area near the ICPP. Land disturbance would be 89.5 ha (221 acres) during construction of which 87 ha (215 acres) would be used during operation. A buffer zone would be provided between operations and the INEL site boundary. Pu and HEU storage in existing DOE storage facilities would be phased out. Direct and indirect effects on land resources would be similar to those described under the Consolidation Alternative.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, land effects during construction and operation would be almost the same in extent and magnitude to the Upgrade with All or Some RFETS Pu and LANL Pu Subalternative, Consolidation Alternative, and Collocation Alternative because the facility would be almost the same. However, because the smaller quantity of material would require smaller facilities, it is likely that less land area would be disturbed during construction and used during operations. [Text deleted.]

Phaseout

No new construction or upgrade of existing facilities would occur under phaseout of the Pu mission. INEL Pu material would be moved out of ANL-W to the Consolidation or Collocation site or to disposition. Potential impacts on visual resources could occur if facilities are not maintained.

[Text deleted.]

4.2.3.2 Site Infrastructure

The INEL infrastructure would be capable of supporting any of the storage alternatives without major modifications to the existing infrastructure. A comparison of site infrastructure and facilities resource needs for the various storage alternatives is shown in Table 4.2.3.2–1.

Preferred Alternative: No Action Alternative

INEL would continue Pu storage at ANL-W. No change to the baseline infrastructure is anticipated, and no additional environmental impacts would be expected.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

Modifying the existing storage facility plus building a new facility to accommodate long-term storage of existing quantities of Pu at INEL would have minimal impact on site infrastructure. Data for construction are presented in Appendix C. [Text deleted.] As shown in Table 4.2.3.2–1, the INEL infrastructure would be capable of supporting the modification of the existing storage facility without major improvements. Adequate electrical energy is available from the regional power grid. [Text deleted.] All infrastructure requirements are within site capacities.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

To accommodate material currently at the site, plus the relocation of material from RFETS and LANL, the ANL-W storage capacity would be upgraded by constructing a new 2,550 m^2 (27,400 ft^2) Material Handling Building to augment modified existing support buildings and by using balance of plant facilities. Building 704 would be modified for an additional 4,100 storage positions above that of the baseline upgrade, while Buildings 774 and 775 would be modified for storage support. The buildings would be interconnected by a new material transfer access corridor.

Construction for upgrading the existing storage facility, plus building a new facility to accommodate long-term storage of existing quantities of Pu, plus material relocated from RFETS and LANL would have minimal impact on site infrastructure. Data for construction are presented in Appendix C. As shown in Table 4.2.3.2–1, additional electrical energy, and peak load would be required to operate the facility. The INEL infrastructure would be capable of supporting the modification of the existing storage facility, plus building a new facility to accommodate long-term storage of existing quantities of Pu, plus material relocated from RFETS and LANL without major improvements. Adequate electrical energy is available from the regional power grid. [Text deleted.] All infrastructure requirements are within site capacities.

Since impacts associated with relocating all of the RFETS Pu and LANL Pu material to INEL for long-term storage are minimal for construction and can be managed for operations, relocating only a portion of this material to INEL would result in minimal impacts on the site infrastructure as well. Additional annual electrical energy requirements would be proportionately less than the 700 MWh/yr required for storage of the full amount of RFETS Pu and LANL Pu material, depending on the amount of material relocated to the site.

Table 4.2.3.2–1. Site Infrastructure Changes Required for Operation at Idaho National Engineering Laboratory (Annual)—No Action (2005) and Storage Alternatives

Alternative	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
No Action							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage	445	48	232,500	42	5,820,000	0	11,340
Upgrade (without RFETS Pu or LANL Pu material)							
Projected usage with upgraded facility	445	48	236,300	43	6,460,000	0	0
Amount required in excess to site availability	0	0	0	0	0	0	0
Upgrade (with RFETS Pu and LANL Pu material)							
Projected usage with upgraded facility	445	48	237,000	43	6,550,000	0	0
Amount required in excess to site availability	0	0	0	0	0	0	0
Consolidation							
Projected usage with consolidated facility	450	53	277,500	50	5,940,000	0	22,340
Amount required in excess to site availability	<5	<5	0	0	0	0	11,000
Collocation							
Projected usage with consolidated and new collocated facilities	450	53	290,500	52	5,960,000	0	25,340
Amount required in excess to site availability	<5	<5	0	0	0	0	14,000
Phaseout							
Projected usage without storage facility	445	48	228,700	41	5,820,000	0	11,340
Amount required in excess to site availability	0	0	0	0	0	0	0

Source: Modified from DOE 1995j; INEL 1993a:5.

Consolidation Alternative

Construct New Plutonium Storage Facility

Under this alternative, all the Pu within the scope of this PEIS would be stored at a new storage facility located at INEL. Construction requirements would constitute a small change in resource requirements at INEL. Since coal availability is governed by usage and not by site storage capacity, the additional coal required could be procured through contractual means. Impacts on the site infrastructure would be negligible. The INEL infrastructure would be capable of supporting operation of the consolidated Pu storage facility without major modifications to the existing infrastructure. As shown in Table 4.2.3.2–1, less than 5 km (3 mi) of roads and less than 5 km (3 mi) of railroad lines would need to be added to the site. Adequate electrical energy is available from the regional power grid.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Under this alternative, all the HEU within the scope of this PEIS would be stored at INEL in a new storage facility, collocated with the consolidated Pu storage facility. Construction requirements would constitute a small change in resource requirements for INEL. Since coal availability is governed by usage and not by site storage capacity, the additional coal required could be procured through contractual means. As shown in Table 4.2.3.2–1, less than 5 km (3 mi) of roads and less than 5 km (3 mi) of railroad lines would need to be added to the site. The INEL infrastructure would be capable of supporting operation of the consolidated and collocated facilities without major modifications to the existing infrastructure. Adequate electrical energy is available from the regional power grid.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Since the existing INEL site infrastructure would be fully capable of supporting construction/modification and operation of facilities for the Upgrade With All or Some RFETS Pu and LANL Pu, Consolidation of Pu, and Collocation of Pu and HEU Alternatives, constructing and operating such facilities without including provisions for storage of strategic reserve and weapons R&D materials could be accommodated as well. Expected reductions in amounts of annual electrical energy requirements for the various storage facilities are the only site infrastructure changes expected if this subalternative is chosen because electric usage is dependant on the amount of material. [Text deleted.]

Phaseout

Because of the relatively small amounts of Pu located on the site, INEL storage operations at ANL-W would be phased out with minimal impact on the site infrastructure.

4.2.3.3 Air Quality and Noise

Construction and operation activities associated with the No Action Alternative and the proposed storage alternatives would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts at INEL, criteria and toxic/hazardous concentrations from the No Action Alternative and the proposed storage alternatives are compared with Federal and State standards and guidelines. Impacts from radiological airborne emissions are described in Section 4.2.3.9.

In general, all of the proposed storage facilities would emit the same types of air pollutants during construction. It is expected emissions would not exceed Federal, State, or local air quality regulations. PM_{10} and TSP concentrations will be increased, especially during peak construction periods.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, and wind erosion of exposed ground surfaces
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

During operation, impacts from each of the individual storage facilities with respect to the concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Table 4.2.3.3–1 presents the estimated pollutant concentrations for each of the fissile materials storage alternatives, indicating little difference between alternatives with respect to impacts on air quality.

Emission rates attributed to operation of the proposed storage facilities are presented in Tables F.1.3–1 to F.1.3–3. [Text deleted.] Air pollutant emission sources associated with operations include the following:

- Operation of boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- Exhaust and road dust generated by vehicles delivering supplies and bringing employees to work
- Toxic/hazardous pollutant emissions from facility processes

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for each storage alternative are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

An analysis was conducted of the potential air quality impacts of emissions from each of the storage alternatives as described in Section 4.1.3.

Section 176 (c) of the 1990 CAA amendments requires that all Federal actions conform with the applicable state implementation plan. EPA has implemented rules that establish the criteria and procedures governing the determination of conformity for all Federal actions in nonattainment and maintenance areas. These are discussed in Section 4.1.3. The attainment status of the area in which INEL is located is discussed in Section 3.4.3. Since

Table 4.2.3.3–1. Estimated Operational Concentrations of Pollutants at Idaho National Engineering Laboratory and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Criteria Pollutants						
Carbon monoxide	8-hour	10,000[b]	284	284.36	285.4	285.6
	1-hour	40,000[b]	614	614.91	617.4	618.1
Lead	Calendar Quarter	1.5[b]	0.001	0.001	0.001	0.001
Nitrogen dioxide	Annual	100[b]	4	4.02	4.73	4.91
Ozone	1-hour	235[b]	[c]	[c]	[c]	[c]
Particulate matter less than or equal to10 microns in diameter	Annual	50[b]	5	5.01	5.05	5.06
	24-hour	150[b]	80	80.14	80.98	81.17
Sulfur dioxide	Annual	80[b]	6	6.04	7.25	7.53
	24-hour	365[b]	135	135.71	158.5	163.7
	3-hour	1,300[b]	579	582.07	681.3	704.2
Mandated by Idaho						
Total suspended particulate	Annual	60[d]	5	5.1	5.05	5.06
	24-hour	150[d]	80	80.4	80.98	81.17
Hazardous and Other Toxic Compounds						
Acetaldehyde	Annual	0.45[e]	0.011	0.011	0.011	0.011
Ammonia	Annual	180[e]	6.0	6.0	6.0	6.0
Arsenic	Annual	0.00023[e]	0.00009	0.00009	0.00009	0.00009
Benzene	Annual	0.12[e]	0.029	0.029	0.029	0.029
1,3-Butadiene	Annual	0.0036[e]	0.001	0.001	0.001	0.001
Carbon tetrachloride	Annual	0.067[e]	0.0060	0.0060	0.0060	0.0060
Chlorine	Annual	30[e]	[f]	<0.01[g]	<0.01[g]	<0.01[g]
Chloroform	Annual	0.043[e]	0.00040	0.00040	0.00040	0.00040
Cyclopentane	Annual	17,000[e]	2.7	2.7	2.7	2.7
Formaldehyde	Annual	0.077[e]	0.012	0.012	0.012	0.012
Hexavalent chromium	Annual	0.000083[e]	0.00006	0.00006	0.00006	0.00006

Table 4.2.3.3–1. Estimated Operational Concentrations of Pollutants at Idaho National Engineering Laboratory and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (Continued)						
Hydrogen chloride	Annual	7.5[e]	0.98	0.98	0.98	0.98
Hydrazine	Annual	0.00034[e]	0.000001	0.000001	0.000004	0.000004
Mercury	Annual	1[e]	0.042	0.042	0.042	0.042
Methylene chloride	Annual	0.24[e]	0.006	0.006	0.006	0.006
Naphthalene	Annual	500[e]	18	18	18	18
Nickel	Annual	0.0042[e]	0.0027	0.0027	0.0027	0.0027
Nitric acid	Annual	50[e]	0.64	0.64	0.64	0.64
Perchloroethylene	Annual	2.1[e]	0.11	0.11	0.11	0.11
Phosphorus	Annual	1[e]	0.30	0.30	0.30	0.30
Phosphoric acid	Annual	10[e]	[f]	<0.01[g]	<0.01[g]	<0.01[g]
Potassium hydroxide	Annual	20[e]	0.20	0.20	0.20	0.20
Proprionaldehyde	Annual	4.3[e]	0.30	0.30	0.30	0.30
Styrene	Annual	1,000[e]	1.3	1.3	1.3	1.3
Sulfuric acid	Annual	10[e]	[f]	<0.01[g]	<0.01[g]	<0.01[g]
Toluene	Annual	3,750[e]	370	370	370	370
Trichloroethylene	Annual	0.077[e]	0.00097	0.00097	0.00097	0.00097
Trimethylbenzene	Annual	1,230[e]	100	100	100	100
Trivalent chromium	Annual	5[e]	0.036	0.036	0.036	0.036

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Federal and State standard.

[c] Ozone, as a criteria pollutant, is not directly emitted or monitored by the candidate site. See Section 4.1.3 for a discussion of ozone-related issues.

[d] State standard or guideline.

[e] Acceptable air concentrations listed in Rules for the Control of Air Pollution in Idaho apply only to new (not existing) sources and are used here only as reference levels.

[f] No sources of this pollutant have been identified.

[g] The concentration represents the alternative contribution only.

Note: Concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from non-facility sources (for example, traffic).

Source: 40 CFR 50; DOE 1995v; DOE 1996e; DOE 1996f; FDI 1996a:1; ID DHW 1995a; ID DHW 1995b; IN DOE 1996a.

the area is considered to be an attainment area for criteria pollutants, the proposed actions at this site do not require that a conformity analysis be performed.

Preferred Alternative: No Action Alternative

This alternative utilizes estimated air emissions data from total site operations at INEL assuming continuation of site missions as described in Section 3.4. These data reflect conservative estimates of criteria and toxic/hazardous emissions at INEL. The emission rates for the criteria and toxic/hazardous pollutants for No Action are presented in Table F.1.2.4–1. Table 4.2.3.3–1 presents the No Action concentrations. During dry and windy conditions, increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside of the scope of this PEIS) under the No Action Alternative. Concentrations of all other criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable Federal, State, and local ambient air quality standards.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

Particulate matter and TSP concentrations are expected to increase during the peak construction period, particularly during dry and windy conditions. Appropriate control measures would be followed to minimize pollutant concentrations during construction. It is expected that concentrations of all pollutants at the site boundary or public access highways would remain within applicable Federal and State ambient air quality standards during construction of new and modified facilities.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.3.3–1. Concentrations of air pollutants are expected to be the same with or without the RFETS and LANL material.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

Air quality impacts for construction and operation for this subalternative are expected to be similar to those previously described for the Upgrade Alternative for INEL.

Consolidation Alternative

Construct New Plutonium Storage Facility

In addition to the types of sources of emissions during construction associated with the No Action and upgrade of storage facilities, fugitive dust resulting from the operation of a concrete batch plant would be an additional emission source associated with a new facility. PM_{10} and TSP concentrations may increase during the peak construction period for a new facility, particularly during dry and windy conditions. Appropriate control measures would be followed to minimize pollutant concentrations during construction. It is expected that

construction period for a new facility, particularly during dry and windy conditions. Appropriate control measures would be followed to minimize pollutant concentrations during construction. It is expected that concentrations of all pollutants at the site boundary or public access highways would remain within applicable Federal and State ambient air quality standards during construction.

During operation, impacts of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.3.3–1.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

The Pu and HEU Collocation Alternative would be located in the same area as the consolidation Pu facility and would have similar air quality impacts, with the following exceptions. During operation, emissions would be higher, as shown in Appendix F. Impacts of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.3.3–1.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Air quality impacts for construction and operation for this subalternative are expected to be similar to those previously described for the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. [Text deleted.]

Phaseout

Phaseout of existing Pu inventories as a result of consolidating Pu at another site is expected to result in a small reduction in air pollutant concentrations from the No Action concentrations and would be in compliance with Federal and State standards.

NOISE

The location of the proposed storage facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy construction equipment and increased traffic. Increased traffic would occur onsite and along offsite local and regional transportation routes used to bring construction materials and workers to the site.

Preferred Alternative: No Action Alternative

Nontraffic noise sources associated with continued storage and other ongoing missions are the same as described in Chapter 3. The continuation of operations at INEL would result in no appreciable change in traffic noise and onsite operational noise sources from current levels. Nontraffic noise sources are located at a sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may be located close enough to onsite noise sensitive areas to result in impacts, such as disturbance of wildlife.

Upgrade, Consolidation, and Collocation Alternatives

Nontraffic noise sources associated with the storage Upgrade Alternative would be similar to those for existing facilities as discussed in Chapter 3. Nontraffic, operational noise sources associated with the storage alternatives include existing or additional equipment and machines (cooling systems, vents, motors, and material handling equipment). These noise sources would be located at a sufficient distance from offsite areas that the contribution to offsite noise levels would be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Noise impacts for construction and operations for this option are expected to be almost the same as those previously described for the Consolidation Alternative and the Collocation Alternative because noise impacts are based on the use of the facility and not the size. [Text deleted.]

Phaseout

A reduction in noise levels associated with facility operations may result from the phaseout of storage facilities.

4.2.3.4 Water Resources

Construction and operation of the proposed long-term storage facilities at INEL would affect water resources. No surface water would be withdrawn for construction or for normal operations. Instead, groundwater from the Snake River Plain Aquifer would be used, which is a sufficient source. Water requirements for normal operation for all storage options would fall within INEL's current allotment (43,000 million l/yr [11,360 million gal/yr]). The site proposed for the upgraded storage facilities would be outside the floodplain that could result from failure of MacKay Dam during a probable maximum flood. The site proposed for the Consolidation or Collocation Alternative, however, falls within that floodplain. During construction, treated sanitary wastewater would be discharged to lined evaporation ponds. While the potential impacts on surface water during the construction phase would result from erosion and sedimentation of drainage channels, the relatively dry climate and application of appropriate controls should preclude these potential impacts. No wastewater would be discharged on surface waters during operation of the facilities, nor would there be impacts on surface water quality from these activities. All wastewater would be treated and recycled for cooling system makeup. Stormwater runoff would be collected and treated, if necessary, before discharge to natural drainage channels. [Text deleted.] Table 4.2.3.4–1 presents No Action water resources uses and discharges and the potential changes to water resources at INEL resulting from the long-term storage alternatives.

Preferred Alternative: No Action Alternative

Surface Water. A description of the activities that would continue at INEL is provided in Section 3.4. Treated wastewater discharged to evaporation/infiltration ponds is expected to continue at a rate of 540 million l/yr (142.7 million gal/yr).

Groundwater. Under this alternative, no additional impacts on groundwater resources are anticipated. Current groundwater usage of 7,949 million l/yr (2,100 million gal/yr) is anticipated to decrease to 7,570 million l/yr (2,000 million gal/yr) by 2005. Existing tritium plumes in groundwater and in perched groundwater are expected to continue to migrate southwest slowly. Studies show that water withdrawals could change the existing plumes' southwesterly direction to the east.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory-West Facilities for Continued Plutonium Storage

Surface Water. There are no unique construction characteristics associated with water requirements and discharges from this alternative. No surface water would be withdrawn for any construction or operation activities associated with any of the proposed upgraded Pu storage facilities. Therefore, there would be no impacts on surface water availability. Nonhazardous wastewater generated during construction and operation of the upgraded Pu storage facilities would be diverted to either the sanitary or industrial waste treatment ponds, where it would be allowed to evaporate into the atmosphere and percolate into the subsurface. It is expected that a total of approximately 4.0 million l/yr (1.1 million gal/yr) of nonhazardous wastewater would be generated during the construction phase. This water would be discharged to the sanitary wastewater treatment ponds, where it would undergo aerobic and anaerobic treatment and then be allowed to evaporate to the atmosphere and percolate into the subsurface under NPDES permit requirements.

Table 4.2.3.4–1. No Action and Potential Changes to Water Resources at Idaho National Engineering Laboratory—No Action (2005) and Storage Alternatives

Affected Resource Indicator	No Action	Upgrade		Consolidation	Collocation	Phaseout
		Without RFETS or LANL Material	With RFETS and LANL Material			
Water Source	Ground	Ground	Ground	Ground	Ground	Ground
Construction						
Water Availability and Use						
Total water requirement (million l/yr)	NA[a]	9.7	12.5	85	104.7	0
Percent increase in projected water use[b]	NA[a]	0.1	0.2	1.1	1.4	0
Water Quality						
Total wastewater discharge (million l/yr)	NA[a]	4.0	6.1	7.8	12.8	0
Percent change in wastewater discharge[c]	NA[a]	0.7	1.1	1.4	2.4	0
Operation						
Water Availability and Use						
Total water requirement (million l/yr)	7,570	17	22	66	87	0
Percent increase in projected water use[d]	0	0.2	0.3	0.9	1.2	0
Water Quality						
Total wastewater discharge (million l/yr)	540	0	0	0	0	0
Percent change in wastewater discharge[e]	0	0	0	0	0	0

Table 4.2.3.4–1. No Action and Potential Changes to Water Resources at Idaho National Engineering Laboratory—No Action (2005) and Storage Alternatives—Continued

Affected Resource Indicator	No Action	Upgrade: Without RFETS or LANL Material	Upgrade: With RFETS and LANL Material	Consolidation	Collocation	Phaseout
Floodplain						
Is action in 100-year floodplain?	NA	No	No	No	No	No
Is critical action in 500-year floodplain?	NA	No	No	Uncertain	Uncertain	No

[a] See operations section of table for No Action water data.

[b] Percent increases in projected water use during construction at INEL are calculated by dividing No Action water requirements (7,570 million l/yr with that for each storage option: upgrade existing storage facility without RFETS or LANL material (9.7 million l/yr), Pu upgrade with all RFETS and LANL material (12.5 million l/yr), consolidate Pu storage facility (85 million l/yr), collocate Pu and HEU storage facility (104.7 million l/yr), and storage phaseout (0 l/yr).

[c] Percent changes in wastewater discharge during construction at INEL are calculated by dividing No Action wastewater discharges (540 million l/yr) with that for each storage option: upgrade existing storage facility without RFETS or LANL material (4.0 million l/yr), Pu upgrade with all RFETS and LANL material (6.1 million l/yr), consolidate Pu storage facility (7.8 million l/yr), collocate Pu and HEU storage facility (12.8 million l/yr), and storage phaseout (0 l/yr).

[d] Percent increases in projected water use during operation at INEL are calculated by dividing No Action water requirements (7,570 million l/yr) with that for each storage option: upgrade existing storage facility without RFETS or LANL material (17 million l/yr), Pu storage upgrade with all RFETS and LANL material (22 million l/yr), consolidate Pu storage facility (66 million l/yr), collocate Pu and HEU storage facility (87 million l/yr), and storage phaseout (0 l/yr).

[e] Present changes in wastewater discharged during operation at INEL are calculated by dividing No Action wastewater discharges (540 million l/yr) with that for each storage option: upgrade existing storage facility without RFETS or LANL material (0 l/yr), Pu storage upgrade with all RFETS and LANL material (0 l/yr), consolidate Pu storage facility (0 l/yr), collocate Pu and HEU storage facility (0 l/yr), and storage phaseout (0 l/yr).

Note: NA=not applicable. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously. During operations wastewater will be recycled.

Source: DOE 1996e; DOE 1996f; IN DOE 1996a; INEL 1995a:1.

[Text deleted.]

During operation, utility, process, and sanitary wastewater for the upgraded Pu storage facilities would be diverted to the sanitary waste treatment ponds, where it would undergo aerobic and anaerobic treatment and then be allowed to evaporate into the atmosphere and percolate into the subsurface. Similarly, cooling system blowdown and stormwater runoff would be diverted to the industrial waste treatment ponds and ANL-W sewage lagoons, where it would be allowed to evaporate or percolate. Industrial and sanitary wastewater treatment pond water is monitored for the parameters specified in the site-specific NPDES permit. If evaporation pond capacity is limited, uncontaminated effluents would be discharged to natural drainage channels. Contaminated effluents would be diverted to, and treated in, the liquid radioactive waste treatment system before disposal.

No construction would occur in areas delineated as 100-year floodplains. The proposed site is also located above the maximum probable flood elevation, which is higher than the 500-year flood elevation. The closest large surface water body, the Big Lost River, is located approximately 16 km (10 mi) west of the proposed site. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. Construction water requirements for the upgraded Pu storage upgrade are small relative to INEL's total usage. As shown in Table 4.2.3.4–1, upgrading the ANL-W facilities would require approximately 9.7 million l/yr (2.6 million gal/yr) of water, which represents a 0.1-percent increase over the projected annual groundwater usage. Annual groundwater requirements for operation of the proposed facilities are estimated to be approximately 17 million l (4.5 million gal), which represents a 0.2-percent increase over the projected No Action groundwater usage. This small increase in overall demand should cause minimal impacts. This would increase the total projected amount to be pumped at INEL to under 18 percent of the total allotment.

Construction and operation of the proposed upgraded Pu storage facilities would not result in direct discharges to groundwater. Treated wastewater discharged to evaporation/infiltration ponds, however, would percolate downward into the groundwater. The water would be monitored and would not be discharged into the ponds until contaminant levels are within the limits specified. Impacts on groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts on groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates. Therefore, the tritium contamination problem in the Snake River Plain Aquifer, as identified in Section 3.4.4, would not be exacerbated by any of the long-term storage alternatives.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory-West Facilities for Continued Plutonium Storage

The Pu storage upgrade using all or some RFETS Pu and LANL Pu material at INEL would increase water discharges during construction by 6.1 million l/yr (1.6 million gal/yr), or 1.1 percent over the projected No Action discharge during construction. During operations, wastewater would be recycled. All other wastewater requirements and floodplain issues of the Pu storage upgrade with RFETS Pu and LANL Pu material are similar to those of the Pu consolidated option. During construction, Pu storage upgrade using RFETS Pu and LANL Pu material would require 12.5 million l/yr (3.3 million gal/yr), or a 0.2-percent increase over projected No Action water use. During operations, 22 million l/yr (5.8 million gal/yr) of water would be required, or a 0.3-percent increase over projected No Action water use.

Water resources impacts for construction and operation upgrading with some RFETS Pu and LANL Pu material are expected to be similar to, but less than, those previously described for the other storage options at INEL.

Consolidation Alternative

Construct New Plutonium Storage Facility

The new consolidated Pu storage facility would be located just outside the ICPP area of INEL. The impacts associated with it are the same as those discussed above for the upgrade of the existing Pu storage area, with the following exceptions.

Sanitary wastewater quantities generated during construction of this alternative would be approximately 7.8 million l/yr (2.1 million gal/yr). These effluents would be discharged to evaporation/infiltration ponds. No impacts are expected. Surface water would not be used for this option, so no impacts on surface water availability would be expected. The groundwater requirements of this option are slightly greater than those for the previous option. This option would require approximately 85 million l/yr (22.5 million gal/yr) and 66 million l/yr (17.4 million gal/yr) of water for construction and operation, respectively. These additional requirements represent 1.1- and 0.9-percent increases, respectively, in the projected No Action annual withdrawals from the Snake River Plain Aquifer and should not cause any impacts on groundwater availability.

The proposed site for this facility falls within the estimated floodplain that could result from failure of the MacKay Dam during a maximum flood, which would be greater than the 500-year flood.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

The new consolidated and collocated storage facilities would be located in the same area as the new storage facility, just outside the ICPP area of INEL. The impacts associated with it are the same as those discussed above, with the following exceptions.

Sanitary wastewater quantities generated during construction and operation of this option would be greater than for the previous option and are approximately 12.8 million l/yr (3.4 million gal/yr). These effluents would be discharged to evaporation/infiltration ponds. During operations, wastewater will be recycled. No impacts are expected. Groundwater requirements during construction and operation of this option would be slightly greater than those for the new Pu storage facility. This option would require approximately 104.7 million l/yr (27.7 million gal/yr) and 87 million l/yr (23 million gal/yr) for construction and operation, respectively. These additional requirements represent 1.4- and 1.2-percent increases, respectively, in the projected No Action annual groundwater withdrawals. These small increases boost the total projected groundwater withdrawal to a maximum of 17.8 percent of the groundwater allotment; there should be no impact on groundwater availability.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Water resource impacts for construction and operation for this option are expected to be slightly less than those previously described for the Pu consolidated and Pu and HEU collocated storage alternatives at INEL because of the reduction in the amount of material. [Text deleted.]

Phaseout

If the current Pu storage mission at INEL was phased out, groundwater withdrawals from the Snake River Plain Aquifer and nonhazardous wastewater discharge to evaporation/percolation ponds would decrease by negligible quantities. No noticeable impacts would occur or be alleviated due to these decreases.

[Text deleted.]

4.2.3.5 Geology and Soils

Construction and operation of the alternatives at INEL would have no impact on the geologic resources. A moderate seismic risk exists, but would be considered in the design of the proposed alternatives. The existing seismic risk does not preclude the safe construction and operation of the proposed alternative facilities. The facilities would be designed for earthquake-generated ground accelerations, in accordance with DOE O 420.1, *Facility Safety*. Because there are no known capable faults at INEL, the potential for ground rupture as a result of an earthquake during the life of a proposed alternative is minimal; ground shaking is more likely. Intensities of approximately VII on the MMI scale are possible but would not affect newly designed facilities. Human health effects from accidents initiated by natural phenomena (for example, earthquakes) are discussed in Section 4.2.3.9. Volcanic activity is improbable during the life of the alternatives and is not anticipated to affect the construction and operation of the alternatives. Lava extrusions could recur with a recurrence probability at approximately once in every 3,000 years. Precursors, such as shallow earthquakes, gas venting activity, and an increase in groundwater temperatures can provide advance warning of most eruption of this type; no such activity is currently indicated at INEL. It is highly unlikely that landslides, sinkhole development, or other nontectonic events would affect project activities. Slopes and underlying foundation materials are generally considered stable. Geologic resources at INEL consist of surficial sand, gravel, or clay deposits that have low economic value. New construction may increase the use of these materials, but because large volumes of these materials are present, the effect to the geologic resource is anticipated to be negligible.

Impacts to the geologic and soil resources occur during, or as a result of, ground-disturbing construction activities. Construction of the alternatives may involve ground-disturbing activities that could affect the soil resources. The amount of land disturbed is specified below for each alternative. Impacts to the soil resource depend on the specific soil units in the disturbed area, the extent of land-disturbing activities, and the amount of soil disturbed. Control measures would be employed to minimize soil erosion. Within INEL, the soil erosion potential is directly related to the amount of land disturbed because soil and climatic conditions are similar throughout the site.

[Text deleted.]

Preferred Alternative: No Action Alternative

Under the No Action Alternative, DOE would continue current and ongoing activities at INEL. There would be no ground-disturbing activities beyond those associated with existing and future site improvements. Because no new construction and the associated ground disturbance for potential soil erosion would occur, the No Action Alternative would have no effect on the soil resources at the site.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory-West Facilities for Continued Plutonium Storage

No apparent direct or indirect effects on the geologic resource are anticipated because neither facility construction and operation activity nor site infrastructure improvements will restrict access to potential geologic resources. Design of the facilities would ensure that they would not be affected by potentially hazardous geologic conditions.

Construction activities will occur completely on previously disturbed land, as described in Section 4.2.3.1, and involve land disturbance of approximately 9 ha (22 acres). Soil disturbance would occur primarily from ground-

disturbing construction activities (foundation preparation) and activities associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increases in wind velocity and duration increase potential soil erosion), and the size, location, and duration of ground-disturbing activities.

Net soil disturbance during operations would be considerably less than during construction because areas temporarily used for construction laydown would be restored. Although stormwater runoff and wind action could occur during operation, they are anticipated to be minimal. [Text deleted.]

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory-West Facilities for Continued Plutonium Storage

Construction and operation effects on geological and soil resources would be the same as those discussed previously for the upgrade without RFETS or LANL Pu Subalternative, because the inclusion or exclusion of RFETS and LANL Pu material would not change the amount of land disturbed during construction.

Consolidation Alternative

Construct New Plutonium Storage Facility

No apparent direct or indirect effects on the geologic resources are anticipated, because neither facility construction and operational activities nor site infrastructure improvements will limit access to potential geologic resources.

[Text deleted.] Additional soil impacts would be expected from the construction of the storage facility, which will occur completely on undisturbed land, as described in Section 4.2.3.1. Approximately 58.5 ha (144 acres) would be disturbed for the Consolidation Alternative, affecting the soil profile and leading to a possible increase in erosion. Analysis in this section is the same as that provided for the Upgrade Alternative.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

No apparent direct or indirect effects on the geologic resource are anticipated, because neither facility construction and operational activities nor site infrastructure improvements will restrict access to potential geologic resources.

[Text deleted.] Construction of the storage facilities would occur on undisturbed land as described in Section 4.2.3.1. However, additional soil impacts would be anticipated because this alternative has the largest construction and land use requirements. During construction, approximately 89.5 ha (221 acres) would be disturbed for the new facilities, affecting the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil impacts during operation are expected to be minimal. Analysis in this section is the same as that provided for the Upgrade Alternative.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Exclusion of strategic reserve and weapons R&D materials would give almost the same effects to the soil resources for the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative. By excluding these materials the size of a facility would be similar, thus not changing the amount of land disturbed by construction activities. No effect to the geologic resource is anticipated as a result of this subalternative.

Phaseout

The phaseout of storage capacity would have no apparent effects on the geologic resources. However, phaseout could result in beneficial effects on the soils of the area. Hazardous, radioactive, and mixed waste sources would be eliminated from the area, thus decreasing the potential for future soil contamination.

[Text deleted.]

4.2.3.6 Biological Resources

Preferred Alternative: No Action Alternative

Under this alternative, the Pu storage mission described in Section 2.2.3 would continue at INEL. These activities would result in no appreciable change to current conditions of biological resources at INEL, as described in Section 3.4.6.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

Upgrading existing Pu storage facilities at the ANL-W area of INEL would cause minimal disturbance to biological resources. This is because all activities, including some new construction, would take place within an area that is currently disturbed. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the current facility would have already adapted to its presence. Impacts on wetlands and aquatic resources would not occur since these resources are not found in the upgrade area, and all discharges would be to existing evaporation ponds. Since the upgrade would take place within a developed area, impacts on threatened and endangered species would not be expected.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

Upgrading with all or some of the RFETS and LANL materials stored at INEL would not be expected to change impacts on biological resources from those described for the Upgrade without RFETS Pu or LANL Pu Subalternative.

Consolidation Alternative

Construct New Plutonium Storage Facility

Under this alternative, Pu reserves would be consolidated in a new storage facility at INEL. Impacts on terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction of the Consolidated Pu storage facility would result in the disturbance of 58.5 ha (144 acres) of terrestrial resources, or less than 0.03 percent of INEL. This includes areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation within the proposed site would be destroyed during land-clearing operations. Big sagebrush is the dominant plant within the proposed site. Plant communities in which big sagebrush is the dominant overstory species are well represented on INEL, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture.

Construction of the Pu storage facility would affect animal populations. Less-mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise

would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources, which could lead to habitat degradation and eventual loss of the excess population. Because pronghorn use of the proposed site is relatively low, the facility should not have a lasting impact on these species. Nests and young animals living within the proposed site may not survive. The site would be surveyed as necessary for the nests of migrating birds prior to construction. Areas disturbed by construction but not occupied by facility structures would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human activity, could affect wildlife living immediately adjacent to the Pu storage facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas. Impacts on vegetation from salt drift would not occur since dry cooling systems would be used.

Wetlands. Construction and operation of the Pu storage facility would not affect wetlands since there are no wetlands on the proposed site. Wetlands associated with the Big Lost River are located 2.4 km (1.5 mi) from the site, so impacts on these wetlands are not expected.

Aquatic Resources. Construction and operation of the Pu storage facility would not affect aquatic resources since there are no surface water bodies on the proposed site. The nearest surface water body is in the Big Lost River, which is located 2.4 km (1.5 mi) from the site. Temporary aquatic habitat may develop in evaporation and retention ponds, as well as in natural channels in the immediate vicinity of NPDES-permitted outfalls.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species would be affected by construction of the Pu storage facility on INEL, but several State-status species may be affected. Up to 58.5 ha (144 acres) of habitat would be lost. Burrows and foraging habitat for the pygmy rabbit would be lost. Bat species such as the Townsend's western big-eared bat may roost in caves and forage throughout the proposed site. One State-listed sensitive plant species could potentially be affected by construction of the facility. The plant species, treelike oxytheca, has been collected at eight sites on INEL and at only two other sites in Idaho (IN DOE 1984a:34,36). If present, individual plants of this species could be destroyed during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the presence of these species in the area to be disturbed. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate.

During operation of the new facilities, several bat species could forage at evaporation and stormwater retention ponds. No impacts on threatened and endangered species are expected due to facility operation.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Under this alternative, consolidated Pu reserves would be stored with HEU inventories in a new collocated storage facility(s) at INEL. Construction and operation of collocated storage facilities at INEL would have effects on biological resources similar to, but somewhat greater than, those described for the consolidated storage facility. Construction of the collocated storage alternative would disturb 89.5 ha (221 acres) of habitat.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve and weapons R&D materials would have almost the same effects to the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the

Collocation Alternative. The size of the facility would be similar and would not reduce the amount of habitat disturbance, and the potential impacts on biological resources would be similar. [Text deleted.]

Phaseout

The phaseout of Pu storage facilities at INEL would not be expected to affect biological resources, although increased human activity could temporarily disturb some wildlife species in the vicinity of the site.

4.2.3.7 Cultural and Paleontological Resources

Preferred Alternative: No Action Alternative

Under this alternative, DOE would continue the existing and planned missions at INEL, which include continued storage of Pu material at ANL-W within the ZPPR and FMF vaults in stabilized form pursuant to DNFSB Recommendation 94-1. Management of INEL's cultural resources is done within the framework of the *INEL Draft Management Plan for Cultural Resources* (DOE/ID-10361, July 1995). Any impacts on cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate NHPA, *American Indian Religious Freedom Act*, and *Native American Graves Protection and Repatriation Act* regulatory compliance procedures.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

The new ANL-W facility is the proposed storage area under this alternative. This option involves new construction and modification of buildings 704, 774, and 775. [Text deleted.] Most of the land required for construction and operation has already been disturbed. Surface surveys have been conducted in some of the areas to be affected. In accordance with INEL's *Draft Management Plan for Cultural Resources*, surveys would be conducted in unsurveyed areas prior to construction. Discovery of any archaeological materials during construction would result in a work stoppage. Prehistoric site types that are known to occur at INEL include campsites, lithic workshops, cairns, and hunting blinds. Remains of small homesteads, sheep and cattle camps, stage and wagon trails, and abandoned towns comprise the historic component of archaeological resources at INEL. Any number of these may occur in areas slated for development. In addition, all of the facilities at INEL are considered potentially eligible for listing on the NRHP. Most have not yet been formally evaluated. These properties are managed within a framework established by DOE, the Idaho SHPO, and the Advisory Council on Historic Preservation.

Some Native American resources, such as archaeological sites and traditionally used plant and animal species, may be affected by construction of new facilities. Operation may affect other resources in the form of reduced access to traditional use areas and visual or auditory impact to sacred sites. The entire INEL site is considered sacred land to the Shoshone Bannock Tribe. DOE has established a Working Agreement with this group and consultation with them may identify resources that may be affected by the proposed alternative.

Although surface exposures of fossiliferous formations do not exist in the proposed location, ground-breaking construction could affect some paleontological resources. There are 31 known fossil localities at INEL, and more may exist. These materials sometimes occur in association with prehistoric archaeological sites and have high research potential.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

Land requirements during construction and operation would not change under this subalternative. Impacts on cultural and paleontological resources with all or some RFETS and LANL material would be the same as described in the Upgrade Without RFETS Pu or LANL Pu Subalternative.

Consolidation Alternative

Construct New Plutonium Storage Facility

A consolidated special nuclear material storage plant would be constructed southeast of the Big Lost River and ICPP. Land disturbance during construction would total approximately 58.5 ha (144 acres), and the operational land disturbance would be 56 ha (138 acres). A reduced-access buffer zone would exist around the facility. Five km (3 mi) of new road or railway may be necessary under this alternative. [Text deleted.] Impacts on cultural and paleontological resources that may result from facility construction and operation under this alternative are similar to those that would occur under the Upgrade Alternative, even though the location is different.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

The area disturbed during construction would be 89.5 ha (221 acres), and new facilities would be collocated with the consolidated special nuclear material storage plant. The total operational land requirement would be 87 ha (215 acres). A reduced-access buffer zone would be created around the new facilities. [Text deleted.] Impacts on cultural and paleontological resources that may result from construction and operation under this alternative are similar to those discussed under the Upgrade Alternative, even though the locations differ.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, facility and other resource requirements would be almost the same as the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. Therefore, impacts on cultural and paleontological resources would be equal to those previously discussed. [Text deleted.]

Phaseout

For this activity, all the Pu materials at INEL within the scope of this PEIS would be transferred to another site, and the storage mission would be phased out. Impacts on prehistoric resources are not anticipated because phaseout is not expected to result in ground-breaking activity. Likewise, no impacts on paleontological remains are expected. It may affect, through alteration, if subsequently proposed, some NRHP-eligible historic structures at INEL. Impacts on Native American resources are not expected.

[Text deleted.]

4.2.3.8 Socioeconomics

Preferred Alternative: No Action Alternative

Regional Economy Characteristics. Total employment in the REA is projected to increase approximately 2 percent annually between 1995 and 2000, reaching about 152,600 in the latter year. Long-term projections indicate slower growth after the year 2000, when employment would increase about 1 percent annually and reach approximately 202,500 in 2040. Unemployment in the REA was 5.4 percent in 1994 and is expected to remain at this level into the near future. Per capita income is projected to increase from approximately $17,701 in 1995 to $24,177 in 2040. Projections for the No Action Alternative are presented in Table L.1–28.

Population and Housing. Population in the ROI is projected to increase from approximately 215,300 in 1995 to 304,500 by 2040. The total number of housing units in the ROI is projected to increase from about 74,600 in 1995 to 105,600 in 2040. Population and housing projections for the No Action alternative are presented in Tables L.1–29 and L.1–30, respectively.

Community Services. Education, public safety, and health care characteristics are used to assess the level of community services in the INEL ROI. School enrollments are projected to increase from about 53,460 students in 1995 to 75,630 students by 2040. The current student-to-teacher ratio is 18.5:1. To maintain this service level, the number of teachers in the ROI would need to increase from approximately 2,890 in 1995 to 4,084 in 2040. These projections are presented in Tables L.1–31 and L.1–32.

The projected numbers of sworn police officers and firefighters serving in ROI communities over the period 1995 to 2040 are shown in Tables L.1–33 and L.1–34, respectively. Under No Action, the number of sworn police officers is projected to increase from approximately 344 in 1995 to 487 in 2040 to maintain the current service level of 1.6 sworn officers per 1,000 persons. The number of firefighters in the ROI would need to increase from about 465 in 1995 to 657 in 2040 to maintain the present service level of 2.2 firefighters per 1,000 persons.

Hospital occupancy rates are based on current capacity. These rates and the estimated number of physicians serving the ROI population between 1995 and 2040 are presented in Tables L.1–35 and L.1–36, respectively. Hospital occupancy rates are projected to increase from approximately 51 percent in 1995 to 72 percent in 2040. To maintain the current physician-to-population ratio of 1.2 physicians per 1,000 persons, the total number of physicians in the ROI would need to increase from approximately 267 in 1995 to 378 in 2040.

Local Transportation. Any increases in traffic would be due to projected growth in the area unrelated to DOE activities. [Text deleted.]

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

Upgrading existing Pu storage facilities at INEL, without RFETS or LANL material, would create minimal changes within the region. Construction of the facility would require 122 workers, and 81 new employees would be needed to operate the upgraded facility. There would be sufficient labor available in the REA to fill both direct and indirect jobs created from this subalternative. Therefore, no workers would in-migrate to the region and no change to the region's population would result beyond No Action projections.

Regional Economy Characteristics. Construction would generate a total of 248 jobs (122 direct and 126 indirect). Operation would generate a total of 298 jobs (81 direct and 217 indirect). [Text deleted.] Total employment would increase by much less than 1 percent during both construction and operation of the facility. Unemployment would decline from 5.4 percent to 5.2 percent during both construction and operation. Per capita income would increase by much less than 1 percent over the No Action Alternative during both phases (Socio 1996a).

Population, Housing, and Community Services. All newly created employment would be filled by the resident labor force. Therefore, there would be no change to the region's population beyond the No Action level. Accordingly, there would be minimal impacts on the housing sector or community services as a result of the construction and operation of this facility.

Local Transportation. A total of 234 and 156 vehicle trips per day would be generated during the construction and operation phases, respectively. There would be no significant impacts to the local road network during either phase (Socio 1996a).

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

Under this option, all or a portion of the RFETS and LANL material would be transferred to INEL. Depending on the modifications required at INEL, between 122 and 144 onsite workers would be employed during construction of the facility. An additional 126 to 148 indirect jobs would also be generated. There would be sufficient available labor in the REA to fill both direct and indirect jobs generated as a result of construction of the upgraded facility. Because constructing a storage facility to include all of the RFETS and LANL material would require at maximum only 22 more workers than a facility that would include none of the material, socioeconomic impacts would be similar to those for the Upgrade Without RFETS Pu or LANL Pu Subalternative.

During the operation phase, 116 workers would be employed if all of the RFETS and LANL material was stored at INEL. However, 35 of these positions would be filled by existing INEL employees. Therefore, only 81 new positions would be created for the operation of the upgraded facility with RFETS and LANL material, which is the same number of personnel required for upgrade without RFETS or LANL material. Therefore, the magnitude of socioeconomic effects for this subalternative would be the same as those discussed above for the Upgrade Without RFETS Pu or LANL Pu Subalternative.

Consolidation Alternative

Construct New Plutonium Storage Facility

To consolidate storage of Pu currently stored at multiple DOE sites, a new storage facility would need to be constructed at INEL. Workers would in-migrate to fill a portion of the direct jobs created during construction and operation of this facility.

Regional Economy Characteristics. Construction would generate a total of 2,237 jobs (1,102 direct and 1,135 indirect). Operation would generate a total of 1,591 jobs (432 direct and 1,159 indirect). Total employment would increase slightly more than 1 percent for construction and approximately 1 percent for operation over No Action projections. Unemployment would decrease to 4.4 percent during construction and 4.5 percent during operation. Per capita income is projected to increase by less than 1 percent for construction and operation (Socio 1996a).

Population and Housing. The in-migration of workers during the construction and operation periods would increase the ROI population by less than 1 percent over No Action projections. The largest increase would occur during construction. Some new housing may be needed. However, expected vacancies and historic housing construction rates indicate that housing would be available to accommodate the population growth (Socio 1996a).

Community Services. The ROI population growth would slightly increase the demand for some community services. Worker in-migration would lead to an increase in ROI school enrollments by about 423 students during construction and 35 students during operation. To maintain the No Action student-to-teacher ratio of 18.5:1, the number of teachers would have to increase by 23 during the construction period and only two during operation (Socio 1996a). Since this additional need for teachers would be distributed over the various jurisdictions in the ROI, the effect on any single school district would be minimal.

To maintain current levels of service, only three police officers and four firefighters would need to be hired during the construction period. No additional police officers or firefighters would be required to maintain current service levels during operation (Socio 1996a).

The small population change would have a negligible effect on health services, increasing hospital occupancy by much less than 1 percent during construction and operation. The number of physicians in the ROI would need to increase by only two during construction to maintain the current service level. No additional physicians would be needed during operation (Socio 1996a).

Local Transportation. A total of 2,116 and 829 vehicle trips per day would be generated during the construction and operation phases, respectively. Construction would cause a drop in the level of service on U.S. 20/26 from U.S. 26 East to State Route 22/33. U.S. 20/26 level of service would change from B to C. Traffic generated from facility operations would not affect the level of service on the local road segments analyzed (Socio 1996a).

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

To collocate storage of Pu and HEU that is currently stored at multiple DOE sites, a new storage facility would need to be constructed at INEL. Workers would in-migrate to fill a portion of the direct jobs created during construction and operation of this facility.

Regional Economy Characteristics. Construction would generate a total of 2,932 jobs (1,444 direct and 1,488 indirect). Operation would generate a total of 2,066 jobs (561 direct and 1,505 indirect). Total employment would increase by about 2 percent for construction and slightly more than 1 percent for operation over No Action projections. Unemployment would decrease to 4.2 percent during construction and operation. Per capita income is projected to increase by less than 1 percent during construction and by about 1 percent during operation (Socio 1996a).

Population and Housing. The in-migration of workers during the construction and operation periods would increase the ROI population by slightly more than 1 percent and much less than 1 percent over No Action projections, respectively. The largest growth would occur during construction. Some new housing may be needed. However, expected vacancies and historic housing construction rates indicate that housing would be available to accommodate the population growth (Socio 1996a).

Community Services. The additional population would slightly increase the demand for some community services. Worker in-migration would lead to an increase in ROI school enrollments by about 646 students during construction and 82 students during operation. To maintain the No Action student-to-teacher ratio of 18.5:1, the

number of teachers would have to increase by 35 during the construction period and by 4 during operation (Socio 1996a). Since this additional need for teachers would be distributed over the various jurisdictions in the ROI, the effect on any single school district would be minimal.

To maintain No Action levels of service, four police officers and six firefighters would need to be hired during the construction period. Only one additional police officer and firefighter would be required to maintain current service levels during operation (Socio 1996a).

The small population increase would have a negligible effect on health services, increasing hospital occupancy by much less than 1 percent during construction and operation. The number of physicians in the ROI would need to increase by four during peak construction to maintain the No Action level of service. No additional physicians would be needed during operation (Socio 1996a).

Local Transportation. A total of 2,772 and 1,077 vehicle trips per day would be generated during the construction and operation phases, respectively. Traffic generated during construction would cause a drop in the level of service on U.S. 20 from U.S 26/91 at Idaho Falls to U.S. 26 East. The level of service would change from D to E. The level of service on U.S. 20/26 from U.S. 26 East to ID 22/33 would change from B to C. Traffic generated from facility operations would not affect the level of service on the local road segments analyzed (Socio 1996a).

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The requirements for each storage option considered would decrease slightly if strategic reserve and weapons R&D materials were not included for storage at INEL. This should result in a decrease in the number of required operation employees for each of the considered alternatives. Therefore, socioeconomic effects on the REA/ROI for the storage alternatives with no strategic reserve and weapons R&D materials should be equal to, or somewhat less than, the Upgrade with All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. [Text deleted.]

Phaseout

Phasing out Pu storage at INEL would result in no loss of jobs in the REA. Only four to five workers are employed in this storage area, and they would be relocated to other areas. Thus, the socioeconomic effects for the phaseout alternative would be the same as discussed under No Action.

4.2.3.9 Public and Occupational Health and Safety

The assessments of potential radiological and chemical impacts associated with the storage alternatives at INEL are presented in this section. Summaries of radiological impacts from normal operations are presented in Tables 4.2.3.9–1 and 4.2.3.9–2 for the public and workers, respectively. Impacts from hazardous chemicals are presented in Table 4.2.3.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.2.3.9–4 through 4.2.3.9–7. Detailed results are presented in Appendix M.

Preferred Alternative: No Action Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from normal operations involved with the sitewide INEL missions, including interim storage of Pu. The impacts would be within applicable regulatory limits. For facility accidents, the risks and consequences are described in site safety documentation.

Normal Operation. The current mission at INEL, where Pu is in interim storage, is described in Section 3.4. The site has identified those facilities that will continue to operate under the No Action Alternative, including interim Pu storage facilities and others, if any, that will become operational by 2005. Based on that information, the radiological and chemical releases to the environment in 2005 and beyond (future operation) were developed and used in the impact assessments. The resulting doses and potential health effects on the public and workers at INEL are described below.

Under No Action Alternative, weapons-usable Pu material at ANL-W would continue to be stored in the material forms deemed most stable according to the ANL-W Plutonium ES&H Vulnerability Assessment Plan (October 31, 1994).

Radiological Impacts. The calculated annual dose to the average and maximally exposed members of the public from total site operation; the associated fatal cancer risks to these individuals from 50 years of operation; the dose to the population within 80 km (50 mi) from total site operation in the year 2030; and the projected number of fatal cancers in this population from 50 years of operation are presented in Table 4.2.3.9–1 under this alternative at INEL. The annual dose of 0.018 mrem to the MEI is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 4.4×10^{-7}. This activity would be included in a program to ensure that doses to the public are ALARA. The annual dose of 2.4 person-rem to the population would be within the limit in proposed 10 CFR 834. The corresponding number of fatal cancers in this population from 50 years of operation would be 0.061. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

Under the No Action Alternative, shown in Table 4.2.3.9–2, the annual average dose to a noninvolved (No Action) site worker and the annual dose to the noninvolved (No Action) total site workforce would be 30 mrem and 220 person-rem, respectively, for total site operations. The associated risk of fatal cancer to the average worker from 50 years of total site operations would be 6.0×10^{-4} and the projected number of fatal cancers among all workers from 50 years of total size operations would be 4.4.

The average annual average dose to a worker involved in the No Action storage operations would be 26 mrem/yr with a total involved No Action workforce dose of 1.5 person-rem. The associated risk of latent fatal cancer to the average No Action involved worker from 50 years of operation would be 5.1×10^{-4} and the projected number of latent fatal cancers among the No Action involved workforce from 50 years of operation would be 0.029.

Hazardous Chemical Impacts. Hazardous chemical impacts on the public resulting from the normal operation under No Action at INEL are presented in Table 4.2.3.9–3. The hazardous chemical impacts from current site

Table 4.2.3.9–1. Potential Radiological Impacts to the Public During Normal Operation at Idaho National Engineering Laboratory—No Action and Storage Alternatives

Receptor	No Action		Upgrade		Consolidation		Collocation	
	Storage Facilities	Total Site	Storage Facilities	Total Site[a]	Storage Facility	Total Site[a]	Storage Facility	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]								
Atmospheric release pathway (mrem)	$1.4x10^{-5}$	0.018	$5.1x10^{-7}$	0.018	$1.6x10^{-6}$	0.018	$1.6x10^{-6}$	0.018
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0
Total liquid release pathway (mrem)	0	0	0	0	0	0	0	0
Atmospheric and liquid release pathways combined (mrem)	$1.4x10^{-5}$	0.018	$5.1x10^{-7}$	0.018	$1.6x10^{-6}$	0.018	$1.6x10^{-6}$	0.018
Percent of natural background[c]	$4.1x10^{-6}$	$5.2x10^{-3}$	$1.5x10^{-7}$	$5.2x10^{-3}$	$4.7x10^{-7}$	$5.2x10^{-3}$	$4.7x10^{-7}$	$5.2x10^{-3}$
50-year fatal cancer risk	$3.5x10^{-6}$	$4.4x10^{-7}$	$1.3x10^{-11}$	$4.4x10^{-7}$	$4.0x10^{-11}$	$4.4x10^{-7}$	$4.0x10^{-11}$	$4.4x10^{-7}$
Population Dose Within 80 Kilometers for Year 2030[d]								
Atmospheric release pathway (person-rem)	$7.6x10^{-5}$	2.4	$3.2x10^{-6}$	2.4	$1.8x10^{-5}$	2.4	$1.8x10^{-5}$	2.4
Total liquid release pathway (person-rem)	0	0	0	0	0	0	0	0
Atmospheric and liquid release pathways combined (person-rem)	$7.6x10^{-5}$	2.4	$3.2x10^{-6}$	2.4	$1.8x10^{-5}$	2.4	$1.8x10^{-5}$	2.4
Percent of natural background[c]	$8.4x10^{-8}$	$2.7x10^{-3}$	$3.5x10^{-9}$	$2.7x10^{-3}$	$2.0x10^{-8}$	$2.7x10^{-3}$	$2.0x10^{-8}$	$2.7x10^{-3}$
50-year fatal cancers	$1.9x10^{-6}$	0.061	$7.2x10^{-8}$	0.061	$4.5x10^{-7}$	0.061	$4.5x10^{-7}$	0.061
Annual Dose to the Average Individual Within 80 Kilometers[e]								
Atmospheric and liquid release pathways combined (mrem)	$2.8x10^{-7}$	$8.9x10^{-3}$	$1.2x10^{-8}$	$8.9x10^{-3}$	$6.7x10^{-8}$	$8.9x10^{-3}$	$6.7x10^{-8}$	$8.9x10^{-3}$
50-year fatal cancer risk	$7.1x10^{-12}$	$2.2x10^{-7}$	$2.9x10^{-13}$	$2.2x10^{-7}$	$1.7x10^{-12}$	$2.2x10^{-7}$	$1.7x10^{-12}$	$2.2x10^{-7}$

[Text deleted.]

[a] Includes impacts from No Action facilities.The location of the MEI may be different under No Action than for the other alternatives. Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[Text deleted.]

[c] The annual natural background radiation level at INEL is 338 mrem for the average individual; the population within 80 km in the year 2030 receives 90,800 person-rem.

[d] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[e] Obtained by dividing the population dose by the number of people projected to live within 80 km of the site in 2030 (269,000).

Source: Section M.2.

Table 4.2.3.9–2. Potential Radiological Impacts to Workers During Normal Operation at Idaho National Engineering Laboratory—Storage Alternatives

Receptor	No Action[a]	Upgrade[b]	Consolidation[b]	Collocation[b]
Involved Workforce[c]				
Average worker dose (mrem/yr)[d]	26	405	258	264
50-year risk of fatal cancer	5.1×10^{-4}	8.1×10^{-3}	5.2×10^{-3}	5.3×10^{-3}
Total dose (person-rem/yr)	1.5	18	24	25
50-year fatal cancers	0.029	0.36	0.48	0.50
Noninvolved Workforce[e]				
Average worker dose (mrem/yr)[d]	30	30	30	30
50-year risk of fatal cancer	6.0×10^{-4}	6.0×10^{-4}	6.0×10^{-4}	6.0×10^{-4}
Total dose (person-rem/yr)	219	219	219	219
50-year fatal cancers	4.4	4.4	4.4	4.4
Total Site Workforce[f]				
Dose (person-rem/yr)	220	237	243	244
50-year fatal cancers	4.4	4.8	4.9	4.9

[a] No Action storage worker doses are based on an average of 1994 to 1996 measured doses for 57 workers totaling 1.5 person-rem/year deep (assumed whole body) dose (ANL 1996a:1).

[b] Under the upgrade alternative, 81 involved workers (of which 42 are badged with dosimeters to monitor radiation exposure) would be required to operate the storage facilities, with an estimated additional 35 involved workers (3 badged) needed if Pu is transferred from RFETS and LANL. The impacts given in the Upgrade column include those associated with these additional workers. The number of involved badged workers for the Consolidation and Collocation Alternatives would be 92 and 95, respectively.

[c] The involved worker is a worker associated with operations of the proposed action. The maximum dose to an involved worker would be kept below 500 mrem per year. An effective ALARA program will ensure that exposure will be reduced to that level which is as low as reasonably achievable.

[d] The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the site must make reasonable attempts to maintain worker doses below this level.

[e] The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The projected number of noninvolved badged workers in 2005 is 7,337. The Noninvolved Workforce is equivalent to the site No Action workforce.

[f] The impact on the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Table 4.2.3.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation at Idaho National Engineering Laboratory—No Action (2005) and Storage Alternatives

	No Action	Upgrade		Consolidation		Collocation	
Receptor	Total Site[a]	Facilities[b]	Total Site[a]	Facility[b]	Total Site[a]	Facility[b]	Total Site[a]
Maximally Exposed Individual (Public)							
Hazard index[c]	1.5×10^{-2}	1.2×10^{-5}	1.5×10^{-2}	4.5×10^{-5}	1.5×10^{-2}	7.7×10^{-5}	1.5×10^{-2}
Cancer risk[d]	3.6×10^{-6}	5.9×10^{-8}	3.7×10^{-6}	5.9×10^{-8}	3.7×10^{-6}	5.9×10^{-8}	3.7×10^{-6}
Worker Onsite							
Hazard index[e]	0.22	3.7×10^{-4}	0.22	1.3×10^{-3}	0.22	1.9×10^{-3}	0.22
Cancer risk[f]	7.7×10^{-4}	1.2×10^{-5}	7.8×10^{-4}	1.2×10^{-5}	7.8×10^{-4}	1.2×10^{-5}	7.8×10^{-4}

[Text deleted.]

[a] Total=Sum of the No Action plus the contributions of the above activity.

[b] Contribution from the above activity only (that is, the amount of increase over the existing, No Action level at the site).

[c] Hazard index for MEI=Sum of Individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer risk for MEI=(Emissions for 8-hr) x (0.286 [Converts concentrations to doses]) x (Slope Factor [SF]).

[e] Hazard index for workers=Sum of Individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer risk for workers=(Emissions for 8-hr) x (0.286 [Converts concentrations to doses]) x (0.237 [Fraction of year exposed]) x (0.571 [Fraction of lifetime working]) x (SF).

Source: Section M.3, Tables M.3.4–10 through M.3.4-13.

operations represent the baseline total site impacts for the various storage alternatives. The noncancer health effects expected and the risk of cancer due to the total chemical exposures were estimated for each site. Since the major releases due to normal operation at INEL would make up nearly all of the exposures to onsite workers and to the public in adjacent communities, contributions to the hazardous chemical concentrations from all other sources (for example, industrial operations) are considered negligible for purposes of risk calculations.

The HI to the MEI of the public at INEL resulting from normal operation under the No Action Alternative is 1.5×10^{-2}, and the cancer risk is 3.6×10^{-6}. The HI to the onsite worker is 0.22, and the cancer risk is 7.7×10^{-4}.

Facility Accidents. Under the No Action alternative, Pu would continue to be stored at INEL in existing facilities. These facilities currently operate in accordance with DOE Orders, which ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations will be minimized. The safety to workers and the public from accidents at existing facilities is also controlled by Technical Safety Requirements specified in detail in SARs or a Basis for Interim Operations document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities would cause a halt in operations until it can be established that worker and public safety has not been compromised.

The *Final Safety Analysis Report for the Fuel Manufacturing Facility, Building 704* (ANL-IFR-57) and the *Final Safety Analysis Report of the Zero Power Plutonium Reactor Facility* (ANL-7471) at ANL-W analyzed a wide spectrum of design-basis accidents. These studies indicate that these facilities are low hazard based on the effects of design-basis accidents. However, these studies do not normally analyze the effects of severe accidents. An estimate of the effects of potential severe accidents in the existing storage vault at INEL can be derived from similar storage accidents that have been postulated for an upgraded storage facility. A severe consequence, low frequency accident for storage under the No Action Alternative would be a beyond design basis earthquake. If this accident were to occur, there would be an estimated 0.33 cancer fatalities in the offsite population within 80 km (50 mi). The estimated frequency of the earthquake with sufficient damage to cause a release is approximately 1.0×10^{-7} per year, which corresponds to a risk of 3.3×10^{-8} cancer fatalities per year. For the MEI and noninvolved worker, the corresponding impacts are 9.8×10^{-4} and 0.02 latent cancer fatalities, respectively, if the accident occurred. The risks would be 9.8×10^{-11} and 2.0×10^{-9} cancer fatalities per year. A potentially more frequent accident is penetration of the PCV caused by corrosion. If this accident were to occur, the estimated number of cancer fatalities in the offsite population would be 5.1×10^{-4} The estimated frequency of this accident is 0.064 per year, which corresponds to a risk to the offsite population of 3.3×10^{-5} cancer fatalities per year. For the MEI and noninvolved worker the corresponding impacts are 1.6×10^{-6} and 2.3×10^{-5} latent cancer fatalities, respectively, if the accident occurred. The risks would be 1.0×10^{-7} and 1.5×10^{-6} cancer fatalities per year.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the upgraded Pu storage alternative at INEL. The section describes the impacts from normal facility operations at INEL; this is followed by a description of impacts from facility accidents.

[Text deleted.]

Normal Operation. There would be no radiological releases during the modification or construction of storage facilities at INEL. Construction worker exposures to materials potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct exposures. The resulting doses and potential health effects on the public and workers at INEL are described below.

Radiological Impacts. Doses to the public from storage under the Upgrade Alternative are included in Table 4.2.3.9–1. Because facility and design features would improve under the Upgrade Alternative, these doses and resulting fatal cancers are surmised to be even smaller than those associated with storage under the No Action alternative. The dose to the MEI of the public due to annual operations under the Upgrade Alternative would be 5.1×10^{-7} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.3×10^{-11}. The impacts to the average individual would be less. As a result of operation under this alternative in the year 2030, the population dose would be 3.2×10^{-6} person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 7.2×10^{-8}.

The dose to the MEI from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 0.018 mrem. From 50 years of operations, the corresponding risk of fatal cancer to this individual would be 4.4×10^{-7}. These values are presented in Table 4.2.3.9–1. The impacts on the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operations in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 2.4 person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 0.061.

Doses to onsite workers from normal operations are given in Table 4.2.3.9–2. Included are involved workers directly associated with upgraded storage, workers who are not involved with the storage facilities, and the entire workforce at INEL. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operations are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemical impacts on the public and on the onsite worker resulting from the normal operations of the upgraded storage facilities at INEL are presented in Table 4.2.3.9–3. The impacts from total site operations, including the upgraded storage facilities, are also included in this table. Total site impacts, which include the No Action impact plus the storage impacts, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 1.2×10^{-5}, and the cancer risk is 5.9×10^{-8} as a result of operation of the upgraded storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation because exposures would be expected to remain the same. The total site operation, including the storage facilities, would result in an HI of 1.5×10^{-2} and a cancer risk of 3.7×10^{-6} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 3.7×10^{-4}, and the cancer risk is 1.2×10^{-5} as a result of operation of the upgraded storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation because exposures are expected to remain the same. The total site operation, including the storage facilities, would result in an HI of 0.22 and a cancer risk of 7.8×10^{-4} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. Modification of the existing Pu storage facilities at INEL may change the existing risks of accidents to workers and the public. ANL-W facilities would be modified and would be in compliance with DOE orders and other applicable regulations and standards. This may result in a reduction of risk compared to No Action.

A set of potential accidents have been postulated for upgraded existing storage facility for which there may be releases of Pu that may impact onsite workers and the offsite population. The impacts of potential accidents and the release of Pu would be dominated by the impacts associated with exposure to Pu. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.3.9–4. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.33 at INEL for the beyond design basis earthquake accident scenario with an estimated probability of 1.0×10^{-7} per year (that is, probability of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.6×10^{-6}, 4.9×10^{-9}, and 1.0×10^{-7}, respectively. The maximum population 50-year facility lifetime risk would be 1.6×10^{-3} (for example, one fatality in about 31,500 years) at INEL for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 5.0×10^{-6} and 7.5×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.3.9–4.

During normal operation at INEL, operation under the upgraded Pu storage alternative would result in impacts that are within applicable regulatory limits. Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

Normal Operation. During normal operations, there would be only a negligible difference in radiological and hazardous chemical impacts if Pu from RFETS and LANL is included in the Upgrade Storage Alternative. Therefore, the impacts are essentially the same as presented in the previous subsection discussing the Upgrade Without RFETS or LANL Pu.

Facility Accidents. A set of potential accidents have been postulated for the incremental impacts for upgraded storage of LANL and RFETS Pu for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the general population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.3.9–5. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.037 at INEL for the beyond design basis earthquake accident scenario with an estimate probability of 1.0×10^{-7} per year (for example, probability of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk

Table 4.2.3.9–4. Upgrade Without Rocky Flats Environmental Technology Site or Los Alamos National Laboratory Material Alternative—Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	1.7×10^{-7}	5.6×10^{-6}	1.1×10^{-8}	3.8×10^{-7}	3.7×10^{-6}	1.2×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	9.9×10^{-9}	5.6×10^{-7}	6.6×10^{-10}	3.8×10^{-8}	2.2×10^{-7}	1.2×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	7.5×10^{-5}	2.3×10^{-5}	5.0×10^{-6}	1.6×10^{-6}	1.6×10^{-3}	5.1×10^{-4}	0.064
Vault fire	6.5×10^{-8}	0.013	3.3×10^{-9}	6.6×10^{-4}	1.1×10^{-6}	0.22	1.0×10^{-7}
Truck bay fire	4.0×10^{-9}	8.0×10^{-4}	2.7×10^{-10}	5.4×10^{-5}	8.9×10^{-8}	0.018	1.0×10^{-7}
Spontaneous combustion	7.9×10^{-12}	1.1×10^{-6}	5.3×10^{-13}	7.5×10^{-8}	1.7×10^{-10}	2.5×10^{-5}	7.0×10^{-7}
Explosion in the vault	4.6×10^{-8}	9.1×10^{-3}	2.5×10^{-9}	4.9×10^{-4}	8.2×10^{-7}	0.16	1.0×10^{-7}
Explosion outside of vault	4.0×10^{-11}	8.0×10^{-6}	2.7×10^{-12}	5.4×10^{-7}	8.9×10^{-10}	1.8×10^{-4}	1.0×10^{-7}
Nuclear criticality	2.0×10^{-11}	4.0×10^{-6}	1.5×10^{-12}	3.0×10^{-7}	4.8×10^{-11}	9.6×10^{-6}	1.0×10^{-7}
Beyond evaluation basis earthquake	1.0×10^{-7}	0.020	4.9×10^{-9}	9.8×10^{-4}	1.6×10^{-6}	0.33	1.0×10^{-7}
Expected risk[d]	7.5×10^{-5}	–	5.0×10^{-6}	–	1.6×10^{-3}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.1.1–5 and M.5.2.1.1–6 and the MACCS computer code.

from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.8×10^{-7}, 8.6×10^{-11}, and 1.1×10^{-8}, respectively. The maximum population 50-year facility lifetime risk would be 1.3×10^{-4} (for example, one fatality in about 38,500 years) at INEL for the PCV penetration by corrosion accident scenario with a probability of 6.6×10^{-3} per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 5.9×10^{-8} and 5.6×10^{-6} respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenario identified in Table 4.2.3.9–5. Table 4.2.3.9–5 also shows the combined expected risk for storage of existing Pu and the RFETS and LANL materials.

During normal operation at INEL, operation under the upgraded Pu storage alternative would result in impacts that are within applicable regulatory limits. Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Table 4.2.3.9–5. Upgrade With Rocky Flats Environmental Technology Site and Los Alamos National Laboratory Material Alternative—Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Number of Cancer Fatalities[c]	
PCV puncture by forklift	1.2×10^{-7}	4.1×10^{-6}	1.3×10^{-9}	4.4×10^{-8}	2.9×10^{-6}	9.6×10^{-5}	6.0×10^{-4}
PCV breach by firearms discharge	7.2×10^{-9}	4.1×10^{-7}	7.8×10^{-11}	4.4×10^{-9}	1.7×10^{-7}	9.6×10^{-6}	3.5×10^{-4}
PCV penetration by corrosion	5.6×10^{-6}	1.7×10^{-5}	5.9×10^{-8}	1.8×10^{-7}	1.3×10^{-4}	3.9×10^{-4}	6.6×10^{-3}
Vault fire	5.8×10^{-9}	1.1×10^{-3}	4.8×10^{-11}	9.5×10^{-5}	1.0×10^{-7}	0.021	1.0×10^{-7}
Truck bay fire	2.9×10^{-9}	5.7×10^{-4}	3.1×10^{-11}	6.2×10^{-6}	6.7×10^{-8}	0.013	1.0×10^{-7}
Spontaneous combustion	2.9×10^{-11}	8.2×10^{-7}	3.1×10^{-13}	8.9×10^{-9}	6.7×10^{-10}	1.9×10^{-5}	7.0×10^{-7}
Explosion in the vault	6.9×10^{-10}	1.3×10^{-4}	7.5×10^{-12}	1.5×10^{-6}	1.6×10^{-8}	3.2×10^{-3}	1.0×10^{-7}
Explosion outside of vault	3.1×10^{-11}	6.2×10^{-6}	3.3×10^{-13}	6.7×10^{-8}	7.2×10^{-10}	1.4×10^{-4}	1.0×10^{-7}
Nuclear criticality	2.0×10^{-11}	4.0×10^{-6}	1.9×10^{-13}	3.9×10^{-8}	4.5×10^{-11}	8.9×10^{-6}	1.0×10^{-7}
Beyond evaluation basis earthquake	1.1×10^{-8}	2.2×10^{-3}	8.6×10^{-11}	1.7×10^{-5}	1.8×10^{-7}	0.037	1.0×10^{-7}
Expected risk[d]	5.6×10^{-6}	–	5.9×10^{-8}	–	1.3×10^{-4}	–	–
Combined expected risk[e]	8.1×10^{-5}	–	5.1×10^{-6}	–	1.7×10^{-3}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the incremental risks for the additional RFETS and LANL material over the lifetime of the plant.

[e] Combined expected risk for upgrade of existing storage and RFETS and LANL storage.

Note: All values are mean values.

Source: Calculated using Table 4.2.3.9–6.

Consolidation Alternative

Construct New Plutonium Storage Facility

This section includes a description of radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the new consolidated Pu storage facility at INEL. Normal operation of the consolidated storage facility would result in impacts that are within applicable regulatory limits.

[Text deleted.]

Normal Operation. There would be no radiological releases during the construction of a new consolidated Pu storage facility at INEL. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However,

concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects on the public and workers at INEL are described below.

Radiological Impacts. Radiological impacts on the public resulting from the normal operation of the new consolidated storage facility are presented in Table 4.2.3.9–1. The impacts from all site operations, including the new consolidated Pu storage facility, are also given in the table. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the MEI from annual storage facility operation would be 1.6×10^{-6} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 4.0×10^{-11}. The impacts on the average individual would be less. As a result of storage facility operation in the year 2030, the population dose would be 1.8×10^{-5} person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 4.5×10^{-7}.

The dose to the MEI from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 0.018 mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 4.4×10^{-7}. The impacts on the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 2.4 person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 0.061.

Doses to onsite workers from normal operations are given in Table 4.2.3.9–2. Included are involved workers directly associated with the new consolidated storage facility, workers who are not involved with the new storage facility, and the entire workforce at INEL. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemical impacts on the public and on the onsite worker resulting from the normal operations of the new consolidated Pu storage facility at INEL are presented in Table 4.2.3.9–3. The impacts from all site operations, including the consolidated storage facility, are included in this table. Total site impacts, which include the No Action impact plus the consolidation alternative, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 4.5×10^{-5}, and the cancer risk is 5.9×10^{-8} as a result of operation of the new consolidated Pu storage facility in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures are expected remain the same. The total site operation, including the consolidated facility, would result in an HI of 1.5×10^{-2} and a cancer risk of 3.7×10^{-6} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 1.3×10^{-3}, and the cancer risk is 1.2×10^{-5} as a result of operation of the new consolidated Pu storage facility in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures are expected to remain the same. The total site operation, including the consolidated Pu storage facility, would result in an HI of 0.22 and a cancer risk of 7.8×10^{-4} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents have been postulated for consolidation of Pu for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident

consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.3.9–6. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.36 at INEL for the beyond design basis earthquake accident scenario with an estimated probability of 1.0×10^{-7} per year (for example, probability of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.8×10^{-6}, 8.4×10^{-10}, and 1.1×10^{-7}, respectively. The maximum population 50-year facility lifetime risk would be 1.2×10^{-3} (for example, one fatality in about 42,000 years) at INEL for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 5.8×10^{-7} and 5.4×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.3.9–6.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities

Table 4.2.3.9–6. Consolidation Alternative Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality (per 50 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality (per 50 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality (per 50 yr)[a]**	**Number of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
PCV puncture by forklift	1.2×10^{-7}	4.1×10^{-6}	1.3×10^{-9}	4.4×10^{-8}	2.9×10^{-6}	9.6×10^{-5}	6.0×10^{-4}
PCV breach by firearms discharge	7.2×10^{-9}	4.1×10^{-7}	7.8×10^{-11}	4.4×10^{-9}	1.7×10^{-7}	9.6×10^{-6}	3.5×10^{-4}
PCV penetration by corrosion	5.4×10^{-5}	1.7×10^{-5}	5.8×10^{-7}	1.8×10^{-7}	1.2×10^{-3}	3.9×10^{-4}	0.064
Vault fire	5.7×10^{-8}	0.011	4.7×10^{-10}	9.3×10^{-4}	1.0×10^{-6}	0.20	1.0×10^{-7}
Truck bay fire	2.9×10^{-9}	5.7×10^{-4}	3.1×10^{-11}	6.2×10^{-6}	6.7×10^{-8}	0.013	1.0×10^{-7}
Spontaneous combustion	2.9×10^{-11}	8.2×10^{-7}	3.1×10^{-13}	8.9×10^{-9}	6.7×10^{-10}	1.9×10^{-5}	7.0×10^{-7}
Explosion in the vault	6.7×10^{-9}	1.3×10^{-3}	7.3×10^{-11}	1.5×10^{-5}	1.6×10^{-7}	0.031	1.0×10^{-7}
Explosion outside of vault	3.1×10^{-11}	6.2×10^{-6}	3.3×10^{-13}	6.7×10^{-8}	7.2×10^{-10}	1.4×10^{-4}	1.0×10^{-7}
Nuclear criticality	2.0×10^{-11}	4.0×10^{-6}	1.9×10^{-13}	3.9×10^{-8}	4.5×10^{-11}	8.9×10^{-6}	1.0×10^{-7}
Beyond evaluation basis earthquake	1.1×10^{-7}	0.021	8.4×10^{-10}	1.7×10^{-4}	1.8×10^{-6}	0.36	1.0×10^{-7}
Expected risk[d]	5.4×10^{-5}	–	5.8×10^{-7}	–	1.3×10^{-3}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.1.1–5 and M.5.2.1.1–6 and the MACCS computer code.

to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

This section includes a description of radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the consolidation of Pu storage and collocation with HEU storage facilities at INEL. This storage would take place in a new Pu and HEU storage facility. Normal operation of the new collocated storage facility at INEL would result in impacts that are within applicable regulatory limits.

[Text deleted.]

Normal Operation. There would be no radiological releases during the construction of a new collocated storage facility at INEL. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored, as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects on the public and workers are described below.

Radiological Impacts. Radiological impacts on the public resulting from the normal operation of the new collocated storage facility at INEL are presented in Table 4.2.3.9–1. The impacts from all site operations, including the new storage facility, are also given in the table. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the MEI from annual storage facility operation would be 1.6×10^{-6} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 4.0×10^{-11}. The impacts on the average individual would be less. As a result of storage facility operation in the year 2030, the population dose would be 1.8×10^{-5} person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 4.5×10^{-7}.

The dose to the MEI from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 0.018 mrem. From 50 years of operation, the corresponding risks of fatal cancer to this individual would be 4.4×10^{-7}. The impacts on the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 2.4 person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 0.061.

Doses to onsite workers from normal operations are given in Table 4.2.3.9–2. Included are involved workers directly associated with the new storage facility, workers who are not involved with the new storage facility, and the entire workforce at INEL. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemical impacts on the public and on the onsite worker resulting from the normal operations of the new consolidated Pu storage facility and collocation with HEU storage facilities at INEL are presented in Table 4.2.3.9–3. The impacts from all site operations, including the consolidation of Pu and collocation with HEU storage facilities are also included in this table. Total site impacts, which include the No Action impact plus the facility, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 7.7×10^{-5}, and the cancer risk is 5.9×10^{-8} as a result of operation of the new consolidation of Pu and collocation with HEU storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures are expected to remain the same. The total site operation, including the new facility, would result in an HI of 1.5×10^{-2} and a cancer risk of 3.7×10^{-6} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 1.9×10^{-3}, and the cancer risk is 1.2×10^{-5} as a result of operation of the new consolidation of Pu and collocation with HEU storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures are expected to remain the same. The total site operation, including the new facility would result in an HI of 0.22 and an cancer risk of 7.8×10^{-4} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents have been postulated for collocation of Pu and HEU for which there may be releases of Pu or HEU that may impact onsite workers and the offsite population. The consequences and risks of potential accidents that release both Pu and HEU would be bounded by the impacts associated with Pu. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the general population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.3.9–7. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.36 at INEL for the beyond design basis earthquake accident scenario with an estimated probability of 1.0×10^{-7} per year (for example, probability of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.8×10^{-6}, 8.4×10^{-10}, and 1.1×10^{-7}, respectively. The maximum population 50-year facility lifetime risk would be 1.2×10^{-3} (for example, one fatality in about 42,000 years) at INEL for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 5.8×10^{-7} and 5.4×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.3.9–7.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Material

If the strategic reserve and weapons R&D is not included, the impacts on the public and on workers from the accident-free storage activities would be reduced in proportion to the decrease in the amount of material stored. The impacts from total site operations would decrease slightly. This subalternative applies to the Upgrade With

Table 4.2.3.9–7. Collocation Alternative Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	1.2×10^{-7}	4.1×10^{-6}	1.3×10^{-9}	4.4×10^{-8}	2.9×10^{-6}	9.6×10^{-5}	6.0×10^{-4}
PCV breach by firearms discharge	7.2×10^{-8}	4.1×10^{-7}	7.8×10^{-11}	4.4×10^{-9}	1.7×10^{-7}	9.6×10^{-6}	3.5×10^{-4}
PCV penetration by corrosion	5.4×10^{-5}	1.7×10^{-5}	5.8×10^{-7}	1.8×10^{-7}	1.2×10^{-3}	3.9×10^{-4}	0.064
Vault fire	5.7×10^{-8}	0.011	4.7×10^{-10}	9.3×10^{-4}	1.6×10^{-6}	0.26	1.0×10^{-7}
Truck bay fire	2.9×10^{-9}	5.7×10^{-4}	3.1×10^{-11}	6.2×10^{-6}	6.7×10^{-8}	0.013	1.0×10^{-7}
Spontaneous combustion	2.9×10^{-11}	8.2×10^{-7}	3.1×10^{-13}	8.9×10^{-8}	6.7×10^{-10}	1.9×10^{-5}	7.0×10^{-7}
Explosion in the vault	6.7×10^{-9}	1.3×10^{-3}	7.3×10^{-10}	1.5×10^{-5}	1.6×10^{-7}	0.031	1.0×10^{-7}
Explosion outside of vault	3.1×10^{-11}	6.2×10^{-6}	3.3×10^{-13}	6.7×10^{-8}	7.2×10^{-10}	1.4×10^{-4}	1.0×10^{-7}
Nuclear criticality	2.0×10^{-11}	4.0×10^{-6}	1.9×10^{-13}	3.9×10^{-8}	4.5×10^{-11}	8.9×10^{-6}	1.0×10^{-7}
Beyond evaluation basis earthquake	1.1×10^{-7}	0.021	8.4×10^{-10}	1.7×10^{-4}	1.8×10^{-6}	0.36	1.0×10^{-7}
Expected risk[d]	7.5×10^{-5}	–	5.8×10^{-7}	–	1.3×10^{-3}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.1.1–5 and M.5.2.1.1–6 and the MACCS computer code.

All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. The risks due to accidents would also tend to be lower.

Phaseout

Normal Operation. A phaseout of existing Pu storage facilities at INEL would reduce the impacts from radiological and chemical releases and exposures to levels slightly below the No Action levels. All workers involved in the removal of the Pu from INEL would be monitored to assure that their doses remain within regulatory limits and as low as reasonably achievable.

Facility Accidents. The phaseout operation will be conducted in accordance with DOE Orders to ensure that the risk to the public of prompt fatalities due to accidents or of cancer fatalities due to operations will be minimized. For current operations in the facility that would be phased out, the safety of workers and the public from accidents is controlled by Technical Safety Requirements that are specified in SARs or Basis for Interim Operations documents that have been prepared for the facility. Prior to initiating phaseout, the potential for accidents that could impact workers and the public will be assessed and, if necessary, applicable existing safety documentation will be modified to ensure safety for workers and the public.

4.2.3.10 Waste Management

This section summarizes the impacts on waste management at INEL under No Action and for each of the long-term storage alternatives to include the phaseout of Pu storage. There is no spent nuclear fuel or HLW associated with Pu or HEU storage. Table 4.2.3.10–1 lists the projected sitewide waste generation rates and treatment, storage, and disposal capacities under No Action for 2005. Projections for No Action were derived from the most recent available environmental data, with appropriate adjustments made for those changing operational requirements where the volume of wastes generated is identifiable. The projection does not include wastes from future, yet uncharacterized, environmental restoration activities. The projections for No Action could change significantly depending on the decisions resulting from the PEIS on waste management being prepared by the Department. Table 4.2.3.10–2 provides the estimated incremental operational waste volumes projected to be generated at INEL as a result of the various storage alternatives prior to treatment. Some of the waste values described in this section are different than the waste values in the table. For those values that differ (for example, LLW), the table gives waste generated pre-treatment values and the text discusses post-treatment values (indicated as after treatment and volume reduction). The waste volumes generated from the various storage alternatives and the resultant waste effluent used for the waste impact analysis are shown in Section E.3.1. Facilities that would support the storage of Pu and HEU would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated and disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous wastes would be treated and disposed of in accordance with current site practice.

Preferred Alternative: No Action Alternative

Under this alternative, INEL would receive spent nuclear fuel from numerous offsite generators/storage locations, and high-level, TRU, low-level, mixed, hazardous, and nonhazardous wastes would continue to be managed from the missions outlined in Section 3.4. INEL's focus would be to continue the restoration of priority sites and the stabilization of other sites. By the year 2010, much of the existing wastes at INEL would have been treated and disposed of or stored in compliance with existing regulations. The waste treatment activities that are planned to be still in operation are the calcination of liquid HLW and LLW after completion of the processing of special fuels and residuals at the ICPP, the retrieval and repackaging of buried TRU waste, and stabilization of spent nuclear fuel for long-term storage. Under No Action, INEL would continue to store its inventory of Pu and to treat, store, and dispose of its legacy and newly generated wastes in current and planned facilities.

Spent nuclear fuel would be managed in accordance with the ROD published on June 1, 1995 (60 FR 28680) from the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F) as amended on March 8, 1996 (61 FR 9441). According to the ROD, INEL would ship its existing inventory of aluminum-clad spent nuclear fuel to SRS. In addition, INEL would receive non-aluminum-clad spent nuclear fuel from the Navy, Hanford, SRS, West Valley Demonstration Project, foreign research reactors, universities, and other generators or storage sites. The following INEL spent nuclear fuel projects will be implemented as a result of the ROD: Increased Rack Capacity for Building 666, Dry Fuel Storage Facility, and Expended Core Facility Dry Cell Project. Decisions regarding other ongoing or planned projects, as it was with the Electrometallurgical Process Demonstration (61 FR 25647), would be made in the future pending further project definition, funding priorities, and appropriate review under NEPA. TRU waste already packaged to current planning-basis WIPP WAC would either be stored or would have been shipped. Mixed waste would have been treated and disposed of according to the INEL Site Treatment Plan, which was developed to comply with the *Federal Facility Compliance Act*. Solid LLW would continue to be buried at the onsite RWMC. Under No Action, the processing of legacy wastes would require new facilities since the necessary treatment, storage, and disposal facilities either do not exist or are nearing capacity.

Table 4.2.3.10–1. Projected Spent Nuclear Fuel and Waste Management Under No Action (2005) at Idaho National Engineering Laboratory

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent Nuclear Fuel	None (offsite receipts are expected)	Stabilization	Being designed	Pools, dry, casks	Planned[a]	To HLW Program	NA
High-Level							
Liquid	538	Calcine	470[b]	Tanks	13,361[c]	NA	NA
Solid	192[d]	Debris treatment filter leach	238[e]	Bins	7,114[f]	To HLW Program	NA
Transuranic							
Liquid	None	None	None	None	None	NA	NA
Solid	3.5	30,534[g]	Planned	TRU storage facility	206,000[h]	WIPP or alternate facility	NA
Low-Level							
Liquid	None[i]	Evaporation, fractionation, calcification	11,600[j]	Tanks	See HLW	NA	NA
Solid	7,200	Incineration, compact	33,423[k]	None	None	Subsurface disposal	180,000[l]
Mixed Low-Level							
Liquid	4	Incineration, stabilize	Included in LLW	RCRA Facility	None	None	None
Solid	170	Incineration, stabilize	Included in LLW	RCRA Facility	114,600[m]	None	None
Hazardous							
Liquid	Included in solid	Offsite	None	Drums, RCRA facility	Included in solid[n]	Offsite	NA
Solid	1,200	Offsite	None	RCRA facility	64[n]	Offsite	NA

Table 4.2.3.10–1. Projected Spent Nuclear Fuel and Waste Management Under No Action (2005) at Idaho National Engineering Laboratory—Continued

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Sanitary)							
Liquid	Included in solid	Evaporation	Planned[d]	Ponds	Planned[d]	None	None
Solid	52,000	None	Planned[d]	None	None	Landfill	1,830,000 to 3,060,000
Nonhazardous (Other)							
Liquid	None	None	NA	NA	NA	NA	NA
Solid	Included in sanitary	None	NA	None	None	Onsite landfill	Included in sanitary

[a] Long-term storage and capacity planned pending implementation of ROD from *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (60 FR 28680).

[b] New Waste Calcining Facility.

[c] ICPP tank farm.

[d] No new waste. Produced in calcining existing liquid waste.

[e] ICPP Debris Treatment, HEPA Filter Leach.

[f] Calcine bin sets.

[g] ICPP Debris Treatment, HEPA Filter Leach, Advanced Mixed Waste Treatment Project, Remote Treatment Facility.

[h] ANL-W, New Waste Calcining Facility, RWMC.

[i] No new waste. Process wastewater from legacy waste.

[j] Portable water treatment unit, Waste Experimental Reduction Facility, New Waste Calcining Facility, Advanced Mixed Waste Treatment Project.

[k] ICPP Debris Treatment, HEPA Filter Leach, New Waste Calcining Facility, Lead Treatment, Sodium Processing Facility, TAN Cask Dismantlement, Waste Experimental Reduction Facility, Advanced Mixed Waste Treatment Project.

[l] RWMC, 67,000 m^3, expansion capacity potentially available.

[m] RWMC, TAN, PBF, ICPP, ANL-W.

[n] ANL-W, Hazardous Waste Storage Facility at the central facilities area.

Note: NA=not applicable.

Source: 60 FR 28680; DOE 1995i; DOE 1995j; DOE 1995v; DOE 1995gg; DOE 1995kk; IN DOE 1995d.

Table 4.2.3.10–2. Estimated Annual Generated Waste Volumes at Idaho National Engineering Laboratory—No Action (2005) and Net Incremental for Storage Alternatives

Category	No Action[a] (m^3)	Upgrade: Without RFETS or LANL Material[b] (m^3)	Upgrade: With RFETS and LANL Material[b] (m^3)	Consolidation[b] (m^3)	Collocation[b] (m^3)	Phaseout (m^3)
Transuranic						
Liquid	None	0.004[c]	0.004[c]	0.02[c]	0.02[c]	0
Solid	3.5	2	2	10	10	0
Mixed Transuranic						
Liquid	None	0	0	0	0	0
Solid	Included in TRU	1	1	4	4	0
Low-Level						
Liquid	None	0.79[c]	0.79[c]	2[c]	2.1[c]	0
Solid	7,200	500	500	1,260	1,300	0
Mixed Low-Level						
Liquid	4	0.015	0.14	0.2	0.2	0
Solid	170	27	27	65	66	0
Hazardous						
Liquid	Included in solid	0.15	1.3	2	2	0
Solid	1,200	1	1	2	2	0
Nonhazardous (Sanitary)						
Liquid	Included in solid	7,600	10,300	65,900	86,800	0
Solid	52,000	240	346	1,320	1,720	0
Nonhazardous (Other)						
Liquid	None	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	0
Solid	Included in sanitary	310[d]	440[d]	1,600[d]	2,100[d]	0

[a] The No Action Waste volumes are from Table 4.2.3.10–1.

[b] Waste volumes for storage alternatives are found in Section E.3.1 (Tables E.3.1.1–2, E.3.1.1–6, E.3.1.2–4, and E.3.1.3–4). Waste effluents (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in these tables.

[c] Liquid TRU and LLW would be treated and solidified prior to disposal.

[d] Recyclable wastes.

The Pu addressed in this PEIS is limited to materials currently stored within protected vaults and gloveboxes, and additional materials within process lines and process equipment associated with Pu storage and surveillance facilities. The Pu facilities have been used to conduct Pu processing operations such as Pu purification, Pu recovery, oxide production, metal production, and parts fabrication. The Pu facilities have also been used for receipt and large-scale storage of onsite and offsite Pu, uranium scrap, and product materials. Under No Action, INEL would not be able to maintain the inventory of Pu scrap and metal in a state that provides for long-term storage while awaiting a decision for future disposition. Modifications to the facilities would be required to meet current regulations. Maintenance, assay, packaging, and monitoring of the inventory would produce TRU, low-level, hazardous, and nonhazardous wastes. These wastes would be treated, stored, and disposed of in compliance with existing regulations.

Upgrade Alternative

Upgrade Without Rocky Flats Environmental Technology Site or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

The upgrading of the existing ANL-W storage facility for the continued storage of Pu would have a small impact on existing ANL-W and INEL waste management activities. Construction waste volumes as presented in Table E.3.1.1–2 would have minimal impact on ANL-W and INEL waste management activities. Waste generated during construction would consist of wastewater and solid nonhazardous and hazardous wastes. Nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous waste would be shipped offsite to commercial RCRA-permitted treatment and disposal facilities. Operational waste volumes as shown in Table 4.2.3.10–2 would increase slightly due to increased surveillance activities over No Action.

Following treatment and volume reduction of TRU waste, approximately 1 m^3 (1.3 yd^3) of solid TRU waste and 1 m^3 (1.3 yd^3) of solid mixed TRU waste from damaged PCVs and contaminated glovebox panels, windows, and gaskets would need to be treated and packaged to meet the current planning-basis WIPP WAC or alternative treatment level. While awaiting shipment to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), the TRU waste would be stored in above-grade storage facilities in the INEL RWMC and processed in the planned Advanced Mixed Waste Treatment Project. One additional truck shipment every 4 years or, if applicable, one regular train shipment every 9 years or one dedicated train shipment every 25 years would be required to transport this waste to WIPP.

After treatment and volume reduction, approximately 250 m^3 (327 yd^3) of LLW from solidified liquid LLW (such as decontamination solutions), protective clothing, HEPA filters, glovebox gloves, and decontamination equipment and materials would be packaged at the existing Waste Experimental Reduction Facility and would require disposal in the RWMC. Assuming a land usage of 6,200 m^3/ha (3,300 yd^3/acre), this would require 0.04 ha/year (0.1 acre/yr) of LLW disposal area.

Contaminated shielding and cleaning materials would be the major contributors to the 0.015 m^3 (4 gal) of liquid and 27 m^3 (35 yd^3) of solid mixed LLW. This small amount of mixed LLW could be treated and disposed of in accordance with the INEL Site Treatment Plan through the use of existing and planned facilities.

The 0.15 m^3 (40 gal) of liquid hazardous wastes such as lubricants, cleaning solvents, paint, and lube oil and 1 m^3 (1.3 yd^3) of solid hazardous wastes such as lead packing, wipes, and solid materials contaminated with oils, lubricants, and cleaning solvents would have a minimal impact on waste management activities at INEL. While awaiting shipment to an offsite RCRA-permitted treatment and disposal facility, the INEL Hazardous Waste Storage Facility has adequate capacity to handle this increase.

Approximately 7,600 m^3 (2,010,000 gal) of liquid nonhazardous wastes to include sanitary, utility, and process wastewaters, and cooling system blowdown could be handled by the existing Industrial Waste Pond and ANL-W sewage lagoons. After volume reductions, 120 m^3 (157 yd^3) of solid nonhazardous wastes such as clean non-Pu metals, packing materials, office trash, defective and damaged equipment, and industrial waste from utility and maintenance operations would be sent to the existing sanitary/industrial landfill on the INEL site.

Upgrade With All or Some Rocky Flats Environmental Technology Site and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing and Construct New Argonne National Laboratory–West Facilities for Continued Plutonium Storage

Construction and operation of an upgraded Pu storage facility that would accommodate material from RFETS and LANL would have the same waste management impacts as the same Upgrade Without RFETS or LANL material for all but nonhazardous wastes. The generation of TRU, mixed TRU, and LLW would be the same during operations. While the liquid mixed low-level and hazardous waste generated during operations is slightly higher, it is not significantly different. Therefore, the impacts would be similar.

Approximately 10,300 m^3 (2,720,000 gal) of liquid nonhazardous wastes to include sanitary, utility, and process wastewaters and cooling system blowdown can be handled by the existing Industrial Waste Pond and ANL-W sewage lagoons. After volume reduction, 173 m^3 (226 yd^3) of solid nonhazardous wastes such as clean non-Pu metals, packing materials, office trash, defective and damaged equipment, and industrial waste from utility and maintenance operations would be sent to the existing sanitary/industrial landfill on the INEL site.

Distributing the RFETS and LANL Pu to more than one site would reduce the operational waste volumes. The decrease would be proportional to the amount of material.

Consolidation Alternative

Construct New Plutonium Storage Facility

Construction and operation of a consolidated Pu storage facility would have an impact on existing ANL-W waste management activities by increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, nonhazardous solids, and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous material or radioactive constituents is expected to be generated during construction. However, if any was generated it would be managed in accordance with site practice and all applicable Federal and State regulations. The types of operational wastes from the consolidated Pu storage facility would be same as those from the upgraded facility, but the quantity would change, as shown in Table 4.2.3.10–2.

After treatment and volume reduction of TRU waste, approximately 5 m^3 (7 yd^3) of solid TRU waste and 4 m^3 (5 yd^3) of mixed TRU waste from leaded gloves, windows, and contaminated Pb shielding would be treated and packaged to meet the current planning-basis WIPP WAC or alternative treatment level. While awaiting shipment to WIPP (depending on decisions resulting from the supplemental EIS noted earlier), the TRU and mixed TRU waste could be stored in above-grade storage facilities in the INEL RWMC and processed in the planned Idaho Waste Processing Facility. One additional truck shipment per year or, if applicable, one regular train shipment every 2 years, or one dedicated train shipment every 6 years, would be required to transport these wastes to WIPP.

Following treatment and volume reduction, approximately 630 m^3 (824 yd^3) of LLW would require disposal in the RWMC. This would require approximately 0.1 ha/year (0.3 acre/yr) of LLW disposal area at the RWMC. The 0.2 m^3 (50 gal) of liquid mixed LLW and 65 m^3 (85 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the INEL Site Treatment Plan through the use of existing and planned facilities. The 2 m^3 (476 gal) of liquid hazardous waste and 2 m^3 (3 yd^3) of solid hazardous wastes would have minimal impact on waste management activities at INEL, as there is adequate storage capacity as noted earlier in the upgrade alternative.

The treatment of 65,900 m^3 (17,400,000 gal) of liquid nonhazardous wastes could use existing sanitary wastewater treatment systems, but the construction of utility and process wastewater treatment systems would be required. After volume reduction, 660 m^3 (863 yd^3) of solid nonhazardous wastes would require disposal at the existing sanitary/industrial landfill on the INEL site.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction and operation of a consolidated Pu storage facility collocated with HEU storage would have an impact on existing INEL waste management activities, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, nonhazardous solids, and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to a commercial RCRA-permitted treatment and disposal facility. No soil contaminated with hazardous material or radioactive constituents is expected to be generated during construction. However, if any was generated it would be managed in accordance with site practice and all applicable Federal and State regulations. Because there is no TRU or mixed TRU waste associated with HEU storage, the impacts from TRU and mixed TRU wastes are identical to those identified in the Consolidated Pu Storage Alternative. The sources of waste are similar to those of the upgraded Pu storage facility, except the source of radioactive contamination from the HEU storage is uranium. Operational waste volumes are shown in Table 4.2.3.10–2.

Following treatment and volume reduction, approximately 630 m^3 (824 yd^3) of solid LLW contaminated with Pu and 20 m^3 (26 yd^3) contaminated with uranium would require disposal in the RWMC. This would require approximately 0.1 ha/yr (0.3 acre/yr) of LLW disposal area. The 0.2 m^3 (55 gal) of liquid mixed LLW and 66 m^3 (86 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the INEL Site Treatment Plan through the use of existing and planned facilities. The 2 m^3 (528 gal) of liquid hazardous wastes and 2 m^3 (3 yd^3) of solid hazardous wastes would have a minimal impact on waste management activities at INEL, as there is adequate storage capacity as noted earlier in the upgrade alternative.

The treatment of 86,800 m^3 (22,900,000 gal) of liquid nonhazardous wastes could use existing sanitary wastewater treatment systems, but the construction of utility and process wastewater treatment systems would be required. After volume reduction, 860 m^3 (1,120 yd^3) of solid nonhazardous wastes would require disposal at the existing sanitary/industrial landfill on the INEL site.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve and weapons R&D materials would reduce the amount of operational waste volumes shown in Table 4.2.3.10–2 for the Upgrade with All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. The decrease would be proportional to the amount of material excluded.

Phaseout

The phaseout of Pu storage would have no impact on INEL waste management activities. The quantities of waste would not decrease until D&D in which Pu is stored was completed.

4.2.4 PANTEX PLANT

A listing of the proposed long-term storage alternatives, subalternatives, and related actions, including the No Action Alternative, at Pantex is provided below. The potential impacts of implementing these alternatives and related actions at Pantex are described in the following sections: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, and waste management. The specific long-term storage alternatives proposed for Pantex are the Preferred Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative.

Preferred Alternative

Upgrade With RFETS Pu Pits Subalternative:

Modify existing buildings in Zone 12 South to accommodate Pantex Pu pits and RFETS Pu pits.

The Preferred Alternative for Pantex is to store those surplus pits currently stored at Pantex, and pits from RFETS at Pantex pending disposition. This alternative includes storing strategic reserve pits at Pantex in accordance with the Preferred Alternative for the Stockpile Stewardship and Management PEIS. The Preferred Alternative would modify the existing buildings 12-66 and 12-82 and utilize buildings 12-116 and 12-117 in Zone 12 South. Pits from RFETS would be moved beginning in 1997. RFETS pits would be transported to Pantex as described in Section 4.4, repackaged in AL-R8 containers (if AT-400A containers are unavailable), and placed in storage in Zone 4 West. The storage of the RFETS pits would be similar to pits currently in storage from disassembly operations at Pantex. Placing the RFETS pits in Zone 4 would not exceed the 20,000 pits storage analyzed in the Pantex EIS.

The Preferred Alternative for storage identified in this PEIS calls for the transfer of Pu pits from RFETS to Pantex with storage of surplus pits continuing until disposition. Pits to be transferred would be packaged in FL (Type B) containers at RFETS before shipment and, upon receipt at Pantex, would be repackaged into AL-R8 containers in Zone 12 South and placed into storage in Zone 4 West pending availability of AT-400A containers and relocation to upgraded storage facilities in Zone 12 South. The environmental analysis of intersite transportation for shipment of the RFETS Pu to Pantex is given in Section 4.4 of this PEIS for both workers and the public. Storage of Pantex pits at Zone 4 West is analyzed in the Pantex EIS; transportation from Zone 4 to Zone 12 and repackaging of the pits from AL-R8 to AT-400A containers, storage, and intrasite transportation of RFETS pits at Zone 4 West are described in Appendix Q.

The data for the Upgrade With RFETS Pu and LANL Pu Subalternative was based on a storage vault with a capacity of 40,000 positions. The data for the Upgrade Without RFETS Pu or LANL Pu Subalternative was based on a storage vault with a capacity of approximately 25,000 positions including about 20,000 positions for surplus pits and about 5,000 positions for the strategic reserve. Because the Preferred Alternative would remove only the pits from RFETS for storage at Pantex, and not all the RFETS Pu and LANL Pu, the storage of 20,000 pits analyzed in the Pantex EIS would not be exceeded.

Proposed Storage Activities at Pantex Plant

- **No Action Alternative:** Continue to store Pantex Pu material within the scope of this PEIS (which consists entirely of pits) in Zone 4 Magazines in stabilized form pursuant to DNFSB Recommendation 94-1.

- **Upgrade Alternative:** There are three subalternatives under this storage alternative.

  - ***Upgrade With RFETS Pu Pits Subalternative (Preferred Alternative):*** Modify existing buildings in Zone 12 South to accommodate Pantex Pu pits and RFETS Pu pits.

  - ***Upgrade Without RFETS Pu or LANL Pu Subalternative:*** Modify existing buildings in Zone 12 South to accommodate Pantex Pu material.

  - ***Upgrade With All or Some RFETS Pu and LANL Pu Subalternative:*** Modify existing buildings in Zone 12 South to accommodate Pantex, RFETS, and LANL Pu material.

- **Consolidation Alternative:** Two options to accommodate all Pu material within the scope of this PEIS: Construct a new facility and modify existing buildings in Zone 12 South; or construct a larger new facility in Zone 12 South.

- **Collocation Alternative:** Construct a new facility in Zone 12 South to accommodate all Pu and HEU material within the scope of this PEIS.

- **Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials:** Facility and other resource requirements would be smaller than the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative.

- **Phaseout:** Pantex Pu material within the scope of this PEIS would be moved out of Zone 4 to the Consolidation or Collocation site (located at another DOE site) or to disposition (for surplus Pu).

4.2.4.1 Land Resources

No Action Alternative

Under this alternative, Pantex Pu material (which consists entirely of pits) would continue to be stored at the current storage location in Zone 4 Magazines pursuant to DNFSB Recommendation 94–1. The ongoing (no new action) activities conform with present and future land-use plans, policies, and controls. A description of No Action facilities and processes is presented in Section 2.2.4. Therefore, no effects to land resources would be anticipated at Pantex beyond those of existing and future activities that are independent of the proposed action.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The Pu storage upgrade at Pantex consists of existing facilities and the expansion of one facility and associated ramp within Zone 12 South to accommodate Pantex Pu and RFETS pit material. Land area requirements would be 0.18 ha (0.45 acres) during construction of which 0.1 ha (0.25 acres) would be used during operations. However, the facility would be situated on previously disturbed land. Buffer zone distances would be based on technical, safety, and security considerations.

Land Use. Construction and operation of the proposed upgrade would conform with the current *Pantex Site Development Plan,* which includes as part of its master plan the Fissile Materials Storage Facility in Zone 12 (PX DOE 1995g:8,11). The proposal would not change existing land use. As discussed in Section 4.2.4.8, in-migration of workers would be anticipated only for operations. However, since projected housing vacancies would be sufficient to accommodate the slight population growth, no indirect effects to offsite lands would be expected.

The storage upgrade would not affect other site land uses. As discussed in Section 3.5.1, there would be no onsite effects to prime farmland. The upgrade would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. The proposed visual environment would be compatible with the existing industrialized landscape character. The current VRM Class 5 designation of Zone 12 would remain.

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The Upgrade Without RFETS Pu or LANL Pu Subalternative is similar to the Upgrade With RFETS Pu Pits Subalternative because the modified facilities in Zone 12 South would be designed with adequate capacity to store all of the RFETS Pu pits. No additional resources would be required and therefore the impacts would be the same.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

Land area requirements during construction and operation for the proposed Pu storage facility at Pantex with all or some RFETS Pu and LANL Pu would be equal to that for Upgrade With RFETS Pu Pits Subalternative because the upgrade without would accommodate both subalternatives. Direct and indirect effects on land resources during construction and operation would be equal to that for Upgrade With RFETS Pu Pits Subalternative. [Text deleted.]

Consolidation Alternative

Construct New and Modify Existing Zone 12 South Facilities

This option would include the modification of existing buildings and construction of a new facility in Zone 12 South. Land area requirements would be 60.5 ha (149 acres) during construction of which 58 ha (143 acres) would be used during operations. However, the construction laydown area and storage facility would be situated on previously disturbed land and would not create any newly disturbed area. A buffer zone would be provided between facilities and the Pantex boundary.

Land Use. Construction and operation of this storage upgrade would be consistent with the site master plan as included within the current *Pantex Site Development Plan*, which identifies a Fissile Materials Storage Facility in Zone 12 (PX DOE 1995g:8,11). [Text deleted.] As discussed in Section 4.2.4.8, vacancies in the projected housing stock would be sufficient to accommodate the slight population growth due to the in-migration of construction and operational workers. Therefore, no indirect effects to offsite land use would be anticipated.

Construction and operation of this storage upgrade option would not affect other site land uses. There would be no onsite effects to prime farmland. This upgrade option would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] The proposed activities would be compatible with the existing industrialized landscape character. The current VRM Class 5 designation of Zone 12 would not change.

Construct New Plutonium Storage Facility

All the Pu would be stored at a new storage facility to be constructed in the north portion of Zone 12 South at Pantex. Land area requirements would be 58.5 ha (144 acres) during construction of which 56 ha (138 acres) would be used during operations. However, the construction laydown area and stand-alone storage facility would be entirely situated on previously disturbed land and would not create any newly disturbed area. A buffer zone would be provided between operations and the Pantex site boundary. Pu storage in existing DOE storage facilities would be phased out.

Land Use. The proposal would conform with the current *Pantex Site Development Plan,* which includes the Fissile Materials Storage Facility in Zone 12 (PX DOE 1995g:8,11) as part of its master plan. [Text deleted.] As discussed in Section 4.2.4.8, available projected housing vacancies would accommodate the population growth attributed to the in-migration of construction and operational workers. Therefore, no indirect effects to offsite land use would be anticipated.

Construction and operation would not affect other site land uses or prime farmland. This upgrade option would be consistent with the city of Amarillo's land-use plans, policies, and controls.

Visual Resources. [Text deleted.] The proposed visual environment would be compatible with the existing industrialized landscape character. The current VRM Class 5 designation of Zone 12 would remain.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

The collocation alternative would store Pu and HEU within the scope of this PEIS at a new facility to be constructed in Zone 12 South at Pantex. Pu and HEU storage in existing DOE facilities would be phased out. Land area requirements would be 89.5 ha (221 acres) during construction of which 87 ha (215 acres) would be used during operations. However, the construction laydown area and storage facility would be situated on previously disturbed land and would not create any newly disturbed area. A buffer zone would be provided between facilities and the Pantex site boundary.

Land Use. Construction and operation would conform with the current *Pantex Site Development Plan,* which includes the Fissile Materials Storage Facility in Zone 12 (PX DOE 1995g:8,11) as part of its master plan. [Text deleted.] As discussed in Section 4.2.4.8, projected housing vacancies would be sufficient to accommodate the increase in demand for housing units due to the in-migration of construction and operational workers. Therefore, no indirect effects to offsite land use would be anticipated.

Construction and operation would not affect other site land uses or prime farmland. This Collocation Alternative would be consistent with the city of Amarillo's land-use plans, policies, and controls.

Visual Resources. Potential impacts from construction and operation to visual resources would be similar to those of the Consolidation Alternative.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, land effects during construction and operation would be almost the same in extent and magnitude to the No Action Alternative, Upgrade Alternative, Consolidation Alternative, and Collocation Alternative because the facility would be almost the same. However, because the smaller quantity of material would require smaller facilities, it is likely that less land area would be disturbed during construction and used during operations. [Text deleted.]

Phaseout

No new construction or upgrade of existing facilities would occur under phaseout of the Pu storage mission. Pantex Pu material would be moved out of Pantex to the consolidation or collocation site or disposition. Potential impacts to visual resources could occur if facilities are not maintained.

[Text deleted.]

4.2.4.2 Site Infrastructure

Pantex would be capable of supporting any of the storage alternatives without major modifications to the existing infrastructure. A comparison of site infrastructure and facilities resource needs for the storage alternatives is shown in Table 4.2.4.2–1. Neither the addition of all or part of the material currently stored at RFETS and LANL nor the removal of strategic reserve and weapons R&D material would require major site infrastructure changes at Pantex.

No Action Alternative

Because of the downsized production mission after nuclear weapons stockpile dismantlement actions are complete, a considerable reduction in site infrastructure requirements is expected to occur. As a result, Pantex can accommodate the No Action Alternative using the site infrastructure that is currently in place at the site.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

Construction to upgrade the existing storage facility to accommodate long-term storage of Pu currently at Pantex and RFETS pits would not affect the site infrastructure. Data for construction are presented in Appendix C. As shown in Table 4.2.4.2–1, operating the upgraded facility would not significantly affect the site infrastructure. All infrastructure requirements are within site capacities.

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The Upgrade Without RFETS Pu or LANL Pu Subalternative is similar to the Upgrade With RFETS Pu Pits Subalternative because the modified facilities in Zone 12 South would be designed with adequate capacity to store all of the RFETS Pu pits. No additional resources would be required and therefore the impacts would be the same.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

Construction to upgrade the existing storage facility to accommodate long-term storage of existing quantities of Pantex, RFETS Pu, and LANL Pu material would have minimal impacts on the site infrastructure. Data for construction and operations presented in Appendix C are much larger than expected and are bounded by the Construct New and Modify Existing Zone 12 South Facilities Collocation Option. As shown in Table 4.2.4.2–1, other than some added roadway, the operational infrastructure resource requirements are within site capacities.

Since impacts associated with storing all of the RFETS Pu and LANL Pu material at Pantex for long-term storage are minimal for construction and can be managed for operations, storing only a portion of the RFETS Pu and LANL Pu material at Pantex would result in minimal impacts to the site infrastructure as well. [Text deleted.]

Table 4.2.4.2–1. Site Infrastructure Changes Required for Operation at Pantex Plant (Annual)—No Action (2005) and Storage Alternatives

Alternative	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
No Action							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage	76	27	46,266	10	795,166	7,200,000	0
Upgrade (with RFETS Pu pits)							
Projected usage with upgraded facility	76	27	47,641	10.3	808,414	7,364,000	0
Amount required in excess to site availability	0	0	0	0	0	0	0
Upgrade (without RFETS Pu or LANL Pu material)							
Projected usage with upgraded facility	76	27	47,641	10.3	808,414	7,364,000	0
Amount required in excess to site availability	0	0	0	0	0	0	0
Upgrade (with RFETS Pu and LANL Pu material)							
Projected usage with upgraded facility	<81	27	94,266	19	833,166	12,300,000	0
Amount required in excess to site availability	<5	0	0	0	0	0	0
Consolidation							
New and Modified Zone 12 South Facilities							
Projected usage with upgraded facility	<81	27	94,266	19	833,166	12,300,000	0
Amount required in excess to site availability	<5	0	0	0	0	0	0
New Storage Facility							
Projected usage with consolidated facility	<81	27	89,266	18	833,166	11,700,000	0
Amount required in excess to site availability	<5	0	0	0	0	0	0
Collocation							
Projected usage with collocated facilities	<81	27	104,266	20	833,166	12,400,000	0
Amount required in excess to site availability	<5	0	0	0	0	0	0
Phaseout							
Projected usage with storage phaseout	76	27	46,266	10	795,166	7,200,000	0
Amount required in excess to site availability	0	0	0	0	0	0	0

Source: DOE 1996e; DOE 1996f; PX 1995a:2; PX DOE 1995g; PX DOE 1996a; PX MH 1994a.

Consolidation Alternative

Construct New and Modify Existing Zone 12 South Facilities

Construction to modify the existing storage facility to consolidate long-term storage of Pu would have minimal impacts on the site infrastructure. Data for construction are presented in Appendix C. As shown in Table 4.2.4.2–1, some additional roadway would be required; the electrical and fuel infrastructure requirements for operations are within site capacities. [Text deleted.]

Construct New Plutonium Storage Facility

Construction of a new facility to consolidate long-term storage of Pu would have minimal impacts on the site infrastructure. Data for construction are presented in Appendix C. As shown in Table 4.2.4.2–1, some additional roadway would be required; the electrical and fuel infrastructure requirements for operations are within site capacities.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction for the collocated Pu and HEU storage facilities would have minimal impacts on the site infrastructure. Data for construction are presented in Appendix C. As shown in Table 4.2.4.2–1, some additional roadway would be required; the electrical and fuel infrastructure requirements for operations are within site capacities.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Since the existing Pantex site infrastructure would be capable of supporting construction/modification and operation of facilities for the No Action, Upgrade, Consolidation, or Collocation Alternatives, operating such facilities without including provisions for storage of strategic reserve and weapons R&D materials could be accommodated as well. Expected reductions in amounts of annual electrical energy requirements for the various storage facilities are the only site infrastructure changes expected if this subalternative is chosen because electric usage is dependent on the amount of material. [Text deleted.]

Phaseout

Pantex would be left with its weapons assembly/disassembly and HE fabrication missions. There would be no effects on the site infrastructure.

4.2.4.3 Air Quality and Noise

Construction and operation activities associated with the No Action Alternative and the proposed storage alternatives would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts at Pantex, criteria and toxic/hazardous concentrations from the No Action Alternative and the storage alternatives are compared with Federal and State standards and guidelines. Impacts from radiological airborne emissions are described in Section 4.2.4.9.

In general, all of the proposed storage facilities would emit the same types of air pollutants during construction. It is expected emissions would not exceed Federal, State, or local air quality regulations. PM_{10} and TSP concentrations will be increased, especially during peak construction periods.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, and wind erosion of exposed ground surfaces
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

During operation, impacts from each of the individual storage facilities with respect to the concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Table 4.2.4.3–1 presents the estimated pollutant concentrations for each of the fissile materials storage alternatives, indicating little difference between alternatives with respect to impacts to air quality.

Emission rates attributed to operation of the proposed storage facilities are presented in Tables F.1.3–1 to F.1.3–3. [Text deleted.] Air pollutant emission sources associated with operations include the following:

- Operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- Exhaust and road dust generated by vehicles delivering supplies and bringing employees to work
- Toxic/hazardous pollutant emissions from facility processes

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for each storage alternative are described separately. Supporting data for the air quality and noise analyses are presented in Appendix F.

AIR QUALITY

An analysis was conducted of the potential air quality impacts of emissions from each of the storage alternatives as described in Section 4.1.3.

Section 176 (c) of the 1990 CAA Amendments requires that all Federal actions conform with the applicable SIP. EPA has implemented rules that establish the criteria and procedures governing the determination of conformity for all Federal actions in nonattainment and maintenance areas. These are discussed in Section 4.1.3. The attainment status of the area in which Pantex is located is discussed in Section 3.5.3. Since the area is considered to be an attainment area for criteria pollutants the proposed actions at this site do not require that a conformity analysis be performed.

Table 4.2.4.3–1. Estimated Operational Concentrations of Pollutants at Pantex Plant and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation: New and Modify Existing Zone 12 South Facilities ($\mu g/m^3$)	Consolidation: New Facility ($\mu g/m^3$)	Consolidation: Collocation ($\mu g/m^3$)
Criteria Pollutants							
Carbon monoxide	8-hour	10,000[b]	602	602	607.9	607.2	607.9
	1-hour	40,000[b]	2,900	2,900	2,921	2,922	2,921
Lead	Calendar Quarter	1.5[b]	0.09	0.09	0.09	0.09	0.09
Nitrogen dioxide	Annual	100[b]	2.15	2.15	2.29	2.28	2.29
Ozone	1-hour	235[b]	c	c	c	c	c
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	8.73	8.73	8.77	8.76	8.77
	24-hour	150[b]	88.5	88.5	89.15	89.08	89.18
Sulfur dioxide	Annual	52[b]	<0.01	<0.01	<0.01	<0.01	<0.01
	24-hour	260[b]	<0.01	<0.01	0.05	0.04	0.05
	3-hour	1,300[b]	<0.01	<0.01	0.26	0.24	0.26
	30-minute	1,045[d]	<0.01	<0.01	0.69	0.65	0.69
Mandated by Texas							
Gaseous fluorides (as HF)	30-day	0.8[d]	<0.75	<0.75	<0.75	<0.75	<0.75
	7-day	1.6[d]	<0.75	<0.75	<0.75	<0.75	<0.75
	24-hour	2.9[d]	0.75	0.75	0.75	0.75	0.75
	12-hour	3.7[d]	1.05	1.05	1.05	1.05	1.05
	3-hour	4.9[d]	4.21	4.21	4.21	4.21	4.21
Hydrogen sulfide	30-minute	111[d]	e	e	e	e	e
Sulfuric acid	24-hour	15[d]	e	e	<0.01[g]	<0.01[g]	<0.01[g]
	1-hour	50[d]	e	e	0.01[g]	0.01[g]	0.01[g]
Total suspended particulates	3-hour	200[d]	f	e	3.62[g]	3.23[g]	3.77[g]
	1-hour	400[d]	f	e	9.75[g]	8.71[g]	10.15[g]

Table 4.2.4.3–1. Estimated Operational Concentrations of Pollutants at Pantex Plant and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation: New and Modify Existing Zone 12 South Facilities ($\mu g/m^3$)	Consolidation: New Facility ($\mu g/m^3$)	Consolidation: Collocation ($\mu g/m^3$)
Hazardous and Other Toxic Compounds							
1.1.1-Chloroethane	Annual	50[d]	0.53	0.53	0.53	0.53	0.53
	30-minute	500[d]	127	127	127	127	127
1.1.2-Trichloroethane	Annual	55[d]	0.08	0.08	0.08	0.08	0.08
	30-minute	550[d]	17.3	17.3	17.3	17.3	17.3
2-Nitropropane	Annual	5[d]	0.04	0.04	0.04	0.04	0.04
	30-minute	50[d]	8.55	8.55	8.55	8.55	8.55
Alcohols	Annual	[h]	0.70	0.70	0.70	0.70	0.70
	30-minute	[h]	195	195	195	195	195
Benzene	Annual	3[d]	0.06	0.06	0.06	0.06	0.06
	30-minute	30[d]	19.5	19.5	19.5	19.5	19.5
Carbon disulfide	Annual	3[d]	0.09	0.09	0.09	0.09	0.09
	30-minute	30[d]	22.6	22.6	22.6	22.6	22.6
Carbon tetrachloride	Annual	13[d]	0.08	0.08	0.08	0.08	0.08
	30-minute	126[d]	19.7	19.7	19.7	19.7	19.7
Chlorine	Annual	1.5[d]	[e]	[e]	<0.01[g]	<0.01[g]	<0.01[g]
	30-minute	15[d]	[e]	[e]	0.03[g]	0.03[g]	0.04[g]
Chlorobenzene	Annual	46[d]	0.08	0.08	0.08	0.08	0.08
	30-minute	460[d]	19.5	19.5	19.5	19.5	19.5

Table 4.2.4.3–1. Estimated Operational Concentrations of Pollutants at Pantex Plant and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Consolidation: Upgrade ($\mu g/m^3$)	Consolidation: New and Modify Existing Zone 12 South Facilities ($\mu g/m^3$)	Consolidation: New Facility ($\mu g/m^3$)	Consolidation: Collocation ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (Continued)							
Chromium	Annual	0.1[d]	0.001	0.001	0.001	0.001	0.001
	30-minute	1[d]	0.13	0.13	0.13	0.13	0.13
Cresol	Annual	[h]	0.002	0.002	0.002	0.002	0.002
	30-minute	5[d]	0.41	0.41	0.41	0.41	0.41
Cresylic acid	Annual	[h]	0.002	0.002	0.002	0.002	0.002
	30-minute	5[d]	0.51	0.51	0.51	0.51	0.51
Dibenzofuran	Annual	[h]	0.00002	0.00002	0.00002	0.00002	0.00002
	30-minute	[h]	0.001	0.001	0.001	0.001	0.001
Ester glycol ethers	Annual	[h]	0.15	0.15	0.15	0.15	0.15
	30-minute	[h]	35.9	35.9	35.9	35.9	35.9
Ethyl benzene	Annual	434[d]	0.13	0.13	0.13	0.13	0.13
	30-minute	2,000[d]	31.1	31.1	31.1	31.1	31.1
Ethylene dichloride	Annual	4[d]	0.04	0.04	0.04	0.04	0.04
	30-minute	40[d]	9.58	9.58	9.58	9.58	9.58
Formaldehyde	Annual	1.5[d]	0.004	0.004	0.004	0.004	0.004
	30-minute	15d	0.37	0.37	0.37	0.37	0.37
Hydrogen chloride	Annual	0.1[d]	0.07	0.07	0.07	0.07	0.07
	30-minute	75[d]	6.17	6.17	6.18	6.18	6.17
Hydrazine	Annual	0.013[d]	[e]	[e]	<0.0001[g]	<0.0001[g]	<0.0001[g]
	30-minute	0.13[d]	[e]	[e]	0.01[g]	<0.01[g]	0.01[g]
Ketones	Annual	[h]	0.14	0.14	0.14	0.14	0.14
	30-minute	[h]	33.4	33.4	33.4	33.4	33.4
Mercury	Annual	0.05[d]	0	0	0	0	0
	30-minute	0.5[d]	0	0	0	0	0

Table 4.2.4.3–1. Estimated Operational Concentrations of Pollutants at Pantex Plant and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation: New and Modify Existing Zone 12 South Facilities ($\mu g/m^3$)	Consolidation: New Facility ($\mu g/m^3$)	Consolidation: Collocation ($\mu g/m^3$)
Hazardous and other Toxic Compounds (Continued)							
Methanol	Annual	262	0.58	0.58	0.58	0.58	0.58
	30-minute	2,620	245	245	245	245	245
Methyl ethyl ketone	Annual	590[d]	5.1	5.1	5.1	5.1	5.1
	30-minute	3,900[d]	1,400	1,400	1,400	1,400	1,400
Methyl isobutyl ketone	Annual	205[d]	0.02	0.02	0.02	0.02	0.02
	30-minute	2,050[d]	4.45	4.45	4.45	4.45	4.45
Methylene chloride	Annual	26[d]	0.74	0.74	0.74	0.74	0.74
	30-minute	260[d]	180	180	180	180	180
Naphthalene	Annual	50[d]	0.0001	0.0001	0.0001	0.0001	0.0001
	30-minute	440[d]	0.005	0.005	0.005	0.005	0.005
Nickel	Annual	0.015[d]	0.0002	0.0002	0.0002	0.0002	0.0002
	30-minute	0.15[d]	0.02	0.02	0.02	0.02	0.02
Nitric acid	Annual	5.2[d]	[e]	[e]	<0.01[g]	<0.01[g]	<0.01[g]
	30-minute	52[d]	[e]	[e]	0.04[g]	<0.04[g]	0.76[g]
Nitrobenzene	Annual	5[d]	0.002	0.002	0.002	0.002	0.002
	30-minute	24[d]	0.51	0.51	0.51	0.51	0.51
Phenol	Annual	19[d]	0.0006	0.0006	0.0006	0.0006	0.0006
	30-minute	154[d]	0.03	0.03	0.03	0.03	0.03
Phosphoric acid	Annual	1[d]	[e]	[e]	<0.01[g]	<0.01[g]	<0.01[g]
	30-minute	10[d]	[e]	[e]	0.01[g]	0.01[g]	0.01[g]
Sulfuric acid	24-hour	15[d]	[e]	[e]	<0.01[g]	<0.01[g]	<0.01[g]
	1-hour	50[d]	[e]	[e]	0.01[g]	0.01[g]	0.01[g]
Tetrachloroethylene	Annual	34[d]	0.07	0.07	0.07	0.07	0.07
	30-minute	340[d]	17.6	17.6	17.6	17.6	17.6

Table 4.2.4.3–1. Estimated Operational Concentrations of Pollutants at Pantex Plant and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation: New and Modify Existing Zone 12 South Facilities ($\mu g/m^3$)	Consolidation: New Facility ($\mu g/m^3$)	Consolidation: Collocation ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (Continued)							
Toluene	Annual	188[d]	1.73	1.73	1.73	1.73	1.73
	30-minute	1,880[d]	556	556	556	556	556
Trichloroethylene	Annual	135[d]	0.21	0.21	0.21	0.21	0.21
	30-minute	1,350[d]	51.1	51.1	51.1	51.1	51.1
Triethylamine	Annual	4[d]	0.002	0.002	0.002	0.002	0.002
	30-minute	40[d]	1.08	1.08	1.08	1.08	1.08
Xylene	Annual	434[d]	0.47	0.47	0.47	0.47	0.47
	30-minute	3,700[d]	145	145	145	145	145

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Federal and State standards.

[c] Ozone, as a criteria pollutant, is not directly emitted or monitored by the candidate site. See Section 4.1.3 for a discussion of ozone-related issues.

[d] State standard or guideline.

[e] No sources of this pollutant have been identified.

[f] Data not available from source document.

[g] The concentration represents the alternative contribution only.

[h] No standard.

Note: 1-hour predicted concentrations were used for 30-minute standard. Concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from non-facility sources (for example, traffic). The Upgrade With RFETS Pu and LANL Pu Material Subalternative is the same as the New and Modify Existing Zone 12 South Facilities Consolidation Option.

Source: 40 CFR 50; DOE 1996e; DOE 1996f; PX DOE 1996a; PX DOE 1996b; PX MH 1994a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a.

No Action Alternative

This alternative utilizes estimated air emissions data from total site operations at Pantex assuming continuation of site missions as described in Section 3.5. These data reflect conservative estimates of criteria and toxic/hazardous emissions at Pantex. The emission rates for the criteria and toxic/hazardous pollutants for No Action for the total site are presented in Table F.1.2.5–1. Table 4.2.4.3–1 presents the No Action concentrations. During dry and windy conditions, increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside of the scope of this PEIS) under the No Action Alternative. Concentrations of all criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable Federal, State, and local ambient air quality standards.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

Increased PM_{10} and TSP concentrations may occur during the peak construction period, particularly during dry and windy conditions. Appropriate control measures would be followed to minimize pollutant concentrations during construction. Concentrations of all pollutants at the site boundary or public-access highways would remain within applicable Federal and State ambient air quality standards during construction.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.4.3–1.

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The Upgrade Without RFETS Pu or LANL Pu Subalternative is similar to the Upgrade With RFETS Pu Pits Subalternative because the modified facilities in Zone 12 South would be designed with adequate capacity to store all of the RFETS Pu pits. No additional resources would be required and therefore the impacts would be the same.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

Air quality impacts for construction and operation for this subalternative are expected to be similar to those for the Consolidation Alternative Construct New and Modify Existing Zone 12 South Facilities Option for Pantex.

Consolidation Alternative

Construct New and Modify Existing Zone 12 South Facilities

Increased PM_{10} and TSP concentrations may occur during the peak construction period, particularly during dry and windy conditions. Appropriate control measures would be followed to minimize pollutant concentrations

during construction. Concentrations of all pollutants at the site boundary would remain within applicable Federal and State ambient air quality standards.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.4.3–1.

Construct New Plutonium Storage Facility

In addition to the types of sources of emissions during construction associated with the No Action Alternative and the Upgrade Alternative, fugitive dust resulting from the operation of a concrete batch plant would be an additional emission source associated with this storage alternative.

Increased PM_{10} and TSP concentrations may occur during the peak construction period for the new storage facility option, particularly during dry and windy conditions. Appropriate control measures would be followed to minimize pollutant concentrations during construction. Concentrations of all pollutants at the site boundary would remain within applicable Federal and State ambient air quality standards during construction.

During operation, impacts with respect to the concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.4.3–1.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

The collocation of Pu and HEU facilities would be located in the same area as the consolidation of Pu facility and would have similar air quality impacts, with the following exceptions. During operation, emissions would be higher, as shown in Appendix F. Concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.4.3–1.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Air quality impacts for construction and operation for this option are expected to be similar to those described previously for the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative. [Text deleted.]

Phaseout

Phaseout of existing Pu inventories as a result of consolidating Pu at another site is expected to result in a small reduction in air pollutant concentrations from the No Action concentrations and would be in compliance with Federal and State standards.

NOISE

The location of the proposed storage facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction may include

heavy construction equipment and increased traffic. Increased traffic would occur onsite and along offsite local and regional transportation routes used to bring construction material and workers to the site.

No Action Alternative

Nontraffic noise sources associated with continued storage and other ongoing missions are the same as described in Chapter 3. The continuation of operations at Pantex would result in no appreciable change in traffic noise and onsite operational noise sources from current levels. Nontraffic noise sources are located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may be located close enough to onsite noise sensitive areas to result in impacts, such as disturbance of wildlife.

Upgrade (Preferred Alternative), Consolidation, and Collocation Alternatives

Nontraffic noise sources associated with the storage Upgrade Alternative would be similar to those for existing facilities as discussed in Chapter 3. Nontraffic, operational noise sources associated with the consolidation of Pu and collocation of Pu and HEU alternatives include additional equipment and machines (cooling systems, vents, motors, and material handling equipment). These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Noise impacts for construction and operations for this option are expected to be almost the same as those previously described for the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative because noise impacts are based on the use of the facility and not the size. [Text deleted.]

Phaseout

A reduction in noise levels may result from the phaseout of storage facilities.

4.2.4.4 Water Resources

Construction and operation of the proposed long-term storage facilities at Pantex would affect water resources. All water required for construction or operation would be supplied from groundwater. The Ogallala Aquifer, which would be used to accommodate water requirements, has been projected to be adequate up to the year 2040 by TNRCC. The proposed facilities would be located outside the 100- and 500-year floodplain. During construction, treated sanitary wastewater would be discharged to the playas. During operations, all wastewater would be treated and either recycled or discharged to the playas. No wastewater would be discharged to non-playa surface waters during operation of the facilities. Thus, impacts to surface water quality are not expected. Stormwater runoff would be collected and treated, if necessary, before discharge to natural drainage channels. [Text deleted.] Table 4.2.4.4–1 presents No Action water resources uses and discharges and the potential changes to water resources at Pantex resulting from the long-term storage alternatives.

No Action Alternative

Surface Water. [Text deleted.] A description of the activities that would continue at Pantex is provided in Section 3.5. No demands on surface water supplies would occur. However, current wastewater discharges to Playas 1, 2, and possibly 4 of 478 million l/yr (126 million gal/yr) would decrease to approximately 141 million l/yr (37.3 million gal/yr) by the year 2005. Since surface water is not used at Pantex, there would be no impacts to surface water availability or quality from the this alternative.

Groundwater. Under this alternative, baseline conditions and operations, described in Section 3.5.4, would continue at the plant, and current groundwater usage of 836 million l/yr (221 million gal/yr) would decrease to 249 million l/yr (65.7 million gal/yr) by the year 2005. Groundwater used would continue to be withdrawn from the Ogallala Aquifer through wells located on the Pantex property. Under this alternative current groundwater restoration and characterization studies would continue. As part of the restoration activities for the perched aquifer, contaminated groundwater is pumped, treated, and reinjected back into this aquifer. This remediation effort should improve the quality of the perched aquifer groundwater. [Text deleted.]

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

Surface Water. There are no unique construction characteristics associated with water requirements and discharges from this alternative. No surface water would be withdrawn for any construction or operation activities associated with any of the proposed Pu storage upgraded facilities. Therefore, there would be no impacts to surface water availability. Nonhazardous wastewater generated during construction and operation of the upgraded Pu storage facilities would either be recycled or treated and released to the playas under the permit requirements. Approximately 3.1 million l/yr (0.83 million gal/yr) of nonhazardous wastewater would be generated during the construction phase. In 1994, Pantex averaged approximately 1.4 million l/day (370,000 gal/day) of wastewater discharge to the playas. This quantity is expected to decrease in the future. Discharge of this additional wastewater to playas would not result in exceedance of the TNRCC-permitted monthly average maximum limit of 2.46 million l/day (650,000 gal/day).

During operation, utility, process, and sanitary wastewater and cooling system blowdown for the upgraded Pu storage facilities would either be recycled or treated and discharged into playas. Approximately 12.9 million l/yr (3.4 million gal/yr) of sanitary wastewater would be processed using existing and planned liquid nonhazardous waste facilities during operation; exceedance of the discharge limitation is not expected. This amount would

Table 4.2.4.4–1. No Action and Potential Changes to Water Resources at Pantex Plant—No Action (2005) and Storage Alternatives

Affected Resource Indicator	No Action	Upgrade			Consolidation			
		With RFETS Pits	Without RFETS or LANL Material	With RFETS and LANL Material	New and Modify Zone 12	New Facility	Collocation	Phaseout
Water Source	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground
Construction								
Water Availability and Use								
Total water requirement (million l/yr)	NA[a]	6.4	6.4	80	80	85	104.7	0
Percent increase in projected water use[b]	NA[a]	2.6	2.6	32.1	32.1	34.1	42	0
Water Quality								
Total wastewater discharge (million l/yr)	NA[a]	3.1	3.1	8.0	8.0	8.0	12.2	0
Percent change in wastewater discharge[c]	NA[a]	2.2	2.2	5.7	5.7	5.7	8.7	0
Operation								
Water Availability and Use								
Total water requirement (million l/yr)	249	27.5	27.5	110	110	98	130	0
Percent increase in projected water use[d]	0	11.0	11.0	44.2	44.2	39.4	52.2	0
Water Quality								
Total wastewater discharge (million l/yr)	141	12.9	12.9	0	0	0	0	0
Percent change in wastewater discharge[e]	0	9.1	9.1	0	0	0	0	0

Table 4.2.4.4–1. No Action and Potential Changes to Water Resources at Pantex Plant—No Action (2005) and Storage Alternatives—Continued

Affected Resource Indicator	No Action	Upgrade			Consolidation			
		With RFETS Pits	Without RFETS or LANL Material	With RFETS and LANL Material	New and Modify Zone 12	New Facility	Collocation	Phaseout
Floodplain								
Is action in 100-year floodplain?	NA	No	No	No	No	No	No	No
Is critical action in 500-year floodplain?	NA	No	No	No	No	No	No	No

[a] See operations section of table for No Action water data.

[b] Percent increases in projected water use during construction at Pantex are calculated by dividing No Action water requirements (249 million l/yr) with that for each storage option: upgrade existing storage facility with RFETS Pu pits (6.4 million l/yr), upgrade existing storage facility without RFETS or LANL material (6.4 million l/yr), Pu storage upgrade with all RFETS and LANL material (80 million l/y), consolidate through modification of existing facility (80 million l/yr), new storage facility (85 million l/yr), collocation of Pu and HEU storage (104.7 million l/yr), and storage phaseout (0 l/yr).

[c] Percent changes in wastewater discharge during construction at Pantex are calculated by dividing No Action wastewater discharges (141 million l/yr) with that for each storage option: upgrade existing storage facility with RFETS Pu pits (3.1 million l/yr), upgrade existing storage facility without RFETS or LANL material (3.1 million l/yr), Pu storage upgrade with all RFETS and LANL material (8.0 million l/yr), consolidate through modification of existing facility (8.0 million l/yr), new storage facility (8.0 million l/yr), collocation of Pu and HEU storage facility (12.2 million l/yr), and storage phaseout (0 l/yr).

[d] Percent increases in projected water use during operations at Pantex are calculated by dividing No Action waste requirements (249 million l/yr) with that for each storage option: upgrade existing storage facility with RFETS Pu pits (27.5 million l/yr), upgrade existing storage facility without RFETS or LANL material (27.5 million l/yr), Pu storage upgrade with all RFETS and LANL material (110 million l/yr), consolidate through modification of existing facility (110 million l/yr), new storage facility (98 million l/yr), collocation of Pu and HEU storage facility (130 million l/yr), and storage phaseout (0 l/yr).

[e] Percent changes in wastewater discharge during operations at Pantex are calculated by dividing No Action wastewater discharges (141 million l/yr) with that for each storage option: upgrade existing storage facility with RFETS Pu pits (12.9 million l/yr), upgrade existing storage facilities without RFETS or LANL material (12.9 million l/yr), Pu storage upgrade with all RFETS and LANL material (0 million l/yr), consolidate through modification of existing facility (0 l/yr), new storage facility (0 l/yr), collocation of Pu and HEU storage facility (0 l/yr), and storage phaseout (0 l/yr).

Note: NA=not applicable. Construction impacts are considered to be temporary, lasting throughout the construction period. Impacts from operations would occur continuously. Wastewater will be recycled during operations for all options, except for Pu storage upgrade.

Source: DOE 1996e; DOE 1996f; PX 1995a:2; PX DOE 1996a; PX MH 1994a.

represent a 9.1 percent increase in the amount being discharged. The treated effluent would be monitored to comply with the requirements. The extent to which treated effluent or stormwater would be recycled for reuse within the facility would be determined during site-specific studies.

The facility to be upgraded is located in Zone 12. Since 100-year, 500-year, or standard project flood boundaries are not located in Zone 12, there will be no impacts to floodplains. No construction would occur in areas delineated as 100-year floodplains.

Groundwater. All water required for construction and operation would be supplied from groundwater. The Ogallala Aquifer, which is the source of water for operations at Pantex, has been projected to be adequate up to the year 2040 by the TNRCC. Construction and operation water requirements for the upgraded Pu storage facilities are small relative to the total water in aquifer storage, which for the year 2010 has been estimated at 287 trillion l (76 trillion gal) (PX WDB 1993a:1). As shown in Table 4.2.4.4–1, construction of the proposed upgraded facilities would require 6.4 million l/yr (1.7 million gal/yr) of water, which represents approximately a 2.6-percent increase over the projected No Action groundwater usage. Regional groundwater levels would have minimal impacts.

Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala aquifer, an average of 1.8-m/yr (5.9-ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the proposed upgraded Pu storage facilities at Pantex would require 27.5 million l/yr (7.3 million gal/yr), resulting in a minimal drawdown representing 1.4 percent of the available groundwater (1,900 million l/yr [502 million gal/yr]). This additional groundwater withdrawal would cumulatively add to the existing decline in water levels of the Ogallala Aquifer. However, there should be minimal impacts to regional groundwater levels from this additional withdrawal. The total water withdrawal including this alternative would be 276.4 million l/yr (73 million gal/yr) which, because of expected cutbacks in other programs, would be 67 percent less than what is currently being withdrawn (836 million l/yr [221 million gal/yr]) from the Ogallala Aquifer by Pantex.

Construction and operation of the proposed upgraded Pu storage facilities would not result in direct discharges to groundwater, so contamination of the Ogallala Aquifer is not expected. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored according to requirements and would not be discharged to the playas until contaminant levels were within the limits specified by the TNRCC. Since the supply wells located in the area withdraw potable water from the deep Ogallala Aquifer, the existing plume in the near-surface aquifer should not be affected by the upgraded Pu storage facilities. Pantex will continue to evaluate groundwater contamination in both the perched and Ogallala aquifers.

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The Upgrade Without RFETS Pu or LANL Pu Subalternative is similar to the Upgrade With RFETS Pu Pits Subalternative because the modified facilities in Zone 12 South would be designed with adequate capacity to store all of the RFETS Pu pits. No additional resources would be required and therefore the impacts would be the same.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The annual water requirements during construction and operation are 80 million l/yr (21.1 million gal/yr) and 110 million l/yr (29.1 million gal/yr), respectively. These additional requirements represent 32.1- and 44.2-percent increases, respectively, in the projected No Action withdrawals from the Ogallala Aquifer. The quantity required for operation represents 5.8 percent of the available groundwater (1,900 million l/yr [502 million gal/yr]). This additional groundwater withdrawal would cumulatively add to the existing decline in water levels of the Ogallala Aquifer. However, there should be minimal impacts to regional groundwater levels from this additional withdrawal. The total water withdrawal including this alternative would be 359 million l/yr (94.8 million gal/yr), which, because of expected cutbacks in other programs, would be 57 percent less than what is currently being withdrawn (836 million l/yr [221 million gal/yr]) from the Ogallala Aquifer by Pantex.

Consolidation Alternative

Construct New and Modify Existing Zone 12 South Facilities

The water resource requirements and impacts for this alternative are identical to those discussed above for the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative.

Construct New Plutonium Storage Facility

The Pu storage facility would be located in Zone 12 South. The impacts associated with this option are the same as those discussed above for the Pu consolidate through upgrading, with the following exceptions. The water requirements of this option are slightly less than those for consolidate through upgrading with RFETS and LANL material. This option would require approximately 85 million l/yr (22.5 million gal/yr) and 98 million l/yr (26 million gal/yr) of water for construction and operation, respectively. These additional requirements represent 34.1- and 39.4-percent increases, respectively, in the projected annual No Action withdrawals from the Ogallala Aquifer. [Text deleted.] The total water withdrawal including this alternative would be 347 million l/yr (91.7 million gal/yr), which, because of expected cutbacks in other programs, would be 58 percent less than what is currently being withdrawn (836 million l/yr [221 million gal/yr]) from the Ogallala Aquifer by Pantex.

Sanitary wastewater quantities generated during construction of this option would be the same as for the previous option and are approximately 8.0 million l/yr (2.1 million gal/yr). These effluents would be discharged to the playas under the permit. The maximum quantity of additional wastewater (approximately 0.03 million l/day [7,900 gal/day]) would not cause any exceedances of the maximum limit of 3.1 million l/day (820,000 gal/day). During operations, wastewater would be recycled. Since surface water would not be used for this option, no impacts to surface water availability would occur.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Because the collocated storage facilities would be located in the same area as the new Pu storage facility (Zone 12 of Pantex), the impacts associated with it are the same as those discussed above, with the following exceptions. The water requirements for construction and operation of this option are greater than those for the previous options. This option would require approximately 104.7 million l/yr (27.7 million gal/yr) and 130 million l/yr (34 million gal/yr) for construction and operation, respectively. These additional requirements

represent 42- and 52.2-percent increases, respectively, in the projected No Action annual groundwater withdrawals from the Ogallala Aquifer and would be 5.5- and 6.8-percent of the available groundwater (1,900 million l/yr [502 million gal/yr]). [Text deleted.] The total water withdrawal including this alternative would be 379 million l/yr (100 million gal/yr) which would be 55 percent less than what is currently being withdrawn (836 million l/yr [221 million gal/yr]) from the Ogallala Aquifer by Pantex.

Sanitary wastewater quantities generated during construction would be approximately 12.2 million l/yr (3.2 million gal/yr); this water would be treated and discharged to the playas. For the same reasons as discussed for the previous option, no exceedances of the discharge limit would be expected. During operations, all wastewater would be recycled, causing no impacts.

Although the expected drawdowns caused by withdrawing the water required for the potential long-term Pu storage options are relatively small, the overall decline of groundwater levels in the Amarillo area is of concern. Groundwater conservation measures that could be considered include limiting groundwater production hours, installing dripless faucets, and reusing process water. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex for industrial use from the Hollywood Road Wastewater Treatment Plant. However, details of this mitigation measure have not been determined. Mitigation measures to reduce wastewater seepage and protect groundwater quality could include building lined evaporation ponds.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Water resource impacts for construction and operation for this subalternative are expected to be slightly less than those discussed for the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative because of the reduction in the amount of material. [Text deleted.]

Phaseout

If the current Pu storage mission at Pantex is phased out, groundwater withdrawals from the Ogallala aquifer and nonhazardous wastewater discharge to playas would decrease by negligible quantities. By decreasing groundwater withdrawals, however, Pantex would lessen its contribution to the declining groundwater levels of the Ogallala Aquifer by a very small amount. Reducing wastewater discharges to the playas by this quantity should not cause any noticeable impacts.

[Text deleted.]

4.2.4.5 Geology and Soils

Construction and operation of the alternatives at Pantex would have no impact on the geologic resources. A low seismic risk exists, but it would be considered in the design of the proposed alternatives. The existing seismic risk does not preclude the safe construction and operation of the proposed alternative facilities. The facilities would be designed for earthquake-generated ground acceleration in accordance with DOE O 420.1, *Facility Safety*. Because there are no known capable faults at Pantex, the potential for ground rupture as a result of an earthquake during the life of the facility is minimal; ground shaking is more likely. Intensities of more than IV on the MMI scale are not likely at Pantex. Ground shaking could affect the integrity of inadequately designed or nonreinforced structures but would not affect newly designed facilities. Human health effects from accidents initiated by natural phenomena (for example, earthquakes) are discussed in Section 4.2.4.9. Volcanic activity is not anticipated to affect the construction and operation of the alternatives. It is also unlikely that landslides or other nontectonic events would affect the proposed alternatives. Salt dissolution is an active process in the southern High Plains area. However, no surficial expression of sinkholes or fractures associated with salt dissolution have been identified in Carson County. Potential effects due to subsidence, are negligible because salt dissolution is a slow process relative to human activities. Properties and conditions of soils underlying Pantex typically have no limitations on construction with the exception of moderate to severe shrink-swell potential in nearly all areas of Pantex. This factor would be considered in facility design and site preparation. No economically viable geologic resources are known to be present at Pantex.

Impacts to the geologic and soil resource occur during, or as a result of, ground-disturbing construction activities. Construction of the alternatives may involve ground-disturbing activities which could impact the soil resources. The amount of land disturbed is specified below for each alternative. Impacts would depend on the specific soil units in the disturbed area, the extent of land disturbing activities, and the amount of soil disturbed. Within Pantex, the soil erosion potential is directly related to the amount of land disturbed because soil and climatic conditions are similar throughout the site. Control measures would be employed to minimize soil erosion.

[Text deleted.]

No Action Alternative

[Text deleted.] Under the No Action Alternative, DOE would continue current and ongoing activities at Pantex. There would be no ground-disturbing activities beyond those associated with existing and future site improvements. Because no new construction and the associated ground disturbance for potential soil erosion would occur, the No Action Alternative would have no effect on the geologic or soil resources at the site.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

No apparent direct or indirect effects on the geologic resource are anticipated, because neither facility construction and operational activities nor site infrastructure improvements will limit access to potential geologic resources.

Construction activities will occur completely on previously disturbed land, as described in Section 4.2.4.1. The soil disturbance during construction activities would be approximately 0.18 ha (0.45 acres). Soil disturbance would occur primarily from ground-disturbing construction activities (foundation preparation) and activities associated with building construction laydown areas that can expose the soil profile and lead to a possible

increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increases in wind velocity and duration increase potential soil erosion), and the size, location, and duration of ground-breaking activities.

Net soil disturbance during operations would be considerably less than during construction because areas temporarily used for construction laydown would be restored. Although stormwater runoff and wind action could occur during operations, they are anticipated to be minimal.

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The Upgrade Without RFETS Pu or LANL Pu Subalternative is similar to the Upgrade With RFETS Pu Pits Subalternative because the modified facilities in Zone 12 South would be designed with adequate capacity to store all of the RFETS Pu pits. No additional resources would be required and therefore the impacts would be the same.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

Construction and operation effects on geological and soil resources would be the same as those described for the Upgrade With RFETS Pu Pits Subalternative. The soil disturbance during construction activities would be approximately 0.18 ha (0.45 acres) and would occur completely on previously disturbed land. This disturbance would affect the soil profile and lead to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil impacts during operation are expected to be minimal. An analysis of the operational effects on the soil resource is provided in the Upgrade With RFETS Pu Pits Subalternative.

Consolidation Alternative

Construct New and Modify Existing Zone 12 South Facilities

No apparent direct or indirect effects on the geologic resource are anticipated because neither facility construction and operational activities nor site infrastructure improvements will restrict access to potential geologic resources.

[Text deleted.] Construction of the storage facilities would occur on previously disturbed land as described in Section 4.2.4.1. However, under this alternative additional soil impacts are anticipated because it has greater construction and operating land use requirements. Approximately 60.5 ha (149 acres) would be disturbed for construction of the Consolidation Alternative. This disturbance would affect the soil profile and lead to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Analysis of operational effects in this section is the same as that provided for the Upgrade Alternative.

Construct New Plutonium Storage Facility

[Text deleted.] Construction of the storage facility would occur on previously disturbed land as described in Section 4.2.4.1. Approximately 58.5 ha (144 acres) of land would be disturbed for the new facility, affecting the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. [Text deleted.]

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

No apparent direct or indirect effects on the geologic resource are anticipated, because neither facility construction and operational activities nor site infrastructure improvements will restrict access to potential geologic resources.

Construction and operation effects on geology and soil resources for the Collocation Alternative would be similar to those described for the Consolidation Alternative. However, additional soil impacts would be expected from the construction of the storage facilities that will occur completely on previously disturbed land. During construction, approximately 89.5 ha (221 acres) would be required for the new facilities, affecting the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil impacts during operation are expected to be minimal.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Exclusion of strategic reserve and weapons R&D materials would give almost the same effects to the geological and soil resources for the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative. By excluding these materials the size of a facility would be similar, thus not changing the amount of land disturbed by construction activities. No effect to the geologic resource is anticipated as a result of this subalternative.

Phaseout

The phaseout of storage capacity would have no apparent effects on the geology and soil resource. However, phaseout could result in beneficial effects on the soils of the area. Hazardous, radioactive, and mixed waste sources would be eliminated from the area, thus decreasing the potential for future soil contamination.

[Text deleted.]

4.2.4.6 Biological Resources

No Action Alternative

Under No Action, the Pu storage mission described in Section 2.2.4 would continue at Pantex. This activity would result in no appreciable change to current conditions of biological resources at Pantex as described in Section 3.5.6.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

Upgrading the existing Pu storage facility at Pantex would cause minimal disturbance to biological resources. This is the case since all activities would take place within an area that is currently disturbed by site structures. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the developed area have already adapted to its presence. Impacts to wetlands and aquatic resources would not occur since these resources are not found in the upgrade area. Since the upgrade would take place within a developed area, impacts to threatened and endangered species would not be expected.

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The Upgrade Without RFETS Pu or LANL Pu Subalternative is similar to the Upgrade With RFETS Pu Pits Subalternative because the modified facilities in Zone 12 South would be designed with adequate capacity to store all of the RFETS Pu pits. No additional resources would be required and therefore the impacts would be the same.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

Upgrading with all or some RFETS and LANL material would not be expected to change impacts to biological resources from those described for the Upgrade With RFETS Pu Pits Subalternative.

Consolidation Alternative

Construct New and Modify Existing Zone 12 South Facilities

Under this alternative, Pu would be consolidated in a modified existing facility at Pantex requiring some new construction. Modification of existing facilities would occur on previously disturbed land and, therefore, would cause minimal disturbance to biological resources. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the developed area have already adapted to its presence. Construction-related ground disturbance may increase the potential for sediment runoff effects to playa wetlands and aquatic habitat. This impact would be controlled through the implementation of standard soil erosion and sediment control measures. Since this alternative

occurs within a developed area, impacts to threatened and endangered species would not be expected. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate. [Text deleted.]

[Text deleted.]

Construct New Plutonium Storage Facility

Impacts to biological resources from a new storage facility would be nearly the same as those described for the construction of a new facility and the modification of an existing facility alternatives addressed above. This is the case since both options would be located in the same general area of the Pantex site and both would occur on previously disturbed land. [Text deleted.]

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Under this alternative, Pu material would be stored with HEU inventories in a new collocated storage facility at Pantex. Construction and operation of collocated storage facilities would occur on previously disturbed land and therefore would cause minimal disturbance to biological resources similar to, but somewhat greater than those described for the consolidated storage facility alone. [Text deleted.]

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve and weapons R&D materials would have almost the same effects to the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative. The size of the facility would be similar and would not result in the reduction of disturbed habitat and/or fewer facility modifications and the potential impacts to biological resources would be similar. [Text deleted.]

Phaseout

During phaseout of Pu storage facilities at Pantex, short-term increased human activity could disturb some wildlife species on the site. Following phaseout activities, the wildlife populations would be expected to return to pre-phaseout size and location. The only effect to wetlands and aquatic resources would be a slight reduction of wastewater discharge to playas.

4.2.4.7 Cultural and Paleontological Resources

No Action Alternative

Under this alternative, DOE would continue the existing and planned missions at Pantex. Pantex material (pits) would continue to be stored in Zone 4 Magazines pursuant to DNFSB Recommendation 94-1. Any impacts to cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate NHPA, *American Indian Religious Freedom Act*, and *Native American Graves Protection and Repatriation Act* regulatory compliance procedures. DOE is developing an interim Programmatic Agreement that will be ready by FY97. This Agreement will be superseded by the Cultural Resources Management Plan for Pantex, which is scheduled for implementation in 1998. Currently, cultural resources are managed through existing interim procedures according to Sections 106 and 110 of the NHPA. A Native American outreach program has also been initiated.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

This option involves the expansion of existing Building 12-66 in Zone 12 and the use of Buildings 12-82, 12-116, and 12-117 and associated ramps. Building 12-66 is not considered NRHP-eligible based on an evaluation of World War II Era structures at Pantex (PX LRA 1994a:125). However, determinations of NRHP-eligible Cold War Era structures have not been completed, and some structures in Zone 12 may be determined eligible on that basis. The zone is developed and disturbed and probably does not contain any intact archaeological deposits, so no impacts to prehistoric or historic sites are anticipated, even on lands used for equipment laydown or construction parking. Minimal impacts to Native American or paleontological resources are expected to result from this option. Land disturbance during building modification is expected to be 0.18 ha (0.45 acres) and the land required during operation would total 0.1 ha (0.25 acres). Impacts to cultural or paleontological resources are expected to be minimal.

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The Upgrade Without RFETS Pu or LANL Pu Subalternative is similar to the Upgrade With RFETS Pu Pits Subalternative because the modified facilities in Zone 12 South would be designed with adequate capacity to store all of the RFETS Pu pits. No additional resources would be required and therefore the impacts would be the same.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

This subalternative involves modification to the previously mentioned facilities. Land disturbance during building modification, construction, and operation is expected to be the same as required for the other upgrade subalternative. Impacts to cultural or paleontological resources are expected to be minimal.

Consolidation Alternative

Construct New and Modify Existing Zone 12 South Facilities

New construction and building modification would occur on previously disturbed land in Zone 12 South. A reduced-access buffer zone would exist around the facility. Buildings 12-66 and 12-82 would be modified. [Text deleted.] Although it is possible that subsurface remains exist within Pantex, the project area is disturbed and probably does not contain any intact archaeological sites. Consequently, impacts to prehistoric or historic resources are not anticipated. Additional surveys may be necessary for compliance with the NHPA. Should any resources be discovered during construction, mitigation measures would be taken in consultation with the Texas SHPO. [Text deleted.]

The DOE has begun a public outreach program to involve Native American groups in decisionmaking related to land use and cultural resources. [Text deleted.] Facility operation can have an auditory or visual impact on sacred or ceremonial sites. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any traditional cultural resources at Pantex. Additional consultation may identify some of these resources.

Construct New Plutonium Storage Facility

This option involves consolidation through new construction on land in Zone 12 South. It would be constructed on previously disturbed land. A reduced-access buffer zone would be created around the facility. The same potential for impacts to cultural and paleontological resources from the construction and operation of the proposed facility exists as described under the previous consolidation option.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

The proposed action is to construct a new facility on previously disturbed land in Zone 12 South to accommodate all Pu and HEU material within the scope of the PEIS. A buffer zone would be created around the facility. Impacts to cultural and paleontological resources resulting from this alternative would be similar to those described under the Consolidation Alternative.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, facility and other resource requirements will be almost the same as the No Action Alternative, the Upgrade Alternatives, the Consolidation Alternative, and the Collocation Alternative. Therefore, the impacts to cultural and paleontological resources would be equal to those previously described. [Text deleted.]

Phaseout

Under this alternative, Pantex Pu material would be moved to the consolidation or collocation sites or to disposition. No impacts to cultural or paleontological resources are expected to result from this action.

[Text deleted.]

4.2.4.8 Socioeconomics

No Action Alternative

Under this alternative, the existing storage facility would remain operational. No new employment or in-migration of workers would be required.

Regional Economy Characteristics. Total employment growth in the REA is projected to average less than 1 percent annually between 1995 and 2040. Total employment is projected to reach 221,800 in 2000 and increase to 254,400 in 2040. Unemployment in the REA was 4.8 percent in 1994 and is projected to remain at this level into the near future. Per capita income is projected to increase from approximately $19,435 in 1995 to $22,671 in 2040. Projections for the No Action alternative are presented in Table L.1–37.

Population and Housing. Population in the ROI is projected to increase from 206,400 in 1995 to 240,800 by 2040. The total number of housing units in the ROI is projected to increase from 85,400 in 1995 to 99,600 by 2040. Population and housing projections for the No Action Alternative are presented in Appendix Tables L.1–38 and L.1–39, respectively.

Community Services. Education, public safety, and health care characteristics are used to assess the level of community services in the Pantex ROI. School enrollments are projected to increase from 39,720 students in 1995 to 46,360 students by 2040. The current student-to-teacher ratio is 16.3:1 and to maintain this level of service, the number of teachers in the ROI would need to increase from 2,438 in 1995 to 2,846 in 2040. No Action projections are presented in Appendix Tables L.1–40 and L.1–41.

The projected numbers of sworn police officers and firefighters serving ROI communities between 1995 and 2040 are shown in Tables L.1–42 and L.1–43, respectively. Under No Action, the number of sworn police officers is projected to increase from 463 in 1995 to 542 in 2040 if the current service level of 2.3 officers per 1,000 persons is maintained. The number of firefighters in the ROI would need to increase from 412 in 1995 to 481 in 2040 to maintain the current level of service of 2.3 firefighters per 1,000 persons.

Hospital occupancy rates are based on current capacity. Hospital occupancy rates and the estimated number of practicing physicians serving the ROI population during the period 1995 to 2040, are presented in Tables L.1–44 and L.1–45, respectively. Hospital occupancy rates in the ROI are projected to increase from 56 percent in 1995 to 65 percent in 2040. If the current physician-to-population ratio of 2.0 physicians per 1,000 persons is maintained, the total number of physicians is projected to increase from 408 in 1995 to 476 in 2040.

Local Transportation. The worker population at Pantex would not increase. Therefore, any increases in traffic would be due to the projected growth in the area unrelated to DOE activities. [Text deleted.]

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The upgrade to continue storing the Pu already located at Pantex and RFETS pits would require 19 workers during peak construction and 90 workers during full operation. There would be sufficient available labor in the REA to fill both direct and indirect jobs created by construction. Therefore, no workers would in-migrate to the region and no change to the region's population would result beyond No Action projections. Some specialized workers would in-migrate during operation.

Regional Economy Characteristics. During peak construction of the upgraded facility, a total of 34 jobs (19 direct and 15 indirect) would be generated. Unemployment in the REA would remain at 4.8 percent, as projected under No Action, and the per capita income would increase by less than 1 percent (Socio 1996a).

Operation of the facility would generate a total of 406 jobs (90 direct and 316 indirect). Total employment in the REA would increase less than 1 percent over No Action, and the unemployment rate would fall to 4.7 percent. Per capita income would increase less than 1 percent (Socio 1996a).

Population and Housing. Projections indicate that there would be sufficient available labor to fill all of the direct and indirect jobs generated by the construction of the facility. However, some qualified workers would in-migrate to the region during the operation of the facility. Any population increase in the region would be much less than 1 percent, and projected housing vacancies would be sufficient to accommodate the slight population growth.

Community Services. No in-migration would occur during construction and the size of the population change during operations would be too small to affect the demand for most community services. Therefore, demand for community services would be the same as for No Action, although one additional physician would be required to maintain the physician to population ratio of 2.0 physicians per 1,000 persons for the ROI.

Local Transportation. During peak construction of the facility, workers would generate 36 vehicle trips per day, and during full operations, workers would generate 173 vehicle trips per day. These increases would not affect the level of service on the local road segments analyzed (Socio 1996a).

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The Upgrade Without RFETS Pu or LANL Pu Subalternative is similar to the Upgrade With RFETS Pu Pits Subalternative because the modified facilities in Zone 12 South would be designed with adequate capacity to store all of the RFETS Pu pits. No additional resources would be required and therefore the impacts would be the same.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

Construction and operation employment requirements for this facility would be greater than for the Upgrade With RFETS Pu Pits Subalternative, but smaller than for the Consolidation Alternative to Construct New and Modify Existing Zone 12 South Facilities. Therefore, the socioeconomic impacts would likely be greater than previously discussed for the Upgrade With RFETS Pu Pits Subalternative, but smaller than discussed for the Consolidation through upgrade.

[Text deleted.]

Consolidation Alternative

Construct New and Modify Existing Zone 12 South Facilities

To upgrade the facility for consolidated Pu storage, 1,142 workers would be needed during peak construction and 509 direct workers would be needed for operations. Some of the direct jobs during both phases would be

filled by in-migrating workers. The effects of this in-migration on the region's economy, employment, population, housing, community services, and local transportation are discussed below.

Regional Economy Characteristics. During peak construction of the facility, the REA's total employment would increase from the projected No Action employment by almost 1 percent. A total of 2,063 jobs (1,142 direct and 921 indirect) would be generated by constructing the facility. Unemployment would decrease from 4.8 percent to 4.2 percent. Per capita income would increase by less than 1 percent (Socio 1996a).

Operation of the facility would generate 2,295 jobs (509 direct and 1,786 indirect). Total employment in the region during full operation would increase approximately 1 percent over the No Action projection, and unemployment would decrease to 4.0 percent. Per capita income would increase by less than 1 percent (Socio 1996a).

Population and Housing. Some qualified workers would in-migrate to the ROI during both the construction and operational phases. However, any population change in the region would be less than 1 percent and projected housing vacancies would be sufficient to accommodate the slight population growth (Socio 1996a).

Community Services. An increase in total ROI school enrollment of 251 during construction and 153 during operation of the facility would require 16 teachers above the No Action level during construction and 9 additional teachers during full operations in order to maintain the No Action level of service (Socio 1996a). These increases represent the sum of changes across all the school districts in the ROI, and no single school district would be significantly affected.

The police force in the ROI would need to expand by two officers during both construction and operation in order to maintain the No Action level of service. The additional population resulting from construction would require three firefighters over No Action, while additional population during operations would require only two additional firefighters (Socio 1996a).

Hospital occupancy rates would increase slightly over No Action projections, but available hospital capacity would be able to absorb this increase. Population increases would require three additional physicians during construction and two additional physicians during both construction and operations to maintain the No Action level of service (Socio 1996a).

Local Transportation. During peak construction, workers would generate 2,193 vehicle trips per day. This increase would cause a drop in level of service on two local road segments. Farm-to-Market Road 683 from U.S. 60 to Farm-to-Market Road 293, a rural two lane highway, would experience a drop in level of service from A to B. I-27 from Local Route 335 at Amarillo to I-40 at Amarillo would experience a drop in level of service from D to E.

During operations, workers would generate 977 vehicle trips per day. This increase would not affect the level of service on the local road segments analyzed (Socio 1996a).

Construct New Plutonium Storage Facility

The new consolidated Pu storage facility would generate over 2,000 jobs (direct and indirect) during peak construction and over 2,100 jobs during operation. Many of the direct jobs during both construction and operation of the new facility would be expected to be filled by in-migrating workers. The effects of this in-migration on the region's economy, employment, population, housing, community services, and local transportation are discussed below.

Regional Economy Characteristics. A total of 2,067 jobs (1,144 direct and 923 indirect) would be generated during construction. Total employment in the REA would increase by almost 1 percent over the No Action projection as a result of construction activities. Unemployment would decrease from the No Action projection of

4.8 percent to 4.2 percent. Per capita income would increase by much less than 1 percent over the No Action projection.

Operation of the consolidated storage facility at Pantex would generate 2,133 jobs (471 direct and 1,660 indirect) during full operation, increasing total employment in the REA by approximately 1 percent over the No Action projection. Unemployment would decrease to 4.1 percent. Per capita income would increase by less than 1 percent over the No Action projection (Socio 1996a).

Population and Housing. Project workers and their families would be expected to in-migrate to the ROI to fill direct jobs created by construction and operation of the storage facility. However, the ROI population is expected to increase by less than 1 percent over No Action projections during both construction and operation, and projected housing vacancies would accommodate the increased demand (Socio 1996a).

Community Services. The in-migration of approximately 1,384 persons during construction and 762 persons during full operation of the facility would slightly increase the demand for community services. Although school enrollments would increase by less than 1 percent over the projected No Action levels during both construction and full operation, additional teachers would be needed to maintain the No Action level of service. The total number of teachers in the ROI would need to increase by 16 during construction and 8 during operation in order to maintain the No Action level of service (Socio 1996a).

The number of sworn police officers would need to increase by two over No Action projections during construction and by one during operation in order to maintain the No Action service level. Additionally, to maintain the No Action service level of fire protection, the number of firefighters would need to increase by three during construction and one during operations (Socio 1996a).

Hospital occupancy rates during construction and full operation would be slightly higher than the projected No Action rates, but existing capacity would be able to absorb the increase. The number of physicians in the ROI would need to increase by two during construction and by one during full operation in order to maintain the No Action service level (Socio 1996a).

Local Transportation. During peak construction, workers would generate 2,196 vehicle trips per day. This increase would cause a drop in level of service on two local road segments. Farm-to-Market Road 683 from U.S. 60 to Farm-to-Market Road 293, a rural two lane highway, would experience a drop in level of service from A to B. I-27 from Local Route 335 at Amarillo to I-40 at Amarillo would experience a drop in level of service from D to E. Operation workers would generate 908 vehicle trips per day and this increase would not affect the level of service on the local road segments analyzed (Socio 1996a).

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction of new storage facilities would be required in order to store Pu and HEU at Pantex. Projections indicate that workers would in-migrate to fill some of the direct jobs generated during both the construction and operation phases at Pantex. However, there would be sufficient labor available in the REA to fill the indirect jobs created during both periods. The effects on the region's economy, population, housing, community services, and local transportation are discussed below.

Regional Economy Characteristics. Construction of the consolidated Pu and HEU storage facilities would generate a total of 2,125 jobs (1,176 direct and 949 indirect) in the REA during peak construction at Pantex. Projections indicate that the available labor force would fill all the indirect jobs created, but approximately 558 in-migrant workers would be needed to fill the direct labor requirements. Total employment in the REA would increase 1.0 percent over No Action projections, and unemployment would decrease from 4.8 percent to 4.2 percent. Per capita income would increase less than 1 percent (Socio 1996a).

Operation of the proposed storage facilities would generate a total of 2,710 jobs (601 direct and 2,109 indirect) in the REA. While some specialized direct jobs would be filled by in-migrating workers, all of the indirect positions would be filled by available labor in the region. Total employment in the REA would increase 1.2 percent over the No Action projection, and the REA unemployment rate would decrease to 3.9 percent. Per capita income would increase by less than 1 percent (Socio 1996a).

Population and Housing. Approximately 1,468 and 1,070 persons are projected to in-migrate to the region during the construction and operation phases of the proposed storage facilities, respectively (Socio 1996a). Projected housing vacancies would be sufficient to accommodate the increase in demand for housing units.

Community Services. The in-migration of population during both the construction and operation phases of the proposed alternative would slightly increase the demand for community services. ROI school enrollments are projected to increase by 269 and 196 students during peak construction and at full operation, respectively. In order to maintain the No Action level of service, the number of teachers would need to increase by 17 during construction and 11 during full operation of the proposed facility (Socio 1996a).

During both peak construction and full operation, the number of sworn police officers would need to increase by two in order to maintain the No Action level of service. [Text deleted.] In order to maintain the No Action service level of 2.0 firefighters per 1,000 persons, the number of firefighters would need to increase by four during peak construction and by two during full operation (Socio 1996a).

Projected hospital occupancy rates, during peak construction and full operation, would be slightly higher than the No Action projections, but existing capacity would be able to accommodate the increase. The number of physicians in the ROI would need to increase by two during both peak construction and full operation in order to maintain the No Action service level (Socio 1996a).

Local Transportation. During peak construction, workers would generate 2,258 vehicle trips per day. This increase would cause a drop in level of service on two local road segments. Farm-to-Market Road 683 from U.S. 60 to Farm-to-Market Road 293, a rural two lane highway, would experience a drop in level of service from A to B. I-27 from Local Route 335 at Amarillo to I-40 at Amarillo would experience a drop in level of service from D to E. Operation employees would generate 1,154 vehicle trips per day. This increase would not affect the level of service on the local road segments analyzed (Socio 1996a).

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Not including the strategic reserve and weapons R&D materials in the storage options would slightly reduce the number of employees needed during operations. Fewer workers would in-migrate, and the increase in demand for housing and community services would be smaller. A smaller workforce would still benefit the regional economy, but on a smaller scale than if the larger facility was constructed for the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative. [Text deleted.]

Phaseout

Phaseout of existing Pu storage facilities at Pantex would result in a loss of five operational employees. Some of these positions would likely be transferred to other onsite activities, reducing the impact of a storage facility phaseout. At maximum, phaseout would result in a total loss of 28 direct and indirect jobs within the region, but decreases to regional employment and income would be imperceptible. In the longer term, some displaced workers would be expected to leave the region to seek other employment opportunities. However, any resulting decreases in population would be negligible.

Phaseout of the existing Pu storage facilities at Pantex would slightly reduce the number of vehicle trips per day generated by site workers. There would be no significant traffic impact to the local road network due to this alternative.

4.2.4.9 Public and Occupational Health and Safety

The assessments of potential radiological and chemical impacts associated with the storage alternatives at Pantex are presented in this section. Summaries of radiological impacts from normal operations are presented in Tables 4.2.4.9–1 and 4.2.4.9–2 for the public and workers, respectively. Impacts from the hazardous chemicals are presented in Table 4.2.4.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.2.4.9–4 through 4.2.4.9–8. Detailed results are presented in Appendix M.

Aircraft Crash. Pantex is located approximately 13.6 km (8.5 mi) from the northeast-southwest runway at Amarillo International Airport. Potential accident scenarios in which an aircraft crashes into one or more facilities at Pantex have been developed for the Pantex EIS. A discussion of aircraft crash accident for this PEIS is contained in Appendix R.

No Action Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from normal operations involved with the Pantex site-wide missions, including storage of Pu. The impacts would be within applicable regulatory limits. For facility accidents, the risks and consequences are described in site safety documentation.

Normal Operation. The current mission at Pantex, where Pu is in interim storage, is described in Section 3.5. The site has identified those facilities that will continue to operate under the No Action Alternative, including Pu storage facilities and others, if any, that will become operational by 2005. Based on that information, the radiological and chemical releases to the environment in 2005 and beyond (future operation) were developed and used in the impact assessments. The resulting doses and potential health effects to the public and workers at Pantex are described below.

Radiological Impacts. The calculated annual dose to the average and maximally exposed members of the public from total site operation; the associated fatal cancer risks to these individuals from 50 years of operation; the dose to the population within 80 km (50 mi) from total site operation in the year 2030; and the projected number of fatal cancers in this population from 50 years of operation are presented in Table 4.2.4.9–1 under this alternative at Pantex. The annual dose of 6.1×10^{-5} mrem to the MEI is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.5×10^{-9}. The annual dose of 2.8×10^{-4} person-rem to the population would be within the limit in proposed 10 CFR 834. The corresponding number of fatal cancers in this population from 50 years of operation would be 7.0×10^{-6}. To put operational dose impacts into perspective, comparisons with doses from natural background radiation are included in the table.

Under the No Action Alternative, as shown in Table 4.2.4.9–2, the annual average dose to a non-involved (No Action) site worker and the annual dose to the non-involved (No Action) total site workforce would be 10 mrem and 14 person-rem, respectively. The associated risk of fatal cancer to the average worker from 50 years of total site operations would be 2.0×10^{-4}, and the projected number of fatal cancers among all workers from 50 years of total site operations would be 0.28. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public resulting from the normal operation under this alternative at Pantex are presented in Table 4.2.4.9–3. The hazardous chemical impacts from current site operations were used to estimate the baseline site impacts for the various storage alternatives. The noncancer health effects expected and the risk of cancer due to the total chemical exposures were estimated for each site. Since the major releases due to normal operations at Pantex are expected to make up nearly all of the exposures

Table 4.2.4.9–1. Potential Radiological Impacts to the Public During Normal Operation at Pantex Plant— No Action and Storage Alternatives

Receptor	No Action		Upgrade		Consolidation				Collocation	
					New and Modify Zone 12 South		New Facility			
	Storage Facilities[a]	Total Site	Storage Facilities[b]	Total Site[c]	Storage Facilities	Total Site[c]	Storage Facility	Total Site[c]	Storage Facility	Total Site[c]
Annual Dose to the Maximally Exposed Individual Member of the Public[d]										
Atmospheric release pathway (mrem)	e	6.1×10^{-5}	e	$<6.1 \times 10^{-5}$	9.5×10^{-6}	6.5×10^{-5}	9.5×10^{-6}	6.5×10^{-5}	9.6×10^{-6}	6.5×10^{-5}
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0	0
Total liquid release pathway (mrem)	0	0	0	0	0	0	0	0	0	0
Atmospheric and liquid release pathways combined (mrem)	1.8×10^{-8}e	6.1×10^{-5}	$<1.8 \times 10^{-8}$e	6.1×10^{-5}	9.5×10^{-6}	6.5×10^{-5}	9.5×10^{-6}	6.5×10^{-5}	9.6×10^{-6}	6.5×10^{-5}
Percent of natural background[f]	5.4×10^{-9}	1.8×10^{-5}	$<5.4 \times 10^{-9}$	$<1.8 \times 10^{-5}$	2.8×10^{-6}	1.9×10^{-5}	2.8×10^{-6}	1.9×10^{-5}	2.9×10^{-6}	1.9×10^{-5}
50-year fatal cancer risk	4.5×10^{-13}	1.5×10^{-9}	$<4.5 \times 10^{-13}$	$<1.5 \times 10^{-9}$	2.4×10^{-10}	1.6×10^{-9}	2.4×10^{-10}	1.6×10^{-9}	2.4×10^{-10}	1.6×10^{-9}
Population Dose Within 80 Kilometers for Year 2030[g]										
Atmospheric release pathway (person-rem)	e	2.8×10^{-4}	e	$<2.8 \times 10^{-4}$	5.5×10^{-5}	3.3×10^{-4}	5.2×10^{-5}	3.3×10^{-4}	5.3×10^{-5}	3.3×10^{-4}
Total liquid release pathway (person-rem)	0	0	0	0	0	0	0	0	0	0
Atmospheric and liquid release pathways combined (person-rem)	6.3×10^{-6}e	2.8×10^{-4}	$<6.3 \times 10^{-6}$e	$<2.8 \times 10^{-4}$	5.5×10^{-5}	3.3×10^{-4}	5.2×10^{-5}	3.3×10^{-4}	5.3×10^{-5}	3.3×10^{-4}
Percent of natural background[f]	5.4×10^{-9}	2.4×10^{-7}	$<5.4 \times 10^{-9}$	$<2.4 \times 10^{-7}$	4.7×10^{-8}	2.9×10^{-7}	4.4×10^{-8}	2.8×10^{-7}	4.5×10^{-8}	2.8×10^{-7}
50-year fatal cancers	1.6×10^{-7}	7.0×10^{-6}	$<1.6 \times 10^{-7}$	$<7.0 \times 10^{-6}$	1.4×10^{-6}	8.4×10^{-6}	1.3×10^{-6}	8.3×10^{-6}	1.3×10^{-6}	8.3×10^{-6}

Table 4.2.4.9–1. Potential Radiological Impacts to the Public During Normal Operation at Pantex Plant—No Action and Storage Alternatives—Continued

	No Action		Upgrade		Consolidation				Collocation	
					New and Modify Zone 12 South		New Facility			
Receptor	Storage Facilities[a]	Total Site	Storage Facilities[b]	Total Site[c]	Storage Facilities	Total Site[c]	Storage Facility	Total Site[c]	Storage Facility	Total Site[c]
Annual Dose to the Average Individual Within 80 Kilometers[h]										
Atmospheric and liquid release pathways combined (mrem)	1.8×10^{-8}	8.0×10^{-7}	$<1.8\times10^{-8}$	$<8.0\times10^{-7}$	1.6×10^{-7}	9.4×10^{-7}	1.5×10^{-7}	9.4×10^{-7}	1.5×10^{-7}	9.4×10^{-7}
50-year fatal cancer risk	4.5×10^{-13}	2.0×10^{-11}	$<4.5\times10^{-13}$	$<2.0\times10^{-11}$	3.9×10^{-12}	2.4×10^{-11}	3.7×10^{-12}	2.4×10^{-11}	3.8×10^{-12}	2.4×10^{-11}

[a] The committed effective dose equivalent for the storage facility is calculated based upon an analysis of measured dose.

[b] For the three upgrade subalternatives including the Preferred Alternative, the dose to the MEI and the population within 80 km would decrease slightly from the No Action Alternative, although the differences are expected to be below detection limits. Therefore, the total site dose would decrease slightly but the change would be undetectable. The quantity of Pu pits at Pantex to be stored in upgraded facilities in Zone 12 would be slightly increased by the addition of RFETS pits (the Preferred Alternative) or by the addition of RFETS Pu and LANL Pu. The difference between these three subalternatives would be below detection limits. The AT-400A has both an inner container and an outer container that provides additional shielding material. The overall effect of moving Pantex and RFETS pits from Zone 4 to upgraded Zone 12 storage facilities would be lower potential releases of radioactive materials to the public because the radiological impacts at Zone 4 would be reduced.

[c] Includes impacts from No Action facilities. The location of the MEI may be different under No Action than for the other alternatives. Therefore, the impacts may not be directly additive.

[d] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway as required by the SWDA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[e] The atmospheric releases for No Action and upgrade would not be measurable above background radiation. The atmospheric and liquid release pathways combined was calculated with measured data from direct doses outside the facility.

[f] The annual natural background radiation level at Pantex is 334 mrem for the average individual; the population within 80 km in the year 2030 receives 116,900 person-rem.

[g] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[h] Obtained by dividing the population dose by the number of people projected to live within 80 km of Pantex in 2030 (350,000).

Source: Section M.2.

Table 4.2.4.9–2. Potential Radiological Impacts to Workers During Normal Operation at Pantex Plant—Storage Alternatives

Receptor	Upgrade[a] With RFETS Pits	Upgrade[a] Without RFETS or LANL Pu	Upgrade[a] With RFETS and LANL Pu	Consolidation[a] New and Modify Zone 12 South	Consolidation[a] New Facility	Collocation[a] New Facility
Involved Workforce[b]						
Average worker dose (mrem/yr)[c]	116	116	116	254	258	264
50-year risk of fatal cancer	2.3×10^{-3}	2.3×10^{-3}	2.3×10^{-3}	5.1×10^{-3}	5.2×10^{-3}	5.3×10^{-3}
Total dose (person-rem/yr)	3	3	6	31	24	25
50-year fatal cancers	0.06	0.06	0.12	0.62	0.48	0.50
Noninvolved Workforce[d]						
Average worker dose (mrem/yr)[c]	24	24	24	24	24	24
50-year risk of fatal cancer	4.8×10^{-4}	4.8×10^{-4}	4.8×10^{-4}	4.8×10^{-4}	4.8×10^{-4}	4.8×10^{-4}
Total dose (person-rem/yr)	34	34	34	34	34	34
50-year fatal cancers	0.68	0.68	0.68	0.68	0.68	0.68
Total Site Workforce[e]						
Dose (person-rem/yr)	37	37	40	65	58	59
50-year fatal cancers	0.74	0.74	0.80	0.90	0.76	0.78

[a] Under the Upgrade Alternative (either without RFETS or LANL Pu or with RFETS pits), 25 in-plant workers badged with dosimeters to monitor radiation exposure would be required to operate the storage facility, with an estimated additional 25 badged in-plant workers needed if Pu (pit and non-pit material) is transferred from RFETS and LANL. The impacts given in the Upgrade Alternative (with RFETS and LANL Pu) include those associated with these additional workers. The number of involved badged workers for the two Consolidation Alternatives would be 123 and 92; for the Collocation Alternative the number of badged workers would be 95.

[b] The involved worker is a worker associated with operations of the proposed action. The maximum dose to an involved worker would be kept below 500 mrem per year. [Text deleted.] An effective ALARA program will ensure that the exposure will be reduced to that level which is as low as reasonably achievable.

[c] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the site must make reasonable attempts to maintain worker doses below this level.

[d] The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The projected number of noninvolved badged workers in 2005 is 1,400. The noninvolved workforce is equivalent to the No Action workforce.

[e] The impact to the total site workforce is the summation of the in-plant worker impact and the noninvolved worker impact.

[Text deleted.]

Source: PX 1996e:2; PX DOE 1996a; and Section M.2.

to onsite workers and to the public in adjacent communities, contributions to the hazardous chemical concentrations from all other sources (for example, industrial operations) are considered negligible for purposes of risk calculations.

The HI to the MEI of the public at Pantex resulting from normal operation under the No Action Alternative is 5.7×10^{-3}, and the cancer risk is 1.1×10^{-8}. The HI to the onsite worker is 6.1×10^{-3}, and the cancer risk is 4.5×10^{-7}.

Facility Accidents. Under the No Action Alternative, Pu would continue to be stored at Pantex in existing facilities. These facilities currently operate in accordance with DOE safety orders which ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations will be minimized. The safety to workers and the public from accidents at existing facilities is also controlled by Technical Safety Requirements specified in detail in SARs or a Basis for Interim Operations document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities would cause a halt in operations until it can be established that worker and public safety has not been compromised.

Table 4.2.4.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation at Pantex Plant—No Action and Storage Alternatives

	No Action	Upgrade[a]		Consolidation		Collocation	
Receptor	Total Site[b]	Facility[c]	Total Site[b]	Facility[c]	Total Site[b]	Facility[c]	Total Site[b]
Maximally Exposed Individual (Public)							
Hazard index[d]	5.7×10^{-3}	0	5.7×10^{-3}	1.4×10^{-4}	5.8×10^{-3}	2.0×10^{-4}	5.9×10^{-3}
Cancer risk[e]	1.1×10^{-8}	0	1.1×10^{-8}	1.5×10^{-7}	1.6×10^{-7}	1.5×10^{-7}	1.6×10^{-7}
Worker Onsite							
Hazard index[f]	6.1×10^{-3}	0	6.1×10^{-3}	7.0×10^{-4}	6.8×10^{-3}	9.3×10^{-4}	7.1×10^{-3}
Cancer risk[g]	4.5×10^{-7}	0	4.5×10^{-7}	6.2×10^{-6}	6.7×10^{-6}	6.2×10^{-6}	6.7×10^{-6}

[a] Chemical impacts are the same for all three upgrade subalternatives.
[b] Total=Sum of the No Action plus the contributions of the above facility.
[c] Contribution from the above activity only (that is, the amount of increase over the existing No Action level at the site).
[d] Hazard index for MEI=Sum of the individual Hazard Quotients (noncancer health effects) for MEI.
[e] Cancer risk for MEI=(Emissions for 8-hour) x (0.286 [converts concentrations to doses]) x (slope factor [SF]).
[f] Hazard index for workers=Sum of individual Hazard Quotients (noncancer health effects) for workers.
[g] Cancer risk for workers=(Emissions for 8-hour) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (SF).
Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors, therefore the calculated cancer risk value is 0.
Source: Section M.3; Tables M.3.4–14 through M.3.4–17.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the modified existing Pu storage facilities under the Upgrade Alternative at Pantex. The section describes the impacts from normal facility operations at Pantex, then describes impacts from facility accidents.

During normal operation at Pantex, the operation of the Pu storage facilities under this alternative would result in impacts that are within applicable regulatory limits. Storage of RFETS pits would occur in Zone 4 until Zone 12 facilities are available for the Preferred Alternative. The radiological impacts for intersite transportation between Zone 4 and Zone 12, the repackaging from FL(B) into AL-R8 containers, and the storage in Zone 4 of pits from RFETS are described in Appendix Q.

[Text deleted.]

Normal Operation. There would be no radiological releases during the modification of existing storage facilities at Pantex. Construction worker exposures to materials potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct exposures. The resulting doses and potential health effects to the public and workers at Pantex are described below.

Radiological Impacts. The dose to the public would be reduced slightly from the No Action Alternative for the Upgrade With RFETS Pu Pits Subalternative, as shown in Table 4.2.4.9–1. The number of pits at Pantex to be

stored in upgraded facilities in Zone 12 South would be slightly increased by the addition of RFETS pits. However, before the material would be placed in facilities in Zone 12, pits would be repackaged from AL-R8 containers into AT-400A containers. The AT-400A has both an inner container (which is welded and prevents the release of any radioactive materials) and an outer container (which also prevents the release of radioactive materials and provides additional shielding material). The upgraded storage facilities in Zone 12 would have improved safety and design features over those in Zone 4, including filters to reduce the possibility of airborne releases to the atmosphere. Therefore, the overall effect of moving Pantex and RFETS pits into upgraded Zone 12 storage facilities would be lower potential releases of radioactive materials to the public.

Doses to onsite workers from normal operations are given in Table 4.2.4.9–2. Included in the table are involved workers directly associated with the storage facilities, workers who are not involved with these facilities, and the entire workforce at Pantex. All doses would fall within regulatory limits and administrative control levels. The total dose to the involved workforce would be 3 person-rem/year, and for 50 years of operation the fatal cancers would be 0.06.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the modified facilities under the Upgrade Alternative at Pantex are presented in Table 4.2.4.9–3. The impacts from all site operations, including the storage facilities, are included in this table. Total site impacts, which include the No Action impact plus the facilities, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public would be zero (because no hazardous substances would be released), and the cancer risk would be zero (because no carcinogens would be released) as a result of operation of the storage facilities under the Upgrade Alternative in the year 2030. The HI and cancer risk from hazardous chemicals would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the storage facilities, would result in an HI of 5.7×10^{-3} and a cancer risk of 1.1×10^{-8} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be zero (because no hazardous substances would be released), and the cancer risk is zero (because no carcinogens would be released from the hazardous chemicals used) as a result of operation of the storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures are expected to remain the same. The total site operation, including the storage facilities, would result in an HI of 6.1×10^{-3} and a cancer risk of 4.5×10^{-7} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents have been postulated for the Upgrade With RFETS Pu Pits Subalternative facility for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.4.9–4. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.26 at Pantex for the beyond design basis earthquake accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.3×10^{-6}, 8.4×10^{-9}, and 2.3×10^{-8}, respectively. The maximum population 50-year facility lifetime risk would be 8.8×10^{-4} (that is, one fatality in about 57,000 years) at Pantex for the PCV penetration accident scenario with a probability of 0.04 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 5.8×10^{-6} and 1.4×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenario identified in Table 4.2.4.9–4.

Table 4.2.4.9–4. Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative—Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	5.3×10^{-8}	1.8×10^{-6}	2.1×10^{-8}	7.1×10^{-7}	3.2×10^{-6}	1.1×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	3.1×10^{-9}	1.8×10^{-7}	1.2×10^{-9}	7.1×10^{-8}	1.9×10^{-7}	1.1×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	1.4×10^{-5}	7.2×10^{-6}	5.8×10^{-6}	2.9×10^{-6}	8.8×10^{-4}	4.4×10^{-4}	0.04
Vault fire	1.2×10^{-8}	2.4×10^{-3}	4.7×10^{-9}	9.4×10^{-4}	7.2×10^{-7}	0.14	1.0×10^{-7}
Truck bay fire	1.2×10^{-9}	2.5×10^{-4}	4.9×10^{-10}	1.0×10^{-4}	7.6×10^{-8}	0.015	1.0×10^{-7}
Spontaneous combustion	1.2×10^{-11}	3.5×10^{-7}	4.9×10^{-12}	1.4×10^{-7}	7.6×10^{-10}	2.2×10^{-5}	7.0×10^{-7}
Explosion in the vault	1.8×10^{-9}	3.6×10^{-4}	7.2×10^{-10}	1.4×10^{-4}	1.1×10^{-7}	0.023	1.0×10^{-7}
Explosion outside of vault	1.3×10^{-11}	2.7×10^{-6}	5.3×10^{-12}	1.1×10^{-6}	8.2×10^{-10}	1.6×10^{-4}	1.0×10^{-7}
Nuclear criticality	9.7×10^{-12}	1.9×10^{-6}	4.6×10^{-12}	9.3×10^{-7}	1.2×10^{-10}	2.3×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	2.3×10^{-8}	4.7×10^{-3}	8.4×10^{-9}	1.7×10^{-3}	1.3×10^{-6}	0.26	1.0×10^{-7}
Expected risk[d]	1.4×10^{-5}	–	5.8×10^{-6}	–	8.8×10^{-4}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the impacts in Table 4.2.4.9–7 with adjustments to reflect smaller quantities of Pu for upgraded storage.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. Because the facilities will be modified, design information necessary to support a reasonable estimate of the accident impacts to the involved workers is not yet available. Such information would specify the locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details that affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Before modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

During normal operation, there would be a slight reduction in radiological and hazardous chemical impacts from the Upgrade With RFETS Pits Subalternative if no RFETS or LANL Pu is moved to Pantex. The radiation impacts during normal operations to the public and workers are shown Tables 4.2.4.9–1 and 4.2.4.9–2, respectively. The doses to the public and workers for upgrade without RFETS Pu or LANL Pu is shown together

with the doses to the public and workers for upgrade with RFETS pits because this reduction in dose to the public and workers would not be measurable above background. The chemical impacts to the public and workers are shown in Table 4.2.4.9–3 and would not be detectable from the impacts for an upgrade facility with RFETS pits. For facility accidents, the impacts without RFETS Pu or LANL Pu would be slightly reduced from the impacts shown in Table 4.2.4.9–4 because of the smaller amount of Pu material. This reduction in potential impacts would not be detectable or measurable above background.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. Because the facilities will be modified, design information necessary to support a reasonable estimate of the accident impacts to the involved workers is not yet available. Such information would specify the locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details that affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Before modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

During normal operation, there would be a slight increase in radiological and hazardous chemical impacts from the Upgrade With RFETS Pits Subalternative if all of the RFETS and LANL Pu is moved to Pantex. The radiation impacts during normal operations to the public and workers are shown Tables 4.2.4.9–1 and 4.2.4.9–2, respectively. The doses to the public for upgrade with all the RFETS Pu and LANL Pu are shown together with the doses to the public and workers for upgrade with RFETS pits because the difference in the dose to the public would not be measurable above background. The doses to the workers with all the RFETS Pu and LANL Pu would be increased to 6 person-rem/year. The increase would be because the non-pit material would require additional handling not currently performed at Pantex. The chemical impacts to the public and workers are shown in Table 4.2.4.9–3 and would not be detectable from the impacts for an upgrade facility with RFETS pits. For facility accidents, the impacts with all RFETS Pu and LANL Pu would be increased above the impacts shown in Tables 4.2.4.9–5 and 4.2.4.9–6 because the non-pit material would require additional handling and operations not currently performed at Pantex.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. Because the facilities will be modified, design information necessary to support a reasonable estimate of the accident impacts to the involved workers is not yet available. Such information would specify the locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details that affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Before modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

[Text deleted.]

Consolidation Alternative

This section includes a description of radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with new or modified consolidated Pu storage

facilities at Pantex. Normal operation under either of the two consolidated storage options would result in impacts that are within applicable regulatory limits.

[Text deleted.]

Construct New and Modify Existing Zone 12 South Facilities

Normal Operation. There would be no radiological releases from constructing a new storage facility or from modifying existing storage facilities to store the consolidated Pu. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at Pantex are described below for consolidated Pu storage in the modified storage facility.

Radiological Impacts. Radiological impacts to the public resulting from the normal operation of the new and modified Pu storage facilities at Pantex are presented in Table 4.2.4.9–1. The impacts from all site operations, including the storage facilities, are also given in the table. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the MEI from annual operations of the new and modified storage facilities would be 9.5×10^{-6} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 2.4×10^{-10}. The impacts to the average member of the public would be less. As a result of operations in the year 2030, the population dose would be 5.5×10^{-5} person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 1.4×10^{-6}.

The dose to the MEI from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 6.5×10^{-5} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.6×10^{-9}. The impacts to the average member of the public would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 3.3×10^{-4} person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 8.4×10^{-6}.

Doses to onsite workers from normal operations are given in Table 4.2.4.9–2. Included are involved workers directly associated with the new and modified storage facilities, workers who are not involved with these facilities, and the entire workforce at Pantex. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Doses to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemicals associated with constructing new and modifying existing facilities for the consolidation of Pu will be equal to, or less than, hazardous chemicals associated with operations under the Collocation Alternative for Pu storage. The resulting hazardous chemical impacts to the public and worker will be equal to, or less than, those appearing in Table 4.2.4.9–3 for the collocation of Pu.

Facility Accidents. A set of potential accidents have been postulated for the upgrade of existing and construction of new storage facilities at Pantex for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft)

from the accident release point, the maximum offsite individual located at the site boundary, and the general population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.4.9–5 for the Surplus Materials Storage Building and in Table 4.2.4.9–6 for the Strategic Reserves Storage Building. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.29 at the Pantex Surplus Materials Storage Buildings for the vault fire accident scenario with a probability of $1x10^{-7}$ per year. The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be $1.5x10^{-6}$, $1.1x10^{-8}$ and $2.9x10^{-8}$, respectively. The maximum population 50-year facility lifetime risk would be $1.8x10^{-3}$ (that is, one fatality in about 28,000 years) at the Pantex Surplus Material Storage Building for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be $1.3x10^{-5}$ and $3.2x10^{-5}$, respectively. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 1.8 at the Pantex Strategic Reserves Storage Building for the vault fire accident with a probability of $1x10^{-7}$ per year. The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be $9.0x10^{-6}$, $7.6x10^{-8}$ and $2.2x10^{-7}$, respectively. The maximum population 50-year facility lifetime risk would be $1.8x10^{-3}$ at the Pantex Strategic Reserves Storage Building for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be $1.3x10^{-5}$ and $3.2x10^{-5}$, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.2.4.9–5 and 4.2.4.9–6.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Before construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Construct New Plutonium Storage Facility

Normal Operation. There would be no radiological releases during the construction of a new consolidated Pu storage facility at Pantex. Construction worker exposures to material potentially contaminated with radioactivity would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at Pantex are described below for consolidated Pu storage in the new storage facility.

Radiological Impacts. Radiological impacts to the public resulting from the normal operation of the new consolidated Pu storage facility are presented in Table 4.2.4.9–1. The impacts from all site operations, including the new consolidated storage facility, are also given in the table. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the MEI from annual storage plant operation would be $9.5x10^{-6}$ mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be $2.4x10^{-10}$. The impacts to the average member of the public would be less. As a result of storage plant operation in the year 2030, the population dose would be $5.2x10^{-5}$ person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be $1.3x10^{-6}$.

Table 4.2.4.9–5. Consolidated Storage for Pantex Plant Surplus Materials Storage Building—Accident Impacts

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality (per 50 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality (per 50 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatality[b]	Population to 80 km: Risk of Cancer Fatalities (per 50 yr)[a]	Population to 80 km: Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	7.3×10^{-8}	2.4×10^{-6}	2.9×10^{-8}	9.7×10^{-7}	4.2×10^{-6}	1.4×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	4.3×10^{-9}	2.4×10^{-7}	1.7×10^{-9}	9.7×10^{-8}	2.2×10^{-7}	1.4×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	3.2×10^{-5}	1.0×10^{-5}	1.3×10^{-5}	4.0×10^{-6}	1.8×10^{-3}	5.7×10^{-4}	0.064
Vault fire	2.9×10^{-8}	5.7×10^{-3}	1.1×10^{-8}	2.1×10^{-3}	1.5×10^{-6}	0.29	1.0×10^{-7}
Truck bay fire	1.7×10^{-9}	3.5×10^{-4}	6.9×10^{-10}	1.4×10^{-4}	1.0×10^{-7}	0.021	1.0×10^{-7}
Spontaneous combustion	1.7×10^{-11}	4.9×10^{-7}	6.8×10^{-12}	1.9×10^{-7}	9.8×10^{-10}	2.8×10^{-5}	7.0×10^{-7}
Explosion in the vault	4.0×10^{-9}	8.1×10^{-4}	1.6×10^{-9}	3.2×10^{-4}	2.3×10^{-7}	0.046	1.0×10^{-7}
Explosion outside of vault	1.7×10^{-11}	3.5×10^{-6}	6.9×10^{-12}	1.4×10^{-6}	1.0×10^{-9}	2.0×10^{-4}	1.0×10^{-7}
Nuclear criticality	9.9×10^{-12}	1.9×10^{-6}	4.6×10^{-12}	9.3×10^{-7}	1.1×10^{-10}	2.1×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	1.8×10^{-8}	3.6×10^{-3}	7.0×10^{-9}	1.4×10^{-3}	1.0×10^{-6}	0.20	1.0×10^{-7}
Expected risk[d]	3.2×10^{-5}	-	1.3×10^{-5}	-	1.9×10^{-3}	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.2.5.1–5 and M.5.2.5.1–6 and the MACCS computer code.

Table 4.2.4.9–6. Consolidated Storage for Pantex Plant Strategic Reserves Storage Building—Accident Impacts

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	
PCV puncture by forklift	7.3×10^{-8}	2.4×10^{-6}	3.0×10^{-8}	9.9×10^{-7}	4.2×10^{-6}	1.4×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	4.3×10^{-9}	2.4×10^{-7}	1.7×10^{-9}	9.9×10^{-8}	2.5×10^{-7}	1.4×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	3.2×10^{-5}	1.0×10^{-5}	1.3×10^{-5}	4.1×10^{-6}	1.8×10^{-3}	5.7×10^{-4}	0.064
Vault fire	2.2×10^{-7}	0.043	7.6×10^{-8}	0.015	9.0×10^{-6}	1.8	1.0×10^{-7}
Truck bay fire	1.7×10^{-9}	3.5×10^{-4}	7.0×10^{-10}	1.4×10^{-4}	1.0×10^{-7}	0.021	1.0×10^{-7}
Spontaneous combustion	1.7×10^{-11}	4.9×10^{-7}	6.9×10^{-12}	2.0×10^{-7}	9.8×10^{-10}	2.8×10^{-5}	7.0×10^{-7}
Explosion in the vault	5.2×10^{-9}	1.0×10^{-3}	2.1×10^{-9}	4.2×10^{-4}	3.0×10^{-7}	0.059	1.0×10^{-7}
Explosion outside of vault	1.7×10^{-11}	3.5×10^{-6}	7.0×10^{-12}	1.4×10^{-6}	1.0×10^{-9}	2.0×10^{-4}	1.0×10^{-7}
Nuclear criticality	9.7×10^{-12}	1.9×10^{-6}	4.7×10^{-12}	9.4×10^{-7}	1.1×10^{-10}	2.1×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	4.0×10^{-8}	8.0×10^{-3}	1.5×10^{-8}	2.9×10^{-3}	2.1×10^{-6}	0.41	1.0×10^{-7}
Expected risk[d]	3.2×10^{-5}	–	1.3×10^{-5}	–	1.9×10^{-3}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.2.5.1–7 and M.5.2.5.1–8 and the MACCS computer code.

The dose to the MEI from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5 and would be 6.5×10^{-5} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.6×10^{-9}. The impacts to the average member of the public would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 3.3×10^{-4} person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 8.3×10^{-6}.

Facility and total site doses to onsite workers from normal operations are given in Table 4.2.4.9–2. Included are involved workers directly associated with the new consolidated storage facility, workers who are not involved with the new storage facility, and the entire workforce at Pantex. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the new consolidated Pu storage facility at Pantex are presented in Table 4.2.4.9–3. The impacts from all site operations, including the consolidated storage facility, are included in this table. Total site impacts, which include the No Action impact plus the facility, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 1.4×10^{-4}, and the cancer risk is 1.5×10^{-7} as a result of operation of the new consolidated Pu storage facility in the year 2030. The HI and cancer risk from hazardous chemicals would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the upgrade facility, would result in an HI of 5.8×10^{-3} and a cancer risk of 1.6×10^{-7} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 7.0×10^{-4}, and the cancer risk is 6.2×10^{-6} as a result of operation of the new consolidated Pu storage facility in the year 2030. The HI and cancer risk from hazardous chemicals would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the new facility, would result in an HI of 6.8×10^{-3} and a cancer risk of 6.7×10^{-6} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents have been postulated for a new consolidated storage facility for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.4.9–7. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.41 at Pantex for the beyond design basis earthquake accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 2.1×10^{-6}, 1.4×10^{-8}, and 3.7×10^{-8} respectively. The maximum population 50-year facility lifetime risk would be 1.4×10^{-3} (that is, one fatality in about 36,000 years) at Pantex for the PCV penetration accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 9.2×10^{-6} and 2.3×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.4.9–7.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of

Table 4.2.4.9–7. Consolidation Alternative Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality (per 50 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality (per 50 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatality[b]	Population to 80 km: Risk of Cancer Fatalities (per 50 yr)[a]	Population to 80 km: Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	5.3×10^{-8}	1.8×10^{-6}	2.1×10^{-8}	7.1×10^{-7}	3.2×10^{-6}	1.1×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	3.1×10^{-9}	1.8×10^{-7}	1.2×10^{-9}	7.1×10^{-8}	1.9×10^{-7}	1.1×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	2.3×10^{-5}	7.2×10^{-6}	9.2×10^{-6}	2.9×10^{-6}	1.4×10^{-3}	4.4×10^{-4}	0.064
Vault fire	1.9×10^{-8}	3.8×10^{-3}	7.5×10^{-9}	1.5×10^{-3}	1.1×10^{-6}	0.23	1.0×10^{-7}
Truck bay fire	1.2×10^{-9}	2.5×10^{-4}	4.9×10^{-10}	1.0×10^{-4}	7.6×10^{-8}	0.015	1.0×10^{-7}
Spontaneous combustion	1.2×10^{-11}	3.5×10^{-7}	4.9×10^{-12}	1.4×10^{-7}	7.6×10^{-10}	2.2×10^{-5}	7.0×10^{-7}
Explosion in the vault	2.9×10^{-9}	5.8×10^{-4}	1.2×10^{-9}	2.3×10^{-4}	1.8×10^{-7}	0.036	1.0×10^{-7}
Explosion outside of vault	1.3×10^{-11}	2.7×10^{-6}	5.3×10^{-12}	1.1×10^{-6}	8.2×10^{-10}	1.6×10^{-4}	1.0×10^{-7}
Nuclear criticality	9.7×10^{-12}	1.9×10^{-6}	4.6×10^{-12}	9.3×10^{-7}	1.2×10^{-10}	2.3×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	3.7×10^{-8}	7.5×10^{-3}	1.4×10^{-8}	2.7×10^{-3}	2.1×10^{-6}	0.41	1.0×10^{-7}
Expected risk[d]	2.3×10^{-5}	–	9.3×10^{-6}	–	1.4×10^{-3}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.1.1–5 and M.5.2.1.1–6 and the MACCS computer code.

worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Before construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

This section includes a description of radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the consolidation of Pu storage and collocation with HEU storage facilities at Pantex. This storage would take place in a new Pu and HEU storage facility.

Normal operation of the new collocated storage facility at Pantex would result in emissions that are within applicable regulatory limits.

[Text deleted.]

Normal Operation. There would be no radiological releases during the construction of a new collocated storage facility at Pantex. Construction worker exposures to material potentially contaminated with

radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored, as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the public resulting from the normal operation of the new collocated storage facility at Pantex are presented in Table 4.2.4.9–1. The impacts from all site operations, including the new storage plant, are also given in the table. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the MEI from annual storage facility operation would be 9.6×10^{-6} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 2.4×10^{-10}. The impacts to the average member of the public would be less. As a result of storage facility operation in the year 2030, the population dose would be 5.3×10^{-5} person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 1.3×10^{-6}.

The dose to the MEI from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR Part 61, Subpart H) and DOE Order 5400.5, and would be 6.5×10^{-5} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.6×10^{-9}. The impacts to the average member of the public would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 3.3×10^{-4} person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 8.3×10^{-6}.

Doses to onsite workers from normal operations are given in Table 4.2.4.9–2. Included are involved workers directly associated with the new storage facility, workers who are not involved with the new storage facility, and the entire workforce at Pantex. All doses are within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of the facility.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the new consolidation of Pu and collocation with HEU storage facilities at Pantex are presented in Table 4.2.4.9–3. The impacts from all site operations, including the consolidation of Pu and collocation with HEU storage facilities, are also included in this table. Total site impacts which include the No Action impact plus the facility impacts, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 2.0×10^{-4} and the cancer risk is 1.5×10^{-7} as a result of operation of the new consolidation of Pu and collocation with HEU storage facilities in the year 2030. The HI and cancer risk from hazardous chemicals would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the new facility, would result in an HI of 5.9×10^{-3} and a cancer risk of 1.6×10^{-7} for the onsite worker in the year 2030 and would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 9.3×10^{-4}, and the cancer risk is 6.2×10^{-6} as a result of operation of the new consolidation of Pu and collocation with HEU storage facilities in the year 2030. The HI and cancer risk from hazardous chemicals would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the new facility, would result in a HI of 7.1×10^{-3},

and a cancer risk of 6.7×10^{-6} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents have been postulated for collocation of Pu and HEU for which there may be releases of Pu or HEU that may impact onsite workers and the offsite population. The consequences and risks of potential accidents that release both Pu and HEU would be bounded by the impacts associated with Pu. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.4.9–8. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.41 at Pantex for the beyond design basis earthquake accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 2.1×10^{-6}, 1.4×10^{-8}, and 3.7×10^{-8}, respectively. The maximum population 50-year facility lifetime risk would be 1.4×10^{-3} (that is, one fatality in about 36,000 years) at Pantex for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 9.2×10^{-6} and 2.3×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.4.9–8.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Before construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

If the strategic reserve and weapons R&D materials are not included, the impacts to the pubic and to workers from the accident-free storage activities would be reduced in proportion to the decrease in the amount of material stored. The impacts from total site operations would decrease slightly. This subalternative applies to the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative. The risks due to accidents would also tend to be lower.

Phaseout

Normal Operation. A phaseout of existing Pu storage facilities at Pantex would reduce the impacts from radiological and chemical releases and exposures to levels slightly below the No Action levels. All workers involved in the transfer of the Pu from existing storage would be monitored to assure that their doses remain within regulatory limits and as low as reasonably achievable.

Facility Accidents. The phaseout operation will be conducted in accordance with DOE Orders to ensure that the risk to the public of prompt fatalities due to accidents or of cancer fatalities due to operations will be minimized. For current operations in the facility that would be phased out, the safety of workers and the public from accidents is controlled by Technical Safety Requirements that are specified in SARs or Basis for Interim Operations documents that have been prepared for the facility. Prior to initiating phaseout, the potential for accidents that could impact workers and the public will be assessed and, if necessary, applicable existing safety documentation will be modified to ensure safety for workers and the public.

Table 4.2.4.9–8. Collocation Alternative Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	5.3×10^{-8}	1.8×10^{-6}	2.1×10^{-8}	7.1×10^{-7}	3.2×10^{-6}	1.1×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	3.1×10^{-9}	1.8×10^{-7}	1.2×10^{-9}	7.1×10^{-7}	1.9×10^{-6}	1.1×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	2.3×10^{-5}	7.2×10^{-6}	9.2×10^{-6}	2.9×10^{-6}	1.4×10^{-3}	4.4×10^{-4}	0.064
Vault fire	1.9×10^{-8}	3.8×10^{-3}	7.5×10^{-9}	1.5×10^{-3}	1.1×10^{-6}	0.23	1.0×10^{-7}
Truck bay fire	1.2×10^{-9}	2.5×10^{-4}	4.9×10^{-10}	1.0×10^{-4}	7.6×10^{-8}	0.015	1.0×10^{-7}
Spontaneous combustion	1.2×10^{-11}	3.5×10^{-7}	4.9×10^{-12}	1.4×10^{-7}	7.6×10^{-10}	2.2×10^{-5}	7.0×10^{-7}
Explosion in the vault	2.9×10^{-9}	5.8×10^{-4}	1.2×10^{-9}	2.3×10^{-4}	1.8×10^{-7}	0.036	1.0×10^{-7}
Explosion outside the vault	1.3×10^{-11}	2.7×10^{-6}	5.3×10^{-12}	1.1×10^{-6}	8.2×10^{-10}	1.6×10^{-4}	1.0×10^{-7}
Nuclear criticality	9.7×10^{-12}	1.9×10^{-6}	4.6×10^{-12}	9.3×10^{-7}	1.2×10^{-10}	2.3×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	3.7×10^{-8}	7.5×10^{-3}	1.4×10^{-8}	2.7×10^{-3}	2.1×10^{-6}	0.41	1.0×10^{-7}
Expected risk[d]	2.3×10^{-5}	–	9.3×10^{-6}	–	1.4×10^{-3}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the MEI) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code.

4.2.4.10 Waste Management

This section summarizes the impacts on waste management at Pantex under No Action and for each of the long-term storage alternatives to include the phaseout of Pu storage. There is no spent nuclear fuel or HLW associated with Pu or HEU storage. Table 4.2.4.10–1 lists the projected sitewide waste generation rates and treatment, storage, and disposal capacities under No Action for 2005. Projections for No Action were derived from the most recent available environmental data, with the appropriate adjustments made for those changing operational requirements where the volume of wastes generated are identifiable. The projection does not include wastes from future, yet uncharacterized, environmental restoration activities. The projections for No Action could change significantly depending on the decisions resulting from the PEIS on waste management being prepared by DOE or the Pantex EIS. Table 4.2.4.10–2 provides the estimated incremental operational waste volumes projected to be generated at Pantex as a result of the various storage alternatives prior to treatment. Some of the waste values described in this section are different than the waste values in the table. For those values that differ (for example, LLW), the table gives waste generated pre-treatment values and the text discusses post-treatment values (indicated as after treatment and volume reduction). The waste volumes generated from the various storage alternatives and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.1. Facilities that would support the storage of Pu and/or HEU would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with RCRA and other applicable statutes. Depending on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous wastes would be treated and disposed of in accordance with current site practice.

No Action Alternative

Under this alternative, LLW, mixed LLW, hazardous, and nonhazardous waste would continue to be generated at Pantex from the missions outlined in Section 3.5. Pantex might also store, over the long term, certain quantities of pits from disassembled weapons, but minimal impacts on waste management is expected since such storage generates minimal additional waste.

Pantex's assembly/disassembly and HE programs would continue to generate low-level, mixed, hazardous, and nonhazardous wastes. Compactible components of solid LLW would continue to be processed at the onsite solid waste compaction facility. Mixed waste would be treated and disposed of according to the *Pantex Plant Federal Facility Compliance Act Site Treatment Plant/Compliance Plan* (September 1995) that was developed in accordance with the *Federal Facility Compliance Act*. Although the predominant workload in 1994 was disassembly operations, the activity levels were assumed to be representative of projected production levels that characterize No Action operations. It is expected that through waste minimization efforts generation rates would decrease.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The upgrading of the existing Pantex storage facility for the continued storage of Pu would have a small impact on existing Pantex waste management activities. Construction waste volumes for the upgraded facility with RFETS Pu pits are presented in Table E.3.1.1–7. Upgrading the existing storage would have minimal impact on Pantex waste management activities. Waste generated during construction would consist of wastewater and solid nonhazardous and hazardous wastes. Nonhazardous waste would be disposed of as part of the construction

Table 4.2.4.10–1. Projected Waste Management Under No Action (2005) at Pantex Plant

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Low-Level							
Liquid	8[a]	Solidification onsite pending	12	Staged for processing	Varies[b]	None	NA
Solid	32[a]	Compaction	168	Staged for shipment	Included in liquid LLW	Ship offsite to NTS	NA
Mixed Low-Level							
Liquid	4[a]	None - onsite encapsulation pending	Planned	Staged for treatment in accordance with Pantex Site Treatment Plan	1,470[c]	None	NA
Solid	46[a]	Compaction and open burning (HE only)	Variable	Staged for treatment in accordance with Pantex Site Treatment Plan	Included in liquid mixed LLW	Offsite planned	NA
Hazardous							
Liquid[d]	2	Offsite	Variable	Staged for shipment	Included in liquid mixed LLW	Shipped offsite	NA
Solid	31	Open burning[e]	Variable	Staged for shipment	Included in liquid mixed LLW	Shipped offsite	NA
Nonhazardous (Sanitary)							
Liquid	141,000	Evaporation and filtration	898,000[f]	None	NA	Playa 1	898,000 m^3/yrf
Solid	339	Compaction	1,020	None	NA	Landfill (offsite)	NA

Table 4.2.4.10–1. Projected Waste Management Under No Action (2005) at Pantex Plant—Continued

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Other)							
Liquid	Included in sanitary	Carbon absorption/ filtration	Included in sanitary	None	NA	Playa 1 and 2	Included in sanitary
Solid	Included in sanitary	Compaction	Included in sanitary	None	NA	Landfill (onsite) construction debris only	Expandable

[a] Estimate based on extrapolation of Table 4.13.1.2–3 of the *Draft Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE/EIS-0225D).

[b] Total amount of storage capacity available for LLW is a function of the percentage of total capacity currently occupied by hazardous wastes and mixed LLW.

[c] Operating capacity. Permitted storage can accommodate both LLW and mixed LLW.

[d] Includes solvent-contaminated wastewater, explosive-contaminated wastewater, and spent organic solvents contaminated with explosives.

[e] High explosive-contaminated wastes only. Open burning done in thermal treatment units on a per burn basis.

[f] Permit limit.

Note: NA=not applicable.

Source: DOE 1996b; PX 1995a:2; PX DOE 1995i; PX DOE 1996b

Table 4.2.4.10–2. Estimated Annual Generated Waste Volumes at Pantex Plant—No Action (2005) and Net Incremental for Storage Alternatives

		Upgrade		Consolidation				
Category	No Action[a] (m^3)	With RFETS Pu Pits[b] (m^3)	Without RFETS or LANL Pu[b] (m^3)	With RFETS and LANL Pu[b] (m^3)	Construct New and Modify Zone 12 South[b] (m^3)	New Facility[b] (m^3)	Collocation[b] (m^3)	Phaseout (m^3)
Transuranic								
Liquid	None	0	0	0.02[c]	0.02[c]	0.02[c]	0.02[c]	0
Solid	None	0.8	0.8	10	10	10	10	0
Mixed Transuranic								
Liquid	None	0	0	0	0	0	0	0
Solid	None	0	0	4	4	4	4	0
Low-Level								
Liquid	8	0.08[c]	0.08[c]	2[c]	2[c]	2[c]	2.1[c]	0
Solid	32	138	138	1,260	1,260	1,260	1,300	0
Mixed Low-Level								
Liquid	4	0.2	0.2	0.2	0.2	0.2	0.2	0
Solid	46	8	8	65	65	65	66	0
Hazardous								
Liquid	2	1	1	2	2	2	2	0
Solid	31	1.5	1.5	2	2	2	2	0
Nonhazardous (Sanitary)								
Liquid	141,000	12,900	12,900	109,500	109,500	97,800	129,500	0
Solid	339	275	275	1,560	1,560	1,440	1,840	0
Nonhazardous (Other)								
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	0
Solid	Included in sanitary	344[d]	344[d]	1,900[d]	1,900[d]	1,800[d]	2,300[d]	0

[a] The No Action waste volumes are from Table 4.2.4.10–1.

[b] Waste volumes for storage alternatives are found in Section E.3.1 (Tables E.3.1.1–3, E.3.1.1–7, E.3.1.2–5, E.3.1.2–6, and E.3.1.3–5). Waste effluents (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in these tables.

[c] Liquid TRU and LLW would be treated and solidified prior to disposal.

[d] Recyclable wastes.

project by the contractor, and the hazardous waste would be shipped offsite to commercial RCRA-permitted treatment and disposal facilities. Operational waste volumes, as shown in Table 4.2.4.10–2, would increase slightly due to increased surveillance activities over No Action. [Text deleted].

Approximately 0.8 m^3 (1 yd^3) of TRU waste from damaged PCVs and contaminated glovebox panels, windows, and gaskets would need to be processed and packaged to meet the WIPP WAC or alternative treatment level. While awaiting shipment to WIPP (depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste), the TRU waste would be stored in above-grade storage facilities. One truck shipment every 11 years or, if applicable, one regular train shipment every 23 years or one dedicated train shipment every 67 years would be required to transport this waste to WIPP.

After treatment and volume reduction, approximately 69 m^3 (90 yd^3) of LLW from solidified liquid LLW (such as decontamination solutions), protective clothing, HEPA filters, glovebox gloves, and decontamination equipment and materials would require disposal. Assuming a land usage of 6,000 m^3/ha (3,200 yd^3/acre), this would require 0.01 ha/yr (0.03 acre/yr) of LLW disposal area at NTS. Assuming 16.6 m^3 (21.7 yd^3) of LLW per shipment, five additional shipments per year from Pantex to NTS would be required.

Contaminated shielding and cleaning materials would be the major contributors to the 0.2 m^3 (50 gals) of liquid and 8 m^3 (10 yd^3) of solid mixed LLW. This small amount of mixed LLW could be treated and disposed of through the use of existing and planned facilities in accordance with the *Pantex Plant Federal Facility Compliance Act Site Treatment Plan/Compliance Plan* (September 1995).

The 1 m^3 (260 gal) of liquid hazardous wastes such as lubricants, cleaning solvents, paint, and lube oil and 1.5 m^3 (2 yd^3) of solid hazardous wastes such as lead packing, wipes, and solid materials contaminated with oils, lubricants, and cleaning solvents would have minimal impact on waste management activities at Pantex, as there is adequate storage capacity while awaiting shipment to a commercial RCRA-permitted treatment and disposal facility.

Approximately 12,900 m^3 (3,400,000 gal) of liquid nonhazardous wastes, including sanitary, utility, and process wastewaters, and cooling system blowdown, would be processed using existing and planned liquid nonhazardous waste facilities. After volume reduction, 138 m^3 (180 yd^3) of solid nonhazardous wastes such as clean non-Pu metals, packing materials, office trash, defective and damaged equipment, and industrial waste from utility and maintenance operations would be shipped to the currently utilized offsite landfill.

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facilities for Continued Plutonium Storage

The Upgrade Without RFETS Pu or LANL Pu Subalternative is similar to the Upgrade With RFETS Pu Pits Subalternative because the modified facilities in Zone 12 South would be designed with adequate capacity to store all of the RFETS Pu pits. No additional resources would be required and therefore the impacts would be the same.

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Existing Zone 12 South Facility for Continued Plutonium Storage

The impacts from the inclusion of RFETS and LANL material are bounded by the impacts from the Consolidation Alternative Construct New and Modify Existing Zone 12 South Facilities Option. The amount of

operational waste volumes would be larger than those presented above in the Upgrade Without RFETS or LANL Material Subalternative.

Consolidation Alternative

Construct New and Modify Existing Zone 12 South Facilities

Construction and operation of a consolidated Pu storage facility through an upgrade of existing facilities would have an impact on existing Pantex waste management activities, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Wastes generated during construction would consist of wastewater, nonhazardous solids, and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous material or radioactive constituents is expected to be generated during construction. However, if any was generated it would be managed in accordance with site practice and all applicable Federal and State regulations. The types of operational wastes from the consolidated Pu storage facility would be same as those from the Pu Storage Upgrade, but the quantity would change, as shown in Table 4.2.4.10–2.

After treatment and volume reduction of TRU waste, approximately 5 m^3 (7 yd^3) of TRU waste and 4 m^3 (5 yd^3) of mixed TRU waste from leaded gloves and windows, and contaminated Pb shielding would be treated and packaged to meet the current planning-basis WIPP WAC or alternative treatment level. While awaiting shipment to WIPP (depending on decisions resulting from the supplemental EIS noted earlier), the TRU and mixed TRU waste would be stored in above-ground storage facilities. One additional truck shipment per year or, if applicable, one regular train shipment every 2 years or one dedicated train shipment every 6 years would be required to transport these wastes to WIPP or an alternate facility.

Following treatment and volume reduction, approximately 630 m^3 (824 yd^3) of LLW would require disposal at NTS. This would require approximately 0.1 ha/yr (0.3 acre/yr) of LLW disposal area and 38 additional LLW shipments to NTS. The 0.2 m^3 (50 gal) of liquid mixed LLW and 65 m^3 (85 yd^3) of solid mixed LLW would be treated and disposed of through the use of existing and planned facilities according to the Pantex Site Treatment Plan. The 2 m^3 (476 gal) of liquid and 2 m^3 (3 yd^3) of solid hazardous wastes would have a minimal impact on waste management activities at Pantex, as there is adequate storage capacity while awaiting shipment to a commercial RCRA-permitted treatment and disposal facility.

Approximately 109,500 m^3 (28,900,000 gal) of liquid nonhazardous wastes would be processed using existing and planned liquid nonhazardous waste facilities. After volume reduction, 780 m^3 (1,020 yd^3) of solid nonhazardous wastes would require disposal at the offsite landfill.

Construct New Plutonium Storage Facility

Construction and operation of a consolidated Pu new storage facility would have an impact on existing Pantex waste management activities by increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, nonhazardous solids, and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous material or radioactive constituents is expected to be generated during construction. However, if any was generated it would be managed in accordance with site practice and all applicable Federal and State regulations. The impacts from TRU, low-level, mixed, and hazardous wastes are identical to those identified in the consolidation through upgrade analysis.

The 97,800 m^3 (25,800,000 gal) of liquid nonhazardous wastes would be processed in existing and planned facilities. After volume reduction, 720 m^3 (942 yd^3) of solid nonhazardous wastes would require disposal at the offsite landfill.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction and operation of a consolidated Pu storage facility collocated with HEU storage would have an impact on existing Pantex waste management activities by increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, nonhazardous solids, and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous material or radioactive constituents is expected to be generated during construction. However, if any was generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Because there is no TRU or mixed TRU waste associated with HEU storage, the impacts from TRU and mixed TRU wastes are identical to those identified in the consolidated Pu storage alternative. The sources of waste are similar to those of the upgraded Pu storage facility, except the source of radioactive contamination from the HEU storage is uranium. Operational waste volumes are shown in Table 4.2.4.10–2.

Following treatment and volume reduction, approximately 630 m^3 (824 yd^3) of LLW contaminated with Pu and 20 m^3 (26 yd^3) of LLW contaminated with uranium would require disposal at NTS. This would require approximately 0.1 ha/yr (0.3 acre/yr) of LLW disposal area and 39 additional LLW shipments to NTS. The 0.2 m^3 (55 gal) of liquid mixed LLW and 66 m^3 (86 yd^3) of solid mixed LLW would be treated and disposed of through the use of existing and planned facilities according to the *Pantex Site Treatment Plan*. The 2 m^3 (528 gal) of liquid and 2 m^3 (3 yd^3) of solid hazardous wastes would have a minimal impact on waste management activities at Pantex, as there is adequate storage capacity while awaiting shipment to a commercial RCRA-permitted treatment and disposal facility. The 129,500 m^3 (34,200,000 gal) of liquid nonhazardous wastes would be processed in existing and planned facilities. After volume reduction, the 920 m^3 (1,200 yd^3) of solid nonhazardous wastes would require disposal at the offsite landfill.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve and weapons R&D materials would reduce the amount of operational waste volumes shown in Table 4.2.4.10–2 for the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative. The decrease would be proportional to the amount of material excluded. [Text deleted.]

Phaseout

The phaseout of Pu storage would have no impact on Pantex waste management activities. The volume of waste would not decrease in any measurable quantity until the facilities in which Pu is stored were D&D.

4.2.5 OAK RIDGE RESERVATION

A listing of the proposed long-term storage alternatives, subalternatives, and related actions, including the No Action Alternative, at ORR is provided below. The potential impacts of implementing these alternatives and related actions at ORR are described in the following sections: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, and waste management. The specific long-term storage alternatives proposed for ORR are the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative.

Preferred Alternative

Modify Existing Y-12 Plant For Continued HEU Storage Subalternative:

Upgrade existing storage facilities at Y-12 to meet natural phenomena requirements. Consolidate storage facilities and reduce storage footprint as surplus HEU disposition is performed pursuant to the HEU EIS.

Proposed Storage Activities at Oak Ridge Reservation

- **No Action Alternative:** Continue to store ORR nonsurplus HEU material within the scope of this PEIS at Y–12 in stabilized form in accordance with the *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y–12 Plant, Oak Ridge, Tennessee.*

- **Upgrade Alternative:**

  - ***Modify Existing Y–12 Plant For Continued HEU Storage Subalternative (Preferred Alternative):*** Upgrade existing storage facilities at Y–12 to meet natural phenomena requirements. Consolidate storage facilities and reduce storage footprint as surplus HEU disposition is performed pursuant to the HEU EIS.

    [Text deleted.]

- **Consolidation Alternative:** This storage alternative does not apply to ORR. Siting the consolidated Pu storage facility at ORR would create an HEU collocation condition and is analyzed as part of the Collocation Alternative.

- **Collocation Alternative:** Three options to accommodate all Pu and HEU material within the scope of this PEIS:

  - *Construct New Plutonium Storage Facility; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant:* Construct a new consolidated Pu storage facility east of K–25 and west of ORNL; existing buildings at Y–12 would continue to store ORR nonsurplus HEU material.

Proposed Storage Activities at Oak Ridge Reservation—Continued

- *Construct New Plutonium Storage Facility and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant:* Construct a new consolidated Pu storage facility east of K–25 and west of ORNL and modify existing Y–12 buildings storing ORR nonsurplus HEU material to comply with all ES&H requirements that include improving the capability of facilities to meet design basis seismic events and tornadoes.

- *Construct New Plutonium and Highly Enriched Uranium Storage Facility:* Construct a new collocated Pu and HEU storage facility east of K–25 and west of ORNL.

- **Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials:** Facility and other resource requirements would be smaller than the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative.

- **Phaseout:** ORR nonsurplus HEU material within the scope of this PEIS would be moved out of Y–12 to the collocation site (located at another DOE site).

4.2.5.1 Land Resources

No Action Alternative

Under this alternative, nonsurplus HEU would continue to be stored in stabilized form in accordance with the *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y–12 Plant, Oak Ridge, Tennessee,* at the current Y–12 Plant interim storage location. The ongoing (no new action) activities conform with present and future land-use plans, policies, and controls. Therefore, no direct or indirect effects to land resources would be anticipated beyond the effects of existing and future activities that are independent of the Proposed Action.

Upgrade Alternative

Preferred Alternative: Modify Existing Y–12 Plant for Continued Highly Enriched Uranium Storage

The ORR nonsurplus HEU inventory requiring storage until final disposition would be stored at Y–12 in existing modified facilities; no new facilities would be built. Therefore, there would be no land disturbance or additional land area required. The majority of this HEU would be housed in facilities currently utilized for HEU storage. The remaining HEU would be stored in facilities that are currently being converted into storage areas. Five existing Y–12 plant facilities would be used for the long-term HEU storage mission.

Land Use. Upgrading the existing HEU storage facility would not change land use. The upgrade would conform with the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan,* which notes that Y–12 is the national storage repository for HEU (OR DOE 1989a:3-5). [Text deleted.] As discussed in Section 4.2.5.8, no in-migration of construction or operation workers is anticipated. Therefore, no indirect effects to offsite land use would occur.

No prime farmlands exist onsite. The upgrade would not be in conflict with city of Oak Ridge land-use plans, policies, and controls since the current *Oak Ridge Area Land Use Plan* designates the potential site for industrial use. Offsite land use would not be affected.

Visual Resources. Because this alternative proposes to modify existing facilities, potential impacts to visual resources would not be caused by the upgrade. The current VRM Class 5 designation of Y–12 would remain.

Collocation Alternative

Construct New Plutonium Storage Facility; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

This option assumes the use of existing storage, No Action for HEU (continued storage of ORR nonsurplus HEU material at Y–12 until final disposition), and construction of a new Pu storage facility east of K–25 and west of ORNL near the intersection of Route 95 and Bear Creek Road, to accommodate all Pu within the scope of this PEIS. Although No Action for HEU would not disturb land or require additional land area, construction of the new consolidated Pu facility would disturb 58.5 ha (144 acres) of land area during construction of which 56 ha (138 acres) of land area would be used during operations. The facility would be sited in a buffer zone less than 1.6 km (1 mi) from the site boundary.

Land Use. Construction and operation of the consolidated Pu storage facility would change the existing forested/undeveloped land use of the potential facility site located near the intersection of Route 95 and Bear Creek Road. A portion of the consolidated proposed facility location is situated in the NERP. The future land-use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* designates a portion of the potential site as a Waste Management Area (OR DOE 1991f:5-3). Therefore, potential direct land-use impacts could occur for the Pu consolidation facilities. No direct effects to land use or visual resources are anticipated with No Action for HEU. As discussed in Section 4.2.5.8, expected vacancies and historic housing construction rates indicate that there would be sufficient housing available to accommodate in-migrant construction and operational workers and their families. Therefore, no indirect impacts to offsite land use would occur.

The option would affect the use of the NERP, but other ORR land uses would not be affected. No prime farmlands exist onsite. The option would not be in conflict with the city of Oak Ridge land-use plans, policies, and controls since the current *Oak Ridge Area Land Use Plan* designates the potential site for Industrial and/or Public land use depending on the exact location chosen.

Visual Resources. [Text deleted.] Construction and operation of the consolidation facility would change the current VRM Class 4 designation of the Bear Creek Road/Route 95 site to Class 5, which would cause potential visual impacts to Bear Creek Road and Route 95, public roadways with high sensitivity levels. Construction and operation activities and facility development on the environmentally sensitive (wooded and steep slopes) site would be highly visible from these roadways and would alter the existing landscape character.

Construct New Plutonium Storage Facility and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

This option includes the construction of a new Pu storage facility at ORR east of K–25 and west of ORNL near the intersection of Route 95 and Bear Creek Road and modification of the existing HEU storage facility at Y–12. The option would disturb 58.5 ha (144 acres) of land area during construction of which 56 ha (138 acres) would be used during operations. The facility would be sited in a buffer zone less than 1.6 km (1 mi) from the site boundary.

Land Use. Land-use effects at the Bear Creek Road/Route 95 site would be similar to the Collocation Alternative new Pu storage facility. Upgrading the existing HEU storage facilities at Y–12 would not change land use; the upgrade would conform with the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* (OR DOE 1989a:3-5). As discussed in Section 4.2.5.8, expected vacancies and historic construction rates indicate that there would be sufficient housing available to accommodate in-migrant construction and operational workers and their families. Therefore, no indirect effects to offsite land use would occur as a result of the option.

Impacts to other ORR land uses, special status lands, and potential conflicts with the city of Oak Ridge land-use plans, policies, and controls would be similar to the Collocation Alternative new Pu storage facility.

Visual Resources. Visual resources effects at the Bear Creek Road/Route 95 site would be similar to the Collocation Alternative new Pu storage facility. However, the magnitude and extent of potential visual effects could be greater due to the larger area of land disturbed. Potential effects of the Y–12 upgrade on the sensitive viewpoints and special status lands would not occur; the existing VRM Class 5 designation of the Y–12 Plant would remain.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Under this option, all HEU within the scope of this PEIS would be stored at a primary new storage plant, collocated with the Pu storage plant at ORR on undisturbed land east of K–25 and west of ORNL near the

intersection of Route 95 and Bear Creek Road. Pu and HEU storage in existing DOE storage facilities would be phased out. The collocated storage plant would require a total of 23 buildings, the majority of which would be one level. No structure would exceed three levels. Land disturbance would be 89.5 ha (221 acres) during construction of which 87 ha (215 acres) would be used during operation. A buffer zone less than 1.6 km (1 mi) would be provided between facilities and the ORR site boundary. Although more land area would be disturbed, impacts to land resources would be similar to the Collocation Alternative new Pu storage facility.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, land effects during construction and operation would be almost the same in extent and magnitude to the No Action Alternative, Upgrade Alternative, and Collocation Alternative because the facility would be almost the same. However, because the smaller quantity of material would require smaller facilities, it is likely that less land area would be disturbed during construction and used during operations. [Text deleted.]

Phaseout

Phaseout of the current HEU storage mission would not require additional land area or new construction. ORR nonsurplus HEU material would be moved out of Y–12 to the collocation site. Potential impacts to visual resources could occur if facilities are not maintained.

[Text deleted.]

4.2.5.2 Site Infrastructure

The ORR site is capable of supporting all of its proposed storage alternatives without major infrastructure modification. Table 4.2.5.2–1 presents a comparison of the annual operating infrastructure resource requirements relative to the availability or capacity for the onsite transportation network, electrical power, and fuel supply.

No Action Alternative

Under this alternative, storage of HEU materials would continue at the Y–12 facility. ORR does not currently store Pu-bearing materials in the form or quantity that would be within the scope of this PEIS, and under No Action no Pu would be shipped to ORR. [Text deleted.] All infrastructure requirements are within site capacities.

Upgrade Alternative

Preferred Alternative: Modify Existing Y–12 Plant for Continued Highly Enriched Uranium Storage

Construction of the Y–12 upgrade to accommodate long-term storage of existing quantities of HEU at ORR would not affect the site infrastructure. Data for construction are presented in Appendix C. Some additional coal would be needed. Since coal availability is governed by usage and not by storage capacity, the additional coal required could be procured through normal contractual means. Site infrastructure requirements for operations are within existing site capacities. As a result, there would be minimal impacts on the site infrastructure.

Collocation Alternative

Construct New Plutonium Storage Facility; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

This option assumes that No Action for HEU storage is taken at Y–12, but that storage for Pu is provided. Construction of the consolidated Pu storage facility at ORR would not affect the site infrastructure. Data for construction are presented in Appendix C. Operations impacts to the ORR infrastructure under this option would be minimal.

Construct New Plutonium Storage Facility and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Construction of a new consolidated Pu storage facility to provide long-term storage of Pu at ORR and modifying Y–12 for long-term HEU storage would not affect the site infrastructure. Data for construction are presented in Appendix C. Operations impacts to the ORR infrastructure under this option would be minimal. As shown in Table 4.2.5.2–1, less than 5 km (3 mi) of roads and less than 10 km (6 mi) of railroad lines would need to be added to the site to accommodate the facility. Also, some additional coal and oil would be needed. Since coal and oil availability is governed by usage and not by storage capacity, the additional coal and oil required could be procured through normal contractual means. All other infrastructure requirements are within site capacities.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction of a new consolidated Pu and HEU storage facility at ORR would consume approximately 25 percent more materials and resources than building the consolidated Pu storage facility and modifying the existing Y–12 HEU storage facility. However, the impact of constructing these facilities is not expected to result

Table 4.2.5.2–1. Site Infrastructure Changes Required for Operation at Oak Ridge Reservation (Annual)—No Action (2005) and Storage Alternatives

Alternative	Transportation		Electrical		Fuel		
	Roads (km)	Railroad (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
No Action							
Site Availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage	71	27	726,000	110	379,000	95,000,000	16,300
Upgrade							
Projected usage	71	27	733,260	111	379,000	95,000,949	16,460
Amount required in excess to site availability	0	0	0	0	0	0	160
Collocation							
New Pu Storage Facility Only							
Projected usage	76	37	779,000	119	427,000	95,000,000	21,800
Amount required in excess to site availability	<5	<10	0	0	11,000	0	5,500
New Pu Storage Facility and Modify Y–12							
Projected usage	76	37	786,260	120	427,000	95,000,949	21,963
Amount required in excess to site availability	<5	<10	0	0	11,000	0	5,663
New Pu and HEU Storage Facilities							
Projected usage	78	37	779,480	119	429,000	94,998,103	22,273
Amount required in excess to site availability	<7	<10	0	0	13,000	0	5,973
Phaseout							
Projected usage	71	27	711,480	108	379,000	94,998,103	15,973
Amount required in excess to site availability	0	0	0	0	0	0	0

Source: DOE 1996e; DOE 1996f; OR LMES 1995e; ORR 1995a:2.

in any significant effects at ORR. Operations impacts to the ORR infrastructure under this option would be minimal. As shown in Table 4.2.5.2–1, less than 7 km (4 mi) of roads and less than 10 km (6 mi) of railroad lines would need to be added to the site to accommodate these facilities. Additional coal and oil required for operations would be procured as stated above for the consolidated Pu storage facility.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Since the existing ORR site infrastructure would be capable of supporting construction/modification and operation of facilities for the No Action Alternative, the Upgrade Alternative, and the Collocation Alternatives, constructing and operating such facilities without including provisions for storage of strategic reserve and weapons R&D materials could be accommodated as well. Expected reductions in amounts of annual electrical requirements for the various storage facilities are the only site infrastructure changes expected if this subalternative is chosen because electric usage is dependent on the amount of material. [Text deleted.]

Phaseout

Phaseout of the HEU storage mission at Y–12 would have little or no impact on the facilities or site infrastructure. Facilities would need to be decontaminated and decommissioned prior to reuse or dismantlement, and any D&D, if proposed, would be accompanied by further NEPA analysis. The decrease in the annual consumption of utility resources is a small fraction (about 2 percent) of the existing annual usage.

4.2.5.3 Air Quality and Noise

Construction and operation activities associated with the No Action Alternative and the proposed storage alternatives would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts at ORR, criteria and toxic/hazardous concentrations from the No Action Alternative and the proposed storage alternatives are compared with Federal and State standards and guidelines. Impacts from radiological airborne emissions are described in Section 4.2.5.9.

In general, all of the proposed storage facilities would emit the same types of air pollutants during construction. It is expected emissions would not exceed Federal, State, or local air quality regulations. PM_{10} and TSP concentrations will be increased, especially during peak construction periods.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, and wind erosion of exposed ground surfaces
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

During operation, concentrations of criteria and toxic/hazardous air pollutants emitted by the individual storage facilities are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Table 4.2.5.3–1 presents the estimated pollutant concentrations for each of the storage alternatives, indicating little difference between alternatives with respect to impacts to air quality.

Emission rates attributed to operation of the proposed storage facilities are presented in Tables F.1.3–1 and F.1.3–3. [Text deleted.] Air pollutant emission sources associated with operations include the following:

- Operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- Exhaust and road dust generated by vehicles delivering supplies and bringing employees to work
- Toxic/hazardous pollutant emissions from facility processes

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for each storage alternative are described separately. Supporting data for the air quality and noise analyses are presented in Appendix F.

AIR QUALITY

An analysis was conducted of the potential air quality impacts of emissions from each of the storage alternatives as described in Section 4.1.3. Section 176 (c) of the 1990 CAA Amendments requires that all Federal actions conform with the applicable SIP. The EPA has implemented rules that establish the criteria and procedures governing the determination of conformity for all Federal actions in nonattainment and maintenance areas. These are discussed in Section 4.1.3. The attainment status of the area in which ORR is located is discussed in Section 3.6.3. Since the area is considered an attainment area for criteria pollutants, the proposed actions at this site do not require that a conformity analysis be performed.

Table 4.2.5.3–1. Estimated Operational Concentrations of Pollutants at Oak Ridge Reservation and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Collocation		
					New Pu Storage Facility Only ($\mu g/m^3$)	New Pu Storage Facility and Modify Y–12 ($\mu g/m^3$)	New Pu and HEU Storage Facilities ($\mu g/m^3$)
Criteria Pollutants							
Carbon monoxide	8-hour	10,000[b]	5	5	5.08	5.07	5.09
	1-hour	40,000[b]	11	11	11.16	11.15	11.18
Lead	Calendar Quarter	1.5[b]	0.05	0.05	0.05	0.05	0.05
Nitrogen dioxide	Annual	100[b]	3	3	3	3.06	3.07
Ozone	1-hour	235[b]	[c]	[c]	[c]	[c]	[c]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	1	1	1	1	1.01
	24-hour	150[b]	2	2	2.05	2.05	2.05
Sulfur dioxide	Annual	80[b]	2	2	2.10	2.10	2.12
	24-hour	365[b]	32	32	33.07	33.03	33.25
	3-hour	1,300[b]	80	80	84.17	84.03	84.87
Mandated by Tennessee							
Total suspended particulates	24-hour	150[d]	2	2	2.05	2.04	2.05
Gaseous fluorides (as HF)	30-day	1.2[d]	0.2	0.2	0.2	0.2	0.2
	7-day	1.6[d]	0.3	0.3	0.3	0.3	0.3
	24-hour	2.9[d]	0.6[e]	0.6[e]	0.6[e]	0.6[e]	0.6[e]
	12-hour	3.7[d]	0.6[e]	0.6[e]	0.6[e]	0.6[e]	0.6[e]
	8-hour	250[d]	0.6	0.6	0.6	0.6	0.6

Table 4.2.5.3–1. Estimated Operational Concentrations of Pollutants at Oak Ridge Reservation and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Collocation		
					New Pu Storage Facility Only ($\mu g/m^3$)	New Pu Storage Facility and Modify Y–12 ($\mu g/m^3$)	New Pu and HEU Storage Facilities ($\mu g/m^3$)
Hazardous and Other Toxic Compounds							
1,1,1-Trichloroethane	8-hour	191,000[d]	1.9	1.9	1.9	1.9	1.9
Acetic acid	8-hour	2,500[d]	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorine	8-hour	150[d]	4.1	4.1	4.1	4.1	4.1
Hydrogen chloride	8-hour	750[d]	57	57	57	57	57
Hydrazine	8-hour	1.3[d]	[f]	[f]	[f]	[f]	<0.01[g]
Mercury	8-hour	5[d]	0.06[h]	0.06[h]	0.06[h]	0.06[h]	0.06[h]
Methyl alcohol	8-hour	26,200[d]	219.3	219.3	219.3	219.3	219.3
Nitric acid	8-hour	[i]	78	78	78	78	78
Phosphoric acid	8-hour	[i]	[f]	[f]	[f]	[f]	<0.01[g]
Sulfuric acid	8-hour	100[d]	20	20	20	20	20

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Federal and State standard.

[c] Ozone, as a criteria pollutant, is not directly emitted or monitored by the candidate site. See Section 4.1.3 for a discussion of ozone-related issues.

[d] State standard or guideline.

[e] 8-hour concentration was used.

[f] No sources of this pollutant have been identified.

[g] The concentration represents the alternative contribution only.

[h] Annual average (monitored value).

[i] No State standard for indicated averaging time.

Note: Concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from non-facility sources (for example, traffic).

Source: 40 CFR 50; DOE 1996e; DOE 1996f; OR DOE 1993a; OR LMES 1996i; OR MMES 1996a;TN DEC 1994a; TN DHE 1991a.

No Action Alternative

This alternative utilizes estimated air emissions data from operations at ORR assuming continuation of site missions as described in Section 3.6. These data reflect conservative estimates of criteria and toxic/hazardous emissions at ORR. The emission rates for the criteria and toxic/hazardous pollutants for No Action for the total site are presented in Table F.1.2.6–1. Table 4.2.5.3–1 presents the No Action concentrations. During dry and windy conditions increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside the scope of this PEIS) under the No Action Alternative. Concentrations of all other criteria and toxic/hazardous air pollutants at the site boundary or public-access highways are expected to remain within applicable Federal, State, and local ambient air quality standards.

Upgrade Alternative

Preferred Alternative: Modify Existing Y–12 Plant for Continued Highly Enriched Uranium Storage

It is expected that concentrations of pollutants at the site boundary or public access highways would remain within applicable Federal and State ambient air quality standards during upgrade of facilities for continued HEU storage.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.5.3–1.

Collocation Alternative

Construct New Plutonium Storage Facility; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

In addition to the types of sources of emissions during construction associated with the No Action and the Upgrade Alternative, fugitive dust resulting from the operation of a concrete batch plant would be an additional emission source associated with this storage alternative.

Increased PM_{10} and TSP concentrations may occur during the peak construction period, particularly during dry and windy conditions. Appropriate control measures would be followed to minimize pollutant concentrations during construction. Concentrations of all pollutants at the site boundary or public-access highways would remain within applicable Federal and State ambient air quality standards during construction.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.5.3–1.

Construct New Plutonium Storage Facility and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Air quality impacts for construction for this option are expected to be similar to those discussed previously for the new Pu storage facility only option.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.5.3–1.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Air quality impacts for construction for this option are expected to be similar to those discussed previously for the new Pu storage facility only option.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative, plus the No Action concentrations, are presented in Table 4.2.5.3–1.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Air quality impacts for construction and operation for this subalternative are expected to be similar to those described previously for the No Action Alternative, the Upgrade Alternative, and the Collocation Alternative. [Text deleted.]

Phaseout

Phaseout of existing HEU inventories as a result of consolidating HEU at another site is expected to result in a small reduction in air pollutant concentrations from the No Action concentrations and would be in compliance with Federal and State standards.

NOISE

The location of the storage facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts.

Noise sources during construction may include heavy construction equipment and increased traffic. Increased traffic would occur onsite and along offsite local and regional transportation routes used to bring construction material and workers to the site.

No Action Alternative

Nontraffic noise sources associated with continued interim storage and other ongoing missions are the same as described in Chapter 3. The continuation of operations at ORR would result in no appreciable change in traffic noise and onsite operational noise sources from current levels. Nontraffic noise sources are located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

Upgrade (Preferred Alternative) and Collocation Alternatives

Nontraffic noise sources associated with the storage alternatives would be similar to those for existing facilities as discussed in Chapter 3. Nontraffic, operational noise sources associated with the storage alternatives include existing or additional equipment and machines (cooling systems, vents, motors, and material handling equipment). These noise sources would be located at sufficient distance from offsite areas that the contribution

to offsite noise levels would be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Noise impacts for construction and operations for this option are expected to be almost the same as those previously described for the No Action Alternative, the Upgrade Alternative, and the Collocation Alternative because noise impacts are based on the use of the facility and not the size.

Phaseout

A reduction in noise levels associated with facility operations may result from the phaseout of storage facilities.

4.2.5.4 Water Resources

Impacts associated with the long-term storage options at ORR would affect water resources. The proposed upgrade storage facilities are located outside any 100-year and 500-year floodplain boundaries. No 100- or 500-year floodplain assessments have been conducted at the area proposed for the Collocation Alternative. This could be developed during the siting process. At ORR, surface water resources, primarily the Clinch River, would be used to meet all construction and operation water requirements. The Clinch River has sufficient flow to support any of the alternatives. No construction- or operation-related water withdrawal would exceed 1 percent of the Clinch River's average flow. During construction and operation of the facilities, treated wastewater would be discharged in compliance with permit requirements to nearby streams. Stormwater runoff would be collected, and treated, if necessary, before discharge to natural drainage channels in accordance with permit requirements. [Text deleted.]

Minimal impacts to groundwater are anticipated because no groundwater would be withdrawn and no direct discharges would occur during construction or operation. Table 4.2.5.4–1 presents No Action water resources uses and discharges and the potential changes to water resources at ORR resulting from the long-term storage alternatives.

No Action Alternative

Surface Water. [Text deleted.] A description of the activities that would continue at ORR is provided in Section 3.6. Under this alternative, because of increased operating requirements of existing facilities at ORR, surface water withdrawals from the Clinch River are expected to increase from the current usage of 14,210 million l/yr (3,750 million gal/yr) to 14,760 million l/yr (3,900 million gal/yr), or 0.35 percent of the river's average flow (132 m^3/s [4,647 ft^3/s]) by the year 2005. Wastewater discharges from Y–12 would continue to East Fork Poplar Creek and Bear Creek, although the volume is expected to increase. As discussed in Section 3.6.4, DOE is currently involved with remediation of East Fork Creek under CERCLA. Under this alternative, current restoration programs would continue.

Groundwater. Under this alternative, no additional impacts to groundwater resources are anticipated beyond those of existing and future activities, which are independent of and unaffected by the proposed action. Currently, one well supplies a small amount of water for a laboratory. Groundwater use is expected to remain constant in 2005.

Water quality data obtained from wells located near the Y–12 facility indicate that water quality has improved near site operations. Under this alternative, current restoration programs would continue. Process and wastewater would continue to be treated at either the Y–12 centralized pollution control facility or at the Y–12 west end treatment facility before being discharged to surface waters. Minimal impacts on groundwater quality are expected due to wastewater releases.

Upgrade Alternative

Preferred Alternative: Modify Existing Y–12 Plant for Continued Highly Enriched Uranium Storage

Surface Water. Water required for construction and operation of the upgraded HEU storage facilities would be provided via existing distribution systems. The source of this water is the Clinch River and its tributaries. [Text deleted.]

Table 4.2.5.4–1. No Action and Potential Changes to Water Resources at Oak Ridge Reservation—No Action (2005) and Storage Alternatives

Affected Resource Indicator	No Action	Upgrade	Collocation			Phaseout
			New Pu Storage Facility Only	New Pu Storage Facility and Modify Y–12	New Pu and HEU Storage Facilities	
Water Source	Surface	Surface	Surface	Surface	Surface	Surface
Construction						
Water Availability and Use						
Total water requirement (million l/yr)	NA[a]	3.0	85	88	104.7	0.0
Percent increase in projected water use[b]	NA[a]	0.02	0.6	0.6	0.7	0.0
Percent of streamflow[c]	NA[a]	0.00007	0.002	0.002	0.003	0.0
Water Quality						
Wastewater discharge (million l/yr)	NA[a]	3.0	7.8	10.8	13.0	0.0
Percent change in wastewater discharge[d]	NA[a]	0.1	0.3	0.5	0.6	0.0
Percent change in streamflow[e]	NA[a]	0.006	0.02	0.02	0.03	0.0
Operation						
Water Availability and Use						
Total water requirement (million l/yr)	14,760	0.24	280	280.2	360	-0.29
Percent increase in projected water use[f]	0.0	0.002	1.9	1.9	2.4	0.00
Percent of streamflow[c]	0.35	0.000005	0.007	0.007	0.009	0.000006

Table 4.2.5.4–1. No Action and Potential Changes to Water Resources at Oak Ridge Reservation—No Action (2005) and Storage Alternatives—Continued

Affected Resource Indicator	No Action	Upgrade	Collocation			Phaseout
			New Pu Storage Facility Only	New Pu Storage Facility and Modify Y–12	New Pu and HEU Storage Facilities	
Water Quality						
Total wastewater discharge (million l/yr)	2,277	0.001	137	137	172	0.0
Percent change in wastewater discharge[g]	0.0	0.00009	6.0	6.0	7.6	0.0
Percent change in streamflow[e]	NA	0.0	0.3	0.3	0.4	0.0
Floodplain						
Is action in 100-year floodplain?	NA	No	Uncertain	Uncertain	Uncertain	No
Is critical action in 500-year floodplain?	NA	No	Uncertain	Uncertain	Uncertain	NA

[a] See operations section of table for No Action water data.

[b] Percent increases in projected water use during construction at ORR are calculated by dividing No Action water requirements (14,760 million l/yr) with that for each storage option: HEU storage upgrade (3 million l/yr), new consolidated Pu storage facility only (85 million l/yr), new consolidated Pu storage facility and upgrade Y–12 facility (88 million l/yr), new consolidated Pu and HEU storage facility (104.7 million l/yr), and HEU storage phaseout (0 million l/yr).

[c] Percent of streamflow is calculated from the average flow of the Clinch River (132 m^3/s).

[d] Percent changes in wastewater discharged during construction at ORR are calculated by dividing No Action wastewater discharges (2,277 million l/yr) with that for each storage option: HEU storage upgrade (3.0 million l/yr), new consolidated Pu storage facility only (7.8 million l/yr), new consolidated Pu storage facility and upgrade Y–12 Plant (10.8 million l/yr), new consolidated Pu and HEU storage facility (13.0 million l/yr), and HEU storage phaseout (0 l/yr).

[e] Percent changes in stream flow from wastewater discharges are calculated from the average flow of the Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for East Fork Poplar Creek is shown in the table.

[f] Percent increases in projected water use during operation at ORR are calculated by dividing No Action water requirements (14,760 million l/yr) with that for each storage option: HEU storage upgrade (0.24 million l/yr), new consolidated Pu storage facility only (280 million l/yr), new consolidated Pu storage facility and upgrade Y–12 Plant (280.2 million l/yr), new consolidated Pu and HEU storage facility (360 million l/yr), and HEU storage phaseout (0.29 million l/yr).

[g] Percent changes in wastewater discharged during operation at ORR are calculated by dividing No Action water discharges (2,277 million l/yr) with that for each storage option: HEU storage upgrade (0.001 million l/yr), new consolidated Pu facility storage (137 million l/yr), new consolidated Pu storage facility and upgrade Y–12 plant (137 million l/yr), new consolidated Pu and HEU storage facility (172 million l/yr), and HEU storage phaseout (0 l/yr).

Note: Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously. NA=not applicable.

Source: DOE 1996e; DOE 1996f; OR LMES 1995e; OR MMES 1996a.

During construction, the quantity of water required would be approximately 3.0 million l/yr (0.79 million gal/yr), which would represent a much less than 1-percent increase over the projected No Action surface water withdrawal. This additional withdrawal would cause minimal impacts. During operation, water requirements would be approximately 0.24 million l/yr (0.063 million gal/yr). Supplying this quantity of water would have minimal impacts.

During construction of the upgraded HEU storage facilities, sanitary wastewater (approximately 3.0 million l/yr [0.8 million gal/yr]) would be generated and discharged to the existing Oak Ridge wastewater treatment facility. This would represent a much less than 1-percent increase in the effluent from this facility. During operation, additional sanitary wastewater (0.001 million l/yr [264 gal/yr]) would be discharged to this wastewater treatment system. This would represent a negligible increase in the effluent from this facility. Stormwater runoff would be collected and treated, if necessary, before discharge to natural drainage channels. These additional quantities are insignificant. All discharges would be monitored to comply with permit limits and other discharge requirements.

As discussed in Section 3.6.4, DOE is currently involved with remediation of East Fork Poplar Creek under CERCLA. Any discharges that may influence and potentially impact East Fork Poplar Creek would require engineering design measures to avoid interference with the goals of the remediation effort. All potential HEU storage locations are outside both the 100- and 500-year floodplains.

Groundwater. No groundwater would be used for any project-related water requirements, and no wastewater would be discharged directly to groundwater. Therefore, neither groundwater quality nor availability would be affected. In addition, because there would be no direct discharges to the environment, limestone deposits located beneath the plant would not be a factor for future contamination.

Collocation Alternative

Construct New Plutonium Storage Facility; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Surface Water. During construction of the facilities, approximately 85 million l/yr (22.5 million gal/yr) would be supplied from the Clinch River. This amount equates to approximately a 0.6-percent increase in annual water use and much less than 1 percent of the Clinch River flow. During operation, water requirements would be 280 million l/yr (74 million gal/yr), representing a 1.9-percent increase in projected water use and much less than 1 percent of the Clinch River flow. Supplying this amount would cause minimal impacts.

During construction, approximately 7.8 million l/yr (2.1 million gal/yr) of sanitary wastewater would be generated, treated, and discharged to the existing Oak Ridge wastewater treatment facility. This would represent a 0.3-percent increase in the effluent from this facility. During operation, additional sanitary wastewater (137 million l/yr [36.2 million gal/yr]) would be discharged to this wastewater treatment system. All discharges would be monitored to comply with discharge requirements.

No 100- or 500-year floodplain assessments have been conducted for the new collocated facilities. This would be developed during the siting process.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater. Therefore, neither groundwater quality nor availability would be affected. In addition, because there would be no direct discharges to groundwater, limestone deposits located beneath the plant would not be a factor for future groundwater contamination transportation.

Construct New Plutonium Storage Facility and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Surface Water. The water requirements during construction and operation of the new consolidated Pu storage facility and upgraded Y–12 are slightly higher than those discussed for the Pu storage facility only. The water requirements are approximately 88 million l/yr (23.2 million gal/yr) during construction and 280.2 million l/yr (74 million gal/yr) during operation, which would represent about a 0.6- and 1.9-percent increase, respectively, over the projected No Action surface water withdrawal. These amounts each represent much less than 1 percent of the Clinch River flow and would cause minimal impacts to river levels.

During construction of the facilities, sanitary wastewater (10.8 million l/yr [2.3 million gal/yr]) would be generated and discharged to the treatment facility. During operations, additional sanitary wastewater (137 million l/yr [36.2 million gal/yr]) would be treated, and the effluent discharged. All discharges would be routinely monitored to comply with NPDES permit limits and other site-specific discharge requirements. All potential locations are located outside both the 100- and 500-year floodplains.

No 100- or 500-year floodplain assessments have been conducted for the new collocated facilities. This would be developed during the siting process.

Groundwater. No groundwater would be used for any project-related water requirements, and no wastewater would be discharged directly to groundwater. Therefore, neither groundwater quality nor availability would be affected. In addition, because there would be no direct discharges to the environment, limestone deposits located beneath the plant would not be a factor for future groundwater contamination.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

[Text deleted.]

The impacts associated with the new Pu and HEU storage facilities are the same as those discussed above, with the following exceptions. The water requirements for construction and operation of this option are greater than those described for the new consolidated Pu storage facility and upgrade of Y–12 Plant and are approximately 104.7 million l/yr (27.7 million gal/yr) and 360 million l/yr (95.1 million gal/yr), respectively. These additional requirements represent 0.7- and 2.4-percent increases, respectively, in the projected annual surface water withdrawals from the Clinch River. These increases, however, represent much less than 1 percent of the average flow of the Clinch River and would cause minimal impacts.

Sanitary wastewater quantities generated during construction and operation of this option are approximately 13.0 million l/yr (3.4 million gal/yr) and 172 million l/yr (45.4 million gal/yr), respectively. These additional effluents represent 0.6- and 7.6-percent increases, respectively, in discharge and 0.03- and 0.4-percent, respectively, of the average flow of East Fork Poplar Creek. No impacts are expected.

As discussed in Section 3.6.4, DOE is currently involved with remediation of East Fork Poplar Creek under CERCLA. Any discharges that may influence and potentially impact East Fork Poplar Creek would require engineering design measures to avoid interference with the goals of the remediation effort. Since groundwater would not be used for this option, no impacts to groundwater availability or quality would be expected.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Water resource impacts during construction and operation for this subalternative are expected to be slightly less than those for the No Action Alternative, the Upgrade Alternative, and the Collocation Alternative because of the reduction in the amount of material. [Text deleted.]

Phaseout

If the current HEU storage mission at ORR was phased out, surface water withdrawals from the Clinch River and nonhazardous wastewater discharge to the Clinch River would decrease by negligible quantities (0.29 million l/yr [0.077 million gal/yr]). No noticeable impacts would occur or be alleviated due to these decreases.

[Text deleted.]

4.2.5.5 Geology and Soils

Construction and operation of the alternatives at ORR would have no impact on the geological resources identified. A low seismic risk exists, but would be considered in the design of the proposed alternatives. The existing seismic risk does not preclude the safe construction and operation of the proposed alternative facilities. The facilities would be designed for earthquake-generated ground acceleration in accordance with DOE O 420.1, *Facility Safety*. Because there are no known capable faults at ORR, ground rupture as a result of an earthquake during the life of the facility is minimal; ground shaking is more likely to occur. Intensities of more than VI on the MMI scale are not likely at ORR. Ground shaking could affect the integrity of inadequately designed (older) or nonreinforced structures but would not affect newly designed or modified facilities. Human health effects from accidents initiated by natural phenomena (for example, earthquakes) are discussed in Section 4.2.5.9. Volcanic activity is improbable during the life of an alternative and is not anticipated to affect the construction and operation of the alternatives. It is also unlikely that landslides or other nontectonic events would affect the proposed alternatives. Slopes and underlying foundation materials are generally stable. Sinkholes are present in the Knox Dolomite, however the Knox Dolomite is not present in Bear Creek Valley or proposed alternative areas. Properties and conditions of soils underlying ORR typically have no limitations on construction. No economically viable geological resources are known to be present at ORR.

Impacts to the geological and soil resources occur during, or as a result of, ground-disturbing construction activities. Construction of the alternatives may involve ground-disturbing activities that could affect the soil resources. The amount of land disturbed is specified below for each alternative. Effects to the soil resource would depend on the specific soil units in the disturbed area, the extent of land-disturbing activities, and the amount of soil disturbed. Within ORR, the soil erosion potential is directly related to the amount of land disturbed because soil and climatic conditions are similar throughout the site. Control measures would be employed to minimize soil erosion.

No Action Alternative

[Text deleted.] Under the No Action Alternative, DOE would continue current and ongoing activities at ORR. There would be no ground-disturbing activities beyond those associated with existing and future site improvements. Because no new construction and the associated ground disturbance for potential soil erosion would occur, the No Action Alternative would have no effect on geologic or soil resources at the site.

Upgrade Alternative

Preferred Alternative: Modify Existing Y–12 Plant for Continued Highly Enriched Uranium Storage

Because no new ground-breaking construction activities are planned under this alternative, no construction or operational effects to geologic or soil resources are anticipated.

Collocation Alternative

Construct New Plutonium Storage Facility; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Construction of the new Pu storage facility will occur on undisturbed land, as described in Section 4.2.5.1. During construction approximately 58.5 ha (144 acres) would be disturbed. Soil disturbance would occur primarily from ground-disturbing construction activities (foundation preparation) and activities associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in erosion as a result of wind and water action. Soil losses would depend on the frequency and severity of storms; wind velocities (increased wind velocities and duration can increase soil erosion potential); and the size, location, and duration of ground-disturbing activities with respect to local drainage and wind patterns.

Net soil disturbance during operations would be considerably less than during construction because areas temporarily used for construction laydown would be restored. Although stormwater runoff and wind action could occur occasionally during operations, they are anticipated to be minimal. [Text deleted.]

Construct New Plutonium Storage Facility and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

No apparent direct or indirect effects on the geologic resources are anticipated, because neither facility construction and operational activities nor site infrastructure improvements will restrict access to potential geologic resources.

Construction and operation effects on geology and soil resources for this option would be similar to those described for the new Pu storage facility and maintain existing HEU storage option. [Text deleted.] Construction of the new Pu storage facility for this subalternative would occur on undeveloped land, as described in Section 4.2.5.1. Approximately 58.5 ha (144 acres) would be disturbed for the new facilities, affecting the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil impacts during operation are expected to be minimal.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

No apparent direct or indirect effects on the geologic resources are anticipated, because neither facility construction and operational activities nor site infrastructure improvements will restrict access to potential geologic resources.

Construction and operation effects on geology and soil resources for this option would be similar to those described for the new Pu storage facility and maintain existing HEU storage option. Construction of these facilities would occur completely on undisturbed land, as described in Section 4.2.5.1. Additional soil impacts would be anticipated because this option has the greatest construction and operations land use. Approximately 89.5 ha (221 acres) would be disturbed for construction of the new facilities, affecting the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil impacts during operation are expected to be minimal.

Subalternatives Not Including Strategic Reserve and Weapons Research and Development Materials

Excluding strategic reserve and weapons R&D materials would give almost the same effects to the geologic and soil resources for the No Action Alternative, the Upgrade Alternative, and the Collocation Alternative. By excluding these materials, the size of a facility would be similar, thus not changing the amount of land disturbed by construction activities. No effect to the geological resource is anticipated as a result of this subalternative.

Phaseout

The phaseout of storage capacity would have no apparent effects on the geology resources. However, phaseout could result in beneficial effects in the soil of the area. Hazardous, radioactive, and mixed waste sources would be eliminated from the area, thus decreasing the potential for future soil contamination.

[Text deleted.]

4.2.5.6 Biological Resources

No Action Alternative

Under No Action, the HEU storage mission described in Section 2.2.5 would continue at ORR. These activities would result in no appreciable change to current conditions of biological resources at ORR as described in Section 3.6.6.

Upgrade Alternative

Preferred Alternative: Modify Existing Y–12 Plant for Continued Highly Enriched Uranium Storage

Upgrading existing HEU storage facilities at Y–12 would cause minimal disturbance to biological resources. This is the case since upgrades would involve existing structures and would take place within an area that is currently disturbed by existing facilities and operations. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to Y–12 have already adapted to its presence. Water withdrawal and wastewater discharge would be through existing structures and would involve relatively minor volumes, so wetlands and aquatic resources would not be affected. Discharges would not be expected to be large enough to affect resident populations of the Tennessee dace (deemed in need of management by the State) in Bear Creek.

Collocation Alternative

Construct New Plutonium Storage Facility; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Under this alternative, consolidated Pu materials would be stored in a new storage facility at ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are described below.

Terrestrial Resources. Construction and operation for the consolidated Pu storage facility at ORR would result in the disturbance of 58.5 ha (144 acres) or about 0.4 percent of ORR. This acreage includes areas on which the facility would be constructed, as well as areas that would be revegetated following construction. Vegetation within the area to be developed would be destroyed during land clearing. Vegetation cover within the proposed site is predominantly oak-hickory forest or pine and pine-hardwood forest (Figure 3.6.6–1). While both types would be affected by construction, it is likely that a greater area of pine and pine-hardwood forests would be removed. This type of forest is more heavily concentrated in valleys, which is where most of the development would occur. Oak-hickory forests are typically found on ridges. Both forest types are common throughout ORR and within the region.

Construction of the proposed facilities would effect some animal populations. Less-mobile animals within the proposed project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources, which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the proposed site may not survive. The site would be surveyed as necessary for the nests of migrating birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human activity, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas. Salt drift generated by mechanical draft cooling systems would be minimal, and no impacts to natural vegetation are expected.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediment control measures would control secondary impacts. Since an existing intake structure would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River. However, a new discharge structure could be required on East Fork Poplar Creek. Depending on its location, this structure could displace some wetlands along the creek. Any potential impacts to wetlands resulting from construction activities would be mitigated in accordance with DOE policy set forth in 10 CFR 1022 and the requirements of a COE permit.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impact on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the consolidated storage facility could cause water quality changes (primarily sediment loading and resulting turbidity) to Bear Creek, Grassy Creek, or Ish Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since a new intake structure would not be required, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little affect on the flow of the river. Flow-related impacts to aquatic resources from increases in impingement and entrainment would be minimal and would be unlikely to affect fish populations in the river.

During construction and operation, wastewater would be discharged to East Fork Poplar Creek. This could require the construction of a new discharge structure that would temporarily disturb aquatic habitat in the vicinity of the outfall. The small volume of wastewater discharged to the stream would not be expected to affect aquatic resources during either construction or operation. In addition, all wastewater would be treated as necessary.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction of the consolidated storage facilities. [Text deleted.] Land-clearing activities may destroy State-protected plant species found within or adjacent to disturbed portions of the proposed site including pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily, and golden seal. The Tennessee dace is sensitive to siltation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Ish Creek or Bear Creek during facility construction could affect this fish species. Preactivity surveys would be conducted, as appropriate, prior to construction to determine the presence of special status species in the area to be disturbed. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate. No additional impacts are expected during operation of the facility. [Text deleted.]

Construct New Plutonium Storage Facility and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Impacts resulting from constructing and operating a new consolidated Pu storage facility and upgrading Y–12 would be similar to those discussed above for the new consolidated Pu storage facility. This is the case since upgrading Y–12 would not disturb any additional land area.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Under this alternative, consolidated Pu materials would be stored with HEU inventories in a new collocated storage facility(s) at ORR. Construction and operation of collocated storage facilities at ORR would have similar, but somewhat greater, effects on biological resources as those described for the new consolidated storage facility only. Construction of the collocated storage alternative would disturb 89.5 ha (221 acres) of habitat.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve and weapons R&D materials would have almost the same effects as the other facilities. The size of the facility would be similar, and would not reduce the area of disturbed habitat or lessen the potential impacts to biological resources for the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative. [Text deleted.]

Phaseout

The phaseout of HEU storage facilities at ORR is not expected to affect biological resources although short-term increased human activity could temporarily disturb some wildlife species in the vicinity of the site.

4.2.5.7 Cultural and Paleontological Resources

No Action Alternative

Under this alternative, DOE would continue the existing and planned missions at ORR. This includes the continued storage of HEU material at Y–12 in stabilized form pursuant to DNFSB Recommendation 94-1. Any impacts to cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate NHPA, *American Indian Religious Freedom Act*, and *Native American Graves Protection and Repatriation Act* regulatory compliance procedures. In May 1994, a Programmatic Agreement was executed among the DOE Oak Ridge Operations Office, the Tennessee SHPO, and the Advisory Council on Historic Preservation regarding the management of historic and cultural properties at ORR. This agreement was administered to satisfy DOE's responsibilities regarding Sections 106 and 110 of the NHPA and requires DOE to develop a cultural resources management plan for ORR and conduct cultural resources surveys as required.

Upgrade Alternative

Preferred Alternative: Modify Existing Y–12 Plant for Continued Highly Enriched Uranium Storage

Under this alternative, existing buildings would be modified at Y–12 to accommodate ORR nonsurplus HEU material. No additional land would be required for construction or operation of the facilities. New construction and building modification pose the greatest threat to prehistoric, historic, and paleontological resources. Operation would not have a direct effect on these resources. Impacts to archaeological and paleontological resources are not likely as a result of this alternative because it would involve the upgrade of five existing facilities (9212 E-Wing Vault, 9204-2 First Floor, 9202E First Floor, 9215, and 9998). Four of these facilities are NRHP-eligible historic resources based on their association with World War II. They would be part of a proposed Y–12 Plant National Register Historic District. No Native American resources have been identified at Y–12. Consequently, no impacts to Native American resources are expected to result under this alternative.

Collocation Alternative

Construct New Plutonium Storage Facility; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Under this alternative, a new facility would be constructed east of K–25 and west of ORNL to accommodate all Pu material within the scope of this PEIS and existing facilities at Y–12 would continue to store ORR nonsurplus HEU material. Land to be disturbed during the construction of this facility would total 58.5 ha (144 acres) and the total operational land disturbance would be 56 ha (138 acres). A reduced-access buffer zone would exist around the facility. [Text deleted.] Construction and operation can have an impact on Native American resources by affecting traditional plant and animal communities through construction and by reducing access to traditional use areas during operation. Paleontological resources can also be affected through new construction, however, those known to occur at ORR are relatively common fossils with low research potential.

Survey work would be conducted prior to construction to identify any cultural resources in the area. A portion of this area on both sides of Bear Creek Road was surveyed prior to construction of the proposed Exxon Nuclear Facility, which was never built (OR UTN 1975a:iii). Some prehistoric sites were identified near the Clinch River, and the potential for sites along the smaller creeks exists. In addition, remains of a number of early 20th-century frame houses and mid-to-late 19th-century log houses and outbuildings are located within the project area. Prehistoric site types that are known to occur at ORR include remains of prehistoric villages, burial grounds, quarries and lithic workshops, and shell scatters. One NRHP-eligible prehistoric site has been identified near K–25, on the Clinch River. Historic resources may include standing structures, as well as remains of dwellings, road traces, cemeteries, and trash scatters. Resources such as these may occur in the area to be

disturbed. Some Native American resources may be affected by construction and operation of the facility. These resources, should any exist, would be identified through consultation with the potentially affected tribes.

Construct New Plutonium Storage Facility and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

This alternative involves upgrades to facilities at Y–12 and the construction of a new Pu storage facility east of K–25 and west of ORNL. Land disturbance during construction would total 58.5 ha (144 acres). The operational land requirements would be 56 ha (138 acres). Impacts to cultural and paleontological resources at Y–12 would be similar to those described under the previously discussed Collocation Alternative, including creation of a 1.6-km (1-mi) buffer zone.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

This option involves the construction of a new facility east of K–25 and west of ORNL to accommodate all Pu and HEU material within the scope of this PEIS. Consequently, the land requirements during construction and operation are greater than those discussed under the previous collocation options. Construction of this facility would disturb 89.5 ha (221 acres) of land. The operational requirement would be 87 ha (215 acres). A reduced-access buffer zone would be created around the facility. Based on location and land requirements, the potential for impacts to cultural resources under this option would be similar to those described under the previous options. A slightly larger land requirement results in a slightly greater potential for impacts.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, facility and other resource requirements will be almost the same as the No Action Alternative, the Upgrade Alternative, and the Collocation Alternative. Therefore, impacts to cultural and paleontological resources would be equal to those previously discussed. [Text deleted.]

Phaseout

No acreage is expected to be disturbed during phaseout. Consequently, no impacts to archaeological sites or paleontological remains are anticipated. Some NRHP-eligible historic structures may be affected by this alternative, depending on the tasks involved with phaseout. No resources of Native American importance have been identified at Y–12, so impacts to these resources are not expected.

4.2.5.8 Socioeconomics

No Action Alternative

Regional Economy Characteristics. Total employment in the REA is projected to increase by approximately 1 percent annually between 1995 and 2000, reaching about 488,100 in the latter year. Long-range projections indicate slower growth after the year 2000, when employment would increase by less than 1 percent annually and reach approximately 665,000 in 2040. Unemployment in the REA was 4.9 percent in 1994 and is expected to remain at this level into the near future. Per capita income is projected to increase from approximately $18,190 in 1995 to $26,368 in 2040. Projections for the No Action Alternative are presented in Table L.1–46.

Population and Housing. Population in the ROI is projected to increase from approximately 518,600 in 1995 to 751,800 by 2040. The total number of available housing units in the ROI is projected to increase from about 214,700 in 1995 to 311,200 in 2040. Population and housing projections for the No Action Alternative are presented in Tables L.1–47 and L.1–48, respectively.

Community Services. Education, public safety, and health care characteristics are used to assess the level of community services in the ORR ROI. School enrollments are projected to increase from about 83,340 students in 1995 to 120,810 students by 2040. The current student-to-teacher ratio is 16.2:1. To maintain this level of service, the number of teachers in the ROI would need to increase from approximately 5,132 in 1995 to 7,442 in 2040. These projections are presented in Tables L.1–49 and L.1–50.

The projected numbers of sworn police officers and firefighters serving the ROI communities over the period 1995 to 2040 are shown in Tables L.1–51 and L.1–52, respectively. Under No Action, the number of sworn police officers is projected to increase from approximately 897 in 1995 to 1,299 in 2040 to maintain the current service level of 1.7 sworn officers per 1,000 persons. The number of firefighters in the ROI would need to increase from about 1,120 in 1995 to 1,624 in 2040 to maintain the present service level of 2.2 firefighters per 1,000 persons.

Hospital occupancy rates are based on current capacity. These rates and the estimated number of physicians serving the ROI population between 1995 and 2040 are presented in Tables L.1–53 and L.1–54, respectively. Hospital occupancy rates are projected to increase from approximately 65 percent in 1995 to about 93 percent in 2040. To maintain the current physician-to-population ratio of 2.5 physicians per 1,000 persons, the total number of physicians in the ROI would need to increase from approximately 1,322 in 1995 to 1,917 in 2040.

Local Transportation. Any increases in traffic would be due to projected growth in the area unrelated to DOE activity. [Text deleted.]

Upgrade Alternative

Preferred Alternative: Modify Existing Y–12 Plant for Continued Highly Enriched Uranium Storage

Of all the long-term storage alternatives being considered at ORR, the upgrade existing HEU storage facilities option would create the smallest socioeconomic changes within the region. This alternative would generate a total of 132 jobs (66 direct and 66 indirect) during construction and a total of 395 jobs (111 direct and 284 indirect) during operation. In both phases, there would be sufficient available labor in the REA to fill both direct and indirect jobs created from this alternative. Therefore, no workers would in-migrate to the REA and no change to the REA population would result beyond No Action projections.

Regional Economy Characteristics. Due to the small number of workers required during construction and operation phases, the regional economy would remain virtually unchanged compared to No Action projections. Total employment would increase by much less than 1 percent during construction and operation of the facilities. Unemployment would decrease from 4.9 to 4.8 percent during construction and operation. Per capita income would also remain virtually unchanged, increasing by much less than 1 percent over the No Action alternative (Socio 1996a).

Population and Housing, Community Services, and Local Transportation. All newly created employment would be filled by the resident labor force. Therefore, there would be no change to the region's population beyond the No Action level. Accordingly, minimal impacts to the housing sector, community services, or local transportation would occur as a result of the construction and operation of these facilities.

Collocation Alternative

Construct New Plutonium Storage Facility; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

To consolidate storage of Pu currently stored at multiple DOE sites, a new storage facility would need to be constructed at ORR. Existing buildings at Y–12 would continue to store ORR nonsurplus HEU material. Workers would in-migrate to fill a portion of the direct jobs created during construction and operation of this facility.

Regional Economy Characteristics. Construction would generate a total of 2,226 jobs (1,115 direct and 1,111 indirect). Operation of the facility would generate a total of 1,575 jobs (443 direct and 1,132 indirect). Total employment would increase by less than 1 percent over No Action projections during both construction and operation. Unemployment would decrease to 4.4 percent during construction and 4.6 percent during operation. Per capita income would increase by much less than 1 percent during both phases (Socio 1996a).

Population and Housing. The in-migration of workers during the construction and operation periods would increase the ROI population by much less than 1 percent over No Action projections. The larger increase would occur during construction. Some new housing may be needed. However, expected vacancies and historic housing construction rates indicate that housing would be available to accommodate the population growth (Socio 1996a).

Community Services. The ROI population growth would slightly increase the demand for some community services. Worker in-migration would lead to an increase in ROI school enrollments by about 40 students during construction and 2 students during operation. To maintain the No Action student-to-teacher ratio of 16.2:1, the number of teachers would have to increase by three during the construction period. Operation would not require any additional teachers (Socio 1996a). This additional need for teachers would be distributed over the various jurisdictions in the ROI, so the effect on any single school district would be minimal.

To maintain No Action level of service, no police officers and one firefighter would need to be hired during the construction period. No additional police officers or firefighters would be required to maintain No Action service levels during operation (Socio 1996a).

The small population increase would have a negligible effect on health services, increasing hospital occupancy by much less than 1 percent during construction and operation. The number of physicians in the ROI would need to increase by only one during construction to maintain the No Action service level. No additional physicians would be needed during operation (Socio 1996a).

Local Transportation. A total of 2,141 and 851 vehicle trips per day would be generated during the construction and operation phases, respectively. During construction, there would be a noticeable increase in the

volume-to-capacity ratio of Tennessee State Route 62, between Tennessee State Route 95 and Tennessee State Route 170. The road segment however, would continue to operate at level of service F, the lowest level of service. Traffic generated from facility operations would not affect the level of service on the road segments analyzed (Socio 1996a).

Construct New Plutonium Storage Facility and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

To consolidate storage of Pu currently stored at multiple DOE sites and improve HEU storage, a new Pu storage facility would need to be constructed and existing HEU facilities upgraded at ORR. Workers would in-migrate to fill a portion of the direct jobs created during construction and operation of these facilities.

Regional Economy Characteristics. Construction would generate a total of 2,316 jobs (1,155 direct and 1,161 indirect). Operation would generate a total of 1,969 jobs (554 direct and 1,415 indirect). Total employment would increase by less than 1 percent over No Action projections during both construction and operation. Unemployment would decrease from 4.9 percent to 4.4 percent during construction and 4.5 percent during operation. Per capita income would increase by less than 1 percent during both phases (Socio 1996a).

Population and Housing. The in-migration of workers during the construction and operation periods would increase the ROI population by much less than 1 percent over No Action projections. The larger increase would occur during construction. Some new housing may be needed. However, expected vacancies and historic housing construction rates indicate that housing would be available to accommodate the population increase (Socio 1996a).

Community Services. The additional population would slightly increase the demand for some community services. Worker in-migration would lead to an increase in ROI school enrollments by about 62 students during construction and 8 students during operation. To maintain the No Action student-to-teacher ratio of 16.2:1, the number of teachers would have to increase by four during the construction period. Operation would not require any additional teachers (Socio 1996a). This additional need for teachers would be distributed over the various jurisdictions in the ROI, so the effect on any single school district would be minimal.

To maintain No Action levels of service, two police officers and three firefighters would need to be hired during the construction period. No additional police officers or firefighters would be required to maintain No Action service levels during operation (Socio 1996a).

The small population increase would have a negligible effect on health services, increasing hospital occupancy by much less than 1 percent during construction and operation. The number of physicians in the ROI would need to increase by three during construction to maintain the No Action service level. No additional physicians would be needed during operation (Socio 1996a).

Local Transportation. A total of 2,337 and 1,064 vehicle trips per day would be generated during the construction and operation phases, respectively. During construction there would be a noticeable increase in the volume-to-capacity ratio of Tennessee State Route 62, between Tennessee State Route 95 and Tennessee State Route 170. The road segment however, would continue to operate at level of service F, the lowest level of service. Traffic generated from facility operations would not affect the level of service on the local road segments analyzed (Socio 1996a).

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

To consolidate storage of Pu and HEU currently stored at multiple DOE sites, new storage facilities would need to be constructed at ORR. Workers would in-migrate to fill a portion of the direct jobs created during construction and operation of these facilities.

Regional Economy Characteristics. Construction would generate a total of 3,063 jobs (1,534 direct and 1,529 indirect). Operation would generate a total of 2,012 jobs (566 direct and 1,446 indirect). Total employment would increase by less than 1 percent over No Action projections during both construction and operation. Unemployment would decrease to 4.4 percent during construction and 4.5 percent during operation. Per capita income would increase by less than 1 percent during both phases (Socio 1996a).

Population and Housing. The in-migration of workers during the construction and operation periods would increase the ROI population by less than 1 percent over No Action projections. The larger increase would occur during construction. Some new housing may be needed. However, expected vacancies and historic housing construction rates indicate that housing would be available to accommodate the population growth (Socio 1996a).

Community Services. The ROI population growth would slightly increase the demand for some community services. Worker in-migration would lead to an increase in ROI school enrollments by about 223 students during construction and 6 students during operation. To maintain the No Action student-to-teacher ratio of 16.2:1, the number of teachers would have to increase by 14 during the construction period. Operation would not require any additional teachers (Socio 1996a). This additional need for teachers would be distributed over the various jurisdictions in the ROI, so the effect on any single school district would be minimal.

To maintain No Action level of service, only one police officer and firefighter would need to be hired during the construction period. No additional police officers or firefighters would be required to maintain No Action service levels during operation (Socio 1996a).

The small population increase would have a negligible effect on health services, increasing hospital occupancy by much less than 1 percent during construction and operation. The number of physicians in the ROI would need to increase by only one during construction to maintain the No Action service level. No additional physicians would be needed during operation (Socio 1996a).

Local Transportation. A total of 2,945 and 1,087 vehicle trips per day would be generated during construction and operation, respectively. During construction there would be a noticeable increase in the volume-to-capacity ratio of Tennessee State Route 62, between Tennessee State Route 95 and Tennessee State Route 170. The road segment however, would continue to operate at level of service F, the lowest level of service. Traffic generated from facility operations would not affect the level of service on the road segments analyzed (Socio 1996a).

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The requirements for each storage option considered would decrease slightly if strategic reserve and weapons R&D materials were not included for storage at ORR. This should result in a decrease in the number of required operation employees for each of the considered alternatives. Therefore, socioeconomic effects on the REA/ROI for the storage alternatives with no strategic reserve and weapons R&D materials should be equal to, or somewhat less than, the No Action Alternative, the Upgrade Alternative, and the Collocation Alternative. [Text deleted.]

Phaseout

Phasing out HEU storage at ORR would result in the loss of 476 total (direct and indirect) jobs in the REA. Should all personnel be phased out at the same time, unemployment would remain at the No Action estimate of 4.9 percent and per capita income would be reduced by much less than 1 percent (Socio 1996a).

Some displaced workers may out-migrate from the ROI to seek other employment opportunities. Under the bounding case (all unemployed workers and their families leaving the ROI at the same time), population would

decrease by less than 1 percent. Some of the projected ROI occupied housing units would likely become vacant as a result of population losses (Socio 1996a).

The out-migration of population during phaseout would slightly lessen the demand for community services. It is unlikely that communities would lower service levels unless decreased revenues made it necessary.

Region of influence school enrollments are projected to decrease by much less than 1 percent during the bounding case scenario for phaseout. The No Action student-to-teacher ratio of 16.2:1 could be maintained if the number of teachers does not decrease from predicted No Action levels by more than 13 (Socio 1996a).

During phaseout, the number of sworn police officers could not decrease from predicted No Action levels if the No Action service level of 1.7 officers per 1,000 persons were to be maintained. The number of firefighters could decrease by one before the No Action service level of 2.2 firefighters per 1,000 persons would be affected (Socio 1996a).

Projected hospital occupancy rates during the bounding case scenario for phaseout would be slightly lower than the No Action projections. The number of physicians in the ROI could decrease by three from predicted No Action levels before the No Action service level of 2.6 physicians per 1,000 persons would be affected (Socio 1996a).

Phaseout would result in the loss of 129 vehicle trips per day. There would be no significant effect to the local road network due to this activity (Socio 1996a).

4.2.5.9 Public and Occupational Health and Safety

The assessments of potential radiological and chemical impacts associated with the storage alternatives at ORR are presented in this section. Summaries of radiological impacts from normal operations are presented in Tables 4.2.5.9–1 and 4.2.5.9–2 for the public and workers, respectively. Impacts from hazardous chemicals are presented in Table 4.2.5.9–3. Summaries of impacts associated with postulated accidents are presented in Table 4.2.5.9–4. Detailed results are presented in Appendix M.

No Action Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from normal operations involved with the current ORR sitewide missions, including interim storage of HEU. The impacts would be within applicable regulatory limits. For facility accidents, the risks and consequences are described in site safety documentation.

Normal Operation. The current mission at ORR, where HEU is in interim storage, is described in Section 3.6. The site has identified those facilities that will continue to operate under the No Action Alternative, including interim HEU storage facilities and others, if any, that will become operational by 2005. Based on that information, the radiological and chemical releases to the environment in 2005 and beyond (future operation) were developed and used in the impact assessments. The resulting doses and potential health effects to the public and workers at ORR are described below.

Radiological Impacts. The calculated annual dose to the average and maximally exposed member of the public from total site operation; the associated fatal cancer risks to these individuals from 50 years of operation; the dose to the population within 80 km (50 mi) from total site operation in the year 2030; and the projected number of fatal cancers in this population from 50 years of operation are presented in Table 4.2.5.9–1 under this alternative at ORR. The annual dose of 3.2 mrem to the MEI is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 8.0×10^{-5}. This activity would be included in a program to ensure that doses to the public are ALARA. The annual dose of 34 person-rem to the population would be within the limit in proposed 10 CFR 834. The corresponding number of fatal cancers in this population from 50 years of operation would be 0.85. To put operational doses into perspective, comparisons with natural background radiation doses are included in the table. The doses and projected fatal cancers associated with the storage component of the No Action Alternative are included in Table 4.2.5.9–1. These are seen to be much lower than those from total site operations.

Under the No Action alternative shown in Table 4.2.5.9–2, the average annual dose to a noninvolved (No Action) site worker and the annual dose to the noninvolved (No Action) total site workforce would be 2.6 mrem and 44 person-rem, respectively. The associated risk of fatal cancer to the average worker from 50 years of total site operations would be 5.2×10^{-5}, and the projected number of fatal cancers among all workers from 50 years of total site operations would be 0.88.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public resulting from the normal operation under No Action at ORR are presented in Table 4.2.5.9–3. The hazardous chemical impacts from current site operations were used to estimate the baseline site impacts for the various storage alternatives. The noncancer health effects expected and the risk of cancer due to the total chemical exposures were estimated for each site. Since the major releases due to normal operation at ORR would make up nearly all of the exposures to onsite workers and to the public in adjacent communities, contributions to the hazardous chemical concentrations from all other sources, for example, industrial operations, are considered negligible for purposes of risk calculations.

Table 4.2.5.9–1. Potential Radiological Impacts to the Public During Normal Operation at Oak Ridge Reservation—No Action and Storage Alternatives

Receptor	No Action		Upgrade		Collocation[a]	
	Storage Facility	Total Site[b]	Storage Facility[c]	Total Site[b]	Storage Facility	Total Site[b]
Annual Dose to the Maximally Exposed Individual Member of the Public[d]						
Atmospheric release pathway (mrem)	$1.4x10^{-3}$	1.5	$2.2x10^{-7}$	1.5	$4.5x10^{-5}$	1.5
Drinking water pathway (mrem)	0	0.10	0	0.10	0	0.10
Total liquid release pathway (mrem)	0	1.7	0	1.7	0	1.7
Atmospheric and liquid release pathways combined (mrem)	$1.4x10^{-3}$	3.2	$2.2x10^{-7}$	3.2	$4.5x10^{-5}$	3.2
Percent of natural background[e]	$4.7x10^{-4}$	1.1	$7.4x10^{-8}$	1.1	$1.5x10^{-5}$	1.1
50-year fatal cancer risk	$3.5x10^{-8}$	$8.0x10^{-5}$	$5.5x10^{-12}$	$8.0x10^{-5}$	$1.1x10^{-9}$	$8.0x10^{-5}$
Population Dose Within 80 Kilometers for Year 2030[f]						
Atmospheric release pathway (person-rem)	0.022	29	$3.4x10^{-6}$	29	$8.7x10^{-4}$	29
Total liquid release pathway (person-rem)	0	4.7	0	4.7	0	4.7
Atmospheric and liquid release pathways combined (person-rem)	0.022	34	$3.4x10^{-6}$	34	$8.7x10^{-4}$	34
Percent of natural background[e]	$5.8x10^{-6}$	$9.0x10^{-3}$	$9.0x10^{-10}$	$9.0x10^{-3}$	$2.3x10^{-7}$	$9.0x10^{-3}$
50-year fatal cancers	$5.5x10^{-4}$	0.85	$8.5x10^{-8}$	0.85	$2.2x10^{-5}$	0.85
Annual Dose to the Average Individual Within 80 Kilometers [g]						
Atmospheric and liquid release pathways combined (mrem)	$1.7x10^{-5}$	0.026	$3.0x10^{-9}$	0.026	$6.8x10^{-7}$	0.026
50-year fatal cancer risk	$4.3x10^{-10}$	$6.6x10^{-7}$	$6.6x10^{-14}$	$6.6x10^{-7}$	$1.7x10^{-11}$	$6.6x10^{-7}$

[a] The impacts to the public would be virtually the same whether the Pu and HEU are stored in a new consolidated and collocated HEU storage facility or whether the Pu is stored in a new facility and the HEU remains stored in the existing or modified Y–12 Plant (refer to the text).

[b] Includes impacts from No Action facilities. The location of the MEI may be different under No Action than for the other alternatives. Therefore, the impacts may not be directly additive.

[c] The impacts from the upgrade facility would be virtually the same as the impacts from storage under the No Action Alternative (OR MMES 1996a).

[d] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[e] The annual natural background radiation level at ORR is 295 mrem for the average individual; the population within 80 km in the year 2030 receives 379,000 person-rem.

[f] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[g] Obtained by dividing the population dose by the number of people projected to live within 80 km of ORR in 2030 (1,285,000).

Source: Section M.2.

Table 4.2.5.9–2. Potential Radiological Impacts to Workers During Normal Operation at Oak Ridge Reservation—Storage Alternatives

Receptor	Upgrade	Collocation[a]
Involved Workforce[b]		
Average worker dose (mrem/yr)[c]	28	264
50-year risk of fatal cancer	5.6×10^{-4}	5.3×10^{-3}
Total dose (person-rem/yr)	3	25
50-year fatal cancers	0.060	0.50
Noninvolved Workforce[d]		
Average worker dose (mrem/yr)[c]	2.6	2.6
50-year risk of fatal cancer	5.2×10^{-5}	5.2×10^{-5}
Total dose (person-rem/yr)	44	44
50-year fatal cancers	0.88	0.88
Total Site Workforce[e]		
Dose (person-rem/yr)	47	69
50-year fatal cancers	0.94	1.4

[a] The impacts are assumed to be the same for each of the three collocation storage options (refer to text).

[b] The involved worker is associated with operations of the proposed action. The maximum dose to the involved worker would be kept below 500 mrem per year. Based on a review of worker doses associated with similar operations (Section M.2.3.2), an average worker dose of 28 mrem per year was assumed. However, an effective ALARA program will ensure that the exposure will be reduced to that level which is as low as reasonably achievable. The number of involved badged workers for the upgrade and collocation alternatives would be 111 and 95, respectively.

[c] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the site must make reasonable attempts to maintain worker doses below this level.

[d] The noninvolved worker is onsite but not associated with operations of the proposed action. The projected number of noninvolved badged workers in 2005, is 17,200. The Noninvolved Workforce is equivalent to the No Action workforce.

[e] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Section M.2.

The HI to the MEI of the public at ORR resulting from normal operation under the No Action Alternative is 4.0×10^{-2}, and the cancer risk is zero (because no carcinogens are introduced). The HI to the onsite worker is 0.15, and the cancer risk is zero (because no carcinogens are introduced).

Facility Accidents. Under the No Action Alternative, uranium would continue to be stored at the ORR site in existing facilities. These facilities currently operate in accordance with DOE safety orders which ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations will be minimized. The safety to workers and the public from accidents at existing facilities is also controlled by Technical Safety Requirements specified in detail in SARs or a Basis for Interim Operations document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities would cause a halt in operations until it can be established that worker and public safety has not been compromised.

Upgrade Alternative

[Text deleted.]

Preferred Alternative: Modify Existing Y–12 Plant for Continued Highly Enriched Uranium Storage

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with upgraded existing HEU storage facilities at ORR. The section describes the impacts from normal facility operations at ORR, then impacts of facility accidents.

Table 4.2.5.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation at Oak Ridge Reservation—No Action and Storage Alternatives

Receptor	No Action	Upgrade		Collocation: Construct New Pu Facility and Modify Existing HEU Facility		Collocation: Construct New Pu and HEU Facilities	
	Total Site[a]	Facility[b]	Total Site[a]	Facility[b]	Total Site[a]	Facility[b]	Total Site[a]
Maximally Exposed Individual (Public)							
Hazard index[c]	4.0×10^{-2}	8.6×10^{-5}	4.0×10^{-2}	7.1×10^{-5}	4.0×10^{-2}	1.5×10^{-4}	4.0×10^{-2}
Cancer risk[d]	0	0	0	1.6×10^{-7}	1.6×10^{-7}	1.6×10^{-7}	1.6×10^{-7}
Worker Onsite							
Hazard index[e]	0.15	5.7×10^{-4}	0.15	8.1×10^{-4}	0.15	1.3×10^{-3}	0.15
Cancer risk[f]	0	0	0	1.3×10^{-5}	1.3×10^{-5}	1.3×10^{-5}	1.3×10^{-5}

[a] Total=Sum of the No Action plus the contributions of the above activity.

[b] Contribution from the above activity only (for example, the amount of increase over the existing, No Action level at the site).

[c] Hazard index for MEI=Sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer risk for MEI=(Emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (slope factor [SF]).

[e] Hazard index for workers=Sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer risk for workers=(Emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237[fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (SF).

Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors, therefore the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4–18 through M.3.4–21.

During normal operation at ORR, the operation of the upgraded Y–12 Plant would result in impacts that are within applicable regulatory limits.

Normal Operation. There would be no radiological releases during the upgrading of existing storage facilities at ORR. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct exposures. The resulting doses and potential health effects to the public and workers at ORR are described below.

Radiological Impacts. Doses to the public from upgraded storage would be slightly less than for storage under No Action, as shown in Table 4.2.5.9–1. This is because the upgraded storage facility safety and design features would improve, although the quantity of stored material would be the same as for the No Action Alternative, the distance to the MEI and the public would not change appreciably, and the population density would not change. Therefore, the risks and numbers of fatal cancers among the public would remain essentially the same as under the No Action Alternative. [Text deleted.] Total site doses to the MEI and the public are expected to be similar because storage represents a small contribution to the total site.

The dose to the MEI from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 3.2 mrem. From 50 years of operations, the corresponding risk of fatal cancer to this individual would be 8.0×10^{-5}. These values are presented in Table 4.2.5.9–1. The impacts to the average member of the public would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operations in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 34 person-rem. The corresponding number of fatal cancers in this population from 50 years of total site operation would be 0.85.

Facility and total site doses to onsite workers from normal operations are given in Table 4.2.5.9–2. Included are involved workers directly associated with the upgraded Y–12 storage plant, workers who are not involved with this plant, and the entire workforce at ORR. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the upgraded storage facilities at ORR are presented in Table 4.2.5.9–3. The impacts from all site operations, including the upgraded storage facilities are also included in this table. Total site impacts, which include the No Action impact plus the facility impacts, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 8.6×10^{-5}, and the cancer risk would be zero (because no carcinogens are introduced) as a result of operation of the upgraded storage facilities, in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the upgrade facility, would result in an HI of 4.0×10^{-2} and a cancer risk of zero (because no carcinogens are introduced) for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 5.7×10^{-4} and the cancer risk would be zero as a result of operation of the upgraded storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation because exposures would be expected to remain the same. The total site operation, including the

upgrade facility, would result in an HI of 0.15 and a cancer risk of zero for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. Under the Preferred Alternative at ORR, nonsurplus HEU and surplus HEU pending disposition would remain in storage at Y–12 in existing and upgraded storage facilities. Upgrades for HEU storage in Building 9212, the building used in the Y–12 EA accident analysis, would include structural modifications to numerous columns, knee braces, and cross braces to provide proper stiffness and load distribution as documented in *Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities* (Y/EN-5080, 1994). Appendix G of the Y–12 EA contains a list of buildings and the modifications required to bring the buildings into conformance with the target performance goal that is equivalent to the structural response of new facilities. The modifications made to these facilities are expected to result in a reduction in risk of accidents to workers and the public for equivalent quantities of stored HEU. Modification to these facilities would ensure that long-term storage would be in accordance with DOE Orders, and that the risks to the public of prompt fatalities due to accidents and of latent cancer fatalities due to normal operations would be minimized. These structural modifications would reduce the risk from seismic initiators such as a beyond design basis earthquake scenario.

Buildings included in the upgrade for long-term storage at Y–12, as described in Section 2.3.1, would be evaluated by analyses employing methodologies outlined in DOE Order 5480.21, Unreviewed Safety Questions; DOE Order 5480.22, Technical Safety Requirements; and DOE Order 5480.23, Nuclear Safety Analysis Reports. Facilities and buildings within Y–12 that contain substantial quantities of enriched uranium have DOE-approved SARs that are currently undergoing review in an SAR Update Program to meet requirements of new DOE Orders (OR DOE 1994:E-3). The SAR Update Program would reflect the long-term storage upgrade at Y–12 in a Conceptual Design Report for these structural modifications as part of the Stockpile Management Restructuring Initiative that DOE is pursuing.

One of the natural phenomena initiators of accident scenarios analyzed (nuclear criticality, fire, and mechanical upset) in the Y–12 EA included a design basis accident earthquake. For the earthquake scenario, the present evaluation criterion for the design basis earthquake corresponds to a hazard exceedance frequency of 5×10^{-4} per year. The Y–12 long-term storage buildings would be upgraded to meet the performance goal for a moderate hazard facility of Performance Category 3 in DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*. The Performance Category 3 facility poses a potential hazard to worker and public health and safety and to the environment because radioactive or toxic materials are present in significant quantities. Design considerations for this category are to limit facility damage so that hazardous materials can be controlled and confined, occupants are protected, and functioning of this facility is not interrupted. A performance goal for Performance Category 3 is a hazard exceedance frequency of 1×10^{-4} per year (DOE Order 5480.28). Meeting this performance goal would reduce the expected risk for the design basis accidents analyzed in the Y–12 EA for Building 9212 by approximately 80 percent, resulting in a latent cancer fatality risk of 5.1×10^{-7} to the MEI and 5.7×10^{-8} to a noninvolved worker, and potential latent cancer fatalities of 7.4×10^{-6} for the 80-km (50-mi) offsite population.

The HEU EIS describes the disposition of surplus HEU currently stored at ORR. As surplus HEU is removed for disposition, the quantity of material in storage would be reduced, and therefore fewer buildings would be needed for storage. As this a reduction in the storage footprint, the risk would be reduced accordingly. The combination of upgrading the buildings with structural modifications (as discussed above) and reducing the storage footprint as surplus HEU disposition continues are expected to result in overall reduction in the risk to the public and workers from facility accidents.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new modification of an existing facility, DOE Orders

require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Collocation Alternative

[Text deleted.]

Construct New Plutonium Storage Facility; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Normal Operation. There would be no radiological releases during the construction of a new Pu storage facility at ORR. Construction worker exposures to materials potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct exposures. The resulting doses and potential health effects to the public and workers at ORR are described below.

Radiological Impacts. Since the storage of the HEU contributes negligibly to the offsite radiological impacts, this alternative would result in impacts to the public that would be virtually the same as those associated with storage in a new consolidated and collocated Pu and HEU storage facility (refer to Table 4.2.5.9–1 and the discussions of the new Pu and HEU storage facilities). Radiological impacts to workers would also be expected to be the same (refer to Table 4.2.5.9–2).

Hazardous Chemical Impacts. Impacts to the public and to the onsite worker resulting from the normal operations of the new consolidated Pu storage facility and existing HEU storage facility at Y–12 are the same, or less than, those impacts shown in Table 4.2.5.9–3 for the Collocation Alternative (construct new Pu facility and modify existing HEU facility). Total site impacts shown in the table are the sum of the impacts under No Action plus the impacts due to the additional consolidated storage facility and any incremental impacts from the modified facility over the existing HEU storage facilities at the Y–12 Plant.

Facility Accidents. A set of potential accidents have been postulated for collocation of Pu and HEU for which there may be releases of Pu or HEU that may affect onsite workers and the offsite population. Impacts of accidents that release both Pu and HEU are bounded by the impacts due to Pu exposure. The accident consequences and risks to a worker located 619 m (2,030 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.5.9–4. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 4.9 at ORR for the beyond design basis earthquake accident scenario with an estimated probability of 1.0×10^{-7} per year (that is, probability of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 619 m (2,030 ft), would be 2.5×10^{-5}, 2.0×10^{-7}, and 1.6×10^{-7}, respectively. The maximum population 50-year facility lifetime risk would be 0.017 (that is, one fatality in about 2,900 years) at ORR for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 9.9×10^{-5}, and 7.9×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.5.9–4.

Table 4.2.5.9–4. Collocation Alternative Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 619 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatalities (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift impact	1.8×10^{-7}	6.0×10^{-6}	2.3×10^{-7}	7.5×10^{-6}	3.9×10^{-5}	1.3×10^{-3}	6.0×10^{-4}
PCV breach by firearms discharge	1.1×10^{-8}	6.0×10^{-7}	1.3×10^{-8}	7.5×10^{-7}	2.3×10^{-6}	1.3×10^{-4}	3.5×10^{-4}
PCV penetration by corrosion	7.9×10^{-5}	2.5×10^{-5}	9.9×10^{-5}	3.1×10^{-5}	1.7×10^{-2}	5.3×10^{-3}	0.064
Vault fire	7.8×10^{-8}	0.016	9.7×10^{-8}	0.019	1.4×10^{-5}	2.7	1.0×10^{-7}
Truck bay fire	4.2×10^{-9}	8.4×10^{-4}	5.3×10^{-9}	1.1×10^{-3}	9.1×10^{-7}	0.18	1.0×10^{-7}
Spontaneous combustion	4.2×10^{-11}	1.2×10^{-6}	5.3×10^{-11}	1.5×10^{-6}	9.1×10^{-9}	2.6×10^{-4}	7.0×10^{-7}
Explosion in the vault	9.9×10^{-9}	2.0×10^{-3}	1.2×10^{-8}	2.5×10^{-3}	2.1×10^{-6}	0.43	1.0×10^{-7}
Explosion outside the vault	4.5×10^{-11}	9.0×10^{-6}	5.6×10^{-11}	1.1×10^{-5}	9.8×10^{-9}	2.0×10^{-3}	1.0×10^{-7}
Nuclear criticality	2.8×10^{-11}	5.5×10^{-6}	3.5×10^{-11}	6.9×10^{-6}	2.1×10^{-9}	4.1×10^{-4}	1.0×10^{-7}
Beyond design basis earthquake	1.6×10^{-7}	0.033	2.0×10^{-7}	0.044	2.5×10^{-5}	4.9	1.0×10^{-7}
Expected risk[d]	7.9×10^{-5}	–	9.9×10^{-5}	–	1.7×10^{-2}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [619 m for the facility at ORR], whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risks is the sum of the risks over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code.

Construct New Plutonium Storage Facility and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Normal Operation. There would be no radiological releases during the construction of a new Pu storage facility and modification of the existing Y–12 Plant at ORR. Construction worker exposures to materials potentially contaminated with radioactivity would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct exposures. The resulting doses and potential health effects to the public and workers at ORR are described below.

Radiological Impacts. Because the storage of the HEU contributes negligibly to offsite radiological impacts, this alternative would also result in impacts to the public that would be virtually the same as those associated with storage in a new consolidated and collocated Pu and HEU storage facility (refer to Table 4.2.5.9–1 and the discussion of the new Pu and HEU storage facilities). Radiological impacts to workers would also be expected to be the same (refer to Table 4.2.5.9–2).

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the new consolidated Pu storage facility and modified Y–12 Plant at ORR are presented in Table 4.2.5.9–3. The impacts from all site operations, including the consolidation of a Pu facility, are also included in this table. Total site impacts, which include the No Action impact plus the facility impacts are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 7.1×10^{-5}, and the cancer risk is 1.6×10^{-7} as a result of operation of the new consolidation of Pu facility in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the consolidation of Pu facility, would result in an HI of 4.0×10^{-2} and a cancer risk of 1.6×10^{-7} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 8.1×10^{-4}, and the cancer risk is 1.3×10^{-5} as a result of operation of the new consolidation of Pu facility in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the new facility, would result in an HI of 0.15 and a cancer risk of 1.30×10^{-5} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. Under this alternative, the impacts of accidents are bounded by the impacts shown in Table 4.2.5.9–4 and are similar to those described in the construct new Pu storage facility; maintain existing HEU storage facilities at Y–12.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

This section includes a description of radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the consolidation of Pu storage and collocation with HEU storage facilities at ORR. This storage would take place in a new consolidated Pu and HEU storage facility.

Normal operation of the new storage facility at ORR would result in impacts that are within applicable regulatory limits.

Normal Operation. There would be no radiological releases during the construction of a new Pu and HEU storage facility at ORR. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the public resulting from the normal operation of the new Pu and HEU storage facility at ORR are presented in Table 4.2.5.9–1. The impacts from all site operations, including the new storage facility, are also given in the table. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the MEI from annual storage facility operation would be 4.5×10^{-5} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 1.1×10^{-9}. The impacts to the average member of the public would be less. As a result of storage facility operation in the year 2030, the population dose would be 8.7×10^{-4} person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 2.2×10^{-5}.

The dose to the MEI of the public from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 3.2 mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 8.0×10^{-5}. The impacts to the average member of the public would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 34 person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 0.85.

Facility and total site doses to onsite workers from normal operations are given in Table 4.2.5.9–2. Included are involved workers directly associated with the new storage facility, workers who are not involved with the storage facility, and the entire workforce at ORR. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the new consolidation of Pu and collocation with HEU storage facilities at ORR are presented in Table 4.2.5.9–3. The impacts from all site operations, including the consolidation of Pu and

collocation with HEU storage facilities, are also included in this table. Total site impacts, which include the No Action impact plus the facility impacts, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 1.5×10^{-4}, and the cancer risk is 1.6×10^{-7} as a result of operation of the consolidation of Pu and collocation with HEU storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the consolidation of Pu and collocation with HEU storage facilities, would result in an HI of 4.0×10^{-2} and a cancer risk of 1.6×10^{-7} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 1.3×10^{-3} and the cancer risk is 1.3×10^{-5} as a result of operation of the new consolidation of Pu and collocation with HEU storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the new facility, would result in an HI of 0.15 and a cancer risk of 1.3×10^{-5} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. Under this alternative, the impacts of accidents are bounded by the impacts shown in Table 4.2.5.9–4 and are similar to those described in the construct new Pu storage facility; maintain existing HEU storage facilities at Y–12.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

If the strategic reserve and weapons R&D materials are not included, the impacts to the public and to workers from the accident-free storage activities would be reduced in proportion to the decrease in the amount of material stored. The impacts from total site operations would decrease slightly. The risks of accidents would also tend to be lower.

Phaseout

Normal Operations. A phaseout of existing HEU storage facilities at ORR would reduce the impacts from radiological and chemical releases and exposures to levels very slightly below the No Action levels. As shown in Table 4.2.5.9–1, the radiological dose to the MEI from annual operations would be reduced by 1.4×10^{-3} mrem; the dose to the population would be reduced by 0.022 person-rem. The associated reductions in fatal cancer are included in the table. All workers involved in the transfer of the HEU from existing storage would be monitored to assure that their doses remain within regulatory limits and ALARA.

Facility Accidents. The phaseout operation will be conducted in accordance with DOE Orders to ensure that the risk to the public of prompt fatalities due to accidents or of cancer fatalities due to operations will be minimized. For current operations in the facility that would be phased out, the safety of workers and the public from accidents is controlled by Technical Safety Requirements that are specified in SARs or Basis for Interim Operations documents that have been prepared for the facility. Prior to initiating phaseout, the potential for accidents that could impact workers and the public will be assessed and, if necessary, applicable existing safety documentation will be modified to ensure safety for workers and the public.

4.2.5.10 Waste Management

This section summarizes the impacts on waste management at ORR under No Action and for each of the long-term storage alternatives to include the phaseout of HEU storage. There is no spent nuclear fuel or HLW associated with Pu or HEU storage. Table 4.2.5.10–1 lists the projected waste generation rates and treatment, storage, and disposal capacities under No Action for the ORR for 2005. Projections for No Action were derived from the most recent available environmental data, with the appropriate adjustments made for those changing operational requirements where the volume of wastes generated were identifiable. The projection does not include wastes from future, yet uncharacterized, environmental restoration activities. The projections for No Action could change significantly depending on the decisions resulting from the PEIS on waste management being prepared by the Department. Table 4.2.5.10–2 provides the estimated incremental operational waste volumes projected to be generated at ORR as a result of the various storage alternatives prior to treatment. Some of the waste values described in this section are different than the waste values in the table. For those values that differ (for example LLW), the table gives waste generated pre-treatment values and the text discusses post-treatment values (indicated as after treatment and volume reduction). For example, the collocated new Pu storage facility and new HEU storage facility would generate 2.1 m^3 (555 gal) of liquid LLW. Since ORR already stores HEU, the waste volumes associated with the phaseout of HEU storage (0.4 m^3 [106 gal]) must be subtracted out to avoid double counting waste volumes associated with HEU storage. This results in a net incremental increase from the alternative of 1.7 m^3 (449 gal). The subtraction of phaseout volumes to avoid the double counting of waste volumes is only applicable to the collocation alternative (new Pu and HEU storage facility). The waste volumes generated from the various storage alternatives and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.1. For the collocation alternative (new Pu and HEU facility), the waste effluent volumes in the impact analysis refer only to wastes from the applicable storage facility, not the net incremental increase/decrease for ORR as a whole. Facilities that would support the storage of Pu and/or HEU would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with RCRA and other applicable statutes. Depending in part on decisions in the ROD for the Waste Management PEIS, wastes could be treated and disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice.

No Action Alternative

Under this alternative spent nuclear fuel and TRU, low-level, mixed, hazardous, and nonhazardous wastes would continue to be generated at ORR from the missions outlined in Section 3.6. Under No Action, ORR would continue to store HEU, and treat, store, and dispose of its legacy and newly generated wastes in current and planned facilities.

A small quantity of spent nuclear fuel could be generated by the ORNL High-Flux Isotope Reactor in the production of isotopes for commercial applications and in conducting research. The reactor pool is almost full, but reracking positions for the fuel is under way. This will provide storage space for the spent fuel generated by the reactor until 2000 (OR LMES 1996a:3-3,3-4). Installing modular dry storage units at the site for further storage is being planned (DOE 1995w:3.2-12). Other fuel and irradiated nuclear material is stored in various locations at ORR. In accordance with the ROD (60 FR 28680) from the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE-EIS-0203-F), ORR would ship 46 t (51 tons) of spent nuclear fuel to INEL and SRS.

Small quantities of TRU waste would be generated from isotope production and research activities at ORNL. Most of this waste would be generated in remedial action projects. TRU waste previously buried and stored

Table 4.2.5.10–1. Projected Spent Nuclear Fuel and Waste Management Under No Action (2005) at Oak Ridge Reservation[a]

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent Fuel	None	None	NA	Pools and storage vaults	57	Ship to INEL or SRS	NA
Transuranic (Solid)							
Contact-handled	115	None	NA	Staged for shipment	1,760	WIPP or alternate facility	NA
Remote-handled	4	None	NA	Staged for shipment	856	WIPP or alternate facility	NA
Low-Level							
Liquid	2,970[b]	Activated sludge, solidification, and incineration	419,000	Stored onsite	3,230	NA	NA
Solid	7,320	Compaction, smelting, and incineration by commercial vendor	30,600	Stored onsite	68,000	Onsite for ORNL only. Onsite and offsite LLW disposal for K–25 and Y–12 under evaluation	3,590 (ORNL only)
Mixed[c]							
Liquid	87,600	Neutralization, incineration, and activated sludge	233,000[d]	Stored in tanks and drums	100,000	NA	NA
Solid	432	Incineration or offsite commercial vendors	Planned	Staged and stored for shipment	132,000	Offsite	NA
Hazardous							
Liquid	6,460[e]	Neutralization, settlement, and offsite	30,300	Stored in tanks and staged for shipment	751	Offsite	NA
Solid	26[f]	Offsite planned and open-burning[g]	Variable	Staged for shipment	300	Offsite	NA

Table 4.2.5.10–1. Projected Spent Nuclear Fuel and Waste Management Under No Action (2005) at Oak Ridge Reservation[a]—Continued

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Sanitary)							
Liquid	550,000	Offsite and extended aeration-activation	3,180,000	None	NA	NPDES outfall	NA
Solid	53,100	Compaction	41,700	None	NA	Landfill (Onsite) Landfill (Offsite)	1,100,000
Nonhazardous (Other)							
Liquid	650,000[h]	Evaporation, settling, and neutralization	1,980,000[i]	None	NA	NPDES outfall	NA
Solid	321[h]	None	NA	None-scrap metal stockpiled	NA	Landfill (K–25, Y–12, and SWSA-6)	119,000[j]

[a] The generation rate, treatment, and storage data for the three sites at ORR were combined.
[b] Some waste included in solid LLW.
[c] Includes RCRA, PCB, and RCRA/PCB waste.
[d] Some waste included in LLW.
[e] Some liquid hazardous waste is treated as mixed LLW.
[f] Some solid hazardous waste included in solid mixed LLW.
[g] The Chemical Detonation Facility treats small amounts of hazardous wastes that would be dangerous to transport offsite.
[h] Some nonhazardous waste included in solid LLW.
[i] Some waste is included in sanitary waste.
[j] Some waste is included in sanitary waste and Y–12 solid disposal.

Note: NA=not applicable.
Source: OR LMES 1995e.

Table 4.2.5.10–2. Estimated Annual Generated Waste Volumes at Oak Ridge Reservation—No Action (2005) and Net Incremental for Storage Alternatives

Category	No Action[a] (m^3)	Upgrade[b] (m^3)	Collocation			Phaseout (m^3)
			New Pu Storage Facility Only[b] (m^3)	New Pu Storage Facility and Upgrade Y–12[b] (m^3)	New Pu and HEU Storage Facility[b] (m^3)	
Transuranic						
Liquid	None	0	0.02[c]	0.02[c]	0.02[c]	0
Solid	119	0	10	10	10	0
Mixed Transuranic						
Liquid	None	0	0	0	0	0
Solid	None	0	4	4	4	0
Low-Level						
Liquid	2,970	0.04[c]	2[c]	2[c]	1.7[c]	-0.4
Solid	7,320	3	1,260	1,263	1,300	-1.5
Mixed Low-Level						
Liquid	87,600	0.02	0.2	0.2	-0.2	-0.4
Solid	432	0.8	65	66	66	-0.4
Hazardous						
Liquid	6,460	Included in mixed LLW	2	2	2	Included in mixed LLW
Solid	26	Included in mixed LLW	2	2	2	Included in mixed LLW

Table 4.2.5.10–2. Estimated Annual Generated Waste Volumes at Oak Ridge Reservation—No Action (2005) and Net Incremental for Storage Alternatives—Continued

Category	No Action[a] (m^3)	Upgrade[b] (m^3)	Collocation			Phaseout (m^3)
			New Pu Storage Facility Only[b] (m^3)	New Pu Storage Facility and Upgrade Y–12[b] (m^3)	New Pu and HEU Storage Facility[b] (m^3)	
Nonhazardous (Sanitary)						
Liquid	550,000	0.8	136,630	136,630	171,840	-0.2
Solid	53,100	31	1,340	1,370	1,720	-15
Nonhazardous (Other)						
Liquid	650,000	0.8	Included in sanitary	0.8	-0.4	-0.4
Solid	321	0.8	1,700[d]	1,700[d]	2,200[d]	-0.4

[a] The No Action waste volumes are from Table 4.2.5.10–1.

[b] Waste volumes for storage alternatives are found in Section E.3.1 (Tables E.3.1.1–4, E.3.1.3–6, and E.3.1.3–7). Net incremental volumes for collocation alternative (new Pu and HEU storage facility) were derived by substituting phaseout volumes so as not to double count waste volumes associated with HEU storage. Waste effluents (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in these tables.

[c] Liquid TRU and LLW would be treated and solidified prior to disposal.

[d] Recyclable wastes.

would be repackaged into TRUPACT-II containers for eventual shipment to WIPP. If shipments to WIPP were delayed, plans for additional TRU storage facilities would be incorporated in the design of these facilities.

Liquid LLW would be solidified, neutralized, and allowed to evaporate. Some liquid waste would also be incinerated. Solid LLW would be compacted and stored onsite at K–25 and ORNL. Contaminated scrap metal would be processed for beneficial reuse where possible, including the DOE Shielding Block Program, or be size-reduced for disposal. Hazardous waste would be treated in both onsite and offsite RCRA-permitted facilities. Disposal of hazardous wastes would be provided by offsite facilities licensed to dispose of waste regulated under RCRA.

Mixed waste would be treated and disposed of according to the ORR Site Treatment Plan, which was developed pursuant to the *Federal Facility Compliance Act*. Liquid mixed waste would also be incinerated at the TSCA Incinerator. The resulting waste would then be stored in a RCRA-permitted facility in DOT-approved containers until it is shipped to an offsite DOE disposal facility. Some of this waste would be placed in interim storage until new technologies for treatment and disposal are identified and evaluated.

A new industrial pretreatment facility for liquid discharges from Y–12 to the City of Oak Ridge sanitary system would be constructed under the terms of their Industrial Pretreatment Permit. Nonhazardous sanitary and nonradioactive process waste liquids would be treated in conventional sewage treatment plants. The resultant solids would be disposed of with solid nonhazardous waste in a permitted landfill sized to handle projected future waste volumes.

Upgrade Alternative

Preferred Alternative: Modify Existing Y–12 Plant for Continued Highly Enriched Uranium Storage

Construction and operation of an upgraded HEU storage facility would have a minimal impact on existing ORR waste management activities. Waste generated during construction would consist of solid LLW and nonhazardous waste. The nonhazardous waste would be disposed of as part of the construction project by the contractor. The low-level contaminated concrete would be placed in appropriate containers and shipped to a DOE LLW disposal facility. The low-level contaminated steel would go to the contaminated Scrap Metal Yard, where it would be shipped to an offsite contractor for processing for beneficial reuse where possible, including the DOE Shielding Block Program.

Operation of the upgraded facility presents very little increase in low-level, mixed, hazardous, and nonhazardous waste volumes as compared to the No Action volumes for any waste category. The contribution of this operation to the ORR waste management activities is illustrated in Table 4.2.5.10–2 and could easily be handled by existing waste management facilities.

Collocation Alternative

Construct New Plutonium Storage Facility; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Construction and operation of a consolidated Pu storage facility in conjunction with No Action for HEU storage would have an impact on existing ORR waste management activities, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous material or radioactive constituents is expected to be generated during construction. However, if any was generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

After treatment and volume reduction of TRU waste, approximately 5 m^3 (7 yd^3) of TRU waste and 4 m^3 (5 yd^3) of mixed TRU waste from leaded gloves, windows, and contaminated lead shielding would be treated and packaged to meet the current planning-basis WIPP WAC or alternative treatment level. While awaiting shipment to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), TRU and mixed TRU wastes would be stored in above-grade storage facilities. One additional truck shipment per year or, if applicable, one regular train shipment every 2 years or one dedicated train shipment every 6 years would be required to transport these wastes to WIPP.

Following treatment and volume reduction, approximately 630 m^3 (824 yd^3) of LLW would require storage/disposal after treatment at ORR. Assuming a land usage of 3,300 m^3/ha (1,700 yd^3/acre), this would require 0.2 ha/yr (0.5 acres/yr) of LLW disposal area. If onsite disposal at ORR is not possible, approximately 38 LLW shipments per year to a DOE disposal facility would be required. The 0.2 m^3 (50 gal) of liquid mixed LLW and 65 m^3 (85 yd^3) of solid mixed LLW would be treated and disposed of in accordance with ORR Site Treatment Plan through the use of existing and planned facilities. The additional 2 m^3 (476 gal) of liquid hazardous waste and 2 m^3 (3 yd^3) of solid hazardous wastes would have minimal impact on waste management activities at ORR, as existing and planned facilities are adequate to store the increase while awaiting shipment to offsite RCRA-permitted facilities. Approximately 136,630 m^3 (36,100,000 gal) of liquid nonhazardous waste may require construction of utility and process wastewater treatment systems. The existing sanitary treatment system would be adequate. After volume reduction, 670 m^3 (876 yd^3) of solid nonhazardous wastes would require disposal at the onsite landfill.

Construct New Plutonium Storage Facility and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Construction and operation of a consolidated Pu storage facility collocated with HEU upgrade would have an impact on existing ORR waste management activities, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, nonhazardous solids, and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. The impacts would be identical to those presented in the previous section.

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction and operation of a consolidated Pu storage facility collocated with HEU storage would have an impact on existing ORR waste management activities, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, nonhazardous solids, and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous waste would be shipped to a commercial RCRA-permitted treatment and disposal facility. The sources of wastes are similar to those of the consolidated Pu storage facility with HEU upgrade; however, the quantity with the exception of TRU waste would change. The impacts from TRU waste would be identical to those identified in the two previous options.

Following treatment and volume reduction, approximately 630 m^3 (824 yd^3) of LLW contaminated with Pu and 20 m^3 (26 yd^3) of LLW contaminated with uranium would require treatment and storage/disposal at ORR. Assuming a land usage of 3,300 m^3/ha (1,700 yd^3/acre), this would require 0.2 ha/yr (0.5 acres/yr) of LLW disposal area. If onsite disposal at ORR is not possible, approximately 39 LLW shipments per year to a DOE disposal facility would be required. The 0.2 m^3 (55 gal) of liquid mixed LLW and 66 m^3 (86 yd^3) of solid mixed LLW would be treated and disposed of through the use of existing and planned facilities. The 2 m^3 (528 gal) of liquid hazardous waste and 2 m^3 (3 yd^3) of solid hazardous waste would have minimal impact on waste management activities at ORR, as existing and planned facilities are adequate to store the increase while

awaiting shipment to offsite RCRA-permitted facilities. The 171,840 m^3 (45,400,000 gal) of liquid nonhazardous waste may require construction of utility and process wastewater treatment systems. The existing sanitary treatment system would be adequate. After volume reduction, 870 m^3 (1,140 yd^3) of solid nonhazardous waste would require disposal at the onsite landfill.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve and weapons R&D materials would reduce the amount of operational waste volumes shown in Table 4.2.5.10–2 for the No Action Alternative, the Upgrade Alternative, and the Collocation Alternative. The decrease would be proportional to the amount of material excluded. [Text deleted.]

Phaseout

The phaseout of HEU storage would have little impact on ORR waste management activities. The quantities of waste would decrease by the increments shown in Table 4.2.5.10–2.

4.2.6 SAVANNAH RIVER SITE

A listing of the proposed long-term storage alternatives, subalternatives, and related actions, including the No Action Alternative, at SRS is provided below. The potential impacts of implementing these alternatives and related actions at SRS are described in the following sections: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, and waste management. The specific long-term storage alternatives proposed for SRS are the Preferred Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative.

Preferred Alternative

Upgrade With RFETS Non-Pit Pu Subalternative:

Modify APSF in F-Area to accommodate RFETS non-pit Pu not including strategic reserve and weapons R&D materials. This subalternative involves a similar but smaller expansion of the APSF compared to the Upgrade with All or Some RFETS Pu or LANL Pu Subalternative.

Proposed Storage Activities at Savannah River Site

- **No Action Alternative:** Continue to store SRS Pu material within the scope of this PEIS in the APSF in F-Area in stabilized form pursuant to DNFSB Recommendation 94-1.
- **Upgrade Alternative:** There are three subalternatives under this storage alternative.
  - ***Upgrade With RFETS Non-Pit Pu Subalternative (Preferred Alternative)*:** Modify APSF in F-Area to accommodate RFETS non-pit Pu not including strategic reserve and weapons R&D materials. This subalternative involves a similar but smaller expansion of the APSF compared to the Upgrade with All or Some RFETS Pu or LANL Pu Subalternative.
  - ***Upgrade Without RFETS Pu or LANL Pu Subalternative*:** Since the APSF would be a new facility, the storage subalternative does not apply to SRS.
  - ***Upgrade With All or Some RFETS Pu and LANL Pu Subalternative*:** Modify APSF in F-Area to accommodate SRS, and RFETS and LANL Pu material.
- **Consolidation Alternative:** Construct a new facility east of Z-Area to accommodate all Pu material within the scope of this PEIS.
- **Collocation Alternative:** Construct a new facility east of Z-Area to accommodate all Pu and HEU material within the scope of this PEIS.
- **Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials:** Facility and other resource requirements would be smaller than the No Action Alternative, the Upgrade with All or Some RFETS Pu and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative.
- **Phaseout:** SRS Pu material within the scope of this PEIS would be moved out of F-Area to the Consolidation or Collocation site (located at another DOE site) or to disposition (for surplus Pu).

4.2.6.1 Land Resources

No Action Alternative

Under this alternative, SRS non-pit Pu material would be stored in a new F-Area facility (proposed APSF) in stabilized form. The ongoing (no new action) activities conform with present and future land-use plans, policies, and controls. Therefore, no impacts on land use or visual resources would be anticipated at SRS beyond those of existing and future activities that are independent of the proposed action.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

The new APSF in the F-Area would be modified to accommodate SRS non-pit Pu material and RFETS non-pit Pu material. The existing F-Area building and maintenance facilities would support the new facility. The modification would increase the existing footprint of the APSF, however, the facility would be situated entirely within a previously-disturbed protected area. A 1.6-km (1-mi) buffer zone is established for the F-Area.

Land Use. Facility construction and operation would conform with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the Plan, current F-Area land use is designated industrial operations, while the future land-use category is primary industrial mission. Specifically, the F-Area is one of four SRS waste management areas (SR DOE 1994d:2,11,12). As discussed in Section 4.2.6.8, no in-migration of workers would be required during construction or operation. Therefore, no indirect effects to offsite land use would occur.

Facility modification would not affect other land uses at SRS. There is no prime farmland on SRS. Construction would not be in conflict with land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS. No additional effects to land use would be anticipated from operations.

Visual Resources. Construction and operation affects would be consistent with the industrial landscape character and current VRM Class 5 designation of the F-Area. Due to distance, hilly terrain, and forest cover, visual effects to public access roads with high sensitivity levels (State Highway 125 and SRS Route 1) would not occur.

[Text deleted.]

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

The new APSF in the F-Area would be modified to accommodate SRS, RFETS, and LANL Pu material. The existing F-Area buildings and maintenance facilities would support the new facility. The facility would be situated entirely within a previously disturbed protected area. A 1.6-km (1-mi) buffer zone is established for the F-Area.

Although the increase in existing building footprint would be slightly larger than the Upgrade With RFETS Non-Pit Pu Subalternative, the same overall land area would be required. Therefore, direct and indirect impacts on land resources would be anticipated to be similar.

Consolidation Alternative

Construct New Plutonium Storage Facility

Under this alternative, all Pu within the scope of this PEIS would be stored at a single new storage facility to be constructed at SRS. The proposed facility location is an undisturbed, forested area east of the Z-Area. The consolidated Pu storage plant would disturb 58.5 ha (144 acres) of land area during construction of which 56 ha (138 acres) would be used during operations. A buffer zone would be provided between facilities and the SRS site boundary. Pu storage in existing DOE facilities would be phased out.

Land Use. Facility construction and operation of a new consolidated facility for Pu storage would convert undeveloped, forested land to a developed use. However, the proposed action would conform with the current *Savannah River Site Development Plan*, which designates the future land use of the proposed facility site for the primary industrial mission (SR DOE 1994d:11). [Text deleted.] As discussed in Section 4.2.6.8, no in-migration would occur during construction and only minimal in-migration during operation. Accordingly, there would be minimal impacts to the housing sector. Therefore, no indirect effects on offsite land use would occur.

The facility site would be situated on lands managed by U.S. Forest Service (forest management activities). Since the majority of SRS land area is forested and the forest management program at SRS encompasses a broad range of activities, use of this land area would be anticipated to have an inconsequential effect on the program (SR DOE 1984a:8). Construction and operation would not affect other land uses at SRS. There are no prime farmlands on SRS. Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since they do not address SRS.

Visual Resources. The current VRM Class 4 designation of the facility site would be changed to Class 5. Due to distance, hilly terrain, and forest cover, visual effects on public access roads with high sensitivity leve's (State Highway 125 and SRS Route 1) visual effects would not occur. [Text deleted.]

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

All HEU and Pu within the scope of this PEIS would be stored at a primary new storage plant at SRS. The proposed facility location would be east of Z-Area on an undisturbed parcel presently forested. The disturbed area would be 89.5 ha (221 acres) during construction of which 87 ha (215 acres) would be used during operations. A buffer zone would be provided between facilities and the SRS boundary. Pu and HEU storage in existing DOE storage facilities would be phased out. Direct impacts on land resources would be similar to the Consolidation Alternative. As discussed in Section 4.2.6.8, in-migration is anticipated during construction and operation. However, expected vacancies and historic housing construction rates indicate that housing would be available to accommodate the population growth. Therefore, no indirect impacts to offsite lands would occur.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, land effects during construction and operation would be almost the same in extent and magnitude to the No Action Alternative, Upgrade With All or Some RFETS Pu and LANL Pu Subalternative, Consolidation Alternative, and Collocation Alternative because the same facility would be almost the same. However, because the smaller quantity of material would require smaller facilities, it is likely that less land area would be disturbed during construction and used during operations. [Text deleted.]

Phaseout

No new construction or upgrade of existing facilities would occur under phaseout of the Pu storage mission. SRS Pu material would be moved out of the F-Area to a non-SRS consolidation or collocation site or to disposition. Potential impacts on visual resources could occur if facilities are not maintained.

[Text deleted.]

4.2.6.2 Site Infrastructure

The SRS infrastructure would be capable of supporting any of the storage alternatives without major modifications to the existing infrastructure. A comparison of site infrastructure and facilities resource needs for the various storage alternatives is shown in Table 4.2.6.2–1.

No Action Alternative

Savannah River Site would continue to store current inventories of Pu which would be stabilized pursuant to DNSFB Recommendation 94-1 corrective actions. Pu storage would be in the soon to be constructed APSF in the F-Area which DOE decided to build after completing the *Environmental Impact Statement, Interim Management of Nuclear Materials* (DOE/EIS-0220, October 1995). Site infrastructure requirements under No Action could continue to be met with current site capacities and structures. As a result, there would be no impacts on the site infrastructure under No Action.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Modification of the APSF to accommodate existing quantities of non-pit Pu material relocated from RFETS would have minimal impact on the site infrastructure. Data for construction are presented in Appendix C. Operations impacts would also be minimal. This subalternative requires an additional amount of coal over that needed for storage of SRS materials without the RFETS Pu and LANL Pu material. This additional requirement would have minimal impact on the site infrastructure.

[Text deleted.]

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Modification of the APSF to accommodate existing quantities of RFETS and LANL Pu material would have a minimal effect on the site infrastructure. Data for construction are presented in Appendix C. Operational data are summarized in Table 4.2.6.2–1. As shown, site infrastructure resource requirements and associated impacts would be proportionately more than the upgrade with RFETS non-pit Pu materials.

Since impacts associated with relocating all of the RFETS Pu and LANL Pu material to SRS are minimal for both construction and operations, relocating only a portion of this material to SRS would result in minimal impacts to the site infrastructure as well. Additional electrical energy and coal requirements would be proportionately less than that required for storage for the full amount of RFETS Pu and LANL Pu material depending on the actual amount relocated to SRS.

Consolidation Alternative

Construct New Plutonium Storage Facility

Construction of a new consolidated Pu storage facility at SRS would have minimal impact on the site infrastructure. Data for construction are presented in Appendix C. Operations impacts to the SRS infrastructure

Table 4.2.6.2–1. Site Infrastructure Changes Required for Operation at Savannah River Site (Annual)—No Action (2005) and Storage Alternatives

Alternative	Transportation		Electrical		Fuel		
	Roads (km)	Rail-roads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
No Action							
Site availability	230	103	1,672,000	330	28,390,500	0	221,352
Projected usage	230	103	794,000	116	28,390,500	0	221,352
Upgrade (With RFETS Non-Pit Pu)							
Projected usage with upgrade facility	230	103	797,600	116	28,390,500	0	221,642
Amount required in excess to site availability	0	0	0	0	0	0	290[a]
[Text deleted.]							
Upgrade (With All or Some RFETS Pu and LANL Pu Material)							
Projected usage with upgrade facility	230	103	798,900	116	28,390,500	0	221,752
Amount required in excess to site availability	0	0	0	0	0	0	400[a]
Consolidation							
Projected usage with consolidated facility	235	108	851,000	126	28,436,500	0	225,552
Amount required in excess to site availability	<5	<5	0	0	46,000[b]	0	4,200[a]
Collocation							
Projected usage with collocated facilities	235	108	870,000	129	28,437,500	0	226,152
Amount required in excess to site availability	<5	<5	0	0	47,000[b]	0	4,800[a]
Phaseout							
Projected usage without storage facility	230	103	794,000	116	28,390,500	0	221,352
Amount required in excess to site availability	0	0	0	0	0	0	0

[a] Coal requirements in excess to site availability could be procured through normal contractual means.

[b] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: Modified from SRS 1993a:3; SRS 1996a:4; WSRC 1995e.

under this subalternative would be minimal. As shown in Table 4.2.6.2–1, less than 5 km (3 mi) of roads and less than 5 km (3 mi) of railroad lines would need to be added to the site. Some additional oil and coal would have to be provided as well. Additional oil and coal would be procured through normal contractual means. Electrical infrastructure requirements would be within site capacities.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Constructing new collocated Pu and HEU storage facilities to accommodate long-term storage of Pu and HEU at SRS would have minimal impact on site infrastructure. Data for construction are presented in Appendix C. As shown in Table 4.2.6.2–1, less than 5 km (3 mi) of roads and less than 5 km (3 mi) of railroad lines would need to be added to the site. Operations impacts to the SRS infrastructure under this subalternative would be minimal. As shown in Table 4.2.6.2–1, some additional coal and oil over that required for the consolidation of Pu alternative would be required. As for other alternatives, this additional amount would be procured through normal contractual means.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Since the existing SRS site infrastructure would be capable of supporting construction/modification and operation of facilities for the Upgrade Alternative With All or Some RFETS Pu and LANL Pu, Consolidation Alternative, and Collocation Alternative, constructing and operating such facilities without including provisions for storage of strategic reserve and weapons R&D materials could be accommodated as well. Expected reductions in amounts of annual electrical energy requirements for the various storage facilities are the only site infrastructure changes expected if this subalternative is chosen because electric usage is dependent on the amount of material. [Text deleted.]

Phaseout

This phaseout would have no impact on the site infrastructure. While Pu storage operation would cease, the storage facilities would remain and utility service would continue until D&D is accomplished.

4.2.6.3 Air Quality and Noise

Construction and operation activities associated with the No Action Alternative and the proposed storage alternatives would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts at SRS, criteria and toxic/hazardous concentrations from the No Action Alternative and the proposed storage alternatives are compared with Federal and State standards and guidelines. Impacts from radiological airborne emissions are described in Section 4.2.6.9.

In general, all of the proposed storage facilities would emit the same types of air pollutants during construction. It is expected emissions would not exceed Federal, State, or local air quality regulations. PM_{10} and TSP concentrations will be increased during peak construction periods.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, and wind erosion of exposed ground surfaces
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

During operation, the concentrations of criteria and toxic/hazardous air pollutants of the individual storage facilities are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations presented in Table 4.2.6.3–1 for each of the fissile materials storage alternatives indicate little difference between alternatives with respect to impacts to air quality.

Emission rates attributable to operation of the proposed storage facilities are presented in Tables F.1.3–1 to F.1.3–3. [Text deleted.] Air pollutant emission sources associated with operations include the following:

- Operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- Exhaust and road dust generated by vehicles delivering supplies and bringing employees to work
- Toxic/hazardous pollutant emissions from facility processes

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for each storage alternative are described separately. Supporting data for the air quality and noise analyses are presented in Appendix F.

AIR QUALITY

An analysis was conducted of the potential air quality impacts of emissions from each of the fissile material storage alternatives as described in Section 4.1.3.

Section 176 (c) of the 1990 CAA Amendments requires that all Federal actions conform with the applicable SIP. EPA has implemented rules that establish the criteria and procedures governing the determination of conformity for all Federal actions in nonattainment and maintenance areas. These are discussed in Section 4.1.3. The attainment status of the area in which SRS is located is discussed in Section 3.7.3. Since the area is considered an attainment area for criteria pollutants, the proposed actions at this site do not require that a conformity analysis be performed.

Table 4.2.6.3–1. Estimated Operational Concentrations of Pollutants at Savannah River Site and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade With RFETS Non-Pit Material ($\mu g/m^3$)	Upgrade With RFETS and LANL Material ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Criteria Pollutants							
Carbon monoxide	8-hour	10,000[b]	22	22.12	22.17	24.15	24.4
	1-hour	40,000[b]	171	171.58	171.78	181.14	182.28
Lead	Calendar Quarter	1.5[b]	0.0004	0.0004	0.0004	0.0004	0.0004
Nitrogen dioxide	Annual	100[b]	5.7	5.77	5.8	6.62	6.78
Ozone	1-hour	235[b]	c	c	c	c	c
Particulate matter less than or equal to 10 microns in diameter	Annual	50[b]	3	3.01	3.01	3.06	3.07
	24-hour	150[b]	50.6	50.71	50.75	51.83	52.04
Sulfur dioxide	Annual	80[b]	14.5	14.71	14.79	15.95	16.28
	24-hour	365[b]	196	200.1	201.65	224.04	230.49
	3-hour	1,300[b]	823	849.46	859.65	1,003.95	1,045.58
Mandated by South Carolina							
Total suspended particulates	Annual	75[d]	12.6	12.6	12.61	12.66	12.67
Gaseous fluorides (as HF)	30-day	0.8[d]	0.09	0.09	0.09	0.09	0.09
	7-day	1.6[d]	0.39	0.39	0.39	0.39	0.39
	24-hour	2.9[d]	1.04	1.04	1.04	1.04	1.04
	12-hour	3.7[d]	1.99	1.99	1.99	1.99	1.99
Hazardous and Other Toxic Compounds							
3,3-Dichlorobenzidine	24-hour	0.15[d]	0.002	0.002	0.002	0.002	0.002
Acrolein	24-hour	1.25[d]	0.016	0.016	0.016	0.016	0.016
Benzene	24-hour	150.00[d]	31.711	31.711	31.711	31.711	31.711
Bis (chloromethyl) ether	24-hour	0.03[d]	0.002	0.002	0.002	0.002	0.002
Cadmium oxide	24-hour	0.25[d]	0.021	0.021	0.021	0.021	0.021
Chlorine	24-hour	75[d]	7.63	7.63	7.63	7.63	7.63
Chloroform	24-hour	250.00[d]	4.957	4.957	4.957	4.957	4.957
Cobalt	24-hour	0.25[d]	0.206	0.206	0.206	0.206	0.206

Table 4.2.6.3–1. Estimated Operational Concentrations of Pollutants at Savannah River Site and Comparison With Most Stringent Regulations or Guidelines—No Action (2005) and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Upgrade With RFETS Non-Pit Material ($\mu g/m^3$)	Upgrade With RFETS and LANL Material ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (continued)							
Formic acid	24-hour	225.00[d]	2.420	2.420	2.420	2.420	2.420
Hydrogen chloride	24-hour	175[d]	e	e	e	<0.01[f]	<0.01[f]
Hydrazine	24-hour	0.5[d]	e	e	e	<0.01[f]	<0.01[f]
Manganese	24-hour	25.00[d]	0.821	0.821	0.821	0.821	0.821
Mercury	24-hour	0.25[d]	0.014	0.014	0.014	0.014	0.014
Nickel	24-hour	0.50[d]	0.271	0.271	0.271	0.271	0.271
Nitric acid	24-hour	125[d]	50.96	50.96	50.96	50.96	51.01
Parathion	24-hour	0.50[d]	0.007	0.007	0.007	0.007	0.007
Phosphoric acid	24-hour	25[d]	0.462	0.462	0.462	0.462	0.462
Sulfuric acid	24-hour	10[d]	e	e	e	<0.01[f]	<0.01[f]

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[Text deleted.]

[b] Federal and State standard.

[c] Ozone, as a criteria pollutant, is not directly emitted nor monitored by the candidate site. See Section 4.1.3 for a discussion of ozone-related issues.

[d] State standard or guideline.

[e] No sources of this pollutant have been identified.

[f] The concentration represents the alternative contribution only.

Note: Concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from non-facility sources (for example, traffic).

Source: 40 CFR 50; DOE 1996e; DOE 1996f; SC DHEC 1991a; SC DHEC 1992b; SR DOE 1995b; SR DOE 1995e; WSRC 1994e.

No Action Alternative

The No Action Alternative is based upon estimated air emissions data from total site operations at SRS assuming continuation of site missions as described in Section 3.7. These data reflect conservative estimates of criteria and toxic/hazardous emissions at SRS. The emission rates for the criteria and toxic/hazardous pollutants for No Action are presented in Table F.1.2.7–1. Table 4.2.6.3–1 presents the No Action concentrations. During dry and windy conditions, increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside of the scope of this PEIS) under the No Action Alternative. Concentrations of all other criteria and toxic/hazardous air pollutants at the site boundary or public access highways are expected to remain within applicable Federal, State, and local ambient air quality standards.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Incremental air quality impacts attributable to increased pollutant concentration during operations are expected to be negligible for this subalternative relative to the No Action Alternative as presented in Table 4.2.6.3–1.

[Text deleted.]

Upgrade With All or Some Rocky Flats Environmental Technology Site and Los Alamos National Laboratory Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Incremental air quality impacts attributable to increased pollutant concentration during operations are expected to be negligible for this subalternative relative to the No Action Alternative as presented in Table 4.2.6.3–1.

Consolidation Alternative

Construct New Plutonium Storage Facility

Air quality impacts for construction of this alternative include increased PM_{10} and TSP concentrations that would typically not exceed Federal, State, or local air quality regulations. During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations attributable to increased operations associated with this storage alternative plus the No Action concentrations are presented in Table 4.2.6.3–1.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

The collocation storage facilities would be located in the same area as the new Pu storage facility and would have similar air quality impacts, with the following exceptions. During operation, emissions would be higher, as shown in Appendix F. Concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. Estimated pollutant concentrations, attributable to increased operations associated with this storage alternative, plus the No Action concentrations are presented in Table 4.2.6.3–1.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Air quality impacts for construction and operation for this subalternative are expected to be similar to those for the No Action Alternative, the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. [Text deleted.]

Phaseout

Phaseout of existing Pu inventories as a result of consolidating Pu at another site is expected to result in a small reduction in air pollutant concentrations from the No Action concentrations and would be in compliance with Federal and State standards.

NOISE

The location of the proposed storage facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy construction equipment and increased traffic. Increased traffic would occur onsite and along offsite local and regional transportation routes used to bring construction material and workers to the site.

No Action Alternative

Nontraffic noise sources associated with continued interim storage and other ongoing missions are the same as described in Chapter 3. The continuation of operations at SRS would result in no appreciable change in traffic noise and onsite operational noise sources from current levels. Nontraffic noise sources are located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may be located close enough to onsite noise-sensitive areas to result in impacts, such as disturbance of wildlife.

Upgrade (Preferred Alternative), Consolidation, and Collocation Alternatives

Nontraffic noise sources associated with the storage upgrade alternative would be similar to those for existing facilities, as discussed in Chapter 3. Nontraffic, operational noise sources associated with the storage alternatives include existing and additional equipment and machines (cooling systems, vents, motors, and material handling equipment). These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Noise impacts for construction and operations for this option are expected to be almost the same as those previously described for the No Action Alternative, the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative because noise impacts are based on the use of the facility and not the size. [Text deleted.]

Phaseout

A reduction in noise levels associated with facility operations may result from the phaseout of storage facilities.

4.2.6.4 Water Resources

Impacts associated with the construction and operation of the potential long-term storage facilities at SRS would affect water resources. The proposed facilities would be located outside the 100-year floodplain. Information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas, but this information could be developed in future environmental documentation. Groundwater would be used for construction and operation of the facilities. The water withdrawals from groundwater would not affect regional groundwater levels. No wastewater would be discharged directly to groundwater, so groundwater quality would not be affected. Any construction-related impacts would be mitigated by standard erosion control practices. During operation of the facilities, treated wastewater would be discharged to nearby streams. All discharges would be monitored to comply with permit limits. During operation, stormwater runoff would be collected and treated, if necessary, before discharge to natural drainage channels. Table 4.2.6.4–1 presents No Action water resources uses and discharges and the potential change resulting from long-term storage alternatives.

No Action Alternative

Surface Water. [Text deleted.] A description of the activities that would continue at SRS is provided in Section 3.7. Because the K-Reactor is shutdown with no provisions for restart, surface water withdrawals from the Savannah River would decrease from 140,400 million l/yr (37,100 million gal/yr) to 127,000 million l/yr (33,600 million gal/yr), or 2.6 percent of the river's minimum flow, by the year 2005. As a result of reduced discharges to site streams, water quality would improve. Treated wastewater discharged is expected to continue at a rate of 700 million l/yr (185 million gal/yr).

Groundwater. Under this alternative, no additional impacts to groundwater resources are anticipated beyond those of existing and future activities, which are independent of and not affected by the proposed action. Groundwater withdrawals for operations of facilities at SRS are expected to remain the same as current usage of 13,247 million l/yr (3,500 million gal/yr) by the year 2005. With the K-Reactor shutdown, and, given the continued implementation of strict waste handling/management practices, it is expected that groundwater quality would not be further degraded.

Upgrade Alternative

Preferred Alternative: Upgrade With All or Some Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Surface Water. No surface water withdrawals would be made. Groundwater would be used for construction and operation of the F-Area facilities. The primary surface water impacts during construction would result from soil erosion of disturbed land and siltation of surface drainage channels. To minimize soil erosion impacts, stormwater management and erosion control measures would be employed. In most cases, impacts from runoff would be temporary and manageable. During operation, stormwater runoff would be collected, monitored, and treated, if necessary, before discharge to natural drainage channels.

During construction of the new F-Area facilities, sanitary wastewater (approximately 1.7 million l/yr [0.4 million gal/yr]), would be generated and discharged to the sitewide wastewater treatment system, which would not require any modifications to this system. This would represent a 0.2-percent increase in the effluent from this facility. During operation, approximately 1.5 million l/yr (0.4 million gal/yr) of sanitary wastewater would be discharged to this wastewater treatment system. This would represent a 0.2-percent increase in the effluent discharged to Fourmile Branch from this facility. All discharges would be monitored to comply with discharge requirements. Minimal impacts are expected.

Table 4.2.6.4–1. No Action and Potential Changes to Water Resources at Savannah River Site—No Action (2005) and Storage Alternatives

Affected Resource Indicator	No Action	Upgrade With RFETS Non-Pit Materials	Upgrade With RFETS and LANL Material	Consolidation	Collocation	Phaseout
Water Source	Surface/Ground	Ground	Ground	Ground	Ground	Ground
Construction						
Water Availability and Use						
Total water requirement (million l/yr)	NA[a]	2.2	3.0	85	104.7	0
Percent increase in projected water use[b]	NA[a]	0.02	0.02	0.6	0.8	0
Water Quality						
Total wastewater discharge (million l/yr)	NA[a]	1.7	2.4	8	13.0	0
Percent change in wastewater discharge[c]	NA[a]	0.2	0.3	1.1	1.9	0
Percent change in streamflow[d]	NA[a]	0.03	0.05	0.2	0.3	0
Operation						
Water Availability and Use						
Total water requirement (million l/yr)	127,000/13,247	5.7	7.1	360	460	0
Percent increase in projected water use[e]	0	0.04	0.05	2.7	3.5	0
Water Quality						
Total wastewater discharge (million l/yr)	700	1.5	1.8	169	215	0
Percent change in wastewater discharge[f]	0	0.2	0.3	24.1	30.7	0
Percent change in streamflow[d]	13.9	0.03	0.04	3.3	4.3	0

Table 4.2.6.4–1. No Action and Potential Changes to Water Resources at Savannah River Site—No Action (2005) and Storage Alternatives—Continued

Affected Resource Indicator	No Action	Upgrade With RFETS Non-Pit Materials	Upgrade With RFETS and LANL Material	Consolidation	Collocation	Phaseout
Floodplain						
Is action in 100-year floodplain?	NA	No	No	No	No	No
Is critical action in 500-year floodplain?	NA	Unlikely	Unlikely	Uncertain	Uncertain	Unlikely

[a] See operations section of table for No Action water data.

[b] Percent increases in projected water use during construction at SRS are calculated by dividing No Action water requirements (13,247 million l/yr) with that for each storage option: upgrade with RFETS non-pit material (2.2 million l/yr), RFETS and LANL material (3.0 million l/yr), new Pu storage facility (85 million l/yr), new Pu and HEU storage facility (104.7 million l/yr), and storage phaseout (0 l/yr [0 gal/yr).

[c] Percent changes in wastewater discharge during construction at SRS are calculated by dividing No Action wastewater discharges (700 million l/yr) with that for each storage alternative: upgrade with RFETS non-pit material (1.7 million l/yr), RFETS and LANL material (2.4 million l/yr), new Pu storage facility (8 million l/yr), new Pu and HEU storage facility (13.0 million l/yr), and storage phaseout (0 l/yr).

[d] Percent changes in stream flow wastewater discharges are calculated using the minimum flow of Fourmile Branch (0.16 m^3/s).

[e] Percent increases in projected water use during operation at SRS are calculated by dividing No Action water requirements (13,247 million l/yr) with that for each storage alternative: upgrade with RFETS non-pit material (5.7 million l/yr), RFETS and LANL material (7.1 million l/yr), new Pu storage facility (360 million l/yr), new Pu and HEU storage facility (460 million l/yr), and storage phaseout (0 l/yr).

[f] Percent changes in wastewater discharge during operation at SRS are calculated by dividing No Action wastewater discharges (700 million l/yr) with that for each storage alternative: upgrade with RFETS non-pit material (1.5 million l/yr), RFETS and LANL material (1.8 million l/yr), new Pu storage facility (169 million l/yr), new Pu and HEU storage facility (215 million l/yr), and storage phaseout (0 l/yr).

Note: Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.
NA=not applicable.

Source: DOE 1996e; DOE 1996f; SR DOE 1994e; SRS 1995a:2; SRS 1996a:4.

The annual quantities of cooling water blowdown and steam condensate generated would be 3.78 million l (1 million gal) and 2.0 million l (530,000 gal), respectively. Cooling system blowdown would be routed to existing storm drains. Steam condensate from heating would also be routed to the storm drain after quenching. Condensation from air conditioning would be recycled as cooling water makeup. All discharges would be monitored. Fire sprinkler water and truck hosedown water would be collected in tanks, monitored for radioactivity, and then transferred by pipeline or tanker to sanitary waste treatment or the ETF as required. Uncontaminated water would be pumped to storm drains.

The potential location of the new F-Area storage facility is outside the 100-year floodplain. Information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas. However, the new storage facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek because the facility would be located at an elevation of about 91 m (300 ft) above mean sea level (MSL) and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about 58 m^3/s (2,040 ft^3/s). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevation of the buildings in F-Area are more than 62 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately 5 m^3/s (186 ft^3/s), and an elevation of about 61 m (199 ft) above MSL (SR USGS 1996a:1). Elevations of the buildings in F-Area are more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. Water requirements during construction would be approximately 2.2 million l/yr (0.6 million gal/yr), which would represent a much less than 1-percent increase over the projected annual No Action groundwater withdrawal. This additional withdrawal should cause minimal impacts to groundwater availability. During operation, water used for cooling system makeup would be obtained from existing supply systems in the F-Area. The water for these systems is groundwater from the Cretaceous Aquifer. Water requirements shown in Table 4.2.6.4–1 represent a maximum of 0.05 percent of the present groundwater usage at SRS. These additional withdrawals would have minimal impact on regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals over 100 times greater than that required for the F-Area facilities from the Cretaceous Aquifer indicate that drawdown could be almost 2.1 m (7 ft) at the well head, but would be smaller in overlying aquifers and would not extend beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Based on this analysis, it is expected that the withdrawals attributed to the upgraded Pu storage facilities would have a minor drawdown at the well head and would not affect any aquifers in the area.

Construction and operation of the proposed upgraded Pu storage facilities would not result in direct discharges to groundwater. Impacts to groundwater quality are therefore not expected. Since the supply wells draw from the deep Cretaceous Aquifer, the existing plume in the near surface aquifer under the F-Area should not be affected by the upgraded Pu storage facilities.

[Text deleted.]

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Surface Water. Impacts to surface water from this subalternative are similar to those discussed above for the Upgrade with RFETS Non-Pit Pu Material Subalternative. During both construction and operation, the quantities of wastewater discharged to the sitewide wastewater treatment system would be slightly greater than for the previous subalternative. As shown in Table 4.2.6.4–1, the increases in wastewater discharge during

construction and operation are 0.1-percent grater than those for the previous subalternative; no impacts are expected. Other surface water impacts are identical to those discussed above for the previous subalternatives.

Groundwater. Impacts to groundwater from this subalternative are also similar to those discussed above for the Upgrade with RFETS Non-Pit Pu Material Subalternative. Water requirements during construction and operation of this subalternative are slightly greater than for the previous subalternative. The quantities required for this subalternative represent a maximum increase of 0.05-percent over the No Action groundwater requirements; no impacts to groundwater availability are expected. Impacts to groundwater quality are not expected to be minimal for the same reasons described above for the previous subalternative.

Consolidation Alternative

Construct New Plutonium Storage Facility

The impacts associated with a new consolidated Pu storage facility are the same as those discussed above for the new F-Area facility, with the following exceptions. The water requirements of this alternative are greater than those for the previous alternative. This alternative would require approximately 85 million l/yr (22.5 million gal/yr) and 360 million l/yr (95 million gal/yr) of water for construction and operation, respectively. These additional requirements represent 0.6- and 2.7-percent increases, respectively, in the projected annual withdrawals from the Cretaceous Aquifer. Based on the previous discussion of potential groundwater level declines due to increased withdrawals, minor declines at the well head could be expected to occur from these additional withdrawals during construction. Water requirements during operation are approximately 7 percent less than the quantity analyzed in the groundwater level decline study previously discussed. Based on the results of that study, minimal impacts to regional groundwater levels are expected.

Sanitary wastewater quantities generated during construction and operation of this alternative are approximately 8 million l/yr (2.1 million gal/yr) and 169 million l/yr (44.6 million gal/yr), respectively. These effluents would be treated at the sitewide wastewater treatment system and then discharged to Fourmile Branch. This quantity of additional wastewater during operation would represent a 24.1-percent increase in the effluent discharged to Fourmile Branch from this facility. The sitewide wastewater treatment system can control its effluent flow to Fourmile Branch, and restrictions are specified in the NPDES permit.

Surface water would not be used for this alternative, so no impacts to surface water availability would occur. The area proposed for the new Pu storage facility is outside the 100-year floodplain. No assessment of the 500-year floodplain has been conducted in this area but could be developed during the siting process.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Because the consolidated and collocated storage facilities would be located in the same area as the Pu storage facility (that is, northeast of the Z-Area at SRS), the impacts associated with it are the same as those discussed above, with the following exceptions. The water requirements for construction and operation of this alternative are slightly greater. This alternative would require approximately 104.7 million l/yr and 460 million l/yr (27.7 million gal/yr and 121.5 million gal/yr) for construction and operation, respectively. These additional requirements represent 0.8- and 3.5-percent increases, respectively, in the projected annual withdrawals from the Cretaceous Aquifer. Based on the previous discussion of potential groundwater level declines due to increased withdrawals, minor declines at the well head during construction could be expected to occur. Water requirements during operation would be approximately 18 percent greater than those analyzed during the potential groundwater level decline previously discussed. Impacts from these additional withdrawals would be analyzed in tiered NEPA documents, as appropriate.

Sanitary wastewater quantities generated during construction and operation of this alternative would be greater than for the previous alternative and are approximately 13.0 million l/yr and 215 million l/yr (3.4 million gal/yr and 56.8 million gal/yr), respectively. These effluents would be treated at the sitewide wastewater treatment system and then discharged to Fourmile Branch. This quantity of additional wastewater during operation would represent a 30.7-percent increase in the discharge to Fourmile Branch and would be approximately 4.3 percent of the minimal flow. [Text deleted.]

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Water resource impacts during construction and operation for this subalternative are expected to be slightly less than those for the No Action Alternative, the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative because of the reduction in the amount of material. [Text deleted.]

Phaseout

For phaseout of the current Pu storage mission at SRS, groundwater withdrawals from the Cretaceous aquifer and nonhazardous wastewater discharge to Fourmile Branch would decrease by negligible quantities. By decreasing groundwater withdrawals, SRS would lessen its impact on the Cretaceous Aquifer by a negligible amount. Lowering wastewater discharges to Fourmile Branch by this quantity should not cause or alleviate any noticeable impacts.

[Text deleted.]

4.2.6.5 Geology and Soils

Construction and operation of the alternatives at SRS would have no impact on the geologic resources. Based on the seismic history of the area, a low seismic risk exists, and would be considered in the design of the proposed alternatives. The existing seismic risk does not preclude the safe construction and operation of the proposed alternative facilities. The facilities would be designed for earthquake-generated ground acceleration in accordance with DOE O 420.1, *Facility Safety*. Because there are no known capable faults at SRS, ground rupture as a result of an earthquake during the lifetime of the facility is minimal; ground shaking is more likely. Intensities of more than VII on the MMI scale are possible but infrequent and are not likely at SRS. Ground shaking could affect the integrity of inadequately designed or nonreinforced structures but would not affect newly designed facilities. Human health effects from accidents initiated by natural phenomena (for example, earthquakes) are discussed in Section 4.2.6.9. There is no evidence to suggest that seismically induced liquefaction of soils represents a hazard at SRS (DOE 1995p:4-23). Volcanic activity is improbable during the life of a facility and is not anticipated to affect the construction and operation of the alternatives. It is unlikely that landslides or other nontectonic events would affect the proposed alternatives. Calcium carbonate dissolution (within thin, discontinuous calcareous sand zones) may be an active process in the area, but no surface expression of sinkholes or fractures associated with calcium carbonate dissolution have been identified at SRS. Potential effects due to subsidence should be negligible because calcium carbonate dissolution is a slow process relative to human activities. Properties and conditions of soils underlying SRS typically have no limitations on construction. No economically viable geologic resources are known to be present at SRS.

Construction of the alternatives may involve ground-disturbing activities that could affect the soil resources. The amount of land disturbed is specified below for each alternative. Effects to the soil resource would depend on the specific soil units in the disturbed area, the extent of land disturbing activities, and the amount of soil disturbed. Within SRS, the soil erosion potential is directly related to the amount of land disturbed because soil and climatic conditions are similar throughout the site. Control measures would be employed to minimize soil erosion.

[Text deleted.]

No Action Alternative

[Text deleted.] Under this alternative, DOE would continue current and ongoing activities at SRS. There would be no ground-disturbing activities beyond those associated with existing and future site improvements. Because no new construction and the associated ground disturbance for potential soil erosion would occur, the No Action Alternative would have no effect to geologic or soil resources at the site.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Construction would occur on previously disturbed land as described in Section 4.2.6.1. Soil disturbance would occur primarily from ground-disturbing construction activities (foundation preparation) and activities associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of storms; wind velocities (increased wind velocities and durations increase potential soil erosion); and the size, location, and duration of ground-disturbing activities with respect to local drainage and wind patterns.

Net soil disturbance during operations would be considerably less than during construction because areas temporarily used for construction laydown would be restored. Although erosion by stormwater runoff and wind action could occur occasionally during operations, they are anticipated to be minimal.

[Text deleted.]

Upgrade With Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Construction and operation effects on geology and soil resources for this option would be the same as those described for the Upgrade With RFETS Non-Pit Pu Subalternative, because the amount of land disturbed during modification of the APSF would be the same.

Consolidation Alternative

Construct New Plutonium Storage Facility

No apparent direct or indirect effects on the geologic resource are anticipated because neither facility construction and operational activities nor site infrastructure improvements would restrict access to potential geologic resources. Analysis in this section is the same as that provided for the Upgrade Alternative.

[Text deleted.] Additional soil impacts would be expected from construction of the Consolidation Alternative. Construction would occur completely on undisturbed land, as described in Section 4.2.6.1. Approximately 58.5 ha (144 acres) will be disturbed during construction of the new facilities, affecting the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil losses would depend on frequency of storms; wind velocity; location of the facility with respect to drainage and wind patterns; slope, shape, and area of the tracts of ground disturbed; and the duration of time the soil is bare.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

No apparent direct or indirect effects on the geologic resource are anticipated, because neither facility construction and operational activities nor site infrastructure improvements would restrict access to potential geologic resources.

[Text deleted.] Additional soil impacts would be expected from the construction of the storage facilities which will occur completely on undisturbed land, as described in Section 4.2.6.1. During construction, approximately 89.5 ha (221 acres) would be disturbed for the new facilities, affecting the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. [Text deleted.]

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Excluding strategic reserve and weapons R&D materials would give almost the same effects to the geologic and soil resources. By excluding these materials, the size of a facility would be similar, thus not changing the amount of land disturbed by construction activities. No effect to the geologic resource is anticipated as a result of this option. [Text deleted.]

Phaseout

The phaseout of storage capacity would have no apparent effects on the geology resources. However, phaseout could result in beneficial effects on the soils of the area. Hazardous radioactive and mixed waste sources would be eliminated from the area, thus decreasing the potential for future soil contamination.

[Text deleted.]

4.2.6.6 Biological Resources

No Action Alternative

Under No Action, the Pu storage mission described in Section 2.2.6 would continue at SRS. These activities would result in no appreciable change to current conditions of biological resources at SRS as described in Section 3.7.6. [Text deleted.]

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Upgrading the APSF to accommodate RFETS non-pit Pu material would result in no appreciable change over the No Action Alternative since all activities would take place within a previously disturbed area.

[Text deleted.]

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Upgrading the APSF to accommodate all or some RFETS and LANL materials would result in no appreciable change over the No Action Alternative since all activities would take place within a previously disturbed area.

Consolidation Alternative

Construct New Plutonium Storage Facility

Under this alternative, Pu materials would be consolidated in a new storage facility at SRS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are described below.

Terrestrial Resources. Construction of the consolidated Pu storage facility would result in the disturbance of 58.5 ha (144 acres), or less than about 0.07 percent of SRS. This includes areas on which permanent facilities would be constructed, as well as areas revegetated following construction. Vegetation within the proposed site would be lost during land-clearing activities. The majority of the proposed site consists of old fields and pine plantations that are common on SRS and throughout the region. Bottomland hardwoods and wetlands would be avoided to the extent possible.

Construction of a Pu storage facility would affect animal populations. Less mobile animals, such as amphibians, reptiles, and small mammals within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources, which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most types of wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human activity, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas. Salt drift generated by mechanical draft cooling systems would be minimal and negligible impacts are expected.

Wetlands. Since the majority of the proposed site is upland, the facility could be located to avoid direct impacts to wetlands. Implementation of soil erosion and sediment control measures would control secondary impacts. Due to the relatively small amount of water required during both construction and operation, existing discharge structures would be used. Thus, it would not be necessary to disturb wetlands along the site streams. Any unavoidable impacts to wetlands would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with the requirements of a COE permit. Wastewater discharge to Fourmile Branch from construction and operation would be minimal and would not be expected to affect wetlands associated with the stream. All discharges would be treated as necessary to comply with NPDES-permit requirements.

Aquatic Resources. Stormwater runoff during construction of a Pu storage facility at SRS could cause temporary water quality changes in Fourmile Branch, Upper Three Mile Creek, and in Carolina bays. Increased turbidity could affect some fish spawning and feeding habitat. Fish populations probably would move to less-disturbed areas of the stream and recolonize disturbed areas shortly after construction is complete and water quality improves. Direct disturbance to aquatic resources in site streams are not expected since groundwater would be used for both construction and operation, and new discharge structures would not be required. During construction and operation, wastewater would be discharged to Fourmile Branch. These discharges (found in Section 4.2.6.4) would be minimal and would not be expected to affect aquatic resources. All wastewater would be treated as required.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species are expected to be affected by construction or operation of a consolidated Pu storage facility. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site that this species would not be directly affected by the storage facility. Special status species that would potentially be affected by construction of the facility include the green fringed orchid, eastern tiger salamander, nailwort, and beak-rush. If present, individuals of each of these species would be lost due to land clearing activities or suffer impacts to habitat due to sedimentation of Carolina bays. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrences of these and other special status species, including the federally listed smooth coneflower (Table 3.7.6–1). Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate.

As described in previous sections, operation of the facility would have minor effects on biotic resources. Therefore, impacts to special status species during facility operations are not expected.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Under this alternative, consolidated Pu materials would be stored with HEU inventories in a new collocated storage facility at SRS. Construction and operation of collocated storage facilities at SRS would have similar, but somewhat greater, effects on biological resources as those described for the consolidated storage facility. Construction of the collocated storage alternative would disturb 89.5 ha (221 acres) of habitat.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve and weapons R&D materials would have almost the same effects to the No Action Alternative, the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation

Alternative, and the Collocation Alternative. The size of the facility would be similar and would not reduce the amount of habitat and thus lessen potential impacts to biological resources would be similar. [Text deleted.]

Phaseout

The phaseout of Pu storage facilities at SRS would not be expected to affect biological resources. Increased human activity could temporarily disturb some wildlife species in the vicinity of the site.

4.2.6.7 Cultural and Paleontological Resources

No Action Alternative

Under this alternative, DOE would continue the existing and planned missions at SRS. This includes continued storage of Pu material in F-Area in stabilized form pursuant to DNFSB Recommendation 94-1. Any impacts to cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate NHPA, *American Indian Religious Freedom Act*, and *Native American Graves Protection and Repatriation Act* regulatory compliance procedures. An extensive archaeological survey program began at SRS in 1974 and includes numerous field studies. A Programmatic Agreement was signed by the DOE Savannah River Operations Office, the South Carolina SHPO, and the Advisory Council on Historic Preservation in 1990 with the purpose of ensuring that appropriate measures are taken to inventory, evaluate, protect and enhance sites on SRS. In addition, there is an *Archaeological Resource Management Plan* in place at SRS.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

This option involves additions to a new facility on previously disturbed land located north of the 235-F Building and east of the 247-F Building in F-Area to accommodate SRS non-pit Pu and RFETS non-pit Pu material. Portions of the F-Area have been surveyed and contain sites potentially eligible for the NRHP. However, the areas under consideration are disturbed and the potential for cultural resources is extremely low. Some paleontological remains may occur on this acreage, but impacts would be considered negligible because the fossil assemblages known to occur at SRS are of low research value. During operation, no additional ground disturbance is expected, so there would be no additional impact to prehistoric, historic, or paleontological sites.

Some Native American resources may be affected by the proposed action. Resources such as prehistoric sites, cemeteries, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to the areas may also result from the proposed option. These resources would be identified through consultation with the potentially affected tribes.

[Text deleted.]

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Impacts for the addition of All or Some RFETS Pu and LANL Pu would be similar to the Upgrade With RFETS Non-Pit Pu Subalternative because no additional land would be disturbed.

[Text deleted]

Consolidation Alternative

Construct New Plutonium Storage Facility

This alternative involves the construction of a new facility on land east of the Z-Area. The total amount of land to be disturbed during construction is 58.5 ha (144 acres). The total operational land requirement is 56 ha (138 acres). A reduced-access buffer zone would exist around the facility. This acreage may contain some prehistoric and historic resources. Surveys would be conducted prior to construction. Some paleontological remains may occur on this acreage, but impacts would be considered negligible because the fossil assemblages known to occur at SRS are of low research value. During operation, no additional ground disturbance is expected, so there would be no additional impact to prehistoric, historic, or paleontological sites. Native American resources may be identified in the area. Potential impacts to these resources are also discussed under the Upgrade Alternative.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Under this alternative, a new facility would be constructed east of the Z-Area to accommodate all Pu and HEU within the scope of this PEIS. Land disturbed during construction would be 89.5 ha (221 acres). The operational land disturbance would be 87 ha (215 acres), and the facilities would be located in the same place as the previously discussed new Pu storage facility. A reduced-access buffer zone would exist around the facility. Effects to cultural and paleontological resources would be similar to those discussed under the Consolidation Alternative.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

Under this subalternative, facility and other resource requirements will be almost the same as the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative. Therefore, impacts to cultural and paleontological resources would be equal to those previously discussed. [Text deleted.]

Phaseout

Under this activity, all SRS Pu material would be moved out of F-Area to the consolidation or collocation sites or to disposition. No acreage is expected to be disturbed during phaseout, so impacts to archaeological and paleontological resources are not anticipated. It is possible, however, that some of the buildings involved in phaseout would be NRHP-eligible, because their original construction and function may be associated with the Cold War Era.

4.2.6.8 Socioeconomics

No Action Alternative

Regional Economy Characteristics. Total employment in the REA is projected to increase approximately 1 percent annually between 1995 and 2000, reaching about 257,000 in the latter year. Long-term projections indicate slower growth after the year 2000, when employment would increase by less than 1 percent annually and reach approximately 354,500 persons in 2040. Unemployment in the REA was 6.7 percent in 1994 and is expected to remain at this level into the near future. Per capita income is projected to increase from approximately $17,332 in 1995 to $25,297 in 2040. Projections for the No Action Alternative are presented in Table L.1–55.

Population and Housing. Population in the ROI is projected to increase from approximately 457,500 in 1995 to 640,200 by 2040. The total number of available housing units in the ROI is projected to increase from about 171,400 in 1995 to 239,700 in 2040. Population and housing projections for the No Action Alternative are presented in Tables L.1–56 and L.1–57, respectively.

Community Services. Education, public safety, and health care characteristics are used to assess the level of community services in the SRS ROI. School enrollments are projected to increase from about 86,730 students in 1995 to 121,620 students by 2040. The current student-to-teacher ratio is 17.5:1. To maintain this level of service, the number of teachers in the ROI would need to increase from approximately 4,966 in 1995 to 6,948 in 2040. These projections are presented in Tables L.1–58 and L.1–59.

The projected number of sworn police officers and firefighters serving in ROI communities over the period 1995 to 2040 are shown in Tables L.1–60 and L.1–61, respectively. Under No Action, the number of sworn police officers is projected to increase from approximately 952 in 1995 to 1,322 in 2040 to maintain the current service level of 2.1 sworn officers per 1,000 persons. The number of firefighters in the ROI would need to increase from about 1,363 in 1995 to 1,919 in 2040 to maintain the current service level of 3.0 firefighters per 1,000 persons.

Hospital occupancy rates are based on current capacity. These rates and the estimated number of practicing physicians serving the ROI population between 1995 and 2040 are presented in Tables L.1–62 and L.1–63, respectively. Hospital occupancy rates are projected to increase from approximately 65 percent in 1995 to 90 percent in 2040. To maintain the current service level of 3.0 physicians per 1,000 persons, the total number of physicians in the ROI would need to increase from approximately 1,350 in 1995 to 1,848 in 2040.

Local Transportation. Any increases in traffic would be due to projected growth in the area unrelated to DOE activities. [Text deleted.]

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Under this alternative, the RFETS non-pit material would be transferred to SRS. An addition to the APSF to accommodate the RFETS non-pit material would require up to 193 workers and take four months to complete. This construction project may be performed as an extension of work already being conducted under No Action. Under this scenario, there would be no additional socioeconomic impacts over the No Action level because the workers would already be on site. If, however, the construction of the RFETS non-pit addition takes place some time after No Action construction is completed, there would be some minor socioeconomic effects.

During the operation phase, 160 workers would be employed if the RFETS non-pit material is stored at SRS. However, 30 of these positions would be filled by existing SRS employees. The other 130 positions would be created as part of No Action. Thus, there would be minimal socioeconomic impacts associated with the operation of the upgraded storage facility beyond those that would result from No Action.

Regional Economy Characteristics. A maximum of 346 jobs (193 direct and 153 indirect) would be generated during construction. Total employment would increase by much less than 1 percent during construction while unemployment would drop from the No Action level of 6.7 percent to 6.6 percent. Per capita income would increase by much less than 1 percent over the No Action Alternative (Socio 1996a).

Population, Housing, Community Services, and Local Transportation. All newly created employment would be filled by the resident labor force. Therefore, there would be no change to the region's population beyond the No Action level. Accordingly, there would be no impacts to either the housing sector, or demand for community services as a result of the construction of these facilities. Local transportation would also be unaffected by the proposed action.

[Text deleted.]

Upgrade With Rocky Flats Environmental Technology Site and Los Alamos National Laboratory Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Under this alternative, all or a portion of the RFETS and LANL material would be transferred to SRS. The upgraded facility would be comparable in size to the upgraded facility described above. Therefore, the number of workers required for construction and operation of the two facilities would be the same. The socioeconomic impacts for the two alternatives would also be identical.

Consolidation Alternative

Construct New Plutonium Storage Facility

To consolidate storage of Pu currently stored at multiple DOE sites, a new storage facility would be built at SRS. Workers would in-migrate to fill a portion of the direct jobs created during construction and operation of this facility.

Regional Economy Characteristics. Construction would generate a total of 2,044 jobs (1,140 direct and 904 indirect). Operation would generate a total of 1,460 jobs (485 direct and 951 indirect). Total employment would increase by less than 1 percent for construction and operation of the facility. Unemployment would decrease to 6.0 percent during construction and 6.2 percent during operation. Per capita income would increase by less than 1 percent over the No Action Alternative during either phase (Socio 1996a).

Population, Housing, and Community Services. Most of the newly created employment would be filled by the resident labor force. There would only be approximately 35 workers in-migrating during operation and no in-migration during construction. Therefore, there would be a minimal change to the region's population beyond the No Action level. Accordingly, there would be minimal impacts to the housing sector or community services as a result of the construction and operation of this facility. [Text deleted.]

Local Transportation. A total of 2,188 and 931 vehicle trips per day would be generated during construction and operation, respectively. During construction, South Carolina State Route 230 from U.S. 25 Business at North Augusta to U.S. 1/25/78/278, a rural two-lane highway, would drop from level of service E to level of

service F. Traffic generated from facility operations would not affect the level of service on the local road segments analyzed (Socio 1996a).

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

To collocate storage of Pu and HEU currently stored at multiple DOE sites, new storage facilities would have to be built at SRS. Workers would in-migrate to fill a portion of the direct jobs created during construction and operation of these facilities.

Regional Economy Characteristics. Construction would generate a total of 2,623 jobs (1,463 direct and 1,160 indirect). Operation would generate a total of 1,818 jobs (614 direct and 1,204 indirect). Total employment would increase by about 1 percent for construction and less than 1 percent for operation. Unemployment would decrease to 5.8 percent during construction and 6.1 percent during operation. Per capita income would increase by less than 1 percent during both phases (Socio 1996a).

Population and Housing. The in-migration of workers during the construction and operation periods would increase the ROI population by much less than 1 percent over No Action projections. The largest increase would occur during construction. Some new housing may be needed. However, expected vacancies and historic housing construction rates indicate that housing would be available to accommodate the population growth (Socio 1996a).

Community Services. The additional population would slightly increase the demand for some community services. Worker in-migration would lead to an increase in ROI school enrollments by about 62 students during construction and 47 students during operation. To maintain the No Action student-to-teacher ratio of 17.5:1, the number of teachers would have to increase by three during both the construction and operation periods (Socio 1996a). This additional need for teachers would be distributed over the various jurisdictions in the ROI; therefore, the effect on any single school district would be minimal.

To maintain the No Action level of service, only one police officer would need to be hired during both construction and operation. To maintain the No Action firefighter level of service, only one firefighter would need to be hired during both phases (Socio 1996a).

The small population increase would have a negligible effect on health services, increasing hospital occupancy slightly greater than the No Action projection. The number of physicians in the ROI would need to increase by only one during construction and no additional physicians would be needed during operation (Socio 1996a).

Local Transportation. A total of 2,809 and 1,179 vehicle trips per day would be generated during construction and operation, respectively. During construction, South Carolina State Route 230 from U.S. 25 Business at North Augusta to U.S. 1/25/78/278, a rural two lane highway, would drop from level of service from E to level of service F (Socio 1996a). Traffic generated from facility operations would not affect the level of service on the local road segments analyzed (Socio 1996a).

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The requirements for each storage option considered, including No Action, would decrease slightly if strategic reserve and weapons R&D materials were not included for storage at SRS. This should also result in a decrease in the number of required operation employees for each of the considered alternatives. Therefore, socioeconomic effects on the REA/ROI for the storage alternatives with no strategic reserve and weapons R&D materials should be equal to or somewhat less than the No Action Alternative, Upgrade With All or Some

RFETS and LANL Pu Subalternative, Consolidation Alternative, and the Collocation Alternative. [Text deleted.]

Phaseout

Phasing out Pu storage at SRS would result in the loss of 592 total (direct and indirect) jobs in the REA. Should all personnel be phased out at the same time, unemployment would increase to 6.9 percent and per capita income will be reduced by much less than 1 percent (Socio 1996a).

Some displaced workers may out-migrate from the ROI to seek other employment opportunities. Under the bounding case (all unemployed workers and their families leaving the ROI at the same time), population would decrease by less than 1 percent. Some of the projected ROI occupied housing units would likely become vacant as a result of population losses (Socio 1996a).

Out-migration of population during phaseout would slightly lessen the demand for community services. However, it is unlikely that communities would lower service levels unless decreased revenues made it necessary.

ROI school enrollments are projected to decrease by much less than 1 percent under the bounding case scenario. The No Action student-to-teacher ratio of 17.5:1 could be maintained if the number of teachers does not decrease from predicted No Action levels by more than 17 (Socio 1996a).

During phaseout, the number of sworn police officers could decrease by four from projected No Action levels if the No Action service level of 2.1 officers per 1,000 persons is to be maintained. The number of firefighters could decrease by five before the No Action service level of 3.0 firefighters per 1,000 persons would be affected (Socio 1996a).

Projected hospital occupancy rates during the bounding case scenario for phaseout would be slightly lower than the No Action projections. The number of physicians in the ROI could decrease by three from predicted No Action levels before the No Action service level of 3.0 physicians per 1,000 persons would be affected (Socio 1996a).

Phaseout at SRS would result in the loss of 384 vehicle trips per day. There would be minimal effects to the local road network due to this activity.

4.2.6.9 Public and Occupational Health and Safety

The assessments of potential radiological and chemical impacts associated with the storage alternatives at SRS are presented in this section. Summaries of the radiological impacts from normal operations are presented in Tables 4.2.6.9–1 and 4.2.6.9–2 for the public and workers, respectively. Impacts from hazardous chemicals are presented in Table 4.2.6.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.2.6.9–4 through 4.2.6.9–7. Detailed results are presented in Appendix M.

No Action Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from normal operations involved with the SRS sitewide missions, including interim storage of Pu. The impacts to the public and to workers would be within applicable regulatory limits. For facility accidents, the risks and consequences are described in site safety documentation.

Normal Operation. The current mission at SRS, where Pu is in interim storage, is described in Section 3.7. The site has identified those facilities that will continue to operate under the No Action Alternative, including interim Pu storage facilities, the APSF, and others, if any, that will or may become operational by 2005. Based on that information, the radiological and chemical releases to the environment in 2005 and beyond (future operation) were developed and used in the impact assessments. The resulting doses and potential health effects to the public and workers at SRS are described below.

Radiological Impacts. The calculated annual dose to the average and maximally exposed members of the public from total site operation; the associated fatal cancer risks to these individuals from 50 years of operation; the dose to the population within 80 km (50 mi) from total site operation in the year 2030; and the projected number of fatal cancers in this population from 50 years of operation are presented in Table 4.2.6.9–1 under this alternative at SRS. The annual dose of 0.79 mrem to the MEI is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 2.0×10^{-5}. The annual dose to the population would be within the limit in proposed 10 CFR 834 and would be 44 person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 1.1. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

Under the No Action Alternative shown in Table 4.2.6.9–2, the annual average dose from total site operations to a noninvolved (No Action) site worker and the annual dose from total site operations to the noninvolved (No Action) total site workforce would be 32 mrem and 226 person-rem, respectively, as shown in Table 4.2.6.9–2. The associated risk of fatal cancer to the average worker from 50 years of total site operations would be 6.5×10^{-4}, and the potential maximum number of fatal cancers among all workers from 50 years of total site operations would be 4.5. Doses to individual workers would be kept low by instituting badged monitoring and ALARA programs and worker rotations. As a result of the implementation of these mitigation measures, the estimated number of potential latent cancer fatalities for the operation of this facility would be reduced.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public resulting from the normal operation under No Action at SRS are presented in Table 4.2.6.9–3. The hazardous chemical impacts from current site operations estimate the baseline site impacts for the various storage and disposition operation alternatives. The noncancer health effects expected and the risk of cancer due to the total chemical exposures were estimated for each site. Since the major releases due to normal operation at SRS would make up nearly all of the exposures to onsite workers and to the public in adjacent communities, contributions to the hazardous chemical concentrations from all other sources (for example, industrial operations), are considered negligible for purposes of risk calculations.

Table 4.2.6.9–1. Potential Radiological Impacts to the Public During Normal Operation at Savannah River Site—No Action and Storage Alternatives

Receptor	No Action	Upgrade		Consolidation		Collocation	
	Total Site	Facility[a]	Total Site[b]	Facility	Total Site[b]	Facility	Total Site[b]
Annual Dose to the Maximally Exposed Individual Member of the Public[c]							
Atmospheric release pathway (mrem)	0.42	6.2×10^{-6}	0.42	1.4×10^{-5}	0.42	1.4×10^{-5}	0.42
Drinking water pathway (mrem)	0.081	[d]	0.081	0	0.081	0	0.081
Total liquid release pathway (mrem)	0.37	6.1×10^{-7}	0.37	0	0.37	0	0.37
Atmospheric and liquid release pathways combined (mrem)	0.79	6.8×10^{-6}	0.79	1.4×10^{-5}	0.79	1.4×10^{-5}	0.79
Percent of natural background[e]	0.27	2.3×10^{-6}	0.27	4.7×10^{-6}	0.27	4.7×10^{-6}	0.27
50-year fatal cancer risk	2.0×10^{-5}	1.7×10^{-10}	2.0×10^{-5}	3.5×10^{-10}	2.0×10^{-5}	3.5×10^{-10}	2.0×10^{-5}
Population Dose Within 80 Kilometers for Year 2030[f]							
Atmospheric release pathway (person-rem)	40	2.8×10^{-4}	40	9.2×10^{-4}	40	8.8×10^{-4}	40
Total liquid release pathway (person-rem)	3.6	1.0×10^{-5}	3.6	0	3.6	0	3.6
Atmospheric and liquid release pathways combined (person-rem)	44	2.9×10^{-4}	44	9.2×10^{-4}	44	8.8×10^{-4}	44
Percent of natural background[e]	0.017	1.1×10^{-7}	0.017	3.5×10^{-7}	0.017	3.3×10^{-7}	0.017
50-year fatal cancers	1.1	7.2×10^{-6}	1.1	2.3×10^{-5}	1.1	2.2×10^{-5}	1.1
Annual Dose to the Average Individual Within 80 Kilometers[g]							
Atmospheric and liquid release pathways combined (mrem)	0.049	3.2×10^{-7}	0.049	1.0×10^{-6}	0.049	9.9×10^{-7}	0.049
50-year fatal cancer risk	1.2×10^{-6}	8.0×10^{-12}	1.2×10^{-6}	2.6×10^{-11}	1.2×10^{-6}	2.5×10^{-11}	1.2×10^{-6}

[a] The dose results are scaled from the APSF which is based on 5,000 storage positions. The SRS Upgrade with RFETS Pu and LANL Pu Subalternative doses shown here contain 4,100 storage positions for the additional material at the upgraded APSF. The health impacts shown here assume that the upgraded storage facility at SRS would include all of the Pu materials from both RFETS and LANL. For the Preferred Alternative, the additional materials to be stored in the upgraded storage facility at SRS would only include the surplus non-pit Pu materials from RFETS. Therefore, the health impacts from the Preferred Alternative at SRS would be slightly less than the impacts presented in the Upgrade Alternative in this table. The difference would be below detection limits.

[b] Includes impacts from No Action facilities. The location of the MEI may be different under No Action than for the other alternatives. Therefore, the impacts may not be directly additive.

[c] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[d] The dose from the drinking water pathway has been included in the total liquid release pathway.

[e] The annual natural background radiation level at SRS is 298 mrem for the average individual; the population within 80 km in the year 2030 receives 266,000 person-rem.

[f] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[g] Obtained by dividing the population dose by the number of people projected to live within 80 km of the site in 2030 (893,000).

Note: The No Action site total included a very small contribution from the current no action storage.

Source: Section M.2.

Table 4.2.6.9–2. Potential Radiological Impacts to Workers During Normal Operation at Savannah River Site—Storage Alternatives

Receptor	Upgrade[a,b]	Consolidation[a]	Collocation[a]
Involved Workforce[c]			
Average worker dose (mrem/yr)[d]	250	258	264
50-year risk of fatal cancer	5.0×10^{-3}	5.2×10^{-3}	5.3×10^{-3}
Total dose (person-rem/yr)	7.5	24	25
50-year fatal cancers	0.15	0.48	0.50
Noninvolved Workforce[e]			
Average worker dose (mrem/yr)[d]	36	36	36
50-year risk of fatal cancer	7.2×10^{-4}	7.2×10^{-4}	6.5×10^{-4}
Total dose (person-rem/yr)	259	259	259
50-year fatal cancers	5.2	5.2	5.2
Total Site Workforce[f]			
Dose (person-rem/yr)	266	283	284
50-year fatal cancers	5.3	5.7	5.7

[a] Under the Upgrade Alternative, an estimated additional 30 involved workers would be needed if Pu is transferred from RFETS and LANL. The impacts given in the Upgrade column include those associated with these additional workers. The number of involved badged workers for the Consolidation and Collocation Alternatives would be 92 and 95, respectively.

[b] The health impacts shown here assume that the upgraded storage facility at SRS would include all of the Pu materials from both RFETS and LANL. For the Preferred Alternative, the additional materials to be stored in the upgraded storage facility at SRS would only include the surplus non-pit Pu materials from RFETS. Therefore, the health impacts from the Preferred Alternative at SRS would be slightly less than the impacts presented in the Upgrade Alternative in this table. The difference would be below detection limits.

[c] The involved worker is associated with operations of the proposed action. The maximum dose to an involved worker would be kept below 500 mrem per year. Based on a review of worker doses associated with similar operations (Section M.2.3.2), an average worker dose of 250 mrem per year was conservatively assumed. However, an effective ALARA program will ensure that the exposure will be reduced to that level which is as low as reasonably achievable.

[d] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem/yr (DOE 1992t); the site must make reasonable attempts to maintain worker doses below this level.

[e] The noninvolved worker is onsite but not associated with operations of the proposed action. The projected number of noninvolved badged workers in 2005 is 7,199. The noninvolved workforce is equivalent to the No Action workforce in addition to a proposed 130 workers associated with future operation of the APSF.

[f] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Table 4.2.6.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation at Savannah River Site—No Action and Storage Alternatives

Receptor	No Action	Upgrade With RFETS Non-Pit Material		Upgrade With RFETS and LANL Material		Consolidation		Collocation	
	Total Site[a]	Facility[b]	Total Site[a]	Facility[b]	Total Site[a]	Facility[b]	Total Site[a]	Facility[b]	Total Site[a]
Maximally Exposed Individual (Public)									
Hazard index[c]	5.2×10^{-3}	1.5×10^{-6}	5.2×10^{-3}	1.6×10^{-6}	5.2×10^{-3}	2.8×10^{-6}	5.2×10^{-3}	6.2×10^{-6}	5.2×10^{-3}
Cancer risk[d]	1.3×10^{-7}	0	1.3×10^{-7}	0	1.3×10^{-7}	7.5×10^{-9}	1.4×10^{-7}	7.5×10^{-9}	1.4×10^{-7}
Worker Onsite									
Hazard index[e]	1.2	2.1×10^{-4}	1.2	2.2×10^{-4}	1.2	6.0×10^{-4}	1.2	1.0×10^{-3}	1.2
Cancer risk[f]	1.9×10^{-4}	0	1.9×10^{-4}	0	1.9×10^{-4}	1.1×10^{-5}	2.1×10^{-4}	1.1×10^{-5}	2.0×10^{-4}

[a] Total=Sum of the No Action plus the contributions of the above activity.

[b] Contribution from above facilities operations only. These values bound the addition of RFETS and LANL.

[c] Hazard Index for MEI=Sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer risk for MEI= (Emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (slope factor [SF]).

[e] Hazard Index for workers=Sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237[fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (SF).

Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors, therefore the calculated cancer risk value is 0.

Source: Section M.3; Tables M.3.4–22 through M.3.4–25.

The HI to the MEI of the public at SRS resulting from normal operation under the No Action Alternative is 5.2×10^{-3}, and the cancer risk is 1.3×10^{-7}. The HI to the onsite worker is 1.2, and the cancer risk is 1.9×10^{-4}. The HIs and cancer risks would remain constant over 50 years of operation because the exposures would be expected to remain the same.

Facility Accidents. Under the No Action Alternative, Pu would continue to be stored at the site in existing facilities. Estimates of facility accident impacts under No Action are described in the *Environmental Impact Statement, Interim Management of Nuclear Materials* for SRS (DOE/EIS-0220).[2]

[2] The EIS estimated the amount of radioactive material that could be released from the F-Canyon into the environment as a result of a severe earthquake. Using up-to-date seismic data, SRS completed a detailed evaluation of the likelihood of a severe earthquake and a structural analysis quantifying the likelihood of structural failure of F-Canyon for a range of ground motions in the *Supplemental Analysis of Seismic Activity on F-Canyon* (August 1996). Based on the evaluation, an earthquake that could occur about once every 8,000 years could cause a level of structural damage to F-Canyon similar to the level of damage attributed to the earthquake considered in the *Environmental Impact Statement, Interim Management of Nuclear Materials*. Additionally, the response spectrum associated with the 8,000-year earthquake was determined to encompass (be more severe than) the Blume response spectra. The earthquake used in the accident analysis was an event with a response spectrum (a profile of ground acceleration over a range of frequencies of motion) and peak ground acceleration as defined by J.A. Blume & Associates Engineers for SRS in the early 1980s. A frequency of occurrence (or return period) of once every 5,000 years was stated to correspond to the Blume earthquake. Thus, the capability of the F-Canyon to survive an earthquake more severe than that evaluated in the EIS, in combination with the fact that the likelihood of this level of damage was less than assumed in the EIS (1 per 8,000 years compared to 1 per 5,000 years), indicates that F-Canyon is seismically as safe, or safer, than indicated in the EIS. Two other analyses were also completed; they concluded that F-Canyon, as built, would withstand an earthquake of a magnitude of the Blume spectrum, with less damage than estimated for the EIS earthquake analysis, and that there would be no greater releases to the environment. Thus, estimates of the health effects (latent cancer fatalities) would not be greater than those described in the EIS and could be smaller than those previously analyzed in the EIS.

For the long-term storage alternatives at SRS in this PEIS, a severe earthquake was postulated with sufficient magnitude to cause major destruction of the facility. The probability of a severe earthquake and release of radioactive material was estimated at $1x10^{-7}$/yr. The *Environmental Impact Statement, Interim Management of Nuclear Materials* for SRS postulates a severe earthquake with a probability of occurrence of $2x10^{-4}$/yr. These two severe earthquake probabilities are not the same because of differences in the underlying assumptions and building characteristics. For example the storage facility in the Storage and Disposition PEIS would be new and designed with features to reduce the potential for earthquake damage and release of radioactive materials. The SRS facilities are not new and would react differently to an earthquake. These facilities would continue to operate in accordance with DOE Orders which ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations will be minimized. The safety to workers and the public from accidents at existing facilities is also controlled by Technical Safety Requirements specified in SARs or a Basis for Interim Operations document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities would cause a halt in operations until it can be established that worker and public safety has not been compromised.

Upgrade Alternative

[Text deleted.]

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with storing SRS Pu and RFETS non-pit Pu in the upgraded APSF at SRS. The section describes the impacts of normal facility operations, then describes impacts of facility accidents.

During normal operation at SRS, the operation of the modified APSF would result in impacts that are within applicable regulatory limits, due in part to worker rotation.

Normal Operation. There would be no radiological releases during construction activities associated with the facility upgrade at SRS. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored, as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits.

Radiological Impacts. Doses to the public from storage under the Upgrade Alternative are included in Table 4.2.6.9–1. The dose to the MEI under the Preferred Alternative would be less. The dose to the MEI of the public due to annual operations under the Upgrade Alternative With RFETS Non-Pit Pu Material would be $6.8x10^{-6}$ mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be $1.7x10^{-10}$. The impacts to the average individual would be less. As a result of operation under this alternative in the year 2030, the population dose would be $2.9x10^{-4}$ person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be$7.2x10^{-6}$. The health impacts shown here assume that the upgraded storage facility at SRS would include the Pu materials from both RFETS and LANL. Therefore, the health impacts from the Preferred Alternative at SRS (only RFETS non-pit Pu) would be slightly less than the impacts presented in the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative as shown in Table 4.2.6.9–1. The difference would be below detection limits.

The dose to the MEI from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 0.79 mrem. From 50 years of total site operations, the corresponding risk of fatal cancer to this individual would be 2.0×10^{-5}. These values are presented in Table 4.2.6.9–1. The impacts on the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operations in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 44 person-rem. The corresponding number of fatal cancers in this population from 50 years of total site operations would be 1.1. The health impacts shown here assume that the upgraded storage facility at SRS would include the Pu materials from both RFETS and LANL. Therefore, the health impacts from the Preferred Alternative at SRS (only RFETS non-pit Pu) would be slightly less than the impacts presented in the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative as shown in Table 4.2.6.9–1. The difference would be below detection limits.

Doses to onsite workers from normal operations are given in Table 4.2.6.9–2. Included are involved workers directly associated with the new storage facility, workers who are not involved with this facility, and the entire workforce at SRS. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operations are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility. The health impacts shown here assume that the upgraded storage facility at SRS would include the non-pit Pu materials from both RFETS and LANL. Therefore, the health impacts from the Preferred Alternative at SRS (only RFETS non-pit Pu) would be slightly less than the impacts presented in the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative as shown in Table 4.2.6.9–2. The difference would be below detection limits.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the upgraded storage facilities at SRS are presented in Table 4.2.6.9–3. The impacts from all site operations, including the upgraded storage facilities are also included in this table. Total site impacts which include the No Action impact plus the upgrade facility impacts, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 1.5×10^{-6}, and the cancer risk is zero (because no carcinogens are released from the hazardous chemicals used) as a result of operation of the upgraded storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the upgrade facility, would result in an HI of 5.2×10^{-3} and a cancer risk of 1.3×10^{-7} for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 2.1×10^{-4} and the cancer risk is zero (because no carcinogens are released from the hazardous chemicals used) as a result of operation of the upgraded storage facilities in the year 2030. The HI and cancer risk from hazardous chemicals would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the upgrade facility, would result in a HI of 1.2 and a cancer risk of 1.9×10^{-4} for the onsite worker in the year 2030 and would be expected to remain constant as a result of 50 years of operation. The HI to the worker resulting from operation of the upgraded storage facilities at SRS may exceed the acceptable health regulatory level. The total site HI of 1.2 is a screening level value which does not necessarily mean that workers will incur hazardous health effects. Moreover, since one of the assumptions used in the ISCST2 model to calculate HI is that the entire emissions inventory is from a single stack and all emissions impact the onsite worker, it may overstate the actual conditions being analyzed. This would be true at a large site, like SRS, where emission sources and receptors are widely dispersed, over 830 km^2 (320 mi^2), and the primary contributor to the HI is CO which is not concentrated in any single emissions stack.

Facility Accidents. Under this upgrade subalternative, non-pit Pu from RFETS would be stored at SRS in a modified APSF. The modified APSF facility is expected to result in a reduced risk of accidents to workers and the public. Design modifications to the storage facility will ensure that the continued storage of Pu will be in accordance with contemporary DOE Orders, and that the risks to the public of prompt fatalities due to accidents and of latent cancer fatalities due to operations would be minimized as shown in Table 4.2.6.9–4. The safety of workers and the public during operations is routinely controlled and monitored through Technical Safety Requirements that are specified in approved safety analyses that would be prepared and implemented for the upgraded facilities.

A set of potential accidents have been postulated for upgraded Pu storage with RFETS non-pit Pu at SRS for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.6.9–4. For the set of accidents analyzed, the maximum number of cancer fatalities in the population with 80 km (50 mi) would be 0.098 at SRS for the beyond design basis earthquake accident with an estimated probability of 1.0×10^{-7} per year (that is, possibility of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 4.9×10^{-7}, 9.8×10^{-11}, and 5.0×10^{-9}, respectively. The maximum population 50-year facility lifetime risk would be 4.6×10^{-4} (that is, one fatality in about 100,000) at SRS for the PCV penetration by corrosion accident scenario with a probability of 4.8×10^{-3} per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 7.0×10^{-8} and 2.9×10^{-6}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.6.9–4.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

[Text deleted.]

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Normal Operation. The impacts from radiological and hazardous chemical emissions would be slightly greater than the impacts for the Upgrade With RFETS Non-Pit Pu Subalternative. The difference would be below detection limits. The radiological dose to the public and workers are shown in Tables 4.2.6.9–1 and 4.2.6.9–2, respectively. Impacts from hazardous chemicals are given in Table 4.2.6.9–3.

Facility Accidents. Under the Upgrade Alternative, Pu from RFETS and LANL would be stored at SRS. The upgraded facility is expected to result in a reduced risk of accidents to workers and the public. Design modifications to the storage facility will ensure that the storage of Pu will be in accordance with contemporary DOE Orders, and that the risks to the public of prompt fatalities due to accidents and of latent cancer fatalities due to operations would be minimized as shown in Table 4.2.6.9–5. The safety of workers and the public during operations is routinely controlled and monitored through Technical Safety Requirements that are specified in approved safety analyses that would be prepared and implemented for the upgraded facilities.

Table 4.2.6.9–4. Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative—Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	8.6×10^{-8}	2.9×10^{-6}	2.1×10^{-9}	7.1×10^{-8}	1.0×10^{-5}	3.4×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	5.0×10^{-9}	2.9×10^{-7}	1.2×10^{-10}	7.1×10^{-9}	6.0×10^{-7}	3.4×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	2.9×10^{-6}	1.2×10^{-5}	7.0×10^{-8}	2.9×10^{-7}	3.4×10^{-4}	1.4×10^{-3}	4.8×10^{-3}
Vault fire	2.6×10^{-9}	5.2×10^{-4}	5.6×10^{-11}	1.1×10^{-5}	2.7×10^{-7}	0.054	1.0×10^{-7}
Truck bay fire	2.0×10^{-9}	4.0×10^{-4}	4.9×10^{-11}	9.9×10^{-5}	2.4×10^{-7}	0.048	1.0×10^{-7}
Spontaneous combustion	2.0×10^{-11}	5.8×10^{-7}	5.0×10^{-13}	1.4×10^{-8}	2.4×10^{-9}	6.9×10^{-5}	7.0×10^{-7}
Explosion in the vault	3.5×10^{-10}	7.1×10^{-5}	9.0×10^{-12}	1.7×10^{-6}	4.2×10^{-8}	8.3×10^{-3}	1.0×10^{-7}
Explosion outside of vault	2.2×10^{-11}	4.3×10^{-6}	5.3×10^{-13}	1.5×10^{-7}	2.6×10^{-9}	5.1×10^{-4}	1.0×10^{-7}
Nuclear criticality	1.4×10^{-11}	2.8×10^{-6}	2.8×10^{-13}	5.7×10^{-8}	2.3×10^{-10}	4.7×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	5.0×10^{-9}	9.8×10^{-4}	9.8×10^{-11}	2.0×10^{-5}	4.9×10^{-7}	0.098	1.0×10^{-7}
Expected risk[d]	3.0×10^{-6}	–	7.2×10^{-8}	–	3.5×10^{-4}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.1.1–4 and M.5.2.1.1–5 and the MACCS computer code.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Consolidation Alternative

Construct New Plutonium Storage Facility

This section includes a description of radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the construction and operation of the new consolidated Pu storage facility at SRS.

Table 4.2.6.9–4. Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative—Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[a]	Risk of Cancer Fatality (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per year)
PCV puncture by forklift	8.6×10^{-8}	2.9×10^{-6}	2.1×10^{-9}	7.1×10^{-8}	1.0×10^{-5}	3.4×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	5.0×10^{-9}	2.9×10^{-7}	1.2×10^{-10}	7.1×10^{-9}	6.0×10^{-7}	3.4×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	3.9×10^{-6}	1.2×10^{-5}	9.5×10^{-8}	2.9×10^{-7}	4.6×10^{-4}	1.4×10^{-3}	6.6×10^{-3}
Vault fire	3.5×10^{-9}	7.1×10^{-4}	7.6×10^{-11}	1.5×10^{-5}	3.7×10^{-7}	0.072	1.0×10^{-7}
Truck bay fire	2.0×10^{-9}	4.0×10^{-4}	4.9×10^{-11}	9.9×10^{-6}	2.4×10^{-7}	0.048	1.0×10^{-7}
Spontaneous combustion	2.0×10^{-11}	5.8×10^{-7}	5.0×10^{-13}	1.4×10^{-8}	2.4×10^{-9}	6.9×10^{-5}	7.0×10^{-7}
Explosion in the vault	4.8×10^{-10}	9.6×10^{-5}	1.2×10^{-11}	2.4×10^{-6}	5.7×10^{-8}	0.011	1.0×10^{-7}
Explosion outside of vault	2.2×10^{-11}	4.3×10^{-6}	5.3×10^{-13}	1.5×10^{-7}	2.6×10^{-9}	5.1×10^{-4}	1.0×10^{-7}
Nuclear criticality	1.4×10^{-11}	2.8×10^{-6}	2.8×10^{-13}	5.7×10^{-8}	2.3×10^{-10}	4.7×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	6.9×10^{-9}	1.3×10^{-3}	1.3×10^{-10}	2.8×10^{-5}	6.7×10^{-7}	0.13	1.0×10^{-7}
Expected risk[d]	3.9×10^{-6}	–	9.7×10^{-8}	–	4.7×10^{-4}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation. Impacts not dependent on the quantity of Pu would be the same as those for the Upgrade With RFETS Non-Pit Pu Subalternative.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.1.1–4 and M.5.2.1.1–5 and the MACCS computer code.

[Text deleted.]

Normal Operation. There would be no radiological releases during the construction of a new consolidated Pu storage facility at SRS. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits and would not result in any health effects. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at SRS are described below.

Radiological Impacts. Radiological impacts to the public resulting from the normal operation of the new consolidated Pu storage facility are presented in Table 4.2.6.9–1. The impact from all site operations, including

the new consolidated storage facility, are also given in the table. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the MEI from annual storage facility operation would be 1.4×10^{-5} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 3.5×10^{-10}. The impacts to the average member of the public would be less. As a result of storage facility operation in the year 2030, the population dose would be 9.2×10^{-4} person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 2.3×10^{-5}.

The dose to the MEI from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 0.79 mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 2.0×10^{-5}. The impacts to the average member of the public would be less This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operations in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 44 person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 1.1.

Doses to onsite workers from normal operations are given in Table 4.2.6.9–2. Included are involved workers directly associated with the new consolidated Pu storage facility, workers who are not involved with the storage facility, and the entire workforce at SRS. All doses fall within regulatory limits and administrative control levels. The associated risks and number of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the new consolidated Pu storage facility at SRS are presented in Table 4.2.6.9–3. The impacts from all site operations, including the consolidated storage facility, are also included in this table. Total site impacts, which include the No Action impact plus the facility impacts, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 2.8×10^{-6}, and the cancer risk is 7.5×10^{-9} as a result of operation of the new consolidated Pu storage facility in the year 2030. The HI and cancer risk from hazardous chemicals would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the upgrade facility, would result in an HI of 5.2×10^{-3} and a cancer risk of 1.4×10^{-7} for the MEI in the year 2030. This would be expected to remain constant over the 50 years of operation.

The HI to the onsite worker would be 6.0×10^{-4} and the cancer risk is 1.1×10^{-5} as a result of operation of the new consolidated Pu storage facility in the year 2030. The HI and cancer risk from hazardous chemicals would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the facility, would result in a HI of 1.2 and a cancer risk of 2.1×10^{-4} for the onsite worker in the year 2030 and would be expected to remain constant over the 50 years of operation.

Facility Accidents. A set of potential accidents have been postulated for consolidation of Pu at SRS for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the general population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.6.9–6. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 1.3 at SRS for the beyond design basis earthquake accident with an estimated probability of 1.0×10^{-7} per year (that is, probability of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario

Table 4.2.6.9–6. Consolidation Alternative Accident Impacts at Savannah River Site

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality (per 50 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality (per 50 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatality[b]	Population to 80 km: Risk of Cancer Fatalities (per 50 yr)[a]	Population to 80 km: Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	8.6×10^{-8}	2.9×10^{-6}	2.1×10^{-9}	7.1×10^{-8}	1.0×10^{-5}	3.4×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	5.0×10^{-9}	2.9×10^{-7}	1.2×10^{-10}	7.1×10^{-9}	6.0×10^{-7}	3.4×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	3.8×10^{-5}	1.2×10^{-5}	9.3×10^{-7}	2.9×10^{-7}	4.5×10^{-3}	1.4×10^{-3}	0.064
Vault fire	3.4×10^{-8}	6.9×10^{-3}	7.4×10^{-10}	1.5×10^{-4}	3.6×10^{-6}	0.72	1.0×10^{-7}
Truck bay fire	2.0×10^{-9}	4.0×10^{-4}	4.9×10^{-11}	9.9×10^{-6}	2.4×10^{-7}	0.048	1.0×10^{-7}
Spontaneous combustion	2.0×10^{-11}	5.8×10^{-7}	5.0×10^{-13}	1.4×10^{-8}	2.4×10^{-9}	6.9×10^{-5}	7.0×10^{-7}
Explosion in the vault	4.7×10^{-9}	9.4×10^{-4}	1.2×10^{-10}	2.3×10^{-5}	5.6×10^{-7}	0.11	1.0×10^{-7}
Explosion outside of vault	2.2×10^{-11}	4.3×10^{-6}	5.3×10^{-13}	1.1×10^{-7}	2.6×10^{-9}	5.1×10^{-4}	1.0×10^{-7}
Nuclear criticality	1.4×10^{-11}	2.8×10^{-6}	2.8×10^{-13}	5.7×10^{-8}	2.3×10^{-10}	4.7×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	6.7×10^{-8}	0.013	1.3×10^{-9}	2.7×10^{-4}	6.5×10^{-6}	1.3	1.0×10^{-7}
Expected risk[d]	3.8×10^{-5}	–	9.3×10^{-7}	–	4.5×10^{-3}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.1.1–4 and M.5.2.1.1–5 and the MACCS computer code.

for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 6.5×10^{-6}, 1.3×10^{-9}, and 6.7×10^{-8}, respectively. The maximum population 50-year facility lifetime risk would be 4.5×10^{-3} (that is, one fatality in about 10,000 years) at SRS for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 9.3×10^{-7} and 3.8×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.6.9–6.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions and criticality could cause fatalities to workers close to the accident. Prior to construction of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

This section includes a description of radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the consolidation of Pu storage and collocation with HEU storage facilities at SRS. This storage would take place in a new Pu and HEU storage facility.

[Text deleted.]

Normal Operation. There would be no radiological releases during the construction of a new collocated storage facility at SRS. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored, as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the public resulting from the normal operation of the new collocated storage facility at SRS are presented in Table 4.2.6.9–1. The impacts from all site operations, including the new storage facility, are also given in the table. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the MEI from annual storage facility operation is 1.4×10^{-5} mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 3.5×10^{-10}. The impacts to the average member of the public would be less. As a result of storage facility operation in the year 2030, the population dose would be 8.8×10^{-4} person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 2.2×10^{-5}.

The dose to the MEI from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 0.79 mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be 2.0×10^{-5}. The impacts to the average member of the public would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 44 person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 1.1.

Doses to onsite workers from normal operations are given in Table 4.2.6.9–2. Included are involved workers directly associated with the new storage facility, workers who are not involved with the storage facility, and the entire workforce at SRS. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operations are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of the facility.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the new consolidation of Pu and collocation with HEU storage facilities at SRS are presented in Table 4.2.6.9–3. The impacts from all site operations, including the consolidation of Pu and collocation with HEU storage facilities are also included in this table. Total site impacts, which include the No

Action impact plus the facility impacts, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is 6.2×10^{-6}, and the cancer risk is 7.5×10^{-9} as a result of operation of the new consolidation of Pu and collocation with HEU storage facilities in the year 2030. The HI and cancer risk from hazardous chemicals would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the new facility, would result in an HI of 5.2×10^{-3} and a cancer risk of 1.4×10^{-7} for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be 1.0×10^{-3}, and the cancer risk is 1.1×10^{-5} as a result of operation of the new consolidation of Pu and collocation with HEU storage facilities in the year 2030. The HI and cancer risk from hazardous chemicals would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the new facility, would result in an HI of 1.2 and a cancer risk of 2.0×10^{-4} for the onsite worker in the year 2030 and would be expected to remain constant as a result of 50 years of operation.

Facility Accidents. A set of potential accidents have been postulated for which there may be releases of Pu or uranium that may impact onsite workers and the offsite population. Impacts of accidents that release both Pu and HEU are bounded by exposures to Pu. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the general population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.6.9–7. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 1.3 at SRS for the beyond design basis earthquake accident scenario with an estimated probability of 1.0×10^{-7} per year (that is, probability of severe earthquake occurring is estimated to be about 1.0×10^{-5}, once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 6.6×10^{-6}, 9.2×10^{-10}, and 6.7×10^{-8}, respectively. The maximum population 50-year facility lifetime risk would be 4.6×10^{-3} (that is, one fatality in about 11,000 years) at SRS for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be 6.3×10^{-7} and 3.8×10^{-5}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.6.9–7.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. [Text deleted.] The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of the facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

If the strategic reserve and weapons R&D materials are not included, the impacts to the public and to workers from the accident-free storage activities would be reduced approximately in proportion to the decrease in the amount of material stored. The impacts from total site operations would decrease slightly. This subalternative applies to the No Action Alternative, the Upgrade Alternative, the Consolidation Alternative, and the Collocation Alternative. The risks due to accidents would also tend to be lower.

Table 4.2.6.9–7. Collocation Alternative Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 50 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 50 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
PCV puncture by forklift	8.6×10^{-8}	2.9×10^{-6}	1.4×10^{-9}	4.8×10^{-8}	1.0×10^{-5}	3.5×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	5.0×10^{-9}	2.9×10^{-7}	1.5×10^{-11}	4.8×10^{-9}	6.1×10^{-7}	3.5×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	3.8×10^{-5}	1.2×10^{-5}	6.3×10^{-7}	2.0×10^{-7}	4.6×10^{-3}	1.4×10^{-3}	0.064
Vault fire	3.4×10^{-8}	6.9×10^{-3}	5.1×10^{-10}	1.0×10^{-4}	3.7×10^{-6}	0.73	1.0×10^{-7}
Truck bay fire	2.0×10^{-9}	4.0×10^{-4}	3.4×10^{-11}	6.7×10^{-6}	2.4×10^{-7}	0.049	1.0×10^{-7}
Spontaneous combustion	2.0×10^{-11}	5.8×10^{-7}	3.4×10^{-13}	9.7×10^{-9}	2.5×10^{-9}	7.0×10^{-5}	7.0×10^{-7}
Explosion in the vault	4.7×10^{-9}	9.4×10^{-4}	7.9×10^{-11}	1.6×10^{-5}	5.8×10^{-7}	0.12	1.0×10^{-7}
Explosion outside the vault	2.2×10^{-11}	4.3×10^{-6}	3.6×10^{-13}	7.3×10^{-8}	2.6×10^{-9}	5.2×10^{-4}	1.0×10^{-7}
Nuclear criticality	1.4×10^{-11}	2.8×10^{-6}	1.8×10^{-13}	3.5×10^{-8}	2.2×10^{-10}	4.4×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	6.7×10^{-8}	0.013	9.2×10^{-10}	1.8×10^{-4}	6.6×10^{-6}	1.3	1.0×10^{-7}
Expected risk[d]	3.8×10^{-5}	–	6.4×10^{-7}	–	4.6×10^{-3}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code.

Phaseout

Normal Operation. A phaseout of existing Pu storage facilities at SRS would reduce the impacts from radiological and chemical releases and exposures to levels slightly below the No Action levels. All workers involved in the transfer of the Pu from existing storage would be monitored to assure that their doses remain within regulatory limits and as low as reasonably achievable.

Facility Accidents. The phaseout operation will be conducted in accordance with DOE Orders to ensure that the risk to the public of prompt fatalities due to accidents or of cancer fatalities due to operations will be minimized. For current operations in the facility that would be phased out, the safety of workers and the public from accidents is controlled by Technical Safety Requirements that are specified in SARs or Basis for Interim Operations documents that have been prepared for the facility. Prior to initiating phaseout, the potential for accidents that could impact workers and the public will be assessed, and if necessary, applicable existing safety documentations will be modified to ensure safety for workers and the public.

4.2.6.10 Waste Management

This section summarizes the impacts on waste management at SRS under No Action, for each of the long-term storage alternatives, and for the phaseout of Pu storage. There is no spent nuclear fuel or HLW associated with Pu or HEU storage. Table 4.2.6.10–1 lists the projected sitewide waste generation rates and treatment, storage, disposal capacities under No Action for 2005. Projections for No Action were derived from the most recent available environmental data, with the appropriate adjustments made for those changing operational requirements where the volume of wastes generated were identifiable. The projection does not include wastes from future, yet uncharacterized, environmental restoration activities. The projections for No Action could change significantly depending on the decisions resulting from the PEIS being prepared by the Department on waste management. Table 4.2.6.10–2 provides the estimated incremental operational waste volumes projected to be generated at SRS as a result of the various storage alternatives prior to treatment. Some of the waste values described in this section are different than the waste values in the table. For those values that differ (for example LLW), the table gives waste generated pre-treatment values and the text discusses post-treatment values (indicated as after treatment and volume reduction). For example, the new consolidated Pu storage facility would generate 10 m^3 (13 yd^3) of solid TRU waste. Since SRS already stores Pu, the waste volumes associated with the phaseout of Pu storage (8 m^3 [10.5 yd^3]) must be subtracted out to avoid double counting waste volumes associated with Pu storage. This results in a net incremental increase from the alternative of 2 m^3 (2.6 yd^3). The subtraction of the phaseout volumes to avoid the double counting of waste volumes is only applicable to the consolidation and collocation alternatives. The waste volumes generated from the various storage alternatives and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.1. For the consolidation and collocation alternatives, the waste effluent volumes in the impact analysis refer only to wastes from the applicable storage facility, not the net incremental increase/decrease for SRS as a whole. Facilities that would support the storage of Pu and/or HEU would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with RCRA, and other applicable statutes. Depending on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice.

No Action Alternative

Under No Action, high-level, TRU, low-level, mixed, hazardous, and nonhazardous wastes, and spent nuclear fuel would continue to be managed from the missions outlined in Section 3.7. SRS's mission would include tritium recycling, management of nuclear materials, isotopes, and aluminum-clad and research reactor spent fuel, decommissioning of reactors and site facilities, and remediation. Under No Action, SRS would continue to store its inventory of Pu, and treat, store, and dispose of its legacy and newly generated wastes in current and planned facilities.

Under No Action, the processing of legacy wastes would require new facilities, since the necessary treatment, storage, and disposal facilities either do not exist or are nearing capacity. Spent nuclear fuel would be managed in accordance with the ROD (60 FR 28680) from the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F) as amended on March 8, 1996 (61 FR 9441) and the ROD from the *Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel Final Environmental Impact Statement* (61 FR 25092), which state that SRS would be responsible for the management of aluminum-clad spent nuclear fuel from the Department's nationwide complex, as well as receiving spent nuclear fuel from domestic and foreign research reactors. The ROD also states that SRS non-aluminum-clad spent nuclear fuel from past production reactor operations would be shipped to INEL by the year 2035.

Table 4.2.6.10–1. Projected Spent Nuclear Fuel and Waste Management Under No Action (2005) at Savannah River Site

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Spent nuclear fuel	None (offsite receipts expected)[a]	Stabilization	Under development[a]	Fuel pools and dry storage	Planned[a]	To HLW Program	Not designed
High-Level							
Liquid	126	Adsorption, evaporation, vitrification	53,700[b]	Tank farm	133,000[c]	NA	NA
Solid	127 canisters[d]	None	None	Shielded vault	2,286 canisters[e]	To HLW Program	NA
Transuranic							
Liquid	None	Vitrify	559[f]	None	None	NA	NA
Solid	338	Sort, shred, vitrify	2,280[g]	Trupact II Containers	34,400[h]	None - WIPP or alternate facility	NA
Low-Level							
Liquid	74,000	Chemical, filtration, saltstone	503,000[i]	Ponds, tanks–awaiting processing	NA	NPDES discharge after treatment	NA
Solid	16,400	Compact, shred, smelt, vitrify, incinerate, soil sort	73,000[j]	Vaults	3,330[k]	Burial vaults and trenches	2,580,000[l]
Mixed Low-Level							
Liquid	1,330	Chemical, filtration, saltstone	516,000[m]	Tanks, ponds, containers in buildings	10,800[n]	NA	NA
Solid	7,700	Incineration, vitrification, stabilization	26,900[o]	DOT containers (solid), facility	5,700[p]	To solid LLW burial onsite	47,570[q]
Hazardous							
Liquid	1,260	Incineration, stabilize, pump, and treat	2,860[r]	Planned RCRA facility	Included in solid	Offsite RCRA facilities	NA
Solid	15,100	Incineration, offsite	9,500[s]	Planned RCRA facility	2,618[t]	Offsite RCRA facility	NA

Table 4.2.6.10–1. Projected Spent Nuclear Fuel and Waste Management Under No Action (2005) at Savannah River Site—Continued

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Sanitary)							
Liquid	703,000	Filter, strip, settle	1,450,000[u]	Flowing ponds	NA	NPDES discharge	Planned
Solid	61,200	Incinerate, compact	Expandable as required	None	None	Onsite lined pit	Planned
Nonhazardous (Other)							
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	NA	NA	NA	NA	NA	NA

[a] Treatment and storage have been evaluated in the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement,* and the *Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel Draft Environmental Impact Statement.* Final evaluation will be accomplished in a tiered site-specific EIS.

[b] Evaporation and ion exchange capacity. Capacity of liquid and sludge processing for vitrification is 24,600 m^3/yr. Capacity to vitrify salts and sludge is 18,800 m^3/yr.

[c] F- and H- Area tank farms.

[d] From vitrification of salts and sludge, not new waste.

[e] Planned construction will add capacity for additional 2,286 logs in 2007.

[f] Alpha Vitrification Facility.

[g] TRU Waste Characterization/Certification Facility, Alpha Vitrification Facility.

[h] TRU waste storage pads.

[i] F- and H-Area Effluent Treatment facility.

[j] Onsite and offsite compactors, Consolidated Incineration Facility, offsite smelter, soil sort.

[k] E-Area Long-lived Waste Vaults.

[l] Saltstone vaults, E-Area vaults, slit trenches.

[m] F-and H-Area Effluent Treatment Facility, M-Area Effluent Treatment Facility, and Savannah River Technology Center Ion Exchange.

[n] Hazardous and Mixed Waste Container Storage, Process Waste Interim Treatment, DWPF Storage Tanks, SRTC Mixed Waste Storage Tanks.

[o] Containment building, M-Area Vendor Treatment, Non-Alpha Vitrification, offsite mixed waste treatment, recycling units, Consolidated Incineration Facility, Soil Sort Facility.

[p] Mixed waste storage buildings.

[q] Hazardous/mixed waste disposal vaults.

[r] Consolidated Incineration Facility, M-Area stripper.

[s] Consolidated Incineration Facility.

[t] Hazardous Waste Storage Facility (buildings T-10B, 645-N, 316-M and Pads 1,2, & 3).

[u] Centralized Sanitary Wastewater Treatment Facility.

Note: NA=not applicable.

Source: 60 FR 28680; 61 FR 25092; DOE 1995kk; SR DOE 1993c; SR DOE 1994b, SR DOE 1994c; SR DOE 1995b; SR DOE 1995c; SR MMES 1993a; SRS 1995a:2; WSRC 1995a; WSRC 1995b; Tables E.2.6–1, E.2.6–2, E.2.6–3, E.2.6–4, E.2.6–5, E.2.6–6, E.2.6–7, E.2.6–8, E.2.6–9, E.2.6–10, and E.2.6–11.

Table 4.2.6.10–2. Estimated Annual Generated Waste Volumes at Savannah River Site— No Action (2005) and Net Incremental for Storage Alternatives

Category	No Action[a] (m^3)	Upgrade With RFETS Non-Pit Material[b] (m^3)	Upgrade With RFETS and LANL Material[b] (m^3)	Consolidation[b] (m^3)	Collocation[b] (m^3)	Phaseout (m^3)
Transuranic						
Liquid	None	0	0	0.02[c]	0.02[c]	0
Solid	338	0	0	2	2	-8
Mixed Transuranic						
Liquid	None	0	0	0	0	0
Solid	Included in TRU	0	0	4	4	0
Low-Level						
Liquid	74,000	0	0	2[c]	2.1[c]	0
Solid	16,400	0	0	1,220	1,260	-38
Mixed Low-Level						
Liquid	1,330	0	0	0.2	0.2	0
Solid	7,700	0	0	65	66	0
Hazardous						
Liquid	1,260	0	0	2	2	0
Solid	15,100	0.56	0.8	2	2	0
Nonhazardous (Sanitary)						
Liquid	703,000	1,490	1,806	149,720	195,780	-19,100
Solid	61,200	13	18	-814	-414	-2,290
Nonhazardous (Other)						
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	13[d]	18[d]	1,800[d]	2,300[d]	Included in sanitary

[a] The No Action waste volumes are from Table 4.2.6.10–1.

[b] Waste volumes for storage alternatives are found in Section E.3.1 (Tables E.3.1.1–8, E.3.1.1–9, E.3.1.2–7, and E.3.1.3–8) net incremental volumes for Consolidation and Collocation Alternatives were derived by subtracting phaseout volumes so as not to double count waste volumes associated with Pu storage. Waste effluents (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in the tables.

[c] Liquid TRU and LLW would be treated and solidified prior to disposal.

[d] Recyclable wastes.

Since the K-Reactor is shutdown with no provision for restart, there would be no additional spent reactor fuel generated. A site-specific EIS is planned for SRS, which is expected to result in an ROD that specifies where and how spent nuclear fuel would be managed at SRS.The Pu addressed in this PEIS is limited to materials currently stored within protected vaults and gloveboxes, and additional materials within process lines and process equipment. Pu processing operations such as Pu purification, Pu recovery, oxide production, metal production, and parts fabrication have been conducted onsite, as well as receipt and large-scale storage of onsite and offsite Pu scrap and product materials. Under No Action, SRS would not be able to maintain the inventory of Pu scrap and metal in a state that provides for long-term storage while awaiting a decision for future disposition. The APSF would be constructed to meet current regulations. Maintenance, assay, packaging, and monitoring of the inventory would produce TRU, low-level, hazardous, and nonhazardous wastes. These wastes would be treated, stored, and disposed of in compliance with existing regulations.

Transuranic waste already packaged to WIPP WAC would either be stored or would have been shipped. Vitrification is planned to reduce waste shipment volume. If shipments to WIPP are delayed, or should the Department decide not to dispose of TRU waste at WIPP, additional storage facilities would be designed and constructed as needed. Mixed waste would have been incinerated, stabilized and the remaining residues disposed of onsite as LLW, according to the SRS Site Treatment Plan, which was developed to comply with the *Federal Facility Compliance Act.*

Liquid LLW would be sent to collection tanks that would be batch transferred to treatment and storage facilities onsite such as the ETF or the F-Area Tank Farm. Liquid LLW concentrate would be processed into saltstone. Solid LLW would continue to be compacted and disposed of by burial onsite in engineered trenches or vaults, depending on the LLW category. The burial ground expansion in the E-Area is expected to accommodate the current waste disposal requirements through 2024. Additional waste disposal facilities would be constructed as needed to ensure compliance. The Consolidated Incineration Facility would also be utilized to reduce the volume of LLW requiring disposal. Discussion of additional LLW disposal capacity was addressed in the *Savannah River Site Waste Management Final Environmental Impact Statement* (DOE/EIS-0217).

Savannah River Site plans to ship hazardous waste offsite for treatment and disposal in RCRA-permitted facilities. A RCRA-permitted hazardous waste storage and disposal facility is currently being designed to handle projected wastes from current operations. Specific areas are being reserved for future expansion.

Sanitary and nonhazardous process waste liquids are treated by various means to remove water and must comply with two CWA settlement agreements. Liquid sanitary waste would be piped to existing wastewater treatment facilities. The treated sanitary and process water would be discharged through NPDES outfalls and the resultant solids would be disposed of with solid nonhazardous waste in a permitted landfill sized to handle projected future waste volumes. SRS-generated municipal solid waste is currently being sent to a permitted offsite disposal facility. DOE is evaluating a proposal to participate in an interagency effort to establish a regional solid waste management center at SRS.

Upgrade Alternative

Preferred Alternative: Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Modification of the APSF to incorporate RFETS non-pit Pu would have a small impact on existing SRS waste management activities. Construction waste volumes as presented in Table E.3.1.1–8 would consist of wastewater and solid nonhazardous and hazardous waste. Nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous waste would be shipped offsite to commercial

RCRA-permitted treatment and disposal facilities. As shown in Table 4.2.6.10–2, the generation of TRU, mixed TRU, low-level, mixed low-level, or liquid hazardous wastes would not increase over that of No Action. The 0.56-m^3 (0.73-yd^3) increase in solid hazardous waste generation would have no impact on SRS hazardous waste management facilities. The 1,490-m^3 (392,500-gal) increase in liquid nonhazardous waste can be accommodated in existing wastewater treatment facilities. After volume reduction, the 11 m^3 (14 yd^3) of solid nonhazardous waste such as clean non-Pu metals, packing materials, trash, defective and damaged equipment, and industrial waste from utility and maintenance operations would be shipped in accordance with site practice to a sanitary landfill with minimal impact.

[Text deleted.]

Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Modify Actinide Packaging and Storage Facility for Continued Plutonium Storage

Modification of the APSF to incorporate RFETS and LANL material would have a small impact on existing SRS waste management activities. Construction waste volumes as presented in Table E.3.1.1–9 would consist of wastewater and solid nonhazardous and hazardous waste. Nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous waste would be shipped offsite to commercial RCRA-permitted treatment and disposal facilities. As shown in Table 4.2.6.10–2 the generation of TRU, mixed TRU, low-level, mixed low-level, or liquid hazardous wastes would not increase over that of No Action. The 0.8 m^3 (1 yd^3) increase in solid hazardous waste generation would have minimal impact on SRS hazardous waste management facilities. The 1,806 m^3 (477,000 gal) increase in liquid nonhazardous waste can be accommodated in existing wastewater treatment facilities. After volume reduction, the 14 m^3 (18 yd^3) of solid nonhazardous waste such as clean non-Pu metals, packing materials, trash, defective and damaged equipment, and industrial waste from utility and maintenance operations would be shipped to a sanitary landfill with minimum impact. Distributing the RFETS and LANL material to more than one site would reduce the operational waste volumes. The decrease would be proportional to the amount of material.

Consolidation Alternative

Construct New Plutonium Storage Facility

Construction and operation of a consolidated Pu storage facility would have an impact on existing SRS waste management activities, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous material or radioactive constituents is expected to be generated during construction. However, if any is generated it would be managed in accordance with site practice and all applicable Federal and State regulations. The types of operational wastes from the consolidated Pu storage facility would be the same as those from the upgrade, but the quantity would change, as shown in Table 4.2.6.10–2.

After treatment and volume reduction of TRU waste, approximately 5 m^3 (7 yd^3) of TRU waste and 4 m^3 (5 yd^3) of mixed TRU waste from leaded gloves and windows, and contaminated lead shielding would be treated and packaged to meet the current planning-basis WIPP WAC or alternative treatment level. While awaiting shipment to WIPP (depending on decisions resulting from the supplemental EIS noted earlier), the TRU waste would be stored in special purpose containers in above-grade storage facilities. One additional truck shipment per year or, if applicable, one regular train shipment every 2 years or one dedicated train shipment every 6 years would be required to transport these wastes to WIPP.

Following treatment and reduction, approximately 630 m^3 (824 yd^3) of LLW would be compacted and buried onsite in engineered trenches or vaults, depending on the LLW category. Assuming a land usage of 8,600 m^3/ha (4,500 yd^3/acre), this would require 0.07 ha/yr (0.2 acres/yr) of LLW disposal area. The 0.2 m^3 (55 gal) of liquid mixed LLW and 65 m^3 (85 yd^3) of solid mixed LLW would be incinerated, stabilized and the remaining residues disposed of onsite as LLW, in accordance with the SRS Site Treatment Plan through the use of existing and planned facilities. The 2 m^3 (476 gal) and 2 m^3 (3 yd^3) of solid hazardous wastes would have minimal impact on waste management activities at SRS as existing and planned facilities are adequate to handle this increase. The 168,830 m^3 (44,600,000 gal) of liquid nonhazardous wastes (sanitary, utility, and process wastewater) may impact existing F-Area utility and process wastewater treatment capabilities and may require construction or expansion of utility and/or process wastewater treatment systems. The centralized sanitary wastewater treatment system is adequate to treat the sanitary portion of the liquid waste. After volume reduction, 740 m^3 (968 yd^3) of solid nonhazardous waste would require disposal at a permitted sanitary landfill.

Collocation Alternative

Construct New Plutonium and Highly Enriched Uranium Storage Facilities

Construction and operation of a consolidated Pu storage facility collocated with HEU storage would have an impact on existing SRS waste management activities, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous material or radioactive constituents is expected to be generated during construction. However, if any is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Because there is no TRU or mixed TRU wastes associated with HEU storage, the impacts from TRU and mixed TRU wastes are identical to those identified in the consolidated Pu storage alternative. The sources of waste are similar to those of the upgraded Pu storage facility except the source of radioactive contamination from the HEU storage is uranium.

After treatment and volume reduction, approximately 630 m^3 (824 yd^3) of LLW contaminated with Pu and 20 m^3 (26 yd^3) of LLW contaminated with uranium would be compacted and buried onsite in engineered trenches or vaults, depending on the LLW category. Assuming a land usage of 8,600 m^3/ha (4,500 yd^3/acre), this would require 0.08 ha/yr (0.2 acre/yr) of LLW disposal area. The 0.2 m^3 (55 gal) of liquid mixed LLW and 66 m^3 (86 yd^3) of solid mixed LLW would be incinerated and stabilized, and the remaining residues disposed of onsite as LLW, in accordance with the SRS Site Treatment Plan through the use of existing and planned facilities. The 2 m^3 (528 gal) of liquid and 2 m^3 (3 yd^3) of solid hazardous waste would have minimal impact on waste management activities at SRS, as existing planned facilities are adequate to handle the increase.

The 214,890 m^3 (56,800,000 gal) of liquid nonhazardous waste may impact existing F-Area utility and process wastewater treatment capabilities and may require construction or expansion of utility and/or process wastewater treatment systems. The centralized sanitary wastewater treatment system is adequate to treat the sanitary portion of the liquid waste. After volume reduction, 940 m^3 (1,230 yd^3) of solid nonhazardous waste would require disposal at a permitted sanitary landfill.

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

The exclusion of strategic reserve and weapons R&D materials would reduce the amount of operational waste volumes shown in Table 4.2.6.10–2 for the No Action Alternative, the Upgrade Alternative, the Consolidation

Alternative, and the Collocation Alternative. The decrease would be proportional to the amount of material excluded. [Text deleted.]

Phaseout

The phaseout of Pu storage would have a small impact on SRS waste management activities. Solid TRU waste generation would decrease by 8 m^3 (11 yd^3), solid LLW by 38 m^3 (50 yd^3), and the sanitary waste would decrease by 19,100 m^3 (5,050,000 gal) for liquid and 2,290 m^3 (3,000 yd^3) for solid. All other waste streams would remain unchanged.

4.2.7 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

A list of the proposed long-term storage alternatives, subalternatives, and related actions, including the No Action Alternative, at RFETS is provided below. The potential impacts of implementing these alternatives and related actions at RFETS are described in the following sections: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, and waste management.

Preferred Alternative

Phaseout:

RFETS Pu material within the scope of this PEIS would be moved out of RFETS. Pits would be sent to Pantex and non-pit material would be sent to SRS.

Proposed Storage Activities at Rocky Flats Environmental Technology Site

- **No Action Alternative:** Continue to store RFETS Pu material within the scope of this PEIS in a new or modified facility in stabilized form pursuant to DNFSB Recommendation 94-1.
- **Upgrade Alternative:** This storage alternative does not apply to RFETS.
- **Consolidation Alternative:** This storage alternative does not apply to RFETS.
- **Collocation Alternative:** This storage alternative does not apply to RFETS.

[Text deleted.]

- **Phaseout (Preferred Alternative):** RFETS Pu material within the scope of this PEIS would be moved out of RFETS. Pits would be sent to Pantex and non-pit material would be sent to SRS.

4.2.7.1 Land Resources

No Action Alternative

Under this alternative, Pu storage would continue in a new or modified facility in stabilized form pursuant to DNFSB Recommendation 94–1. The ongoing (no new action as covered in the June 1995 EA and FONSI for the *Consolidation and Interim Storage of Special Nuclear Material at Rocky Flats Environmental Technology Site*) activities conform with present and future land-use plans, policies, and controls; therefore, no direct or indirect effects to land use or visual resources would be anticipated at RFETS beyond those of existing and future activities that are independent of the proposed action.

Preferred Alternative: Phaseout

No new construction or modification of existing facilities would occur under phaseout of the storage mission. RFETS Pu material would be moved out of RFETS to the upgrade, consolidation, or collocation sites, or to disposition. Potential impacts on visual resources could occur if facilities are not maintained.

4.2.7.2 Site Infrastructure

For selected site infrastructure parameters, Table 4.2.7.2–1 shows the site availability, projected usage under No Action, and projected usage following phaseout of the Pu storage mission. Adequate infrastructure is available to accommodate all projected site missions.

Table 4.2.7.2–1. Site Infrastructure Changes Required for Operation at Rocky Flats Environmental Technology Site (Annual)—No Action (2005) and Storage Phaseout

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
No Action							
Site Availability	40	5	184,000	26	8,140,000	18,600,000	0
Projected usage	40	5	184,000	26	8,140,000	18,600,000	0
Amount required in excess of site availability	0	0	0	0	0	0	0
Phaseout							
Projected usage with storage phaseout	40	5	184,000	26	8,140,000	18,600,000	0
Amount required in excess of site availability	0	0	0	0	0	0	0

Source: RFETS 1995a:1.

No Action Alternative

Under No Action, RFETS would continue to consolidate surplus and strategic reserve Pu into a single interim storage facility. Processing of Pu materials is addressed in the RFETS SISMP (including solid and liquid Pu residues). The RFETS SISMP describes all near-term actions necessary to place special nuclear material into safe interim storage as well as actions designed to prepare and place the material for safe long-term storage in accordance with DNFSB Recommendation 94-1 and the *DOE Criteria for Safe Storage of Plutonium Metals and Oxides* (DOE-STD-3013-94). The RFETS SISMP is a comprehensive management plan to handle issues and vulnerabilities associated with the RFETS storage and handling of Pu and other special nuclear material and describes actions currently being implemented at RFETS.

Preferred Alternative: Phaseout

Phaseout of the Pu storage mission at RFETS would have no impact on the facilities and site infrastructure. The storage facilities would remain for D&D and/or waste management, and utility consumption would remain constant.

4.2.7.3 Air Quality and Noise

Activities associated with the No Action Alternative would generate criteria and toxic/hazardous pollutants. The Pu Storage Phaseout Alternative would result in a decrease of criteria and toxic/hazardous pollutants over the No Action Alternative. To evaluate the air quality impacts at RFETS, criteria and toxic/hazardous concentrations from the No Action Alternative are compared with Federal and State standards and guidelines. Impacts from radiological airborne emissions are described in Section 4.2.7.9.

[Text deleted.]

Emission rates attributed to site operations (No Action) are presented in Table F.1.2.8–1. Air pollutant emission sources associated with operations include the following:

- Operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- Exhaust and road dust generated by vehicles delivering supplies and bringing employees to work
- Toxic/hazardous pollutant emissions from facility processes

Noise impacts during phaseout are expected to be low. Air quality and noise impacts for each storage alternative are described separately. Supporting data for the air quality and noise analyses are presented in Appendix F.

AIR QUALITY

An analysis was conducted of the potential air quality impacts of emissions for the storage phaseout alternative as described in Section 4.1.3.

Section 176 (c) of the 1990 CAA amendments requires that all Federal actions conform with the applicable SIP. EPA has implemented rules that establish the criteria and procedures governing the determination of conformity for all Federal actions in nonattainment and maintenance areas. These are discussed in Section 4.1.3. The attainment status of the area in which RFETS is located is discussed in Section 3.8.3. Since the area is considered a nonattainment area for O_3, PM_{10}, and CO, proposed actions at this site need to be evaluated for applicability of the conformity regulations. Total direct and indirect emissions from the No Action Alternative result in no change in emissions from RFETS. Therefore, the requirement for a conformity determination is not applicable to the No Action Alternative. Total direct and indirect emissions from Phaseout, which would include transportation emissions, have been estimated based on SST shipments of material from RFETS. These emissions are about 510 kg/yr (0.56 tons/yr) for NO_2, 56 kg/yr (0.061 tons/yr) for hydrocarbons (assumed to be VOC), and 225 kg/yr (0.25 tons/yr) for CO. These emissions are a small fraction of the total emissions from transportation emissions in the Denver area and are less than the applicability levels of 90,700 kg/yr (100 tons/yr) for VOC, NO_2, and CO for the Denver area (40 CFR 51; 40 CFR 93). Emissions of PM_{10} consist primarily of reentrainment of road dust and emissions from diesel-powered SSTs and are expected to be a small fraction of total emissions from vehicles in the Denver area. There is expected to be minimal change in emissions from other activities related to Pu storage phaseout at RFETS. Therefore, no further analysis of conformity of phaseout at RFETS is required.

No Action Alternative

This alternative utilizes estimated air emissions data from total site operations at RFETS, assuming continuation of site missions as described in Section 3.8. These data reflect conservative estimates of criteria and toxic/hazardous emissions at RFETS. The emission rates for the criteria and toxic/hazardous pollutants for No

Action are presented in Table F.1.2.8–1. Table 3.8.3–1 presents the No Action concentrations. During dry and windy conditions, increased PM_{10} and TSP concentrations may occur due to ongoing construction associated with other activities (that are outside of the scope of the PEIS) under the No Action Alternative. It is expected that the site will continue to comply with applicable Federal, State, and local ambient air quality standards.

Preferred Alternative: Phaseout

Phaseout of existing Pu inventories as a result of consolidating Pu at another site is expected to result in a small reduction in air pollutant concentrations from the No Action concentrations. The reduction in emissions associated with the reduction in activities at RFETS should contribute to the goal of meeting the standards for O_3, PM_{10}, and CO. Concentrations for other pollutants would be in compliance with Federal and State standards.

NOISE

The location of the fissile materials storage facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Traffic would occur onsite and along offsite large and regional transportation routes used to bring construction materials and workers to the site.

No Action Alternative

Nontraffic noise sources associated with continued interim storage and other ongoing missions are the same as described in Section 3.8. The continuing operations at RFETS would result in no appreciable change from current levels in traffic noise and onsite operational noise. Nontraffic noise sources are located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in some impacts, such as disturbance of wildlife.

Preferred Alternative: Phaseout

A reduction in noise levels associated with facility operations may result from the phaseout of storage facilities.

4.2.7.4 Water Resources

Impacts associated with the No Action and phaseout of Pu storage facilities at RFETS would not affect water resources. All required water would be supplied by the City of Denver via the South Boulder Diversion Canal from the South Boulder Creek and Ralston Reservoir. Wastewater would be discharged to Walnut and Woman Creeks. Table 4.2.7.4–1 presents No Action water resources uses and discharges and the potential changes to water resources at RFETS resulting from phaseout.

Table 4.2.7.4–1. No Action and Potential Changes to Water Resources at Rocky Flats Environmental Technology Site—No Action (2005) and Storage Phaseout

Affected Resource Indicator	No Action	Phaseout
Water Source	Surface	Surface
Construction		
Water Availability and Use		
Total water requirements (million l/yr)	NA[a]	0
Percent increase in projected water usage[b]	NA[a]	0
Water Quality		
Total wastewater discharge	NA[a]	0
Percent change in wastewater discharge[c]	NA[a]	0
Operation		
Water Availability and Use		
Total water requirements (million l/yr)	439	0
Percent increase in projected water usage[d]	0	0
Water Quality		
Total wastewater discharge	130	0
Percent change in wastewater discharge[e]	0	0
Floodplain		
Is action in 100-year floodplain?	No	No
Is critical action in 500-year floodplain?	No	No

[a] See operations section of table for No Action water data.

[b] Percent increase in projected water usage during phaseout at RFETS is calculated by dividing No Action water requirements (439 million l/yr) with that for storage phaseout (0 l/yr).

[c] Percent change in wastewater discharge during phaseout at RFETS is calculated by dividing No Action water discharges (130 million l/yr) with that for storage phaseout (0 l/yr).

[d] Percent increase in projected water usage during operation at RFETS is calculated by dividing No Action water requirements (439 million l/yr) with that for storage phaseout (0 l/yr).

[e] Percent change in wastewater discharge during operation at RFETS is calculated by dividing No Action water discharges (130 million l/yr) with that for storage phaseout (0 l/yr).

Note: NA= not applicable.

Source: RFETS 1995a:1.

No Action Alternative

Surface Water. [Text deleted.] A description of the activities that would continue at RFETS is provided in Section 3.8. Under this alternative, because of reduced operating requirements of existing facilities at RFETS, treated wastewater from RFETS would continue to be discharged to Walnut and Woman Creeks, and the volume would decrease from current discharge of 150 million l/yr (40 million gal/yr) to 130 million l/yr (34 million gal/yr) by the year 2005. Water requirements (439 million l/yr [116 million gal/yr]) would continue to be obtained from the city of Denver via the South Boulder Diversion Canal from the South Boulder Creek and Ralston Reservoir and are not anticipated to increase by 2005.

Groundwater. Under this alternative, no additional impacts to groundwater resources are anticipated. Water quality data obtained from monitoring wells at RFETS indicate that water quality meets or exceeds drinking water standards for a number of parameters. Under this alternative, current restoration programs would continue. Pumped, treated, and released groundwater from restoration activities is anticipated to decrease in volume from the current removal rate of 10.6 million l/yr (2.8 million gal/yr) to 7.8 million l/yr (2.1 million gal/yr) by the year 2005.

Preferred Alternative: Phaseout

Phaseout of missions at RFETS would not involve any new construction. Because existing facilities are not located in the 100- or 500-year floodplain, phaseout would not affect the floodplain area.

Surface Water. The phaseout would not result in an incremental change in the total wastewater volume handled by the plant. No impact to flow and water quality of Walnut and Woman Creeks would result. There would be no impact to water quality from phaseout activities.

Groundwater. Because RFETS does not withdraw groundwater, there would be no impact on the availability of this resource. A minor beneficial impact on groundwater resources would occur due to the lessened potential for degradation of water quality. Spill protection systems and plans exist to contain and minimize effects of releases of hazardous substances during phaseout activities. Given normal safeguards and procedures, no impact to groundwater quality would be expected to result from activities associated with the phaseout of Pu storage functions at RFETS. Current restoration activities would continue under this alternative.

4.2.7.5 Geology and Soils

RFETS is considered only for the No Action Alternative and under storage phaseout. As discussed below, neither of these activities involves new construction and would therefore have no effect on the geologic and soil resources at the site. Impacts to geologic and soil resources occur during, or as a result of, ground-disturbing activities.

No Action Alternative

Under the No Action Alternative, DOE would continue current and ongoing activities at RFETS. There would be no new ground-disturbing activities beyond those already associated with existing and future site improvements. Because no new construction (associated with this program) or associated ground disturbance for potential soil erosion would occur, the No Action Alternative would have no effect on geologic or soil resources at the site.

Preferred Alternative: Phaseout

The phaseout of storage capacity would have no apparent effects on the geology. However, phaseout could result in beneficial effects on the soils of the area. Hazardous, radioactive, and mixed waste sources would be eliminated from the area, thus decreasing the potential for future soil contamination.

4.2.7.6 Biological Resources

No Action Alternative

The Pu storage mission described in Section 2.2.7 would continue at RFETS. This would result in no appreciable change in current conditions of biological resources at RFETS as described in Section 3.8.6.

Preferred Alternative: Phaseout

Pu materials at RFETS would be phased out of operation. The phaseout of Pu storage facilities is not expected to affect biological resources, although increased human activity could, as a result of phaseout activities, temporarily disturb some wildlife species in the vicinity of the site.

4.2.7.7 Cultural and Paleontological Resources

No Action Alternative

Under this alternative, DOE would continue the existing and planned missions at RFETS, including the continued storage of Pu material in a new facility in stabilized form pursuant to DNFSB Recommendation 94-1. Any impacts to cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate NHPA, *American Indian Religious Freedom Act*, and *Native American Graves Protection and Repatriation Act* regulatory compliance procedures. A cultural resources management plan is in preparation for RFETS.

Preferred Alternative: Phaseout

For this alternative, all Pu materials at RFETS within the scope of this PEIS would be transferred to another site and the storage mission would be phased out. Impacts to prehistoric resources are not anticipated because phaseout is not expected to result in ground-breaking activity. Likewise, no impacts to paleontological remains are expected. It may affect, through alteration, if subsequently proposed, some of the 65 historic structures at RFETS that have been identified as NRHP-eligible. DOE has recently begun efforts to identify Native American groups with ties to the land at RFETS, however, phaseout is not expected to affect important Native American resources.

4.2.7.8 Socioeconomics

No Action Alternative

Regional Economy Characteristics. Total employment in the REA is projected to increase approximately 2 percent annually between 1995 and 2000, reaching 1,985,400 in the latter year. Long-range projections indicate slower growth after the year 2000, when employment would increase about 1 percent annually and reach approximately 2,970,500 persons in 2040. Unemployment in the REA was 4.1 percent in 1994 and is expected to remain at this level into the near future. Per capita income is projected to increase from approximately $22,721 in 1995 to $37,025 in 2040. Projections for the No Action Alternative are presented in Table L.1–64.

Population and Housing. Population in the ROI is projected to increase from approximately 1,991,700 in 1995 to 3,245,300 by 2040. The total number of housing units in the ROI is projected to increase from about 855,200 in 1995 to 1,371,600 in 2040. Population and housing projections for the No Action Alternative are presented in Tables L.1–65 and L.1–66, respectively.

Community Services. Education, public safety, and health care characteristics are used to assess the level of community services in the RFETS ROI. School enrollments are projected to increase from about 336,840 students in 1995 to 562,320 students by 2040. The current student-to-teacher ratio is 19.0:1. To maintain this level of service, the number of teachers in the ROI would need to increase from approximately 17,751 in 1995 to 29,417 in 2040. These projections are presented in Tables L.1–67 and L.1–68.

The projected numbers of sworn police officers and firefighters serving in ROI communities over the period 1995 to 2040 are shown in Tables L.1–69 and L.1–70, respectively. Under No Action the number of sworn police officers is projected to increase from approximately 3,871 in 1995 to 6,036 in 2040 to maintain the current service level of 2.0 sworn officers per 1,000 persons. The number of firefighters in the ROI would need to increase from about 5,408 in 1995 to 9,118 in 2040 to maintain the present service level of 2.7 firefighters per 1,000 persons.

Hospital occupancy rates are based on current capacity. These rates and the estimated number of physicians serving the ROI population between 1995 and 2040 are presented in Tables L.1–71 and L.1–72, respectively. Hospital occupancy rates are projected to increase from approximately 56 percent in 1995 to 91 percent in 2040. To maintain the current service level of 2.6 physicians per 1,000 persons, the total number of physicians in the ROI would need to increase from approximately 5,085 in 1995 to 7,387 in 2040.

Local Transportation. Any increases in traffic would be due to projected growth in the area unrelated to DOE activities. The only alternative considered at RFETS is phaseout, which involves decreasing employment, and, therefore, decreasing traffic. Since there would be no impacts, modeling was not done.

Preferred Alternative: Phaseout

Phasing out Pu storage at RFETS would result in the loss of 10,051 (2,129 direct and 7,922 indirect) jobs in the REA, which would be considered a potential impact. Should all personnel be phased out at the same time, unemployment would increase to 4.6 percent and per capita income would be reduced by less than 1 percent (Socio 1996a).

Some displaced workers may out-migrate from the ROI to seek other employment opportunities. Under the bounding case (all unemployed workers and their families leaving the ROI at the same time), population would decrease by about 1 percent. Some of the projected ROI occupied housing units would become vacant as a result of population losses (Socio 1996a).

The out-migration of population during phaseout would slightly lessen the demand for community services. It is unlikely that communities would lower service levels unless decreased revenues made it necessary.

School enrollments in the ROI could decrease by about 1 percent under the bounding-case scenario for phaseout. The No Action student-to-teacher ratio of 19.0:1 could be maintained if the number of teachers does not decrease from predicted No Action levels by more than 193 (Socio 1996a).

During phaseout, the number of sworn police officers could decrease by as many as 35 officers from projected No Action levels before the No Action service level of 2.0 officers per 1,000 persons would not be maintained. Additionally, the number of firefighters could decrease by as much as 50 before the No Action service level of 2.7 firefighters per 1,000 persons would be affected (Socio 1996a).

Projected hospital occupancy rates under the bounding-case scenario for phaseout would be slightly lower than the No Action projections. The number of physicians in the ROI could decrease by up to 43 from predicted No Action levels before the No Action service level of 2.6 physicians per 1,000 persons would be affected (Socio 1996a).

If the phaseout of Pu storage at RFETS led to a reduction of the ROI population, traffic conditions should improve over the No Action baseline.

4.2.7.9 Public and Occupational Health and Safety

Assessments have been made of potential radiological and chemical impacts associated with the No Action Alternative at RFETS. A discussion of reduced impacts associated with the phaseout of existing Pu storage is also presented. Summaries of radiological impacts from normal operations are presented in Tables 4.2.7.9–1 and 4.2.7.9–2 for the public and workers, respectively. Impacts from hazardous chemicals are presented in Table 4.2.7.9–3. Impacts associated with postulated accidents are addressed in this section.

No Action Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the current sitewide mission including interim storage of Pu at RFETS. The section describes the impacts from normal operation, then describes the potential risks of impacts from facility accidents.

The impacts on the public and on workers under the No Action Alternative during normal operation at RFETS would be within applicable regulatory limits.

Normal Operation. The current mission at RFETS, where Pu is in interim storage, is described in Section 3.8. The site has identified those facilities that will continue to operate under the No Action Alternative, including interim Pu storage facilities. Radiological and chemical impacts on the public and workers at RFETS are described below.

Radiological Impacts. The calculated annual dose to the average and maximally exposed members of the public, the associated fatal cancer risks to these individuals from 50 years of total site operation, the dose to the population within 80 km (50 mi) from total site operation in the year 2030, and the projected number of fatal cancers in this population from 50 years of operation are presented in Table 4.2.7.9–1 under this alternative at RFETS. The annual dose of 0.48 mrem to the MEI is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The annual dose of 0.10 person-rem to the population is within the proposed reporting limit. To put operational dose impacts into perspective, comparisons with doses from natural background radiation are included in the table.

The average annual dose to a site worker and the associated risk of fatal cancer from 50 years of total site operations, and the annual dose to the total site workforce and the projected number of fatal cancers from 50 years of total site operations, are presented in Table 4.2.7.9–2 for the No Action Alternative at RFETS.

Hazardous Chemical Impacts. Hazardous chemical impacts on the public resulting from the normal operation under No Action at RFETS are presented in Table 4.2.7.9–3. The noncancerous health effects expected and the risk of cancer due to the total chemical exposures, must be estimated for each site. Since the major releases due to normal operation at RFETS would make up nearly all of the exposures to onsite workers and to the public in adjacent communities, contributions to the hazardous chemical concentrations from all other sources, for example, industrial operations, are considered negligible for purposes of risk calculations.

The HI for the MEI of the public at RFETS resulting from normal operation under the No Action Alternative is 1.2×10^{-3}, and the cancer risk is 2.1×10^{-8}. The HI to the onsite worker is 1.3×10^{-2}, and the cancer risk is 2.3×10^{-6}.

Table 4.2.7.9–1. Potential Radiological Impacts to the Public During Normal Operation at Rocky Flats Environmental Technology Site—No Action

Receptor	No Action
Annual Dose to the Maximally Exposed Individual Member of the Public[a]	
Atmospheric release pathway (mrem)	0.13
Drinking water pathway (mrem)	0.35
Total liquid release pathway (mrem)	0.35
Atmospheric and liquid release pathways combined (mrem)	0.48
Percent of natural background[b]	0.14
50-year fatal cancer risk	1.2×10^{-5}
Population Dose Within 80 Kilometers for Year 2030[c]	
Atmospheric release pathways (person-rem)	0.10
Total liquid release pathways (person-rem)	0
Atmospheric and liquid release pathway combined (person-rem)	0.10
Percent of natural background[b]	9.1×10^{-6}
50-year fatal cancers	2.5×10^{-3}
Annual Dose to the Average Individual Within 80 Kilometers[d]	
Atmospheric and liquid release pathways combined (mrem)	3.2×10^{-5}
50-year fatal cancer risk	8.0×10^{-10}

[a] The applicable radiological limits for an individual member of the public from site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway as required by the SDWA; and 100 mrem per year from all pathway combined. Refer to DOE Order 5400.5.

[b] The annual natural background radiation level at RFETS is 353 mrem for the average individual; the population within 80 km in the year 2030 receives 1.1×10^{6} person-rem.

[c] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[d] Obtained by dividing the population dose by the number of people projected to live within 80 km of the site in 2030 (3,116,000).

Note: It is assumed that these doses will not be exceeded in the future since no additional activities are planned at the RFETS under the No Action Alternative.

Source: RFETS 1994a.

Table 4.2.7.9–2. Potential Radiological Impacts to Workers During Normal Operation at Rocky Flats Environmental Technology Site—No Action

Receptor	No Action
Involved Workforce[a]	
Average worker dose (mrem/yr)[b]	250
50-year risk of fatal cancer	5.0×10^{-3}
Total dose (person-rem/yr)	25
50-year fatal cancers	0.50
Noninvolved Workforce[c]	
Average worker dose (mrem/yr)[b]	122
50-year risk of fatal cancer	2.4×10^{-3}
Total dose (person-rem/yr)	775
50-year fatal cancers	15
Total Site Workforce[d]	
Dose (person-rem/yr)	800
50-year fatal cancers	16

[a] The involved worker is a worker associated with operations of interim Pu storage. It is assumed that there are 100 workers, badged with dosimeters to monitor radiation exposure, with a conservatively estimated average dose of 250 mrem/yr per worker. However, an effective ALARA program will ensure that the exposure will be reduced to that level which is as low as reasonably achievable.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem/yr (DOE1992t); the site must make reasonable attempts to maintain doses below this level.

[c] The noninvolved worker is a worker onsite but not associated with interim Pu storage operations. The projected number of noninvolved badged workers in 2005 is 6,350.

[d] The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: DOE 1993n:7.

Table 4.2.7.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation at Rocky Flats Environmental Technology Site—No Action

Receptor	Total Site[a]
Maximally Exposed Individual (Public)	
Hazard Index[b]	1.2×10^{-3}
Cancer risk[c]	2.1×10^{-8}
Worker Onsite	
Hazard Index[d]	1.3×10^{-2}
Cancer risk[e]	2.3×10^{-6}

[a] Total=The No Action contributions.

[b] Hazard Index for MEI: sum of individual Hazard Quotients (noncancerous health effects) for MEI.

[c] Cancer risk for MEI=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (slope factor [SF]).

[d] Hazard Index for workers: sum of individual Hazard Quotients (noncancerous health effects) for workers.

[e] Cancer risk for workers= (emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237[fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (SF).

Source: Section M.3, Table M.3.4-26.

Facility Accidents. Under the No Action Alternative, Pu would continue to be stored at the site in existing facilities. These facilities currently operate in accordance with DOE Orders which ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations will be in accordance with the DOE safety goals. The safety to workers and the public from accidents at existing facilities is also controlled by technical safety requirements specified in detail in a SAR or Basis for Interim Operations document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities would cause a halt in operations until it can be established that worker and public safety has not been compromised.

Preferred Alternative: Phaseout

Normal Operation. The phaseout of Pu storage at RFETS would reduce the impacts from radiological and chemical releases and exposures to levels below the No Action levels. All workers involved in the removal of Pu from RFETS would be monitored to ensure that their doses remain within acceptable levels.

Facility Accidents. The phaseout operation will be conducted in accordance with DOE Orders to ensure that the risk to the public of prompt fatalities due to accidents or of cancer fatalities due to operations will be minimized. For current operations in the facility that would be phased out, the safety of workers and the public from accidents is controlled by Technical Safety Requirements that are specified in SARs or Basis for Interim Operations documents that have been prepared for the facility. Prior to initiating phaseout, the potential for accidents that could impact workers and the public will be assessed and, if necessary, applicable existing safety documentation will be modified to ensure safety for workers and the public.

4.2.7.10 Waste Management

This section summarizes the impacts on waste management at RFETS under No Action and the phaseout of Pu storage. There is no spent nuclear fuel or HLW associated with Pu storage. Table 4.2.7.10–1 lists the projected waste generation rates and treatment, storage, and disposal capacities under No Action for 2005. Projections for No Action were derived from the most recent available environmental data, with the appropriate adjustments made for those changing operational requirements where the volume of wastes generated are identifiable. The projection does not include wastes from future, yet uncharacterized, environmental restoration activities. The projections for No Action could change depending on decisions resulting from the Waste Management PEIS. Facilities that would support the storage of Pu would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with RCRA and other relevant statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated and disposed of onsite or at regionalized and centralized DOE sites. For the purpose of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice.

No Action Alternative

Under No Action, TRU, low-level, mixed residues, hazardous, and nonhazardous waste would continue to be managed at RFETS from the missions described in Section 3.8. Waste management activities at RFETS are categorized as regulatory compliance and project administration, waste minimization, waste treatment, waste storage, and waste disposal. Within each category of waste management activity, various wastes are handled according to waste type as defined by various DOE orders, as well as Federal and State regulations. Applicable permitting, treatment, storage, and disposal requirements are determined according to these waste types. Under No Action, RFETS would continue to store quantities of Pu in various forms. This storage would generate small quantities of TRU, low-level, hazardous, mixed, and nonhazardous wastes. The primary focus for waste management at RFETS would be the continued processing of existing wastes, transition of facilities, and environmental restoration. It is anticipated that the Pu storage mission would have minimal impact on the waste management program at RFETS. The plant has stored Pu since 1956 and is adequately equipped to manage the wastes from the storage mission using the existing waste management infrastructure. Waste generated by cleanup activities is expected to be much greater than wastes generated from continued storage of Pu. The impacts of the wastes generated as part of environmental restoration and D&D activities would be addressed in individual remedial action feasibility studies. The Rocky Flats Cleanup Agreement provides the legal enforcement framework for assessing the native and extent of contamination, determining the risks imposed by that contamination to workers, the public, and the environment; and implementing actions designed to remediate the contamination.

Transuranic waste would be treated and packaged to meet the current planning-basis WIPP WAC or alternative treatment level and then stored in one of the RCRA-permitted storage units pending approval of WIPP as a repository for these wastes. Assuming WIPP is determined to be a suitable repository for these wastes, pursuant to the requirements of 40 CFR 191 and 40 CFR 268, these wastes would be packaged in accordance with DOE and DOT requirements for transport to WIPP depending on decisions made in the ROD associated with the Supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU wastes.

Low-level waste would be compacted whenever possible, packaged to meet the WAC of the NTS low-level disposal facility, and then shipped to NTS for disposal. Mixed LLW would be treated and disposed in accordance with the *RFETS Treatment Plan* that was developed to comply with the *Federal Facility Compliance Act*. Hazardous wastes would be collected and packaged in DOT-approved containers for shipment to offsite RCRA-permitted commercial treatment, storage, and disposal facilities. Solid nonhazardous wastes would be disposed in the onsite permitted landfill.

Table 4.2.7.10–1. Projected Waste Management Under No Action (2005) at Rocky Flats Environmental Technology Site

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)[a]	Disposal Method	Disposal Capacity (m^3)
Transuranic							
Liquid	<1	Solidification	149,000[b]	None	None	NA	NA
Solid	1,583	Compaction	4,630[c]	Drums on pads	6,220[d]	WIPP or alternate facility	NA
Mixed Transuranic							
Liquid	<1	Solidification	Included in TRU liquid	None	None	NA	NA
Solid	1,505	Compaction	Included in TRU solid	Drums on pads	Included in solid TRU	WIPP or alternate facility	NA
Low-Level							
Liquid	<1	Evaporation and solidification	Included in liquid mixed LLW	Staged	105[e]	NA	NA
Solid	701	None	5,600[f]	Staged	4,540[e]	Offsite	NA
Mixed Low-Level							
Liquid	None[g]	Solidification	47,500[h]	Staged for treatment	Included in solid mixed LLW	NA	NA
Solid	6,019	None	7,100[i]	DOT containers	17,700[j]	Offsite	NA
Hazardous							
Liquid	<1	Neutralization & precipitation	None	Staged in DOT containers	Included in solid hazardous	Offsite	NA
Solid	25	None	None	Staged in DOT containers	260[k]	Offsite	NA
Hazardous (Residues)		None	None				
Liquid	None	None	None	Staged only	Included in liquid hazardous	Offsite	NA
Solid	None	None	None	Staged only	Included in liquid hazardous	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	457,600[l]	Sedimentation	565,000	None	None	Surface water	NA
Solid	11,400	None	None	None	None	Onsite landfill	Expandable[m]

Table 4.2.7.10–1. Projected Waste Management Under No Action (2005) at Rocky Flats Environmental Technology Site—Continued

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)[a]	Disposal Method	Disposal Capacity (m^3)
Nonhazardous (Other)							
Liquid	Included in sanitary	Sedimentation	Included in sanitary	None	None	Surface water	NA
Solid	73	None	None	None	None	Onsite landfill	Expandable[l]

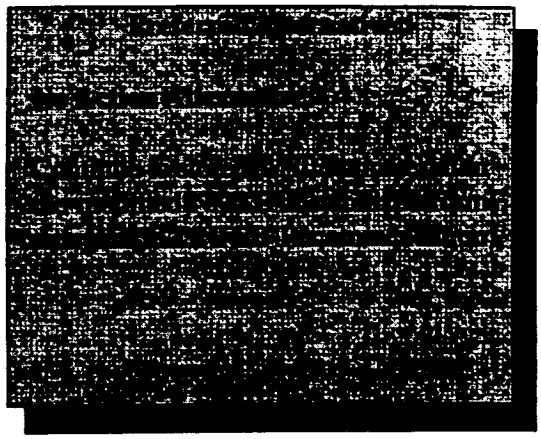
[a] Additional storage capacity requirements depend upon the existing storage requirements, existing storage capacity, and existing permit conditions.
[b] Value taken from Draft Waste Management PEIS and includes Process Waste Treatment Facility and Organic and Sludge Immobilization System.
[c] Value taken from Draft Waste Management PEIS and includes Supercompaction and Repackaging Facility, Advance Size Reduction Facility, and Size Reduction Vault.
[d] Value taken from Draft Waste Management PEIS and includes the current TRU inventory and the projected 20-year generation.
[e] Cumulative volume of LLW stored at end of 1993 as per a Memorandum from McGlochlin, EG&G to Reece, DOE on updated information for Nonnuclear Consolidation EA.
[f] Value taken from Draft Waste Management PEIS and reflects compaction activities.
[g] No waste in this category is expected to be generated in 2005. Treatment, storage, and disposal are expected to continue for waste generated from past activities.
[h] Based on the operating capacities of Building 374 and 774 as described in the 1995 Mixed Waste Inventory Report.
[i] Based on the operating capacities of Building 776 as described in the 1995 Mixed Waste Inventory Report. Value calculated using the conversion ratio of 1,500 kg/m^3.
[j] Value taken from Draft Waste Management PEIS and reflects Mixed Waste container storage activities.
[k] Value based on the 1991 Waste Storage Inventory Report and the Memorandum from McGlochlin, EG&G to Reece, DOE on updated information for Nonnuclear Consolidation EA.
[l] Value taken from 1993 *RFETS Site Environmental Report* and reflects Annual Discharge from main collection pond (Pond A-4).
[m] Landfill will provide additional 20 years of capacity.
Note: NA=not applicable.
Source: DOE 1995cc; DOE 1995gg; RF EG&G 1992e; RFETS 1994a; RFETS 1995a:1; RFP 1993a:1; RFP 1993a:2.

Preferred Alternative

Phaseout

[Text deleted.] The small amount of waste associated with Pu storage would no longer be generated, but the total wastes generated at RFETS could increase as a result of the cleanup activities of facilities formerly used for Pu storage.

4.2.8 LOS ALAMOS NATIONAL LABORATORY



A list of the proposed long-term storage alternatives, subalternatives, and related actions, including the No Action Alternative, at LANL is provided below. The potential impacts of implementing these alternatives and related actions at LANL are described in the following sections: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, and waste management.

Proposed Storage Activities at Los Alamos National Laboratory

- **No Action Alternative (Preferred Alternative):** Continue to store LANL Pu material in the modified NMSF in stabilized form pursuant to DNFSB Recommendation 94-1.
- **Upgrade Alternative:** This storage alternative does not apply to LANL.
- **Consolidation Alternative:** This storage alternative does not apply to LANL.
- **Collocation Alternative:** This storage alternative does not apply to LANL.
- **Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials:** This storage subalternative does not apply to LANL.
- **Phaseout:** LANL Pu material would be moved out of LANL to the upgrade, consolidation, or collocation sites (located at another DOE site) or to disposition (for surplus Pu).

4.2.8.1 Land Resources

Preferred Alternative: No Action Alternative

Under this alternative, LANL would continue to store Pu material in the upgraded NMSF in stabilized form pursuant to DNFSB Recommendation 94-1. The ongoing (no new action) activities conform with present and future land-use plans, policies, and controls; therefore, no direct or indirect impacts to land resources would be anticipated beyond those of existing and future activities that are independent of the proposed action.

Phaseout

No new construction or upgrade of existing facilities would occur under the phaseout of the Pu mission at LANL. Pu material would be moved out of LANL to the upgrade, consolidation or collocation sites, or to disposition. Potential impacts on visual resources could occur if facilities are not maintained.

4.2.8.2 Site Infrastructure

For selected site infrastructure parameters, Table 4.2.8.2–1 shows the site availability, projected usage under No Action, and projected usage following phaseout of surplus Pu storage at LANL. Adequate infrastructure is available to accommodate all projected site missions.

Table 4.2.8.2–1. Site Infrastructure Changes Required for Operation at Los Alamos National Laboratory (Annual)—No Action (2005) and Storage Phaseout

	Transportation		Electrical			Fuel	
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
No Action							
Site Availability	137	0	500,000	100	0	103,368,000	0
Projected usage	137	0	381,425	87	0	43,414,560	0
Amount required in excess of site availability	0	0	0	0	0	0	0
Phaseout							
Projected usage with storage phaseout	137	0	381,425	87	0	43,414,560	0
Amount required in excess of site availability	0	0	0	0	0	0	0

Source: LANL 1995b:1.

Preferred Alternative: No Action Alternative

Under No Action, weapons-usable Pu materials would be stabilized pursuant to DNFSB Recommendation 94-1, with all identified Pu ES&H vulnerabilities addressed in accordance with LANL's proposed *Corrective Action Plan*. Consistent with this plan, Pu materials not required for operational use would be stored in the renovated NMSF.

Phaseout

Phaseout of the Pu storage mission at LANL would have no impact on the existing facilities and site infrastructure. The storage facilities would remain for operational use, and utility consumption would remain constant.

4.2.8.3 Air Quality and Noise

Activities associated with the No Action Alternative would generate criteria and toxic/hazardous pollutants. The Pu Storage Phaseout Alternative would result in a decrease of criteria and toxic/hazardous pollutants over the No Action Alternative. To evaluate the air quality impacts at LANL, criteria and toxic/hazardous concentrations from the No Action Alternative are compared with Federal and State standards and guidelines. Impacts from radiological airborne emissions are described in Section 4.2.8.9.

Emission rates attributed to site operations (No Action) are presented in Table F.1.2.9–1. Air pollutant emission sources associated with operations include the following:

- Operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- Exhaust and road dust generated by vehicles delivering supplies and bringing employees to work
- Toxic/hazardous pollutant emissions from facilities processes

Noise impacts during phaseout are expected to be low. Air quality and noise impacts for each alternative are described separately. Supporting data for the air quality and noise analyses are presented in Appendix F.

AIR QUALITY

An analysis was conducted of the potential air quality impacts of emissions for the Pu Storage Phaseout Alternative as described in Section 4.1.3.

Section 176 (c) of the 1990 CAA amendments requires that all Federal actions conform with the applicable SIP. The EPA has implemented rules that establish the criteria and procedures governing the determination of conformity for all Federal actions in nonattainment and maintenance areas. These are discussed in Section 4.1.3. The attainment status of the area in which LANL is located is discussed in Section 3.9.3. Since the area is considered to be an attainment area for the criteria pollutants, the proposed actions at this site do not require that a conformity analysis be performed.

Preferred Alternative: No Action Alternative

This alternative utilizes estimated air emissions data from total site operations at LANL, assuming continuation of site missions to calculate pollutant concentrations at or beyond the LANL site boundary. The emission rates for criteria and toxic/hazardous pollutants for No Action are presented in Table F.1.2.9–1. Table 4.2.8.3–1 presents the No Action concentrations calculated from the 2005 emission rates. In this table, pollutant concentrations are compared with applicable Federal and State regulations and guidelines. Concentrations are expected to remain within these standards.

Phaseout

Phaseout of existing Pu inventories as a result of consolidating Pu at another site is expected to result in a small reduction in air pollutant concentrations from the No Action concentrations. Concentrations are expected to remain within the standards.

Table 4.2.8.3–1. Estimated Operational Concentrations of Pollutants at Los Alamos National Laboratory and Comparison With Most Stringent Regulations or Guidelines—No Action (2005)

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines ($\mu g/m^3$)	No Action ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	7,689[a]	115
	1-hour	11,578[a]	630
Lead	Calendar Quarter	1.5[b]	<0.01
Nitrogen dioxide	Annual	73[a]	3.8
	24-hour	145[a]	[c]
Ozone	1-hour	235[b]	[d]
Particulate matter	Annual	50[b]	8
	24-hour	150[b]	21
Sulfur dioxide	Annual	40[a]	1.3
	24-hour	202[a]	[c]
	3-hour	1,300[b]	[c]
Mandated by New Mexico			
Hydrogen sulfide	1-hour	11[a]	[c]
Total reduced sulfur	30-minute	3[a]	[c]
Total suspended particulates	Annual	60[a]	8
	30-day	90[a]	<21
	7-day	110[a]	<21
	24-hour	150[a]	21
Hazardous and Other Toxic Compounds			
Acetic acid	8-hour	250[a]	2.87
Ammonia	8-hour	180[a]	4.27
2-Butoxyethanol	8-hour	1,200[a]	0.66
Chloroform	8-hour	[e]	2.61
Ethyl acetate	8-hour	14,000[a]	0.44
Ethylene glycol	8-hour	[e]	0.39
Formaldehyde	8-hour	[e]	0.24
Heptane (N-heptane)	8-hour	[e]	9.06
Hexane (N-hexane)	8-hour	[e]	0.41
Hydrogen chloride	8-hour	[e]	3.41
Hydrogen fluoride	8-hour	[e]	1.29
Isopropyl alcohol	8-hour	9,800[a]	2.88
Kerosene	8-hour	[e]	1.27
Methyl alcohol	8-hour	[e]	3.14
Methyl ethyl ketone	8-hour	[e]	9.95
Methylene chloride	8-hour	[e]	5.90
Nickel	8-hour	10[a]	0.27
Nitric acid	8-hour	50[a]	3.53
Nitrogen oxide	8-hour	[e]	2.29
Propane sultone	8-hour	400[a]	1.00
Stoddard solvent	8-hour	5,250[a]	1.41
Toluene	8-hour	[e]	13.26

Table 4.2.8.3–1. Estimated Operational Concentrations of Pollutants at Los Alamos National Laboratory and Comparison With Most Stringent Regulations or Guidelines—No Action (2005)—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines ($\mu g/m^3$)	No Action ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (continued)			
Tungsten (as W) (insoluble)	8-hour	50[a]	0.53
1,1,2-Trichloroethane	8-hour	[e]	4.95
Trichloroethylene	8-hour	[e]	1.12
VM&P naphtha	8-hour	13,500[a]	3.27
Xylene	8-hour	[e]	9.41

[a] State standard or guideline. The conversion from ppm to mg/m^3 for ambient air quality standards is calculated with the corrections for temperature (21 °C) and pressure (elevation) (2,250 m MSL).

[b] Federal standard.

[c] No monitoring data available, concentration assumed less than applicable standard.

[d] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[e] No State standard for indicated averaging time.

Source: 40 CFR 50; LANL 1994a; NM EIB 1995a; NM EIB 1996a.

NOISE

The location of the fissile materials storage facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Traffic would occur onsite and along offsite large and regional transportation routes used to bring materials and workers to the site.

Preferred Alternative: No Action Alternative

Nontraffic noise sources associated with continued interim storage and other ongoing missions are the same as described in Section 3.9.3. The continuing operations at LANL would result in no appreciable change from current levels in traffic noise and onsite operational noise. Nontraffic noise sources are located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public due to the size of the site. Some noise sources may result in impacts, such as disturbance of wildlife.

Phaseout

A reduction in noise levels associated with facility operations may result from the phaseout of storage facilities.

4.2.8.4 Water Resources

Impacts associated with the No Action and phaseout of Pu storage facilities at LANL would not affect water resources. The vast majority of water used at LANL would be to continue to be supplied by three DOE-owned well fields. Wastewater would continue to be discharged to Los Alamos, Sandia, and Mortandad Canyons. Table 4.2.8.4–1 presents No Action water resources uses and discharges and the potential changes to water resources at LANL resulting from phaseout.

Table 4.2.8.4–1. No Action and Potential Changes to Water Resources at Los Alamos National Laboratory—No Action (2005) and Storage Phaseout

Affected Resource Indicator	No Action	Phaseout
Water Source	Ground	Ground
Construction		
Water Availability and Use		
Total water requirements (million l/yr)	NA[a]	0
Percent increase in projected water usage[b]	NA[a]	0
Water Quality		
Total wastewater discharge (million l/yr)	NA[a]	0
Percent change in wastewater discharge[c]	NA[a]	0
Operation		
Water Availability and Use		
Total water requirements (million l/yr)	5,760[a]	0
Percent increase in projected water usage[d]	0	0
Water Quality		
Total wastewater discharge (million l/yr)	693	0
Percent change in wastewater discharge[e]	0	0
Floodplain		
Is action in 100-year floodplain?	No	No
Is critical action in 500-year floodplain?	No	No

[a] See operations section of table for No Action water data.

[b] Percent increase in projected water usage during phaseout at LANL is calculated by dividing No Action water requirements (5,760 million l/yr) with that for storage phaseout (0 l/yr).

[c] Percent change in wastewater discharge during phaseout at LANL is calculated by dividing No Action water discharges (693 million l/yr) with that for storage phaseout (0 l/yr).

[d] Percent increase in projected water usage during operation at LANL is calculated by dividing No Action water requirements (5,760 million l/yr) with that for storage phaseout (0 l/yr).

[e] Percent change in wastewater discharge during operation at LANL is calculated by dividing No Action water discharges (693 million l/yr) with that for storage phaseout (0 l/yr).

Note: NA=not applicable.

Source: LANL 1995b:1.

Preferred Alternative: No Action Alternative

Surface Water. A description of the activities that would continue at LANL is provided in Section 3.9. For No Action, treated wastewater discharged to Los Alamos, Sandia, and Mortandad Canyons is expected to remain at 693 million l/yr (183 million gal/yr). No surface water would be withdrawn for drinking water or facility operations.

Groundwater. Under this alternative, minimal impacts to groundwater resources are anticipated. Groundwater withdrawals are expected to increase from 5,519 million l/yr to 5,760 million l/yr (1,460 million gal/yr to 1,520 million gal/yr). No additional impacts to groundwater quality are expected because there are no direct discharges to groundwater.

Phaseout

Phaseout of Pu storage at LANL would not involve any new construction. Because existing facilities are not located in the 100- or 500-year floodplains, phaseout would not affect floodplains.

Surface Water. The phaseout would not result in an incremental change in the total wastewater volume handled at LANL. No impacts to flow or water quality of the receiving canyons would occur. There would be no impact to surface waters from phaseout activities.

Groundwater. The phaseout would not result in an incremental change in the total volume of groundwater withdrawn at LANL. No impacts to groundwater availability would occur. A minor beneficial impact on groundwater resources would occur due to the lessened potential for degradation of water quality. Spill protection systems and plans exist to contain and minimize effects of releases of hazardous substances during phaseout activities. Given normal safeguards and procedures, no impact to groundwater quality would be expected to result from activities associated with the phaseout of Pu storage functions at LANL.

4.2.8.5 Geology and Soils

Impacts to the geologic and soil resources occur during, or as a result of, ground-disturbing activities. LANL is considered only for the No Action Alternative and under the phaseout process. As discussed below, neither of these activities involves new construction and therefore would have no effect on geologic and soil resources at the site.

Preferred Alternative: No Action Alternative

Under the No Action Alternative, DOE would continue current and ongoing activities at LANL. There would be no new ground-disturbing activities beyond those already associated with existing and future site improvements. Because no new construction (associated with this program) or associated ground disturbance for potential soil erosion would occur, the No Action Alternative would have no effect on geologic or soil resources at the site.

Phaseout

The phaseout of storage capacity would have no apparent effects on the geology. However, phaseout could result in beneficial effects on the soils of the area. Hazardous, radioactive and mixed waste sources would be reduced or eliminated from the area, thus decreasing the potential for future soil contamination.

4.2.8.6 Biological Resources

Preferred Alternative: No Action Alternative

The Pu storage mission described in Section 2.2.8 would continue at LANL. This would result in no appreciable change in current conditions of biological resources at LANL as described in Section 3.9.6.

Phaseout

Pu materials at LANL would be phased out of operation. The phaseout of Pu storage facilities is not expected to affect biological resources, although increased human activity could temporarily disturb some wildlife species in the vicinity of the site.

4.2.8.7 Cultural and Paleontological Resources

Preferred Alternative: No Action Alternative

Under this alternative, DOE would continue the existing and planned mission at LANL. This includes continued storage of Pu material in the upgraded NMSF in stabilized forms pursuant to DNFSB Recommendation 94-1. Any impacts to cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate NHPA, *American Indian Religious Freedom Act*, and *Native American Graves Protection and Repatriation Act* regulatory compliance procedures.

Phaseout

For this alternative, all Pu materials at LANL within the scope of this PEIS would be transferred to another site and the storage mission would be phased out. Impacts to prehistoric resources are not anticipated because phaseout is not expected to result in ground-breaking activity. None of the formations within LANL are known to be fossiliferous, so no effects to paleontological resources are expected either. Phaseout may affect, through alteration, if subsequently proposed, some of the historic structures at LANL that have been identified as NRHP-eligible. Native American resources are not expected to be affected.

4.2.8.8 Socioeconomics

Preferred Alternative: No Action Alternative

Regional Economy Characteristics. Total employment in the REA is projected to increase less than 2 percent annually between 1995 and 2000, reaching 122,000 in the latter year. Long-range projections indicate slower growth after the year 2000, when employment would increase over 1 percent annually and reach approximately 179,300 persons in 2040. Unemployment in the REA was 6.2 percent in 1994 and is expected to remain at this level into the near future. Per capita income is projected to increase from approximately $18,259 in 1995 to $29,221 in 2040. Projections for the No Action Alternative are presented in Table L–73.

Population and Housing. Population in the ROI is projected to increase from approximately 169,900 in 1995 to 272,000 by 2040. The total number of housing units in the ROI is projected to increase from about 71,100 in 1995 to 113,900 in 2040. Population and housing projections for the No Action Alternative are presented in Tables L–74 and L–75, respectively.

Community Services. Education, public safety, and health care characteristics are used to assess the level of community services in the LANL ROI. School enrollments are projected to increase from about 26,310 students in 1995 to 42,130 students by 2040. The current student-to-teacher ratio is 17.3:1. To maintain this level of service, the number of teachers in the ROI would need to increase from approximately 1,518 in 1995 to 2,431 in 2040. These projections are presented in Tables L–76 and L–77.

The projected numbers of sworn police officers and firefighters serving in ROI communities over the period 1995 to 2040 are shown in Tables L–78 and L–79, respectively. Under No Action, the number of sworn police officers is projected to increase from approximately 267 in 1995 to 428 in 2040 to maintain the current service level of 1.6 sworn officers per 1,000 persons. The number of firefighters in the ROI would need to increase from about 800 in 1995 to 1,280 in 2040 to maintain the present service level of 4.7 firefighters per 1,000 persons.

Hospital occupancy rates are based on current capacity. These rates and the estimated number of practicing physicians serving the ROI population between 1995 and 2040 are presented in Tables L–80 and L–81, respectively. Hospital occupancy rates are projected to increase from approximately 32 percent in 1995 to 51 percent in 2040. To maintain the current physician-to-population ratio of 1.9 per 1,000 persons, the total number of physicians in the ROI would need to increase from approximately 316 in 1995 to 506 in 2040.

Local Transportation. Any increases in traffic would be due to projected growth in the area unrelated to DOE activities. The only alternative considered at LANL is Phaseout which involves no change in employment. Since there would be no impacts, modeling was not performed.

Phaseout

Phasing out of Pu storage at LANL would result in no loss of jobs in the REA. Workers currently employed in this storage area would be relocated to other areas. Thus, the socioeconomic effects for Phaseout would be the same as discussed under No Action (Socio 1996a).

4.2.8.9 Public and Occupational Health and Safety

Assessments have been made of potential radiological and chemical impacts associated with the No Action Alternative at LANL. A discussion of reduced impacts associated with the phaseout of existing Pu storage is also presented. Summaries of radiological impacts from normal operations are presented in Tables 4.2.8.9–1 and 4.2.8.9–2 for the public and workers, respectively. Impacts from hazardous chemicals are presented in Table 4.2.8.9–3. Impacts associated with postulated accidents are addressed in this section.

Preferred Alternative: No Action Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the current sitewide mission including interim storage of Pu at LANL. The section describes the impacts from normal operation, then describes the potential risks of impacts from facility accidents.

The impacts on the public and on workers under the No Action Alternative during normal operation at LANL would be within applicable regulatory limits.

Normal Operation. The current mission at LANL, where Pu is in interim storage, is described in Section 3.9. The site has identified those facilities that will continue to operate under the No Action Alternative, including interim Pu storage facilities. Radiological and chemical impacts on the public and workers at LANL are described below.

Radiological Impacts. The calculated annual dose to the average and maximally exposed members of the public, the associated fatal cancer risks to these individuals from 50 years of total site operation, the dose to the population within 80 km (50 mi) from total site operation in the year 2030, and the projected number of fatal cancers in this population from 50 years of operation are presented in Table 4.2.8.9–1 under this alternative at LANL. The annual dose of 6.5 mrem to the MEI is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The annual dose of 2.7 person-rem to the population would be within the limit in proposed 10 CFR 834. To put operational dose impacts into perspective, comparisons with doses from natural background radiation are included in the table.

The Pu storage component of the No Action Alternative is not expected to contribute to public impacts since the radiological releases from storage are anticipated to be virtually zero.

The average annual dose to a site worker and the associated risk of fatal cancer from 50 years of total site operations, and the annual dose to the total site workforce and the projected number of fatal cancers from 50 years of total site operations, are presented in Table 4.2.8.9–2 for the No Action Alternative at LANL.

Hazardous Chemical Impacts. Hazardous chemical impacts on the public resulting from the normal operation under No Action at LANL are presented in Table 4.2.8.9–3. The noncancerous health effects expected and the risk of cancer due to the total chemical exposures, must be estimated for each site. Since the major releases due to normal operation at LANL would make up nearly all of the exposures to onsite workers and to the public in adjacent communities, contributions to the hazardous chemical concentrations from all other sources, for example, industrial operations, are considered negligible for purposes of risk calculations.

The HI for the MEI of the public at LANL resulting from normal operation under the No Action Alternative is 3.0×10^{-2}, and the cancer risk is 5.2×10^{-6}. The HI to the onsite worker is 4.7×10^{-2}, and the cancer risk is 1.5×10^{-4}.

Facility Accidents. Under the No Action Alternative, Pu would continue to be stored at the site in existing facilities. These facilities currently operate in accordance with DOE Orders which ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations will be in accordance with the

Table 4.2.8.9–1. Potential Radiological Impacts to the Public During Normal Operation at Los Alamos National Laboratory—No Action

Receptor	No Action
Annual Dose to the Maximally Exposed Individual Member of the Public[a]	
Atmospheric release pathway (mrem)	5.7
Drinking water pathway (mrem)	0
Total liquid release pathway (mrem)	0.80
Atmospheric and liquid release pathways combined (mrem)	6.5
Percent of natural background[b]	1.9
50-year fatal cancer risk	1.6×10^{-4}
Population Dose Within 80 Kilometers for Year 2030[c]	
Atmospheric release pathways (person-rem)	2.7
Total liquid release pathways (person-rem)	-0[d]
Atmospheric and liquid release pathway combined (person-rem)	2.7
Percent of natural background[b]	2.8×10^{-3}
50-year fatal cancers	0.068
Annual Dose to the Average Individual Within 80 Kilometers[e]	
Atmospheric and liquid release pathways combined (mrem)	9.7×10^{-3}
50-year fatal cancer risk	2.4×10^{-7}

[a] The applicable radiological limits for an individual member of the public from site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway as required by the SDWA; and 100 mrem per year from all pathway combined. Refer to DOE Order 5400.5.

[b] The annual natural background radiation level at LANL is 342 mrem for the average individual; the population within 80 km in the year 2030 receives 95,000 person-rem.

[c] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined.

[d] Although the maximally exposed individual receives a dose, no population groups are exposed to any liquid pathways.

[Text deleted.]

[e] Obtained by dividing the population dose by the number of people projected to live within 80 km of the site in 2030 (278,000).

Note: It is assumed that these doses will not be exceeded in the future under the No Action Alternative. Further, impacts from the Pu storage component of the No Action Alternative are taken to be zero (refer to the text).

Source: LANL 1995s.

Table 4.2.8.9–2. Potential Radiological Impacts to Workers During Normal Operation at Los Alamos National Laboratory—No Action

Receptor	No Action
Involved Workforce[a]	
Average worker dose (mrem/yr)[b]	250
50-year risk of fatal cancer	5.0×10^{-3}
Total dose (person-rem/yr)	12.5
50-year fatal cancers	0.25
Noninvolved Workforce[c]	
Average worker dose (mrem/yr)[b]	32
50-year risk of fatal cancer	6.4×10^{-4}
Total dose (person-rem/yr)	183
50-year fatal cancers	3.7
Total Site Workforce[d]	
Dose (person-rem/yr)	196
50-year fatal cancers	3.9

[a] The involved worker is a worker associated with operations of interim Pu storage. It is assumed that there are 50 workers, badged with dosimeters to monitor radiation exposure, with a conservatively estimated average dose of 250 mrem/yr per worker. However, an effective ALARA program will ensure that the exposure will be reduced to that level which is as low as reasonably achievable.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem/yr (DOE 1992t); the site must make reasonable attempts to maintain doses below this level.

[c] The noninvolved worker is a worker onsite but not associated with interim Pu storage operations. The projected number of noninvolved badged workers in 2005, and beyond, is 5,720.

[d] The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: DOE 1993n:7.

Table 4.2.8.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation at Los Alamos National Laboratory—No Action

Receptor	No Action
Maximally Exposed Individual (Public)	
Hazard Index[a]	3.0×10^{-2}
Cancer risk[b]	5.2×10^{-6}
Worker Onsite	
Hazard Index[c]	4.7×10^{-2}
Cancer risk[d]	1.5×10^{-4}

[a] Hazard Index for MEI: sum of individual Hazard Quotients (noncancerous health effects) for MEI.

[b] Cancer risk for MEI=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (slope factor [SF]).

[c] Hazard Index for workers: sum of individual Hazard Quotients (noncancerous health effects) for workers.

[d] Cancer risk for workers= (emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237[fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (SF).

Source: Section M.3, Table M.3.4–27.

DOE safety goals. The safety to workers and the public from accidents at existing facilities is also controlled by Technical Safety Requirements specified in detail in a SAR or Basis for Interim Operations document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities would cause a halt in operations until it can be established that worker and public safety has not been compromised.

Phaseout

Normal Operation. There are virtually no radiological or hazardous chemical releases associated with the storage of Pu at LANL under the No Action Alternative. Therefore, the phaseout of the Pu storage would not result in any impact changes. All workers involved in the removal of Pu from LANL would be monitored to ensure that their doses remain within acceptable levels.

Facility Accidents. The phaseout operation will be conducted in accordance with DOE Orders to ensure that the risk to the public of prompt fatalities due to accidents or of cancer fatalities due to operations will be minimized. For current operations in the facility that would be phased out, the safety of workers and the public from accidents is controlled by Technical Safety Requirements that are specified in SARs or Basis for Interim Operations documents that have been prepared for the facility. Prior to initiating phaseout, the potential for accidents that could impact workers and the public will be assessed and, if necessary, applicable existing safety documentation will be modified to ensure safety for workers and the public.

4.2.8.10 Waste Management

This section summarizes the impacts on wastes management at LANL under No Action and the phaseout of Pu storage. There is no spent nuclear fuel or HLW associated with Pu storage. Table 4.2.8.10-1 lists the projected waste generation rates and treatment, storage, and disposal capacities under No Action for 2005. Projections for No Action were derived from the most recent available environmental data, with appropriate adjustments made for those changing operational requirements where the volume of wastes generated are identifiable. The projection does not include wastes from future, yet uncharacterized, environmental restoration activities. The projections for No Action could change depending on decisions resulting from the PEIS on waste management being prepared by the Department. Facilities that would support the storage of Pu would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with RCRA and other relevant statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated and disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice.

Preferred Alternative: No Action Alternative

Under No Action, TRU, low-level, mixed, hazardous, and nonhazardous wastes would continue to be generated at LANL from the missions outlined in Section 3.9. LANL would continue to treat, store, and dispose of its legacy and newly generated wastes in current and planned facilities. Waste management activities at LANL are categorized as regulatory compliance and project administration, waste minimization, waste treatment, waste storage, and waste disposal. Within each category of waste management activity, various wastes are handled according to waste type as defined by various DOE Orders, as well as Federal and State regulations. Applicable permitting, treatment, storage, and disposal requirements are determined according to these waste types.

Liquid TRU waste would continue to be generated at the Plutonium Facility (TA-55). The residual TRU waste sludge that remains after treatment would continue to be loaded into 208-l (55-gal) steel drums, solidified, and transported to Area G for storage. Solid TRU waste would be characterized, certified to meet the current planning-basis criteria for acceptance at WIPP or an alternative treatment level, and placed in storage at Area G pending decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste and the approval of WIPP as a repository for these wastes pursuant to the requirements of 40 CFR 191 and 40 CFR 268. A new planned facility for characterizing and processing solid TRU waste is projected to be operational in 2006.

Liquid LLW would be neutralized and solidified in two onsite treatment facilities. Depending on decisions from the site-wide EIS, solid LLW would be compacted, packaged, and stored for disposal either in an onsite, expanded Area G LLW burial site or through other disposal options. Liquid mixed waste would undergo neutralization/pH adjustment, oxidation/reduction, precipitation, chelation/flocculation, and filtration. Both liquid and solid mixed waste would be treated and disposed of according to the LANL Site Treatment Plan that was developed pursuant to the *Federal Facility Compliance Act*. The resulting waste would then be stored in a RCRA-permitted facility in DOT-approved containers until it is shipped to an offsite DOE disposal facility. Some of this waste would be placed in interim storage until new technologies for treatment and disposal are identified and evaluated. Liquid sanitary wastes would be treated by a consolidation and collection system and discharged to NPDES permitted sanitary tile fields. Solid nonhazardous waste would be disposed of in a regional commercial disposal facility.

Table 4.2.8.10–1. Projected Waste Management Under No Action (2005) at Los Alamos National Laboratory

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Transuranic							
Liquid	0.1	Pretreatment at TA-50: neutralization, clariflocculation, filtration, precipitation, cement mixing	132,659	NA	NA	NA	NA
Solid	54	Volume reduction	51,989	Storage pads at TA-54, modified LLW burial pits and shafts	24,355	None: Federal repository in the future	None
Mixed Transuranic							
Liquid	None	Included in TRU	Included in TRU	NA	NA	NA	NA
Solid	255	Included in TRU	Included in TRU	Included in TRU	Included in TRU	None: Federal repository in the future	None
Low-Level							
Liquid	21,400	Chemical treatment and ion-exchange, solidification; and volume reduction (vial crusher)	45 m^3/hr	Chemical and Ion-Exchange Plant at TA-50 and the Chemical Plant at TA-21	663	Treatment effluent is discharged to the environment. Residual sludge is solidified and disposed of at TA-54, Area G as solid LLW	None
Solid	2,690	Compaction	76	TA-54 in Area G	Variable	Currently solid LLW goes to TA-54, Area G for burial. Continued construction at Area G under evaluation in the site-wide EIS	24 to 28 ha
Mixed Low-Level							
Liquid	0	Neutralization, precipitation, oxidation, thermal treatment; solidification; volume reduction; liquid scintillation cocktail vials	Capabilities under development per site treatment plan	RCRA-permitted bldgs. (not built yet) and interim status container storage areas	583	NA	None

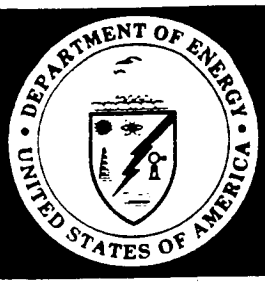
Table 4.2.8.10–1. Projected Waste Management Under No Action (2005) at Los Alamos National Laboratory—Continued

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Solid	45	None	Capabilities under development per site treatment plan	TA-54, Area L, or G	1,864	Capabilities under development as per Site Treatment Plan for Mixed Wastes	None
Hazardous							
Liquid	273	Thermal treatment, treatment tanks, neutralization, precipitation, and evaporation	Varies depending on the waste stream	Thermal treatment TAs-14, -15, -16, - 36, and - 39 and storage and treatment at TA-54, Area L	502	Offsite	NA
Solid	669	Thermal treatment and flashpad	Varies depending on the waste stream	Thermal treatment TAs-14, -15, -16, - 36, and - 39 and storage and treatment at TA-54, Area L	502	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	692,827	Filtration, settling, and stripping	1,060,063	NA	NA	Permitted discharge sanitary tile fields	2,271,240 liters/day
Solid	5,453	None	None	NA	NA	Offsite county landfill and onsite landfill Area J	NA
Nonhazardous (Other)							
Liquid	Included in sanitary	See sanitary	Included in sanitary	NA	NA	See sanitary	Included in sanitary
Solid	Included in sanitary	None	None	NA	NA	See sanitary	NA

Note: NA=not applicable.
Source: LANL 1990a; LANL 1994b.

Phaseout

Upgrades to facilities at the site may be required in order to ensure compliance with all applicable Federal and State laws, DOE Orders, and standing agreements during the transition. The small amount of waste associated with Pu storage would no longer be generated.



Office of
Fissile Materials Disposition

United States Department of Energy

Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Volume II - Part B

December 1996

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Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Volume II - Part B

United States Department of Energy
Office of Fissile Materials Disposition

December 1996

FOREWORD

This is the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (PEIS), prepared by the U.S. Department of Energy, Office of Fissile Materials Disposition. The document is composed of four volumes and a separate Summary. Changes made since the Draft PEIS are shown by change bar notation (vertical lines adjacent to the changes) in this Final PEIS for both text and tables. Deletion of one or more sentences is indicated by the phrase "Text deleted." in brackets. This Final PEIS includes the Preferred Alternative, which is a combination of alternatives. The Preferred Alternative is described in Section 1.6 and Chapter 2 of Volume I, and analyzed in Chapter 4 of Volume II. For all the alternatives, including the Preferred Alternative, a comparison of alternatives is presented in Section 2.5 of Volume I and a summary of impacts is presented in Section 4.6 of Volume II (Part B). Information from these sections is also presented in the Summary.

Volume I contains Chapters 1 through 3 of the PEIS. Chapter 1 includes a description of the history and background of the fissile materials disposition program, the purpose of and need for the proposed action, a summary of changes made to the Draft PEIS, and the Preferred Alternative. Chapter 2 gives a description of the proposed long-term storage and disposition alternatives, a description of how the alternatives were selected and why others were eliminated from further consideration, and a comparison of the alternatives in terms of their potential environmental impacts. Chapter 3 describes the affected environment at candidate long-term storage locations, and at sites and environmental settings for the disposition alternatives.

Volume II (Parts A and B) contains Chapters 4 through 10 of the PEIS. Chapter 4 describes the potential environmental impacts resulting from construction and operation of the proposed long-term storage and disposition alternatives, including the Preferred Alternative. Also contained in this chapter are intersite transportation impacts, a discussion of environmental justice issues, cumulative impacts due to the implementation of the proposed alternatives in addition to other actions at a site, avoided environmental impacts, and a summary of impacts. Chapter 5 provides a list of references used in the preparation of this document. Chapter 6 provides an index to the main text of the PEIS. Chapter 7 is a glossary of key terms used in the document. Chapter 8 is a list of preparers. Chapter 9 lists government agencies and organizations contacted during the preparation of this PEIS. Chapter 10 provides a distribution list for the document.

Volume III contains the appendices to this PEIS. Appendix A contains the fact sheet on the President's *Nonproliferation and Export Control Policy*, and the Joint Statement Between the United States and Russia on Nonproliferation. Appendix B provides specifications for key buildings within each facility complex analyzed in this PEIS. Appendix C describes requirements for construction and operation of the various facilities required to accomplish the storage and disposition activities essential to the alternatives described in this PEIS. Appendix D provides information on overall water usage for the storage and disposition facilities discussed in this PEIS. Appendix E gives a general overview of the Department of Energy (DOE) environmental restoration and waste management program, baseline waste management at DOE sites, and project-specific waste management activities associated with the proposed long-term storage and disposition alternatives. Appendix F provides detailed data supporting the air quality and noise analyses. Appendix G describes the methodology used for intersite transportation risk analysis and provides a summary of hazardous materials shipped to and from DOE sites, plus information on shipping containers. Appendix H evaluates various plutonium waste forms for potential disposal in a high-level waste repository. Appendix I describes operations of a Canadian Deuterium Uranium Reactor. Appendix J identifies the compliance requirements associated with the Proposed Action, as specified by the major Federal and State environmental, safety, and health statutes, regulations, and orders. Appendix K lists the scientific names of common nonthreatened and nonendangered animal and plant species identified in Chapters 3 and 4. Appendix L includes the supporting data used for assessing the No Action

Alternative in the socioeconomics sections of this PEIS. Appendix M presents detailed information on the potential health risks associated with releases of radioactivity and hazardous chemicals from the proposed storage and disposition alternatives during normal operations and from postulated accidents. Appendix N describes different concepts for, and provides cost and benefit information on, the multipurpose reactor. Appendix O provides a description of facilities and operations for a can-in-canister approach to plutonium immobilization at the Savannah River Site in South Carolina. Appendix P describes the potential environmental impacts of using the Manzano Weapons Storage Area in New Mexico for the long-term storage of plutonium pits. Appendix Q identifies the potential health impacts from the storage of Rocky Flats Environmental Technology Site plutonium pits at the Pantex Plant in Texas. Appendix R discusses the aircraft crash and radioactive release probabilities for proposed storage and disposition facilities at Pantex Plant in Texas. A separate Classified Appendix was also prepared, which provides detailed analysis results for intersite transportation risks based on classified inventories of materials stored at DOE sites.

Volume IV (Parts A and B) is the Comment Response Document. It contains an overview of the public comment process, the comments received on the Draft PEIS during the public review period, and the DOE responses to those comments, including identifying changes made to the Draft PEIS in response to public comments.

The Summary provides a brief overview of the PEIS. It includes the purpose of and need for the Proposed Action, a description of the storage and disposition alternatives including the Preferred Alternative, and the potential environmental impacts resulting from these alternatives.

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LIST OF ACRONYMS AND ABBREVIATIONS

AADT	Average Annual Daily Traffic
ACEC	Area of Critical Environmental Concern
ACGIH	American Conference of Governmental Industrial Hygienists
AEA	*Atomic Energy Act*
AEC	Atomic Energy Commission
AGV	automated guided vehicle
ALARA	as low as reasonably achievable
ALE	Arid Lands Ecology Reserve
ANL-W	Argonne National Laboratory-West
APSF	Actinide Packaging and Storage Facility
AQCR	Air Quality Control Region
ARA	Auxiliary Reactor Area
ARIES	Advanced Recovery and Integrated Extraction System
BEA	Bureau of Economic Analysis
BEIR	biological effects of ionizing radiation
BLM	Bureau of Land Management
BOP	balance-of-plant
BPA	Bonneville Power Administration
BWR	boiling water reactor
CAA	*Clean Air Act*
CANDU	Canadian deuterium uranium
CAS	Chemical Abstracts Service
CCDF	complimentary cumulative distribution function
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
CI	confidence interval
CIC	can-in-canister
CLUP	Comprehensive Land-Use Plan
CMR	Chemistry and Metallurgy Research

COE	Corps of Engineers
Complex	Nuclear Weapons Complex
CRD	Comment Response Document
CRT	Cargo Restraint Transporters
CWA	*Clean Water Act*
D&D	decontamination and decommissioning
DAF	Device Assembly Facility
DCG	derived concentration guide
DHLW	defense high-level waste
DNB	departure of nucleate boiling
DNFSB	Defense Nuclear Facilities Safety Board
DNL	day and night average sound levels
DNWR	Desert National Wildlife Range
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DP	Office of Defense Programs
DRCOG	Denver Regional Council of Governments
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EBR	Experimental Breeder Reactor
EDNA	Environmental Design for Noise Abatement
EIA	Energy Information Administration
EIS	environmental impact statement
EM	Office of Environmental Management
EPA	Environmental Protection Agency
ERR	excess relative risk
ES&H	Office of Environment, Safety, and Health
ESA	*Endangered Species Act*
ETF	effluent treatment facility
FAIR	Forest, Agriculture, Industry, and Research
FCF	Fuel Cycle Facility
FEMA	Federal Emergency Management Agency
FFCA	Federal Facility Compliance Agreement
FFTF	Fast Flux Test Facility

FLPMA	*Federal Land Planning Management Act*
FMEF	Fuels and Materials Examination Facility
FMF	Fuel Manufacturing Facility
FONSI	Finding of No Significant Impact
FR	Federal Register
FSAR	Final Safety Analysis Report
GBZ	Glass-bonded zeolite
GESMO	Generic Environmental Statement on Mixed Oxide
GIS	Geographical Information System
GMA	*Growth Management Act*
GMODS	Glass Material Oxidation Dissolution System
HAD	hazard analysis document
Hanford	Hanford Site
HE	high explosives
HEAST	Health Effects Summary Table
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HEU EIS	*Disposition of Surplus Highly Enriched Uranium Environmental Impact Statement*
HFEF	Hot Fuel Examination Facility
HI	Hazard Index
HLW	high-level waste
HQ	Hazard Quotient
HRA EIS	*Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan*
HVAC	Heating Ventilation and Air Conditioning
HWR	Heavy Water Reactor
IAEA	International Atomic Energy Agency
ICPP	Idaho Chemical Processing Plant
ICRP	International Commission of Radiological Protection
INEL	Idaho National Engineering Laboratory
IRIS	Integrated Risk Information System
ISCST2	Industrial Source Complex Short-Term Model Version 2
ISO	International Standards Organization
IWG	Interagency Working Group
K-25	K-25 Site

L/ER	Energy Research Program Office
LA	Limited Area
LAA	Limited Access Area
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Scattering Center
LCF	latent cancer fatalities
LDR	Land Disposal Restriction
LEU	low-enriched uranium
LIGO	Laser Interferometer Gravitational-Wave Observatory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LOB	Laboratory Office Building
LWR	Light Water Reactor
MAA	Material Access Area
MACCS	Melcor Accident Consequence Code System
MC&A	Material Control and Accountability
MD	Office of Fissile Materials Disposition
MEI	maximally exposed individual
MHR	Modular Helium Reactor
MMI	Modified Mercalli Intensity
MOX	mixed oxide
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAGPRA	*Native American Graves Protection and Repatriation Act*
NAS	National Academy of Sciences
NCDC	National Climatic Data Center
NCRP	National Commission of Radiological Protection
NEIC	National Earthquake Information Center
NEPA	*National Environmental Policy Act*
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFS	Nuclear Fuel Services Fuel Fabrication Plant
NHPA	*National Historic Preservation Act*
NIOSH	National Institute of Occupational Safety and Health
NMSF	Nuclear Material Storage Facility

NMSM	Nuclear Materials and Stockpile Management
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NRHP	National Register of Historic Places
NTS	Nevada Test Site
NTS EIS	*Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*
NWI	National Wetlands Inventory
NWPA	*Nuclear Waste Policy Act*
NWS	National Weather Service
OCRWM	Office of Civilian Radioactive Waste Management
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PA	Protected Area
Pantex	Pantex Plant
Pantex EIS	*Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*
PBF	Power Burst Facility
PCV	Primary Containment Vessel
PEIS	programmatic environmental impact statement
PEL	Permissible Exposure Level
PFP	Plutonium Finishing Plant
PFP EIS	*Plutonium Finishing Plant Stabilization Environmental Impact Statement*
PIDAS	Perimeter Intrusion Detection and Alarm System
PNNL	Pacific Northwest National Laboratory
PPA	Property Protection Area
PRA	probabilistic risk assessment
PSAR	Preliminary Safety Analysis Report
PSD	Prevention of Significant Deterioration

PUREX	Plutonium-Uranium Extraction Plant
PWR	pressurized water reactor
R&D	Research and Development
RCRA	*Resource Conservation and Recovery Act*
REA	regional economic area
RIA	reactivity insertion accident
RFETS	Rocky Flats Environmental Technology Site
RIMS II	Regional Input-Output Modeling System
RL	Richland Operations Office
ROD	Record of Decision
ROI	region of influence
RSWF	Radioactive Scrap and Waste Facility
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SAR	Safety Analysis Report
SARA	*Superfund Amendments and Reauthorization Act*
sd	standard deviation
SDWA	*Safe Drinking Water Act*
SEB	Security Equipment Building
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SISMP	Site Integrated Stabilization and Management Plan
SMR	Standardized Mortality Ratio
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SRR	standardize rate ratio
SRS	Savannah River Site
Stockpile Stewardship and Management PEIS	*Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*
Storage and Disposition PEIS	*Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement*
SST	safe secure trailer
START	Strategic Arms Reduction Talks

TA	Technical Area
TAN	Test Area North
TCLP	toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environmental Conservation
TDS	total dissolved solids
TI	transport index
TLV	Threshold Limit Values
TNRCC	Texas Natural Resources Conservation Commission
TRA	Test Reactor Area
TRU	transuranic
TSCA	*Toxic Substance Control Act*
TSD	Transportation Safeguards Division
TSP	total suspended particulates
TSR PEIS	*Tritium Supply and Recycling Programmatic Environmental Impact Statement*
TVA	Tennessee Valley Authority
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Survey
VOC	volatile organic compound
VRM	Visual Resource Management
WAC	Waste Acceptance Criteria
Waste Management PEIS	*Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*
WIPP	Waste Isolation Pilot Plant
WMIS	Waste Management Information System
WNP	Washington Nuclear Power
WPPSS	Washington Public Power Supply System
WSA	Weapons Storage Area
WSCC	Western Systems Coordinating Council
WSCF	Waste Sampling and Characterization Facility
Y–12	Y–12 Plant
Y–12 EA	*Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Level at the Y–12 Plant, Oak Ridge, Tennessee*
YMSCO	Yucca Mountain Site Characterization Office
ZPPR	Zero Power Physics Reactor

CHEMICALS AND UNITS OF MEASURE

°C	degrees Celsius
Ci	curie
cm	centimeter
CO	carbon monoxide
CO_2	carbon dioxide
Co-60	cobalt-60
Cs	cesium
Cs-137	cesium-137
CsCl	cesium chloride
Cu	copper
dB	decibel
dBA	decibel A-weighted
°F	degrees Fahrenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
g	gram
G	gravitational acceleration
gal	gallon
Gd	gadolinium
GWd	gigawatt-days
ha	hectare
H_2	hydrogen
HF	hydrogen fluoride
HNO_3	nitric acid
hr	hour
I-129	iodine-129
in	inch
k_{eff}	effective neutron multiplication factor
kg	kilogram
km	kilometer
km^2	square kilometer

Kr	krypton
kV	kilovolt
l	liter
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
mCi	millicurie
mg	milligram
mi	mile
mi^2	square miles
min	minute
mph	miles per hour
mrem	millirem (one thousandth of a rem)
MW	megawatt
MWe	megawatt electric
N_2	nitrogen
nCi	nanocurie (one-billionth of a Curie)
Ni	nickel
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
oz	ounce
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocurie (one-trillionth of a Curie)
PM_{10}	particulate matter less than or equal to 10 microns
ppm	parts per million
Pu	plutonium
PuCl	plutonium chloride
PuO_2	plutonium dioxide
rad	radiation absorbed dose
rem	roentgen equivalent man
RfC	Reference Concentration
RfD	Reference Dose

s	second
SO_2	sulfur dioxide
Sr-90	strontium-90
t	metric ton
Tc-99	technetium-99
ton	short ton
U	uranium
U-233	uranium-233
U-234	uranium-234
U-235	uranium-235
U-236	uranium-236
U-238	uranium-238
UF_6	uranium hexafluoride
UNH	uranyl nitrate hexahydrate
UO_2	uranium dioxide
U_3O_8	triuranium octaoxide
VOC	volatile organic compound
yd	yard
yr	year
µg	microgram (one-millionth of a gram)

METRIC CONVERSION CHART

To Convert Into Metric			To Convert Out of Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor
exa-	E	$1\,000\,000\,000\,000\,000\,000 = 10^{18}$
peta-	P	$1\,000\,000\,000\,000\,000 = 10^{15}$
tera-	T	$1\,000\,000\,000\,000 = 10^{12}$
giga-	G	$1\,000\,000\,000 = 10^{9}$
mega-	M	$1\,000\,000 = 10^{6}$
kilo-	k	$1\,000 = 10^{3}$
hecto-	h	$100 = 10^{2}$
deka-	da	$10 = 10^{1}$
deci-	d	$0.1 = 10^{-1}$
centi-	c	$0.01 = 10^{-2}$
milli-	m	$0.001 = 10^{-3}$
micro-	μ	$0.000\,001 = 10^{-6}$
nano-	n	$0.000\,000\,001 = 10^{-9}$
pico-	p	$0.000\,000\,000\,001 = 10^{-12}$
femto-	f	$0.000\,000\,000\,000\,001 = 10^{-15}$
atto-	a	$0.000\,000\,000\,000\,000\,001 = 10^{-18}$

COVER SHEET

RESPONSIBLE AGENCY: U.S. Department of Energy (DOE)

TITLE: *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE/EIS-0229)

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ABSTRACT: This document analyzes the potential environmental consequences of alternatives for the long-term storage (up to 50 years), including storage until disposition, and disposition of weapons-usable fissile materials from U.S. nuclear weapon dismantlements under the responsibility of the DOE. Long-term storage of nonsurplus inventories of weapons-usable plutonium (Pu) and highly enriched uranium (HEU) are required for national defense purposes, while the disposition of surplus weapons-usable Pu is necessary in order to implement our national nonproliferation policy. In addition to the No Action Alternative, this PEIS assesses three storage alternatives (that is, upgrade at multiple sites, consolidation of Pu, and collocation of Pu and HEU) at six DOE candidate sites located across the country. These sites are Hanford Site, Nevada Test Site, Idaho National Engineering Laboratory, Pantex Plant, Oak Ridge Reservation, and Savannah River Site. Although they are not candidate sites for storage, Rocky Flats Environmental Technology Site (RFETS) and Los Alamos National Laboratory are assessed for the No Action Alternative. For the disposition of surplus Pu, three alternative categories (that is, deep borehole, immobilization, and reactor) with nine primary alternatives are assessed at several DOE and representative sites for analysis purposes. Evaluations of impacts on site infrastructure, water resources, air quality and noise, socioeconomics, waste management, public and occupational health and safety, and environmental justice are included in the assessment. The intersite transportation of nuclear and hazardous materials is also assessed. DOE's Preferred Alternative is identified in this Final PEIS. The Preferred Alternative for storage is a combination of No Action and Upgrade Alternatives for the various DOE sites, and phaseout of Pu storage at RFETS. The Preferred Alternative for disposition of surplus Pu is to pursue a disposition strategy involving a combination of immobilization and reactor alternatives, including vitrification, ceramic immobilization, and existing reactors.

PUBLIC INVOLVEMENT: The DOE issued a Draft PEIS on March 8, 1996, and held a formal public comment period on the Draft through June 7, 1996. In preparing the Final PEIS, DOE considered comments received via mail, fax, electronic bulletin board (Internet), and transcripts of messages recorded by telephone. In addition, comments and concerns were recorded by notetakers during interactive public meetings held during March and April 1996 in Denver, CO, Las Vegas, NV, Oak Ridge, TN, Richland, WA, Idaho Falls, ID, Washington, DC, Amarillo, TX, and North Augusta, SC. Comments received and DOE's responses to those comments are found in Volume IV of the Final PEIS.

4.3 PLUTONIUM DISPOSITION ALTERNATIVES AND RELATED ACTIVITIES

This section describes the potential environmental impacts associated with the disposition of surplus Pu. A key to locating information on the disposition alternatives for deep borehole, immobilization, and reactors categories; common activities; and sites and environmental setting analyzed is shown in Table 4–2. Pit disassembly/conversion and Pu conversion are activities common to all of the disposition alternatives, while MOX fuel fabrication is an activity common to only the reactor alternatives. All three of these activities are analyzed individually in this section. Because at this programmatic stage of NEPA review and decisionmaking, DOE is analyzing and anticipates selecting a technology strategy and not specific locations or facilities at a specific site, representative and generic sites are used for analysis. The representative DOE sites are Hanford, NTS, INEL, Pantex, ORR, and SRS. Additionally, some disposition alternatives (specifically those involving deep borehole placement, MOX fuel fabrication at a commercial facility, and the use of existing or partially completed reactor facilities) do not lend themselves to specific site analysis at this time.Therefore, generic and representative site characteristics have been used for the environmental analysis of these alternatives and activities. For the CANDU Reactor Alternative, common disposition-related activities in the United States are analyzed in this section. [Text deleted.] A description of operational and key environmental issues regarding the use of CANDU reactors for burning MOX fuel is provided in Appendix I.

4.3.1 PIT DISASSEMBLY/CONVERSION FACILITY

The environmental impacts described in the following sections are based on the analysis of the pit disassembly/conversion facility as described in Section 2.4.1. The representative sites analyzed for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS. These sections describe the construction and operational impacts of the pit disassembly/conversion facility on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, and waste management.

In accordance with the Preferred Alternative for surplus Pu disposition, the pit disassembly/conversion facility could be located at either Hanford, INEL, Pantex, or SRS. Further tiered NEPA review will be conducted to examine alternative locations including new and existing facilities at these four sites should the Preferred Alternative be selected at the ROD. Although new facilities are analyzed in Section 4.3.1.1 through 4.3.1.10, DOE would preserve the option for using existing facilities to the extent practical pursuant to subsequent tiered NEPA review.

4.3.1.1 Land Resources

At all sites, the pit disassembly/conversion facility would disturb 14 ha (35 acres) of land during construction, of which 12 ha (30 acres) would be used for the operating facility. The facility would be sited in a 1.6-km (1-mi) buffer zone contained within the site boundary except at ORR, where the buffer zone is less than 1.6 km (1 mi). With the 1.6-km (1-mile) buffer zone, total land requirement would be 1,853 ha (4,580 acres). This section describes the construction and operational impacts of the pit disassembly/conversion facility on land resources for each representative site.

As discussed in Section 4.3.1.8, historic housing construction rates at all sites would be sufficient to absorb the increase in population caused by the in-migration of operational workers. No in-migration would occur during construction. No offsite land use would be affected; therefore, no indirect impacts would occur.

Hanford Site

Land Use. The potential site for the pit disassembly/conversion facility would be vacant land in the 200 Area adjacent to 200 East. Construction and operation of the pit disassembly/conversion facility would conform with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land use planning process. According to the *Hanford Site Development Plan*, 200 Area land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction and operation would be consistent with State and local (Benton, Franklin, and Grant Counties and the city of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Area. Construction and operation would be consistent with the current VRM Class 5 designation.

Nevada Test Site

Land Use. The potential location for the pit disassembly/conversion facility would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area. However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program materials disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8—3-9); NT DOE 1996e:A-18.

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, or controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The pit disassembly/conversion facility would be located on undeveloped land within the ICPP security area that is part of the central core area/Prime Development Zone of INEL (IN DOE 1992g:12). The potential action would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan*, which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction and operation would not be in conflict with land use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation of the facility would be consistent with the existing industrialized landscape character of the ICPP. The alternative would not change the existing VRM Class 5 designation of the area.

Pantex Plant

Land Use. Zone 12 is the potential location for the pit disassembly/conversion facility. The potential action would be consistent with the current *Pantex Site Development Plan* master plan, which designates Zone 12 for weapons assembly/disassembly (PX DOE 1995g:16), although vacant land would be used. [Text deleted.]

Construction and operation would not affect other Pantex or offsite land uses. There would be no impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] The visual environment would be consistent with the existing industrialized landscape character. The current VRM Class 5 designation of Zone 12 would not change.

Oak Ridge Reservation

Land Use. The pit disassembly/conversion facility is proposed to be sited on undeveloped land at Y–12. Weapons component manufacturing and development is among the future land uses designated for Y–12 by the future land use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* (OR DOE 1989a:5-6,5-7). The proposal is compatible with the Plan.

Construction and operation of the pit disassembly/conversion facility would not affect other ORR or offsite land uses. Construction and operation would not be in conflict with the city of Oak Ridge land-use plans, policies, and controls since the current *Oak Ridge Area Land Use Plan* designates the potential site for industrial land use.

Visual Resources. [Text deleted.] The visual environment would be consistent with the existing industrial landscape character. The current VRM Class 5 designation would not change.

Savannah River Site

Land Use. Vacant land in the F-Area would be used for the pit disassembly/conversion facility. The proposed action would conform with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the Plan, current F-Area land use is designated industrial operations, while the future land-use category is primary industrial mission (SR DOE 1994d:11,12). [Text deleted.]

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] The visual environment would be consistent with the industrial landscape character. The current VRM Class 5 designation of the F-Area would not change.

[Text deleted.]

4.3.1.2 Site Infrastructure

This section discusses the impacts upon site infrastructure needed to support the pit disassembly/conversion facility at each of the six representative sites. Construction and operation of the facility would impact infrastructure at each site differently, depending on current operating resources.

The pit disassembly/conversion facility would consist of a Pu processing structure with shipping and receiving, disassembly and conversion, residue recovery, solid waste treatment, liquid waste treatment, analytical laboratory, and interim storage. The following support facilities would be in adjacent structures: offices, change rooms, central control room, operator training/process demonstration, mechanical shops, emergency generator, warehouse, guard stations, entry portals, and parking. Buildings would be either steel frame/metal skin or concrete construction. For each of the representative sites, Table 4.3.1.2–1 presents infrastructure resources needed annually for construction as well as site availability and consumption without the facility. Comparative impact of average annual resource needs for operation are presented in Table 4.3.1.2–2.

Hanford Site

Resources needed for construction are well within site availability. These resources would represent a small fraction of those needed to operate the site. [Text deleted.] The planned pit disassembly/conversion facility would use natural gas as the primary utility fuel, and the total requirement for natural gas during operations would be higher than the site currently has available. [Text deleted.] The additional amount could be procured through normal contractual means.

Nevada Test Site

Resources needed for construction would be within site availability for everything except oil. The additional oil could be procured through normal contractual means. Operations impacts would be small except for utility fuel. The planned pit disassembly/conversion facility would use natural gas as the primary utility fuel. Since NTS uses fuel oil as its primary utility fuel, use of natural gas in lieu of fuel oil would require additional infrastructure. The final facility design could be converted to use fuel oil. Fuel oil requirements would exceed current site availability, but can be procured through normal contractual means.

Idaho National Engineering Laboratory

Resources needed for construction would be within site availability. The planned pit disassembly/conversion facility would use natural gas as the primary utility fuel. Since INEL does not use natural gas, this facility would be designed to burn fuel oil if INEL were selected as the pit disassembly/conversion facility site.

Pantex Plant

Resources needed for construction would be within site availability. [Text deleted.] Operations impacts would be small. Adequate electrical energy would be available from the regional power grid.

Oak Ridge Reservation

Except for fuel oil, resources required for construction would be within site capacities. Additional fuel oil for construction could be procured through normal contractual means. These resources would represent a small fraction of those needed to operate the site. There would be minimal site infrastructure impacts for operation.

Savannah River Site

Resources needed for construction would be within site availability for everything except oil. The additional oil for construction would be procured through normal contractual means. Operational impacts would be small except for utility fuel and natural gas. The planned pit disassembly/conversion facility would use natural gas as the primary utility fuel. Since SRS uses fuel oil as its primary utility fuel, use of natural gas in lieu of fuel oil would require additional infrastructure. The final facility design would be adapted to use fuel oil. Fuel oil requirements would exceed current site availability, but could be procured through normal contractual means.

Table 4.3.1.2–1. Additional Site Infrastructure Needed for the Construction of the Pit Disassembly/ Conversion Facility (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	2,500	5	126,200	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage (without facility)	345,500	58	9,334,800	21,039,531	0
Projected usage (with facility)	348,000	63	9,461,000	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage (without facility)	124,940	25	5,716,000	0	0
Projected usage (with facility)	127,440	30	5,847,200	0	0
Amount required in excess to site availability	0	0	126,200	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage (without facility)	232,500	42	5,820,000	0	11,340
Projected usage (with facility)	235,000	47	5,946,200	0	11,340
Amount required in excess to site availability	0	0	0	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage (without facility)	46,266	10	795,166	7,200,000	0
Projected usage (with facility)	48,766	15	921,366	7,200,000	0
Amount required in excess to site availability	0	0	0	0	0

Table 4.3.1.2–1. Additional Site Infrastructure Needed for the Construction of the Pit Disassembly/ Conversion Facility (Annual)—Continued

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	2,500	5	126,200	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250.760,000	16,300
Projected usage (without facility)	726,000	110	379,000	95,000,000	16,300
Projected usage (with facility)	728,500	115	505,200	95,000,000	16,300
Amount required in excess to site availability	0	0	89,200[a]	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage (without facility)	794,000	116	28,390,500	0	221,352
Projected usage (with facility)	796,500	121	28,516,700	0	221,352
Amount required in excess to site availability	0	0	126,200[a]	0	0

[a] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

Table 4.3.1.2–2. Additional Site Infrastructure Needed for the Operation of the Pit Disassembly/ Conversion Facility (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	<5	0	20,000	5	28,000	3,398,000	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage (without facility)	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage (with facility)	425	204	365,500	63	9,362,800	24,437,531	0
Amount required in excess to site availability	<5	0	0	0	0	3,398,000[a]	0
NTS							
Site availability	1,100[b]	0	176,844	45	5,716,000	0	0
Projected usage (without facility)	645	0	124,940	25	5,716,000	0	0
Projected usage (with facility)	650	0	144,940	30	5,744,000	3,398,000	0

Table 4.3.1.2–2. Additional Site Infrastructure Needed for the Operation of the Pit Disassembly/ Conversion Facility (Annual)—Continued

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	<5	0	20,000	5	28,000	3,398,000	0
Amount required in excess to site availability	0	0	0	0	28,000[c]	3,398,000[a]	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage (without facility)	445	48	232,500	42	5,820,000	0	11,340
Projected usage (with facility)	450	48	252,500	47	5,848,000	3,398,000	11,340
Amount required in excess to site availability	<5	0	0	0	0	3,398,000[a]	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage (without facility)	76	27	46,266	10	795,166	7,200,000	0
Projected usage (with facility)	81	27	66,266	15	823,166	10,598,000	0
Amount required in excess to site availability	<5	0	0	0	0	0	0
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage (without facility)	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage (with facility)	76	27	746,000	115	407,000	98,398,000	16,300
Amount required in excess to site availability	<5	0	0	0	0	0	0
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage (without facility)	230	103	794,000	116	28,390,500	0	221,352
Projected usage (with facility)	235	103	814,000	121	28,418,500	3,398,000	221,352
Amount required in excess to site availability	<5	0	0	0	28,000[c]	3,398,000[a]	0

[a] Facility would be adapted to use fuel oil instead of natural gas.

[b] Includes both paved and unpaved roads.

[c] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

4.3.1.3 Air Quality and Noise

Construction and operation of the pit disassembly/conversion facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the pit disassembly/conversion facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction.

The pit disassembly/conversion process involves pure Pu materials that would not require chemical processing. The emissions estimates for the facility are based on data from similar processes at LANL's TA-55 facility. The ventilation system for the pit disassembly/conversion facility would be used specifically for contamination control and would use a large volume of air to assure contamination control. Primary confinement would be provided by a glove box system and associated zone air-handling system. There would be four stages of HEPA filters on the glovebox exhaust that would eliminate (or reduce below detection limits) a minimum of 99.95 percent of nonradioactive particulates. Radioactive particulate emissions are discussed in Section 4.3.1.9. The glovebox exhaust would be mixed with room air exhaust, which also has two stages of HEPA filters. The use of HEPA filters would not reduce VOC emissions because VOCs are not in a particulate form. There would also be process-specific scrubbers, vacuum traps, and filters that reduce the chance of criteria or toxic/hazardous pollutants releases from occurring. Because of the processing technology (which does not create some of the criteria pollutants), the defense-in-depth for Pu processing systems, and the extensive HEPA filtration (which removes the remaining criteria pollutants), emissions for criteria pollutants other than VOCs are expected to be below detection limits. VOC emissions of 1,500 kg/yr (3,300 lb/yr) are shown in Table F.1.3–4, and would give trace concentrations at the site boundaries.

NOISE

The location of the facilities associated with pit disassembly/conversion facility relative to the site boundary and sensitive receptors was examined for each of the six sites to evaluate the potential contribution to noise levels

at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Non-traffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, and material handling equipment. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.1.4 Water Resources

The construction and operation of a pit disassembly/conversion facility would affect water resources. Water resource requirements, and discharges provided in Tables C.1.1.2–1 and C.2.1.2–1 and Table E.3.2.1–1 were used to assess impacts to surface and groundwater. A discussion of impacts is provided for each site separately. Table 4.3.1.4–1 presents No Action surface and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the pit disassembly/conversion facility.

Hanford Site

Surface Water. Surface water obtained from the Columbia River would be used as the water source for construction and operation of the pit disassembly/conversion facility. During construction, the quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which represents a 0.01-percent increase over the existing annual surface water withdrawal. These additional withdrawals would cause negligible impacts. During operation, water requirements for the new pit disassembly/conversion facility would be approximately 94.6 million l/yr (25 million gal/yr), which would represent a 0.7-percent increase over the existing surface water withdrawal.

[Text deleted.]

During construction of the pit disassembly/conversion facility, sanitary wastewater (1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the existing wastewater treatment system at the 200-Area. [Text deleted.] During operation, approximately 85.2 million l/yr (22.5 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system, then to lined evaporation ponds or recycled. This would represent a 34.6-percent increase in the effluent discharged at Hanford. All discharges would be monitored to comply with discharge requirements.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity, and if uncontaminated, discharged to natural drainage channels or evaporation/infiltration ponds. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity, and if uncontaminated, discharged to storm drains that discharge to local drainage channels.

The pit disassembly/conversion facility would be located in the 200 Area which is above the 100-year, 500-year, and probable maximum floods; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for any project-related water requirements; therefore, groundwater availability would not be affected.

No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected. Some stormwater runoff and other discharges routed to storm drains could percolate into the subsurface. These discharges would be monitored and, therefore, no impacts to groundwater quality would be expected.

Nevada Test Site

Surface Water. No surface water would be withdrawn for construction or operation activities associated with the facility; groundwater would be used as the water source for the pit disassembly/conversion facility. Therefore, there would be no impacts to surface water availability.

Table 4.3.1.4–1. Potential Changes to Water Resources Resulting from Pit Disassembly/Conversion Facility

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Water source	Surface	Ground	Ground	Ground	Surface	Ground
No Action water requirements (million l/yr)	13,511	2,400	7,570	249	14,760	13,247
No Action wastewater discharges (million l/yr)	246	82	540	141	2,277	700
Construction						
Water availability and use						
Total water requirement (million l/yr)	1.9	1.9	1.9	1.9	1.9	1.9
Percent increase in projected water use[a]	0.01	0.08	0.03	0.8	0.01	0.01
Water quality						
Total wastewater discharge (million l/yr)	1.9	1.9	1.9	1.9	1.9	1.9
Percent change in wastewater discharge[b]	0.8	2.3	0.4	1.3	0.08	0.3
Percent change in streamflow	neg	NA	NA	NA	0.004[c]	0.04[d]
Operation						
Water availability and use						
Total water requirement (million l/yr)	94.6	94.6	94.6	94.6	94.6	94.6
Percent increase in projected water use[e]	0.7	3.9	1.2	38.0	0.6	0.7
Water quality						
Total wastewater discharge (million l/yr)	85.2	85.2	85.2	85.2	85.2	85.2
Percent change in wastewater discharge[f]	34.6	103.9	15.8	60.4	3.7	12.2
Percent change in streamflow	neg	NA	NA	NA	0.2[c]	1.7[d]

Table 4.3.1.4–1. Potential Changes to Water Resources Resulting from Pit Disassembly/Conversion Facility—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Floodplain						
Is action in 100-year floodplain?	No	No	No	No	No	No
Is critical action in 500-year floodplain?	No	Uncertain	Uncertain	No	No	Unlikely

[a] Percent increases in water requirements during construction of the pit/disassembly conversion facility are calculated by dividing water requirements for the facility (1.9 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[b] Percent increases in wastewater discharged during construction of a pit disassembly/conversion facility are calculated by dividing wastewater discharges for the facility (1.9 million l/yr) with that for No Action water requirements at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

[c] Percent change in stream flow from wastewater discharges is calculated from the average flow of Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for the East Fork Poplar Creek is shown in the table.

[d] Percent change in stream flow from wastewater discharges is calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).

[e] Percent increases in water requirements during operation of a pit disassembly/conversion facility are calculated by dividing water requirements for the facility (94.6 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[f] Percent increases in wastewater discharged during operation of a pit disassembly/conversion facility are calculated by dividing wastewater discharges for the facility (85.2 million l/yr) with that for No Action discharge at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

[Text deleted.]

During construction of the pit disassembly/conversion facility, approximately 1.9 million l/yr (0.5 million gal/yr) of sanitary wastewater would be generated. During operation, approximately 85.2 million l/yr (22.5 million gal/yr) of sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity, and if uncontaminated, recycled or discharged to local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity, and if uncontaminated, discharged to local drainage channels or be available for recycle.

Because there are no continuously flowing streams on NTS and no designated floodplains, there are no studies to assess the 500-year floodplain boundaries. Studies of the 100-year floodplain showed it to be confined to the Jackass Flats and Frenchman Lake areas. The proposed site for the pit disassembly/conversion facilities is not located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms that can create brief (less than 6 hours) flash floods, the facility would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater via the existing supply system. The Lower and Upper Carbonate, the Volcanic, and the Valley-Fill Aquifers are the source of water for operations at NTS.

Total construction water requirements for the facilities (1.9 million l/yr [0.5 million gal/yr]) represent 0.003-percent of the minimum estimated annual recharge to the regional aquifer under the entire NTS. This is based on two studies conducted in recent years which estimated recharge to be 38 to 57 billion l (10 to 15 billion gal) (NT DOE 1992b:41-43; NT USGS 1988a). As shown in Table 4.3.1.4–1, the quantity of water required for construction of the facility represents approximately a 0.08-percent increase over the total projected No Action groundwater usage. Operating the facilities at NTS would require 94.6 million l/yr (25 million gal/yr), which is approximately a 3.9-percent increase in the projected groundwater usage. This additional withdrawal represents a 0.2-percent of the minimum estimated annual recharge. Minimal impacts to groundwater availability would be expected from these additional water withdrawals.

Construction and operation of the pit disassembly/conversion facilities would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward into the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified in the State of Nevada permit. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the pit disassembly/conversion facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the pit disassembly/conversion facility, sanitary wastewater (total of approximately 1.9 million l/yr [0.5 million gal/yr]) would be generated and after treatment discharged to

evaporation/percolation ponds or be available for recycle. During operation, approximately 85.2 million l/yr (22.5 million gal/yr) of sanitary and other wastewater would be generated and handled similarly. All discharges would be monitored to comply with discharge limit.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity, and if uncontaminated, discharged to evaporation/infiltration ponds or to local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity, and if uncontaminated, discharged to local drainage channels or be available for recycle.

The potential site for the new pit disassembly/conversion facilities is not located in an area historically prone to flooding, but is within the flood zone which could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. As shown in Table 4.3.1.4–1, water requirements for operation of the pit disassembly/conversion facility (94.6 million l/yr [25 million gal/yr]) would fall within INEL's current allotment and represent a 1.2-percent increase over the projected annual groundwater usage. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). Construction water requirements for the facility are much less than those for operation. These withdrawals would increase the total site projected amount to be pumped at INEL to 17.8 percent of the allotment during operation. This increase (and that due to construction) should not affect groundwater availability.

Construction and operation of the pit disassembly/conversion facilities would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater which does not evaporate, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for construction or operation activities associated with the facility; groundwater (or possibly reclaimed wastewater from the Hollywood Road Wastewater Treatment Plant) would be used as the water source for the pit disassembly/conversion facility. Therefore, there would be no impacts to surface water availability.

[Text deleted]

During construction of the pit disassembly/conversion facility, approximately 1.9 million l/yr (0.5 million gal) of sanitary wastewater would be generated and discharged to the existing wastewater treatment systems north of Zone 12. During operation, a maximum of approximately 85.2 million l/yr (22.5 million gal/yr) of sanitary wastewater and other wastewater would be discharged to either of these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would either be discharged to the playa lakes or would be available for recycle. The expected quantity of additional wastewater potentially discharged to the playas (approximately 0.23 million l/day [61,670 gal/day]) should not cumulatively cause any exceedances of the monthly average limit of 2.46 million l/day (650,000 gal/day). This is based on Pantex's

1994 discharges, which averaged approximately 1.4 million l/day (370,000 gal/day) and are expected to decline in the future.

Water from heating the facility will be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity, and if uncontaminated, discharged to playas or local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity, and if uncontaminated, discharged to playas or local drainage channels, or be available for recycle.

The pit disassembly/conversion facility would be located in Zone 12. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 12, there would be no impacts to flood plains. However, flooding at Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would probably be supplied from groundwater using the existing supply system. Construction water requirements for the pit disassembly/conversion facilities are small relative to the recoverable water in aquifer storage, which for the year 2010 was estimated to be 287 trillion l (76 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.1.4–1, construction of the proposed pit disassembly/conversion facility would require 1.9 million l/yr (0.5 million gal/yr) of water, which represents a 0.8-percent increase over the projected annual groundwater usage and 0.1 percent of the total groundwater system capacity (1,900 million l/yr [502 million gal/yr]). [Text deleted.] Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8-m/yr (5.9-ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the pit disassembly/conversion facility at Pantex would require 94.6 million l/yr (25 million gal/yr), resulting in a small drawdown. This additional groundwater withdrawal would add to the existing decline in water levels of the Ogallala Aquifer. However, this very small decline would not affect regional groundwater levels and would represent approximately 5.0 percent of the available groundwater. The total site groundwater withdrawal including this facility would be 343.6 million l/yr (90.8 million gal/yr) which, because of expected cutbacks in other programs, would be 59 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the new facilities would not result in direct discharges to groundwater. Treated wastewater discharged to playas, could percolate downward into the groundwater of the near surface aquifer. However, water discharged to playas would be monitored and would not be discharged until contaminant levels are within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the pit disassembly/conversion facilities would be provided via existing distribution systems. The source of this water is the Clinch River and its tributaries. [Text deleted.] During construction, the total quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent a 0.01-percent increase over the existing projected annual surface

water withdrawal. This additional withdrawal would cause negligible impacts to surface water availability. During operation, water requirements would be approximately 94.6 million l/yr (25 million gal/yr) annually. This represents a 0.6-percent increase in the projected annual surface water withdrawal and is 0.001-percent of the average flow of the Clinch River (132 m^3/s [4,647 ft^3/s]). These additional water withdrawals from the Clinch River would not impact availability.

During construction of the pit disassembly/conversion facilities, sanitary wastewater (total of 1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the existing wastewater treatment system in the Y–12 area. This would cause a very minor increase in the effluent from this facility. During operation, a total of 85.2 million l/yr (22.5 million gal/yr) of wastewater would be generated by the facility. This would cause a 3.7-percent increase in the effluent discharged from the Y–12 Area. All discharges would be monitored to comply with discharge requirements. Fire sprinkler water and truck hosedown water would be collected in tanks, monitored for radioactivity, and then transferred to a treatment facility as required. Uncontaminated water would be pumped to storm drains.

Since the pit disassembly/conversion facilities would be located outside both the 500- and 100-year floodplains, there would be no impacts to floodplains.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water would be used for project requirements during construction or operation of the facility. [Text deleted.] During construction of the pit disassembly/conversion facility, sanitary wastewater (total of 1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modifications. This would represent less than a 0.2-percent increase in the effluent from SRS. During operation, approximately 85.2 million l/yr (22.5 million gal/yr) of sanitary wastewater would be discharged to this wastewater treatment system. This would represent a 12.2-percent increase in the effluent discharged from SRS and would be 1.7 percent of Fourmile Branch's minimum flow. Since this facility can regulate its effluent flow and all discharges would be monitored to comply with discharge requirements, no impacts are expected. Fire sprinkler water and truck hose-down water would be collected in tanks, monitored for radioactivity, and then transferred to a treatment facility as required. Uncontaminated water would be pumped to storm drains.

The potential location of the pit disassembly/conversion facility would be located outside the 100-year floodplain. Information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas. However, the pit disassembly/conversion facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek because the facility would be located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these steams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about 58 m^3/s (2,040 ft^3/s). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 62 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately 5 m^3/s (186 ft^3/s), and an elevation of about 61 m (199 ft) above MSL (SR USGS 1996a:1). Elevations of the buildings in F-Area are more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, water requirements would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent less than a 0.01-percent increase over the projected annual

groundwater withdrawal. This additional withdrawal should cause negligible impacts to groundwater availability. During operation, water used for cooling system makeup would be obtained from existing supply systems in the F-Area. The water for these systems is groundwater from the Cretaceous Aquifer. The total annual water requirements shown in Table 4.3.1.4–1 would represent a 0.7-percent increase in the projected No Action groundwater usage at SRS. The water withdrawals from groundwater would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals over 20 times greater than that required for the pit disassembly/conversion facility from the Cretaceous Aquifer indicate that drawdown could be almost 2 m (7 ft) at the well head, but would be smaller in overlying aquifers and would not extend beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that withdrawals attributed to the pit disassembly/conversion facility would have a minor drawdown at the well head and would not affect any aquifers in the area. No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

[Text deleted.]

4.3.1.5 Geology and Soils

This section describes the environmental impacts to the geologic and soil resource as related to the construction and operation of the pit disassembly/conversion facility at any of the six sites analyzed: Hanford, NTS, INEL, Pantex, ORR, and SRS. A pit disassembly/conversion facility would involve some ground-disturbing construction activities (14 ha [35 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rainfall) is greater at ORR and SRS, than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities nor site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to the greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction (foundation preparation) and activities associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (as wind velocities and duration increase, soil erosion potential increases), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal. Indirect effects to the soil resource from infrastructure improvements would have a similar impact to the soil profile and erosion potential.

[Text deleted.]

4.3.1.6 Biological Resources

Construction of the pit disassembly/conversion facility would disturb 14 ha (35 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate, to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that the pit disassembly/conversion facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the pit disassembly/conversion facility would result in the disturbance of terrestrial habitat equaling about 0.01 percent of Hanford. This includes areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation within the assumed project site would be destroyed during land clearing operations. The facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the pit disassembly/conversion facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the pit disassembly/conversion facility. These disturbances may cause some species to move from the area. Disturbances to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the pit disassembly/conversion facility would not affect wetlands since no wetlands exist near the assumed facility location. Since water would be withdrawn from the Columbia River through an existing intake structure and wastewater would be discharged to evaporation/infiltration ponds, wetlands bordering the river would not be affected by placement of intake and discharge structures.

Aquatic Resources. Construction of a pit disassembly/conversion facility at Hanford would not impact aquatic resources, because there are no surface water bodies near the assumed facility location. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entertainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds, so aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the pit disassembly/conversion facility; however, sagebrush habitat would be disturbed. The sagebrush community is also important nesting/breeding and foraging habitat for several State-listed and candidate species, such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the pit disassembly/conversion facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the pit disassembly/conversion facility at NTS would result in the disturbance of terrestrial resources equaling less than 0.01 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the assumed project area, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land-clearing operations. Creosote bush communities are well represented on NTS.

Construction of the pit disassembly/conversion facility would affect some animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. Before construction, the site would be surveyed as necessary for the nests of migratory birds. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the pit disassembly/conversion facility would not affect wetlands, because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the pit disassembly/conversion facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the pit disassembly/conversion facility at NTS. Construction activities, such as land-clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicular traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training, putting restrictions on vehicle speeds and off-road movement, conducting clearance surveys prior to surface disturbance, approving stop work authority if tortoises are found within work areas, removing tortoises from roadways and work areas, placing permanent and temporary tortoise-proof fencing around trenches, landfills, and treatment ponds, inspecting trenches, and having biologists survey when heavy

equipment is in use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the pit disassembly/conversion facility.

[Text deleted.] Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicular traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the pit disassembly/conversion facility (Section 4.3.1.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the pit disassembly/conversion facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to small mammals and some birds and reptiles which could be displaced or suffer mortality. Large mammals are excluded from the assumed facility location by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources at the assumed facility location, these resources would not be affected by construction or operation of the pit disassembly/conversion facility. Since the facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected.

Pantex Plant

It is assumed that the pit disassembly/conversion facility would be located in Zone 12 which is a developed area that lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed site; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the pit disassembly/conversion facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to a minor increase in open water near the outfall, as well as a slight change in plant species composition. No federally listed threatened or endangered species would be affected by construction or operation of the pit disassembly/conversion facility. Although the assumed site has been disturbed, it is possible that the State-listed Texas horned lizard could be present. Before construction, preactivity surveys would be conducted as appropriate.

Oak Ridge Reservation

It is assumed that the pit disassembly/conversion facility would be constructed on a disturbed area within Y–12. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal, since animals living adjacent to Y–12 would have already adapted to similar disturbances. There would be minimal direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal, since water would be taken from existing sources and discharged via NPDES-permitted outfalls and would involve minor volumes. Construction and operation of the pit disassembly/conversion facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Impacts to the Tennessee dace (State deemed in need of

management) would not be expected since erosion would be controlled and discharges would be through permitted outfalls.

Savannah River Site

It is assumed that the pit disassembly/conversion facility would be constructed within the F-Area, which is one of the highly developed industrial areas of the SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be minimal direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since minor volumes of water would be taken from existing sources and discharged via NPDES permitted outflows. Impacts from construction and operation of the pit disassembly/conversion facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site so that this species would not be directly affected by this action.

4.3.1.7 Cultural and Paleontological Resources

This section discusses potential impacts to cultural and paleontological resources that may result from the construction and operation of the pit disassembly/conversion facility at each of the representative sites analyzed. The total land disturbance for this facility is 14 ha (35 acres) during construction of which 12 ha (30 acres) would be used during operation. A 1.6-km (1-mi) reduced-access buffer zone would be created around the facility. The buffer zone would be contained within existing boundaries at all sites except ORR. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources have been identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through additional surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The pit disassembly/conversion facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to any identified resources would occur during construction, but not operation, of the proposed facility.

The CGTO has conducted surveys over portions of Frenchman Flat and has identified at least 20 plant species of importance to Native Americans. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from the construction and operation of the facility. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological resources may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The pit disassembly/conversion facility would be constructed within the existing ICPP security area. The facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of the proposed project area identified no sites. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites occur adjacent to the ICPP: one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have visual or auditory impact on traditional use areas or sacred sites. Resources may be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain, which have produced fossilized remains. Operation would not have an effect on paleontological resources.

Pantex Plant

The pit disassembly/conversion facility would be constructed within Zone 12. Areas to be disturbed by development have not been systematically surveyed for cultural or paleontological resources. Prior to construction, additional survey work may be necessary. Because Zone 12 is disturbed and removed from water sources, it is unlikely to contain intact subsurface prehistoric or historic remains. Operation would have no additional impact to archaeological resources as it does not involve additional ground disturbance.

DOE has recently initiated consultation with Native American groups that have expressed interest in Pantex lands. To date, no Native American resources have been identified within Zone 12. Resources may be identified through additional consultation. Although no mortuary remains have been discovered at Pantex to date, it is possible that some exist within land to be disturbed by development. Burials are often considered to be important Native American resources. Also, construction and operation could affect traditionally used plant and animal species.

The surficial geology of the Pantex area consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the High Plains, this formation has produced Late Pleistocene vertebrate remains including wooly mammoth, bison, and camel, sometimes in context with archaeological remains. The land to be disturbed during construction may contain some fossilized remains. Operation would not have an effect on paleontological resources.

Oak Ridge Reservation

No impacts to cultural or paleontological resources are expected to result from the construction or operation of the facility at ORR. It would be sited within Y–12. The area is disturbed and therefore unlikely to contain any intact archaeological deposits. No Native American resources have been identified at Y–12 to date, nor is it known to contain scientifically valuable paleontological remains.

Savannah River Site

The location for the pit disassembly/conversion facility is open space within F-Area. Portions of F-Area have been surveyed and contain sites potentially eligible for the NRHP. Additional surveys would be conducted in unsurveyed areas to be disturbed by construction. Site types known to occur at SRS include remains of

prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by new facility construction, but not operation.

Some Native American resources may be affected by the proposed action. Resources such as prehistoric sites, cemeteries, and traditionally used plants could be affected during construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to the areas may also result from facility construction or operation. Resources would be identified through consultation with the potentially affected tribes.

No scientifically valuable fossil remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

[Text deleted.]

4.3.1.8 Socioeconomics

This section analyzes the socioeconomic effects of the pit disassembly/conversion facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all sites are found in the Supplemental Socioeconomic Data Report (Socio 1996).

Regional Economy Characteristics. Constructing the pit disassembly/conversion facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 185 workers in the peak year of construction at any site. The largest increase in regional employment (much less than 1 percent) among the sites analyzed would be at INEL. A total of 376 new jobs (185 direct and 191 indirect) would be generated and regional unemployment would fall from 5.4 to 5.1 percent. The largest increase in regional per capita income would also occur at INEL, but the increase would be much less than 1 percent over No Action (Socio 1996a).

Operating the facility would generate greater socioeconomic changes than would construction, due to the larger, more permanent workforce. A workforce of 830 would be required for full operation at any site. Implementing the alternative at INEL would generate the largest increases in regional employment (about 2 percent) and per capita income (about 1 percent). A total of 3,056 new jobs (830 direct and 2,226 indirect) would be generated by the operational activities and regional unemployment would fall to 3.8 percent (Socio 1996a).

Population and Housing. At all of the sites analyzed, construction employment requirements would be met by the available resident labor force, but some in-migrating workers would be needed to fill more specialized positions during operations. Project-related population increases would be greatest if the facility is located at Pantex. However, this increase would be less than 1 percent over No Action population projections. Housing units, in excess of existing vacancies, may be required at all of the sites analyzed, except NTS and ORR, to accommodate the population increase. The greatest increase would be needed in the INEL ROI but this would be less than 1 percent over No Action estimates. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the population growth at all of the sites analyzed (Socio 1996a).

Community Services. During construction, there would be minimal impacts to community services in the ROIs of any of the sites analyzed. However, operation of the facility would slightly increase the demand for community services. The effects of population increase due to in-migrating workers during operations would be minor at all sites analyzed. The following discussion focuses on the Pantex and INEL ROIs, which are expected to experience the greatest increases in demand for community services among the sites analyzed.

To maintain the No Action student-to-teacher ratio of 16.3:1 in the Pantex ROI, 18 new teachers would be needed during operation of the proposed facility. The increase in teacher requirements, however, would be distributed over several school districts in the ROI; therefore, no single district would be significantly affected (Socio 1996a).

To maintain the No Action service level of 1.6 sworn police officers per 1,000 persons, only 2 new police officers would be needed in the INEL ROI. Five additional firefighters would be required to sustain the No Action service level of 2.3 firefighters per 1,000 persons in the Pantex ROI (Socio 1996a).

Projected hospital occupancy rates would increase slightly over No Action levels at each site analyzed. However, projected capacities would be capable of accommodating these small increases in patient load. To maintain the No Action service level of 1.2 physicians per 1,000 persons, only 2 additional physicians would be required in the INEL ROI during operation (Socio 1996a).

Local Transportation. Construction of the pit disassembly/conversion facility would not affect the level of service on the local road segments analyzed for any of the sites. However, traffic generated from facility

operations at INEL would affect the level of service on one road segment. U.S. 20/26 from U.S. 26 East to Idaho State Route 22/33 would experience a drop in level of service from B to C (Socio 1996a).

4.3.1.9 Public and Occupational Health and Safety

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the pit disassembly/conversion facility, whose activities are common to the Pu disposition alternatives. The section first describes the impacts from normal facility operation at each potential site, followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation are presented in Tables 4.3.1.9–1 and 4.3.1.9–2, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.1.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.3.1.9–4 through 4.3.1.9–9. Detailed results are presented in Appendix M.

Normal Operation. There would be no radiological releases associated with the construction of the pit disassembly/conversion facility at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the pit disassembly/conversion facility at each of the sites are presented in Table 4.3.1.9–1. The impacts from all site operations, including the new pit disassembly/conversion facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the maximally exposed member of the public from annual pit facility operation would range from 1.5×10^{-4} mrem at NTS to 0.014 mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 7.6×10^{-10} to 7.0×10^{-8}. The impacts to the average individual would be less. As a result of annual facility operation, the population dose would range from 2.9×10^{-4} person-rem at NTS to 0.12 person-rem at ORR. The corresponding numbers of fatal cancer in these populations from 10 years of operation would range from 1.5×10^{-6} to 6.0×10^{-4}.

The dose to the maximally exposed member of the public from annual total site operations are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 1.1×10^{-3} mrem at Pantex to 3.2 mrem at ORR. From 10 years of operation, the corresponding risk of fatal cancers to this individual would range from 5.5×10^{-9} to 1.6×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population doses would be within the limit in proposed in 10 CFR 834, and would range from 4.0×10^{-3} person-rem at NTS to 44 person-rem at SRS. The corresponding number of fatal cancers in these populations from 10 years of operation would range from 2.0×10^{-5} to 0.22.

Doses to onsite workers from normal operations are given in Table 4.3.1.9–2. Included are involved workers directly associated with the pit disassembly/conversion facility, workers who are not involved with the pit disassembly/conversion facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to pit disassembly/conversion facility workers is site-independent and would be 200 mrem to the average facility worker and 83 person-rem to the entire facility workforce. The annual dose to the average noninvolved worker would range from 2.6 mrem at ORR to 32 mrem at SRS. The annual total dose to all noninvolved workers would range from 3.0 person-rem at NTS to 250 person-rem at Hanford. The annual dose

Table 4.3.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Pit Disassembly/Conversion Facility

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]												
Atmospheric release pathway (mrem)	2.9×10^{-4}	4.5×10^{-3}	1.5×10^{-4}	4.2×10^{-3}	1.8×10^{-4}	0.018	1.1×10^{-3}	1.1×10^{-3}	0.014	1.5	1.6×10^{-3}	0.42
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0	0.10	0	0.081
Total liquid release pathway (mrem)	0	9.5×10^{-4}	0	0	0	0	0	0	0	1.7	0	0.37
Atmospheric and liquid release pathways combined (mrem)	2.9×10^{-4}	5.4×10^{-3}	1.5×10^{-4}	4.2×10^{-3}	1.8×10^{-4}	0.018	1.1×10^{-3}	1.1×10^{-3}	0.014	3.2	1.6×10^{-3}	0.79
Percent of natural background[c]	9.6×10^{-5}	1.8×10^{-3}	4.8×10^{-5}	1.4×10^{-3}	5.4×10^{-5}	5.3×10^{-3}	3.4×10^{-4}	3.4×10^{-4}	4.8×10^{-3}	1.1	5.4×10^{-4}	0.27
10-year fatal cancer risk	1.4×10^{-9}	2.7×10^{-8}	7.6×10^{-10}	2.1×10^{-8}	9.0×10^{-10}	9.0×10^{-8}	5.5×10^{-9}	5.5×10^{-9}	7.0×10^{-8}	1.6×10^{-5}	8.0×10^{-9}	4.0×10^{-6}
[Text deleted.]												
Annual Population Dose Within 80 Kilometers[d]												
Atmospheric release pathway (person-rem)	0.016	0.48	2.9×10^{-4}	4.0×10^{-3}	3.2×10^{-3}	2.4	6.4×10^{-3}	6.7×10^{-3}	0.12	29	0.11	41
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6
Atmospheric and liquid release pathways combined (person-rem)	0.016	1.6	2.9×10^{-4}	4.0×10^{-3}	3.2×10^{-3}	2.4	6.4×10^{-3}	6.7×10^{-3}	0.12	34	0.11	44
Percent of natural background[c]	8.6×10^{-6}	8.4×10^{-4}	3.2×10^{-6}	4.4×10^{-5}	3.5×10^{-6}	2.7×10^{-3}	5.5×10^{-6}	5.8×10^{-6}	3.1×10^{-5}	9.0×10^{-3}	4.1×10^{-5}	0.017
10-year fatal cancers	8.0×10^{-5}	7.9×10^{-3}	1.5×10^{-6}	2.0×10^{-5}	1.5×10^{-5}	0.012	3.3×10^{-5}	3.4×10^{-5}	6.0×10^{-4}	0.17	5.6×10^{-4}	0.22
[Text deleted.]												

Table 4.3.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Pit Disassembly/Conversion Facility—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Average Individual Within 80 Kilometers[c]												
Atmospheric and liquid release pathways combined (mrem)	2.6×10^{-5}	2.6×10^{-3}	9.9×10^{-6}	1.3×10^{-4}	1.1×10^{-5}	8.9×10^{-3}	1.8×10^{-5}	1.9×10^{-5}	9.4×10^{-5}	0.026	1.2×10^{-4}	0.049
10-year fatal cancer risk	1.3×10^{-10}	1.3×10^{-8}	4.9×10^{-11}	6.6×10^{-10}	5.5×10^{-11}	4.5×10^{-8}	9.2×10^{-11}	9.6×10^{-11}	4.7×10^{-10}	1.3×10^{-7}	6.1×10^{-10}	2.5×10^{-7}
[Text deleted.]												

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the MEI may be different under No Action than for operation of the new pit disassembly/conversion facility. Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km (50mi) receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem.

[d] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[e] Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford; 29,400 at NTS; 269,000 at INEL; 350,000 at Pantex; 1,285,000 at ORR; and 893,000 at SRS).

Source: Section M.2.

Table 4.3.1.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Pit Disassembly/Conversion Facility

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce[a]						
Average worker dose (mrem/yr)[b]	200	200	200	200	200	200
10-year risk of fatal cancer	8.0×10^{-4}	8.0×10^{-4}	8.0×10^{-4}	8.0×10^{-4}	8.0×10^{-4}	8.0×10^{-4}
[Text deleted.]						
Total dose (person-rem/yr)	83	83	83	83	83	83
10-year fatal cancers	0.34	0.34	0.34	0.34	0.34	0.34
[Text deleted.]						
Noninvolved Workforce[c]						
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	1.1×10^{-4}	2.0×10^{-5}	1.2×10^{-4}	4.0×10^{-5}	1.0×10^{-5}	1.3×10^{-4}
[Text deleted.]						
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	1.9
[Text deleted.]						
Total Site Workforce[d]						
Dose (person-rem/yr)	333	86	303	97	127	309
10-year fatal cancers	1.7	0.43	1.5	0.49	0.64	1.5
[Text deleted.]						

[a] The involved worker is a worker associated with operations of the proposed action.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The noninvolved workforce is equivalent to the No Action workforce.

[d] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

to the total site workforces would range from 86 person-rem at NTS to 333 person-rem at Hanford. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts from normal operation of the pit disassembly/conversion facility at several sites are presented in Table 4.3.1.9–3. Included are the impacts due only to operation of the pit disassembly/conversion facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI of the public due to the pit disassembly/conversion facility operation ranges from 4.0×10^{-6} at NTS to 1.6×10^{-4} at ORR. The cancer risk from hazardous chemicals to the MEI from the pit disassembly/conversion facility operation is zero (because no carcinogens are released from the hazardous chemicals used) at all sites. The HI to the onsite worker from the facility operation ranges from 2.6×10^{-4} at NTS and Pantex to 5.3×10^{-4} at ORR, and the cancer risk from the facility operation to the onsite worker is zero (because no carcinogens are released from the hazardous chemicals used) at all sites.

Facility Accidents. A set of potential accidents for the pit disassembly/conversion facility has been postulated for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.1.9–4 through 4.3.1.9–9 for the sites analyzed (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed at each site, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 2.2 at ORR for the oxyacetylene explosion in a process cell accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 10-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 2.2×10^{-6}, 1.4×10^{-8}, and 1.1×10^{-8}, respectively. The maximum population 10-year facility lifetime risk would be 1.7×10^{-4} (that is, one fatality in about 60,000 years) at ORR for the fire on the loading dock accident scenario with a probability of 5.0×10^{-4} per year. The corresponding maximum offsite individual and worker 10 year facility lifetime risks would be 9.3×10^{-7} and 7.5×10^{-7}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.1.9–4 through 4.3.1.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is a possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] Admission of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude to the impacts of an aircraft crash into a disposition facility is given by the earthquake scenario. The earthquake and aircraft crash scenarios are similar in that they both result in major

Table 4.3.1.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Pit Disassembly/Conversion Facility

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]
Maximally Exposed Individual (Public)												
Hazard index[c]	2.7×10^{-5}	8.8×10^{-5}	4.0×10^{-6}	4.0×10^{-6}	5.8×10^{-5}	0.015	1.5×10^{-4}	5.8×10^{-3}	1.6×10^{-4}	0.039	7.3×10^{-6}	5.2×10^{-3}
Cancer risk[d]	0	0	0	0	0	3.6×10^{-6}	0	1.1×10^{-8}	0	0	0	1.3×10^{-7}
Worker Onsite												
Hazard index[e]	5.0×10^{-4}	4.4×10^{-3}	2.6×10^{-4}	2.6×10^{-4}	5.1×10^{-4}	0.22	2.6×10^{-4}	6.4×10^{-3}	5.3×10^{-4}	0.15	4.5×10^{-4}	1.2
Cancer risk[f]	0	0	0	0	0	7.7×10^{-4}	0	4.4×10^{-7}	0	0	0	1.9×10^{-4}

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=Sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer Risk for MEI: (Emissions Concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor [SF]).

[e] Hazard Index for Workers=Sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer Risk for Workers: (Emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [Fraction of year exposed]) x (0.571 [Fraction of lifetime working]) x (Slope Factor).

Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4–28 through M.3.4–33.

Table 4.3.1.9–4. Pit Disassembly/Conversion Facility Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	
Fire on the loading dock	6.4×10^{-7}	1.3×10^{-4}	2.5×10^{-8}	5.1×10^{-6}	4.6×10^{-5}	9.3×10^{-3}	5.0×10^{-4}
Fire in a process cell	7.6×10^{-13}	7.6×10^{-10}	3.0×10^{-14}	3.0×10^{-11}	5.5×10^{-11}	5.5×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	1.6×10^{-10}	1.6×10^{-7}	6.4×10^{-12}	6.4×10^{-9}	1.2×10^{-8}	1.2×10^{-5}	1.0×10^{-4}
Impact induced spill	1.2×10^{-16}	2.7×10^{-13}	4.9×10^{-18}	1.1×10^{-14}	8.8×10^{-15}	2.0×10^{-11}	4.5×10^{-5}
Nuclear criticality	6.9×10^{-13}	6.9×10^{-7}	2.9×10^{-14}	2.9×10^{-8}	7.8×10^{-12}	7.8×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	5.4×10^{-12}	5.4×10^{-6}	2.2×10^{-13}	2.2×10^{-7}	3.9×10^{-10}	3.9×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	9.4×10^{-9}	9.4×10^{-3}	3.2×10^{-10}	3.2×10^{-4}	5.8×10^{-7}	0.58	1.0×10^{-7}
Beyond evaluation basis earthquake	4.1×10^{-9}	4.1×10^{-3}	1.6×10^{-10}	1.6×10^{-4}	2.9×10^{-7}	0.29	1.0×10^{-7}
Expected risk[d]	6.5×10^{-7}	-	2.6×10^{-8}	-	4.7×10^{-5}	-	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1–5 and the MACCS computer code.

Table 4.3.1.9–5. Pit Disassembly/Conversion Facility Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	4.4×10^{-7}	8.7×10^{-5}	1.0×10^{-8}	2.0×10^{-6}	1.0×10^{-6}	2.1×10^{-4}	5.0×10^{-4}
Fire in a process cell	5.2×10^{-13}	5.2×10^{-10}	1.2×10^{-14}	1.2×10^{-11}	1.3×10^{-12}	1.3×10^{-9}	1.0×10^{-4}
Deflagration inside a glovebox	1.1×10^{-10}	1.1×10^{-7}	2.5×10^{-12}	2.5×10^{-9}	2.6×10^{-10}	2.6×10^{-7}	1.0×10^{-4}
Impact induced spill	8.3×10^{-17}	1.9×10^{-13}	1.9×10^{-18}	4.3×10^{-15}	2.0×10^{-16}	4.5×10^{-13}	4.5×10^{-5}
Nuclear criticality	5.0×10^{-13}	5.0×10^{-7}	1.1×10^{-14}	1.1×10^{-8}	1.6×10^{-13}	1.6×10^{-7}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	3.7×10^{-12}		8.6×10^{-14}	8.6×10^{-8}	8.9×10^{-12}	8.9×10^{-6}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	6.3×10^{-9}	6.3×10^{-3}	1.3×10^{-10}	1.3×10^{-4}	1.3×10^{-8}	0.013	1.0×10^{-7}
Beyond evaluation basis earthquake	2.7×10^{-9}	2.7×10^{-3}	6.3×10^{-11}	6.3×10^{-5}	6.5×10^{-9}	6.5×10^{-3}	1.0×10^{-7}
Expected risk[d]	4.5×10^{-7}	–	1.0×10^{-8}	–	1.1×10^{-6}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1–5 and the MACCS computer code.

Table 4.3.1.9–6. Pit Disassembly/Conversion Facility Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	6.0×10^{-7}	1.2×10^{-4}	6.4×10^{-9}	1.3×10^{-6}	1.4×10^{-5}	2.8×10^{-3}	5.0×10^{-4}
Fire in a process cell	7.1×10^{-13}	7.1×10^{-10}	7.7×10^{-15}	7.7×10^{-12}	1.7×10^{-11}	1.7×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	1.5×10^{-10}	1.5×10^{-7}	1.6×10^{-12}	1.6×10^{-9}	3.5×10^{-9}	3.5×10^{-6}	1.0×10^{-4}
Impact induced spill	1.1×10^{-16}	2.5×10^{-13}	1.2×10^{-18}	2.7×10^{-15}	2.7×10^{-15}	5.9×10^{-12}	4.5×10^{-5}
Nuclear criticality	6.7×10^{-13}	6.7×10^{-7}	6.7×10^{-15}	6.7×10^{-9}	2.1×10^{-12}	2.1×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	5.1×10^{-12}	5.1×10^{-6}	5.5×10^{-14}	5.5×10^{-8}	1.2×10^{-10}	1.2×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	9.2×10^{-9}	9.2×10^{-3}	8.0×10^{-11}	8.0×10^{-5}	1.7×10^{-7}	0.17	1.0×10^{-7}
Beyond evaluation basis earthquake	3.7×10^{-9}	3.7×10^{-3}	4.0×10^{-11}	4.0×10^{-5}	8.6×10^{-8}	0.086	1.0×10^{-7}
Expected risk[d]	6.1×10^{-7}	–	6.6×10^{-9}	–	1.4×10^{-5}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1–5 and the MACCS computer code.

Table 4.3.1.9–7. Pit Disassembly/Conversion Facility Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	2.6×10^{-7}	5.1×10^{-5}	1.0×10^{-7}	2.0×10^{-5}	1.6×10^{-5}	3.2×10^{-3}	5.0×10^{-4}
Fire in a process cell	3.1×10^{-13}	3.1×10^{-10}	1.2×10^{-13}	1.2×10^{-10}	1.9×10^{-11}	1.9×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	6.4×10^{-11}	6.4×10^{-8}	2.6×10^{-11}	2.6×10^{-8}	3.9×10^{-9}	3.9×10^{-6}	1.0×10^{-4}
Impact induced spill	4.9×10^{-17}	1.1×10^{-13}	2.0×10^{-17}	4.3×10^{-14}	3.0×10^{-15}	6.7×10^{-12}	4.5×10^{-5}
Nuclear criticality	3.1×10^{-13}	3.1×10^{-7}	1.4×10^{-13}	1.4×10^{-7}	4.8×10^{-12}	4.8×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	2.2×10^{-12}	2.2×10^{-6}	8.7×10^{-13}	8.7×10^{-7}	1.3×10^{-10}	1.3×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	3.3×10^{-9}	3.3×10^{-3}	1.3×10^{-9}	1.3×10^{-3}	2.0×10^{-7}	0.20	1.0×10^{-7}
Beyond evaluation basis earthquake	1.6×10^{-9}	1.6×10^{-3}	6.4×10^{-10}	6.4×10^{-4}	9.8×10^{-8}	0.098	1.0×10^{-7}
Expected risk[d]	2.6×10^{-7}	-	1.0×10^{-7}	-	1.6×10^{-5}	-	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1–5 and the MACCS computer code.

Table 4.3.1.9–8. Pit Disassembly/Conversion Facility Accident Impacts at Oak Ridge Reservation

	Worker at 772 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	7.5×10^{-7}	1.5×10^{-4}	9.3×10^{-7}	1.9×10^{-4}	1.7×10^{-4}	0.035	5.0×10^{-4}
Fire in a process cell	8.9×10^{-13}	8.9×10^{-10}	1.1×10^{-12}	1.1×10^{-9}	2.1×10^{-10}	2.1×10^{-7}	1.0×10^{-4}
Deflagration inside a glovebox	1.9×10^{-10}	1.9×10^{-7}	2.3×10^{-10}	2.3×10^{-7}	4.3×10^{-8}	4.3×10^{-5}	1.0×10^{-4}
Impact induced spill	1.4×10^{-16}	3.2×10^{-13}	1.8×10^{-17}	4.0×10^{-13}	3.3×10^{-14}	7.4×10^{-11}	4.5×10^{-5}
Nuclear criticality	7.8×10^{-13}	7.8×10^{-7}	9.8×10^{-13}	9.8×10^{-7}	6.6×10^{-11}	6.6×10^{-5}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	6.3×10^{-12}	6.3×10^{-6}	7.9×10^{-12}	7.9×10^{-6}	1.5×10^{-9}	1.5×10^{-3}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	1.1×10^{-8}	0.011	1.4×10^{-8}	0.014	2.2×10^{-6}	2.2	1.0×10^{-7}
Beyond evaluation basis earthquake	4.6×10^{-9}	4.6×10^{-3}	5.8×10^{-9}	5.8×10^{-3}	1.1×10^{-6}	1.1	1.0×10^{-7}
Expected risk[d]	7.6×10^{-7}	-	9.5×10^{-7}	-	1.8×10^{-4}	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 772 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [772 m for the facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1–5 and the MACCS computer code.

Table 4.3.1.9–9. Pit Disassembly/Conversion Facility Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	4.2×10^{-7}	8.4×10^{-5}	1.0×10^{-8}	2.0×10^{-6}	5.0×10^{-5}	9.9×10^{-3}	5.0×10^{-4}
Fire in a process cell	5.0×10^{-13}	5.0×10^{-10}	1.2×10^{-14}	1.2×10^{-11}	5.9×10^{-11}	5.9×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	1.0×10^{-10}	1.0×10^{-7}	2.6×10^{-12}	2.6×10^{-9}	1.2×10^{-8}	1.2×10^{-5}	1.0×10^{-4}
Impact induced spill	8.0×10^{-17}	1.8×10^{-13}	2.0×10^{-18}	4.4×10^{-15}	9.5×10^{-15}	2.1×10^{-11}	4.5×10^{-5}
Nuclear criticality	4.5×10^{-13}	4.5×10^{-7}	1.0×10^{-14}	1.0×10^{-8}	1.0×10^{-11}	1.0×10^{-5}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	3.6×10^{-12}	3.6×10^{-6}	8.7×10^{-14}	8.7×10^{-8}	4.2×10^{-10}	4.2×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	5.8×10^{-9}	5.8×10^{-3}	1.3×10^{-10}	1.3×10^{-4}	6.2×10^{-7}	0.62	1.0×10^{-7}
Beyond evaluation basis earthquake	2.8×10^{-9}	2.8×10^{-3}	6.4×10^{-11}	6.4×10^{-5}	3.1×10^{-7}	0.31	1.0×10^{-7}
Expected risk[d]	4.3×10^{-7}	-	1.0×10^{-8}	-	5.1×10^{-5}	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1–5 and the MACCS computer code.

structural damage and the release of Pu directly to the environment. They differ in that an earthquake induced fire is based on limited combustible materials while the aircraft crash has the potential for a major fuel related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive serious or fatal injuries.

[Text deleted.]

4.3.1.10 Waste Management

This section summarizes the waste management impacts for the construction and operation of a pit disassembly/conversion facility. There is no spent nuclear fuel or HLW associated with the operation of the pit disassembly/conversion facility. Table 4.3.1.10–1 provides the estimated operational waste volumes projected to be generated at the sites analyzed as a result of the pit disassembly/conversion facility. Facilities that would support the pit disassembly/conversion facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA, and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous and nonhazardous wastes would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the pit disassembly/conversion facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.2.1. A detailed description of the waste management activities that would be required to support the pit disassembly/conversion facility can also be found in Section E.3.2.1.

Construction and operation of a pit disassembly/conversion facility would impact existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any are generated, it would be managed in accordance with site practice, and all applicable Federal and State regulations.

Approximately 67 m^3 (88 yd^3) of TRU waste consisting of retired gloveboxes, contaminated wipes and rags, plastics, packaging materials, declassified components, and glovebox sweepings would require treatment and repackaging to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. ORNL has the only existing or planned capability at ORR to handle TRU waste. ORNL existing and planned TRU waste facilities could handle this increase. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the pit disassembly/conversion facility if sited at Pantex or NTS. A small quantity (4 m^3 [6 yd^3]) of mixed TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would be principally leaded rubber gloves. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), eight truck shipments per year or, if applicable, four regular train shipments per year or one dedicated train shipment per year, would be required.

All of the sites analyzed have existing or planned facilities that could manage the small quantities of LLW. Approximately 102 m^3 (133 yd^3) of LLW from paper and surgeon's gloves, which are discarded inside the Radioactive Materials Area but external to gloveboxes, and solidified liquid LLW would require disposal. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.03 ha/yr (0.08 acre/yr) at Hanford and ORR, 0.02 ha/yr (0.04 acre/yr) at NTS and INEL, and 0.01 ha/yr (0.03 acre/yr) at SRS. With no onsite LLW disposal capability, Pantex would require six additional LLW shipments per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

A small quantity (0.4 m^3 [100 gal]) of liquid and (1.7 m^3 [2.2 yd^3]) of solid mixed LLW consisting of solvents, lead, and vacuum pump oil that have been contaminated with radioactive constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party

Table 4.3.1.10–1. Estimated Annual Generated Waste Volumes for the Pit Disassembly/Conversion Facility[a]

Category	New Facility (m^3)	Hanford No Action (m^3)	NTS No Action (m^3)	INEL No Action (m^3)	Pantex No Action (m^3)	ORR No Action (m^3)	SRS No Action (m^3)
Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	67	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	4	98	None	Included in TRU	None	None	Included in TRU
Low-Level							
Liquid	4[b]	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	102	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-Level							
Liquid	0.4	3,760	None	4	4	87,600	1,330
Solid	1.7	1,505	50	170	46	432	7,700
Hazardous							
Liquid	2	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	0.7	560	212	1,200	31	26	15,100
Nonhazardous (Sanitary)							
Liquid	85,200	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	100	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	3[c]	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

[a] The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1. Incremental waste generation volumes for pit disassembly/conversion are from Table E.3.2.1–1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.2.1–1.

[b] Liquid LLW would be treated and solidified prior to disposal.

[c] Recyclable wastes.

Agreement for Hanford or the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

Liquid hazardous waste would consist of cleaning solvents, vacuum pump oils, film processing fluids, hydraulic fluids from mechanical equipment, antifreeze solutions, and paint. Liquid hazardous waste would be treated onsite or collected in DOT-approved containers and shipped offsite to RCRA-permitted treatment facilities. After treatment, the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities. Solid hazardous waste would consist of lead packing and wipes contaminated with oils, lubricants, and cleaning solvents. After compaction, solid hazardous waste would be packaged in DOT-approved containers, treated onsite or offsite, and shipped to RCRA-permitted treatment and disposal facilities. All the sites analyzed would have adequate capacity to stage the 2 m^3 (500 gal) of liquid and 0.7 m^3 (0.9 yd^3) of solid hazardous waste until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately 85,200 m^3 (22,500,000 gal) of liquid nonhazardous sanitary and industrial wastewater, steam plant blowdown, and estimated stormwater runoff would require treatment, in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required. The 100 m^3 (131 yd^3) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.2 PLUTONIUM CONVERSION FACILITY

The environmental impacts described in the following sections are based on the analysis of the Pu conversion facility as described in Section 2.4.2. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS. These sections describe the construction and operational impacts of the Pu conversion facility on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomic, public and occupational health and safety, and waste management.

In accordance with the Preferred Alternative for surplus Pu disposition, the Pu conversion facility could be located at either Hanford or SRS. Further tiered NEPA review will be conducted to examine alternative locations including new and existing facilities at these two sites should the Preferred Alternative be selected at the ROD. Although new facilities are analyzed in Section 4.3.2.1 through 4.3.2.10, DOE would preserve the option for using existing facilities to the extent practical pursuant to subsequent tiered NEPA review.

4.3.2.1 Land Resources

At all sites, the Pu conversion facility would disturb 36 ha (90 acres) of land during construction of which approximately 28 ha (70 acres) would be used during operations. The facility would be sited in a 1.6-km (1-mi) buffer zone contained within the boundary except at ORR, where the buffer zone is less than 1.6 km (1 mi). With the 1.6-km (1-mi) buffer zone, total land requirement would be 1,416 ha (3,500 acres). This section describes the impacts of constructing and operating the Pu conversion facility to land resources for each analysis site.

As discussed in Section 4.3.2.8, new housing construction at all sites should be sufficient to absorb the increase in population due to the in-migration of operational workers. No in-migration would occur during construction. No offsite land use would be affected; therefore, no indirect impacts would occur.

Hanford Site

Land Use. The potential site for the Pu conversion facility would utilize vacant land in the 200 Area adjacent to 200 East. Construction and operation of the Pu conversion facility would be in conformance with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land use planning process. According to the *Hanford Site Development Plan*, 200 Areas land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction would be consistent with State and local (Benton, Franklin, and Grant Counties and the city of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Areas. Construction and operation would be consistent with the current VRM Class 5 designation.

Nevada Test Site

Land Use. The potential location for the Pu conversion facility would be on undeveloped land in Area 6. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area. [Text deleted.] However, Area 6 is under a potential site for long-term storage and disposition of weapons-usable fissile materials as part of

the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8–3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of these counties and municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The proposed Pu conversion facility would be located on undeveloped land within the ICPP security area which is part of the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). Construction and operation of the facility would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan* which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation of the facility would be consistent with the existing industrialized landscape character of the ICPP. Construction and operation would be consistent with the current VRM Class 5 designation of the area.

Pantex Plant

Land Use. Undeveloped land in Zone 12 is the potential location for the Pu conversion facility. The potential action would be consistent with the current *Pantex Site Development Plan* master plan, which designates Zone 12 as weapons assembly/disassembly (PX DOE 1995g:16). [Text deleted.]

Construction and operation would not affect other Pantex or offsite land uses. There would be no impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] The proposed visual environment would be consistent with the existing industrialized landscape character. Construction and operation would be consistent with the current VRM Class 5 designation of Zone 12.

Oak Ridge Reservation

Land Use. The Pu conversion facility is proposed to be sited on undeveloped land at Y–12. Weapons component manufacturing and development is among the future land uses designated for Y–12 by the future land use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* (OR DOE 1989a:5-6–5-7). The alternative is compatible with the plan.

Construction and operation of the Pu conversion facility would not affect other ORR or offsite land uses. No prime farmlands exist onsite. Construction and operation would not be in conflict with the city of Oak Ridge

land-use plans, policies, and controls since the current *Oak Ridge Area Land Use Plan* designates the potential site for Industrial land use.

Visual Resources. Potential impacts to visual resources would not occur. The visual environment would be consistent with the existing industrial landscape character. Construction and operation would be consistent with the current VRM Class 5 designation of Y–12.

Savannah River Site

Land Use. Vacant land in the F-Area would be used for the Pu conversion facility. Construction and operation of the proposed facility would be in conformance with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the plan, current F-Area land use is designated industrial operations, while the future land-use category is primary industrial mission (SR DOE 1994d:11,12). Vacant land would be utilized.

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] The visual environment would be consistent with the industrial landscape character. Construction and operation would be consistent with current VRM Class 5 designation of the F-Area.

[Text deleted.]

4.3.2.2 Site Infrastructure

This section discusses the impacts on site infrastructure needed to support the Pu conversion facility at each of the six representative sites. Constructing and operating the facility would impact infrastructure at each site differently, depending on operating resources.

The Pu conversion facility would be composed of shipping and receiving, material management, processing operations, waste management, and necessary facility infrastructure and utility support functions. Construction would require approximately 6 years to complete. Table 4.3.2.2–1 presents a comparison of annual construction resource needs for each of the representative sites. Comparative impact of average annual resource needs for operation are presented in Table 4.3.2.2–2.

Table 4.3.2.2–1. Additional Site Infrastructure Needed for the Construction of the Plutonium Conversion Facility (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	1,100	<1	157,850	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage (without facility)	345,500	58	9,334,800	21,039,531	0
Projected usage (with facility)	346,600	59	9,492,650	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage (without facility)	124,940	25	5,716,000	0	0
Projected usage (with facility)	126,040	26	5,873,850	0	0
Amount required in excess to site availability	0	0	157,850[a]	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage (without facility)	232,500	42	5,820,000	0	11,340
Projected usage (with facility)	233,600	43	5,977,850	0	11,340
Amount required in excess to site availability	0	0	0	0	0

Table 4.3.2.2–1. Additional Site Infrastructure Needed for the Construction of the Plutonium Conversion Facility (Annual)—Continued

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	1,100	<1	157,850	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage (without facility)	46,266	10	795,166	7,200,000	0
Projected usage (with facility)	47,366	11	953,016	7,200,000	0
Amount required in excess to site availability	0	0	0	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage (without facility)	726,000	110	379,000	95,000,000	16,300
Projected usage (with facility)	727,100	111	536,850	95,000,000	16,300
Amount required in excess to site availability	0	0	120,850[a]	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage (without facility)	794,000	116	28,390,500	0	221,352
Projected usage (with facility)	795,100	117	28,548,350	0	221,350
Amount required in excess to site availability	0	0	148,350	0	0

[a] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

Table 4.3.2.2–2. Additional Site Infrastructure Needed for the Operation of the Plutonium Conversion Facility (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	<5	0	21,000	5	39,750	4,361,000	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage (without facility)	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage (with facility)	425	204	366,500	63	9,374,550	25,400,531	0
Amount required in excess to site availability	<5	0	0	0	0	4,361,000[a]	0
NTS							
Site availability	1,100[b]	0	176,844	45	5,716,000	0	0
Projected usage (without facility)	645	0	124,940	25	5,716,000	0	0
Projected usage (with facility)	650	0	145,940	30	5,755,750	4,361,000	0
Amount required in excess to site availability	0	0	0	0	39,750[c]	4,361,000[a]	0
INEL							
Site availability	445	48	394,000	124	16,000,000	0	11,340
Projected usage (without facility)	445	48	232,500	42	5,820,000	0	11,340
Projected usage (with facility)	450	48	253,500	47	5,859,750	4,361,000	11,340
Amount required in excess to site availability	<5	0	0	0	0	4,361,000[a]	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage (without facility)	76	27	46,266	10	795,166	7,200,000	0

Table 4.3.2.2–2. Additional Site Infrastructure Needed for the Operation of the Plutonium Conversion Facility (Annual)—Continued

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	<5	0	21,000	5	39,750	4,361,000	0
Projected usage (with facility)	81	27	67,266	15	834,916	11,561,000	0
Amount required in excess to site availability	<5	0	0	0	0	0	0
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage (without facility)	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage (with facility)	76	27	747,000	115	418,750	99,361,000	16,300
Amount required in excess to site availability	<5	0	0	0	2,750[c]	0	0
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage (without facility)	230	103	659,000	130	28,390,500	0	210,000
Projected usage (with facility)	235	103	680,000	135	28,430,250	4,361,000	210,000
Amount required in excess to site availability	<5	0	0	0	39,750[c]	4,361,000[a]	0

[a] Facility would be adapted to use fuel oil instead of natural gas.

[b] Includes both paved and unpaved roads.

[c] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

Hanford Site

Resources needed for construction are well within site availability. These resources would represent a small fraction of those needed to operate the site. Operations impacts would be small. The planned Pu conversion facility would use natural gas as the primary utility fuel, and the total requirement for natural gas would be higher than the site currently has available. The additional amount could be procured normal contractual means. [Text deleted.]

Nevada Test Site

Resources needed for construction would be well within site availability for all resources except oil. These resources would represent a small fraction of those needed to operate the site. Operational impacts would be small except for utility fuel. The planned Pu conversion facility would use natural gas as the primary utility fuel. Since NTS uses fuel oil as its primary utility fuel, using natural gas in lieu of fuel oil would require additional infrastructure. The final facility design would be converted to a fuel oil basis. Fuel oil requirements would exceed current site availability, but can be procured through normal contractual means.

Idaho National Engineering Laboratory

Resources needed for construction would be within site availability. These resources would represent a small fraction of those needed to operate the site. Operations impacts would be small except for utility fuel. The planned Pu conversion facility would use natural gas as the primary utility fuel. Since INEL uses fuel oil as its primary utility fuel, using natural gas in lieu of fuel oil would require additional infrastructure. The final facility design would be converted to a fuel oil basis. With this conversion from natural gas to fuel oil, site infrastructure requirements are within site capacities. [Text deleted.]

Pantex Plant

Resources needed for construction would be within site availability. [Text deleted.] Operations requirements would be within site availability. Adequate electrical energy would be available from the regional power grid.

Oak Ridge Reservation

Except for fuel oil, resources needed for construction would be well within site availability. Additional fuel oil for construction could be procured through normal contractual means. These resources would represent a small fraction of those needed to operate the site. Operational impacts would be small. [Text deleted.] However, the total requirement for oil would be slightly higher than the site currently has available. The additional amount could be procured through normal contractual means.

Savannah River Site

Resources needed for construction would be within site availability for all resources except oil. Additional fuel oil for construction could be procured through normal contractual means. These resources would represent a small fraction of those needed to operate the site. Operational impacts would be within availability capacity except for oil and natural gas. Since SRS uses fuel oil as its primary utility fuel, using natural gas in lieu of fuel oil would require additional infrastructure. The final facility design would be converted to a fuel oil basis. With this conversion from natural gas to fuel oil, site infrastructure requirements would be within site capacities, except for oil. Additional oil could be procured through normal contractual means.

4.3.2.3 Air Quality and Noise

Construction and operation of the Pu conversion facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.2.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period, especially during dry and windy conditions. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of the Pu conversion facility are presented in Table F.1.3–5. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators

[Text deleted.]

- Toxic/hazardous pollutant emissions from facility processes

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation plus the No Action concentrations are presented in Table 4.3.2.3–1.

NOISE

The location of the facilities associated with the Pu conversion facility relative to the site boundary and sensitive receptors was examined for each of the six sites to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Table 4.3.2.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Plutonium Conversion Facility and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] (μg/m³)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)
Criteria Pollutants														
Carbon monoxide	8-hour	10,000	0.08	0.71	2,290	2,290.5	284	285.59	602	608.13	5	5.16	22	27.42
	1-hour	40,000	0.3	5.23	2,748	2,751.56	614	618.03	2,900	2,932.0	11	11.33	171	196.51
Lead	Calendar Quarter	1.5	<0.01	<0.01	[b]	[b]	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01
	24-hour	0.5	<0.01	<0.01	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
Nitrogen dioxide	Annual	100	0.03	0.06	[b]	<0.01[d]	4	4.03	2.15	2.29	3	3.01	5.7	5.81
Ozone	1-hour	235	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01	<0.01	9.4	9.4	5	5	8.73	8.73	1	1	3	3
	24-hour	150	0.02	0.02	106	106	80	80	88.5	88.51	2	2	50.6	50.61
Sulfur dioxide	Annual	52	<0.01	<0.01	8.4	8.4	6	6	<0.01	<0.01	2	2	14.5	14.5
	24-hour	260	<0.01	<0.01	94.6	94.6	135	135	<0.01	0.01	32	32	196	196
	3-hour	1,300	0.01	0.01	725	725	579	579	<0.01	0.04	80	80	823	823.03
	1-hour	1,018	0.02	0.02	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	1-hour	655[f]	0.02	0.02	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	30-minute	1,045	[c]	[c]	[c]	[c]	[c]	[c]	<0.01	0.09	[c]	[c]	[c]	[c]
Mandated by State														
Gaseous fluoride (as HF)	30-day	0.8	[b]	<0.01[d]	[c]	[c]	[c]	[c]	<0.75	<0.75	0.2	0.2	0.09	0.09
	7-day	1.6	[b]	<0.01[d]	[c]	[c]	[c]	[c]	<0.75	<0.75	0.3	0.3	0.39	0.39
	24-hour	2.9	[b]	<0.01[d]	[c]	[c]	[c]	[c]	0.75	0.75	0.6[g]	0.6[g]	1.04	1.04
	12-hour	3.7	[b]	<0.01[d]	[c]	[c]	[c]	[c]	1.05	1.05	0.6[g]	0.6[g]	1.99	1.99
	8-hour	250	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	0.6	0.6	[c]	[c]
	3-hour	4.9	[c]	[c]	[c]	[c]	[c]	[c]	4.21	4.21	[c]	[c]	[c]	[c]
Hydrogen sulfide	1-hour	112	[c]	[c]	[b]	[b]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	30-minute	111	[c]	[c]	[c]	[c]	[c]	[c]	[b]	[b]	[c]	[c]	[c]	[c]

Table 4.3.2.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Plutonium Conversion Facility and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)
Total suspended particulates	Annual	60	<0.01	<0.01	c	c	5	5	c	c	c	c	12.6	12.6
	24-hour	150	0.02	0.02	c	c	80	80	c	c	2	2	c	c
	3-hour	200	c	c	c	c	c	c	b	d	c	c	c	c
	1-hour	400	c	c	c	c	c	c	b	d	c	c	c	c
Hazardous and Other Toxic Compounds														
Ammonia	Annual	17	c	c	c	c	6	6	b	<0.01[d]	c	c	c	c
	24-hour	100	<0.01	<0.01	c	c	c	c	c	c	c	c	b	<0.01[d]
	8-hour	404.8	c	c	b	<0.01[d]	c	c	c	c	b	<0.01[d]	c	c
	30-minute	170	c	c	c	c	c	c	b	0.08[d]	c	c	c	c
Chlorine	Annual	1.5	c	c	c	c	b	<0.01[d]	b	<0.01[d]	c	c	c	c
	24-hour	5	b	<0.01[d]	c	c	c	c	c	c	c	c	7.63	7.63
	8-hour	35.7	c	c	b	<0.01[d]	c	c	c	c	4.1	4.1	c	c
	30-minute	15	c	c	c	c	c	c	b	0.06[d]	c	c	c	c
Ethanol	Annual	1,880	c	c	c	c	b	<0.01[d]	b	<0.01[d]	c	c	c	c
	24-hour	6,300	b	<0.01[d]	c	c	c	c	c	c	c	c	b	<0.01[d]
	8-hour	44,762	c	c	b	<0.01[d]	c	c	c	c	b	<0.01[d]	c	c
	30-minute	18,800	c	c	c	c	c	c	b	0.16[d]	c	c	c	c
Hydrogen chloride	Annual	0.1	c	c	c	c	0.98	0.98	0.07	0.07	c	c	c	c
	24-hour	7	b	<0.01[d]	c	c	c	c	c	c	c	c	b	0.01[d]
	8-hour	750	c	c	b	<0.01[d]	c	c	c	c	57	57	c	c
	30-minute	75	c	c	c	c	c	c	6.17	6.27	c	c	c	c
Hydrazine	Annual	0.0002	b	<0.00001[d]	c	c	0.000001	0.000001	b	<0.0001[d]	c	c	c	c
	24-hour	0.5	c	c	c	c	c	c	c	c	c	c	b	<0.01[d]
	8-hour	1.3	c	c	b	<0.01[d]	c	c		c	b	<0.01[d]	c	c
	30-minute	0.13	c	c	c	c	c	c	b	0.01[d]	c	c	c	c

Table 4.3.2.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Plutonium Conversion Facility and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] (μg/m³)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)
Hazardous and Other Toxic Compounds (continued)														
Nitric acid	Annual	5.2	c	c	c	c	0.64	0.64	b	<0.01[d]	c	c	c	c
	24-hour	17	b	<0.01[d]	c	c	c	c	c	c	c	c	50.96	50.96
	8-hour	123.8	c	c	b	<0.01[d]	c	c	c	c	78	78	c	c
	30-minute	52	c	c	c	c	c	c	b	0.02[d]	c	c	c	c
Phosphoric acid	Annual	1	c	c	c	c	b	<0.01[d]	b	<0.01[d]	c	c	c	c
	24-hour	3.3	b	<0.01[d]	c	c	c	c	c	c	c	c	0.462	0.462
	8-hour	23.8	c	c	b	<0.01[d]	c	c	c	c	b	<0.01[d]	c	c
	30-minute	10	c	c	c	c	c	c	b	0.01[d]	c	c	c	c
Sulfuric acid	Annual	10	c	c	c	c	b	<0.01[d]	b	<0.01[d]	c	c	c	c
	24-hour	3.3	b	<0.01[d]	c	c	c	c	c	c	c	c	b	<0.01[d]
	8-hour	23.8	c	c	b	<0.01[d]	c	c	c	c	20	20	c	c
	30-minute	50	c	c	c	c	c	c	b	0.01[d]	c	c	c	c

Table 4.3.2.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Plutonium Conversion Facility and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (continued)														
Trichloroethylene	Annual	0.077	[b]	<0.01[d]	[c]	[c]	0.00097	0.004	0.21	0.24	[c]	[c]	[c]	[c]
	24-hour	6,750	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[b]	0.21[d]
	8-hour	6,405	[c]	[c]	[b]	0.06[d]	[c]	[c]	[c]	[c]	[b]	0.02[d]	[c]	[c]
	30-minute	1,350	[c]	[c]	[c]	[c]	[c]	[c]	51.1	54.69	[c]	[c]	[c]	[c]

[a] The more stringent of the Federal and State standards is presented for each averaging time.

[b] No sources of this pollutant have been identified.

[c] No State standard for indicated averaging time.

[d] The concentration represents the alternative contribution only.

[e] Ozone, as a criteria pollutant, is not directly emitted nor monitored by the sites. See Section 4.1.3 for discussion of ozone-related issues.

[f] At Hanford, the level is not to be exceeded more than twice in any seven consecutive days.

[g] 8-hour averaging time concentration was used.

Note: Total concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from non-facility sources. Concentrations for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here. Emission of unspecified cleaning solvents was not modeled.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LANL 1996c; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

Nontraffic noise sources associated with operation of the Pu conversion facility include ventilation systems, cooling systems, and material handling equipment. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.2.4 Water Resources

The construction and operation of a Pu conversion facility would affect water resources. Water resource requirements and discharges provided in Tables C.1.1.2–2, C.2.1.2–2, and E.3.2.2–1 were used to assess impacts to surface and groundwater. The discussion of impacts are provided for each site separately. Table 4.3.2.4–1 presents No Action surface and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the Pu conversion facility.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the Pu conversion facility. During construction, water requirements would be approximately 2.4 million l/yr (0.6 million gal/yr), which would represent a 0.02-percent increase over the existing annual surface water withdrawal. This additional withdrawal would be negligible. During operation, water requirements would be approximately 80.5 million l/yr (21.2 million gal/yr), which would represent a 0.6-percent increase over the existing surface water withdrawal. This additional withdrawal would also be negligible.

[Text deleted.]

During construction of the Pu conversion facility, sanitary and other nonhazardous wastewater (2.4 million l/yr [0.6 million gal/yr]), would be generated and discharged to the existing wastewater treatment systems at the 200 Area. The effluents from this facility would be discharged to evaporation/infiltration ponds. During operation, approximately 15 million l/yr (4 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. This would represent a 6.1-percent increase in the wastewater discharged at Hanford. All discharges would be monitored to comply with discharge limits. No impacts to surface water are expected.

The Pu conversion facility would be located in the 200 Area which is above the 100-year, 500-year, and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used during construction or operation of the Pu conversion facility; therefore, there would be no impacts to groundwater availability. No wastewater would be discharged directly to groundwater; therefore, groundwater quality should not be affected. Treated wastewater discharged to evaporation/infiltration ponds that does not evaporate, however, could percolate downward into the groundwater. This water would be monitored before discharge to the ponds and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with any of the proposed facilities; groundwater would be used as the water source for the Pu conversion facility. Therefore, there should be no impacts to surface water availability.

[Text deleted.]

During construction of the Pu conversion facility, sanitary wastewater (2.4 million l/yr [0.6 million gal/yr]), would be generated. During operation, a maximum of approximately 15 million l/yr (4 million gal/yr) of

Table 4.3.2.4–1. Potential Changes to Water Resources Resulting From the Plutonium Conversion Facility

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Water Source	Surface	Ground	Ground	Ground	Surface	Ground
No Action water requirements (million l/yr)	13,511	2,400	7,570	249	14,760	13,247
No Action wastewater discharge (million l/yr)	246	82	540	141	2,277	700
Construction						
Water Availability and Use						
Total water requirement (million l/yr)	2.4	2.4	2.4	2.4	2.4	2.4
Percent increase in projected water use[a]	0.02	0.1	0.03	1.0	0.02	0.02
Water Quality						
Total wastewater discharge (million l/yr)	2.4	2.4	2.4	2.4	2.4	2.4
Percent change in wastewater discharge[b]	1.0	2.9	0.4	1.7	0.1	0.3
Percent change in streamflow	neg	NA	NA	NA	0.005[c]	0.05[d]
Operation						
Water Availability and Use						
Total water requirement (million l/yr)	80.5	80.5	80.5	80.5	80.5	80.5
Percent increase in projected water use[e]	0.6	3.4	1.1	32.3	0.6	0.6
Water Quality						
Total wastewater discharge (million l/yr)	15	15	15	15	15	15
Percent change in wastewater discharge[f]	6.1	18.2	2.8	10.6	0.7	2.1
Percent change in streamflow	neg	NA	NA	NA	0.03[c]	0.3[d]

Table 4.3.2.4–1. Potential Changes to Water Resources Resulting From the Plutonium Conversion Facility—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Floodplain						
Is action in 100-year floodplain?	No	No	No	No	No	No
Is critical action in 500-year floodplain?	No	Uncertain	Uncertain	No	No	Unlikely

[a] Percent increases in water requirements during construction of a Pu conversion facility are calculated by dividing water requirements for the facility (2.4 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 l/yr).

[b] Percent increases in wastewater discharged during construction of a Pu conversion facility are calculated by dividing waste water discharges for the facility (2.4 million l/yr) with that for No Action water discharges at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

[c] Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for the East Fork Poplar Creek is shown in the table.

[d] Percent changes in stream flow from wastewater discharge are calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).

[e] Percent increases in water requirements during operation of a Pu conversion facility are calculated by dividing water requirements for the facility (80.5 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[f] Percent increases in wastewater discharged during operation of a Pu conversion facility are calculated by dividing wastewater discharges for the facility (15.0 million l/yr) with that for No Action discharges at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle.

Because there are no continuously flowing streams on NTS and no designated floodplains, there are no studies to assess the 500-year floodplain boundaries. Studies of the 100-year floodplain have shown it to be confined to the Jackass Flats and Frenchman Lake area. The site for the Pu conversion facility is not located in either of these areas. However, since the NTS is in a region where most flooding occurs from locally intense thunderstorms that can create brief (less than 6 hours) flash floods, the facility would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater. The Lower and Upper Carbonate, the Volcanic, and the Valley-Fill Aquifers are the sources of water for operations at NTS.

Water requirements for construction of the proposed facilities (2.4 million l/yr [0.6 million gal/yr]), represent approximately 0.006 percent of the minimum estimated annual recharge to the regional aquifer under the entire NTS. This is based on several recent studies that estimated that recharge would be 38 to 57 billion l (10 to 15 billion gal). As shown in Table 4.3.2.4–1, the quantity of water required for construction of the proposed facilities represents approximately a 0.1-percent increase over the total projected No Action groundwater usage. Withdrawal of this additional quantity should have minimal impact on groundwater availability. Operating the proposed facilities at NTS would require 80.5 million l/yr (21.2 million gal/yr) of water, which is approximately 3.4 percent of the projected groundwater usage. This additional withdrawal represents less than 0.2 percent of the estimated minimum annual recharge. No impacts are expected.

Construction and operation of the Pu conversion facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are, therefore, not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the Pu conversion facility. Therefore, there should be no impacts to surface water availability.

[Text deleted.]

During construction of the Pu conversion facility, sanitary wastewater (2.4 million l/yr [0.6 million gal]), would be generated and discharged to the existing wastewater treatment system at the ICPP Area. This amount would represent a 0.4-percent increase in the effluent discharged at INEL. During operation, approximately 15 million l/yr (4 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. This amount represents a 2.8-percent increase in INEL's effluent. After treatment, all wastewater generated during construction and operation would be available to recycle or would then be allowed to evaporate to the atmosphere and/or infiltrate to the subsurface. All discharges would be monitored to comply with discharge limits.

The site for the Pu conversion facility is not located in an area historically prone to flooding, but is within the flood zone that could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This

flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facility would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. Construction water requirements for the Pu conversion facilities are small relative to INEL's total usage. Construction and operation water requirements for the facility (2.4 million l/yr [0.6 million gal/yr]), and 80.5 million l/yr (21.2 million gal/yr), respectively, represent 0.03- and 1.1-percent increases over the projected annual groundwater usage. These withdrawals would increase the total projected amount to be pumped at INEL to 17.6 percent of the total allotment during construction and 17.8 percent of the allotment during operation. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). These additional withdrawals should not impact groundwater availability.

Construction and operation of the proposed Pu conversion facility would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater that would be discharged to disposal ponds but does not evaporate, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are, therefore, not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the proposed facility; groundwater would be used as the water source for the Pu conversion facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the Pu conversion facility, sanitary wastewater (2.4 million l/yr [0.6 million gal/yr]), would be generated and discharged to the existing wastewater treatment systems north of Zone 12. During operation, approximately 15 million l/yr (4 million gal/yr) of sanitary wastewater and other wastewater would be discharged to either of these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would be discharged to the playa lakes or would be available for recycle. In 1994, Pantex averaged approximately 1.4 million l/day (0.37 million gal/day) of wastewater discharged to the playas. This quantity is expected to decrease in the future. The expected quantity of additional wastewater potentially discharged to the playas during operation (0.04 million l/day [0.01 million gal/day]) should not cumulatively cause any exceedances of the monthly average limit of 2.46 million l/day (0.65 million gal/day).

The new Pu conversion facility would be located in Zone 12. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 12, there would be no impacts to flood plains. However, flooding at the playas could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system or possibly reclaimed wastewater from the Hollywood Road Wastewater Treatment Plant. Construction water requirements for the Pu conversion facilities are small relative to the recoverable water in aquifer storage which for the year 2010 was estimated to be 287 trillion l (76 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.2.4–1, construction of the proposed Pu conversion facility would require 2.4 million l/yr (0.6 million gal/yr) of water, which represents approximately a 1.0-percent increase over the projected annual groundwater usage. [Text deleted.] Water required for operations (80.5 million l/yr [21.2 million gal/yr]) would increase projected water requirements by 32.3 percent. Previous studies have

shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8-m/yr (5.9-ft/yr) decline in the water table occurred over a 10-yr period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the proposed Pu conversion facility at Pantex would require 80.5 million l/yr (21.2 million gal/yr), resulting in a small drawdown representing 4.2 percent of the capacity of the groundwater system. Although this additional groundwater withdrawal would add to the existing decline in water levels of the Ogallala Aquifer, the estimated degree would not affect regional groundwater levels. The total site groundwater withdrawal including this facility would be 329 million l/yr (86.9 million gal/yr) which, because of expected cutbacks in other programs, would be 61 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the proposed Pu conversion facility would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative is small, the overall decline in groundwater levels in the Amarillo are is of concern. Possible groundwater conservation measures at Pantex that could be considered including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the Pu conversion facility would be provided via existing distribution systems. The source of this water is the Clinch River and its tributaries. Water requirements during construction (2.4 million l/yr [0.6 million gal/yr]) and operation (80.5 million l/yr [21.2 million gal/yr]) would represent a 0.02-percent and 0.6-percent increase respectively in the projected annual surface water withdrawal. These additional water withdrawals from the Clinch River should cause negligible impacts to surface water availability.

During construction of the Pu conversion facility, sanitary wastewater (approximately 2.4 million l/yr [0.6 million gal/yr]) would be generated and discharged to the existing wastewater treatment system in the Y–12 area. This would cause a 0.1-percent increase in the effluent from this facility. During operation, a total of 15 million l/yr (3.9 million gal/yr) of wastewater would be generated by the new facilities. This would cause a 0.7-percent increase in the effluent discharged from the Y–12 area. All discharges would be monitored to comply with discharge requirements. Minimal impacts would be expected.

Since the potential site for the Pu conversion facility would be located outside both the 500- and 100-year floodplains, there would be no impacts to floodplains.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water would be used for project requirements during construction and operation of the Pu conversion facility. [Text deleted.]

During construction of the Pu conversion facility, sanitary wastewater (2.4 million l/yr [0.6 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modifications. This amount would represent a 0.3-percent increase in the estimated annual flow to this facility and could be handled within the existing capacity. During operation, a total of 15 million l/yr (3.9 million gal/yr) of wastewater would be generated by the new facility, representing a 2.1-percent increase. [Text deleted.]

The potential location of the Pu conversion facility would be located outside the 100-year floodplain. Information on the location of the 500-year floodplain at SRS is only available for a limited number of project areas. However, the Pu Conversion facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek because the facility would be located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about 58 m^3/s (2,040 ft^3/s). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 62 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately 5 m^3/s (186 ft^3/s), and an elevation of about 61 m (199 ft) above MSL (SR USGS 1996a:1). Elevations of the buildings in F-Area are more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, the quantity of water required would be approximately 2.4 million l/yr (0.6 million gal/yr), which would represent a 0.02-percent increase over the existing projected annual ground water withdrawal. During operation, water requirements would be approximately 80.5 million l/yr (21.2 million gal/yr), which would represent a 0.6-percent increase in ground water withdrawals. Minimal impacts to groundwater availability are expected.

No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

[Text deleted.]

4.3.2.5 Geology and Soils

This section describes the environmental impacts to the geologic and soil resource as related to the construction and operation of the Pu conversion facility. A Pu conversion facility, at any of the sites analyzed, would involve some ground-disturbing construction activities (36 ha [90 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rainfall) is greater at ORR and SRS than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities nor site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to the greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction activities (foundation preparation) and associated building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind (increases in wind velocity and duration increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal.

[Text deleted.]

4.3.2.6 Biological Resources

Construction of the Pu conversion facility would disturb 36 ha (90 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas to be used for construction laydown. Consultation with USFWS and State agencies would be conducted at the site-specific level as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that the Pu conversion facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the Pu conversion facility would result in the disturbance of terrestrial habitat equaling about 0.02 percent of Hanford. This includes areas on which plant facilities would be constructed as well as areas that would be revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the Pu conversion facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the Pu conversion facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the Pu conversion facility would not affect wetlands since no wetlands exist near the assumed facility location. Since water would be withdrawn from the Columbia River through an existing intake structure and wastewater would be discharged to evaporation/infiltration ponds, wetlands would not be affected by placement of intake and discharge structures.

Aquatic Resources. Construction of a Pu conversion facility at Hanford would not impact aquatic resources since there are no surface water bodies near the assumed facility location. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entertainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the Pu conversion facility; however, sagebrush habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the Pu conversion facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are described below.

Terrestrial Resources. Construction and operation of the Pu conversion facility at NTS would result in the disturbance of terrestrial resources equaling about 0.01 percent of NTS. This includes areas on which plant facilities would be constructed as well as areas that would be revegetated following construction. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the Pu conversion facility would affect animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the Pu conversion facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the Pu conversion facility would not affect aquatic resources because there are no permanent surface water bodies near the facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the Pu conversion facility at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicular traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training, putting restrictions on vehicle speeds and off-road movement, conducting clearance surveys prior to surface disturbance, approving stop work authority if tortoises are found within work areas, removing tortoises from roadways and work areas, placing permanent and temporary tortoise proof fencing around trenches, landfills, and treatment ponds, inspecting trenches, and having biologists survey when heavy equipment is in use. The

USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the Pu conversion facility.

[Text deleted.]

Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicular traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the Pu conversion facility (Section 4.3.2.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the Pu conversion facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to smaller mammals and some birds and reptiles which could be displaced or suffer mortality. Larger mammals are excluded from the assumed facility location by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources near the assumed facility location, these resources would not be affected by construction or operation of the Pu conversion facility. Since the new facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected since they are not present at the ICPP.

Pantex Plant

It is assumed that the Pu conversion facility would be located within Zone 12 which is a developed area that lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed facility location; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the Pu conversion facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to a minor increase in open water near the outfall, as well as a slight change in plant species composition. No federally listed threatened or endangered species would be affected by construction or operation of the Pu conversion facility. Although the assumed facility location has been disturbed, it is possible that the State-listed Texas horned lizard could be present. Preactivity surveys would be conducted as appropriate prior to construction.

Oak Ridge Reservation

It is assumed that the Pu conversion facility would be constructed on a disturbed area within Y–12. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to Y–12 would have already adapted to similar disturbance. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since water would be taken from existing sources and discharged via NPDES permitted outfalls and would involve minor volumes. Construction and operation of the Pu conversion facility would not be expected

to impact threatened and endangered species due to the developed nature of the assumed facility location. Impacts to the Tennessee dace (State deemed in need of management) would not be expected since erosion would be controlled and discharges would be through permitted outfalls.

Savannah River Site

It is assumed that the Pu conversion facility would be constructed within the F-Area, which is one of the highly developed industrial areas of the SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since minor volumes of water would be taken from existing sources and discharged via NPDES-permitted outflows. Impacts from construction and operation of the Pu conversion facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site that this species would not be directly affected by this action.

4.3.2.7 Cultural and Paleontological Resources

This section discusses potential impacts to cultural and paleontological resources that may result from the construction and operation of the Pu conversion facility at each of the representative sites analyzed. The total land disturbance for this facility is 36 ha (90 acres) during construction, of which 28 ha (70 acres) would be used during operation. A 1.6-km (1-mi) reduced-access buffer zone would be created around the facility, except ORR which would have a reduced buffer zone at the site. The buffer zone would be contained within existing boundaries at all sites. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through additional surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The Pu conversion facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction, but not the operation, of the facility.

The CGTO conducted surveys over portions of Frenchman Flat and has identified at least 20 plant species of importance to Native Americans there. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from the construction and operation of the facility. Potential impacts may include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological resources may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The Pu conversion facility would be constructed within the existing ICPP security area. The facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. An associated surface survey identified no sites within the proposed project area. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites occur adjacent to the ICPP—one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have a visual or auditory impact on traditional use areas or sacred sites. Resources may be identified through consultation with the interested tribes.

Some paleontological resources may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain which have produced fossilized remains. Operation would not have an effect on paleontological resources.

Pantex Plant

The Pu conversion facility would be constructed in Zone 12. A surface survey of the plant was completed in 1981. No prehistoric or historic resources were identified in Zone 12 except for 12 remaining World War II Era structures, some of which may be potentially NRHP eligible. Although it is possible that subsurface remains exist within Pantex boundaries, Zone 12 is disturbed and probably does not contain any intact archaeological sites. Consequently, impacts to prehistoric and historic resources are not anticipated. [Text deleted.] Should any resources be discovered during testing or construction, mitigation measures would be taken in consultation with the Texas SHPO. Operation of the facility would not result in additional impacts to prehistoric or historic resources.

DOE has initiated a public outreach program to involve Native American groups in decision-making related to land use and cultural resources. Native American resources such as cemeteries may be affected by new construction. Facility operation may have an auditory or visual impact on sacred or ceremonial sites. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any resources in Zone 12. Some may be identified through additional consultation.

Important paleontological remains such as bison and camel bones have been found in other areas of the High Plains. It is possible that some of the land to be affected by construction may contain fossilized remains. Operation would not affect paleontological resources because it does not involve additional ground disturbance.

Oak Ridge Reservation

The facility would be constructed within Y–12. Because most of Y–12 is already developed or disturbed, construction and operation would not affect prehistoric or historic sites. No Native American resources have been identified at Y–12, so impacts to these resources are not expected to result from the construction or operation of the proposed facility. Paleontological resources at ORR include common invertebrate fossils with relatively low research potential, so any impacts to them would be considered negligible.

Savannah River Site

The location for the Pu conversion facility is on open space within F-Area. Portions of F-Area have been surveyed and contain sites potentially eligible for the NRHP. Additional surveys would be conducted in any unsurveyed areas to be disturbed by construction. Site types known to occur at SRS include remains of prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by facility construction, but not operation.

Some Native American resources may be affected by the proposed action. Resources such as prehistoric sites, cemeteries, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to such areas may also result. Any resources would be identified through consultation with the potentially affected tribes.

No scientifically valuable fossil remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

[Text deleted.]

4.3.2.8 Socioeconomics

This section analyzes the socioeconomic effects of the Pu conversion facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all candidate sites are found in the Supplemental Socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Constructing a Pu conversion facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 358 workers during the peak year of construction at any site. The largest increase in regional employment (less than 1 percent) among the sites analyzed would be at INEL. A total of 727 new jobs (358 direct and 369 indirect) would be generated and regional unemployment would fall from 5.4 percent to 4.9 percent. The largest increase in regional per capita income would also occur at INEL during the construction of the facility, but the increase would be much less than 1 percent over No Action (Socio 1996a).

Operating the facility would generate greater socioeconomic changes than would construction, due to the larger, more permanent workforce. A workforce of 883 would be required for full operation at any site. Implementing the alternative at INEL would generate the largest changes in regional employment (about 2 percent) and per capita income (about 1 percent). A total of 3,251 new jobs (883 direct and 2,368 indirect) would be created by the operational activities, and INEL regional unemployment would fall to 3.7 percent (Socio 1996a).

Population and Housing. At all of the sites analyzed, construction employment requirements would be met by the available resident labor force, but some in-migrating workers would be needed to fill more specialized positions during operations. Locating the facility at Pantex would induce the largest population increase among the sites analyzed. However, project-related immigration would increase the ROI population by only about 1 percent over No Action population projections. Housing units, in excess of existing vacancies, may be required at all of the sites analyzed, except NTS and ORR, to accommodate the population growth. The greatest increase would occur in the INEL ROI, but this would be less than 1 percent over No Action projections. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the population growth at all of the sites analyzed (Socio 1996a).

Community Services. During construction, there would be minimal impacts to community services in the ROIs of any of the sites analyzed. However, operation of the facility would slightly increase the demand for community services. The effects of population growth due to in-migrating workers during operations would be minor at all sites analyzed. The following discussion focuses on the Pantex and INEL ROIs, which would experience the greatest increases in demand for community services.

To maintain the No Action student-to-teacher ratio of 16.3:1 in the Pantex ROI, 19 new teachers would be needed during operation of the proposed facility. The increase in teacher requirements, however, would be distributed over several school districts in the ROI; therefore, no single school district would be significantly affected (Socio 1996a).

To maintain the No Action service level of 1.6 sworn police officers per 1,000 persons in the INEL ROI, 2 new officers would be needed. Four additional firefighters would be required to sustain the No Action service level of 2.3 firefighters per 1,000 persons in the Pantex ROI (Socio 1996a).

Projected hospital occupancy rates would increase slightly over No Action levels. However, projected capacities would be capable of accommodating these small increases in patient load. To maintain the No Action service level of 2.0 physicians per 1,000 persons, 3 additional physicians would be needed in the Pantex ROI during full operation (Socio 1996a).

Local Transportation. Traffic generated from construction of the Pu conversion facility would not affect the level of service on the local road segments analyzed at any of the sites. However, traffic generated during

operations at INEL would cause a drop in the level of service on one road segment. U.S. 20/26 from U.S. 26 East to ID 22/33 would drop from level of service B to C (Socio 1996a).

4.3.2.9 Public and Occupational Health and Safety

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the Pu conversion facility, whose activities are common to Pu disposition alternatives. The section first describes the impacts from normal facility operation at each potential site followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation are presented in Tables 4.3.2.9–1 and 4.3.2.9–2, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.2.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.3.2.9–4 through 4.3.2.9–9. Detailed results are presented in Section M.

Normal Operation. There would be no radiological releases associated with the construction of a new Pu conversion facility at any of the sites. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the new Pu conversion facility at each of the sites are presented in Table 4.3.2.9–1. The impacts from all site operations, including the new Pu conversion facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses to the maximally exposed member of the public from annual Pu conversion facility operation would range from 9.5×10^{-5} mrem at NTS site to 9.2×10^{-3} mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 4.8×10^{-10} to 4.6×10^{-8}. The impacts to the average individual would be less. As a result of annual facility operation, the population doses would range from 1.9×10^{-4} person-rem at NTS site to 0.074 person-rem at ORR. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 9.5×10^{-7} to 3.7×10^{-4}.

The doses to the maximally exposed member of the public from annual total site operations are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 7.0×10^{-4} mrem at Pantex to 3.2 mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.5×10^{-9} to 1.6×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population doses would be within the limit given in proposed 10 CFR 834, and would range from 3.9×10^{-3} person-rem at NTS to 44 person-rem at SRS. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 2.0×10^{-5} to 0.22.

Doses to onsite workers from normal operations are given in Table 4.3.2.9–2. Included are involved workers directly associated with the new Pu conversion facility, workers who are not involved with the Pu conversion facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to Pu conversion facility workers is site-independent and would be 233 mrem to the average facility worker and 133 person-rem to the entire facility workforce. The annual dose to the average noninvolved worker would range from 2.6 mrem at ORR to 32 mrem at SRS. The annual total dose to all noninvolved workers would range from 3.0 person-rem at the NTS site to 250 person-rem at the Hanford site. The annual

Table 4.3.2.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Plutonium Conversion Facility

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]												
Atmospheric release pathway (mrem)	1.8×10^{-4}	4.4×10^{-3}	9.5×10^{-5}	4.2×10^{-3}	1.2×10^{-4}	0.018	6.9×10^{-4}	7.0×10^{-4}	9.2×10^{-3}	1.5	1.0×10^{-3}	0.42
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0	0.1	0	0.081
Total liquid release pathway (mrem)	0	9.5×10^{-4}	0	0	0	0	0	0	0	1.7	0	0.37
Atmospheric and liquid release pathways combined (mrem)	1.8×10^{-4}	5.4×10^{-3}	9.5×10^{-5}	4.2×10^{-3}	1.2×10^{-4}	0.018	6.9×10^{-4}	7.0×10^{-4}	9.2×10^{-3}	3.2	1.0×10^{-3}	0.79
Percent of natural background[c]	6.0×10^{-5}	1.8×10^{-3}	3.0×10^{-5}	1.3×10^{-3}	3.6×10^{-5}	5.3×10^{-3}	2.1×10^{-4}	2.1×10^{-4}	3.1×10^{-3}	1.1	3.4×10^{-4}	0.27
10-year fatal cancer risk	9.0×10^{-10}	2.7×10^{-8}	4.8×10^{-10}	2.1×10^{-8}	6.0×10^{-10}	8.9×10^{-8}	3.5×10^{-9}	3.5×10^{-9}	4.6×10^{-8}	1.6×10^{-5}	5.0×10^{-9}	4.0×10^{-6}
[Text deleted.]												
Annual Population Dose Within 80 Kilometers[d]												
From atmospheric release pathway (person-rem)	8.4×10^{-3}	0.47	1.9×10^{-4}	3.9×10^{-3}	1.2×10^{-3}	2.4	3.8×10^{-3}	4.1×10^{-3}	0.074	29	0.066	41
From total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6
From atmospheric and liquid release pathways combined (person-rem)	8.4×10^{-3}	1.6	1.9×10^{-4}	3.9×10^{-3}	1.2×10^{-3}	2.4	3.8×10^{-3}	4.1×10^{-3}	0.074	34	0.066	44
Percent of natural background[c]	4.5×10^{-6}	8.4×10^{-4}	2.1×10^{-6}	4.2×10^{-5}	1.3×10^{-6}	2.7×10^{-3}	3.3×10^{-6}	3.5×10^{-6}	2.0×10^{-5}	9.0×10^{-3}	2.5×10^{-5}	0.017
10-year fatal cancers	4.2×10^{-5}	7.8×10^{-3}	9.5×10^{-7}	2.0×10^{-5}	6.0×10^{-6}	0.012	1.9×10^{-5}	2.0×10^{-5}	3.7×10^{-4}	0.17	3.3×10^{-4}	0.22
[Text deleted.]												

Table 4.3.2.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Plutonium Conversion Facility—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Average Individual Within 80 Kilometers[c]												
Atmospheric and liquid release pathways combined (mrem)	1.4×10^{-5}	2.6×10^{-3}	6.5×10^{-6}	1.3×10^{-4}	4.5×10^{-6}	8.9×10^{-3}	1.1×10^{-5}	1.2×10^{-5}	5.8×10^{-5}	0.026	7.4×10^{-5}	0.049
10-year fatal cancer risk	6.8×10^{-11}	1.3×10^{-8}	3.2×10^{-11}	6.6×10^{-10}	2.2×10^{-11}	4.5×10^{-8}	5.5×10^{-11}	6.0×10^{-11}	2.9×10^{-10}	1.3×10^{-7}	3.7×10^{-10}	2.5×10^{-7}
[Text deleted.]												

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the MEI may be different under No Action than for operation of the new Pu conversion facility. Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem.

[d] For DOE activities proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose exceeds 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[e] Obtained by dividing the population dose by the number of people projected to be living within the 80 km of the site (621,000 at Hanford; 29,400 at NTS; 269,000 at INEL; 350,000 at Pantex; 1,285,000 at ORR; and 893,000 at SRS).

Source: Section M.2.

Table 4.3.2.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Plutonium Conversion Facility

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce[a]						
Average worker dose (mrem/yr)[b]	233	233	233	233	233	233
10-year risk of fatal cancer	$9.3x10^{-4}$	$9.3x10^{-4}$	$9.3x10^{-4}$	$9.3x10^{-4}$	$9.3x10^{-4}$	$9.3x10^{-4}$
[Text deleted.]						
Total dose (person-rem/yr)	133	133	133	133	133	133
10-year fatal cancers	0.53	0.53	0.53	0.53	0.53	0.53
[Text deleted.]						
Noninvolved Workforce[c]						
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	$1.1x10^{-4}$	$2.0x10^{-5}$	$1.2x10^{-4}$	$4.0x10^{-5}$	$1.0x10^{-5}$	$1.3x10^{-4}$
[Text deleted.]						
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	1.9
[Text deleted.]						
Total Site Workforce[d]						
Dose (person-rem/yr)	383	136	353	147	177	359
10-year fatal cancers	1.5	0.54	1.4	0.59	0.71	1.4
[Text deleted.]						

[a] The involved worker is a worker associated with operations of the proposed action.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The noninvolved workforce is equivalent to the No Action workforce.

[d] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

dose to the total site workforce would range from 136 person-rem at the NTS site to 383 person-rem at Hanford. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.2.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts from normal operation of the Pu conversion facility at several sites are presented in Table 4.3.2.9–3. Included are the impacts due to operation of the Pu stabilization and conversion facility, and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected, and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI ranges from 4.3×10^{-6} at the NTS site to 6.2×10^{-4} at INEL due to the Pu conversion facility operation. The cancer risk from hazardous chemicals to the MEI ranges from 4.7×10^{-9} at NTS to 1.9×10^{-7} at ORR. The HI to the onsite worker ranges from 8.0×10^{-4} at Pantex to 3.3×10^{-3} at ORR, and the cancer risk to the onsite worker ranges from 7.2×10^{-6} at Pantex to 1.5×10^{-5} at the ORR site.

Facility Accidents. A set of potential accidents have been postulated for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.2.9–4 through 4.3.2.9–9 for the sites analyzed (Hanford, NTS, INEL Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 1.6 at ORR for the oxyacetylene explosion in a process cell accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 10-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.6×10^{-6}, 9.8×10^{-9}, and 7.9×10^{-9}, respectively. The maximum population 10-year facility lifetime risk would be 1.3×10^{-4} (that is, one fatality in about 7,500 years) at ORR for the fire on the loading dock accident scenario with a probability of 5.0×10^{-4} per year. The corresponding maximum offsite individual and worker 10-year facility lifetime risks would be 7.0×10^{-7} and 5.6×10^{-7}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.2.9–4 through 4.3.2.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas to minimize the risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is the possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude of the impacts of an aircraft crash into a disposition facility is given by the earthquake scenario. The earthquake and aircraft crash scenarios are similar in that they both result in major structural damage and the release of plutonium directly to the environment. They differ in that an earthquake-induced fire is based on limited combustible materials while the aircraft crash has the potential for a major fuel related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the

Table 4.3.2.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Plutonium Conversion Facility

Receptor	Hanford		INEL		NTS		ORR		Pantex		SRS	
	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]
Maximally Exposed Individual (Public)												
Hazard Index[c]	2.9×10^{-5}	9.1×10^{-5}	6.2×10^{-4}	0.015	4.3×10^{-6}	1.7×10^{-6}	3.3×10^{-4}	0.040	1.6×10^{-4}	5.8×10^{-3}	7.9×10^{-6}	5.2×10^{-3}
Cancer Risk[d]	3.2×10^{-8}	3.2×10^{-8}	6.8×10^{-8}	3.7×10^{-6}	4.7×10^{-9}	1.9×10^{-9}	1.9×10^{-7}	1.9×10^{-7}	1.8×10^{-7}	1.9×10^{-7}	8.7×10^{-9}	1.4×10^{-7}
Worker Onsite												
Hazard Index[e]	1.6×10^{-3}	5.6×10^{-3}	1.6×10^{-3}	0.23	8.3×10^{-4}	1.7×10^{-4}	3.3×10^{-3}	0.16	8.0×10^{-4}	6.9×10^{-3}	1.4×10^{-3}	1.2
Cancer Risk[f]	1.4×10^{-5}	1.4×10^{-5}	1.4×10^{-5}	7.8×10^{-4}	7.4×10^{-6}	7.4×10^{-6}	1.5×10^{-5}	1.5×10^{-5}	7.2×10^{-6}	7.7×10^{-6}	1.3×10^{-5}	2.1×10^{-4}

[a] Facility=contribution from the proposed new facility operation only.

[b] Total=includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer Risk for MEI=(emissions concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor).

[e] Hazard Index for workers=sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer Risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor).

Source: Section M.3, Tables M.3.4–34 through M.3.4–39.

Table 4.3.2.9–4. Plutonium Conversion Facility Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	4.8×10^{-7}	9.7×10^{-5}	1.9×10^{-8}	3.8×10^{-6}	3.5×10^{-5}	7.0×10^{-3}	5.0×10^{-4}
Fire in the process cell	5.8×10^{-13}	5.8×10^{-10}	2.3×10^{-14}	2.3×10^{-11}	4.2×10^{-9}	4.2×10^{-6}	1.0×10^{-4}
Deflagration inside a glovebox	1.2×10^{-10}	1.2×10^{-7}	4.8×10^{-12}	4.8×10^{-9}	8.7×10^{-9}	8.7×10^{-6}	1.0×10^{-4}
Forklift breach of containment	9.2×10^{-17}	2.0×10^{-13}	3.7×10^{-18}	8.2×10^{-15}	6.7×10^{-15}	1.5×10^{-11}	4.5×10^{-5}
Nuclear criticality	2.1×10^{-13}	2.1×10^{-7}	8.4×10^{-15}	8.4×10^{-9}	1.7×10^{-12}	1.7×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	4.1×10^{-12}	4.1×10^{-6}	1.6×10^{-13}	1.6×10^{-7}	3.0×10^{-10}	3.0×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	$6.8.\times10^{-9}$	6.8×10^{-3}	2.4×10^{-10}	2.4×10^{-4}	4.4×10^{-7}	0.44	1.0×10^{-7}
Beyond evaluation basis earthquake	3.1×10^{-9}	3.1×10^{-3}	1.2×10^{-10}	1.2×10^{-4}	2.2×10^{-7}	0.22	1.0×10^{-7}
Expected risk[d]	4.9×10^{-7}	–	2.0×10^{-8}	–	3.6×10^{-5}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

Table 4.3.2.9–5. Plutonium Conversion Facility Accident Impacts at Nevada Test Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	
Fire on the loading dock	3.3×10^{-7}	6.6×10^{-5}	7.6×10^{-9}	1.5×10^{-6}	7.9×10^{-7}	1.6×10^{-4}	5.0×10^{-4}
Fire in the process cell	4.0×10^{-13}	4.0×10^{-10}	9.1×10^{-15}	9.1×10^{-12}	9.5×10^{-13}	9.5×10^{-10}	1.0×10^{-4}
Deflagration inside a glovebox	8.2×10^{-11}	8.2×10^{-8}	1.9×10^{-12}	1.9×10^{-9}	2.0×10^{-10}	2.0×10^{-7}	1.0×10^{-4}
Forklift breach of containment	6.3×10^{-17}	1.4×10^{-13}	1.4×10^{-18}	3.2×10^{-15}	1.5×10^{-16}	3.4×10^{-13}	4.5×10^{-5}
Nuclear criticality	1.5×10^{-13}	1.5×10^{-7}	3.2×10^{-15}	3.2×10^{-9}	3.3×10^{-14}	3.3×10^{-8}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	2.8×10^{-12}	2.8×10^{-6}	6.4×10^{-14}	6.4×10^{-8}	6.7×10^{-12}	6.7×10^{-6}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	4.5×10^{-9}	4.5×10^{-3}	9.4×10^{-11}	9.4×10^{-5}	9.9×10^{-9}	9.9×10^{-3}	1.0×10^{-7}
Beyond evaluation basis earthquake	2.1×10^{-9}	2.1×10^{-3}	4.7×10^{-11}	4.7×10^{-5}	4.9×10^{-9}	4.9×10^{-3}	1.0×10^{-7}
Expected risk[d]	3.4×10^{-7}	–	7.7×10^{-9}	–	8.1×10^{-7}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

Table 4.3.2.9–6. Plutonium Conversion Facility Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	4.5×10^{-7}	9.0×10^{-5}	4.9×10^{-9}	9.7×10^{-7}	1.0×10^{-5}	2.1×10^{-3}	5.0×10^{-4}
Fire in the process cell	5.4×10^{-13}	5.4×10^{-10}	5.8×10^{-15}	5.8×10^{-12}	1.3×10^{-11}	1.3×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	1.1×10^{-10}	1.1×10^{-7}	1.2×10^{-12}	1.2×10^{-9}	2.6×10^{-9}	2.6×10^{-6}	1.0×10^{-4}
Forklift breach of containment	8.6×10^{-17}	1.9×10^{-13}	9.3×10^{-19}	2.1×10^{-15}	2.0×10^{-15}	4.5×10^{-12}	4.5×10^{-5}
Nuclear criticality	2.0×10^{-13}	2.0×10^{-7}	1.9×10^{-15}	1.9×10^{-9}	4.3×10^{-13}	4.3×10^{-7}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	3.8×10^{-12}	3.8×10^{-6}	4.1×10^{-14}	4.1×10^{-8}	8.9×10^{-11}	8.9×10^{-5}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	6.9×10^{-9}	6.9×10^{-3}	6.1×10^{-11}	6.1×10^{-5}	1.3×10^{-7}	0.13	1.0×10^{-7}
Beyond evaluation basis earthquake	2.8×10^{-9}	2.8×10^{-3}	3.0×10^{-11}	3.0×10^{-5}	6.5×10^{-8}	0.065	1.0×10^{-7}
Expected risk[d]	4.6×10^{-7}	–	5.0×10^{-9}	–	1.1×10^{-5}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

Table 4.3.2.9–7. Plutonium Conversion Facility Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	1.9×10^{-7}	3.9×10^{-5}	7.7×10^{-8}	1.5×10^{-5}	1.2×10^{-5}	2.4×10^{-3}	5.0×10^{-4}
Fire in the process cell	2.3×10^{-13}	2.3×10^{-10}	9.3×10^{-14}	9.3×10^{-11}	1.4×10^{-11}	1.4×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	4.8×10^{-11}	4.8×10^{-8}	1.9×10^{-11}	1.9×10^{-8}	3.0×10^{-9}	3.0×10^{-6}	1.0×10^{-4}
Forklift breach of containment	3.7×10^{-17}	8.2×10^{-14}	1.5×10^{-17}	3.3×10^{-14}	2.3×10^{-15}	5.1×10^{-12}	4.5×10^{-5}
Nuclear criticality	9.7×10^{-14}	9.7×10^{-8}	4.6×10^{-14}	4.6×10^{-8}	1.1×10^{-12}	1.1×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	1.6×10^{-12}	1.6×10^{-6}	6.6×10^{-13}	6.6×10^{-7}	1.0×10^{-10}	1.0×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	2.5×10^{-9}	2.5×10^{-3}	9.7×10^{-10}	9.7×10^{-4}	1.5×10^{-7}	0.15	1.0×10^{-7}
Beyond evaluation basis earthquake	1.2×10^{-9}	1.2×10^{-3}	4.8×10^{-10}	4.8×10^{-4}	7.4×10^{-8}	0.074	1.0×10^{-7}
Expected risk[d]	2.0×10^{-7}	–	7.9×10^{-8}	–	1.2×10^{-5}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

Table 4.3.2.9–8. Plutonium Conversion Facility Accident Impacts at Oak Ridge Reservation

	Worker at 722 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	5.6×10^{-7}	1.1×10^{-4}	7.0×10^{-7}	1.4×10^{-4}	1.3×10^{-4}	0.026	5.0×10^{-4}
Fire in the process cell	6.8×10^{-13}	6.8×10^{-10}	8.4×10^{-13}	8.4×10^{-10}	1.6×10^{-10}	1.6×10^{-7}	1.0×10^{-4}
Deflagration inside a glovebox	1.4×10^{-10}	1.4×10^{-7}	1.8×10^{-10}	1.8×10^{-7}	3.3×10^{-8}	3.3×10^{-5}	1.0×10^{-4}
Forklift breach of containment	1.1×10^{-16}	2.4×10^{-13}	1.3×10^{-16}	3.0×10^{-13}	2.5×10^{-14}	5.6×10^{-11}	4.5×10^{-5}
Nuclear criticality	2.4×10^{-13}	2.4×10^{-7}	3.0×10^{-13}	3.0×10^{-7}	1.8×10^{-11}	1.8×10^{-5}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	4.8×10^{-12}	4.8×10^{-6}	6.0×10^{-12}	6.0×10^{-6}	1.1×10^{-9}	1.1×10^{-3}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	7.9×10^{-9}	7.9×10^{-3}	9.8×10^{-9}	9.8×10^{-3}	1.6×10^{-6}	1.6	1.0×10^{-7}
Beyond evaluation basis earthquake	3.5×10^{-9}	3.5×10^{-3}	4.4×10^{-9}	4.4×10^{-3}	8.2×10^{-7}	0.82	1.0×10^{-7}
Expected risk[d]	5.8×10^{-7}	–	7.2×10^{-7}	–	1.3×10^{-4}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 772 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [772 m for the facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

Table 4.3.2.9–9. Plutonium Conversion Facility Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	3.2×10^{-7}	6.3×10^{-5}	7.7×10^{-9}	1.5×10^{-6}	3.2×10^{-5}	7.5×10^{-3}	5.0×10^{-4}
Fire in the process cell	3.8×10^{-13}	3.8×10^{-10}	9.3×10^{-15}	9.3×10^{-12}	4.5×10^{-11}	4.5×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	7.9×10^{-11}	7.9×10^{-8}	1.9×10^{-12}	1.9×10^{-9}	9.4×10^{-9}	9.4×10^{-6}	1.0×10^{-4}
Forklift breach of containment	6.0×10^{-17}	1.3×10^{-13}	1.5×10^{-18}	3.3×10^{-15}	7.2×10^{-15}	1.6×10^{-11}	4.5×10^{-5}
Nuclear criticality	1.4×10^{-13}	1.4×10^{-7}	2.8×10^{-15}	2.8×10^{-9}	2.3×10^{-12}	2.3×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	2.7×10^{-12}	2.7×10^{-6}	6.6×10^{-14}	6.6×10^{-8}	3.2×10^{-10}	3.2×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	4.4×10^{-9}	4.4×10^{-3}	9.7×10^{-11}	9.7×10^{-5}	4.7×10^{-7}	0.47	1.0×10^{-7}
Beyond evaluation basis earthquake	2.1×10^{-9}	2.1×10^{-3}	4.8×10^{-11}	4.8×10^{-5}	2.3×10^{-7}	0.23	1.0×10^{-7}
Expected risk[d]	3.2×10^{-7}	–	7.9×10^{-9}	–	3.8×10^{-5}	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive serious or fatal impacts.

[Text deleted.]

4.3.2.10 Waste Management

This section summarizes the waste management impacts for the construction and operation of a Pu conversion facility. There is no spent nuclear fuel or HLW associated with the operation of the Pu conversion facility. Table 4.3.2.10–1 provides the projected operational waste volumes generated at the sites analyzed as a result of the Pu conversion facility. Facilities that would support the Pu conversion facility would treat and package all generated waste into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste, disposed of, onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the Pu conversion facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.2.2. A detailed description of the waste management activities that would be required to support the Pu conversion facility can also be found in Section E.3.2.2.

Construction and operation of a Pu conversion facility would impact existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, solid nonhazardous, and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any is generated, it would be managed in accordance with site practice, and all applicable Federal and State regulations.

Table 4.3.2.10–1. Estimated Annual Generated Waste Volumes for the Plutonium Conversion Facility[a]

Category	New Facility (m^3)	Hanford No Action (m^3)	NTS No Action (m^3)	INEL No Action (m^3)	Pantex No Action (m^3)	ORR No Action (m^3)	SRS No Action (m^3)
Transuranic							
Liquid	3.2[b]	None	None	None	None	None	None
Solid	278	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	191	98	None	Included in TRU	None	None	Included in TRU
Low-level							
Liquid	56[b]	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	1,743	3,390	15,000	7,200	32	7,320	16,400
Mixed low-level							
Liquid	0.04	3,760	None	4	4	87,600	1,330
Solid	191	1,505	50	170	46	432	7,700
Hazardous							
Liquid	2	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	11	560	212	1,200	31	26	15,100

Table 4.3.2.10–1. Estimated Annual Generated Waste Volumes for the Plutonium Conversion Facility[a]—Continued

Category	New Facility (m^3)	Hanford No Action (m^3)	NTS No Action (m^3)	INEL No Action (m^3)	Pantex No Action (m^3)	ORR No Action (m^3)	SRS No Action (m^3)
Nonhazardous (sanitary)							
Liquid	15,000	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	2,060	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (other)							
Liquid	56	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	0	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

[a] The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1. Incremental waste generation volumes for Pu conversion are from Table E.3.2.2–1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.2.2–1.

[b] Liquid TRU and LLW would be treated and solidified prior to disposal.

Following treatment and volume reduction, approximately 278 m^3 (364 yd^3) of TRU waste consisting of solidified liquid TRU waste (such as decontamination solutions, used HEPA filters, contaminated wipes and rags, and glovebox sweepings), would require treatment and repackaging in a radwaste facility to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the Pu conversion facility if sited at Pantex, ORR, or NTS. An estimated 191 m^3 (250 yd^3) of mixed TRU waste would also require treatment and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would principally be leaded rubber gloves. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), 54 truck shipments per year or, if applicable, 27 regular train shipments per year or 9 dedicated train shipments per year, would be required.

The Pu conversion facility conceptual design includes a radioactive liquid waste treatment facility which would treat the 56 m^3 (14,800 gal) of liquid LLW from infrequent container decontamination, laboratory solutions, and scrubber solutions from stacks and exhaust systems. After treatment and volume reduction, approximately 1,743 m^3 (2,280 yd^3) of solid LLW from solidified liquid LLW, packaging materials, HEPA filters, glovebox parts, protective clothing, decontamination materials (swipes, mops), and damaged equipment would require disposal in a DOE LLW disposal facility. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.5 ha/yr (1.3 acres/yr) at Hanford and ORR; 0.3 ha/yr (0.7 acres/yr) at NTS and INEL; and 0.2 ha/yr (0.5 acres/yr) at SRS. With no onsite LLW disposal capability, Pantex would require 105 additional LLW shipments per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

Approximately 0.04 m^3 (11 gal) of liquid and 191 m^3 (250 yd^3) of solid mixed LLW, consisting of solvent rags, Pb, and hydraulic fluids which have been contaminated with radioactive constituents, would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party Agreement for Hanford or the respective site treatment plans that were developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

Liquid hazardous wastes would consist of cleaning solvents, cutting oils, vacuum pump oils, film processing fluids, hydraulic fluids from mechanical equipment, antifreeze solutions, and paint. Liquid hazardous wastes would be treated onsite or collected in DOT-approved containers and shipped offsite to RCRA-permitted treatment and disposal facilities. Solid hazardous wastes would consist of lead packing and wipes contaminated with oils, lubricants, and cleaning solvents. After compaction, solid hazardous wastes would be packaged in DOT-approved containers, treated onsite or offsite and shipped to RCRA-permitted treatment facilities. After treatment the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities. All the sites analyzed would have adequate capacity to stage the 2 m^3 (528 gal) of liquid and 11 m^3 (15 yd^3) of solid hazardous wastes until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately 15,000 m^3 (3,960,000 gal) of liquid nonhazardous sanitary and industrial wastewater, steam plant blowdown, and stormwater runoff would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required. Approximately 2,060 m^3 (2,700 yd^3) of solid nonhazardous wastes such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.3 DEEP BOREHOLE ALTERNATIVE CATEGORY

These sections describe two deep borehole alternatives for the disposition of Pu: Direct Disposition Alternative and Immobilized Disposition Alternative. Impacts from borehole construction and operations are described on a generic range of site conditions within the United States. Impacts from the immobilization facility on the following representative sites are described: Hanford, NTS, INEL, Pantex, ORR, and SRS. The sections describe the construction and operational impacts of the Deep Borehole Alternative facilities on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomic, public and occupational health and safety, and waste management. The impacts for either of the alternatives in these sections would be in addition to those associated with the pit disassembly/conversion facility (Section 4.3.1) and the Pu conversion facility (Section 4.3.2). The deep borehole complex is defined for a generic site over a range of characteristics as defined in Section 3.10. [Text deleted.] Should either of the deep borehole alternatives be selected, a siting study would be conducted in support of tiered NEPA documentation.

4.3.3.1 Direct Disposition Alternative

The environmental impacts described in the following sections are based on the analysis of the deep borehole complex for the Direct Disposition Alternative as described in Section 2.4.3.1. Environmental impacts for this facility are described in the context of a generic range of conditions that could exist at potential locations.

4.3.3.1.1 *Land Resources*

The deep borehole complex would disturb 63 ha (156 acres) of land during construction of which 57 ha (141 acres) would be used during operation. The facility would be sited within a 1.6-km (1-mi) buffer zone for a total land requirement of 2,041 ha (5,044 acres). However, the potential site could range up to 20,000 ha (49,420 acres) of land area. If the borehole site were located on privately owned land, it would likely require the low to middle range of land area. If the site were located on publicly owned land (Federal, State, or local), the borehole could be part of a much larger site and could require the upper range of land area. [Text deleted.] Because no site has been identified for analysis, impacts to land use and visual resources cannot be determined at this time. If this alternative is selected, a siting study would be conducted in support of NEPA tiered documentation.

4.3.3.1.2 *Site Infrastructure*

Since no actual sites for a deep borehole complex have been considered, the site infrastructure impact analysis for constructing, operating, and post-closure monitoring of the new complex compares the requirements shown in the tables in the appendices against the generic deep borehole disposition site described in Section 3.9.2.

Implementation of the alternative for direct emplacement of Pu into a deep borehole requires construction of a stand-alone complex containing five groupings of surface facilities and several very deep boreholes, about 2 to 4 km (1.3 to 2.5 mi) below the surface. Upon completion of the Pu disposition mission, only a concrete cap remains on the surface.

The region's utility and transportation infrastructure must be extended to support the facilities and operations of this proposed borehole complex. Connection of the borehole complex to the nearest existing electrical utility via high-voltage transmission lines may require constructing additional transmission lines and obtaining rights-of-way.

Impacts from construction of the deep borehole complex using standard construction practices for the surface facilities and transportation links are shown in Table 4.3.3.1.2–1. At a minimum, a 1.6-km (1-mi) two-lane paved road and railroad spur track would have to be constructed for the deep borehole complex to transport workers and material and to deliver equipment. The length depends on the specific site selected and distance from existing transportation. Rights-of-way may also be required.

The surface facilities would be metal framed, sealed buildings with a 10- to 20-year usable life, which would be typical for a packaging and handling operation. It is estimated to require approximately 3 years to construct the necessary borehole complex facilities. The greatest surface effects from subsurface borehole construction would be caused by the surface retention areas containing all material removed during drilling operations. The total amount of utilities and material resources consumed during the construction period, assuming only 1.6 km (1 mi) of roads, is shown in Table 4.3.3.1.2–1.

Table 4.3.3.1.2–1. Additional Site Infrastructure Needed for the Construction of the Deep Borehole Complex—Direct Disposition Alternative (Annual)

Resource	Construction Requirement	Range of Resource Availability at the Generic Borehole Site
Electrical	600 MWh	6,500 to 12,000 MWh
Oil	2,133,000 l	0 to 100 million
Natural gas	0	0 to 5 million m^3
Coal	0	0 to 200,000 t

Source: LLNL 1996a.

Since the lower end of the range of resources available generally exceeds the annualized construction requirement, there would be minimal impact on these resources during construction.

Borehole facility operations require electrical power, compressed air, process water, and process wastewater treatment. The impacts to site infrastructure from these emplacement operations are shown in Table 4.3.3.1.2–2. The range of available resources at the generic borehole site was previously described in Section 3.9.2. The 6,500 MWh electrical requirement to operate the entire borehole array area for a year would have no measurable impact on any of the sub-regional power pools in the contiguous 48 states. Fuel and transportation requirements present no measurable impacts. Since oil and natural gas availability is governed by usage, any additional oil and natural gas could be procured.

Table 4.3.3.1.2–2. Additional Site Infrastructure Needed for the Operation of the Deep Borehole Complex—Direct Disposition Alternative (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	1.6	1.6	6,500	2	774,400	5,100,000	0
Range of available resources	0 to 60	0 to 20	6,500 to 12,000	2 to 1,000	0 to 100 million	0 to 5 million	0 to 200,000
Amount required in excess of low-end site availability	1.6	1.6	0	0	774,100	5,100,000	0

Source: LLNL 1996a.

During the post-closure period, the borehole array area of 25 ha (60 acres) would be declared a limited access area indefinitely, and a 1.6-km (1-mi) buffer zone of 1,358 ha (3,355 acres) may also be declared off limits. The disturbed area remaining after decommissioning would be the 15 m x 15 m (50 ft x 50 ft) concrete security and water anti-infiltration caps installed above the borehole array, assumed to be four holes. Even though the borehole area would be designated as limited access, there are minimal continuing requirements or effects above ground. These minimal requirements include surveillance and groundwater monitoring. Surveillance could be accomplished from a remote location without impact at the site. Groundwater monitoring could be done from locations at various distances from the site. There would be a continuing infrastructure impact directly at the site in that any future land use requiring excavation or mining operations would be restricted in perpetuity due to the long half-life of Pu. Such restrictions could be institutionalized by constructing drilling barriers and installing a variety of permanent markers.

4.3.3.1.3 *Air Quality and Noise*

Construction and operation of the deep borehole complex would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from operation of this facility have been compared with Federal standards. Impacts for radiological airborne emissions are discussed in Section 4.3.3.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at the generic site. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period, especially during dry and windy conditions. Appropriate control measures would be followed. It is expected that the site will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of the deep borehole complex are presented in Table F.1.3–7. Air pollutant emissions sources associated with operations include the following:

- Operation of boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators

[Text deleted.]

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation plus the No Action concentration are presented in Table 4.3.3.1.3–1.

NOISE

The location of the facilities associated with the deep borehole complex relative to the site boundary and sensitive receptors was examined to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Table 4.3.3.1.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Deep Borehole Complex and No Action Alternative—Direct Disposition Alternative

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Generic Site[b] ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000	72.38
	1-hour	40,000	103.40
Lead	Calendar Quarter	1.5	[c]
Nitrogen dioxide	Annual	100	28.37
Ozone	1-hour	235	[d]
Particulate matter less than or equal to 10 microns in diameter	Annual	50	10.84
	24-hour	150	43.38
Sulfur dioxide	Annual	80	2.59
	24-hour	365	10.36
	3-hour	1,300	23.32
Hazardous and Other Toxic Compounds[e]			
[Text deleted.]			

[a] The Federal standards are presented.

[b] The concentration represents the alternative contribution only. No Action concentrations at a generic site cannot be determined since there is a range of possible pollutants and conditions that could be found at a potential site.

[c] No sources of this pollutant have been identified.

[d] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[e] Emissions of unspecified hydrocarbons were not modeled.

Note: Concentrations are based on site contribution and do not include the contribution from non-facility sources.

Source: 40 CFR 50; LLNL 1996a.

Non-traffic noise sources associated with operation of these facilities include: ventilation systems, cooling systems, material handling equipment, drilling rigs, pumps, and generators. These noise sources are assumed to be located at sufficient distance from offsite areas so that the contribution to offsite noise levels would continue to be small. It is assumed that, due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.3.1.4 *Water Resources*

Water resources would be affected by the operation of a direct emplacement deep borehole complex. Water resource requirements and discharges provided in Tables C.1.1.3–1 and C.2.1.3–1 and Table E.3.3.1–1 were used to assess impacts to surface and groundwater. Table 4.3.3.1.4–1 provides the total water requirements and estimated construction and operation wastewater effluent volumes projected to be generated as a result of the deep borehole complex. If this alternative is selected, a siting study would be considered and met in future site specific tiered NEPA documents, as appropriate. During construction and operation, either surface water, groundwater, or a municipal source could be used to support the facility. Support facilities for the deep borehole complex would treat and dispose of wastewater in accordance with regulatory requirements.

Surface Water. Surface water could be used to supply the fresh water required for the deep borehole facility. Water quantities required for both construction and operation of the generic deep borehole facility are shown in Table 4.3.3.1.4–1. The facility would be located such that these quantities of surface water would be readily available.

Table 4.3.3.1.4–1. Potential Changes to Water Resources Resulting From the Deep Borehole Complex—Direct Disposition Alternative

Affected Resource Indicator	Generic Site
Water Source	Surface or Ground
Construction	
Water Availability and Use	
Total water requirement (million l/yr)	15.1
Water Quality	
Total wastewater discharge (million l/yr)	12.0
Operation	
Water Availability and Use	
Total water requirement (million l/yr)	165.4
Water Quality	
Total wastewater discharge (million l/yr)	17.4
Floodplain	
Is action in 100-year floodplain?	No
Is critical action in 500-year floodplain?	No

Source: LLNL 1996a.

Surface water quality could be affected by the discharge of treated industrial and sanitary wastewater to surface impoundments (that is, evaporation/infiltration ponds), dry lake beds, or natural drainage channels. NPDES permits would be obtained prior to any such discharge. These permits would specify the allowable limits for any potential pollutants and would establish strict effluent monitoring requirements.

Drilling operations also include activities that have the potential to affect surface water quality. The primary effluents from drilling are the overflow of briny water from the mud pits and the briny water that would be pumped out of the well from conductive features in the rock. Water and drilling muds are circulated through the borehole during drilling. Drilling mud, which includes chemicals such as polymers, soaps, and pH control additives, and rock cuttings removed from the borehole are staged in surface impoundments called mud pits. The rock cuttings settle by gravity and the mud is recirculated to the borehole. These pits could be lined to prevent infiltration to the subsurface. Depending on State and local regulations, the rock cuttings may be left in place in the mud pit and covered following completion of the drilling process. Because the drilling mud and chemical additives would be selected for compatibility with the specific downhole conditions, the exact

composition of the drilling mud and specific chemical additives would not be known until the site-specific geology was determined.

No wastewater would be generated by the emplacement and borehole sealing process. Water produced from the borehole, however, would be sampled for radioactivity and brine chemical composition. The sample would first be tested for radioactivity (from the fissile material) and, if not contaminated, the water would be returned to the mud pits. If the water is contaminated, it would be routed to the process wastewater treatment facility. Other wastewater originating from the borehole array area would be expected to consist of mopwaters and cleaning solutions, sealants and additives, drilling mud and grout additives, and machine coolant wastes.

The process wastewater treatment facility would be equipped to treat conventional, hazardous, radioactive, and mixed liquid wastes generated at several facilities onsite (for example, the surface processing and fissile material-grout preparation facilities). Treatment processes for each type of waste stream would be segregated. Effluent from this facility would be reclaimed after treatment and used as makeup water to the cooling tower; there would be no surface discharge.

Utility operations would also generate wastewater. This wastewater would consist of cooling tower blowdown and boiler blowdown and would be treated in the utility wastewater treatment facility. Treatment would consist of reverse osmosis followed by evaporation and spray drying. Reclaimed water produced by this facility would be used as makeup water for the cooling tower; there would be no surface discharge.

Another potential source of impacts to surface water quality is stormwater runoff from graded areas, raw material and drilling waste storage areas, and paved areas. This water would be retained in catch tanks or ponds, tested for the appropriate parameters, and then discharged to an infiltration pond if it passed the testing requirements. If the water exceeded any established thresholds, it would be diverted to an evaporation basin where any distillate would be treated and used as reclaimed water. NPDES permits, which would specify the exact testing requirements, would be required for each type of discharge (for example, point source and stormwater).

Groundwater. If water required for construction and operation were obtained from groundwater resources, it likely would be supplied from groundwater from the near-surface aquifer. Groundwater quantities required for both construction and operation of the generic deep borehole facility are shown in Table 4.3.3.1.4–1.

Several factors contribute to the theory that the deep borehole can isolate the fissile material for the required timeframe (many tens of thousands of years): the very slow movement of "groundwater" (brine) at great depths; the very slow release of radionuclides from the disposal form (molecular diffusion); the retardation or adsorption of released radionuclides by physiochemical interactions with the host rock; and the capability to perform the drilling, emplacing, and borehole-sealing operations without compromising the natural barriers of the earth's crust (host rock) or creating new pathways to the biosphere (that is, accessible environment) (LLNL 1996a:1-2,1-5).

In order for this alternative to be feasible, several site-specific environmental features are preferred: competent, seismically stable host rock with low fracture density and no fault zones; brines with high salinity (indicative of long-term isolation from the biosphere), low carbonate concentrations, and slightly basic and reducing geochemistry; low thermal gradient; and a high salinity gradient. Thermal and salinity gradients are key factors in the potential for brine circulation (advective transport) within the borehole. This is the principle mechanism for potential radionuclide migration in the deep borehole environment. Radionuclides will also migrate extremely slowly in the deep subsurface via molecular diffusion. Site specific siting criteria would be met in future tiered NEPA documents, as appropriate.

Casing the borehole (in the upper portion before competent bedrock is encountered) and sealing or cementing around the casing would be a primary barrier to fluid flow. The cement would seal the void space between the

casing and the borehole wall, thus eliminating this potential pathway for convective fluid circulation and possible mobilization of fissile material to the biosphere. In addition, the casing and cement grout would prevent groundwater from near-surface aquifers in the upper portion of the borehole from entering the borehole. This effectively isolates the potable, near-surface groundwater from the drilling muds in the borehole during drilling and also from the waste in the emplacement zone. Similarly, at greater depths, the grout would prevent brines from entering the borehole during drilling. The grout would also seal fractures in the host rock that intersect the borehole, which would otherwise represent potential flow pathways. In addition, to further isolate the fissile material, specially formulated sealing plugs would be installed across the entire borehole cross-section at strategic locations within the borehole.

Other engineered safety features at the ground surface would be provided to ensure that the disposal system would operate in compliance with regulatory requirements. For instance, wastewater discharge holding ponds could be lined and used as evaporation ponds instead of infiltration ponds. Additionally, near-surface groundwater would be periodically sampled and analyzed for radioactivity (and nonradioactive contaminants) emanating from the surface facilities and from the emplaced waste. The groundwater monitoring wells would be located both onsite and at strategically placed distant, downgradient points. All of the design criteria would be evaluated in future site-specific tiered NEPA documentation, as appropriate, should the Direct Disposition Alternative be selected.

4.3.3.1.5 *Geology and Soils*

Construction of a deep borehole complex would require the disturbance of approximately 63 ha (156 acres). The deep borehole complex represents an irreversible commitment because wastes in below-ground area could not be completely removed, nor could the site be feasibly used for any other purposes following closure of the facility. This land would be perpetually unusable because of the substrata and would not be suitable for potentially intrusive facilities such as mining, utilities, or building foundations. Because no site has been identified for analysis, impacts to geologic and soil resources cannot be determined at this time.

The identification and acceptance of a site location would require extensive site characterization to ensure that the primary objective of the deep borehole complex, isolation from the biosphere, would be met. A siting study would be conducted in support of the tiered NEPA documentation.

4.3.3.1.6 *Biological Resources*

Construction of a deep borehole complex would disturb 63 ha (156 acre) of land at an unspecified location. Additional land would be needed for rights-of-way. If this alternative is selected, a siting study would be conducted in support of tiered NEPA documentation. During the siting process, concern for individual species (and critical habitats) that are sensitive to disturbance and whose existence may be threatened by development would be a primary consideration. Further, once a site is selected, consultation with USFWS and the appropriate state agency would take place to ensure that threatened and endangered species would be protected. Potential impacts to individual species, necessary consultation, and protection measures will be addressed in site-specific NEPA documentation.

Terrestrial Resources. The excavation of material from a deep borehole could lead to potential impacts to terrestrial resources. Dust from drilling operations and the stockpiling of spoils could be deposited on plant surfaces and interfere with normal photosynthesis. Runoff from spoils disposal areas could affect vegetation in nearby areas.

Construction of the facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the deep borehole complex. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Clearing and grading operations could result in the direct loss of wetlands, although proper placement of the facility within the overall site would eliminate or reduce the potential for such loss. Where direct loss is unavoidable, mitigation measures would be developed. [Text deleted.] In general, direct impacts to wetlands from construction and operations would not be expected at dry sites.

Indirect impacts to wetlands from a deep borehole complex could occur as a result of stormwater runoff carrying sediments to wetlands located adjacent to the site. Changes in hydrology, water quality, and soils could occur as a result of alterations in water levels, runoff, and the buildup of sediments. These changes could, in turn, change the vegetative composition of the wetland.

Aquatic Resources. During construction of a deep borehole complex, potential impacts to aquatic resources could result from stormwater runoff, including runoff from spoils disposal areas. Runoff could alter flow rates, increase turbidity, and lead to sedimentation of stream beds. These impacts could, in turn, cause temporary and permanent changes in species compositions and density, and alter breeding habitats. Operational impacts to aquatic resources would generally be expected to be minimal since wastewater volumes would be minimal and would be discharged through an NPDES permitted outfall. However, runoff from spoils disposal areas could impact aquatic resources during operation. In general, direct impacts to aquatic resources from construction and operations would not be expected at dry sites.

Threatened and Endangered Species. Construction and operation of the deep borehole complex would have the potential to impact threatened and endangered species. Sources of impacts would be similar to those

discussed above for terrestrial resources, wetlands, and aquatic resources. The primary difference is that the resources of concern involve individual species (and critical habitats) that are sensitive to disturbance and whose existence may be threatened by development. Consultations with USFWS and State agencies would be conducted at the site-specific level, as appropriate.

4.3.3.1.7 *Cultural and Paleontological Resources*

The construction of the deep borehole site complex would disturb approximately 63 ha (156 acres) of land. The operational land requirement is 2,041 ha (5,044 acres), which includes a 1.6-km (1-mi) buffer zone. The actual facility requires 57 ha (141 acres) during operation. In addition, approximately 1.6 km (1 mi) each of road or railway would also be constructed. No specific site has been proposed for this alternative. Impacts to cultural and paleontological resources would be addressed in tiered NEPA documents as appropriate. A siting study would be conducted in support of tiered NEPA documentation.

Prehistoric and historic resources that may be NRHP eligible would be identified through additional surveys. Specific concerns about the presence, type, and location of Native American resources would be addressed through consultation with the potentially affected tribes in accordance with NHPA, the *Native American Graves Protection and Repatriation Act*, and the *American Indian Religious Freedom Act*. Therefore, it is not possible to determine potential effects on cultural and paleontological resources.

4.3.3.1.8 *Socioeconomics*

Candidate sites for the deep borehole complex have not been identified; therefore, the socioeconomic characteristics of the associated REAs and ROIs cannot be fully described. Instead, the following section describes a range of impacts that could potentially result from locating the facility in different types of geographical areas. Although the borehole complex would likely be located in an area away from population centers, the workforce needed to support the construction and operation of the facility would either have to reside in communities within commuting distance, or a small community would develop near the site. Once a specific site is selected, a more detailed analysis will be performed in tiered NEPA documents.

Regional Economy Characteristics. Constructing a deep borehole facility would require 870 workers at peak construction and 342 workers each year for 10 years of operation. The number of indirect jobs created by construction and operation of the borehole facility would depend upon the economic structure of the REA where the facility is located.

In a rural REA consisting of small communities, construction of the borehole facility could create as many as 400 indirect jobs. The number of indirect jobs created from operation could range from 0 to 350 depending on the types and concentration of businesses that are located in the region. If the borehole facility were constructed in an REA that included a large metropolitan area, up to 1,300 indirect jobs could be generated during construction, and up to 650 indirect jobs could be created during operation.

No matter where the borehole facility is located, the affected region's per capita income would increase and its unemployment rate would decrease. The magnitude of economic benefit to the REA would depend on the state of the regional economy and the availability of resident labor at the time of construction, as well as the capacity of the region's infrastructure (for example, transportation network) to accommodate increased business activity.

At the end of the 10-year operating period, the workforce would be phased out, and, in the absence of alternative job opportunities, regional unemployment would increase and per capita income would decrease. Phaseout in a diversified economy would lead to minimal losses; however, the more rural the REA the more unlikely it is there would be new employment opportunities to offset the loss of jobs.

The socioeconomic effects of a borehole facility on an REA would be maximized if the facility were located in a region with little or no previous economic activity. The effect would be similar to that of a mining town undergoing a boom-bust cycle. In other words, a community would develop, there would be an influx of workers and their families, and after the project was completed, there would be mass out-migration from the community.

Population and Housing. Most REAs would probably have sufficient available labor to construct the borehole facility, and few or no new workers would in-migrate to the ROI. Many construction workers would likely commute long distances rather than relocate near the site. However, some temporary housing may be needed near the site to accommodate a portion of the workforce who are not willing to endure a long commute during the construction period.

If the available labor force in REA would be sufficient to operate the facility, little or no in-migration would occur. However, labor availability would decrease the more rural the REA, thus increasing in-migration to the region. In any case, housing to accommodate in-migrating workers and their families would depend upon the ROI's owner/renter vacancy rates and housing market trends.

Following completion of the 10-year operation period, there would likely be out-migration of population because of the reduced job opportunities. Such out-migration would increase housing vacancies and could affect housing market values.

Community Services. There could be an increase in demand for community services during the construction phase of the project, depending on the need for in-migrating construction workers. The demand for these services would most likely increase further during operation. The ability to meet these new demands would depend on the level and capacities of services in the ROI where the borehole facility would be located. A more rural ROI would likely be the most affected.

Once the 10-year operation of the borehole facility is completed, there could be some out-migration. Any out-migration would reduce the demand on community services.

Local Transportation. Traffic levels in the vicinity of the borehole facility would increase by 1,670 vehicle trips per day during the construction phase and 657 during the operation phase. It is possible that the borehole facility would be located in a remote area, requiring improvement or construction of some roads to enable workers to access the site (Socio 1996a).

4.3.3.1.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and the associated impacts resulting from either normal operation or accidents involved with the direct emplacement of the Pu in a deep borehole. The section first describes the impacts from normal operation at the generic site, followed by a description of impacts from postulated facility accidents.

For the public, the analysis includes an annual dose and cumulative risk to the maximally exposed individual, population, and average individual within 80 km (50 mi). For workers, the analysis includes an annual and cumulative risk to an average involved and noninvolved worker and total involved and noninvolved workers. The radiological health effects were derived from data for representative DOE sites described in Sections 3.2 through 3.8. Data for the representative DOE sites were used to allow quantification of impacts, but do not necessarily capture the entire range of potential deep borehole complex sites. This approach to the radiological risk assessment differs from the analysis of other resources, which are analyzed based on a generic deep borehole site. Because the analysis of radiological dose impacts requires site-specific conditions, such as meteorology and surrounding populations, a generic site analysis would not be possible because of the infinite number of site-specific conditions.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 10-year campaign time are presented in Tables 4.3.3.1.9–1 and 4.3.3.1.9–2, respectively. [Text deleted.] Impacts from hazardous chemicals to these same groups are given in Table 4.3.3.1.9–3. Summaries of impacts associated with postulated accidents are given in Table 4.3.3.1.9–4. Detailed results are presented in Section M.

Normal Operation. There would be no radiological releases associated with the construction of the deep borehole complex. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment as well as direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the deep borehole complex are presented in Table 4.3.3.1.9–1. The impacts from all site operations, including the new borehole complex, are also given. Comparisons of operational doses with natural background radiation doses are included in the table.

The dose to the maximally exposed member of the public due to annual operation of the borehole complex would range from 2.7×10^{-9} to 9.4×10^{-8} mrem. From 10 years of operation, the risk of fatal cancer to this individual would range from 1.4×10^{-14} to 4.7×10^{-13}. The impacts to the average individual would be less. As a result of annual operations, the population dose would range from 5.3×10^{-9} to 1.8×10^{-6} person-rem/yr. The number of fatal cancers in the population due to 10 years of operation would range from 2.7×10^{-11} to 9.0×10^{-9}.

The upper bounding dose of 3.2 mrem to the maximally exposed member of the public due to annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The risk of fatal cancer to this individual from 10 years of operation would be 1.6×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operations, the upper bounding population dose would be within the limit in proposed 10 CFR 834 and would be 44 person-rem. The number of fatal cancers in this population due to 10 years of operation would be 0.22.

Table 4.3.3.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Deep Borehole Complex—Direct Disposition Alternative

Receptor	Generic Site[a]	
	Borehole Complex	Total Site[b]
Annual Dose to the Maximally Exposed Individual Member of the Public [c]		
Atmospheric release pathway (mrem)	2.7×10^{-9} to 9.4×10^{-8}	6.1×10^{-5} to 1.5
Drinking water pathway (mrem)	0	0 to 0.10
Total liquid release pathway (mrem)	0	0 to 1.7
Atmospheric and liquid release pathways combined (mrem)	2.7×10^{-9} to 9.4×10^{-8}	6.1×10^{-5} to 3.2
Percent of natural background[d]	8.6×10^{-10} to 3.2×10^{-8}	1.8×10^{-5} to 1.1
10-year fatal cancer risk	1.4×10^{-14} to 4.7×10^{-13}	3.1×10^{-10} to 1.6×10^{-5}
Annual Population Dose Within 80 Kilometers [e]		
Atmospheric release pathways (person-rem)	5.3×10^{-9} to 1.8×10^{-6}	2.8×10^{-4} to 40
Total liquid release pathways (person-rem)	0	0 to 4.7
Atmospheric and liquid release pathways combined (person-rem)	5.3×10^{-9} to 1.8×10^{-6}	2.8×10^{-4} to 44
Percent of natural background[d]	5.7×10^{-11} to 4.7×10^{-10}	2.4×10^{-7} to 0.017
10-year fatal cancers	2.7×10^{-11} to 9.0×10^{-9}	1.4×10^{-6} to 0.22
Annual Dose to the Average Individual Within 80 Kilometers[f]		
Atmospheric and liquid release pathways combined (mrem)	1.8×10^{-10} to 1.4×10^{-9}	8.0×10^{-7} to 0.049
10-year fatal cancer risk	9.0×10^{-16} to 7.0×10^{-15}	4.0×10^{-12} to 2.5×10^{-7}

[a] Ranges for the "Borehole Complex" and "Total Site" doses may not necessarily reflect the same respective sites.

[b] Includes impacts from No Action baseline facilities (refer to Sections 4.2.1.9 through 4.2.6.9) if the borehole were located on a DOE site, shown for comparison purposes only, and would not apply if a generic non-DOE site were selected for the borehole complex.

[c] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[d] The annual natural background radiation level: the average individual receives a dose that could range from 295 to 338 mrem; the population within 80 km receives a dose that could range from 9,190 to 379,000 person-rem.

[e] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[f] Obtained by dividing the population dose at a site by the number of people projected to be living within 80 km of that site. The number of people ranges from 29,400 to 1,285,000.

Source: Section M.2.

Doses to onsite workers due to normal operations are given in Table 4.3.3.1.9–2. Included are involved workers directly associated with the deep borehole complex, workers who are not involved with the deep borehole complex, and the entire workforce at the site. All doses fall within regulatory limits.

The annual dose to the average borehole complex worker would be 13 mrem; the entire borehole complex workforce would receive 2.7 person-rem annually. The annual dose to the noninvolved worker would range from 2.6 to 32 mrem depending on the borehole site (if an existing DOE site were chosen), and the annual total dose to all noninvolved workers would range from 3.0 to 250 person-rem. The annual dose to the total site workforce would range from 5.7 to 253 person-rem. The risks and numbers of fatal cancers among the different workers due to 10 years of operation are included in Table 4.3.3.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Table 4.3.3.1.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Deep Borehole Complex—Direct Disposition Alternative

Receptor	Generic Site
Involved Workforce[a]	
Average worker dose (mrem/yr)[b]	13
10-year risk of fatal cancer	5.2×10^{-5}
Total dose (person-rem/yr)	2.7
10-year fatal cancers	0.011
Noninvolved Workforce[c]	
Average worker dose (mrem/yr)[b]	2.6 to 32
10-year risk of fatal cancer	1.0×10^{-5} to 1.3×10^{-4}
Total dose (person-rem/yr)	3.0 to 250
10-year fatal cancers	0.012 to 1.0
Total Site Workforce[d]	
Dose (person-rem/yr)	5.7 to 253
10-year fatal cancers	0.023 to 1.0

[a] The involved worker is a worker associated with operations of the proposed action. The estimated number of badged in-plant workers is 205.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem/yr (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is an onsite worker not associated with operations of the proposed operations of the borehole complex. The ranges for noninvolved workers are based on No Action values for Hanford, NTS, INEL, Pantex, ORR, and SRS. Noninvolved worker doses are shown for comparison purposes and would not apply if the borehole were located at a separate dedicated site. The noninvolved workforce is equivalent to the No Action workforce.

[d] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: LLNL 1996a for involved workers. For the noninvolved workers the ranges are based on the No Action values for Hanford, NTS, INEL, Pantex, ORR, and SRS given in Sections 4.2.1.9, 4.2.2.9, 4.2.3.9, 4.2.4.9, 4.2.5.9, and 4.2.6.9, respectively.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public due to normal operation of the deep borehole facility at the generic site are presented in Table 4.3.3.1.9–3. Included are the impacts due only to operation of the deep borehole facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI is 1.2×10^{-3} at the borehole complex generic site. The cancer risk from hazardous chemicals to the MEI is zero (because no carcinogens are released from hazardous chemicals) at the borehole complex generic site. The HI to the onsite worker is 0.29 at the borehole complex generic site, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals).

Facility Accidents. A set of potential accidents for a deep borehole complex for which there may be a release of radioactivity that could impact onsite workers and the offsite population has been postulated. Accident scenarios considered are Pu storage container breakage during storage; Pu storage container breakage during handling; nuclear criticality during emplacement canister filling; criticality during Pu storage container spill; fire in process area; canister string dropped during emplacement and ruptured in emplacement zone; canister string dropped during emplacement and stuck in isolation zone; Pu container criticality during storage; emplacement canister nuclear criticality in storage; and nuclear criticality of canister contents at bottom of emplacement zone upon rupture of dropped canister string. The range of consequences and risks for a set of accidents at the generic site is presented in Table 4.3.3.1.9–4. The estimated range of environmental data (wet-to-dry site) and the general public population density data (low-to-high density) for the generic site envelopes the site characteristics expected for the direct emplacement site.

Table 4.3.3.1.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Deep Borehole Complex—Direct Disposition Alternative

Receptor	Facility[a]	Total Site[b]
Maximally Exposed Individual (Public)		
Hazard Index[c]	1.2×10^{-3}	1.2×10^{-3}
Cancer Risk[d]	0	0
Worker Onsite		
Hazard Index[e]	0.29	0.29
Cancer Risk[f]	0	0

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=Sum of individual Hazard Quotients (noncancer health effects) for the maximally exposed individual.

[d] Cancer Risk for MEI=(Emissions concentrations) x (0.286 [converts concentrations to doses]) x (slope factor [SF]). [Text deleted.]

[e] Hazard Index for Workers=Sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer Risk for Workers=(Emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (SF). [Text deleted.]

Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Table M.3.4–40.

[Text deleted.] The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Before construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Table 4.3.3.1.9–4. Range of Accident Impacts for a Set of Accidents for the Deep Borehole Complex—Direct Disposition Alternative

Accident Scenario	Worker at 1,000 m				Maximum Offsite Individual				Population to 80 km				Accident Frequency (per yr)
	Risk of Cancer Fatality (per 10 yr)[a]		Probability of Cancer Fatality[b]		Risk of Cancer Fatality (per 10 yr)[a]		Probability of Cancer Fatality[b]		Risk of Cancer Fatality (per 10 yr)[a]		Number of Cancer Fatalities[c]		
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	
Pu storage container breakage during storage	5.1×10^{-16}	2.1×10^{-16}	5.1×10^{-14}	2.1×10^{-14}	1.0×10^{-16}	4.7×10^{-18}	1.0×10^{-14}	4.7×10^{-16}	9.0×10^{-14}	8.4×10^{-16}	9.0×10^{-12}	8.4×10^{-14}	1.0×10^{-3}
Pu storage container breakage during handling	5.1×10^{-14}	2.1×10^{-14}	5.1×10^{-12}	2.1×10^{-12}	1.0×10^{-14}	4.7×10^{-16}	1.0×10^{-12}	4.7×10^{-14}	9.0×10^{-12}	8.4×10^{-14}	9.0×10^{-10}	8.4×10^{-12}	1.0×10^{-3}
Nuclear criticality during emplacement canister filling	1.4×10^{-9}	6.2×10^{-10}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-10}	1.0×10^{-11}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-8}	2.3×10^{-9}	6.3×10^{-4}	2.3×10^{-5}	1.0×10^{-5}
Nuclear criticality during Pu storage canister spill	1.4×10^{-9}	6.2×10^{-10}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-10}	1.0×10^{-11}	2.9×10^{-6}	1.0×10^{-7}	6.0×10^{-8}	3.3×10^{-10}	6.0×10^{-4}	3.3×10^{-6}	1.0×10^{-5}
Fire in process area	4.6×10^{-13}	1.9×10^{-13}	4.6×10^{-9}	1.9×10^{-9}	9.3×10^{-14}	4.2×10^{-15}	9.3×10^{-10}	4.2×10^{-11}	8.1×10^{-11}	3.3×10^{-10}	8.1×10^{-7}	3.3×10^{-6}	1.0×10^{-5}
Canister string dropped during emplacement, ruptured in emplacement zone	4.6×10^{-12}	1.9×10^{-12}	4.6×10^{-8}	1.9×10^{-8}	9.3×10^{-13}	4.2×10^{-14}	9.3×10^{-9}	4.2×10^{-10}	8.1×10^{-10}	7.6×10^{-12}	8.1×10^{-6}	7.6×10^{-8}	1.0×10^{-5}
Canister string dropped during emplacement, ruptured in isolation zone	2.8×10^{-15}	1.1×10^{-15}	2.8×10^{-11}	1.1×10^{-11}	5.6×10^{-16}	2.5×10^{-17}	5.6×10^{-12}	2.5×10^{-13}	4.9×10^{-13}	4.5×10^{-15}	4.9×10^{-9}	4.5×10^{-11}	1.0×10^{-5}
Pu container nuclear criticality in storage	1.4×10^{-10}	6.2×10^{-11}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-11}	1.0×10^{-12}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-9}	3.3×10^{-11}	6.3×10^{-4}	3.3×10^{-6}	1.0×10^{-6}
Emplacement canister nuclear criticality in storage	1.4×10^{-10}	6.2×10^{-11}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-11}	1.0×10^{-12}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-9}	3.3×10^{-11}	6.3×10^{-4}	3.3×10^{-6}	1.0×10^{-6}
Nuclear criticality of canister contents at bottom of emplacement zone upon rupture of dropped canister string	1.4×10^{-10}	6.2×10^{-11}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-11}	1.0×10^{-12}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-9}	3.3×10^{-11}	6.3×10^{-4}	3.3×10^{-6}	1.0×10^{-6}
Expected risk[d]	3.2×10^{-9}	1.4×10^{-9}	–	–	6.7×10^{-10}	2.3×10^{-11}	–	–	1.4×10^{-7}	3.1×10^{-9}	–	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual or the number of cancer fatalities [for the population to 80 km]) by the accident frequency and the number of years of operations.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks under the lifetime of the facility.

Note: The impacts shown are the maximum for the reference sites. All values are mean values.

Source: Section M.5.

4.3.3.1.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of a deep borehole complex for the Direct Disposition Alternative. There is no spent nuclear fuel or HLW associated with the operation of the deep borehole disposal facility. Table 4.3.3.1.10–1 provides the estimated operational waste volumes projected to be generated as a result of the deep borehole complex for direct disposal. Facilities that would support the deep borehole complex would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, waste could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purpose of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. For purposes of analysis, a pristine site with no waste management infrastructure was assumed for No Action because the deep borehole disposal facility was assumed to be a rural setting where no waste is currently being generated. The incremental waste volumes generated from the deep borehole complex and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.1. A detailed description of the waste management activities that would be required to support the deep borehole disposal facility for direct disposal can also be found in Section E.3.3.1.

Table 4.3.3.1.10–1. Estimated Annual Generated Waste Volumes for the Deep Borehole Complex—Direct Disposition Alternative[a]

Category	New Facility (m^3)	No Action (m^3)
Transuranic		
Liquid	0.2[b]	None
Solid	0.2	None
Mixed Transuranic		
Liquid	0	None
Solid	0.04	None
Low-Level		
Liquid	2[b]	None
Solid	5	None
Mixed Low-Level		
Liquid	0	None
Solid	0	None
Hazardous		
Liquid	110	None
Solid	17	None
Nonhazardous (Sanitary)		
Liquid	10,600	None
Solid	306	None
Nonhazardous (Other)		
Liquid	6,800	None
Solid	1,250[c]	None

[a] No waste generation was assumed for No Action. Waste generation volumes for deep borehole disposal facility for direct disposal are from Table E.3.3.1–1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.3.1–1.

[b] Liquid TRU and LLW would be treated and solidified prior to disposal.

[c] Includes rock cuttings, bentonite, and polymers from drilling and emplacing borehole sealing facilities.

Construction and operation of a deep borehole complex for direct disposal would require the construction of waste management facilities to treat and store generated TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, solid nonhazardous, and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any is generated it would be managed in accordance with all applicable Federal and State regulations.

Less than 1 m^3 (40 gal) of liquid TRU waste generated per year from equipment decontamination would be treated in a waste handling facility to form grout. In the solids treatment area of the waste handling facility less than 1 m^3 (<1 yd^3) of solid TRU waste from process and facility operations, equipment decontamination, failed equipment, and used tools would be compacted as appropriate, then packaged, assayed, and certified to the current planning-basis WIPP WAC or alternative treatment level. A small quantity (<0.1 m^3[<0.1 yd^3]) of solid mixed TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC. Mixed TRU waste would be principally rubber gloves and leaded box gloves. To transport the TRU and mixed TRU wastes to WIPP (depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste), one truck shipment every 45 years would be required.

Approximately 2 m^3 (600 gal) of liquid LLW from process wash liquids and excess water from the borehole would be solidified in the waste handling facility. The solidified liquid LLW and solid LLW comprised of sealant residues, contaminated reagent containers, deformed Pu shipping containers, wipes, rags, and paper clothing would result in approximately 5 m^3 (6 yd^3) of LLW that would require disposal at a DOE LLW disposal facility. It would take approximately 4 years to accumulate sufficient quantity for one truck shipment. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.001 ha/yr (0.003 acre/yr) at Hanford and ORR, 0.0008 ha/yr (0.002 acre/yr) at NTS and INEL, and 0.0005 ha/yr (0.001 acre/yr) at SRS. The ultimate disposal of LLW will be in accordance with waste-type-specific ROD(s) from the Waste Management PEIS.

Approximately 110 m^3 (29,000 gal) of liquid hazardous waste consisting of 2 m^3 (500 gal) of chemical makeup and reagents from the surface facility and 108 m^3 (28,500 gal) of oil, antifreeze, and hydraulic fluid from the drilling and emplacing-borehole sealing facilities would be treated onsite or collected in DOT-approved containers and shipped to offsite RCRA-permitted treatment facilities. After treatment, the waste would be disposed of off-site in commercial, RCRA-permitted disposal facilities. An estimated 17 m^3 (22 yd^3) of solid hazardous waste such as wipes contaminated with oils, lubricants, and cleaning solvents would be compacted as appropriate and then packaged in DOT-approved containers treated onsite or offsite, and shipped to offsite RCRA-permitted treatment and disposal facilities.

Approximately 10,600 m^3 (2.8 million gal) of liquid nonhazardous sanitary and industrial wastewater and 6,800 m^3 (1.8 million gal) of steam plant blowdown and evaporator condensate would require treatment in accordance with standard industrial practices. Treated wastewater would be designated as reclaimed water recycle and would be used as makeup to the cooling tower. Construction of sanitary, utility, and process wastewater treatment systems would be required. The 306 m^3 (400 yd^3) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste would be shipped to a permitted landfill. The drilling and emplacing-borehole sealing facilities would generate approximately 1,250 m^3 (1,630 yd^3) of rock cuttings, bentonite and polymers. As per customary drilling industry practices, these wastes would end up in mud pits that would then be filled with earth and leveled.

4.3.3.2 Immobilized Disposition Alternative

The environmental impacts described in the following sections are based on the analysis of two facilities for the Immobilized Disposition Alternative. These two facilities are the ceramic immobilization facility (Section 4.3.3.2.1) and the deep borehole complex (Section 4.3.3.2.2).

4.3.3.2.1 *Ceramic Immobilization Facility (for Borehole)*

The environmental impacts described in the following sections are based on the analysis of the ceramic immobilization facility for the Immobilized Disposition Alternative as described in Section 2.4.3.2.1. No radioactive isotopes would be included in the ceramic matrix. The representative sites used for this analysis are Hanford, NTS, INEL, Pantex, ORR, and SRS.

4.3.3.2.1.1 *Land Resources*

A new ceramic immobilization facility would disturb 28.3 ha (70 acres) of land during construction of which 18.2 ha (45 acres) would be used during operations. The need for buffer zones would be determined during site-specific, tiered NEPA documentation. This section describes the impacts of constructing and operating the ceramic immobilization facility to land resources for each representative site.

Construction and operation of the ceramic immobilization facility should not cause indirect land use impacts at the analysis sites. As discussed in Section 4.3.3.2.1.8, in-migration of workers would be required during the operational phase at all sites analyzed. In-migration would occur during construction only at INEL and Pantex. However, it is expected that historic housing construction rates at each analysis site should accommodate the in-migrating population. Therefore, offsite land use at the analysis sites would not be affected.

Hanford Site

Land Use. The ceramic immobilization facility would utilize vacant land in the 200 Area adjacent to 200 East. Construction and operation of the ceramic immobilization facility would be in conformance with the existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land-use planning process. According to the *Hanford Site Development Plan*, 200 Area's land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction and operation of the facility would be compatible with State and local (Benton, Franklin, and Grant Counties and the City of Richland) land use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Areas and current VRM Class 5 designation. A potential visual impact during operation would be from stack plumes which could be visible from public viewpoints with high sensitivity levels including State Highways 24 and 240, and the City of Richland; however, because of the viewing distance and compatibility of the proposal with existing industrial character, visual impacts would not occur.

Nevada Test Site

Land Use. The ceramic immobilization facility would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area. [Text deleted.] However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as

part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. [Text deleted.] Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The ceramic immobilization facility would be located on undeveloped land in the ICPP security area, which is situated within the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). Construction and operation of the facility would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan*, which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction would not be in conflict with land-use plans, policies, and controls of adjacent counties and the City of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operations would be compatible with the present visual character of INEL, which consists of large industrial facilities and stack plumes. Potential visual impacts during operation could occur from the additional stack plumes; however, the proposal would be consistent with the existing Class 5 industrial character of the ICPP.

Pantex Plant

Land Use. The ceramic immobilization facility would be located on undeveloped land in Zone 4. The potential action would be inconsistent with the current *Pantex Site Development Plan* master plan, which designates Zone 4 for weapons and weapon components staging (PX DOE 1995g:16). However, Pantex could revise the site development plan should Pantex be selected for this alternative.

Construction and operation would not affect other Pantex or offsite land uses. There would be no impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] Potential visual impacts could occur during operation from the additional stack plumes; however, the visual environment would be consistent with the existing industrialized landscape character, and current VRM Class 5 designation of Zone 4.

Oak Ridge Reservation

Land Use. The ceramic immobilization facility would be located on undeveloped land at the northwest quadrant of the Route 95/Bear Creek Road intersection. The alternative would be in conformance with the future land-use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan*, which designates a portion of the site as a major waste management area (OR DOE 1991f:1-7). Vacant land would be used. [Text deleted.]

Construction and operation would be compatible with other ORR and offsite land uses. No prime farmlands exist onsite. The ceramic immobilization facility would not be in conflict with city of Oak Ridge land use plans, policies, and controls since the current *Oak Ridge Area Land Use Plan* designates the potential site for Industrial and Public land use.

Visual Resources. [Text deleted.] Construction and operation of the facility would change the current VRM Class 4 designation of the Bear Creek Road/Route 95 site to Class 5. Additionally, potential visual impacts could occur during operation from the new stack plumes. Construction and operation activities would be highly visible from Bear Creek Road and Route 95, public roadways with high sensitivity levels.

Savannah River Site

Land Use. A new ceramic immobilization facility would be located on undeveloped land in the F-Area. Facility construction and operation would conform with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the plan, current F-Area land use is designated industrial operations, while the future land use category is primary industrial mission. Specifically, the F-Area is one of four SRS Waste Management facilities (SR DOE 1994d:2,11,12). Vacant land would be used.

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction would not be in conflict with land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] Construction and operation would occur within an area of similar industrial landscape character. Potential visual impacts could occur during operation from additional stack plumes; however, the proposal would be consistent with the VRM Class 5 designation of the F-Area.

[Text deleted.]

4.3.3.2.1.2 *Site Infrastructure*

The potential impacts to the site infrastructure at six representative DOE sites for construction and operation of a ceramic immobilization facility are described below. Data for construction and annual operations are presented in Appendix C. Site infrastructure changes resulting from such construction are presented in Table 4.3.3.2.1.2–1 and changes from operations in Table 4.3.3.2.1.2–2 for the six representative sites.

Hanford Site

[Text deleted.] Construction and operation of this new facility would require construction of transportation links to the existing road and rail networks. DOE would site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure. Hanford would require additional natural gas supplies to operate the ceramic immobilization facility. Since natural gas availability is governed by usage and not by storage capacity onsite, the additional natural gas required for operations could be procured through normal contractual means.

Nevada Test Site

[Text deleted.] Construction and operation of this new facility would require construction of transportation links to the existing road and rail networks. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers. Since NTS does not use natural gas, this facility would be designed to burn fuel oil if NTS were selected as the site. [Text deleted.]

Idaho National Engineering Laboratory

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. INEL plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure. Since INEL does not use natural gas, this facility would be designed to burn fuel oil if INEL were selected as the ceramic immobilization facility site.

Pantex Plant

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE would site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure. Additional oil would be required during the period of construction. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required for construction could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers.

Oak Ridge Reservation

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE would site this facility close to existing roads and railroads to ensure that such construction and operation impacts would be negligible to the site infrastructure. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers for construction use.

Savannah River Site

[Text deleted.] Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers for construction use. Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE would site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure. Since SRS does not use natural gas, this facility would be designed to burn fuel oil if SRS were selected as the site.

Table 4.3.3.2.1.2–1. Additional Site Infrastructure Needed for the Construction of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	**Peak Load (MWe)**	**Oil (l/yr)**	**Natural Gas (m^3/yr)**	**Coal (t/yr)**
Facility Requirement	10,200	2	3,000,000	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	355,700	60	12,334,800	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Projected usage with facility	135,140	27	8,716,000	0	0
Amount required in excess to site availability	0	0	3,000,000[a]	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Projected usage with facility	242,700	44	8,820,000	0	11,340
Amount required in excess to site availability	0	0	0	0	0

Table 4.3.3.2.1.2–1. Additional Site Infrastructure Needed for the Construction of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative (Annual)—Continued

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Projected usage with facility	56,466	12.1	3,795,166	7,200,000	0
Amount required in excess to site availability	0	0	2,019,446[a]	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	736,200	112	3,379,000	95,000,000	16,300
Amount required in excess to site availability	0	0	2,963,000[a]	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Projected usage with facility	804,200	118	31,390,500	0	221,352
Amount required in excess to site availability	0	0	3,000,000[a]	0	0

[a] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996e; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

Table 4.3.3.2.1.2–2. Additional Site Infrastructure Needed for the Operation of the Ceramic Immobilization Facility (for Borehole)—Immobilized Disposition Alternative (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	< 5	< 5	35,000	5	210,000	3,800,000	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	380,500	63	9,544,800	24,839,531	0
Amount required in excess to site availability	< 5	< 5	0	0	0	3,800,000[a]	0
NTS							
Site availability	1,100[b]	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	<5	159,940	30	5,926,000	3,800,000	0
Amount required in excess to site availability	0	< 5	0	0	210,000[c]	3,800,000[a]	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	267,500	47	6,030,000	3,800,000	11,340
Amount required in excess to site availability	< 5	< 5	0	0	0	3,800,000[a]	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	81,266	15	1,005,166	11,000,000	0
Amount required in excess to site availability	< 5	< 5	0	0	0	0	0
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	76	32	761,000	115	589,000	98,800,000	16,300
Amount required in excess to site availability	< 5	< 5	0	0	173,000[c]	0	0

Table 4.3.3.2.1.2–2. Additional Site Infrastructure Needed for the Operation of the Ceramic Immobilization Facility (for Borehole)—Immobilized Disposition Alternative (Annual)—Continued

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	829,000	121	28,600,500	3,800,000	221,352
Amount required in excess to site availability	< 5	< 5	0	0	210,000[c]	3,800,000[a]	0

[a] Facility would be adapted to use fuel oil instead of natural gas.

[b] Includes paved and unpaved roads.

[c] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996e; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

4.3.3.2.1.3 *Air Quality and Noise*

Construction and operation of the ceramic immobilization facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.3.2.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of the ceramic immobilization facility are presented in Table F.1.3–8. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators

[Text deleted.]

During operation, concentrations of criteria air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation plus the No Action concentrations are presented in Table 4.3.3.2.1.3–1. There are no toxic/hazardous chemical emissions associated with this facility.

NOISE

The location of the facilities associated with the ceramic immobilization facility relative to the site boundary and sensitive receptors was examined for each of the sites to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Non-traffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, and material handling equipment. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the sites,

Table 4.3.3.2.1.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Ceramic Immobilization Facility and No Action Alternative (For Borehole)—Immobilized Disposition Alternative

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)
Criteria pollutant														
Carbon monoxide	8-hour	10,000	0.08	5.15	2,290	2,294.03	284	296.7	602	650.7	5	6.26	22	65.35
	1-hour	40,000	0.3	40.58	2,748	2,776.46	614	646.2	2,900	3,155	11	13.6	171	375.1
Lead	Calendar Quarter	1.5	<0.01	[b]	[b]	[b]	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01
	24-hour	0.5	<0.01	<0.01	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
Nitrogen dioxide	Annual	100	0.03	0.08	[b]	0.01[d]	4	4.07	2.15	2.43	3	3.01	5.7	5.92
Ozone	1-hour	235	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01	<0.01	9.4	9.4	5	5	8.73	8.74	1	1	3	3.01
	24-hour	150	0.02	0.04	106	106	80	80.06	88.5	88.71	2	2.01	50.6	50.79
Sulfur dioxide	Annual	52	<0.01	<0.01	8.4	8.4	6	6	<0.01	0.03	2	2	14.5	14.51
	24-hour	260	<0.01	0.04	94.6	94.62	135	135.1	<0.01	0.28	32.01	32.01	196	196.24
	3-hour	1,300	0.01	0.22	725	725.1	579	579.3	<0.01	1.50	80	80.03	823	824.53
	1-hour	1,018	0.02	0.65	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	1-hour	655[f]	0.02	0.65	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	30-minute	1,045	[c]	[c]	[c]	[c]	[c]	[c]	<0.01	4	[c]	[c]	[c]	[c]
Mandated by State														
Hydrogen fluorides (as HF)	30-day	0.8	[b]	[b]	[c]	[c]	[c]	[c]	<0.75	<0.75	0.2	0.2	0.09	0.09
	7-day	1.6	[b]	[b]	[c]	[c]	[c]	[c]	<0.75	<0.75	0.3	0.3	0.39	0.39
	24-hour	2.9	[b]	[b]	[c]	[c]	[c]	[c]	0.75	0.75	0.6[g]	0.6[g]	1.04	1.04
	12-hour	3.7	[b]	[b]	[c]	[c]	[c]	[c]	1.05	1.05	0.6[g]	0.6[g]	1.99	1.99
	8-hour	250	[b]	[b]	[c]	[c]	[c]	[c]	[c]	[c]	0.6	0.6	[c]	[c]
	3-hour	4.9	[b]	[b]	[c]	[c]	[c]	[c]	4.21	4.21	[c]	[c]	[c]	[c]

Table 4.3.3.2.1.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Ceramic Immobilization Facility and No Action Alternative (For Borehole)—Immobilized Disposition Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)
Hydrogen sulfide	1-hour	112	c	c	b	b	c	c	c	c	c	c	c	c
	30-minute	111	c	c	c	c	c	c	b	b	c	c	c	c
Total suspended particulates	Annual	60	<0.01	<0.01	c	c	5	5	c	c	c	c	12.6	12.61
	24-hour	150	0.02	0.04	c	c	80	80.06	c	c	2	2.01	c	c
	3-hour	200	c	c	c	c	c	c	b	1.19[d]	c	c	c	c
	1-hour	400	c	c	c	c	c	c	b	3.20[d]	c	c	c	c
[Text deleted.]														

[a] The more stringent of the Federal and State standards is presented for the averaging time.

[b] No sources of this pollutant have been identified.

[c] No State standard for indicated averaging time.

[d] The concentration represents the alternative contribution only.

[e] Ozone, as a criteria pollutant, is not directly emitted nor monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

[f] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.

[g] 8-hour averaging time concentration was used.

[Text deleted.]

Note: Total concentrations are based on site contribution, including concentrations from ongoing activities (No Actions), and do not include the contribution from non-facility sources. Concentrations for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LLNL 1996e; LLNL 1996h; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.3.2.1.4 *Water Resources*

The construction and operation of a ceramic immobilization facility would affect water resources. Water resource requirements, and discharges provided in Tables C.1.1.3–3 and C.2.1.3–3 and Table E.3.3.3–1, were used to assess impacts to surface water and groundwater. The discussion of impacts is provided for each site separately. Table 4.3.3.2.1.4–1 presents No Action surface and groundwater uses and discharges at each site, and the potential changes to water resources resulting from construction and operation of the ceramic immobilization facility.

Hanford Site

Surface Water. Surface water would be used as the water source for construction and operation of the ceramic immobilization facility, and would be obtained from the Columbia River. During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr), which would represent less than a 0.3-percent increase over the existing annual surface water withdrawal. These additional withdrawals would cause negligible impact to surface water availability.

During operation, water requirements for the ceramic immobilization facility would be approximately 320 million l/yr (84.5 million gal/yr), which would represent a 2.4-percent increase over the existing surface water withdrawal.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (29.6 million l/yr [7.8 million gal/yr]), would be generated and discharged to percolation ponds at the 200 East Area. During operation, approximately 123.9 million l/yr (32.7 million gal/yr) of sanitary and other wastewater would also be discharged to percolation ponds. All discharges would be monitored. Percolation of this treated wastewater into the unconfined aquifer could contribute to the rising, or mounding, of the water table at the 200 Areas. However, no other impacts to the aquifer would be expected.

Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored, sampled, and treated as process wastewater, when required. The wastewater would be monitored for radioactivity, and if uncontaminated, discharged to percolation ponds or storm drains that discharge to local drainage channels. Impacts to the unconfined aquifer would be the same as discussed above.

The ceramic immobilization facility would be located in the 200 Area which is above the 100-year, 500-year and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for any project-related water requirements; therefore groundwater availability would not be affected. Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater which does not evaporate, however, could percolate downward toward the groundwater of the unconfined aquifer. This water would be monitored and would not be discharged until contaminant levels are within the limits. Impacts to groundwater quality would, therefore, not be expected. In addition, other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Table 4.3.3.2.1.4–1. Potential Changes to Water Resources Resulting From Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Water Source	Surface	Ground	Ground	Ground	Surface	Ground
No Action Water Requirements (million l/yr)	13,511	2,400	7,570	249	14,760	13,247
No Action Wastewater Discharge (million l/yr)	246	82	540	141	2,277	700
Construction						
Water Availability and Use						
Total water requirement (million l/yr)	38	38	38	38	38	38
Percent increase in projected water use[a]	0.3	1.6	0.5	15.2	0.3	0.3
Water Quality						
Total wastewater discharge (million l/yr)	29.6	29.6	29.6	29.6	29.6	29.6
Percent change in wastewater discharge[b]	12	36.1	5.5	21	1.3	4.2
Percent change in streamflow	neg	NA	NA	NA	0.06[c]	0.6[d]
Operation						
Water Availability and Use						
Total water requirement (million l/yr)	320	320	320	320	320	320
Percent increase in projected water use[e]	2.4	13.3	4.2	129	2.2	2.4
Water Quality						
Total wastewater discharge (million l/yr)	123.9	123.9	123.9	123.9	123.9	123.9
Percent change in wastewater discharge[f]	50.4	151	22.9	87.9	5.4	17.7
Percent change in streamflow	neg	NA	NA	NA	0.3[c]	2.5[d]

Table 4.3.3.2.1.4–1. Potential Changes to Water Resources Resulting From Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Floodplain						
Is action in 100-year floodplain?	No	No	No	No	No	No
Is critical action in 500-year floodplain?	No	Uncertain	Uncertain	No	Uncertain	Unlikely

[a] Percent increases in water requirements during construction of the ceramic immobilization facility are calculated by dividing water requirements for the facility (38 million l/yr) with that for No Action water requirement at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[b] Percent changes in wastewater discharged during construction for the ceramic immobilization facility are calculated by dividing wastewater discharges for the facility (29.6 million l/yr) with that for No Action discharge at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

[c] Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for the East Fork Poplar Creek is shown in the table.

[d] Percent changes in stream flow from wastewater discharges are calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).

[e] Percent increases in water requirements during operations of the ceramic immobilization facility are calculated by dividing water requirements for the facility (320 million l/yr) with that for No Action water requirement at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[f] Percent changes in wastewater discharged during operation of the ceramic immobilization facility are calculated by dividing wastewater discharge for the facility (123.9 million l/yr) with that for No Action discharge at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996e; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for construction and operation of the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (29.6 million l/yr [7.8 million gal/yr]) would be generated, treated, and discharged to evaporation/percolation ponds or be available for recycle. During operation, approximately 123.9 million l/yr (32.7 million gal/yr) of sanitary and other wastewater would be discharged to the wastewater treatment system and would then be available for recycle. Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored, sampled, and treated as process wastewater when required. This wastewater would be monitored for radioactivity, and if uncontaminated, would be available for recycling or discharge to local drainage channels.

Because there are no continuously flowing streams on NTS and no designated floodplains, there are no studies to assess the 500-year floodplain boundaries. Studies of the 100-year floodplain showed it to be confined to the Jackass Flats and Frenchman Lake areas. The site for the ceramic immobilization facility would not be located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms which can create brief (less than 6 hours) flash floods, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater. Quantities required and the percent increase in projected water use are shown in Table 4.3.3.2.1.4–1. Annual construction water requirements for the facility (38 million l/yr [10 million gal/yr]), represent approximately 0.2 percent of the estimated minimal annual recharge (38 billion l/yr [10 billion gal/yr]) to the regional aquifer under the entire NTS. As shown in Table 4.3.3.2.1.4–1, the quantity of water which would be required for construction of the facility represents approximately a 1.6-percent increase over the projected No Action groundwater usage. Operating the facilities at NTS would require 320 million l/yr (84.5 million gal/yr), which is approximately 13.3 percent of the projected groundwater usage. This additional withdrawal would represent 0.8 percent of the estimated minimal annual recharge, and would increase the total amount withdrawn annually at NTS to 7.2 percent of the estimated annual recharge. These additional withdrawals would have minimal impacts on groundwater availability.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward into the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are therefore not expected. Other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (29.6 million l/yr [7.8 million gal/yr]), would be generated, treated, and discharged to evaporation/infiltration ponds or be available as recycle. During operation, a maximum of approximately 123.9 million l/yr (32.7 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. All discharges would be monitored to comply with discharge limits. Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored, sampled, and treated as process wastewater, when required. This wastewater would be monitored for radioactivity, and if uncontaminated, discharged to evaporation ponds or storm drains which discharge to local drainage channels.

The site for the ceramic immobilization facility is not located in an area historically prone to flooding, but is within the flood zone that could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facility would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. During construction, water requirements for the facility (38 million l/yr [10 million gal/yr]) would represent a 0.5-percent increase over the projected annual groundwater usage. This would increase the total projected amount to be pumped at INEL to 17.7 percent of the total allotment. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). During operation, the water requirements for the facilities would be 320 million l/yr (84.5 million gal/yr). This amount would represent a 4.2-percent increase over the projected annual groundwater usage and would increase the total projected amount to be pumped at INEL to 18.3 percent of the total allotment. This increase should not have any impact on groundwater availability, as INEL would be well within its total allotment.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater which does not evaporate, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged into the treatment ponds until contaminant levels are within the limits. Impacts to groundwater quality are therefore not expected. In addition, other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with any of the facilities; groundwater would be used as the water source for construction and operation of the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (29.6 million l/yr [7.8 million gal/yr]), would be generated and discharged to the existing wastewater treatment systems north of Zone 12 and then discharged to the playa lakes or would be available for recycling. During operation, approximately 123.9 million l/yr (32.7 million gal/yr) of sanitary wastewater and other wastewater would be discharged to either of these wastewater treatment systems, and then discharged to the playa lakes or would be available for recycling. The expected quantity of additional wastewater potentially discharged to the playas during operation (approximately 339,500 l/day [89,700 gal/day]) should not cumulatively cause any exceedances of the monthly average limit of 2.46 million l/day (0.65 million gal/day). This is based on Pantex's 1994 discharges, which averaged approximately 1.4 million l/day (0.37 million gal/day), and are expected to decline in the future.

Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored, sampled, and treated as process wastewater, when required. This wastewater would be monitored for radioactivity, and if uncontaminated, discharged to natural drainage channels or the playas.

The proposed location for the ceramic immobilization facility is in Zone 4. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 4, there would be no impacts to floodplains. However, flooding at Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system which obtains water from the Ogallala Aquifer. Construction water requirements for the ceramic immobilization facility would be small relative to the recoverable water in aquifer storage, which for the year 2010 was estimated to be 287 trillion l (75.8 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.3.2.1.4–1, construction of the facility would require 38 million l/yr (10 million gal/yr) of water, which represents approximately a 15.2-percent increase over the projected annual No Action groundwater usage. [Text deleted.] Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8-m/yr (5.9-ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the ceramic immobilization facility at Pantex would require 320 million l/yr (84.5 million gal/yr), which represents approximately a 129-percent increase over the projected annual No Action groundwater usage and 16.9 percent of the capacity of the groundwater system. The small additional drawdown attributed to this additional withdrawal would add to the declining groundwater levels in the area thus decreasing regional availability. The total site groundwater withdrawal including this facility would be 569 million l/yr (150.3 million gal/yr) which because of expected cutbacks in other programs, would be 32 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged to the playas until contaminant levels are within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered include decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the ceramic immobilization facility would be provided by the Clinch River and its tributaries. Water required during construction would be approximately 38 million l/yr (10 million gal/yr) which would represent a 0.3-percent increase over the projected annual surface water withdrawal. This additional withdrawal would be approximately 0.0009 percent of the average flow of the Clinch River. During operation, water requirements would be approximately 320 million l/yr (84.5 million gal/yr) annually. This would represent a 2.2-percent increase over the projected annual surface water withdrawal. Including this increase, ORR's total annual withdrawal would be 0.4 percent of the average flow of the Clinch River (132 m^3/s [4,647 ft^3/s]). These additional water withdrawals from the Clinch River

would cause negligible impacts to surface water availability. [Text deleted.] During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (approximately 29.6 million l/yr [7.8 million gal/yr]) would be generated, treated, and discharged to the East Fork Poplar Creek and would represent a 1.3-percent increase in the amount being discharged. During operation, a total of 123.9 million l/yr (32.7 million gal/yr) of wastewater would be generated by the facility. This quantity would represent 0.3 percent of the average flow of East Fork Poplar Creek and a 5.4-percent increase in the amount of wastewater being discharged. All discharges would be monitored to comply with discharge requirements. No impacts are expected. Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored, sampled, and treated as process wastewater, when required. This wastewater would be monitored for radioactivity, and if uncontaminated, discharged to storm drains which discharge to local drainage channels.

The potential location for the ceramic immobilization facility would be located outside of the 100-year floodplain. The 500-year floodplain has not been determined in this area but could be developed in future studies.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water withdrawals would be made; groundwater would be used for all construction and operational needs of the ceramic immobilization facility. [Text deleted.] During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (approximately 29.6 million l/yr [7.8 million gal/yr]), would be generated and discharged to the sitewide wastewater treatment system which would not require any modifications. This wastewater would represent a 4.2-percent increase in the effluent from the site. During operation, approximately 123.9 million l/yr (32.7 million gal/yr) of sanitary wastewater would be discharged to this wastewater treatment system. This would represent a 17.7-percent increase in the projected effluent discharged to Fourmile Branch from this facility. This additional quantity would represent approximately 2.5 percent of Fourmile Branch's minimum flow. All discharges would be monitored to comply with discharge requirements. [Text deleted.] Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored for radioactivity, and if uncontaminated, discharged to storm drains which discharge to local drainage channels. If contaminated, this wastewater would then be transferred by pipeline or tanker to treatment facilities as required.

The potential location of the ceramic immobilization facility is outside the 100-year floodplain. Information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas. However, the ceramic immobilization facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek because the facility would be located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about 58 m^3/s (2,040 ft^3/s). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 63 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately 5 m^3/s (186 ft^3/s), and an elevation of about 61 m (199 ft) above MSL (SR USGS 1996a:1). Elevations of the buildings in F-Area are more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr) which would represent less than a 0.3-percent increase over the projected annual No Action groundwater withdrawal. This additional withdrawal should cause negligible impacts to groundwater availability. During operation, water used for cooling system makeup would be obtained from existing supply systems in the F-Area. The water for these systems is groundwater from the Cretaceous aquifer. The total annual water requirements during operations would be 320 million l/yr (84.5 million gal/yr). As shown in Table 4.3.3.2.1.4–1, this would represent a 2.4-percent increase in the projected No Action groundwater usage at SRS. These additional water withdrawals from groundwater would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals up to 6 times greater than that required for the ceramic immobilization facilities from the Cretaceous aquifer indicate drawdown of almost 2.1 m (6.9 ft) at the well head, but smaller in overlying aquifers and not beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that the withdrawals attributed to these facilities would cause a small drawdown at the well head and would not impact aquifers in the area. No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

[Text deleted.]

4.3.3.2.1.5 *Geology and Soils*

This section describes the environmental impacts to the geologic and soils resource as related to the construction and operation of the ceramic immobilization facility. A ceramic immobilization facility, at any of the sites analyzed, would involve some ground-disturbing construction activities (28.3 ha [70 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rainfall) is greater at ORR and SRS than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities nor site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to the greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction (foundation preparation) and activities associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increased wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvements (buildings, roads and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal. Indirect effects to the soil resource from infrastructure improvements would have a similar impact on the soil profile and erosion potential.

[Text deleted.]

4.3.3.2.1.6 *Biological Resources*

Construction of the ceramic immobilization facility would require 28.3 ha (70 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be considered, as well as areas used for construction laydown. Consultation with USFWS and State agencies would be conducted in conjunction with the site-specific level of NEPA review, as appropriate, to avoid potential impacts to threatened and endangered species.

Hanford Site

It is assumed that the ceramic immobilization facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility would result in the disturbance of terrestrial habitat equaling about 0.02 percent of Hanford. This includes areas on which plant facilities would be constructed as well as areas that would be revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the ceramic immobilization facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a ceramic immobilization facility at Hanford would not impact aquatic resources since there are no surface water bodies near the assumed facility location. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entrainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the ceramic immobilization facility; however, sagebrush

habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the existence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the ceramic immobilization facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at NTS would result in the disturbance of terrestrial resources equaling about 0.008 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the ceramic immobilization facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the ceramic immobilization facility at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicle traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training; putting restrictions on vehicle speeds and off-road movement; conducting clearance surveys before surface disturbance; approving stop work authority if tortoises are found within work areas; removing tortoises from roadways and work areas; placing permanent and temporary tortoise-proof fencing around trenches, landfills, and treatment ponds; inspecting trenches; and having biologists survey when heavy equipment is in use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the ceramic immobilization facility.

[Text deleted.] Any listed plant species located within the construction area would be lost during land-clearing activities (Table 3.3.6–1). Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicular traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the ceramic immobilization facility (Section 4.3.3.2.1.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

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It is assumed that the ceramic immobilization facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to smaller mammals and some birds and reptiles which could be displaced or suffer mortality. Larger mammals are excluded from the assumed site by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources on the assumed facility location, these resources would not be affected by construction or operation of the ceramic immobilization facility. Since the facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected since they are not present at the ICPP.

Pantex Plant

It is assumed that the ceramic immobilization facility would be located within Zone 4 which is a developed area with minimal natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the site; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the ceramic immobilization facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to a minor increase in open water near the outfall, as well as a change in plant species composition. No federally listed threatened or endangered species would be likely affected by construction or operation of the ceramic immobilization facility. Although the assumed site has been disturbed, it is possible that the State-listed Texas horned lizard could be present. Preactivity surveys would be conducted as appropriate before construction.

Oak Ridge Reservation

It is assumed that the ceramic immobilization facility would be located about 3 km (2 mi) east of the K–25 area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at ORR would result in the disturbance of terrestrial habitat equaling about 0.2 percent of ORR. Vegetation within the area to be developed would be destroyed during land clearing. Vegetation cover within the assumed site is predominantly oak-hickory forest or pine and pine-hardwood forest (Figure 3.6.6–1). While both types would be affected by construction, it is likely that a greater area of pine and pine-hardwood forests would be removed. This type of forest is more heavily concentrated in valleys where most of the development would occur. Oak-hickory forests are typically found on ridges. Both forest types are common throughout ORR and within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals within the proposed project area, such as amphibians, reptiles, and smaller mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds before construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediment control measures would control secondary impacts. Since an existing intake structure would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River. However, a new wastewater discharge structure could be required on East Fork Poplar Creek. Depending on its location, this structure could displace some wetlands along the creek. Any unavoidable impact to wetlands would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with the requirements of a COE permit.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impact on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the ceramic immobilization facility could cause water quality changes (primarily sediment loading and resulting turbidity) to Bear Creek, Grassy Creek, or Ish Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since a new intake structure would not be required, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little affect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river.

During construction and operation, wastewater would be discharged to East Fork Poplar Creek. This could require the construction of a new discharge structure which would temporarily disturb aquatic habitat on the vicinity of the outfall. The small volume of wastewater discharged to the stream would not be expected to impact aquatic resources during either construction or operation. In addition, NPDES-permit requirements would be met. [Text deleted.]

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the ceramic immobilization facility. [Text deleted.] Land clearing activities may destroy State protected plant species found within or adjacent to disturbed portions of the proposed site including pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily and golden seal. The Tennessee dace is sensitive to siltation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Ish Creek or Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as

appropriate before construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility. [Text deleted.]

Savannah River Site

It is assumed that the ceramic immobilization facility would be constructed within the F-Area, which is one of the highly developed industrial areas of SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since water would be taken from existing sources and discharged via NPDES-permitted outflows and would involve minor volumes. Construction and operation of the ceramic immobilization facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the facility that this species would not be directly affected by this action.

4.3.3.2.1.7 *Cultural and Paleontological Resources*

This section discusses construction and operational impacts to cultural and paleontological resources that may result from the ceramic immobilization facility at each of the representative sites analyzed. The total land disturbed for this facility is 28.3 ha (70 acres) during construction of which 18.2 ha (45 acres) would be used during operation. [Text deleted.] For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through additional surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The ceramic immobilization facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction, but not operation, of the facility.

The CGTO has conducted surveys over portions of Frenchman Flat and has identified at least 20 plant species of importance to Native Americans there. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from facility construction and operation. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space or ceremonial space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

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The facility would be constructed within the existing ICPP security area. No sites have been identified through surface surveys of the area. Because the ICPP is developed and disturbed, it is unlikely to contain subsurface

cultural deposits. Impacts to NRHP-eligible sites are not anticipated during construction or operation of the facility.

Some Native American resources such as traditional use areas and sacred space may be affected by the construction of the facility. For example, construction and operation could create auditory or visual impacts to important Native American resources in the vicinity. Resources would be identified through consultation with the potentially affected tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River Floodplain which have produced fossilized remains. Operation would not have an additional effect on these resources.

Pantex Plant

The ceramic immobilization facility would be constructed in Zone 4 of Pantex. A historic buildings survey was conducted in Zone 4 to identify significant World War II Era structures and none of the buildings there are considered NRHP eligible on that basis. [Text deleted.] Archaeological surveys would be conducted on any unsurveyed areas that would be affected by construction prior to ground-breaking activities. Because the area is developed and disturbed, it is unlikely to contain NRHP-eligible archaeological resources. Recorded prehistoric site types at Pantex include lithic scatters, hunting/kill sites, and concentrations of fire-cracked rock. Sites are located predominantly near the playas. Historic sites are generally associated with farming, such as remains of homes and outbuildings as well as World War II and Cold War Era structures. Resources such as these may occur on the land to be disturbed during construction. Operation would not result in any additional impact to prehistoric or historic resources.

DOE has initiated a public outreach program at Pantex to involve Native American groups in decisionmaking related to land use and cultural resources. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any sacred sites, ceremonial areas, or cemeteries near Zone 4. Additional consultation may identify some of these resources. Resources such as cemeteries could be affected by new construction. Operation could have an auditory or visual impact on sacred or ceremonial sites.

Important paleontological remains such as bison and camel bones have been found in other areas of the High Plains and it is possible that some may occur in lands to be disturbed by construction at Pantex. Operation would not have an additional effect on these resources.

Oak Ridge Reservation

This facility would be constructed at the intersection of Route 95 and Bear Creek Road. A portion of the proposed project area on both sides of Bear Creek Road was surveyed in association with the proposed Exxon Nuclear Facility, which was never built (OR UTN 1975a:ii). Some prehistoric sites were identified near the Clinch River, and the potential for sites along the smaller creeks exists. In addition, remains of a number of 20th-century frame houses and mid-to-late 19th century log houses and outbuildings are located within the project area. Survey work would be conducted prior to construction on any unsurveyed lands to be affected by construction. Prehistoric site types that are known to occur at ORR include remains of prehistoric villages, burial grounds, quarries and lithic workshops, and shell scatters. Historic resources may include standing structures, as well as remains of dwellings, road traces, cemeteries, and trash scatters. Resources such as these may occur in the area and may be affected by construction, but not operation, of the facility.

Some Native American resources may be affected by construction and operation of the facility. These resources, should any exist, would be identified through consultation with the potentially affected tribes. For example, construction could affect traditionally used plant and animal species. Operation may result in reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Fossilized remains occur at ORR. Some of these may exist in areas to be disturbed during construction. However, any impacts would be considered negligible because the fossil assemblages at ORR consist of common invertebrates with low research potential. Operation would not affect paleontological remains.

Savannah River Site

The ceramic immobilization facility would be located in open space within F-Area. Portions of F-Area have been surveyed and contain sites potentially eligible for the NRHP. Additional surveys would be conducted in unsurveyed areas to be disturbed by construction. Site types known to occur at SRS include remains of prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by construction but not operation.

Some Native American resources may be affected by the proposed action. Construction may affect resources such as prehistoric sites, cemeteries, and traditional plants. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to the areas may also result from facility construction and operation. Any resources would be identified through consultation with the potentially affected tribes.

No scientifically valuable paleontological resources have been recorded at SRS to date. Facility construction and operation are not expected to have an effect on paleontological resources.

[Text deleted.]

4.3.3.2.1.8 *Socioeconomics*

This section analyzes the socioeconomic effects of the ceramic immobilization facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all of the candidate sites are found in the Supplemental Socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Constructing the ceramic immobilization facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 1,000 workers in the peak year of construction at any site. The largest increases in regional employment (about 1 percent) and regional per capita income (much less than 1 percent) would occur at INEL. A total of 2,030 new jobs (1,000 direct and 1,030 indirect) would be generated and regional unemployment would fall from 5.4 to 4.5 percent (Socio 1996a).

A workforce of 900 would be required during full operation at any site. Operating the facility would generate larger socioeconomic changes than would construction, due to the larger, more permanent workforce. Implementing the alternative at INEL would generate the largest increases in regional employment (about 2 percent) and in the per capita income (about 1 percent). A total of 3,314 new jobs (900 direct and 2,414 indirect) would be created by the operational activities, and regional unemployment would fall to 3.8 percent in the INEL REA (Socio 1996a).

Population and Housing. At all of the sites analyzed, except Pantex and INEL, construction employment requirements would be met by the available resident labor force. Some in-migrating workers would be needed to fill more specialized positions during operation at all of the sites analyzed. Project-related in-migration would produce the largest population increases in the INEL ROI during construction of the facility. Pantex, however, would require the largest number of in-migrating workers for operation. These population increases in either the INEL or Pantex ROI, however would be less than 1 percent above No Action.

Housing units, in excess of existing vacancies, would be required in the INEL and Pantex ROIs during construction of the project. Additional housing construction would also be required at all of the sites analyzed, except NTS, during operation to accommodate the in-migrating population. The greatest increase in housing requirements (less than 1 percent) during construction and operation would be in the INEL ROI. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at all of the analyzed sites. (Socio 1996a).

Community Services. During construction, only the Pantex and INEL ROIs would experience an increase in demand for community services. However, operation of the facility would slightly increase the demand for community services at all sites analyzed. The effects of population growth due to in-migrating workers during operation would be minor at all of the sites analyzed. The following discussion focuses on the INEL and Pantex ROIs which would experience the largest increases in demand for community services.

To maintain the student-to-teacher ratio of 18.5:1 in the INEL ROI, 18 additional teachers would be needed during construction of the facility. In the Pantex ROI, 22 additional teachers would be needed during operation to maintain the No Action student-to-teacher ratio of 16.3:1. These increases in teacher requirements, however, would be distributed over several school districts in the respective ROIs, and no single school district would be significantly affected (Socio 1996a).

To maintain No Action service levels of 1.6 police officers and 2.2 firefighters per 1,000 persons in the INEL ROI, two additional police officers and three new firefighters would be needed during construction. Two additional police officers and four additional firefighters at Pantex would be needed to maintain No Action levels of service of 2.3 police officers and 2.3 firefighters per 1,000 persons during operations (Socio 1996a).

Projected hospital occupancy rates would increase slightly over the No Action levels. However, projected capacity would be capable of accommodating these small increases in patient load. Only two additional physicians would be needed in the INEL ROI during construction and four physicians would be needed in the Pantex ROI during operation to maintain the No Action service level of 1.2 and 2.0 physicians per 1,000 persons, respectively (Socio 1996a).

Local Transportation. Traffic generated during construction of the immobilization facility would affect INEL and ORR local road segments. U.S. 20/26 between U.S. 26 East and Idaho State Route 22/33 near INEL would experience a drop in level of service from B to C. Tennessee State Route 62 from Tennessee State Route 95 at Oak Ridge to Tennessee State Route 170 would experience a significant increase in volume-to-capacity ratio and the level of service would remain F.

During the facility operations phase, INEL would experience a drop in level of service on one road segment. U.S. 20/26 between U.S. 26 East and Idaho State Route 22/33 near INEL would experience a drop in level of service from B to C. (Socio 1996a).

4.3.3.2.1.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the ceramic immobilization facility. The section first describes the impacts from normal facility operation at each potential site, followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation of the immobilization facility during the assumed 10-year campaign time are presented in Tables 4.3.3.2.1.9–1 and 4.3.3.2.1.9–2, respectively. [Text deleted.] Impacts from hazardous chemicals to these same groups are given in Table 4.3.3.2.1.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.3.3.2.1.9–4 through Table 4.3.3.2.1.9–9. Detailed results are presented in Section M.

Normal Operation. There would be no radiological releases during the construction of a ceramic immobilization facility at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the ceramic immobilization facility at each of the sites are presented in Table 4.3.3.2.1.9–1. The impacts from all site operations, including the ceramic immobilization facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses to the maximally exposed member of the public from annual ceramic immobilization facility operation range from 1.6×10^{-8} mrem at the NTS site to 5.9×10^{-7} mrem at the ORR site. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 8.0×10^{-14} to 3.0×10^{-12}. The impacts to the average individual would be less. As a result of annual facility operations, the population doses would range 3.3×10^{-8} person-rem at the NTS site to 1.2×10^{-5} person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 1.7×10^{-10} to 6.0×10^{-8}.

The doses to the maximally exposed member of the public from annual total site operations are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 6.1×10^{-5} mrem at Pantex to 3.2 mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.1×10^{-10} to 1.6×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population doses would be within the limit in proposed 10 CFR 834, and would range from 2.8×10^{-4} person-rem at Pantex to 44 person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 1.4×10^{-6} to 0.22.

Doses to onsite workers from normal operations are given in Table 4.3.3.2.1.9–2. Included are involved workers directly associated with the ceramic immobilization facility, workers who are not involved with the ceramic immobilization facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to ceramic immobilization facility workers is site-independent and would be 244 mrem to the average facility worker and 110 person-rem to the entire facility workforce. The annual dose to the average

Table 4.3.3.2.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]												
Atmospheric release pathway (mrem)	3.2×10^{-8}	4.4×10^{-3}	1.6×10^{-8}	4.2×10^{-3}	2.0×10^{-8}	0.018	2.5×10^{-7}	6.1×10^{-5}	5.9×10^{-7}	1.5	1.8×10^{-7}	0.42
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0	0.10	0	0.081
Total liquid release pathway (mrem)	0	9.5×10^{-4}	0	0	0	0	0	0	0	1.7	0	0.37
Atmospheric and liquid release pathways combined (mrem)	3.2×10^{-8}	5.3×10^{-3}	1.6×10^{-8}	4.2×10^{-3}	2.0×10^{-8}	0.018	2.5×10^{-7}	6.1×10^{-5}	5.9×10^{-7}	3.2	1.8×10^{-7}	0.79
Percent of natural background[c]	1.1×10^{-8}	1.8×10^{-3}	5.1×10^{-9}	1.3×10^{-3}	5.9×10^{-9}	5.2×10^{-3}	7.5×10^{-8}	1.8×10^{-5}	2.0×10^{-7}	1.1	6.0×10^{-8}	0.27
10-year fatal annual cancer risk	1.6×10^{-13}	2.7×10^{-8}	8.0×10^{-14}	2.1×10^{-8}	1.0×10^{-13}	8.9×10^{-8}	1.3×10^{-12}	3.1×10^{-10}	3.0×10^{-12}	1.6×10^{-5}	9.0×10^{-13}	4.0×10^{-6}
Annual Population Dose Within 80 Kilometers[d]												
Atmospheric release pathway (person-rem)	1.5×10^{-6}	0.46	3.3×10^{-8}	3.7×10^{-3}	2.3×10^{-7}	2.4	6.3×10^{-7}	2.8×10^{-4}	1.1×10^{-5}	29	1.2×10^{-5}	40
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6
Atmospheric and liquid release pathways combined (person-rem)	1.5×10^{-6}	1.6	3.3×10^{-8}	3.7×10^{-3}	2.3×10^{-7}	2.4	6.3×10^{-7}	2.8×10^{-4}	1.1×10^{-5}	34	1.2×10^{-5}	44
Percent of natural background[c]	8.0×10^{-10}	8.4×10^{-4}	3.6×10^{-10}	4.0×10^{-5}	2.5×10^{-10}	2.7×10^{-3}	5.4×10^{-10}	2.4×10^{-7}	2.9×10^{-9}	9.0×10^{-3}	4.5×10^{-9}	0.017
10-year fatal cancers	7.5×10^{-9}	7.8×10^{-3}	1.7×10^{-10}	1.9×10^{-5}	1.2×10^{-9}	0.012	3.2×10^{-9}	1.4×10^{-6}	5.5×10^{-8}	0.17	6.0×10^{-8}	0.22

Table 4.3.3.2.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Average Individual Within 80 Kilometers[c]												
Atmospheric and liquid release pathways combined (mrem)	2.4×10^{-9}	2.6×10^{-3}	1.1×10^{-9}	1.3×10^{-4}	8.6×10^{-10}	8.9×10^{-3}	1.8×10^{-9}	8.0×10^{-7}	8.6×10^{-9}	0.026	1.3×10^{-8}	0.049
10-year fatal cancer risk	1.2×10^{-14}	1.3×10^{-8}	5.6×10^{-15}	6.3×10^{-10}	4.3×10^{-15}	4.5×10^{-8}	9.0×10^{-15}	4.0×10^{-12}	4.3×10^{-14}	1.3×10^{-7}	6.7×10^{-14}	2.5×10^{-7}

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the maximally exposed individual may be different under No Action than for operation of the ceramic immobilization facility. Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from total site operations are: 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 rem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem.

[d] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[e] Obtained by dividing the population dose by the number of people projected to be living within 80 km (50 mi) of the site (621,000 at Hanford, 29,400 at NTS, 269,000 at INEL, 350,000 at Pantex, 1,285,000 at ORR, and 893,000 at SRS).

Source: Section M.2.

Table 4.3.3.2.1.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce[a]						
Average worker dose (mrem/yr)[b]	244	244	244	244	244	244
10-year risk of fatal cancer	9.8×10^{-4}	9.8×10^{-4}	9.8×10^{-4}	9.8×10^{-4}	9.8×10^{-4}	9.8×10^{-4}
Total dose (person-rem/yr)	110	110	110	110	110	110
10-year fatal cancers	0.44	0.44	0.44	0.44	0.44	0.44
Noninvolved Workforce[c]						
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	1.1×10^{-4}	2.0×10^{-5}	1.2×10^{-4}	4.0×10^{-5}	1.0×10^{-5}	1.3×10^{-4}
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	0.90
Total Site Workforce[d]						
Dose (person-rem/yr)	360	113	330	124	154	336
10-year fatal cancers	1.4	0.45	1.3	0.50	0.62	1.3

[a] The involved worker is a worker associated with operations of the ceramic immobilization facility.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is a worker onsite but not associated with operations of the ceramic immobilization facility. The noninvolved workforce is equivalent to the No Action workforce.

[d] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

noninvolved worker would range from 2.6 mrem at the ORR site to 32 mrem at the SRS site. The annual total dose to all noninvolved workers would range from 3.0 person-rem at NTS to 250 person-rem at the Hanford site. The annual dose to the total site workforces would range from 113 person-rem at NTS to 360 person-rem at Hanford. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.3.2.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation resources, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the ceramic immobilization without radionuclides facility at each of several sites are presented in Table 4.3.3.2.1.9–3. Included is the impact due only to operation of the ceramic immobilization facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI ranges from 2.3×10^{-4} at the NTS site to 9.1×10^{-3} at the ORR site due to the facility operation. The cancer risk from hazardous chemicals to the MEI is zero at all sites. The HI to the onsite worker ranges from 7.2×10^{-2} at Pantex to 0.15 at ORR, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals) at all sites.

Facility Accidents. A set of potential accidents have been postulated for a ceramic immobilization without radionuclides facility for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.3.2.1.9–4 through 4.3.3.2.1.9–9 for the sites analyzed (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 6.3×10^{-4} at ORR for the calciner feed criticality accident scenario with a probability of 1.0×10^{-5} per year. The corresponding 10 year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 6.3×10^{-8}, 2.9×10^{-10}, and 1.3×10^{-9}, respectively. The maximum population 10-year facility lifetime risk would be 6.3×10^{-8} (that is, one fatality in over 1 million years) at ORR for the calciner feed criticality accident scenario with a probability of 1.0×10^{-5} per year. The corresponding maximum offsite individual and worker 10 year facility lifetime risks would be 2.9×10^{-10} and 1.3×10^{-9}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.3.2.1.9–4 through 4.3.3.2.1.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE orders require detailed safety analyses to assure that facility designs and operation procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new ceramic immobilization facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is a possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

Table 4.3.3.2.1.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]
Maximally Exposed Individual (Public)												
Hazard Index[c]	1.6×10^{-3}	1.6×10^{-3}	2.3×10^{-4}	2.3×10^{-4}	3.3×10^{-3}	0.019	8.7×10^{-3}	0.014	9.1×10^{-3}	0.049	4.2×10^{-4}	5.6×10^{-3}
Cancer Risk[d]	0	0	0	0	0	3.6×10^{-6}	0	1.1×10^{-8}	0	0	0	1.3×10^{-7}
Worker Onsite												
Hazard Index[e]	0.14	0.14	0.074	0.074	0.14	0.37	0.072	0.078	0.15	0.30	0.13	1.3
Cancer Risk[f]	0	0	0	0	0	7.7×10^{-4}	0	4.5×10^{-7}	0	0	0	1.9×10^{-4}

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer Risk for MEI=(emissions concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor). Where there are no known carcinogens among the hazardous chemicals emitted, therefore the calculated cancer risk value is 0.

[e] Hazard Index for Workers=sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer Risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among the hazardous chemicals emitted, there are no Slope Factors, therefore the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4–41 through M.3.4–46.

Table 4.3.3.2.1.9–4. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	
Earthquake	2.3×10^{-13}	2.3×10^{-9}	2.3×10^{-15}	2.3×10^{-11}	1.6×10^{-11}	1.6×10^{-7}	1.0×10^{-5}
Glovebox fire	2.3×10^{-13}	2.3×10^{-9}	2.3×10^{-15}	2.3×10^{-11}	1.6×10^{-11}	1.6×10^{-7}	1.0×10^{-5}
Glovebox nuclear criticality	1.4×10^{-10}	1.4×10^{-6}	1.2×10^{-12}	1.2×10^{-8}	1.6×10^{-9}	1.6×10^{-5}	1.0×10^{-5}
Calciner feed tank nuclear criticality	1.4×10^{-9}	1.4×10^{-5}	1.2×10^{-11}	1.2×10^{-7}	1.6×10^{-8}	1.6×10^{-4}	1.0×10^{-5}
Ceramic can drop .	5.7×10^{-16}	5.7×10^{-14}	5.7×10^{-18}	5.7×10^{-16}	4.1×10^{-14}	4.1×10^{-12}	1.0×10^{-3}
Pellet container breakage	5.7×10^{-18}	5.7×10^{-16}	5.7×10^{-20}	5.7×10^{-18}	4.1×10^{-16}	4.1×10^{-14}	1.0×10^{-3}
Dissolver spill	1.4×10^{-15}	2.7×10^{-15}	1.4×10^{-17}	2.7×10^{-17}	1.0×10^{-13}	2.0×10^{-13}	0.05
Calciner feed spill	4.0×10^{-15}	7.9×10^{-15}	4.0×10^{-17}	7.9×10^{-17}	2.9×10^{-13}	5.8×10^{-13}	0.05
Calciner product spill	1.0×10^{-12}	2.0×10^{-12}	1.0×10^{-14}	2.0×10^{-14}	7.2×10^{-11}	1.4×10^{-10}	0.05
Sintering furnace explosion	3.4×10^{-13}	3.4×10^{-8}	3.4×10^{-15}	3.4×10^{-10}	2.5×10^{-11}	2.5×10^{-6}	1.0×10^{-6}
Uncontrolled chemical reaction	1.6×10^{-14}	1.6×10^{-9}	1.6×10^{-16}	1.6×10^{-11}	1.2×10^{-12}	1.2×10^{-7}	1.0×10^{-6}
Nuclear criticality	1.4×10^{-11}	1.4×10^{-6}	1.2×10^{-13}	1.2×10^{-8}	1.6×10^{-10}	1.6×10^{-5}	1.0×10^{-6}
Expected risk[d]	1.5×10^{-9}	—	1.3×10^{-11}	—	1.8×10^{-8}	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table 4.3.3.2.1.9–5. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	1.6×10^{-13}	1.6×10^{-9}	3.6×10^{-15}	3.6×10^{-11}	3.7×10^{-13}	3.7×10^{-9}	1.0×10^{-5}
Glovebox fire	1.6×10^{-13}	1.6×10^{-9}	3.6×10^{-15}	3.6×10^{-11}	3.7×10^{-13}	3.7×10^{-9}	1.0×10^{-5}
Glovebox nuclear criticality	1.0×10^{-10}	1.0×10^{-6}	2.3×10^{-12}	2.3×10^{-8}	3.3×10^{-11}	3.3×10^{-7}	1.0×10^{-5}
Calciner feed tank nuclear criticality	1.0×10^{-9}	1.0×10^{-5}	2.3×10^{-11}	2.3×10^{-7}	3.3×10^{-10}	3.3×10^{-6}	1.0×10^{-5}
Ceramic can drop	3.9×10^{-16}	3.9×10^{-14}	9.0×10^{-18}	9.0×10^{-16}	9.3×10^{-16}	3.3×10^{-14}	1.0×10^{-3}
Pellet container breakage	3.9×10^{-18}	3.9×10^{-16}	9.0×10^{-20}	9.0×10^{-18}	9.3×10^{-18}	9.3×10^{-16}	1.0×10^{-3}
Dissolver spill	9.3×10^{-16}	1.9×10^{-15}	2.2×10^{-17}	4.3×10^{-17}	2.2×10^{-15}	4.5×10^{-15}	0.05
Calciner feed spill	2.7×10^{-15}	5.4×10^{-15}	6.3×10^{-17}	1.3×10^{-16}	6.5×10^{-15}	1.3×10^{-14}	0.05
Calciner product spill	6.8×10^{-13}	1.4×10^{-12}	1.6×10^{-14}	3.1×10^{-14}	1.6×10^{-12}	3.3×10^{-12}	0.05
Sintering furnace explosion	2.3×10^{-13}	2.3×10^{-8}	5.4×10^{-15}	5.4×10^{-10}	5.6×10^{-13}	5.6×10^{-8}	1.0×10^{-6}
Uncontrolled chemical reaction	1.1×10^{-14}	1.1×10^{-9}	2.5×10^{-16}	2.5×10^{-11}	2.6×10^{-14}	2.6×10^{-9}	1.0×10^{-6}
Nuclear criticality	1.0×10^{-11}	1.0×10^{-6}	2.3×10^{-13}	2.3×10^{-8}	3.3×10^{-12}	3.3×10^{-7}	1.0×10^{-6}
Expected risk[d]	1.1×10^{-9}	—	2.5×10^{-11}	—	3.6×10^{-10}	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table 4.3.3.2.1.9–6. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	
Earthquake	2.1×10^{-13}	2.1×10^{-9}	2.3×10^{-15}	2.3×10^{-11}	4.9×10^{-12}	4.9×10^{-8}	1.0×10^{-5}
Glovebox fire	2.1×10^{-13}	2.1×10^{-9}	2.3×10^{-15}	2.3×10^{-11}	4.9×10^{-12}	4.9×10^{-8}	1.0×10^{-5}
Glovebox nuclear criticality	1.4×10^{-10}	1.4×10^{-6}	3.5×10^{-12}	1.3×10^{-8}	4.3×10^{-10}	4.3×10^{-6}	1.0×10^{-5}
Calciner feed tank nuclear criticality	1.4×10^{-9}	1.4×10^{-5}	1.3×10^{-11}	1.3×10^{-7}	4.3×10^{-9}	4.3×10^{-5}	1.0×10^{-5}
Ceramic can drop	5.3×10^{-16}	5.3×10^{-14}	5.7×10^{-18}	5.7×10^{-16}	1.2×10^{-14}	1.2×10^{-12}	1.0×10^{-3}
Pellet container breakage	5.3×10^{-18}	5.3×10^{-16}	5.7×10^{-20}	5.7×10^{-18}	1.2×10^{-16}	1.2×10^{-14}	1.0×10^{-3}
Dissolver spill	1.3×10^{-15}	2.5×10^{-15}	1.4×10^{-17}	2.8×10^{-17}	3.0×10^{-14}	5.9×10^{-14}	0.05
Calciner feed spill	3.7×10^{-15}	7.4×10^{-15}	4.0×10^{-17}	8.0×10^{-17}	8.7×10^{-14}	1.7×10^{-13}	0.05
Calciner product spill	9.3×10^{-13}	1.9×10^{-12}	1.0×10^{-14}	2.0×10^{-14}	2.2×10^{-11}	4.3×10^{-11}	0.05
Sintering furnace explosion	3.2×10^{-13}	3.2×10^{-8}	3.4×10^{-15}	3.4×10^{-10}	7.4×10^{-12}	7.4×10^{-7}	1.0×10^{-6}
Uncontrolled chemical reaction	1.5×10^{-14}	1.5×10^{-9}	1.6×10^{-16}	1.6×10^{-11}	3.5×10^{-13}	3.5×10^{-8}	1.0×10^{-6}
Nuclear criticality	1.4×10^{-11}	1.4×10^{-6}	1.3×10^{-13}	1.3×10^{-8}	4.3×10^{-11}	4.3×10^{-6}	1.0×10^{-6}
Expected risk[d]	1.5×10^{-9}	—	1.5×10^{-11}	—	4.8×10^{-9}	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table 4.3.3.2.1.9–7. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	9.1×10^{-14}	9.1×10^{-10}	2.6×10^{-14}	2.6×10^{-10}	5.6×10^{-12}	5.6×10^{-8}	1.0×10^{-5}
Glovebox fire	9.1×10^{-14}	9.1×10^{-10}	2.6×10^{-14}	2.6×10^{-10}	5.6×10^{-12}	5.6×10^{-8}	1.0×10^{-5}
Glovebox nuclear criticality	6.2×10^{-11}	6.2×10^{-7}	2.2×10^{-11}	2.2×10^{-7}	9.5×10^{-10}	9.5×10^{-6}	1.0×10^{-5}
Calciner feed tank nuclear criticality	6.2×10^{-10}	6.2×10^{-6}	2.2×10^{-10}	2.2×10^{-6}	9.5×10^{-9}	9.5×10^{-5}	1.0×10^{-5}
Ceramic can drop	2.3×10^{-16}	2.3×10^{-14}	6.6×10^{-17}	6.6×10^{-15}	1.4×10^{-14}	1.4×10^{-12}	1.0×10^{-3}
Pellet container breakage	2.3×10^{-18}	2.3×10^{-16}	6.6×10^{-19}	6.6×10^{-17}	1.4×10^{-16}	1.4×10^{-14}	1.0×10^{-3}
Dissolver spill	5.5×10^{-16}	1.1×10^{-15}	1.6×10^{-16}	3.2×10^{-16}	3.4×10^{-14}	6.7×10^{-14}	0.05
Calciner feed spill.	1.6×10^{-15}	3.2×10^{-15}	4.6×10^{-16}	9.2×10^{-16}	9.8×10^{-14}	2.0×10^{-13}	0.05
Calciner product spill	4.0×10^{-13}	8.0×10^{-13}	1.2×10^{-13}	2.3×10^{-13}	2.5×10^{-11}	4.9×10^{-11}	0.05
Sintering furnace explosion	1.4×10^{-13}	1.4×10^{-8}	4.0×10^{-14}	4.0×10^{-9}	8.5×10^{-12}	8.5×10^{-7}	1.0×10^{-6}
Uncontrolled chemical reaction	6.4×10^{-15}	6.4×10^{-10}	1.9×10^{-15}	1.9×10^{-10}	3.9×10^{-13}	3.9×10^{-8}	1.0×10^{-6}
Nuclear criticality	6.2×10^{-12}	6.2×10^{-7}	2.2×10^{-12}	2.2×10^{-7}	9.5×10^{-11}	9.5×10^{-6}	1.0×10^{-6}
Expected risk[d]	6.9×10^{-10}	—	2.4×10^{-10}	—	1.1×10^{-8}	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table 4.3.3.2.1.9–8. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	
Earthquake	2.1×10^{-13}	2.1×10^{-9}	4.6×10^{-14}	4.6×10^{-10}	4.0×10^{-11}	4.0×10^{-7}	1.0×10^{-5}
Glovebox fire	2.1×10^{-13}	2.1×10^{-9}	4.6×10^{-14}	4.6×10^{-10}	4.0×10^{-11}	4.0×10^{-7}	1.0×10^{-5}
Glovebox nuclear criticality	1.3×10^{-10}	1.3×10^{-6}	2.9×10^{-11}	2.9×10^{-7}	6.3×10^{-9}	6.3×10^{-5}	1.0×10^{-5}
Calciner feed tank nuclear criticality	1.3×10^{-9}	1.3×10^{-5}	2.9×10^{-10}	2.9×10^{-6}	6.3×10^{-8}	6.3×10^{-4}	1.0×10^{-5}
Ceramic can drop	5.3×10^{-16}	5.3×10^{-14}	1.2×10^{-16}	1.2×10^{-14}	1.0×10^{-13}	1.0×10^{-11}	1.0×10^{-3}
Pellet container breakage	5.3×10^{-18}	5.3×10^{-16}	1.2×10^{-18}	1.2×10^{-16}	1.0×10^{-15}	1.0×10^{-13}	1.0×10^{-3}
Dissolver spill	1.3×10^{-15}	2.5×10^{-15}	2.8×10^{-16}	5.5×10^{-16}	2.4×10^{-13}	4.8×10^{-13}	0.05
Calciner feed spill	3.7×10^{-15}	7.3×10^{-15}	8.1×10^{-16}	1.6×10^{-15}	7.0×10^{-13}	1.4×10^{-12}	0.05
Calciner product spill	9.2×10^{-13}	1.8×10^{-12}	2.0×10^{-13}	4.0×10^{-13}	1.7×10^{-10}	3.5×10^{-10}	0.05
Sintering furnace explosion	3.2×10^{-13}	3.2×10^{-8}	6.9×10^{-14}	6.9×10^{-9}	6.0×10^{-11}	6.0×10^{-6}	1.0×10^{-6}
Uncontrolled chemical reaction	1.5×10^{-14}	1.5×10^{-9}	3.2×10^{-15}	3.2×10^{-10}	2.8×10^{-12}	2.8×10^{-7}	1.0×10^{-6}
Nuclear criticality	1.3×10^{-11}	1.3×10^{-6}	2.9×10^{-12}	2.9×10^{-7}	6.3×10^{-10}	6.3×10^{-5}	1.0×10^{-6}
Expected risk[d]	1.4×10^{-9}	—	3.2×10^{-10}	—	7.0×10^{-8}	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table 4.3.3.2.1.9–9. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Savannah River Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	
Earthquake	1.5×10^{-13}	1.5×10^{-9}	3.6×10^{-15}	3.6×10^{-11}	1.8×10^{-11}	1.8×10^{-7}	1.0×10^{-5}
Glovebox fire	1.5×10^{-13}	1.5×10^{-9}	3.6×10^{-15}	3.6×10^{-11}	1.8×10^{-11}	1.8×10^{-7}	1.0×10^{-5}
Glovebox nuclear criticality	9.1×10^{-11}	9.1×10^{-7}	2.0×10^{-12}	2.0×10^{-8}	2.0×10^{-9}	2.0×10^{-5}	1.0×10^{-5}
Calciner feed tank nuclear criticality	9.1×10^{-10}	9.1×10^{-6}	2.0×10^{-11}	2.0×10^{-7}	2.0×10^{-8}	2.0×10^{-4}	1.0×10^{-5}
Ceramic can drop	3.7×10^{-16}	3.7×10^{-14}	9.1×10^{-18}	9.1×10^{-16}	4.4×10^{-14}	4.4×10^{-12}	1.0×10^{-3}
Pellet container breakage	3.7×10^{-18}	3.7×10^{-16}	9.1×10^{-20}	9.1×10^{-18}	4.4×10^{-16}	4.4×10^{-14}	1.0×10^{-3}
Dissolver spill	8.9×10^{-16}	1.8×10^{-15}	2.2×10^{-17}	4.4×10^{-17}	1.1×10^{-13}	2.1×10^{-13}	0.05
Calciner feed spill	2.6×10^{-15}	5.2×10^{-15}	6.4×10^{-17}	1.3×10^{-16}	3.1×10^{-13}	6.2×10^{-13}	0.05
Calciner product spill	6.5×10^{-13}	1.3×10^{-12}	1.6×10^{-14}	3.2×10^{-14}	7.8×10^{-11}	1.6×10^{-10}	0.05
Sintering furnace explosion	2.2×10^{-13}	2.2×10^{-8}	5.5×10^{-15}	5.5×10^{-10}	2.7×10^{-11}	2.7×10^{-6}	1.0×10^{-6}
Uncontrolled chemical reaction	1.0×10^{-14}	1.0×10^{-9}	2.6×10^{-16}	2.6×10^{-11}	1.2×10^{-12}	1.2×10^{-7}	1.0×10^{-6}
Nuclear criticality	9.1×10^{-12}	9.1×10^{-7}	2.0×10^{-13}	2.0×10^{-8}	2.0×10^{-10}	2.0×10^{-5}	1.0×10^{-6}
Expected risk[d]	1.0×10^{-9}	—	2.2×10^{-11}	—	2.3×10^{-8}	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

An indication of the magnitude of the impacts of an aircraft crash into a ceramic immobilization facility is given by the earthquake scenario. The earthquake and aircraft scenarios are similar in that they both result in major structural damage and the release of plutonium directly to the environment. They differ in that an earthquake induced fire is based on limited combustible materials while the aircraft crash has the potential for a major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive fatal injuries.

[Text deleted.]

4.3.3.2.1.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of a ceramic immobilization facility. There is no spent nuclear fuel or HLW associated with the operation of the ceramic immobilization facility; however, the facility does generate as its output product a stabilized coated ceramic pellet form that would require interim storage with final disposal at the deep borehole complex whose impacts are outlined in Section 4.3.3.2.2.10. The ceramic immobilization facility would provide the necessary storage of the immobilized Pu in ceramic form until its disposal in the deep borehole complex. Table 4.3.3.2.1.10–1 provides the estimated operational waste volumes projected to be generated as a result of the ceramic immobilization facility at the sites analyzed. Facilities that would support the ceramic immobilization facility would treat and package all generated waste into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste disposed of, onsite or at regionalized or centralized DOE sites. For the purposes of analysis only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the ceramic immobilization facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.3. A detailed description of the waste management activities that would be required to support the ceramic immobilization facility can also be found in Section E.3.3.3.

Construction and operation of a ceramic immobilization facility would impact existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

The conceptual design of the ceramic immobilization facility using coated pellets includes a radioactive liquid waste treatment facility which would be required to treat the 110 m^3 (30,000 gal) of liquid TRU waste. Approximately 150 m^3 (200 yd^3) of TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and solidified sludge from liquid TRU waste treatment would require treatment and repackaging to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the ceramic immobilization facility if sited at ORR, Pantex, and NTS. A small quantity 1.5 m^3 (2 yd^3) of mixed TRU waste would require processing and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), 18 additional truck shipments per year, or if applicable, 9 regular train shipments per year or 3 dedicated train shipments per year would be required.

The radioactive liquid waste treatment facility would also treat the 10 m^3 (2,700 gal) of liquid LLW from infrequent container decontamination, laboratory solutions, and scrubber solutions from stacks and exhaust systems. Following treatment and volume reduction, approximately 15 m^3 (20 yd^3) of LLW from solidified liquid LLW, protective clothing, soil, and small equipment would require disposal. Except for disposal, all of

Table 4.3.3.2.1.10–1. Estimated Annual Generated Waste Volumes for Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative[a]

Category	New Facility (m^3)	Hanford No Action (m^3)	NTS No Action (m^3)	INEL No Action (m^3)	Pantex No Action (m^3)	ORR No Action (m^3)	SRS No Action (m^3)
Transuranic							
Liquid	110[b]	None	None	None	None	None	None
Solid	150	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	1.5	98	None	Included in TRU	None	None	Included in TRU
Low-level							
Liquid	10[b]	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	23	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-level							
Liquid	0	3,760	None	4	4	87,600	1,330
Solid	0.3	1,505	50	170	46	432	7,700
Hazardous							
Liquid	45	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	23	560	212	1,200	31	26	15,100
Nonhazardous (Sanitary)							
Liquid	43,000	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	910	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	186,900	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	15[c]	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

[a] The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1. Incremental waste generation volumes for the ceramic immobilization facility were derived from Table E.3.3.3–1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.3.3–1.

[b] Liquid TRU and LLW would be treated and solidified prior to disposal.

[c] Recyclable wastes.

the sites analyzed have existing or planned facilities that could manage the small quantities of LLW. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.004 ha/yr (0.01 acres/yr) at Hanford and ORR, 0.003 ha/yr (0.006 acres/yr) at NTS and INEL, and 0.002 ha/yr (0.004 acres/yr) at SRS. With no onsite LLW disposal capability, Pantex would require one additional LLW shipment per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

A small quantity (0.3 m^3 [0.4 yd^3]) of solid mixed LLW consisting of contaminated solvent rags and equipment that have been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party Agreement for Hanford and the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

An estimated 45 m^3 (12,000 gal) of liquid and 23 m^3 (30 yd^3) of solid hazardous wastes would be generated. Hazardous waste would consist primarily of analytical solutions and solvent rags contaminated with methylene chloride, acetonitrile, and acetone. Other hazardous waste would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous waste would be stored in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately 43,000 m^3 (11,500,000 gal) of liquid nonhazardous sanitary and industrial wastewater and 186,900 m^3 (49,500,000 gal) of steam plant blowdown, process wastewater, and estimated stormwater runoff would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required. The 910 m^3 (1,200 yd^3) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.3.2.2 *Deep Borehole Complex*

The environmental impacts described in the following sections are based on the analysis of the deep borehole complex for the Immobilization Disposition Alternative as described in Section 2.4.3.2.2. Environmental impacts for this facility are described in the context of a generic range of conditions that could exist at potential locations.

4.3.3.2.2.1 *Land Resources*

The deep borehole complex would disturb 63 ha (156 acres) of land during construction, of which 57 ha (141 acres) would be used during operation. The facility would be sited within a 1.6-km (1-mi) buffer zone for a total land requirement of 2,041 ha (5,044 acres). However, the potential site could range up to 20,000 ha (49,420 acres) of land area. If the borehole site were located on privately owned land, it would likely require the low to middle range of land area. If the site were located on publicly owned land (Federal, State, or local), the borehole could be part of a much larger site and could require the upper range of land area. Because no site has been identified for analysis, impacts to land use and visual resources cannot be determined at this time. If this alternative is selected, a siting study would be conducted in support of NEPA tiered documentation.

4.3.3.2.2.2 *Site Infrastructure*

Implementation of the alternative for immobilization of Pu with emplacement into a deep borehole requires construction and operation of both a stand-alone borehole complex and a ceramic immobilization facility. The ceramic immobilization facility impacts are previously shown in Section 4.3.3.2.1.2.

Since no actual sites for a deep borehole complex have been considered, the site infrastructure impact analysis for constructing, operating, and post-closure monitoring of the borehole complex compares the borehole requirements shown in the appendices, with the generic borehole site described in Section 3.9.2. Upon completion of the Pu disposition mission, only a concrete cap would remain on the surface of the borehole.

The region's utility and transportation infrastructure must be extended to support the facilities and operations of this proposed borehole complex. Connection of the borehole complex to the nearest existing electrical utility via high-voltage transmission lines may require construction of additional transmission lines and obtaining rights-of-way. The additional 6,100 MWh electrical requirement for the entire borehole complex would not have a noticeable effect on a sub-regional electrical power pool. Since emergency power would be provided by diesel generators located in the facility utility area, there would be no additional impact to the electrical pool during emergencies.

Impacts from construction of the deep borehole facility using standard construction practices for the surface facilities and transportation links are similar to those of the deep borehole complex for Direct Disposition Alternative shown in Section 4.3.3.1.2. As in Section 4.3.3.1.2, the greatest surface effects from subsurface borehole construction/drilling would be caused by the surface retention areas, which would contain all material removed during drilling operations. The total amount of utility and material resources consumed during the construction period, assuming 1.6 km (1 mi) of roads, is shown in Table 4.3.3.2.2.2–1.

Table 4.3.3.2.2.2–1. Additional Site Infrastructure Needed for the Construction of the Deep Borehole Complex—Immobilized Disposition Alternative (Annual)

Resource	Construction Requirement	Range of Resource Availability
Electrical	567 MWh	6,500 to 12,000 MWh
Oil	2,000,000 l	0 to 100 million l
Natural gas	0	0 to 5 million m^3
Coal	0	0 to 200,000 t

Source: LLNL 1996h.

Since the lower end of the range of resources available generally exceeds the annualized construction requirement, there would be minimal impact due to construction of the borehole complex.

Operations at the surface processing facilities require electrical power, compressed air, and water. Emplacing-borehole sealing and drilling facilities require process water, process water waste treatment, and electrical power. The resulting site infrastructure changes required to operate the deep borehole complex for disposal of immobilized forms during normal operations are shown in Table 4.3.3.2.2.2–2. The range of available resources was previously described in Section 3.9.2. The additional 6,100 MWh electrical requirement to operate the entire borehole complex for a year would have no measurable impact on any of the sub-regional power pools in the contiguous 48 states. Fuel and transportation requirements present no measurable impacts. Since oil and natural gas availability is governed by usage, the additional oil and natural gas could be procured.

During the post-closure period, the borehole array area of 25 ha (62 acres) would be declared a limited access area indefinitely, and a 1.6-km (1-mi) buffer zone of 1,358 ha (3,355 acres) may also be declared off-limits. The disturbed area remaining after decommissioning would be the 15x15 m (50x50 ft) concrete security and water anti-infiltration caps installed above the borehole array, assumed to be four holes. Even though the borehole

Table 4.3.3.2.2.2–2. Additional Site Infrastructure Needed for the Operation of the Deep Borehole Complex—Immobilized Disposition Alternative (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	1.6	1.6	6,100	2	773,280	4,810,000	0
Range of resource availability	0 to 60	0 to 20	6,500 to 12,000	2 to 1,000	0 to 100 million	0 to 5 million	0 to 200,000
Amount required in excess to low-end range of available resources	1.6	1.6	0	0	773,280	4,810,000	0

Source: LLNL 1996h.

would be designated as limited access, there are minimal continuing requirements or effects above ground. These minimal requirements include surveillance and groundwater monitoring. Surveillance could be accomplished from a remote location without impact at the site. Groundwater monitoring could be done from locations at various distances from the site. There would be a continuing infrastructure impact directly at the site in that any future land use requiring excavation or mining operations would be restricted in perpetuity. Such restrictions could be institutionalized through construction of drilling barriers and installing a variety of permanent markers.

4.3.3.2.2.3 *Air Quality and Noise*

Construction and operation of the deep borehole complex would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal standards. Impacts for radiological airborne emissions are discussed in Section 4.3.3.2.2.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for this facility are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants for the generic sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected the site will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of the deep borehole complex are presented in Table F.1.3–8. Air pollutant emissions sources associated with operations include the following:

- Operation of boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]

During operation, impacts with respect to the concentrations of criteria and toxic/hazardous air pollutants are expected to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for operation of this facility plus the No Action concentrations are presented in Table 4.3.3.2.2.3–1.

NOISE

The location of the facilities associated with the deep borehole complex relative to the site boundary and sensitive receptors was examined to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Non-traffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, material handling equipment, drilling rigs, pumps, and generators. These noise sources are assumed to

Table 4.3.3.2.2.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Deep Borehole Complex and No Action Alternative—Immobilized Disposition Alternative

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Generic Site ($\mu g/m^3$)[b]
Criteria Pollutants			
Carbon monoxide	8-hour	10,000	72.20
	1-hour	40,000	103.10
Lead	Calendar Quarter	1.5	[c]
Nitrogen dioxide	Annual	100	28.78
Ozone	1-hour	235	[d]
Particulate matter less than or equal to 10 microns in diameter	Annual	50	10.41
	24-hour	150	41.64
Sulfur dioxide	Annual	80	2.57
	24-hour	365	10.28
	3-hour	1,300	23.13
Hazardous and Other Toxic Compounds[e]			
[Text deleted.]			

[a] The Federal standards are presented.

[b] The concentration represents the alternative contribution only. No Action concentrations at a generic site cannot be determined since there is a range of possible pollutants and conditions that could be found at a potential site.

[c] No sources of this pollutant have been identified.

[d] Ozone, as a criteria pollutant, is not directly emitted or monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

[e] Emissions of unspecified hydrocarbons were not modeled.

Note: Concentrations are based on site contribution and do not include the contribution from non-facility sources.

Source: 40 CFR 50; LLNL 1996h.

be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. It is assumed that due to the size of the sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

4.3.3.2.2.4 *Water Resources*

Water usage and wastewater generated differ slightly between the two deep borehole alternatives. However, these differences should not cause any additional impacts to those described in Section 4.3.3.1.4. Water resource data for immobilization to a deep borehole facility are slightly less than the impacts shown in Table 4.3.3.1.4–1.

In general, ceramic immobilization would aid in preventing/delaying the emplaced materials from interacting with the subsurface environment (that is, being dissolved by the brine at depth). These interactions were described in Section 4.3.3.1.4.

[Text deleted.]

4.3.3.2.2.5 *Geology and Soils*

The deep borehole complex area disturbed during construction activities for this alternative would be 63 ha (156 acres). The deep borehole complex represents an irreversible commitment because wastes in below-ground area could not be completely removed, nor could the site be feasibly used for any other purposes following closure of the facility. This land would be perpetually unusable because the substrata would not be suitable for potentially intrusive facilities such as mining, utilities, or building foundations. Because no site has been identified for analysis, impacts to geologic and soil resources cannot be determined at this time.

The identification and acceptance of a site location would require extensive site characterization to ensure that the primary objective of the deep borehole complex, isolation from the biosphere, would be met. A site study would be conducted in support of the tiered NEPA documentation.

4.3.3.2.2.6 *Biological Resources*

Potential impacts to biological resources described for direct disposition in a deep borehole complex described in Section 4.3.3.1.6 would also apply to the disposal of immobilized Pu in a deep borehole complex. Both borehole complexes would require the same amount of land and would be subject to the same siting criteria.

4.3.3.2.2.7 *Cultural and Paleontological Resources*

The construction of the deep borehole complex would disturb approximately 63 ha (156 acres) of land. The operational land requirement is 2,041 ha (5,044 acres), which includes a 1.6-km (1-mile) buffer zone. The actual facility requires 57 ha (141 acres) during operation. In addition, approximately 1.6 km (1 mi) each of road or railway would also be constructed. No specific site has been proposed for this alternative. Impacts to cultural and paleontological resources would be addressed in tiered NEPA documents as appropriate. A siting study would be conducted in support of tiered NEPA documentation.

Prehistoric and historic resources that may be NRHP-eligible would be identified through additional surveys. Specific concerns about the presence, type, and location of Native American resources would be addressed through consultation with the potentially affected tribes in accordance with the NHPA, the *Native American Graves Protection and Repatriation Act*, and the *American Indian Religious Freedom Act*. Therefore, it is not possible to determine potential effects on cultural and paleontological resources.

4.3.3.2.2.8 *Socioeconomics*

The deep borehole complex for the Immobilized Disposition Alternative is similar to the deep borehole complex for the Direct Disposition Alternative. The only difference between the two alternatives with respect to socioeconomic effects is in the number of construction and operation workers required. The Immobilization Disposition Alternative would require 810 construction and 280 operation workers versus 870 construction and 342 operation workers needed for the Direct Disposition Alternative. Thus, the socioeconomics effects for this alternative would be slightly less than the Direct Disposition Alternative because fewer workers would be required and any population growth resulting from in-migrating workers and associated effects on the ROI would be smaller. For a detailed discussion of the socioeconomic effects of constructing and operating a deep borehole complex, see Section 4.3.3.1.8.

4.3.3.2.2.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with disposal of immobilized Pu in a deep borehole complex. The section first describes the impacts from normal operation at the generic site, followed by a description of impacts from facility accidents.

For the public, the analysis includes an annual dose and cumulative risk to the maximally exposed individual, population, and average individual within 80 km (50 mi). For workers, the analysis includes an annual dose and cumulative risk to an average individual worker and total involved and noninvolved workforce. The health effects were derived from data for representative DOE sites described in Sections 3.2 through 3.7. Data for the representative DOE sites were used to allow qultification of impacts, but do not necessarily capture the entire range of potential deep borehole complex sites. This approach to the radiological risk assessment differs from the analysis of other resources, which are analyzed based on a generic deep borehole site. Because the analysis of radiological dose impacts requires site-specific conditions, such as meteorology and surrounding populations, a generic site analysis would not be possible because of the infinite number of site-specific conditions.

Summaries of the radiological impacts to the public and to workers associated with normal operation of the deep borehole complex during the assumed 10-year campaign time are presented in Tables 4.3.3.2.2.9–1 and 4.3.3.2.2.9–2, respectively. [Text deleted.] Impacts from hazardous chemicals to these same groups are given in Table 4.3.3.2.2.9–3. Summaries of impacts associated with postulated accidents are given in Table 4.3.3.2.2.9–4. Detailed results are presented in Section M.

Normal Operation. There would be no radiological releases associated with the construction of a deep borehole complex. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the deep borehole complex are presented in Table 4.3.3.2.2.9–1. The impacts from all site operations, including the deep borehole complex, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the maximally exposed member of the public from annual operation of the deep borehole complex would range from 3.4×10^{-9} to 1.2×10^{-7} mrem. From 10 years of operation, the risk of fatal cancer to this individual would range from 1.7×10^{-14} to 6.0×10^{-13}. The impacts to the average individual would be less. As a result of annual operations, the population dose would range from 6.6×10^{-9} to 2.2×10^{-6} person-rem. The number of fatal cancers in the population from 10 years of operation would range from 3.3×10^{-11} to 1.1×10^{-8}.

The upper bounding dose of 3.2 mrem to the maximally exposed member of the public from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The risk of fatal cancer to this individual from 10 years of operation would be 1.6×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are as low as reasonably conceivable. As a result of annual total site operations, the upper bound population dose would be within the limit proposed in 10 CFR 834, and would be 44 person-rem. The number of fatal cancers in this population from 10 years of operation would be 0.22.

Table 4.3.3.2.2.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Receptor	Generic Site[a]	
	Deep Borehole Complex	Total Site
Annual Dose to the Maximally Exposed Individual Member of the Public[b]		
Atmospheric release pathway (mrem)	3.4×10^{-9} to 1.2×10^{-7}	6.1×10^{-5} to 1.5
Drinking water pathway (mrem)	0	0 to 0.10
Total liquid release pathway (mrem)	0	0 to 1.7
Atmospheric and liquid release pathways combined (mrem)	3.4×10^{-9} to 1.2×10^{-7}	6.1×10^{-5} to 3.2
Percent of natural background[c]	1.1×10^{-9} to 4.1×10^{-8}	1.8×10^{-5} to 1.1
10-year fatal cancer risk	1.7×10^{-14} to 6.0×10^{-13}	3.1×10^{-10} to 1.6×10^{-5}
Annual Population Dose Within 80 Kilometers[d]		
Atmospheric release pathways (mrem)	6.6×10^{-9} to 2.2×10^{-6}	2.8×10^{-4} to 40
Total liquid release pathways (mrem)	0	0 to 4.7
Atmospheric and liquid release pathways combined (mrem)	6.6×10^{-9} to 2.2×10^{-6}	2.8×10^{-4} to 44
Percent of natural background[c]	7.2×10^{-11} to 8.3×10^{-10}	2.4×10^{-7} to 0.017
10-year fatal cancers	3.3×10^{-11} to 1.1×10^{-8}	1.4×10^{-6} to 0.22
Annual Dose to the Average Individual Within 80 Kilometers[e]		
Atmospheric and liquid release pathways combined (mrem)	2.2×10^{-10} to 2.5×10^{-9}	8.0×10^{-7} to 0.049
10-year fatal cancer risk	1.1×10^{-15} to 1.2×10^{-14}	4.0×10^{-12} to 2.5×10^{-7}

[a] Ranges for the "Deep Borehole Complex" and "Total Site" doses may not necessarily reflect the same respective sites. The total site values are applicable only if the deep borehole complex were located on DOE sites and would not apply if generic non-DOE sites were selected.

[b] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year for the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] Annual natural background radiation levels: the average individual receives a dose that could range from 295 to 338 mrem; the population within 80 km receives a dose that could range from 9,190 to 379,000 person-rem.

[d] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[e] Obtained by dividing the population dose at a site by the number of people projected to be living within 80 km of that site. The number of people ranges from 29,400 to 1,285,000.

Source: HNUS 1996a. Ranges are based on impacts from the following representative DOE sites: Hanford, NTS, INEL, Pantex, ORR, and SRS.

Doses to onsite workers from normal operations are given in Table 4.3.3.2.2.9–2. Included are involved workers directly associated with the deep borehole complex, workers who are not involved with the deep borehole complex, and the entire workforce at the site. All doses fall within regulatory limits.

Table 4.3.3.2.2.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Receptor	Generic Site
Involved Workforce[a]	
Average worker dose (mrem/yr)[b]	13
10-year risk of fatal cancer	5.2×10^{-5}
Total dose (person rem/yr)	2.2
10-year fatal cancers	8.8×10^{-3}
Noninvolved Workforce[c]	
Average worker dose (mrem/yr)[b]	2.6 to 32
10-year risk of fatal cancer	1.0×10^{-5} to 1.3×10^{-4}
Total dose (person rem/yr)	3.0 to 250
10-year fatal cancers	0.012 to 1.0
Total Site Workforce[d]	
Dose (person-rem/yr)	5.2 to 252
10-year fatal cancers	0.021 to 1.0

[a] The involved worker is a worker associated with operations of the deep borehole complex. The estimated number of badged involved workers is 168.

[b] The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem/yr (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is a worker on-site but not associated with operations of the deep borehole complex. The ranges for the noninvolved workers are based on No Action values for Hanford, NTS, INEL, Pantex, ORR, and SRS. Noninvolved worker doses are shown for comparison purposes only and would not apply if the deep borehole complex were located at a separate dedicated site. The Noninvolved Workforce is equivalent to the No Action workforce.

[d] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: LLNL 1996a for involved workers. For the noninvolved workers see Sections 4.2.1.9, 4.2.2.9, 4.2.3.9, 4.2.4.9, 4.2.5.9, and 4.2.6.9, respectively.

The annual dose to the average deep borehole complex worker would be 13 mrem; the entire deep borehole complex workforce would receive 2.2 person-rem annually. The annual dose to the average noninvolved worker would range from 2.6 to 32 mrem, depending on the borehole site (if an existing DOE site were chosen), and the annual total dose to all noninvolved workers would range from 3.0 to 250 person-rem. The annual dose to the total site workforces would range from 5.2 to 252 person-rem. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.3.2.2.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the deep borehole complex at the generic site are presented in Table 4.3.3.2.2.9–3. Included is the impact due only to operation of the deep borehole complex and the sites's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

Table 4.3.3.2.2.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Receptor	Deep Borehole Complex Generic Site	
	Facility [a]	Total Site[b]
Maximally Exposed Individual (Public)		
Hazard Index[c]	$1.2x10^{-3}$	$1.2x10^{-3}$
Cancer risk[d]	0	0
Worker Onsite		
Hazard Index[e]	0.28	0.28
Cancer risk[f]	0	0

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer risk for MEI=(emission concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor). Where there are no known carcinogens among the chemicals emitted, therefore the calculated cancer risk is 0.

[e] Hazard Index for workers=sum of Individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer risk for workers=(emission for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among the chemicals emitted, there are no Slope Factors; therefore the calculated cancer risk is 0.

Section M.3, Table M.3.4–47.

The HI to the MEI is $1.2x10^{-3}$ at the deep borehole complex site. The cancer risk to the MEI is zero (because no carcinogens are released from hazardous chemicals) at the deep borehole complex site. The HI to the onsite worker is 0.28 at the deep borehole complex generic site, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals).

Facility Accidents. A set of potential accidents have been postulated for a deep borehole for disposal of immobilized Pu for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident scenarios considered are: earthquake, Pu storage container breakage, Pu storage container breach, pellet-grout mixing process facility fire, ceramic pellet spill, pellet-grout mix spill, dropped bucket during emplacement, failure of release-open early during emplacement, mixing system breaks pellets during bucket emplacement, pellets break during emplacement release, rupture of delivery pipe during pumped emplacement, mixing system breaks during pumped emplacement, pellets break during pumped emplacement, failure of ventilation filter, uncontrolled chemical reaction, pellet storage criticality, and pellet-grout mixing criticality. The range of consequences and risks for a set of accidents at the generic site are presented in Table 4.3.3.2.2.9–4. The estimated range of environmental data (wet to dry site) and the general public population density data (low to high density) for the generic site envelopes the site characteristics expected for the immobilized Pu disposition site.

[Text deleted.] The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Table 4.3.3.2.2.9–4. Range of Accident Impacts of the Deep Borehole Complex—Immobilized Disposition Alternative

	Worker at 1,000 m				Maximum Offsite Individual				Population to 80 km				
	Risk of Cancer Fatality (per 10 yr)[a]		Probability of Cancer Fatality[b]		Risk of Cancer Fatality (per 10 yr)[a]		Probability of Cancer Fatality[b]		Risk of Cancer Fatalities (per 10 yr)[c]		Number of Cancer Fatalities[b]		Accident Frequency (per yr)
Accident Scenario	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	
Earthquake	5.7×10^{-18}	2.3×10^{-18}	5.7×10^{-14}	2.3×10^{-14}	1.2×10^{-18}	5.2×10^{-20}	1.2×10^{-14}	5.2×10^{-16}	1.0×10^{-15}	9.3×10^{-18}	1.0×10^{-11}	9.3×10^{-14}	1.0×10^{-5}
Pu storage container breakage	5.7×10^{-18}	2.3×10^{-18}	5.7×10^{-16}	2.3×10^{-16}	1.2×10^{-18}	5.2×10^{-20}	1.2×10^{-16}	5.2×10^{-18}	1.0×10^{-15}	9.3×10^{-18}	1.0×10^{-13}	9.3×10^{-16}	1.0×10^{-3}
Pu storage container breach	5.7×10^{-18}	2.3×10^{-18}	5.7×10^{-16}	2.3×10^{-16}	1.2×10^{-18}	5.2×10^{-20}	1.2×10^{-16}	5.2×10^{-18}	1.0×10^{-15}	9.3×10^{-18}	1.0×10^{-13}	9.3×10^{-16}	1.0×10^{-3}
Pellet - grout mixing process facility fire	5.7×10^{-18}	2.3×10^{-18}	5.7×10^{-14}	2.3×10^{-14}	1.2×10^{-18}	5.2×10^{-20}	1.2×10^{-14}	5.2×10^{-16}	1.0×10^{-15}	9.3×10^{-18}	1.0×10^{-11}	9.3×10^{-14}	1.0×10^{-5}
Ceramic pellet spill	5.7×10^{-19}	2.3×10^{-19}	5.7×10^{-17}	2.3×10^{-17}	1.2×10^{-19}	5.2×10^{-21}	1.2×10^{-17}	5.2×10^{-19}	1.0×10^{-16}	9.3×10^{-19}	1.0×10^{-14}	9.3×10^{-17}	1.0×10^{-3}
Pellet grout mix spill	1.7×10^{-15}	6.9×10^{-16}	3.4×10^{-15}	1.4×10^{-15}	3.6×10^{-16}	1.6×10^{-17}	7.2×10^{-16}	3.1×10^{-17}	3.0×10^{-13}	2.8×10^{-15}	6.0×10^{-13}	5.5×10^{-15}	6.0×10^{-2}
Bucket dropped during emplacement	5.7×10^{-15}	2.3×10^{-15}	5.7×10^{-11}	2.3×10^{-11}	1.2×10^{-15}	5.2×10^{-17}	1.2×10^{-11}	5.2×10^{-13}	1.0×10^{-12}	9.3×10^{-15}	1.0×10^{-8}	9.3×10^{-11}	1.0×10^{-5}
Failure of release - opens early during bucket emplacement	2.8×10^{-14}	1.1×10^{-14}	2.8×10^{-10}	1.1×10^{-10}	5.9×10^{-15}	2.6×10^{-16}	5.9×10^{-11}	2.6×10^{-12}	4.9×10^{-12}	4.6×10^{-14}	4.9×10^{-8}	4.6×10^{-10}	4.9×10^{-5}
Mixing system breaks pellets during emplacement	5.7×10^{-14}	2.3×10^{-14}	5.7×10^{-12}	2.3×10^{-12}	1.2×10^{-14}	5.2×10^{-16}	1.2×10^{-12}	5.2×10^{-14}	1.0×10^{-11}	9.3×10^{-14}	1.0×10^{-9}	9.3×10^{-12}	1.0×10^{-3}
Pellets break during bucket emplacement release	5.7×10^{-14}	2.3×10^{-14}	5.7×10^{-12}	2.3×10^{-12}	1.2×10^{-14}	5.2×10^{-16}	1.2×10^{-12}	5.2×10^{-14}	1.0×10^{-11}	9.3×10^{-14}	1.0×10^{-9}	9.3×10^{-12}	1.0×10^{-3}
Rupture of delivering pipe during pumped emplacement	3.4×10^{-15}	1.4×10^{-15}	3.4×10^{-11}	1.4×10^{-11}	7.2×10^{-16}	3.1×10^{-17}	7.2×10^{-12}	3.1×10^{-13}	6.0×10^{-13}	5.5×10^{-15}	6.0×10^{-9}	5.5×10^{-11}	1.0×10^{-5}
Delivering pipe dropped during pumped emplacement	6.8×10^{-16}	2.7×10^{-16}	6.8×10^{-12}	2.7×10^{-12}	1.4×10^{-16}	6.2×10^{-18}	1.4×10^{-12}	6.2×10^{-14}	1.2×10^{-13}	1.1×10^{-15}	1.2×10^{-9}	1.1×10^{-11}	1.0×10^{-5}
Mixing system breaks pellets during pumped emplacement	6.8×10^{-15}	2.7×10^{-15}	6.8×10^{-13}	2.7×10^{-13}	1.4×10^{-15}	6.2×10^{-17}	1.4×10^{-13}	6.2×10^{-15}	1.2×10^{-12}	1.1×10^{-14}	1.2×10^{-10}	1.1×10^{-12}	1.0×10^{-13}
Pellets break during pumped emplacement release	6.8×10^{-15}	2.7×10^{-15}	6.8×10^{-13}	2.7×10^{-13}	1.4×10^{-15}	6.2×10^{-17}	1.4×10^{-13}	6.2×10^{-15}	1.2×10^{-12}	1.1×10^{-14}	1.2×10^{-10}	1.1×10^{-12}	1.0×10^{-13}
Failure of ventilation filter	3.4×10^{-18}	1.4×10^{-18}	3.4×10^{-13}	1.4×10^{-13}	7.2×10^{-19}	3.1×10^{-20}	7.2×10^{-14}	3.1×10^{-15}	6.0×10^{-16}	5.5×10^{-18}	6.0×10^{-11}	5.5×10^{-13}	1.0×10^{-6}
Uncontrolled chemical reaction	5.7×10^{-18}	2.3×10^{-18}	5.7×10^{-13}	2.3×10^{-13}	1.2×10^{-18}	5.2×10^{-20}	1.2×10^{-13}	5.2×10^{-15}	1.0×10^{-15}	9.3×10^{-18}	1.0×10^{-10}	9.3×10^{-13}	1.0×10^{-6}
Pellet storage criticality	1.4×10^{-10}	6.2×10^{-11}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-11}	1.0×10^{-12}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-9}	3.3×10^{-11}	6.3×10^{-4}	3.3×10^{-6}	1.0×10^{-6}

Table 4.3.3.2.2.9–4. Range of Accident Impacts of the Deep Borehole Complex—Immobilized Disposition Alternative—Continued

	Worker at 1,000 m				Maximum Offsite Individual				Population to 80 km				
	Risk of Cancer Fatality (per 10 yr)[a]		Probability of Cancer Fatality[b]		Risk of Cancer Fatality (per 10 yr)[a]		Probability of Cancer Fatality[b]		Risk of Cancer Fatalities (per 10 yr)[c]		Number of Cancer Fatalities[b]		Accident Frequency (per yr)
Accident Scenario	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	
Pellet-grout mixing criticality	1.4×10^{-10}	6.2×10^{-11}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-11}	1.0×10^{-12}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-9}	3.3×10^{-11}	6.3×10^{-4}	3.3×10^{-6}	1.0×10^{-6}
Expected risk[d]	2.8×10^{-10}	1.2×10^{-10}			5.9×10^{-11}	2.0×10^{-12}			1.3×10^{-8}	6.6×10^{-11}			

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the MEI) or the number of cancer fatalities (for the population within 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the incident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks for each accident over the 10-year lifetime of the facility.

Note: The impacts shown are the maximum for the reference sites. All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.8.1–3 and M.5.2.8.1–4 and the MACCS computer code.

4.3.3.2.2.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of a deep borehole complex which disposes of the waste form produced by the ceramic immobilization facility outlined in Section 4.3.3.2.1.10. There is no spent nuclear fuel or HLW associated with the operation of the deep borehole facility; however, the product output from the immobilization facility is a stabilized coated ceramic pellet. Table 4.3.3.2.2.10–1 provides the operational waste volumes projected to be generated from the deep borehole facility for immobilized disposal. Facilities that would support the deep borehole facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, waste could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated on-site to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. For purposes of analysis, a pristine site with no waste management infrastructure was assumed for No Action because the deep borehole facility was assumed to be a rural setting where no waste is currently being generated. The incremental waste volumes generated from the deep borehole facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.2. A detailed description of the waste management activities that would be required to support the new deep borehole disposal facility can be found in Section E.3.3.2.

Construction and operation of a deep borehole disposal facility for immobilized disposal would require the construction of waste management facilities to treat and store generated TRU, low-level, mixed, hazardous, and nonhazardous wastes. Wastes generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any is generated it would be managed in accordance with all applicable Federal and State regulations.

Less than 1 m^3 (120 gal) of liquid TRU waste generated per year from equipment decontamination would be treated in a waste handling facility to form grout. In the solids treatment area of the waste handling facility less than 1 m^3 (<1 yd^3) of solid TRU waste from process and facility operations, equipment decontamination, failed equipment, and used tools would be compacted, as appropriate, then packaged, assayed, and certified to the WIPP WAC or alternative treatment level. A small quantity (0.1 m^3 [0.2 yd^3]) of mixed TRU solid waste would require treatment and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would be principally rubber gloves and leaded gloveboxes. To transport the TRU and mixed TRU wastes to WIPP (depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste), one truck shipment every 15 years would be required.

An estimated 3 m^3 (800 gal) of liquid LLW from process wash liquids and excess water from the borehole would be solidified in the waste handling facility. The solidified liquid LLW and solid LLW comprised of sealant residues, contaminated reagent containers, deformed shipping containers, wipes, rags, and paper clothing would result in approximately 5 m^3 (7 yd^3) of LLW that would require disposal at a DOE LLW disposal facility. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.002 ha/yr (0.004 acres/yr) at Hanford and ORR, 0.0008 ha/yr (0.002 acre/yr) at NTS and INEL, and 0.0006 ha/yr (0.002 acres/yr) at SRS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

Approximately 141 m^3 (37,400 gal) of liquid hazardous waste consisting of 2 m^3 (600 gal) of chemical makeup and reagents from the surface facility and 139 m^3 (36,800 gal) of decontamination water, oil, antifreeze, and hydraulic fluid from the drilling and emplacing-borehole sealing facilities would be collected in DOT-approved

Table 4.3.3.2.2.10–1. Estimated Annual Generated Waste Volumes for the Deep Borehole Complex[a]—Immobilized Disposition Alternative

Category	New Facility (m^3)	No Action (m^3)
Transuranic		
Liquid	0.5[b]	None
Solid	0.5	None
Mixed Transuranic		
Liquid	0	None
Solid	0.1	None
Low-level		
Liquid	3[b]	None
Solid	6	None
Mixed low-level		
Liquid	0	None
Solid	0	None
Hazardous		
Liquid	141	None
Solid	15	None
Nonhazardous (sanitary)		
Liquid	9,460	None
Solid	291	None
Nonhazardous (other)		
Liquid	6,060	None
Solid	1,250[c]	None

[a] No waste generation was assumed for No Action. Waste generation volumes for deep borehole disposal facility for immobilized disposal are from Table E.3.3.2–1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.3.2–1.

[b] Liquid TRU and LLW would be treated and solidified prior to disposal.

[c] Includes rock cuttings, bentonite, and polymers from drilling and emplacing borehole sealing facilities.

containers and shipped to RCRA-permitted treatment and disposal facilities. An estimated 15 m^3 (20 yd^3) of solid hazardous waste such as wipes contaminated with oils, lubricants, and cleaning solvents would be compacted, as appropriate, and then packaged in DOT-approved containers and shipped to RCRA-permitted treatment and disposal facilities.

Approximately 9,460 m^3 (2,500,000 gal) of liquid nonhazardous sanitary and industrial wastewater and 6,060 m^3 (1,600,000 gal) of steam plant blowdown and evaporator condensate would require treatment in accordance with standard industrial practices. Treated wastewater would be designated as reclaimed water recycle and would be used as makeup to the cooling tower. Construction of sanitary, utility, and process wastewater treatment systems would be required. The 291 m^3 (380 yd^3) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste would be shipped to a permitted landfill. The drilling and emplacing-borehole sealing facilities would generate approximately 1,250 m^3 (1,630 yd^3) of rock cuttings, bentonite, and polymers. As per customary drilling industry practices, these wastes would end up in mud pits and then filled with earth and leveled.

4.3.4 IMMOBILIZATION ALTERNATIVE CATEGORY

These sections describe three immobilization alternatives for the final disposition of Pu: Vitrification Alternative, Ceramic Immobilization Alternative, and Electrometallurgical Treatment Alternative (GBZ). The representative sites are: Hanford, NTS, INEL, Pantex, ORR, and SRS. The sections describe the construction and annual operational impacts of the immobilization alternative facilities on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomic, public and occupational health and safety, and waste management. The impacts for all of the alternatives in these sections are in addition to those associated with the pit disassembly/conversion facility (Section 4.3.1) and the Pu conversion facility (Section 4.3.2). The potential can-in-canister approach at SRS for either vitrification or ceramic immobilization has been described in Appendix O. Should either of these variants be selected, follow-on tiered NEPA documentation will be completed, as appropriate.

4.3.4.1 Vitrification Alternative

The environmental impacts described in the following sections are based on the analysis of a new vitrification facility described in Section 2.4.4.1. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS.

In accordance with the Preferred Alternative for surplus Pu disposition, the vitrification facility could be located at either Hanford or SRS. Further tiered NEPA review will be conducted to examine alternative locations, including new and existing facilities at these two sites, should the Preferred Alternative be selected at the ROD.

For the Vitrification Alternative, the analysis in Sections 4.3.4.1.1 to 4.3.4.1.10 assumes that a new facility would be built. However, there are several potential variations described in Table 2.4–1, some of which could potentially use existing facilities for portions of the operations. For example, under the can-in-canister approach, the existing DWPF at SRS could be used to provide vitrified glass for the outer canister which surrounds the inner can of vitrified Pu.

4.3.4.1.1 *Land Resources*

A new facility for the Vitrification Alternative would disturb 24 ha (60 acres) of land during construction, of which 12 ha (30 acres) would be used during operations. The need for buffer zones would be determined during site-specific, tiered NEPA documentation. Land use would be less if existing facilities were used for portions of the vitrification operation.

Construction and operation of the vitrification facility would not cause indirect land use impacts at the analysis sites. As discussed in Section 4.3.4.1.8, in-migration of workers should be required only during the operational phase. However, it is expected that housing construction should be sufficient to absorb the increase in population at each site. Therefore, offsite land use at the analysis sites would not be affected. Direct and indirect impacts to land resources during construction and operation are described by representative site.

Hanford Site

Land Use. The vitrification facility site would utilize vacant land in the 200 Areas adjacent to 200 East. Construction would be in conformance with existing and future land use as described in the *Hanford Site Development Plan* and with ongoing discussions in the Comprehensive Land Use Planning Process (HF DOE 1993c:13,14). According to the current *Hanford Site Development Plan*, 200 Area's land use is identified as waste operations which includes radioactive material management, processing, and storage. [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction of the vitrification alternative would be consistent with State and local (Benton, Franklin, and Grant counties and the City of Richland) land use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Areas and current VRM Class 5 designation. A potential visual impact during operation would be from stack plumes which would be visible from public viewpoints with high sensitivity levels including State Highways 24 and 240 and the City of Richland; however, because of the viewing distance and compatibility of the proposal with existing industrial character, visual impacts would not occur.

Nevada Test Site

Land Use. The potential location for the vitrification alternative would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area. [Text deleted.] However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans policies, or controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked form sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. A new vitrification facility would be located on undeveloped land in the ICPP security area, which is situated within the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). Construction and operation of the facility would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan*, which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction would not be in conflict with land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation would be compatible with the present visual character of INEL, which consists of large industrial facilities and stack plumes. Potential visual impacts could occur during operation during operation from additional stack plumes; however, the proposal would be consistent with the existing Class 5 industrial landscape character of the ICPP.

Pantex Plant

Land Use. The vitrification facility would be located on undeveloped land in Zone 4. The potential action would be inconsistent with the current *Pantex Site Development Plan* which designates Zone 4 for weapons and

weapon components staging (PX DOE 1995g:16). However, Pantex could revise the site development plan should Pantex be selected for this alternative.

Construction would not affect other site land uses. There would be no onsite impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] Construction and operation of the vitrification alternative would be consistent with the industrialized landscape character. The current VRM Class 5 designation of Zone 4 would not change.

Oak Ridge Reservation

Land Use. A new vitrification facility would be located on undeveloped land at the northwest quadrant of the Route 95/Bear Creek Road intersection. The alternative would be in conformance with the future land use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* designates a portion of the site as a major waste management area (OR DOE 1991f:1-7). [Text deleted.]

Construction and operation would be compatible with ORR or offsite land uses. No prime farmlands exist onsite. The vitrification facility would not be in conflict with City of Oak Ridge land-use plans, policies, and controls since the current *Oak Ridge Area Land-Use Plan* designates the potential site for Industrial and Public land use.

Visual Resources. [Text deleted.] Construction and operation of the facility would change the current VRM Class 4 designation of the Bear Creek Road/Route 95 site to Class 5. Additionally, potential visual impacts could occur during operation from the new stack plumes. Construction and operation activities would be highly visible from Bear Creek Road and Route 95, public roadways with high sensitivity levels.

Savannah River Site

Land Use. A new vitrification facility would be located on undeveloped land in the F-Area. Facility construction and operation would conform with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the plan, current F-Area land use is designated industrial operations, while the future land use category is Primary Industrial Mission. Specifically, the F-Area is one of four SRS waste management facilities (SR DOE 1994d:11,12). [Text deleted.]

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction would not be in conflict with land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] Construction and operation would occur within an area of similar industrial landscape character. Potential visual impacts could occur during operation from additional stack plumes; however, the proposal would be consistent with the VRM Class 5 designation of the F-Area.

[Text deleted.]

4.3.4.1.2 *Site Infrastructure*

Implementation of the vitrification alternative for immobilization of Pu with radionuclides requires construction and operation of facilities to conduct the vitrification processes. The potential impacts to the site infrastructure at six representative DOE sites for construction and operation of a vitrification facility are described below. Data for construction and operation are presented in Appendix C. Site infrastructure changes resulting from such construction are presented in Table 4.3.4.1.2–1, and changes from operations in Table 4.3.4.1.2–2.

Hanford Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operational requirements would have negligible impact on the site infrastructure.

Nevada Test Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to existing road and rail networks. Additional oil would be required during the period of construction and for operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers.

Idaho National Engineering Laboratory

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure.

Pantex Plant

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure.

Oak Ridge Reservation

Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers for construction use. Construction and operation of this facility would require construction of transportation links to existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operational impacts would be negligible to the site infrastructure.

Savannah River Site

[Text deleted.] If existing facilities were used for part of the operations, the construction impacts would be lower. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide this additional oil from local suppliers for construction use. Construction and operation of this facility would require construction of transportation links to existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operational impacts would be negligible to the site infrastructure.

Table 4.3.4.1.2–1. Additional Site Infrastructure Needed for the Construction of the Vitrification Facility Alternative (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	2,000	5	94,000	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	347,500	63	9,428,800	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Projected usage with facility	126,940	30	5,810,000	0	0
Amount required in excess to site availability	0	0	94,000	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Projected usage with facility	234,500	47	5,914,000	0	11,340
Amount required in excess to site availability	0	0	0	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Projected usage with facility	48,266	15	889,166	7,200,000	0
Amount required in excess to site availability	0	0	0	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	728,000	115	473,000	95,000,000	16,300
Amount required in excess to site availability	0	0	57,000[a]	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Projected usage with facility	796,000	121	28,484,500	0	221,352
Amount required in excess to site availability	0	0	94,000[a]	0	0

[a] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Table 4.3.4.1.2–2. Additional Site Infrastructure Needed for the Operation of the Vitrification Facility Alternative (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Rail-roads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	<5	<5	12,000	3	378,500	0	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	357,500	61	9,713,300	21,039,531	0
Amount required in excess to site availability	<5	<5	0	0	0	0	0
NTS							
Site availability	1,100[a]	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	<5	136,940	28	6,094,000	0	0
Amount required in excess to site availability	0	<5	0	0	378,500[b]	0	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	244,500	45	6,198,500	0	11,340
Amount required in excess to site availability	<5	<5	0	0	0	0	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	58,266	13	1,173,666	7,200,000	0
Amount required in excess to site availability	<5	<5	0	0	0	0	0
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	76	32	738,000	113	757,500	95,000,000	16,300
Amount required in excess to site availability	<5	<5	0	0	341,500[b]	0	0
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	806,000	119	28,769,000	0	221,352
Amount required in excess to site availability	<5	<5	0	0	378,500[b]	0	0

[a] Includes paved and unpaved roads.

[b] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

4.3.4.1.3 *Air Quality and Noise*

Construction and operation of the vitrification facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.4.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction. Construction impacts would be lower if existing facilities were used.

Emission rates for operation of the vitrification facility are presented in Table F.1.3–9. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers for space heating
- Operation of diesel generators, diesel driven pumps, and periodic testing of emergency diesel generators
- [Text deleted.]

The PSD regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on the emission rates presented in Appendix F, PSD permits may be required for this alternative at any of the sites. This may require "offsets" (reductions of existing emissions) to permit any additional or new emission source.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation, plus the No Action concentrations, are presented in Table 4.3.4.1.3–1. VOCs are the only toxic/hazardous emissions and were not modeled for this PEIS.

Table 4.3.4.1.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Vitrification Alternative and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)
Criteria Pollutants														
Carbon monoxide	8-hour	10,000	0.08	11.49	2,290	2,299.06	284	312.6	602	712.3	5	7.83	22	119.5
	1-hour	40,000	0.3	90.92	2,748	2,812.03	614	686.5	2,900	3,475	11	16.85	171	630.2
Lead	Calendar Quarter	1.5	<0.01	<0.01	[b]	[b]	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01
	24-hour	0.5	<0.01	<0.01	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
Nitrogen dioxide	Annual	100	0.03	0.44	[b]	0.06[d]	4	4.55	2.15	4.42	3	3.09	5.7	7.47
Ozone	1-hour	235	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01	<0.01	9.4	9.4	5	5	8.73	8.75	1	1	3	3.01
	24-hour	150	0.02	0.05	106	106.02	80	80.08	88.5	88.81	2	2.01	50.6	50.87
Sulfur dioxide	Annual	52	<0.01	0.02	8.4	8.4	6	6.01	<0.01	0.06	2	2	14.5	14.55
	24-hour	260	<0.01	0.11	94.6	94.68	135	135.27	<0.01	0.99	32	32.02	196	196.9
	3-hour	1,300	0.01	0.78	725	725.55	579	580.2	<0.01	5.49	80	80.09	823	828.7
	1-hour	1,018	0.02	2.34	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	1-hour	655[f]	0.02	2.34	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	30-minute	1,045	[c]	[c]	[c]	[c]	[c]	[c]	<0.01	14.74	[c]	[c]	[c]	[c]
Mandated by State														
Gaseous fluorides (as HF)	30-day	0.8	[b]	[b]	[c]	[c]	[c]	[c]	<0.75	<0.75	0.2	0.2	0.09	0.09
	7-day	1.6	[b]	[b]	[c]	[c]	[c]	[c]	<0.75	<0.75	0.3	0.3	0.39	0.39
	24-hour	2.9	[b]	[b]	[c]	[c]	[c]	[c]	0.75	0.75	0.6[g]	0.6[g]	1.04	1.04
	12-hour	3.7	[b]	[b]	[c]	[c]	[c]	[c]	1.05	1.05	0.6[g]	0.6[g]	1.99	1.99
	8-hour	250	[b]	[b]	[c]	[c]	[c]	[c]	[c]	[c]	0.6	0.6	[c]	[c]
	3-hour	4.9	[b]	[b]	[c]	[c]	[c]	[c]	4.21	4.21	[c]	[c]	[c]	[c]
Hydrogen sulfide	1-hour	112	[c]	[c]	[b]	[b]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	30-minute	111	[c]	[c]	[c]	[c]	[c]	[c]	[b]	[b]	[c]	[c]	[c]	[c]
Total suspended particulates	Annual	60	<0.01	<0.01	[c]	[c]	5	5	[c]	[c]	[c]	[c]	12.6	12.61
	24-hour	150	<0.02	0.05	[c]	[c]	80	80.08	[c]	[c]	2	2.01	[c]	[c]

Table 4.3.4.1.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Vitrification Alternative and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)
Total suspended particulates (continued)	3-hour	200	c	c	c	c	c	c	b	1.70[d]	c	c	c	c
	1-hour	400	c	c	c	c	c	c	b	4.58[d]	c	c	c	c
[Text deleted.]														

[a] The more stringent of the Federal and State standards is presented for the averaging time.

[b] No sources for this pollutant have been identified.

[c] No State standard for indicated averaging time.

[d] The concentration represents the alternative contribution only.

[e] Ozone, as a criteria pollutant, is not directly emitted or monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

[f] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.

[g] 8-hour averaging time concentration was used.

Note: Total concentrations are based on site contribution, including contribution from ongoing activities (No Action), and do not include the contribution from non-facility sources. Concentrations for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LLNL 1996c; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

NOISE

The location of the facilities associated with the vitrification facility relative to the site boundary and sensitive receptors was examined for each of the six sites to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction materials and workers to the site.

Nontraffic noise associated with operation of these facilities would include ventilation systems, cooling systems, and emergency diesel generators. These noise sources would be located at sufficient distance from offsite areas, so that the contribution to offsite noise levels would continue to be small. Due to the size of the sites, noise emission from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.4.1.4 *Water Resources*

The construction and operation of a vitrification facility would affect surface water and groundwater resources. Water resource requirements and discharges provided in Table C.1.1.3–4, Table C.2.1.3–4, and Table E.3.3.4–1 were used to assess impacts to surface water and groundwater. The discussion of impacts is provided for each site separately. Table 4.3.4.1.4–1 presents No Action surface water and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the vitrification facility.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the vitrification facility. During construction, the quantity of water required would be approximately 10.6 million l/yr (2.8 million gal/yr), which would represent less than a 0.08-percent increase over the expected annual surface water withdrawal. This additional withdrawal would not affect surface water availability. During operation, the total annual water requirement would be approximately 250 million l/yr (66 million gal/yr). This would represent a 1.9-percent increase over the existing surface water withdrawal and approximately 0.0002 percent of the average annual flow of the Columbia River and would cause negligible impacts.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater (4.6 million l/yr [1.2 million gal/yr]), would be generated, treated, and discharged to evaporation/percolation ponds. [Text deleted.] During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary and other wastewater would be recycled or discharged to evaporation/percolation ponds. All discharges would be monitored to comply with discharge requirements.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown, etc.) would be monitored, collected, and treated if necessary prior to either recycling within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The vitrification facility would be located in the 200 Area which is above the 100-year, 500-year and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for construction or operation of the vitrification facility; therefore, there would be no impact to groundwater availability.

Construction and operation of the vitrification facility would not result in direct discharges to groundwater. Treated wastewater would be discharged to disposal ponds which does not evaporate, however, could percolate downward into the near surface aquifer groundwater. This water would be monitored and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. Other factors limiting the potential impacts to groundwater quality are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the vitrification facility. Therefore, there would be no impacts to surface water availability.

Table 4.3.4.1.4–1. Potential Changes to Water Resources Resulting From the Vitrification Alternative

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Water Source	Surface	Ground	Ground	Ground	Surface	Ground
No Action						
No Action water requirements (millions l/yr)	13,511	2,400	7,570	249	14,760	13,247
No Action wastewater discharges (millions l/yr)	246	82	540	141	2,277	700
Construction						
Water Availability and Use						
Total water requirement (million l/yr)	10.6	10.6	10.6	10.6	10.6	10.6
Percent increase in project water use[a]	0.08	0.4	0.1	4.3	0.07	0.08
Water Quality						
Total wastewater discharge (million l/yr)	4.6	4.6	4.6	4.6	4.6	4.6
Percent change in wastewater discharge[b]	1.9	5.6	0.9	2.5	0.2	0.7
Percent change in streamflow	neg	NA	NA	NA	0.01[c]	0.09[d]
Operation						
Water Availability and Use						
Total water requirement (million l/yr)	250	250	250	250	250	250
Percent increase in projected water use[e]	1.9	10.4	3.3	100.4	1.7	1.9
Water Quality						
Wastewater discharge (million l/yr)	197	197	197	197	197	197
Percent change in wastewater discharge[f]	80.1	240	36.5	139.7	8.7	28.1
Percent change in streamflow	neg	NA	NA	NA	0.4[c]	3.9[d]
Floodplain						
Action in 100-year floodplain	No	No	No	No	No	No
Critical action in 500-year floodplain	No	Uncertain	Uncertain	No	Uncertain	Unlikely

[a] Percent increases in water requirements during construction of the vitrification facility are calculated by dividing water requirements for the facility (10.6 million l/yr) with that for each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[b] Percent changes in wastewater discharged during construction of the vitrification facility are calculated by dividing wastewater discharges for the facility (4.6 million l/yr) with that for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

[c] Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for the East Fork Poplar Creek is shown in the table.

[d] Percent changes in stream flow from wastewater discharges are calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).

[e] Percent increases in water requirements during operation of the vitrification facility are calculated by dividing water requirements (250 million l/yr) with that for each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[f] Percent changes in wastewater discharged during operation of the vitrification facility are calculated by dividing wastewater discharge rate for the new facility (197 million l/yr) with that for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater 4.6 million l/yr (1.2 million gal/yr), would be generated. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycling.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Condensation from heating, air conditioning, and other distillates; fire sprinkler water; and truck hose-down water would be monitored for radioactivity, and if uncontaminated, available for recycling or discharge to natural drainage channels.

There have been no studies to assess the 500-year floodplain boundaries at NTS. Information on the 500-year floodplain could be developed in future environmental studies. Studies have shown the 100-year floodplain to be confined to the Jackass Flats and Frenchman Lake areas. The proposed sites for the vitrification facility are not located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms which can create brief (less than 6 hours) flash floods, the facility would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater. Quantities required for construction and operation and the percent increase in projected water use are shown in Table 4.3.4.1.4–1. Annual construction water requirements for the facilities (10.6 million l/yr [2.8 million gal/yr]), would represent less than 0.03 percent of the minimum estimated annual recharge to the regional aquifer under the NTS (38 billion l [10 billion gal]) and a 0.4-percent increase over the projected groundwater usage. Operating the facility at NTS would require 250 million l/yr (66 million gal/yr), which would be approximately 10.4 percent of the projected groundwater usage and 0.7 percent of the minimum estimated annual recharge. This additional amount would increase the total amount withdrawn annually at NTS to 7.0 percent of the estimated annual recharge. These additional withdrawals would not impact groundwater availability.

Construction and operation of the vitrification facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are therefore not expected. Other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the vitrification facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater (4.6 million l/yr [1.2 million gal/yr]) would be generated, treated, and discharged to evaporation/percolation ponds, or would be available for recycling. All discharges would be monitored to comply with discharge limits. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary and other wastewater would be either treated and discharged to

evaporation/percolation ponds or available for recycling. This amount would increase wastewater discharges by 36.5 percent. All discharges would be monitored to comply with discharge limit.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown, etc.) would be monitored, collected, and treated if necessary prior to recycling within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The potential site for the vitrification facility is not located in an area historically prone to flooding, but is within the flood zone which would occur as a result of the failure of the MacKay Dam during a maximum probable flood, which would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. Water requirements for operation of the vitrification facility would fall within INEL's current allotment. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). As shown in Table 4.3.4.1.4–1, construction water requirements (10.6 million l/yr [2.8 million gal/yr]) for the proposed facilities, which are small relative to INEL's total usage, would represent a 0.1-percent increase over the projected annual groundwater usage. Minimal impacts to groundwater availability would occur. During operation, the water requirements for the facility would be 250 million l/yr (66 million gal/yr), which represents a 3.3-percent increase over the projected No Action annual groundwater usage. INEL would still be well within the total groundwater allotment.

Construction and operation of the vitrification facility would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are therefore not expected. Other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates. Because no new groundwater supply wells would be installed, the vitrification facility is not expected to affect existing groundwater contamination in the ICPP area.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the vitrification facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater (4.6 million l/yr [1.2 million gal/yr]) would be generated and would be discharged to the existing wastewater treatment systems north of Zone 12. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary wastewater and other wastewater would be discharged to these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would be discharged to the playa lakes or would be recycled. Since Pantex discharged approximately 1.4 million l/day (0.37 million gal/day) of wastewater into the playas in 1994 and is expecting this quantity to decrease in the future, the estimated quantity of additional wastewater that would be discharged to the playas (approximately 539,700 l/day [142,600 gal/day]) should not cause any exceedances of the monthly average limit of 2.46 million l/day (650,000 gal/day).

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated if necessary prior to recycling within the facility or discharge to the playas. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The proposed location for the vitrification facility is in Zone 4. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 4, there would be no impacts to floodplains. However, flooding in other areas of Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system which obtains water from the Ogallala Aquifer or possibly from reclaimed wastewater. Construction water requirements for the vitrification facilities would be small relative to the recoverable water in aquifer storage, which for the year 2010 was estimated to be 287 trillion l (75.8 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.4.1.4–1, construction of the facilities would require 10.6 million l/yr (2.8 million gal/yr) of water, which would represent approximately a 4.3-percent increase over the No Action annual groundwater usage and 0.6 percent of the capacity of groundwater system (1,900 million l/yr [502 million gal/yr]). [Text deleted.] Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8 m/yr (5.9 ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the proposed vitrification facilities at Pantex would require 250 million l/yr (66 million gal/yr), resulting in a small drawdown representing 13.2 percent of the capacity of the groundwater system. This additional drawdown would not impact regional groundwater levels. The water requirements would be approximately 13.1 percent of the capacity of the groundwater system and about a 100-percent increase in projected No Action water usage. The total site groundwater withdrawal including this facility would be 499 million l/yr (131.8 million gal/yr) which, because of expected cutbacks in other programs, would be 40 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the vitrification facilities would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged to the playas until contaminant levels are within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the vitrification facility would be obtained from the Clinch River and its tributaries. [Text deleted.]

During construction, the quantity of water required would be approximately 10.6 million l/yr (2.8 million gal/ yr), which would represent a 0.07-percent increase over the projected annual surface water withdrawal. During operation, water requirements would be approximately 250 million l/yr (66 million gal/yr), which would represent a 1.7-percent increase over the projected No Action annual surface water withdrawal and would be 0.006 percent

of the average flow of the Clinch River (132 m^3/s [4,647 ft^3/s]). Minimal impacts to surface water availability would occur.

During construction of the vitrification facility, sanitary wastewater (approximately 4.6 million l/yr [1.2 million gal/yr]) would be generated, treated, and discharged to East Fork Poplar Creek. During operation, a total of 197 million l/yr (52 million gal/yr) of sanitary wastewater would be generated by the new facility. This quantity would represent less than 0.4 percent of the average flow of East Fork Poplar Creek and would be a 8.7-percent increase in wastewater discharges. All discharges would be monitored to comply with discharge requirements. No impacts are expected.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated if necessary prior to recycling within the facility or discharge to natural drainage channels. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The potential location of the vitrification facility is outside the 100-year floodplain; there would be no impact to the floodplain. The 500-year floodplain has not been determined in this area but could be developed in future studies.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. Groundwater would be used for construction and operation of a new vitrification facility. No surface water withdrawals would be made. [Text deleted.] During construction of the vitrification facility, sanitary and other nonhazardous wastewater (approximately 4.6 million l/yr [1.2 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modifications. This would represent a 0.7-percent increase in the wastewater discharge from this facility. If existing facilities were used there would be less water used and wastewater discharged during construction. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary wastewater would be discharged to this wastewater treatment system. This would represent a 28.1-percent increase in the effluent discharged to Fourmile Branch from this facility. This discharge would not exceed 3.9-percent of the minimum flow of this stream. All discharges would be monitored to comply with discharge requirements. [Text deleted.] Other nonhazardous wastewater effluents (for example, condensation from air conditioning and heating, fire sprinkler water, cooling system blowdown) would be collected, monitored, and treated if necessary prior to recycling within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The potential location of the vitrification facility is outside the 100-year floodplain. Although information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas, the vitrification facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek. This is because facility would be is located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about 58 m^3/s (2,040 ft^3/s). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 62 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately 5 m^3/s (186 ft^3/s), and an elevation of about 61 m (199 ft) above MSL (SR USGS 1996a:1). Elevations of the

vitrification buildings in F-Area would be more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, the quantity of water required would be approximately 10.6 million l/yr (2.8 million gal/yr), which would represent less than a 0.08-percent increase over the projected No Action annual groundwater withdrawal. This additional withdrawal would cause minimal impacts to groundwater availability.

During operation, water used for cooling system makeup would be obtained from existing supply systems in the F-Area. The water for these systems is groundwater from the Cretaceous Aquifer. The total annual water requirements of 250 million l/yr (66 million gal/yr) shown in Table 4.3.4.1.4–1 represent a 1.9-percent increase in the projected groundwater usage at SRS. There would be reduced impacts if existing facilities are used. These additional withdrawals would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals over 100 times greater than that required for the vitrification facility from the Cretaceous Aquifer indicate drawdown of almost 2.1 m/yr (6.9 ft/yr) at the well head, but would be less in overlying aquifers and not extend beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that the withdrawals attributed to the facility would cause a slight drawdown at the well head and would not affect any aquifers in the area. No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

[Text deleted.]

4.3.4.1.5 *Geology and Soils*

This section describes the environmental impacts to the geologic and soil resource as related to the construction and operation of the vitrification facility. This facility at any of the alternative sites, would involve some ground-disturbing construction activities (24 ha [60 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rain) is greater at ORR and SRS than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities or site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to greater relative annual precipitation. Soil disturbance would occur primarily from ground-breaking construction activities (foundation preparation) and associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increase wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns. Soil loss associated with construction would be less if existing facilities were used for part of the vitrification process.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal. [Text deleted.]

4.3.4.1.6 *Biological Resources*

Construction of the vitrification facility would require 24 ha (60 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Land requirements and impacts on biological resources would be less if existing facilities were used for portions of the vitrification operations. Consultation with USFWS and State agencies would be conducted at the site-specific level as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that a new vitrification facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the vitrification facility would result in the disturbance of terrestrial habitat equaling about 0.02 percent of Hanford. This includes areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The assumed facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the vitrification facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the vitrification facility. These disturbances may cause some species to move from the area. Disturbances to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the vitrification facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a vitrification facility at Hanford would not impact aquatic resources since there are no surface water bodies sufficiently near the assumed facility location to be affected by runoff. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entrainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the vitrification facility; however, sagebrush habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the existence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the vitrification facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are described below.

Terrestrial Resources. Construction and operation of the vitrification facility at NTS would result in the disturbance of terrestrial habitat equaling about 0.007 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the vitrification facility would affect animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitats nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the vitrification facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the vitrification facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the vitrification facility at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicular traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training; putting restrictions on vehicle speeds and off-road movement; conducting clearance surveys prior to surface disturbance; approving stop work authority if tortoises are found within work areas; removing tortoises from roadways and work areas; placing permanent and temporary tortoise proof fencing around trenches, landfills, and treatment ponds; inspecting trenches; and having biologists survey when heavy equipment is in use. The

USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the vitrification facility.

[Text deleted.] Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicular traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the vitrification facility (Section 4.3.4.1.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the vitrification facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to smaller mammals and some birds and reptiles which could be displaced or suffer mortality. Larger mammals are excluded from the site by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources near the assumed facility location, these resources would not be affected by construction or operation of the vitrification facility. Since the facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected since they are not present at the ICPP.

Pantex Plant

It is assumed that the vitrification facility would be located within Zone 4, which is a developed area that lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed facility location; however, small mammals and some birds and reptiles could be displaced by construction. Since Zone 4 does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the vitrification facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to an increase in open water near the outfall, as well as a change in plant species composition. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of the vitrification facility. Although the assumed facility location has been disturbed, the State-listed Texas horned lizard could be present. Preactivity surveys would be conducted as appropriate prior to construction.

Oak Ridge Reservation

It is assumed that the vitrification facility would be located about 3 km (5 miles) east of the K–25 area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the vitrification facility at ORR would result in the disturbance of about 0.2 percent of ORR. This acreage includes areas on which the facility would be constructed, as well as areas that would be revegetated following construction.

Vegetation within the area to be developed would be destroyed during land clearing. Vegetation cover within the assumed site is predominantly oak-hickory forest or pine and pine-hardwood forest. While both types would be affected by construction, it is likely that a greater area of pine and pine-hardwood forests would be removed. This type of forest is more heavily concentrated in valleys were most of the development would occur. Oak-hickory forests are typically found on ridges. Both forest types are common throughout ORR and within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals within the assumed project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediment control measures would control secondary impacts. Since an existing intake structure would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River. However, a new wastewater discharge structure could be required on East Fork Poplar Creek. Depending on its location, this structure could displace some wetlands along the creek. Any unavoidable impacts to wetlands would be mitigated in accordance with 10 CFR 1022.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impact on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the vitrification facility could cause water quality changes (primarily sediment loading and resulting turbidity) to Bear Creek, Grassy Creek, or Ish Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since a new intake structure would not be required, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little affect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river. During construction and operation, wastewater would be discharged to East Fork Poplar Creek. This could require the construction of a new discharge structure which would temporarily disturb aquatic habitat in the vicinity of the outfall. The small volume of wastewater discharged to the stream would provide minimal impacts to aquatic resources during either construction or operation.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the vitrification facility. Land-clearing activities may destroy State protected plant species found within or adjacent to disturbed portions of the assumed site including pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily, and golden seal. The Tennessee dace is sensitive to siltation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Ish Creek or Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility. [Text deleted.]

Savannah River Site

It is assumed that a new vitrification facility would be constructed within the F-Area, which is one of the highly developed industrial areas of SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since water would be taken from existing sources and discharged via NPDES permitted outfalls and would involve minor volumes. Impacts from construction and operation of the vitrification facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site that this species would not be directly affected by this action.

4.3.4.1.7 *Cultural and Paleontological Resources*

This section discusses the potential impacts to cultural and paleontological resources that may result from the construction and operation of the vitrification facility at each of the representative sites analyzed. The total land disturbed during the construction of this facility is 24 ha (60 acres), of which 12 ha (30 acres) would be used during operation. [Text deleted.] If existing facilities were used for a portion of the vitrification operation, less land would be disturbed and there would be fewer impacts to cultural and paleontological resources. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through additional surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified in close proximity to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The vitrification facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction, but not operation, of the proposed facility.

The CGTO conducted surveys over portions of Frenchman Flat and identified at least 20 significant plant species. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from the construction and operation of the facility. Impacts could include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The vitrification facility would be constructed within the existing ICPP security area. The facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of the area identified no sites within the proposed project area. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites occur adjacent to the ICPP—one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP-listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have a visual or auditory impact on traditional use areas or sacred sites. Such resources may be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain which have produced fossilized remains. Operation would not have an effect on paleontological resources.

Pantex Plant

The vitrification facility would be constructed in Zone 4 of Pantex. A historic buildings survey was conducted in Zone 4 to identify significant World War II Era structures and none of the buildings there are considered NRHP eligible on that basis. This area has not been systematically surveyed for archaeological resources. Because the area is developed and disturbed, it is unlikely to contain NRHP-eligible archaeological resources. In compliance with the standing Programmatic Agreement, survey work would be conducted on all areas that would be affected by construction prior to ground-breaking activities. Recorded prehistoric resources at Pantex include lithic scatters, hunting/kill sites, and concentrations of fire-cracked rock and are located predominantly near the playas (PX MH 1981a:58). Historic sites are generally associated with farming, such as remains of homes and outbuildings, and World War II and Cold War Era structures. Resources such as these may occur on the land that would be disturbed during construction. Construction, but not operation, may have an effect on any identified resources.

DOE has initiated a public outreach program to involve Native American groups in decision-making related to land use and cultural resources. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any sacred sites, ceremonial areas, or cemeteries in Zone 4. Additional consultation may identify some of these resources. Resources such as cemeteries could be affected by new construction. Operation could have an auditory or visual impact on sacred or ceremonial sites.

Important paleontological remains such as bison and camel bones have been found in other areas of the High Plains and it is possible that some may occur in lands to be disturbed by construction at Pantex. Operation would not affect paleontological resources.

Oak Ridge Reservation

This facility would be constructed at the intersection of Route 95 and Bear Creek Road. A portion of this area on both sides of Bear Creek Road was surveyed prior to construction of the proposed Exxon Nuclear Facility which was never built (OR UTN 1975a:ii). Some prehistoric sites were identified near the Clinch River, and the potential for sites along the smaller creeks exists. In addition, remains of a number of early 20th-century frame houses and mid-to-late 19th-century log houses and outbuildings are located within the project area. Some of

these resources may be affected by facility construction. Additional sites may occur on unsurveyed lands to be disturbed.

No Native American resources have been identified in the project area to date. Some may be identified during project-specific consultation. Native American resources such as cemeteries and traditionally used plant and animal species could be affected by construction. Operation may have an auditory or visual impact on sacred or ceremonial sites.

Some paleontological remains may be encountered on the acreage to be disturbed during construction but no fossil remains with high research value are known to occur at ORR. During operation, no additional ground disturbance is expected, so there would be no additional impact to resources.

Savannah River Site

The vitrification facility would be located on open space within F-Area. Portions of F-Area have been surveyed and contain sites potentially eligible for the NRHP. Site types known to occur at SRS include remains of prehistoric base camps, and lithic quarries and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by the proposed action. Operation would not have an additional impact on archaeological resources.

Some Native American resources may be affected by the proposed action. Resources such as prehistoric sites, cemeteries, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to these areas may also result from the proposed alternative. These resources would be identified through consultation with the potentially affected tribes.

Some paleontological remains may occur on this acreage, but impacts would be considered negligible because the fossil assemblages known to occur at SRS are of low research value. During operation, no additional ground disturbance would be expected, so there would be no additional impact to resources.

[Text deleted.]

4.3.4.1.8 *Socioeconomics*

This section analyzes the socioeconomic effects of the vitrification facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. Socioeconomic impacts attributable to construction would be reduced if existing facilities are used for part of the vitrification operation. The effects at all of the candidate sites are found in the supplemental socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Constructing a vitrification facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 382 workers in the peak year of construction at any site. The largest increases in regional employment (less than 1 percent) and regional per capita income (much less than 1 percent) among the sites analyzed would be at INEL. A total of 776 new jobs (382 direct and 394 indirect) would be generated and regional unemployment would fall from 5.4 percent to 4.9 percent (Socio 1996a).

Operating the facility would generate greater socioeconomic changes than would construction, due to the larger, more permanent workforce. A workforce of 768 would be required for full operation at any site. Implementing the alternative at INEL would generate the largest increases in regional employment (almost 2 percent) and per capita income (less than 1 percent). A total of 2,828 new jobs (768 direct and 2,060 indirect) would be generated by the operational activities and regional unemployment would fall to 4.0 percent (Socio 1996a).

Population and Housing. At all of the sites analyzed, construction employment requirements would be met by the available resident labor force, but some in-migrating workers would be needed to fill specialized positions during operation. Project-related increases in population would be greatest if the facility is located at Pantex. However, this increase would be less than 1 percent over No Action population projections. Housing units, in excess of existing vacancies, may be required at all of the sites analyzed, except NTS and ORR, to accommodate the in-migrating population during operation. The greatest increase in housing requirements would be in the INEL ROI but this would be much less than 1 percent over No Action estimates. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the population growth at all of the sites analyzed (Socio 1996a).

Community Services. During construction, there would be no increased demand for community services at any of the sites analyzed. However, operation of the facility would slightly increase the demand for community services at all sites analyzed. The effects of population growth due to in-migrating workers during construction or operations would be minor. The following discussion focuses on the Pantex ROI which is expected to experience the largest increase in demand for community services.

To maintain the No Action student-to-teacher ratio of 16.3:1 in the Pantex ROI, 15 new teachers would be needed during operation of the proposed facility. However, the increase in teacher requirements would be distributed over several school districts in the ROI, and no single school district would be significantly affected (Socio 1996a).

Only three additional police officers and three firefighters would need to be added in the Pantex ROI to maintain No Action service levels of 2.3 police officers and 2.3 firefighters per 1,000 persons (Socio 1996a).

Projected hospital occupancy rates would increase slightly over No Action estimates. However, projected hospital capacities would be capable of accommodating the small increase in patient load. To maintain the No Action service level of 2.0 physicians per 1,000 persons, only 2 additional physicians would be needed in the Pantex ROI (Socio 1996a).

Local Transportation. Traffic generated during the construction of the vitrification facility would not affect the level of service on the local road segments analyzed at any of the sites. However traffic would have the greatest

effect on local transportation at INEL. U.S. 20/26 from U.S. 26 East to Idaho State Route 22/33 would experience a drop in level of service from B to C (Socio 1996a).

4.3.4.1.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the vitrification facility. The section first describes the impacts from normal facility operation at each potential site followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 10-year campaign time are presented in Tables 4.3.4.1.9–1 and 4.3.4.1.9–2, respectively, are presented in the text. Impacts from hazardous chemicals to these same groups are given in Table 4.3.4.1.9–3. Summaries of impacts associated with postulated accidents are given in Table 4.3.4.1.9–4 through 4.3.4.1.9–9. Detailed results are presented in Section M. For the Preferred Alternative, the duration would be reduced to 3.5 years and the risk and fatalities would also be reduced proportionally. The vitrification facility would be collocated with the Pu conversion facility under the Preferred Alternative but are analyzed separately in this PEIS.

The DOE's Preferred Alternative for Pu disposition includes the use of vitrification or immobilization technologies for the disposition of Pu in existing reactors. As a result of implementing a multiple technology disposition strategy for analysis purposes, approximately 30 percent of the surplus Pu would be vitrified or immobilized. Summaries of the radiological and hazardous chemical impacts to the public and to workers associated with normal operations and with postulated accidents are presented for an assumed 10-year operational campaign for the disposition of 50 t (55.1 tons) of Pu and for an assumed 3.5-year operational campaign for the Preferred Alternative. The impacts and risks associated with the Preferred Alternative would be reduced due to a shorter period of operations. It should also be noted that a Pu conversion facility may be collocated with the vitrification or immobilized facility. Impacts attributed to the Pu conversion facility are described in Section 4.3.2.9 for 10 years of operation.

Normal Operation. There would be no radiological releases associated with the construction of a vitrification facility at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. If existing facilities are used, the hazardous chemical releases would be reduced. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the vitrification facility at each of the sites are presented in Table 4.3.4.1.9–1. The impacts from all site operations, including the vitrification facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses to the maximally exposed member of the public from annual vitrification facility operation range from 7.2×10^{-6} mrem at the NTS site to 2.5×10^{-4} mrem at the ORR site. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 3.6×10^{-11} to 1.3×10^{-9}. The impacts to the average individual would be less. As a result of annual operations, the population doses would range from 1.4×10^{-5} person-rem at the NTS site to 5.0×10^{-3} person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 7.0×10^{-8} to 2.5×10^{-5}.

The dose to the maximally exposed member of the public from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range

Table 4.3.4.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Vitrification Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]												
Atmospheric release pathway (mrem)	1.4×10^{-5}	4.4×10^{-3}	7.2×10^{-6}	4.2×10^{-3}	8.9×10^{-6}	0.018	1.1×10^{-4}	1.3×10^{-4}	2.5×10^{-4}	1.5	7.7×10^{-5}	0.42
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0	0.10	0	0.081
Total liquid release pathway (mrem)	0	9.5×10^{-4}	0	0	0	0	0	0	0	1.7	0	0.37
Atmospheric and liquid release pathways combined (mrem)	1.4×10^{-5}	5.3×10^{-3}	7.2×10^{-6}	4.2×10^{-3}	8.9×10^{-6}	0.018	1.1×10^{-4}	1.3×10^{-4}	2.5×10^{-4}	3.2	7.7×10^{-5}	0.79
Percent of natural background[c]	4.7×10^{-6}	1.8×10^{-3}	2.3×10^{-6}	1.3×10^{-3}	2.6×10^{-6}	5.2×10^{-3}	3.3×10^{-5}	3.9×10^{-5}	8.5×10^{-5}	1.1	2.6×10^{-5}	0.27
10-year fatal cancer risk	7.0×10^{-11}	2.7×10^{-8}	3.6×10^{-11}	2.1×10^{-8}	4.5×10^{-11}	8.8×10^{-8}	5.5×10^{-10}	6.4×10^{-10}	1.3×10^{-9}	1.6×10^{-5}	3.9×10^{-10}	4.0×10^{-6}
3.5-year fatal cancer risk[d]	2.5×10^{-11}	9.5×10^{-9}	1.3×10^{-11}	7.4×10^{-9}	1.6×10^{-11}	3.1×10^{-8}	1.9×10^{-10}	2.2×10^{-10}	4.6×10^{-10}	5.6×10^{-6}	1.4×10^{-10}	1.4×10^{-6}
Annual Population Dose Within 80 Kilometers[e]												
Atmospheric release pathway (person-rem)	7.9×10^{-4}	0.46	1.4×10^{-5}	3.7×10^{-3}	1.6×10^{-4}	2.4	3.4×10^{-4}	6.2×10^{-4}	4.4×10^{-3}	29	5.0×10^{-3}	40
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6
Atmospheric and liquid release pathways combined (person-rem)	7.9×10^{-4}	1.6	1.4×10^{-5}	3.7×10^{-3}	1.6×10^{-4}	2.4	3.4×10^{-4}	6.2×10^{-4}	4.4×10^{-3}	34	5.0×10^{-3}	44
Percent of natural background[c]	4.2×10^{-7}	8.4×10^{-4}	1.5×10^{-7}	4.1×10^{-5}	1.8×10^{-7}	2.7×10^{-3}	2.9×10^{-7}	5.3×10^{-7}	1.2×10^{-6}	9.0×10^{-3}	1.9×10^{-6}	0.017
10-year fatal cancers	4.0×10^{-6}	7.8×10^{-3}	7.0×10^{-8}	1.9×10^{-5}	8.0×10^{-7}	0.012	1.7×10^{-6}	3.1×10^{-6}	2.2×10^{-5}	0.17	2.5×10^{-5}	0.22
3.5-year fatal cancers[d]	1.4×10^{-6}	2.7×10^{-3}	2.5×10^{-8}	6.7×10^{-6}	2.8×10^{-7}	4.2×10^{-3}	6.0×10^{-7}	1.1×10^{-6}	7.7×10^{-6}	0.060	8.8×10^{-6}	0.077

Table 4.3.4.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Vitrification Alternative—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Average Individual Within 80 Kilometers[f]												
Atmospheric and liquid release pathways combined (mrem)	1.3×10^{-6}	2.6×10^{-3}	4.8×10^{-7}	1.3×10^{-4}	5.9×10^{-7}	8.9×10^{-3}	9.7×10^{-7}	1.8×10^{-6}	3.4×10^{-6}	0.026	5.6×10^{-6}	0.049
10-year fatal cancer risk	6.4×10^{-12}	1.3×10^{-8}	2.4×10^{-12}	6.3×10^{-10}	3.0×10^{-12}	4.5×10^{-8}	4.9×10^{-12}	8.9×10^{-12}	1.7×10^{-11}	1.3×10^{-7}	2.8×10^{-11}	2.5×10^{-7}
3.5-year fatal cancer risk[d]	2.2×10^{-12}	4.6×10^{-9}	8.4×10^{-13}	2.2×10^{-10}	1.1×10^{-12}	1.6×10^{-8}	1.7×10^{-12}	3.1×10^{-12}	6.0×10^{-12}	4.6×10^{-8}	9.8×10^{-12}	8.8×10^{-8}

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the maximally exposed individual may be different under No Action than for operation of the vitrification facility.Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from site operations are 10 mrem per year from the air pathways, as required by the NESHAPs (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem.

[d] For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies, the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionally reduced to a 3.5-year campaign.

[e] For DOE activities proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[f] Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford, 29,400 at NTS, 269,000 at INEL, 350,000 at Pantex, 1,285,000 at ORR, and 893,000 at SRS.)

Source: Section M.2.

from $1.3x10^{-4}$ mrem at Pantex to 3.2 mrem at the ORR site. From 10 years of operation, the corresponding risk of fatal cancer to this individual would range from $6.4x10^{-10}$ to $1.6x10^{-5}$. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operations, the population doses would be within the limit in proposed 10 CFR 834, and would range from $6.2x10^{-4}$ person-rem at Pantex to 44 person-rem at the SRS site. The corresponding number of fatal cancers in these populations from 10 years of operation would be range from $3.1x10^{-6}$ to 0.22. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected in this table for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionately reduced.

Doses to onsite workers from normal operations are given in Table 4.3.4.1.9–2. Included are involved workers directly associated with the vitrification facility, workers who are not involved with the vitrification facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to vitrification facility workers is site-independent and would be 200 mrem to the average facility worker and 110 person-rem to the entire facility workforce. The annual dose to the noninvolved worker would range from 2.6 mrem at the ORR site to 32 mrem at the SRS site. The annual total dose to all noninvolved workers would range from 3.0 person-rem at the NTS site to 250 person-rem at Hanford. The annual dose to the total site workforce would range from 113-person-rem at the NTS site to 360 person-rem at the Hanford site. The risks and numbers of fatal cancer among the different workers from 10 years of operation are included in Table 4.3.4.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also worker rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the vitrification facility at each of several sites are presented in Table 4.3.4.1.9–3. Included is the impact due only to operation of the vitrification facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI ranges from $1.0x10^{-4}$ at the NTS site to $3.9x10^{-3}$ at the ORR site due to the new facility operation. The cancer risk from hazardous chemicals to the MEI is zero (because no carcinogens are released from hazardous chemicals) at all sites. The HI to the onsite worker ranges from 0.019 at the Pantex site to 0.040 at ORR, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals) at all sites. [Text deleted.]

Facility Accidents. A set of potential accidents has been postulated for the vitrification facility, where releases of Pu may occur that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and general population located within 80 km (50 mi) of the accident release point are summarized in Table 4.3.4.1.9–4 through 4.3.4.1.9–9 for the sites analyzed (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be $9.9x10^{-3}$ at ORR for the Cs fire accident scenario with a probability of $1.0x10^{-6}$ per year. The corresponding 10 year cancer facility lifetime risk from the same accident scenarios for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be $9.9x10^{-8}$, $7.7x10^{-11}$ and $3.8x10^{-10}$, respectively. The maximum population 10-year facility lifetime risk would be $1.8x10^{-5}$ (that is, one fatality in over 600,000 years) at ORR for the Cs ion processing fire accident scenario with a probability of $1.0x10^{-6}$ per year. The corresponding maximum offsite individual and worker 10 year facility lifetime risks would be $1.4x10^{-8}$ and $6.8x10^{-8}$, respectively. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionally reduced.

Table 4.3.4.1.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Vitrification Alternative

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce[a]						
Average worker dose (mrem/yr)[b]	200	200	200	200	200	200
10-year risk of fatal cancer	8.0×10^{-4}	8.0×10^{-4}	8.0×10^{-4}	8.0×10^{-4}	8.0×10^{-4}	8.0×10^{-4}
3.5-year risk of fatal cancer[c]	2.8×10^{-4}	2.8×10^{-4}	2.8×10^{-4}	2.8×10^{-4}	2.8×10^{-4}	2.8×10^{-4}
Total dose (person-rem/yr)	110	110	110	110	110	110
10-year fatal cancers	0.44	0.44	0.44	0.44	0.44	0.44
3.5-year risk of fatal cancer[c]	0.15	0.15	0.15	0.15	0.15	0.15
Noninvolved Workforce[d]						
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	1.1×10^{-4}	2.0×10^{-5}	1.2×10^{-4}	4.0×10^{-5}	1.0×10^{-5}	1.3×10^{-4}
3.5-year risk of fatal cancer[c]	3.9×10^{-5}	7.0×10^{-6}	4.2×10^{-5}	1.4×10^{-5}	3.5×10^{-6}	4.6×10^{-5}
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	0.90
3.5 year fatal cancers[c]	0.35	4.2×10^{-3}	0.31	0.020	0.063	0.32
Total Site Workforce[e]						
Dose (person-rem/yr)	360	113	330	124	154	336
10-year fatal cancers	1.4	0.45	1.3	0.50	0.62	1.3
3.5 year fatal cancers[c]	0.49	0.16	0.46	0.18	0.22	0.46

[a] The involved worker is associated with operations of the vitrification facility.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionally reduced to a 3.5-year campaign.

[d] The noninvolved worker is onsite but not associated with operations of the vitrification facility. The Noninvolved Workforce is equivalent to the No Action workforce.

[e] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Table 4.3.4.1.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Vitrification Alternative

	Hanford		NTS		INEL		Pantex		ORR		SRS	
Receptor	**Facility[a]**	**Total Site[b]**	**Facility[a]**	**Total Site[b]**	**Facility[a]**	**Total Site[b]**	**Facility[b]**	**Total Site[c]**	**Facility[a]**	**Total Site[b]**	**Facility[a]**	**Total Site[b]**
Maximally Exposed Individual (Public)												
Hazard Index[c]	6.7×10^{-4}	7.3×10^{-4}	1.0×10^{-4}	1.0×10^{-4}	1.4×10^{-3}	0.017	3.7×10^{-3}	9.4×10^{-3}	3.9×10^{-3}	0.043	1.8×10^{-4}	5.3×10^{-3}
Cancer Risk[d]	0	0	0	0	0	3.6×10^{-6}	0	1.1×10^{-8}	0	0	0	1.3×10^{-7}
Worker Onsite												
Hazard Index[e]	0.038	0.042	0.020	0.020	0.038	0.26	0.019	0.025	0.040	0.19	0.034	1.2
Cancer Risk[f]	0	0	0	0	0	7.7×10^{-4}	0	4.5×10^{-7}	0	0	0	1.9×10^{-4}

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer Risk for MEI=(Emissions concentration) x (0.286 [converts concentrations to doses]) x (Slope Factor).

[e] Hazard Index for workers=sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer Risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor).

Where there are no known carcinogens among chemicals emitted, there are no Slope Factors, therefore the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4–48 through M.3.4–53.

Table 4.3.4.1.9–4. Vitrification Alternative Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Blender spill	9.1×10^{-10}	1.8×10^{-9}	8.6×10^{-12}	1.7×10^{-11}	7.6×10^{-8}	1.5×10^{-7}	0.05
	(3.2×10^{-10})		(3.0×10^{-12})		(2.7×10^{-8})		
Melter spill	9.1×10^{-13}	9.1×10^{-10}	8.6×10^{-15}	8.6×10^{-13}	7.6×10^{-11}	7.6×10^{-9}	1.0×10^{-3}
	(3.2×10^{-13})		(3.0×10^{-15})		(2.7×10^{-11})		
Cs capsule drop	5.3×10^{-12}	5.3×10^{-11}	4.0×10^{-14}	4.0×10^{-12}	6.4×10^{-10}	6.4×10^{-8}	1.0×10^{-3}
	(1.8×10^{-12})		(1.4×10^{-14})		(2.2×10^{-10})		
Canister drop	9.0×10^{-12}	9.0×10^{-10}	8.5×10^{-14}	8.5×10^{-12}	7.5×10^{-10}	7.5×10^{-8}	1.0×10^{-3}
	(3.1×10^{-12})		(3.0×10^{-14})		(2.6×10^{-10})		
CPC ion column fire	6.9×10^{-8}	6.9×10^{-6}	5.3×10^{-10}	5.3×10^{-8}	8.4×10^{-6}	8.4×10^{-4}	1.0×10^{-3}
	(2.4×10^{-8})		(1.9×10^{-10})		(2.9×10^{-6})		
Pu oxide oven solids fire	1.7×10^{-14}	1.7×10^{-12}	1.7×10^{-16}	1.7×10^{-14}	1.2×10^{-13}	1.2×10^{-10}	1.0×10^{-3}
	(5.9×10^{-15})		(6.0×10^{-17})		(4.2×10^{-11})		
Earthquake	4.4×10^{-12}	4.4×10^{-8}	4.4×10^{-14}	4.4×10^{-10}	3.2×10^{-10}	3.2×10^{-6}	1.0×10^{-5}
	(1.5×10^{-12})		(1.5×10^{-14})		(1.1×10^{-10})		1.0×10^{-5}
Cs fire	3.9×10^{-10}	3.9×10^{-5}	3.0×10^{-12}	3.0×10^{-7}	4.7×10^{-8}	4.7×10^{-3}	1.0×10^{-6}
	(1.4×10^{-10})		(1.0×10^{-12})		(1.6×10^{-8})		1.0×10^{-6}
Blender fire	7.0×10^{-11}	7.0×10^{-6}	5.3×10^{-13}	5.3×10^{-8}	8.4×10^{-9}	8.4×10^{-4}	1.0×10^{-6}
	(2.5×10^{-11})		(1.9×10^{-13})		(2.9×10^{-9})		1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	4.2×10^{-12}	4.2×10^{-7}	3.3×10^{-14}	3.3×10^{-9}	3.5×10^{-11}	3.5×10^{-6}	1.0×10^{-6}
	(1.5×10^{-12})		(1.2×10^{-14})		(1.2×10^{-11})		
Expected risk[d]	7.1×10^{-8}	–	5.4×10^{-10}	–	8.5×10^{-6}	–	–
	(2.5×10^{-8})	–	(1.9×10^{-10})	–	(3.0×10^{-6})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–5. Vitrification Alternative Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Blender spill	6.2×10^{-10} (2.2×10^{-10})	1.2×10^{-9}	1.4×10^{-11} (4.9×10^{-12})	2.7×10^{-11}	1.7×10^{-9} (5.9×10^{-10})	3.5×10^{-9}	0.05
Melter spill	6.2×10^{-13} (2.2×10^{-13})	6.2×10^{-11}	1.4×10^{-14} (4.9×10^{-15})	1.4×10^{-12}	1.7×10^{-12} (5.9×10^{-13})	1.7×10^{-10}	1.0×10^{-3}
Cs capsule drop	3.6×10^{-12} (1.3×10^{-12})	3.6×10^{-10}	6.6×10^{-14} (2.3×10^{-14})	6.6×10^{-12}	1.5×10^{-11} (5.2×10^{-12})	1.5×10^{-9}	1.0×10^{-3}
Canister drop	6.1×10^{-12} (2.1×10^{-12})	6.1×10^{-10}	1.4×10^{-13} (4.9×10^{-14})	1.4×10^{-11}	1.7×10^{-11} (5.9×10^{-12})	1.7×10^{-9}	1.0×10^{-3}
CPC ion column fire	4.7×10^{-8} (1.6×10^{-8})	4.7×10^{-6}	8.7×10^{-10} (3.0×10^{-10})	8.7×10^{-8}	1.9×10^{-7} (6.6×10^{-8})	1.9×10^{-5}	1.0×10^{-3}
Pu oxide oven solids fire	1.2×10^{-14} (4.2×10^{-15})	1.1×10^{-12}	2.7×10^{-16} (9.4×10^{-17})	2.7×10^{-14}	2.8×10^{-14} (9.8×10^{-15})	2.8×10^{-12}	1.0×10^{-3}
Earthquake	3.0×10^{-12} (1.0×10^{-12})	3.0×10^{-8}	7.0×10^{-14} (2.4×10^{-14})	7.0×10^{-10}	7.2×10^{-12} (2.5×10^{-12})	7.2×10^{-8}	1.0×10^{-5}
Cs fire	2.6×10^{-10} (9.1×10^{-11})	2.6×10^{-5}	4.9×10^{-12} (1.7×10^{-12})	4.9×10^{-7}	1.1×10^{-9} (3.8×10^{-10})	1.1×10^{-4}	1.0×10^{-6}
Blender fire	4.7×10^{-11} (1.6×10^{-11})	4.7×10^{-6}	8.7×10^{-13} (2.3×10^{-14})	8.7×10^{-8}	2.0×10^{-10} (7.0×10^{-11})	2.0×10^{-5}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	3.1×10^{-12} (1.1×10^{-12})	3.1×10^{-7}	6.5×10^{-14} (2.3×10^{-14})	6.5×10^{-9}	6.9×10^{-13} (2.4×10^{-13})	6.9×10^{-8}	1.0×10^{-6}
Expected risk[d]	4.8x10-8 (1.7x10-8)	–	8.9×10^{-10} (3.1×10^{-10})	–	2.0×10^{-7} (7.0×10^{-8})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–6. Vitrification Alternative Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Blender spill	8.4×10^{-10} (2.9×10^{-10})	1.7×10^{-9}	8.6×10^{-12} (3.0×10^{-12})	1.7×10^{-11}	2.3×10^{-8} (8.0×10^{-9})	4.7×10^{-8}	0.05
Melter spill	8.4×10^{-13} (2.9×10^{-13})	8.4×10^{-11}	8.7×10^{-15} (3.0×10^{-15})	8.7×10^{-13}	2.3×10^{-11} (8.0×10^{-12})	2.3×10^{-9}	1.0×10^{-3}
Cs capsule drop	4.6×10^{-12} (1.6×10^{-12})	4.6×10^{-10}	3.8×10^{-14} (1.3×10^{-14})	3.8×10^{-12}	2.0×10^{-10} (7.0×10^{-11})	2.0×10^{-8}	1.0×10^{-3}
Canister drop	8.3×10^{-12} (2.9×10^{-12})	8.3×10^{-10}	8.5×10^{-14} (3.0×10^{-14})	8.5×10^{-12}	2.3×10^{-10} (8.0×10^{-11})	2.3×10^{-8}	1.0×10^{-3}
CPC ion column fire	6.1×10^{-8} (2.1×10^{-8})	6.1×10^{-6}	5.0×10^{-10} (1.7×10^{-10})	5.0×10^{-8}	2.6×10^{-6} (9.1×10^{-7})	2.6×10^{-4}	1.0×10^{-3}
Pu oxide oven solids fire	1.6×10^{-14} (5.6×10^{-15})	1.6×10^{-12}	1.7×10^{-16} (5.9×10^{-17})	1.7×10^{-14}	3.7×10^{-13} (1.3×10^{-13})	3.7×10^{-11}	1.0×10^{-3}
Earthquake	4.1×10^{-12} (1.4×10^{-12})	4.1×10^{-8}	4.4×10^{-14} (1.5×10^{-4})	4.4×10^{-10}	9.6×10^{-11} (3.3×10^{-11})	9.6×10^{-7}	1.0×10^{-5}
Cs fire	3.4×10^{-10} (1.2×10^{-10})	3.4×10^{-5}	2.9×10^{-12} (1.0×10^{-12})	2.9×10^{-7}	1.5×10^{-8} (5.2×10^{-9})	1.5×10^{-3}	1.0×10^{-6}
Blender fire	6.1×10^{-11} (2.1×10^{-11})	6.1×10^{-6}	5.1×10^{-13} (1.8×10^{-13})	5.1×10^{-8}	2.7×10^{-9} (9.4×10^{-10})	2.7×10^{-4}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	4.0×10^{-12} (1.4×10^{-12})	4.0×10^{-7}	3.9×10^{-14} (1.4×10^{-14})	3.9×10^{-9}	9.0×10^{-12} (3.1×10^{-12})	9.0×10^{-7}	1.0×10^{-6}
Expected risk[d]	6.2×10^{-8} (2.2×10^{-8})	–	5.2×10^{-10} (1.8×10^{-10})	–	2.7×10^{-6} (9.4×10^{-7})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–7. Vitrification Alternative Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Blender spill	3.7×10^{-10} (1.3×10^{-10})	7.5×10^{-10}	1.1×10^{-10} (3.8×10^{-11})	2.1×10^{-10}	2.5×10^{-8} (8.7×10^{-9})	5.0×10^{-8}	0.05
Melter spill	3.7×10^{-13} (1.3×10^{-13})	3.7×10^{-11}	1.0×10^{-13} (3.5×10^{-14})	1.0×10^{-11}	2.5×10^{-11} (8.7×10^{-12})	2.5×10^{-9}	1.0×10^{-3}
Cs capsule drop	2.2×10^{-12} (7.7×10^{-13})	2.2×10^{-10}	5.9×10^{-13} (2.1×10^{-13})	5.9×10^{-11}	1.9×10^{-10} (6.6×10^{-11})	1.9×10^{-8}	1.0×10^{-3}
Canister drop	3.7×10^{-12} (1.3×10^{-12})	3.7×10^{-10}	1.0×10^{-12} (3.5×10^{-13})	1.0×10^{-10}	2.5×10^{-10} (8.7×10^{-11})	2.5×10^{-8}	1.0×10^{-3}
CPC ion column fire	3.0×10^{-8} (1.0×10^{-8})	3.0×10^{-6}	7.7×10^{-9} (2.7×10^{-9})	7.7×10^{-7}	2.5×10^{-6} (8.7×10^{-7})	2.5×10^{-4}	1.0×10^{-3}
Pu oxide oven solids fire	6.9×10^{-15} (2.4×10^{-15})	6.9×10^{-13}	2.0×10^{-15} (7.0×10^{-16})	2.0×10^{-13}	4.2×10^{-13} (1.5×10^{-13})	4.2×10^{-11}	1.0×10^{-3}
Earthquake	1.8×10^{-12} (6.3×10^{-13})	1.8×10^{-8}	5.1×10^{-13} (1.8×10^{-13})	5.1×10^{-9}	1.1×10^{-10} (3.8×10^{-11})	1.1×10^{-6}	1.0×10^{-5}
Cs fire	1.7×10^{-10} (5.9×10^{-11})	1.7×10^{-5}	4.4×10^{-11} (1.5×10^{-11})	4.4×10^{-6}	1.4×10^{-8} (4.9×10^{-9})	1.4×10^{-3}	1.0×10^{-6}
Blender fire	3.0×10^{-11} (1.0×10^{-11})	3.0×10^{-6}	7.8×10^{-12} (2.7×10^{-12})	7.8×10^{-7}	2.5×10^{-9} (8.7×10^{-10})	2.5×10^{-4}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	1.9×10^{-12} (6.6×10^{-13})	1.9×10^{-7}	7.0×10^{-13} (2.4×10^{-13})	7.0×10^{-8}	2.2×10^{-11} (7.7×10^{-12})	2.2×10^{-6}	1.0×10^{-6}
Expected risk[d]	3.0×10^{-8} (1.0×10^{-8})	–	7.9×10^{-9} (7.8×10^{-9})	–	2.6×10^{-6} (9.1×10^{-7})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–8. Vitrification Alternative Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Blender spill	8.5×10^{-10} (3.0×10^{-10})	1.7×10^{-9}	1.8×10^{-10} (6.3×10^{-11})	3.7×10^{-10}	1.8×10^{-7} (6.3×10^{-8})	3.5×10^{-7}	0.05
Melter spill	8.6×10^{-13} (3.0×10^{-13})	8.6×10^{-11}	1.8×10^{-13} (6.3×10^{-14})	1.8×10^{-11}	1.8×10^{-10} (6.3×10^{-11})	1.8×10^{-8}	1.0×10^{-3}
Cs capsule drop	5.2×10^{-12} (1.8×10^{-12})	5.2×10^{-10}	1.0×10^{-12} (3.5×10^{-13})	1.0×10^{-10}	1.3×10^{-9} (4.5×10^{-10})	1.3×10^{-7}	1.0×10^{-3}
Canister drop	8.4×10^{-12} (2.9×10^{-12})	8.4×10^{-10}	1.8×10^{-12} (6.3×10^{-13})	1.8×10^{-10}	1.7×10^{-9} (5.9×10^{-10})	1.7×10^{-7}	1.0×10^{-3}
CPC ion column fire	6.8×10^{-8} (2.4×10^{-8})	6.8×10^{-6}	1.4×10^{-8} (4.9×10^{-9})	1.4×10^{-6}	1.8×10^{-5} (6.3×10^{-6})	1.8×10^{-3}	1.0×10^{-3}
Pu oxide oven solids fire	1.6×10^{-14} (5.6×10^{-15})	1.6×10^{-12}	3.5×10^{-15} (1.2×10^{-15})	3.5×10^{-13}	3.0×10^{-12} (1.0×10^{-12})	3.0×10^{-10}	1.0×10^{-3}
Earthquake	4.1×10^{-12} (1.4×10^{-12})	4.1×10^{-8}	8.9×10^{-13} (3.1×10^{-13})	8.9×10^{-9}	7.7×10^{-10} (2.7×10^{-10})	7.7×10^{-6}	1.0×10^{-5}
Cs fire	3.8×10^{-10} (1.3×10^{-11})	3.8×10^{-5}	7.7×10^{-11} (2.7×10^{-11})	7.7×10^{-6}	9.9×10^{-8} (3.5×10^{-8})	9.9×10^{-3}	1.0×10^{-6}
Blender fire	6.8×10^{-11} (2.4×10^{-11})	6.8×10^{-6}	1.4×10^{-11} (4.9×10^{-12})	1.4×10^{-6}	1.8×10^{-8} (6.3×10^{-9})	1.8×10^{-3}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	3.8×10^{-12} (1.3×10^{-12})	3.8×10^{-7}	8.5×10^{-13} (3.0×10^{-13})	8.5×10^{-8}	1.6×10^{-10} (5.6×10^{-11})	1.6×10^{-5}	1.0×10^{-6}
Expected risk[d]	6.9×10^{-8} (2.4×10^{-8})	–	1.4×10^{-8} (4.9×10^{-9})	–	1.8×10^{-5} (6.3×10^{-6})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–9. Vitrification Alternative Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Blender spill	6.1×10^{-10} (2.1×10^{-10})	1.2×10^{-9}	1.5×10^{-13} (5.2×10^{-14})	2.9×10^{-11}	8.0×10^{-8} (2.8×10^{-8})	1.6×10^{-7}	0.05
Melter spill	6.1×10^{-13} (2.1×10^{-13})	6.1×10^{-11}	1.5×10^{-14} (5.2×10^{-15})	1.5×10^{-12}	8.0×10^{-11} (2.8×10^{-11})	8.0×10^{-9}	1.0×10^{-3}
Cs capsule drop	3.7×10^{-12} (1.3×10^{-12})	3.7×10^{-10}	8.2×10^{-14} (2.9×10^{-14})	8.2×10^{-12}	6.4×10^{-10} (2.2×10^{-10})	6.4×10^{-8}	1.0×10^{-3}
Canister drop	6.0×10^{-12} (2.1×10^{-12})	6.0×10^{-10}	1.4×10^{-13} (4.9×10^{-14})	1.4×10^{-11}	7.9×10^{-10} (2.8×10^{-10})	7.9×10^{-8}	1.0×10^{-3}
CPC ion column fire	4.8×10^{-8} (1.7×10^{-8})	4.8×10^{-6}	1.1×10^{-9} (3.8×10^{-10})	1.1×10^{-7}	8.4×10^{-6} (2.9×10^{-6})	8.4×10^{-4}	1.0×10^{-3}
Pu oxide oven solids fire	1.1×10^{-14} (3.8×10^{-15})	1.1×10^{-12}	2.7×10^{-16} (9.4×10^{-17})	2.7×10^{-14}	1.3×10^{-12} (4.5×10^{-13})	1.3×10^{-10}	1.0×10^{-3}
Earthquake	2.9×10^{-12} (1.0×10^{-12})	2.9×10^{-8}	7.1×10^{-14} (2.5×10^{-14})	7.1×10^{-10}	3.4×10^{-10} (1.2×10^{-10})	3.4×10^{-6}	1.0×10^{-5}
Cs fire	2.7×10^{-10} (9.4×10^{-11})	2.7×10^{-5}	6.1×10^{-12} (2.1×10^{-12})	6.1×10^{-7}	4.7×10^{-8} (1.6×10^{-8})	4.7×10^{-3}	1.0×10^{-6}
Blender fire	4.8×10^{-11} (1.7×10^{-11})	4.8×10^{-6}	1.1×10^{-12} (3.8×10^{-13})	1.1×10^{-7}	8.4×10^{-9} (2.9×10^{-9})	8.4×10^{-4}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	2.8×10^{-12} (9.8×10^{-13})	2.8×10^{-7}	5.7×10^{-14} (2.0×10^{-14})	5.7×10^{-9}	4.7×10^{-11} (1.6×10^{-11})	4.7×10^{-6}	1.0×10^{-6}
Expected risk[d]	4.9×10^{-8} (1.7×10^{-8})	– –	1.1×10^{-9} (3.8×10^{-10})	– –	8.5×10^{-6} (3.0×10^{-6})	– –	– –

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.4.1.9–4 through 4.3.4.1.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details that affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas to minimize the risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is the possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude of the impacts of an aircraft into a disposition facility is given by the earthquake scenario. The earthquake and aircraft crash scenarios are similar in that they both result in major structural damage and the release of Pu directly to the environment. They differ in that an earthquake-induced fire is based on limited combustible materials while the aircraft crash has the potential for a major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive serious or fatal impacts.

4.3.4.1.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of a vitrification facility. There is no spent nuclear fuel or HLW associated with the operation of the vitrification facility; however, the facility does generate as its product output a glass log. The vitrification facility would provide interim storage of the glass log until entry into the Federal Waste Management System for final disposition. Table 4.3.4.1.10–1 provides the estimated operational waste volumes projected to be generated at the sites analyzed as a result of the vitrification facility. Facilities that would support the vitrification facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated on-site to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the vitrification facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.4. A detailed description of the waste management activities that would be required to support the vitrification facility can also be found in Section E.3.3.4.

Construction and operation of a vitrification facility would impact existing waste management activities at each of the sites analyzed by increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Wastes generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Approximately 99 m^3 (130 yd^3) of solid TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and sludge from liquid TRU waste treatment would require treatment and repackaging to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the vitrification facility if sited at ORR, Pantex, or NTS. A small quantity (0.7 m^3 [0.9 yd^3]) of solid mixed TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), 12 additional truck shipments per year or, if applicable, 6 regular train shipments per year or 2 dedicated train shipments per year would be required. [Text deleted.]

All of the sites analyzed have existing or planned facilities that could manage the small quantities of LLW. Following treatment and volume reduction, approximately 14 m^3 (18 yd^3) of LLW from solidified liquid LLW, protective clothing, soil, and small equipment would require disposal. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.004 ha/yr (0.01 acre/yr) at Hanford and ORR, 0.002 ha/yr (0.006 acre/yr) at NTS and INEL, and 0.002 ha/yr (0.004 acre/yr) at SRS. With no onsite LLW disposal capability, Pantex would require one additional LLW shipment per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

A small quantity (0.15 m^3 [0.2 yd^3]) of solid mixed LLW consisting of contaminated solvent rags and equipment that has been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party

Table 4.3.4.1.10–1. Estimated Annual Generated Waste Volumes for the Vitrification Alternative[a]

Category	New Facility (m^3)	Hanford No Action (m^3)	NTS No Action (m^3)	INEL No Action (m^3)	Pantex No Action (m^3)	ORR No Action (m^3)	SRS No Action (m^3)
Transuranic							
Liquid	0.8[b]	None	None	None	None	None	None
Solid	99	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	0.7	98	None	Included in TRU	None	None	Included in TRU
Low-Level							
Liquid	7[b]	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	14	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-Level							
Liquid	0	3,760	None	4	4	87,600	1,330
Solid	0.15	1,505	50	170	46	432	7,700
Hazardous							
Liquid	19	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	19	560	212	1,200	31	26	15,100
Nonhazardous (Sanitary)							
Liquid	34,000	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	920	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	269,000	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	15[c]	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

[a] The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1. Incremental waste generation volumes for vitrification facility are from Table E.3.3.4–1. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.3.4–1.

[b] Liquid TRU and LLW would be treated and solidified prior to disposal.

[c] Recyclable wastes.

Agreement for Hanford or the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

An estimated 19 m^3 (5,000 gals) of liquid and 19 m^3 (25 yd^3) of solid hazardous wastes would be generated annually. Hazardous waste would consist primarily of analytical solutions and solvent rags contaminated with methylene chloride, acetonitrile, and acetone. Other hazardous wastes would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous waste would be staged in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately 34,000 m^3 (9 million gal) of liquid nonhazardous sanitary and industrial wastewater and 269,000 m^3 (71 million gal) of steam plant blowdown, process wastewater, and estimated stormwater runoff would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required for some of the DOE sites. For the Preferred Alternative, construction of sanitary, utility, and process wastewater treatment systems may not be required because approximately 30 percent of the surplus Pu would be vitrified. The construction of these treatment systems would be determined in further tiered NEPA documentation. The 920 m^3 (1,200 yd^3) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.4.2 Ceramic Immobilization Alternative

The environmental impacts described in the following sections are based on the analysis of the ceramic immobilization facility described in Section 2.4.4.2. The highly radioactive isotope Cs-137, would be included into the ceramic matrix to serve as a radiation barrier to theft and diversion. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS.

In accordance with the Preferred Alternative for surplus Pu disposition, the ceramic immobilization facility could be located at either Hanford or SRS. Further tiered NEPA review will be conducted to examine alternative locations including new and existing facilities at these two sites, should the Preferred Alternative be selected at the ROD.

For the ceramic immobilization, the analysis in Section 4.3.4.2.1 to 4.3.4.2.10 assumes that a new facility would be built. However, there are several potential variations described in Table 2.4–1, some of which could potentially use existing facilities for portions of the operations. For example, under the can-in-canister approach, the existing DWPF at SRS could be used to provide vitrified glass for the outer canister which surrounds the inner can of immobilized Pu.

4.3.4.2.1 *Land Resources*

A new ceramic immobilization facility would disturb 20 ha (49 acres) of land during construction of which 12 ha (30 acres) is used during operations. The need for buffer zones would be determined during site-specific, tiered NEPA documentation. This section describes the impacts to land resources from construction and operation of the facility for each representative site. Land use would be less if existing facilities were used for portions of the ceramic immobilization operation.

Construction and operation of the ceramic immobilization facility would not cause indirect land-use impacts at the analysis sites. As discussed in Section 4.3.4.2.8, in-migration of workers would be required during construction at INEL and Pantex and at all sites analyzed during operations. It is expected that historic housing construction rates would be sufficient to accommodate the in-migrating population at each site. Therefore, offsite land use at the analysis sites would not be affected.

Hanford Site

Land Use. The potential site for a new ceramic immobilization facility would utilize vacant land in the 200 Area adjacent to 200 East. Construction and operation of the ceramic immobilization alternative would be in conformance with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land use planning process. According to the *Hanford Site Development Plan*, 200 Area land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction and operation would be compatible with State and local (Benton, Franklin, and Grant counties and the city of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Area and current VRM Class 5 designation. A potential source of visual impact during operations would be from the stack plumes which could be visible from public viewpoints with high sensitivity levels, including State Highways 24 and 240 and the city of Richland; however, because of the viewing distance and compatibility of the proposal with existing industrial character, visual impacts would not occur.

Nevada Test Site

Land Use. [Text deleted.] Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area. [Text deleted.] However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of these counties or municipalities currently undertakes land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The proposed ceramic immobilization facility would be located on undeveloped land in the ICPP security area which is situated within the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). Construction and operation of the facility would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan* which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation would be compatible with the present visual character of INEL, which consists of large industrial facilities and stack plumes. Potential visual impacts could occur during operation from the additional stack plumes; however, the proposal would be consistent with the existing Class 5 industrial character of the ICPP.

Pantex Plant

Land Use. A new ceramic immobilization facility would be located on undeveloped land in Zone 4. The potential action would be inconsistent with the current *Pantex Site Development Plan* master plan which designates Zone 4 for weapons and weapon components for staging (PX DOE 1995g:16). However, Pantex could revise the site development plan should Pantex be selected for this alternative.

Construction would not affect other Pantex or offsite land uses. There would be no impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] Potential visual impacts could occur during operation from the additional stack plumes; however, the visual environment would be consistent with the existing industrialized landscape character, and VRM Class 5 designation of Zone 4.

Oak Ridge Reservation

Land Use. A new ceramic immobilization facility would be located on undeveloped land at the northwest quadrant of the Route 95/Bear Creek Road intersection. The alternative would be in conformance with future land-use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan,* which designates a portion of the site as a major waste management area (OR DOE 1991f:1-7). [Text deleted.]

Construction and operation would be compatible with ORR and offsite land uses. No prime farmlands exist onsite. A new ceramic immobilization facility would not be in conflict with city of Oak Ridge land-use plans, policies, and controls since the current *Oak Ridge Area Land Use Plan* designates the potential site for Industrial and Public land use.

Visual Resources. [Text deleted.] Construction and operation of the facility would change the current VRM Class 4 designation of the Bear Creek Road/Route 95 site to Class 5. Additionally, potential visual impacts could occur during operations from the new stack plumes. Construction and operation activities would be highly visible from Bear Creek Road and Route 95, public roadways with high sensitivity levels.

Savannah River Site

Land Use. A new ceramic immobilization facility would be located on undeveloped land in the F-Area. Facility construction and operation would conform with existing and future land use as designated by the *Savannah River Site Development Plan.* According to the plan, current F-Area land use is designated Industrial Operations, while the future land-use category is primary industrial mission. Specifically, the F-Area is one of four SRS waste management facilities (SR DOE 1994d:2,11,12). [Text deleted.]

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction would not be in conflict with local land use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] Construction would occur within an area of similar industrial landscape character. Potential visual impacts could occur during operation from additional stack plumes; however, the proposal would be consistent with the VRM Class 5 designation of the F-Area.

[Text deleted.]

4.3.4.2.2 *Site Infrastructure*

Implementation of the alternative for ceramic immobilization requires construction and operation of facilities to conduct the ceramic immobilization processes. Data for annual construction and operations are presented in Appendix C. Site infrastructure changes resulting from such construction are presented in Table 4.3.4.2.2–1 and changes from operations in Table 4.3.4.2.2–2 for six representative sites.

Hanford Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Hanford would require additional natural gas supplies to operate the ceramic immobilization facility. Since natural gas availability is governed by usage and not by storage capacity onsite, the additional natural gas required for operations could be procured through normal contractual means.

Nevada Test Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers. Since NTS uses fuel oil as its primary utility fuel, use of natural gas in lieu of fuel oil would require additional infrastructure during operations. The final facility design could be converted to use fuel oil. Construction and operation of this facility could require construction of transportation links to the existing road and rail networks, of less than 5 km (3 mi). Since NTS does not use natural gas, this facility would be designed to burn fuel oil if NTS were selected as the site.

Idaho National Engineering Laboratory

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Since INEL does not use natural gas, this facility would be designed to burn fuel oil if INEL were selected as the ceramic immobilization facility site.

Pantex Plant

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Additional oil would be required during the period of construction. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required for construction could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers.

Oak Ridge Reservation

[Text deleted.] Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers. Construction and operation of this facility would require construction of transportation

Table 4.3.4.2.2–1. Additional Site Infrastructure Needed for the Construction of the Ceramic Immobilization Alternative (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	8,000	1.5	2,200,000	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	353,500	59.5	11,534,800	21,039,531	0
Amount required in excess of site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Projected usage with facility	132,940	26.5	7,916,000	0	0
Amount required in excess of site availability	0	0	2,200,000[a]	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Projected usage with facility	240,500	43.5	8,020,000	0	11,340
Amount required in excess of site availability	0	0	0	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Projected usage with facility	54,266	11.5	2,995,166	7,200,000	0
Amount required in excess of site availability	0	0	1,219,446[a]	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	734,000	111.5	2,579,000	95,000,000	16,300
Amount required in excess of site availability	0	0	2,163,000[a]	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Projected usage with facility	802,000	118	30,590,500	0	221,352
Amount required in excess of site availability	0	0	2,200,000[a]	0	0

[a] Fuel oil requirements in excess of site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Table 4.3.4.2.2–2. Additional Site Infrastructure Needed for the Operation of the Ceramic Immobilization Alternative (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	< 5	< 5	25,000	3	190,000	3,500,000	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	370,500	61	9,524,800	24,539,531	0
Amount required in excess of site availability	< 5	<5	0	0	0	3,500,000[a]	0
NTS							
Site availability	1,100[b]	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	<5	149,940	28	5,906,000	3,500,000	0
Amount required in excess of site availability	0	<5	0	0	190,000[c]	3,500,000[a]	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	257,500	45	6,010,000	3,500,000	11,340
Amount required in excess of site availability	< 5	< 5	0	0	0	3,500,000[a]	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	71,266	13	985,166	10,700,000	0
Amount required in excess of site availability	< 5	< 5	0	0	0	0	0
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	76	32	751,000	113	569,000	98,500,000	16,300
Amount required in excess of site availability	< 5	< 5	0	0	153,000[c]	0	0

Table 4.3.4.2.2–2. Additional Site Infrastructure Needed for the Operation of the Ceramic Immobilization Alternative (Annual)—Continued

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	819,000	119	28,580,500	3,500,000	221,352
Amount required in excess of site availability	< 5	< 5	0	0	190,000[c]	3,500,000[a]	0

[a] Facility would be adapted to use fuel oil instead of natural gas.

[b] Includes paved and unpaved roads.

[c] Fuel oil requirements in excess of site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible.

Savannah River Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to the existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contracts, or the construction companies could provide for this additional oil from local suppliers. Because SRS does not use natural gas, this facility would be designed to burn fuel oil if SRS were selected as the ceramic immobilization facility site.

4.3.4.2.3 *Air Quality and Noise*

Construction and operation of the ceramic immobilization facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.4.2.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction. Construction impacts would be lower if existing facilities were used.

Emission rates for operation of the ceramic immobilization facility are presented in Table F.1.3–10. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]

The PSD regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on the emission rates presented in Appendix F, PSD permits may be required for this alternative at any of the sites. This may require "offsets," reductions of existing emissions, to permit any additional or new emission source.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation, plus the No Action concentrations, are presented in Table 4.3.4.2.3–1. VOCs are the only toxic/hazardous emissions and were not modeled for this PEIS.

NOISE

The location of the facilities associated with the ceramic immobilization facility relative to the site boundary and sensitive receptors was examined for each site to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include

Table 4.3.4.2.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Ceramic Immobilization Alternative and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)
Criteria Pollutant														
Carbon monoxide	8-hour	10,000	0.08	39.68	2,290	2,321.46	284	383.5	602	984.8	5	14.81	22	360.7
	1-hour	40,000	0.3	314.95	2,748	2,970.3	614	865.9	2,900	4,897	11	31.31	171	1,765
Lead	Calendar Quarter	1.5	<0.01	<0.01	[b]	[b]	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01
	24-hour	0.5	<0.01	<0.01	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
Nitrogen dioxide	Annual	100	0.03	3.75	[b]	0.56[d]	4	9.08	2.15	22.95	3	3.84	5.7	21.91
Ozone[c]	1-hour	235	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01	<0.01	9.4	9.4	5	5.01	8.73	8.75	1	1	3	3.02
	24-hour	150	0.02	0.06	106	106	80	80.11	88.5	88.91	2	2.01	50.6	50.97
Sulfur dioxide	Annual	52	<0.01	<0.01	8.4	8.4	6	6	<0.01	<0.01	2	2	14.5	14.5
	24-hour	260	<0.01	<0.01	94.6	94.6	135	135	<0.01	0.05	32	32	196	196.03
	3-hour	1,300	0.01	0.04	725	725	579	579	<0.01	0.21	80	80	823	823.21
	1-hour[f]	1,018	0.02	0.11	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	1-hour	655[f]	0.02	0.11	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	30-minute	1,045	[c]	[c]	[c]	[c]	[c]	[c]	<0.01	0.54	[c]	[c]	[c]	[c]
Mandated by State														
Gaseous fluoride (as HF)	30-day	0.8	[b]	[b]	[c]	[c]	[c]	[c]	<0.75	<0.75	0.2	0.2	0.09	0.09
	7-day	1.6	[b]	[b]	[c]	[c]	[c]	[c]	<0.75	<0.75	0.3	0.3	0.39	0.39
	24-hour	2.9	[b]	[b]	[c]	[c]	[c]	[c]	0.75	0.75	0.6[g]	0.6[g]	1.04	1.04
	12-hour	3.7	[b]	[b]	[c]	[c]	[c]	[c]	1.05	1.05	0.6[g]	0.6[g]	1.99	1.99
	8-hour	250	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	0.6	0.6	[c]	[c]
	3-hour	4.9	[c]	[c]	[c]	[c]	[c]	[c]	4.21	4.21	[c]	[c]	[c]	[c]

Table 4.3.4.2.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Ceramic Immobilization Alternative and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)
Hydrogen sulfide	1-hour	112	[c]	[c]	[b]	[b]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	30-minute	111	[c]	[c]	[c]	[c]	[c]	[c]	[b]	[b]	[c]	[c]	[c]	[c]
Total suspended particulates	Annual	60	<0.01	<0.01	[c]	[c]	5	5.01	[c]	[c]	[c]	[c]	12.6	12.62
	24-hour	150	0.02	0.06	[c]	[c]	80	80.11	[c]	[c]	2	2.01	[c]	[c]
	3-hour	200	[c]	[c]	[c]	[c]	[c]	[c]	[b]	2.29[d]	[c]	[c]	[c]	[c]
	1-hour	400	[c]	[c]	[c]	[c]	[c]	[c]	[b]	6.15[d]	[c]	[c]	[c]	[c]

[Text deleted.]

[a] The more stringent of the Federal and State standards is presented for the averaging time.

[Text deleted.]

[b] No sources of this pollutant have been identified.

[c] No State standard for indicated averaging time.

[d] The concentration represents the alternative contribution only.

[e] Ozone, as a criteria pollutant, is not directly emitted or monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

[f] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.

[g] 8-hour averaging time concentration was used.

Note: Total concentrations are based on site contribution, including contribution from ongoing activities (No Action), and do not include the contribution from non-facility sources. Concentrations from other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LLNL 1996d; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

heavy-construction equipment and increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Nontraffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, and emergency diesel generators. These noise sources would be located at sufficient distance from offsite areas so that the contribution to offsite noise levels would continue to be small. Due to the size of the sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.4.2.4 *Water Resources*

The construction and operation of a ceramic immobilization facility would affect water resources. Water resource requirements and discharges provided in Tables C.1.1.3–5 and C.2.1.3–5 and Table E.3.3.5–1, were used to assess impacts to surface water and groundwater. The discussion of impacts is provided for each site separately. Table 4.3.4.2.4–1 presents No Action surface water and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the ceramic immobilization facility to a HLW repository.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the ceramic immobilization facility. During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr), which would represent a 0.3-percent increase over the projected annual surface water withdrawal (13,511 million l/yr [3,569 million gal/yr]). During operation, the total annual water requirement for the ceramic immobilization facility would be approximately 250 million l/yr (66 million gal/yr). This would represent a 1.9-percent increase over the projected surface water annual withdrawal and would increase Hanford's total withdrawals to 0.04-percent of the minimum average flow of the Columbia River. These additional withdrawals would have a negligible impact on surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated, treated, and discharged to evaporation/percolation ponds. This amount would represent a 11.7-percent increase in the annual amount being discharged. During operation, approximately 98 million l/yr (25.9 million gal/yr) of sanitary and other wastewater would be recycled or discharged to evaporation/percolation ponds. This amount would represent a 39.8-percent increase in the amount being discharged. All discharges would be monitored to comply with discharge requirements.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown, etc.) would be monitored, collected, and treated if necessary prior to recycle within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The ceramic immobilization facility would be located in the 200 Area which is above the 100-year, 500-year, and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for construction or operation of the facility; therefore there would be no impact to groundwater availability. Construction and operation of the facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds which does not evaporate, however, could percolate downward into the near surface aquifer groundwater. This water would be monitored and would not be discharged to the ponds until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of the potential impacts to groundwater quality are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Table 4.3.4.2.4–1. Potential Changes to Water Resources Resulting From the Ceramic Immobilization Alternative

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Water Source	Surface	Ground	Ground	Ground	Surface	Ground
No Action water requirements (million l/yr)	13,511	2,400	7,570	249	14,760	13,247
No Action wastewater discharge (million l/yr)	246	82	540	141	2,277	700
Construction						
Water Availability and Use						
Total water requirement (million l/yr)	38	38	38	38	38	38
Percent increase in projected water use[a]	0.3	1.6	0.5	15.3	0.3	0.3
Water Quality						
Total wastewater discharge (million l/yr)	28.8	28.8	28.8	28.8	28.8	28.8
Percent change in wastewater discharge[b]	11.7	35.1	5.3	20.4	1.3	4.1
Percent change in streamflow	neg	NA	NA	NA	0.06[c]	0.6[d]
Operation						
Water Availability and Use						
Total water requirement (million l/yr)	250	250	250	250	250	250
Percent increase in projected water use[e]	1.9	10.4	3.3	100	1.7	1.9
Water Quality						
Total wastewater discharge (million l/yr)	98	98	98	98	98	98
Percent change in wastewater discharge[f]	39.8	119.5	18.1	69.5	4.3	14.0
Percent change in streamflow	neg	NA	NA	NA	0.2[c]	1.9[d]
Floodplain						
Is action in 100-year floodplain?	No	No	No	No	No	No
Is critical action in 500-year floodplain?	No	Uncertain	Uncertain	No	Uncertain	Unlikely

[a] Percent increases in water requirements during construction of the ceramic immobilization facility are calculated by dividing water requirements for the facility (38 million l/yr with that for each site No Action water requirements: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[b] Percent changes in wastewater discharged during construction for the new ceramic immobilization facility are calculated by dividing wastewater discharges for the facility (28.8 million l/yr) with the No Action wastewater discharge for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr]), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

[c] Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for the East Fork Poplar Creek is shown in the table.

[d] Percent changes in stream flow from wastewater discharges are calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).

[e] Percent increases in water requirements during operation of the ceramic immobilization facility are calculated by dividing water requirements (250 million l/yr with that for each site No Action water requirements: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[f] Percent changes in wastewater discharged during operation of the ceramic immobilization facility are calculated by dividing wastewater discharge rate for the new facility (98 million l/yr) with the No Action wastewater discharge for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only through the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with facility; groundwater would be used as the water source for construction and operation of the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater, and other nonhazardous wastewater (28.8 million l/yr [7.6 million gal/yr]), would be generated. During operation, a maximum of approximately 98 million l/yr (25.9 million gal/yr) of sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle.

Water from heating the facility will be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Condensation from heating, air conditioning and other distillates, fire sprinkler water and truck hose-down water would be monitored for radioactivity, and if uncontaminated, available for recycle or discharge to natural drainage channels.

No studies to assess the 500-year floodplain boundaries at NTS have been conducted. Studies of the 100-year floodplain have shown it to be confined to the Jackass Flats and Frenchman Lake areas. The proposed site for the ceramic immobilization facility is not located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms which can create brief (less than 6 hours) flash floods, the facilities would be designed to withstand such flooding. Information on the location of the 500-year floodplain could be developed in future environmental studies.

Groundwater. All water required for construction and operation would be supplied from groundwater. Quantities required and the percent increase in projected water use are shown in Table 4.3.4.2.4–1. Construction water requirements for the facilities (38 million l/yr [10 million gal/yr]) would represent approximately 0.1 percent of the minimum estimated annual recharge (38 billion l/yr [10 billion gal/yr]) to the regional aquifer under the entire NTS. As shown in Table 4.3.4.2.4–1, the quantity of water required for construction of the proposed facility would represent a 1.6-percent increase over the projected No Action groundwater use. Operating the facility at NTS would require 250 million l/yr (66 million gal/yr), which is approximately 10.4 percent of the projected groundwater use. This additional withdrawal would represent 0.7 percent of the estimated minimum annual recharge, and would increase the total amount withdrawn annually at NTS to 7.0 percent of the estimated annual recharge. These additional withdrawals would not impact groundwater availability.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged to the ponds until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combine effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated, treated, and discharged to evaporation/percolation ponds, or be available for recycle. During operation, approximately 98 million l/yr (25.9 million gal/yr) of sanitary and other nonhazardous liquids (including industrial wastewater, cooling water, blowdown, and stormwater runoff) would be treated and discharged to evaporation/percolation ponds, or be available for recycle. All discharges would be monitored to comply with discharge limits.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated, if necessary, prior to recycle within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The candidate site for the ceramic immobilization facility is not located in an area historically prone to flooding, but is within the flood zone which could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. As shown in Table 4.3.4.2.4–1, construction water requirements for the facility (38 million l/yr [10.0 million gal/yr]), would represent a 0.5-percent increase over the projected annual groundwater usage and would be within INEL's current allotment. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr) has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). No impacts to groundwater availability would occur. During operation, the water requirements for the facilities would be 250 million l/yr (66 million gal/yr). This would represent a 3.3-percent increase over the projected annual groundwater usage; INEL would still be well within the total groundwater allotment.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged to the disposal ponds until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combine effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for construction and operation of the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated and discharged to the existing wastewater treatment systems north of Zone 12. During operation, a maximum of approximately 98 million l/yr (25.9 million gal/yr) of sanitary wastewater and other wastewater would be discharged to these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would be discharged to the playa lakes or would be recycled. Since Pantex discharged approximately 1.4 million l/day (0.37 million gal/day) of wastewater into the

playas in 1994 and since this quantity is expected to decrease in the future, the expected quantity of additional wastewater potentially discharged to the playas should not cause any exceedance of the monthly average limit of 2.46 million l/day (0.65 million gal/day).

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated if necessary prior to recycle within the facility or discharge to the playas. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The proposed location for the ceramic immobilization facility is in Zone 4. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 4, there would be no impacts to floodplains. However, flooding in other areas of Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system which obtains water from the Ogallala Aquifer or possibly from reclaimed wastewater. Construction water requirements for the ceramic immobilization facilities would be small relative to the recoverable water in aquifer storage, which for the year 2010 was estimated to be 287 trillion l (75.8 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.4.2.4–1, construction of the proposed consolidated facilities would require 38 million l/yr (10 million gal/yr) of water, which would represent approximately a 15.3-percent increase over the projected annual No Action groundwater usage and 2-percent of the capacity of the groundwater wells. [Text deleted.] Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8 m/yr (5.9 ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the ceramic immobilization facilities at Pantex would require 250 million l/yr (66 million gal/yr) resulting in a small drawdown representing 13.2 percent of the capacity of the groundwater system. This additional drawdown would not impact regional groundwater levels. The total site groundwater withdrawal including this facility would be 449 million l/yr (131.8 million gal/yr) which, because of expected cutbacks in other programs, would be 40 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered includes decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the ceramic immobilization facility would be obtained from the Clinch River and its tributaries. [Text deleted.] During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr), which would represent a 0.3-percent increase over the projected annual No Action surface water withdrawal. During operation, water requirements would be approximately 250 million l/yr (66 million gal/yr). This would represent a 1.7-percent increase over the projected annual No Action surface water withdrawal. Total ORR withdrawals would be 0.4-percent of the

average flow of the Clinch River (132 m^3/s [4,647 ft^3/s]). Minimal impacts to surface water availability would occur.

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated, treated, and discharged to East Fork Poplar Creek. During operation, a total of 98 million l/yr (25.9 million gal/yr) of wastewater would be generated by the facility. This quantity would represent about 0.2-percent of the minimum flow of East Fork Poplar Creek and a 4.3-percent increase in annual discharge amounts. All discharges would be monitored to comply with discharge requirements. No impacts are expected.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, etc.) would be monitored, collected, and treated if necessary prior to recycle within the facility or discharged to natural drainage channels. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The potential site location of the ceramic immobilization facility is located outside the 100-year floodplain; there would be no impact to the floodplain. The 500-year floodplain has not been determined in this area but could be developed in future studies.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water withdrawals would be made; groundwater would be used for all construction and operation needs of a new ceramic immobilization facility. During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modifications. This would represent a 4.1-percent increase in the effluent from this facility. If existing facilities were used, there would be less water used and wastewater discharged during construction. During operation, approximately 98 million l/yr (25.9 million gal/yr) of sanitary wastewater would be discharged to this wastewater treatment system. This would represent a 14.0-percent increase in the effluent discharged to Fourmile Branch from this facility. This discharge would not exceed 1.9 percent of the minimum flow of this stream; no impacts are expected. All discharges would be monitored to comply with discharge requirements. Other nonhazardous wastewater effluents (for example, condensation from air conditioning and heating, fire sprinkler water, cooling system blowdown) would be collected, monitored, and treated if necessary prior to recycle within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The potential location for a new ceramic immobilization facility is outside the 100-year floodplain. Although, information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas, the ceramic immobilization facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek. This is because the facility would be is located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about 58 m^3/s (2,040 ft^3/s). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 63 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately 5 m^3/s (186 ft^3/s), and an elevation of about 61 m (199 ft) above MSL

(SR USGS 1996a:1). Elevations of the buildings in F-Area would be more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr), which would represent a 0.3-percent increase over the projected annual No Action groundwater withdrawal. This additional withdrawal should cause negligible impacts to groundwater availability. During operation, water used for cooling system makeup would be obtained from existing supply systems in the F-Area. The water for these systems is groundwater from the Cretaceous Aquifer. Water requirements during operations (250 million l/yr [66 million gal/yr]), as shown in Table 4.3.4.2.4–1, represent a 1.9-percent increase in the projected No Action groundwater usage at SRS. There would be reduced impacts if existing facilities are used. These additional withdrawals would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals from the Cretaceous Aquifer of eight times greater than that required for the ceramic immobilization facility indicate that drawdown could be almost 2.1 m/yr (6.9 ft/yr) at the well head, but would be smaller in overlying aquifers and would not extend beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that the withdrawals attributed to the ceramic immobilization facility would cause a small drawdown at the well head and should not affect any aquifers in the area.

No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

[Text deleted.]

4.3.4.2.5 *Geology and Soils*

This section describes the environmental impacts to the geologic and soil resource as related to the construction and operation of the ceramic immobilization facility. This facility at any of the alternative sites, would involve some ground-disturbing construction activities (20 ha [49 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rain) is greater at ORR and SRS than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities or site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to greater relative annual precipitation. Soil disturbance would occur primarily from ground-breaking construction activities (foundation preparation) and associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increase wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns. Soil loss associated with construction would be less if existing facilities were used for part of the immobilization process.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal.

[Text deleted.]

4.3.4.2.6 *Biological Resources*

Construction of the ceramic immobilization facility would require 20 ha (49 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Land requirements and impacts on biological resources would be less if existing facilities were used for portions of the ceramic immobilization operations. Consultation with USFWS and State agencies would be conducted at the site-specific level as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that a new ceramic immobilization facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility would result in the disturbance of terrestrial habitat equaling about 0.01 percent of Hanford. This includes areas on which plant facilities would be constructed as well as areas that would be revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The assumed facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the ceramic immobilization facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a ceramic immobilization facility at Hanford would not impact aquatic resources since there are no surface water bodies sufficiently near the assumed facility location so as to be directly affected by construction activities or indirectly affected by runoff. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure. Since the volume of water included represents a small percentage of the flow of the river, impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the ceramic immobilization facility; however, sagebrush habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the ceramic immobilization facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at NTS would result in the disturbance of terrestrial habitat equaling about 0.01 percent of NTS. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operations, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the ceramic immobilization facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the ceramic immobilization facility at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicle traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training, putting restrictions on vehicle speeds and off-road movement, conducting clearance surveys prior to surface disturbance, approving stop work authority if tortoises are found within work areas, removing tortoises from roadways and work areas, placing permanent and temporary tortoise-proof fencing around trenches, landfills, and treatment ponds, inspecting trenches, and having biologists survey when heavy equipment is in

use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the ceramic immobilization facility.

[Text deleted.] Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicle traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the ceramic immobilization facility (Section 4.3.4.2.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the ceramic immobilization facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to smaller mammals and some birds and reptiles which could be displaced or suffer mortality. Larger mammals are excluded from the assumed facility location by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources near the assumed facility location, these resources would not be affected by construction or operation of the ceramic immobilization facility. Since the facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected since they are not present at the ICPP.

Pantex Plant

It is assumed that the ceramic immobilization facility would be located within Zone 4 which is a developed area with minimal natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the facility location; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to an increase in open water near the outfall, as well as a change in plant species composition. No federally listed threatened or endangered species would be affected by construction or operation of the facility. Although the facility location has been disturbed, it is possible that the State-listed Texas horned lizard could be present. Preactivity surveys would be conducted as appropriate prior to construction.

Oak Ridge Reservation

It is assumed that the ceramic immobilization facility would be located about 3 km (2 mi) east of the K–25 area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at ORR would result in the disturbance of terrestrial habitat equaling about 0.1 percent of ORR. Vegetation within the area to be developed would be destroyed during land clearing. Vegetation cover within the assumed site is predominantly oak-hickory forest or pine and pine-hardwood forest (Figure 3.6.6–1). While both types would be affected by construction, it is likely that a greater area of pine and pine-hardwood forests would be removed. This type of

forest is more heavily concentrated in valleys where most of the development would occur. Oak-hickory forests are typically found on ridges. Both forest types are common throughout ORR and within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals within the assumed project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbances to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediment control measures would control secondary impacts. Since an existing intake structure would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River. However, a new wastewater discharge structure could be required on East Fork Poplar Creek. Depending on its location, this structure could displace some wetlands along the creek. Any unavoidable impacts to wetlands would be mitigated.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impact on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the ceramic immobilization facility could cause water quality changes (primarily sediment loading and resulting turbidity) to Bear Creek, Grassy Creek, or Ish Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since a new intake structure would not be required, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little affect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river.

During construction and operation, wastewater would be discharged to East Fork Poplar Creek. This could require the construction of a new discharge structure which would temporarily disturb aquatic habitat in the vicinity of the outfall. The small volume of wastewater discharged to the stream would not be expected to impact aquatic resources during either construction or operation. In addition, NPDES discharge requirements would be met.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the ceramic immobilization facility. Land-clearing activities may destroy State protected plant species found within or adjacent to disturbed portions of the assumed site including pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily,

and golden seal. The Tennessee dace is sensitive to siltation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Ish Creek or Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility.

[Text deleted.]

Savannah River Site

It is assumed that a new ceramic immobilization facility would be constructed within the F-Area, which is one of the highly developed industrial areas of SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since water would be taken from existing sources and discharged via NPDES-permitted outfalls and would involve minor volumes. Construction and operation of the ceramic immobilization facility is not expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site so that this species would not be directly affected by this action.

4.3.4.2.7 *Cultural and Paleontological Resources*

This section discusses potential impacts to cultural and paleontological resources that may result from construction and operation of the ceramic immobilization facility at each of the representative sites analyzed. The land to be disturbed during construction totals 20 ha (49 acres) of which 12 ha (30 acres) would be used during operation. If existing facilities were used for a portion of the ceramic immobilization operation, less land would be disturbed and there would be fewer impacts to cultural and paleontological resources. [Text deleted.] For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through pre-construction surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The ceramic immobilization facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. However, additional unsurveyed lands necessary for the proposed facility may contain prehistoric or historic resources. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Impacts to any prehistoric or historic resources would occur during construction, but not operation, of the proposed facility.

The CGTO has conducted surveys over portions of Frenchman Flat and has identified at least 20 plant species of importance to Native Americans. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from facility construction and operation. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The ceramic immobilization facility would be constructed within the existing developed and disturbed ICPP security area. The facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of the area identified no sites within the proposed project area. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites occur adjacent to the ICPP—one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have a visual or auditory impact on traditional use areas or sacred sites. Such resources may be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain which have produced fossilized remains.

Pantex Plant

The ceramic immobilization facility would be constructed in Zone 4 of Pantex. A historic buildings survey was conducted in Zone 4 to identify significant World War II Era structures and none of the buildings there is considered NRHP-eligible on that basis. Zone 4 has not been systematically surveyed for archaeological sites. Because the area is developed and disturbed, it is unlikely to contain NRHP-eligible archaeological resources. The area is a developed industrial zone and the probability of archaeological sites there is low. In compliance with the standing programmatic agreement, survey work would be conducted on all areas that would be affected by construction prior to ground-breaking activities. Recorded site types at Pantex include lithic scatters, hunting/kill sites, and concentrations of fire-cracked rock, and are located predominantly near the playas. Historic sites are generally associated with farming, such as remains of homes and outbuildings, and World War II and Cold War Era structures. Resources such as these may occur on the land that would be disturbed during construction. Operation would not have an additional impact on archaeological sites.

The Department has initiated a public outreach program to involve Native American groups in decision-making related to land use and cultural resources. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any sacred sites, ceremonial areas, or cemeteries in Zone 4. Additional consultation may identify some of these resources. Resources such as cemeteries could be affected by new construction. Operation could have an auditory or visual impact on sacred or ceremonial sites.

Important paleontological remains, such as bison and camel bones, have been found in other areas of the High Plains and it is possible that some may occur in lands to be disturbed by construction at Pantex. Operation would not affect paleontological remains.

Oak Ridge Reservation

This facility would be constructed at the intersection of Route 95 and Bear Creek Road, north of Bear Creek Road. A portion of this area on both sides of Bear Creek Road was surveyed prior to construction of the proposed Exxon Nuclear Facility which was never built (OR UTN 1975a:ii). Some prehistoric sites were identified near the Clinch River, and the potential for sites along the smaller creeks exists. In addition, remains of a number of early 20th-century frame houses and mid-to-late 19th-century log houses and outbuildings are located within the project area. Some of these resources may be affected by facility construction. Prehistoric site types that are known to occur at ORR include remains of prehistoric villages, burial grounds, quarries and lithic workshops,

and shell scatters. Historic resources may include standing structures, as well as remains of dwellings, road traces, cemeteries, and trash scatters. Resources such as these may occur in the area and may be affected by construction, but not operation, of the facility.

No Native American resources have been identified in the project area to date. Some may be identified during project-specific consultation. Native American resources such as ancestral sites, cemeteries, and traditionally used plant and animal species could be affected by construction. Operation may have an auditory or visual impact on sacred or ceremonial sites.

Some paleontological resources may occur in the area to be disturbed during construction but no fossil remains with high research value are known to occur at ORR. During operation, no additional ground disturbance is expected so, there would be no impact to paleontological resources.

Savannah River Site

A new ceramic immobilization facility would be located in open space within F-Area. Portions of F-Area have been surveyed and contain sites that are considered potentially eligible for the NRHP. Additional surveys would be conducted in areas to be disturbed by construction. Site types known to occur at SRS include remains of prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by facility construction but not operation.

Some Native American resources may be affected by the proposed action. Resources such as prehistoric sites, cemeteries, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to these areas may also result from facility construction or operation. These resources would be identified through consultation with the potentially affected tribes.

No scientifically valuable fossilized remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

[Text deleted.]

4.3.4.2.8 *Socioeconomics*

This section analyzes the socioeconomic effects of the ceramic immobilization facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all of the candidate sites are found in the Supplemental Data Report (Socio 1996a). Socioeconomic impacts attributable to construction would be reduced if existing facilities are used for part of the ceramic immobilization operation.

Regional Economy Characteristics. Constructing the ceramic immobilization facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 1,000 workers in the peak year of construction at any site. The largest increases in regional employment (about 1 percent) and regional per capita income (much less than 1 percent) would be at INEL. A total of 2,030 new jobs (1,000 direct and 1,030 indirect) would be generated and regional unemployment would fall from 5.4 percent to 4.5 percent in the INEL REA (Socio 1996a).

Operating the facility would generate greater socioeconomic changes than would construction, due to the larger, more permanent workforce. A workforce of 860 would be required for full operation at any site. Implementing the alternative at INEL would generate the largest increases in regional employment (about 2 percent) and per capita income (less than 1 percent). A total 3,167 new jobs (860 direct and 2,307 indirect) would be created by the operational activities, and regional unemployment would fall to 3.9 percent (Socio 1996a).

Population and Housing. At all of the sites analyzed, except INEL and Pantex, construction employment requirements would be met by the available resident labor force. However, some in-migrating workers would be needed to fill more specialized positions during operation. Project-related population increases would be the largest at INEL during construction of the facility. Pantex would require the largest number of in-migrating workers for operations; however, population increases in either ROI would be less than 1 percent over No Action projects.

Housing units, in excess of existing vacancies, would be required in the Pantex and INEL ROIs during construction of the project. Additional housing construction would also be required during operation at all sites analyzed, except NTS, to accommodate the in-migrating population. The greatest increase in housing requirement during both phases would be in the INEL ROI, but this would be less than 1 percent over No Action estimates. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at all of the sites analyzed (Socio 1996a).

Community Services. Constructing the ceramic immobilization facility would increase demand for community services at Pantex and INEL, but not at the other sites analyzed. However, operation of the facility would slightly increase the demand for community services at all of the sites analyzed. The effects of population growth due to in-migrating workers during construction or operations on community services at any of the sites analyzed would be minor. The following discussion focuses on the INEL and Pantex ROIs where the greatest increases in demand for community services would occur.

To maintain the No Action student-to-teacher ratio of 18.5:1 in the INEL ROI, 17 new teachers would be needed during construction. The Pantex ROI would need 22 teachers to maintain the No Action student-to-teacher ratio of 16.3:1 during operation. These increases in teacher requirements, however, would be distributed over several school districts in the ROI, and no single school district would be significantly affected (Socio 1996a).

During construction, 2 police officers and 3 firefighters would be needed to maintain the No Action service levels of 1.6 police officers and 2.2 firefighters per 1,000 persons in the INEL ROI. Three additional police officers and 5 new firefighters would be needed to maintain No Action service levels of 2.3 police officers and 2.3 firefighters per 1,000 persons in the Pantex ROI during operations (Socio 1996a).

Projected hospital occupancy rates would increase slightly over No Action levels at all of the sites analyzed during operations. However projected capacities would be capable of accommodating these small increases in patient load. Two additional physicians would be needed in the INEL ROI during construction and 3 additional physicians during operation in the Pantex ROI to maintain the No Action service levels of 1.2 and 2.0 physicians per 1,000 persons, respectively (Socio 1996a).

Local Transportation. Construction of the ceramic immobilization facility would have the greatest relative effect on local transportation at INEL. A total of 1,920 vehicle trips per day would be generated during the construction of the ceramic immobilization facility. This increase would cause a drop in the level of service to two road segments in the INEL ROI. U.S. 20 from U.S. 26/91 at Idaho Falls to U.S. 26 East would change from D to E; U.S. 20/26 from U.S. 26 East to State Route 22/33 would change form B to C.

Operations at INEL would generate 1,651 vehicle trips per day. The impacts would be the same as described for the construction phase of the ceramic immobilization facility.

4.3.4.2.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the ceramic immobilization facility. The section first describes the impacts from normal facility operation at each potential site followed by a description of impacts from facility accidents. The impacts associated with the ultimate disposal of the immobilized form in an HLW repository are presented separately in technical documents that specifically address repository operations.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 10-year campaign time are presented in Tables 4.3.4.2.9–1 and 4.3.4.2.9–2, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.4.2.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.3.4.2.9–4 through 4.3.4.2.9–9. Detailed results are presented in Section M. For the Preferred Alternative, the duration would be reduced to 3.5 years and the risk and fatalities would also be reduced proportionally. The ceramic immobilization facility would be collocated with the Pu conversion facility under the Preferred Alternative but are analyzed separately in this PEIS.

The DOE's Preferred Alternative for Pu disposition includes the use of vitrification or immobilization technologies for the disposition of Pu in existing reactors. As a result of implementing a multiple technology disposition strategy for analysis purposes, approximately 30 percent of the surplus Pu would be vitrified or immobilized. Summaries of the radiological and hazardous chemical impacts to the public and to workers associated with normal operations and with postulated accidents are presented for an assumed 10-year operational campaign for the disposition of 50 t (55.1 tons) of Pu and for an assumed 3.5-year operational campaign for the Preferred Alternative. The impacts and risks associated with the Preferred Alternative would be reduced due to a shorter period of operations. It should also be noted that a Pu conversion facility may be collocated with the vitrification or immobilization facility. Impacts attributed to the Pu conversion facility are described in Section 4.3.2.9 for 10 years of operation.

Normal Operation. There would be no radiological releases associated with the construction of a ceramic immobilization facility at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. If existing facilities are used, the hazardous chemical releases would be reduced. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed member of the public resulting from the normal operation of a ceramic immobilization facility at each of the sites are presented in Table 4.3.4.2.9–1. The impacts from all site operations, including the ceramic immobilization facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses to the maximally exposed member of the public from annual ceramic immobilization facility operation would range from 1.2×10^{-7} mrem at NTS to 4.2×10^{-6} mrem at the ORR site. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 6.0×10^{-13} to 2.1×10^{-11}. The impacts to the average individual would be less. As a result of annual facility operations, the population doses would range from 1.7×10^{-7} person-rem at the NTS site to 6.7×10^{-5} person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 8.5×10^{-10} to 3.4×10^{-7}.

Table 4.3.4.2.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Ceramic Immobilization Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]												
Atmospheric release pathway (mrem)	2.3×10^{-7}	4.4×10^{-3}	1.2×10^{-7}	4.2×10^{-3}	1.5×10^{-7}	0.018	1.8×10^{-6}	6.2×10^{-5}	4.2×10^{-6}	1.5	1.3×10^{-6}	0.42
Drinking water pathway	0	0	0	0	0	0	0	0	0	0.10	0	0.081
Total liquid release pathway (mrem)	0	9.5×10^{-4}	0	0	0	0	0	0	0	1.7	0	0.37
Atmospheric and liquid release pathways combined (mrem)	2.3×10^{-7}	5.3×10^{-3}	1.2×10^{-7}	4.2×10^{-3}	1.5×10^{-7}	0.018	1.8×10^{-6}	6.2×10^{-5}	4.2×10^{-6}	3.2	1.3×10^{-6}	0.79
Percent of natural background[c]	7.7×10^{-8}	1.8×10^{-3}	3.8×10^{-8}	1.3×10^{-3}	4.4×10^{-8}	5.2×10^{-3}	5.4×10^{-7}	1.9×10^{-5}	1.4×10^{-6}	1.1	4.4×10^{-7}	0.27
10-year fatal cancer risk	1.2×10^{-12}	2.7×10^{-8}	6.0×10^{-13}	2.1×10^{-8}	7.5×10^{-13}	8.9×10^{-8}	9.0×10^{-12}	3.1×10^{-10}	2.1×10^{-11}	1.6×10^{-5}	6.5×10^{-12}	4.0×10^{-6}
3.5-year fatal cancer risk[d]	4.2×10^{-13}	9.5×10^{-9}	2.1×10^{-13}	7.4×10^{-9}	2.6×10^{-13}	3.1×10^{-8}	3.2×10^{-12}	1.1×10^{-10}	7.4×10^{-12}	5.6×10^{-6}	2.3×10^{-12}	1.4×10^{-6}
Annual Population Dose Within 80 Kilometers[e]												
Atmospheric release pathway (person-rem)	3.9×10^{-5}	0.46	1.7×10^{-7}	3.7×10^{-3}	1.4×10^{-5}	2.4	1.9×10^{-5}	3.0×10^{-4}	3.2×10^{-5}	29	6.7×10^{-5}	40
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6
Atmospheric and liquid release pathways combined (person-rem)	3.9×10^{-5}	1.6	1.7×10^{-7}	3.7×10^{-3}	1.4×10^{-5}	2.4	1.9×10^{-5}	3.0×10^{-4}	3.2×10^{-5}	34	6.7×10^{-5}	44
Percent of natural background[c]	2.1×10^{-8}	8.4×10^{-4}	1.8×10^{-9}	4.0×10^{-5}	1.5×10^{-8}	2.7×10^{-3}	1.6×10^{-8}	2.6×10^{-7}	8.4×10^{-9}	9.0×10^{-3}	2.5×10^{-8}	0.017
10-year fatal cancers	2.0×10^{-7}	7.8×10^{-3}	8.5×10^{-10}	1.9×10^{-5}	7.0×10^{-8}	0.012	9.5×10^{-8}	1.5×10^{-6}	1.6×10^{-7}	0.17	3.4×10^{-7}	0.22
3.5-year fatal cancers[d]	7.0×10^{-8}	2.7×10^{-3}	3.0×10^{-10}	6.7×10^{-6}	2.5×10^{-8}	4.2×10^{-3}	3.3×10^{-8}	5.3×10^{-7}	5.6×10^{-8}	0.060	1.2×10^{-7}	0.077

Table 4.3.4.2.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Ceramic Immobilization Alternative—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Average Individual Within 80 Kilometers[f]												
Atmospheric and liquid release pathways combined (mrem)	6.3×10^{-8}	2.6×10^{-3}	5.8×10^{-9}	1.3×10^{-4}	5.2×10^{-8}	8.9×10^{-3}	5.4×10^{-8}	8.6×10^{-7}	2.5×10^{-8}	0.026	7.5×10^{-8}	0.049
10-year fatal cancer risk	3.1×10^{-13}	1.3×10^{-8}	2.9×10^{-14}	6.3×10^{-10}	2.6×10^{-13}	4.5×10^{-8}	2.7×10^{-13}	4.3×10^{-12}	1.2×10^{-13}	1.3×10^{-7}	3.8×10^{-13}	2.5×10^{-7}
3.5 year fatal cancer risk[d]	1.1×10^{-13}	4.6×10^{-9}	1.0×10^{-14}	2.2×10^{-10}	9.1×10^{-14}	1.6×10^{-8}	9.5×10^{-14}	1.5×10^{-12}	4.2×10^{-14}	4.6×10^{-8}	1.3×10^{-14}	8.8×10^{-8}

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the MEI may be different under No Action than for operation of ceramic facility. Therefore, the impacts may not be directly additive.

[b] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem, the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem, the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem, the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem, the population within 80 km (50 mi) receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem, the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem, the population within 80 km receives 266,000 person-rem.

[c] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem, the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem, the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem, the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem, the population within 80 km (50 mi) receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem, the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem, the population within 80 km receives 266,000 person-rem.

[d] Since the Preferred Alternative would result in the disposition of approximately 30 percent of Pu using vitrification or immobilization technologies, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced.

[e] For DOE activity proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[f] Obtained by dividing the population dose by the number of people projected to be living within 80 km of site in 2030 (621,000 at Hanford, 29,400 at NTS, 269,000 at INEL, 350,000 at Pantex, 1,285,000 at ORR, and 893,000 at SRS).

Source: Section M.2.

The doses to the maximally exposed member of the public from annual total site operations are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 6.2×10^{-5} mrem at Pantex to 3.2 mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.1×10^{-10} to 1.6×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operations, the population doses would be within the limit in proposed 10 CFR 834 and would range from 3.0×10^{-4} person-rem at Pantex to 44 person-rem at SRS. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 1.5×10^{-6} to 0.22. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionately reduced.

Doses to onsite workers from normal operations are given in Table 4.3.4.2.9–2. Included are involved workers directly associated with the ceramic immobilization facility, workers who are not involved with the immobilization facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to ceramic immobilization facility workers is site-independent and would be 279 mrem to the average facility worker and 120 person-rem to the entire facility workforce. The annual dose to the average noninvolved worker would range from 2.6 mrem at ORR to 32 mrem at SRS. The annual total dose to all noninvolved workers would range from 3.0 person-rem at NTS to 250 person-rem at Hanford. The annual dose to the total site workforces would range from 123 person-rem at NTS to 370 person-rem at Hanford. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.4.2.9–2.

Table 4.3.4.2.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Ceramic Immobilization Alternative

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce[a]						
Average worker dose (mrem/yr)[b]	279	279	279	279	279	279
10-year risk of fatal cancer	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}
3.5-year risk of fatal cancer[c]	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}
Total dose (person-rem/yr)	120	120	120	120	120	120
10-year fatal cancers	0.46	0.46	0.46	0.46	0.46	0.46
3.5-year fatal cancers[c]	0.16	0.16	0.16	0.16	0.16	0.16
Noninvolved Workforce[d]						
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	1.1×10^{-4}	2.0×10^{-5}	1.2×10^{-4}	4.0×10^{-5}	1.0×10^{-5}	1.3×10^{-4}
3.5-year risk of fatal cancer[c]	3.9×10^{-5}	7.0×10^{-6}	4.2×10^{-5}	1.4×10^{-5}	3.5×10^{-6}	4.6×10^{-5}
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	0.90
3.5-year fatal cancers[c]	0.35	4.2×10^{-3}	0.31	0.020	0.063	0.32

Table 4.3.4.2.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Ceramic Immobilization Alternative—Continued

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Total Site Workforce[e]						
Dose (person-rem/yr)	370	123	340	134	164	346
10-year fatal cancers	1.5	0.50	1.4	0.54	0.66	1.4
3.5-year fatal cancers[c]	0.53	0.18	0.49	0.19	0.23	0.49

[a] The involved worker is associated with operations of the ceramic immobilization facility.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] Since the Preferred Alternative would result in the disposition of approximately 30 percent of Pu using vitrification or immobilization technologies, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced to 3.5-year campaign.

[d] The noninvolved worker is onsite but not associated with operations of the ceramic immobilization facility. The noninvolved workforce is equivalent to the No Action workforce.

[e] The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the ceramic immobilization facility at each of several sites are presented in Table 4.3.4.2.9–3. Included is the impact due only to operation of the ceramic immobilization facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI ranges from 3.9×10^{-4} at NTS to 1.5×10^{-2} at ORR due to the new facility operation. The incremental cancer risk from hazardous chemicals to the MEI is zero (because no carcinogens are released from hazardous chemicals) at all sites. The HI to the onsite worker ranges from 8.1×10^{-2} at Pantex to 0.17 at ORR, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals) at all sites.

Table 4.3.4.2.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Ceramic Immobilization Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]
Maximally Exposed Individual (Public)												
Hazard index[c]	2.6×10^{-3}	2.7×10^{-3}	3.9×10^{-4}	3.9×10^{-4}	5.6×10^{-3}	0.021	0.015	0.020	0.015	0.055	7.1×10^{-4}	5.9×10^{-3}
Cancer Risk[d]	0	0	0	0	0	3.6×10^{-6}	0	1.1×10^{-8}	0	0	0	1.3×10^{-7}
Worker onsite												
Hazard index[e]	0.16	0.16	0.083	0.083	0.16	0.39	0.081	0.087	0.17	0.32	0.14	1.3
Cancer Risk[f]	0	0	0	0	0	7.7×10^{-4}	0	4.5×10^{-7}	0	0	0	1.9×10^{-4}

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer Risk for MEI=(emissions concentration) x (0.286 [converts concentrations to doses]) x Slope Factor. Where there are no known carcinogens among chemicals emitted, therefore, the calculated cancer risk is 0.

[e] Hazard Index for workers=Sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [Fraction of year exposed]) x (0.571 [Fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted, there are no Slope Factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4–54 through M.3.4–59.

Facility Accidents. A set of potential accidents has been postulated for the ceramic immobilization facility for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.4.2.9–4 through 4.3.4.2.9–9 form the sites analyzed (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.019 at ORR for the criticality accident scenario with a probability of 1.0×10^{-6} per year. The corresponding 10-year cancer facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.9×10^{-7}, 8.6×10^{-10}, and 3.8×10^{-9}, respectively. The maximum population 10-year facility lifetime risk would be 2.6×10^{-7} (that is, one fatality in over one million years) at ORR for the criticality accident scenario with a probability of 1.0×10^{-6} per year. The corresponding maximum offsite individual and worker 10-year facility lifetime risks would be 1.2×10^{-9} and 512×10^{-9}, respectively. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionately reduced. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.4.2.9–4 through 4.3.4.2.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Before construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is a possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude of the impacts of an aircraft crash into a disposition facility is given by the earthquake scenario. The earthquake and aircraft scenarios are similar in that they both result in major structural damage and the release of plutonium directly into the environment. They differ in that an earthquake-induced fire is based on limited combustible materials while the aircraft crash has the potential for major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive fatal injuries.

Table 4.3.4.2.9–4. Ceramic Immobilization Alternative Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	7.9×10^{-14} (2.8×10^{-14})	7.9×10^{-10}	7.9×10^{-16} (2.8×10^{-16})	7.9×10^{-12}	5.8×10^{-12} (2.0×10^{-12})	5.8×10^{-8}	1.0×10^{-5}
Glovebox fire	7.9×10^{-14} (2.8×10^{-14})	7.9×10^{-10}	7.9×10^{-16} (2.8×10^{-16})	7.9×10^{-12}	5.8×10^{-12} (2.0×10^{-12})	5.8×10^{-8}	1.0×10^{-5}
Glovebox criticality	1.4×10^{-10} (4.9×10^{-11})	1.4×10^{-6}	1.1×10^{-12} (3.8×10^{-15})	1.2×10^{-8}	1.6×10^{-9} (5.6×10^{-10})	1.6×10^{-5}	1.0×10^{-5}
Mixing tank criticality	1.4×10^{-9} (4.9×10^{-10})	1.4×10^{-5}	1.1×10^{-11} (3.8×10^{-12})	1.2×10^{-7}	1.6×10^{-8} (5.6×10^{-9})	1.6×10^{-4}	1.0×10^{-5}
Bellows drop	5.8×10^{-15} (2.0×10^{-15})	5.8×10^{-13}	5.5×10^{-17} (1.9×10^{-17})	5.5×10^{-15}	4.9×10^{-13} (1.7×10^{-13})	4.9×10^{-11}	1.0×10^{-3}
Cesium capsule drop	1.2×10^{-11} (4.2×10^{-12})	1.2×10^{-9}	9.2×10^{-14} (3.2×10^{-14})	9.2×10^{-12}	1.5×10^{-9} (5.2×10^{-10})	1.5×10^{-7}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	1.4×10^{-15} (4.9×10^{-16})	2.7×10^{-15}	1.4×10^{-17} (4.9×10^{-18})	2.7×10^{-17}	9.9×10^{-14} (3.5×10^{-14})	2.0×10^{-13}	0.05
Calciner feed spill	9.2×10^{-15} (3.2×10^{-15})	1.8×10^{-14}	8.7×10^{-17} (3.0×10^{-17})	1.7×10^{-16}	7.7×10^{-13} (2.7×10^{-13})	1.5×10^{-12}	0.05

Table 4.3.4.2.9–4. Ceramic Immobilization Alternative Accident Impacts at Hanford Site—Continued

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	
Calciner product spill	2.6×10^{-12} (9.1×10^{-13})	5.1×10^{-12}	2.4×10^{-14} (8.4×10^{-15})	4.8×10^{-14}	2.1×10^{-10} (7.3×10^{-11})	4.3×10^{-10}	0.05
Cesium fire	3.9×10^{-15} (1.4×10^{-15})	3.9×10^{-10}	3.0×10^{-17} (1.1×10^{-17})	3.0×10^{-12}	4.7×10^{-13} (1.6×10^{-13})	4.7×10^{-8}	1.0×10^{-6}
Process cell fire	5.7×10^{-16} (2.0×10^{-16})	5.7×10^{-11}	5.7×10^{-18} (2.0×10^{-18})	5.7×10^{-13}	4.1×10^{-14} (1.4×10^{-18})	4.1×10^{-9}	1.0×10^{-6}
Criticality	4.2×10^{-9} (1.5×10^{-9})	4.2×10^{-4}	4.5×10^{-11} (1.6×10^{-11})	3.5×10^{-6}	4.8×10^{-8} (1.7×10^{-8})	4.8×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	3.7×10^{-16} (1.3×10^{-16})	3.7×10^{-11}	3.5×10^{-18} (1.2×10^{-18})	3.5×10^{-13}	3.1×10^{-14} (1.1×10^{-14})	3.1×10^{-9}	1.0×10^{-6}
Expected risk[d]	5.7×10^{-9} (2.0×10^{-9})	–	4.7×10^{-11} (1.6×10^{-11})	–	6.7×10^{-8} (2.3×10^{-8})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

Table 4.3.4.2.9–5. Ceramic Immobilization Alternative Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	5.4×10^{-14} (1.9×10^{-14})	5.4×10^{-10}	1.3×10^{-15} (4.5×10^{-16})	1.3×10^{-11}	1.3×10^{-13} (4.5×10^{-14})	1.3×10^{-9}	1.0×10^{-5}
Glovebox fire	5.4×10^{-14} (1.9×10^{-14})	5.4×10^{-10}	1.3×10^{-15} (4.5×10^{-16})	1.3×10^{-11}	1.3×10^{-13} (4.5×10^{-14})	1.3×10^{-9}	1.0×10^{-5}
Glovebox criticality	1.0×10^{-10} (3.5×10^{-11})	1.0×10^{-6}	2.3×10^{-12} (8.0×10^{-13})	2.3×10^{-8}	3.3×10^{-11} (1.1×10^{-11})	3.3×10^{-7}	1.0×10^{-5}
Mixing tank criticality	1.0×10^{-9} (3.5×10^{-10})	1.0×10^{-5}	2.3×10^{-11} (8.0×10^{-12})	2.3×10^{-7}	3.3×10^{-10} (1.1×10^{-10})	3.3×10^{-6}	1.0×10^{-5}
Bellows drop	4.0×10^{-15} (1.4×10^{-15})	4.0×10^{-13}	8.8×10^{-17} (8.1×10^{-17})	8.8×10^{-15}	1.1×10^{-14} (3.8×10^{-15})	1.1×10^{-12}	1.0×10^{-3}
Cesium capsule drop	8.1×10^{-12} (2.8×10^{-12})	8.1×10^{-10}	1.5×10^{-13} (5.2×10^{-14})	1.5×10^{-11}	3.4×10^{-11} (1.2×10^{-11})	3.4×10^{-9}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	9.3×10^{-16} (3.2×10^{-16})	1.9×10^{-15}	2.2×10^{-17} (7.7×10^{-18})	4.3×10^{-17}	2.2×10^{-15} (7.7×10^{-16})	4.5×10^{-15}	0.05
Calciner feed spill	6.2×10^{-15} (2.2×10^{-15})	1.2×10^{-14}	1.4×10^{-16} (4.9×10^{-17})	2.8×10^{-16}	1.7×10^{-14} (5.9×10^{-15})	3.5×10^{-14}	0.05

Table 4.3.4.2.9–5. Ceramic Immobilization Alternative Accident Impacts at Nevada Test Site—Continued

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Calciner product spill	1.7×10^{-12} (5.9×10^{-13})	3.5×10^{-12}	3.9×10^{-14} (1.4×10^{-14})	7.7×10^{-14}	4.9×10^{-12} (1.7×10^{-12})	9.7×10^{-12}	0.05
Cesium fire	2.6×10^{-15} (9.1×10^{-16})	2.6×10^{-10}	4.9×10^{-17} (1.7×10^{-17})	4.9×10^{-12}	1.1×10^{-14} (3.8×10^{-15})	1.1×10^{-9}	1.0×10^{-6}
Process cell fire	3.9×10^{-16} (1.4×10^{-16})	3.9×10^{-11}	9.0×10^{-18} (3.1×10^{-18})	9.0×10^{-13}	9.3×10^{-16} (3.2×10^{-16})	9.3×10^{-11}	1.0×10^{-6}
Criticality	3.0×10^{-9} (1.0×10^{-9})	3.0×10^{-4}	6.8×10^{-11} (2.4×10^{-11})	6.8×10^{-6}	9.7×10^{-10} (3.4×10^{-10})	9.7×10^{-5}	1.0×10^{-6}
Uncontrolled chemical reaction	2.5×10^{-16} (8.7×10^{-17})	2.5×10^{-11}	5.5×10^{-18} (1.9×10^{-18})	5.5×10^{-13}	7.0×10^{-16} (2.4×10^{-16})	7.0×10^{-11}	1.0×10^{-6}
Expected risk[d]	4.2×10^{-9} (1.5×10^{-9})	–	9.3×10^{-12} (3.2×10^{-12})	–	1.4×10^{-9} (4.9×10^{-10})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

Table 4.3.4.2.9–6. Ceramic Immobilization Alternative Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	7.4×10^{-14} (2.6×10^{-14})	7.4×10^{-10}	8.0×10^{-16} (2.8×10^{-16})	8.0×10^{-12}	1.7×10^{-12} (6.0×10^{-13})	1.7×10^{-8}	1.0×10^{-5}
Glovebox fire	7.4×10^{-14} (2.6×10^{-14})	7.4×10^{-10}	8.0×10^{-16} (2.8×10^{-16})	8.0×10^{-12}	1.7×10^{-12} (6.0×10^{-13})	1.7×10^{-8}	1.0×10^{-5}
Glovebox criticality	1.4×10^{-10} (4.9×10^{-11})	1.4×10^{-6}	1.3×10^{-12} (4.5×10^{-13})	1.3×10^{-8}	4.3×10^{-10} (1.5×10^{-10})	4.3×10^{-6}	1.0×10^{-5}
Mixing tank criticality	1.4×10^{-9} (4.9×10^{-10})	1.4×10^{-5}	1.3×10^{-11} (4.5×10^{-12})	1.3×10^{-7}	4.3×10^{-9} (1.5×10^{-9})	4.3×10^{-5}	1.0×10^{-5}
Bellows drop	5.4×10^{-15} (1.9×10^{-15})	5.4×10^{-13}	5.5×10^{-17} (1.9×10^{-17})	5.5×10^{-15}	1.5×10^{-13} (5.2×10^{-14})	1.5×10^{-11}	1.0×10^{-3}
Cesium capsule drop	1.1×10^{-11} (3.8×10^{-12})	1.1×10^{-9}	8.8×10^{-14} (3.1×10^{-14})	8.8×10^{-12}	4.6×10^{-10} (1.6×10^{-10})	4.6×10^{-8}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	1.3×10^{-15} (4.5×10^{-16})	2.5×10^{-15}	1.4×10^{-17} (4.9×10^{-18})	2.8×10^{-17}	3.0×10^{-14} (1.0×10^{-14})	5.9×10^{-14}	0.05
Calciner feed spill	8.4×10^{-15} (2.9×10^{-13})	1.7×10^{-14}	8.7×10^{-17} (3.0×10^{-17})	1.7×10^{-16}	2.3×10^{-13} (8.0×10^{-14})	4.7×10^{-13}	0.05

Table 4.3.4.2.9–6. Ceramic Immobilization Alternative Accident Impacts at Idaho National Engineering Laboratory—Continued

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	
Calciner product spill	2.4×10^{-12} (8.4×10^{-13})	4.7×10^{-12}	2.4×10^{-14} (8.4×10^{-15})	4.8×10^{-14}	6.5×10^{-11} (2.3×10^{-11})	1.3×10^{-10}	0.05
Cesium fire	3.4×10^{-15} (1.2×10^{-15})	3.4×10^{-10}	2.9×10^{-17} (1.0×10^{-17})	2.9×10^{-12}	1.5×10^{-13} (5.2×10^{-14})	1.5×10^{-8}	1.0×10^{-6}
Process cell fire	5.3×10^{-16} (1.8×10^{-16})	5.3×10^{-11}	5.7×10^{-18} (2.0×10^{-18})	5.7×10^{-13}	1.2×10^{-14} (4.2×10^{-15})	1.2×10^{-9}	1.0×10^{-6}
Criticality	4.0×10^{-9} (1.4×10^{-9})	4.0×10^{-4}	4.0×10^{-11} (1.4×10^{-11})	4.0×10^{-6}	1.3×10^{-8} (4.5×10^{-9})	1.3×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	3.4×10^{-16} (1.2×10^{-16})	3.4×10^{-11}	3.5×10^{-18} (1.2×10^{-18})	3.5×10^{-13}	9.3×10^{-15} (3.2×10^{-15})	9.3×10^{-10}	1.0×10^{-6}
Expected risk[d]	5.6×10^{-9} (2.0×10^{-9})	–	5.5×10^{-11} (1.9×10^{-11})	–	1.8×10^{-9} (6.3×10^{-10})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

Table 4.3.4.2.9–7. Ceramic Immobilization Alternative Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	
Earthquake	3.2×10^{-14} (1.1×10^{-14})	3.2×10^{-10}	9.2×10^{-15} (3.2×10^{-15})	9.2×10^{-11}	2.0×10^{-12} (7.0×10^{-13})	2.0×10^{-8}	1.0×10^{-5}
Glovebox fire	3.2×10^{-14} (1.1×10^{-14})	3.2×10^{-10}	9.2×10^{-15} (3.2×10^{-15})	9.2×10^{-11}	2.0×10^{-12} (7.0×10^{-13})	2.0×10^{-8}	1.0×10^{-5}
Glovebox criticality	6.2×10^{-11} (2.2×10^{-11})	6.2×10^{-7}	2.2×10^{-11} (7.7×10^{-12})	2.2×10^{-7}	9.5×10^{-10} (3.3×10^{-10})	9.5×10^{-6}	1.0×10^{-5}
Mixing tank criticality	6.2×10^{-10} (2.2×10^{-10})	6.2×10^{-6}	2.2×10^{-10} (7.7×10^{-11})	2.2×10^{-6}	9.5×10^{-9} (3.3×10^{-9})	9.5×10^{-5}	1.0×10^{-5}
Bellows drop	2.4×10^{-15} (8.4×10^{-16})	2.4×10^{-13}	6.7×10^{-16} (2.3×10^{-16})	6.7×10^{-14}	1.6×10^{-13} (5.6×10^{-14})	1.6×10^{-11}	1.0×10^{-3}
Cesium capsule drop	5.1×10^{-12} (1.8×10^{-12})	5.1×10^{-10}	1.3×10^{-12} (4.5×10^{-13})	1.3×10^{-10}	4.4×10^{-10} (1.5×10^{-10})	4.4×10^{-8}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	5.5×10^{-16} (1.9×10^{-16})	1.1×10^{-15}	1.6×10^{-16} (5.6×10^{-17})	3.2×10^{-16}	3.4×10^{-14} (1.2×10^{-14})	6.7×10^{-14}	0.05
Calciner feed spill	3.7×10^{-15} (1.3×10^{-15})	7.5×10^{-15}	1.1×10^{-15} (3.8×10^{-16})	2.1×10^{-15}	2.5×10^{-13} (8.7×10^{-14})	5.0×10^{-13}	0.05

Table 4.3.4.2.9–7. Ceramic Immobilization Alternative Accident Impacts at Pantex Plant—Continued

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Calciner product spill	1.0×10^{-12} (3.5×10^{-13})	2.1×10^{-12}	3.0×10^{-13} (1.0×10^{-13})	5.9×10^{-13}	7.0×10^{-11} (2.4×10^{-11})	1.4×10^{-10}	0.05
Cesium fire	1.7×10^{-15} (5.9×10^{-16})	1.7×10^{-10}	4.4×10^{-16} (1.5×10^{-16})	4.4×10^{-11}	1.4×10^{-13} (4.9×10^{-14})	1.4×10^{-8}	1.0×10^{-6}
Process cell fire	2.3×10^{-16} (8.0×10^{-17})	2.3×10^{-11}	6.6×10^{-17} (2.3×10^{-17})	6.6×10^{-12}	1.4×10^{-14} (4.9×10^{-15})	1.4×10^{-9}	1.0×10^{-6}
Criticality	1.9×10^{-9} (6.6×10^{-10})	1.9×10^{-4}	6.5×10^{-10} (2.3×10^{-10})	6.5×10^{-5}	2.8×10^{-8} (9.8×10^{-9})	2.8×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	1.5×10^{-16} (5.2×10^{-17})	1.5×10^{-11}	4.2×10^{-17} (1.5×10^{-17})	4.2×10^{-12}	1.0×10^{-14} (3.5×10^{-15})	1.0×10^{-9}	1.0×10^{-6}
Expected risk[d]	2.5×10^{-9} (8.7×10^{-10})	–	8.9×10^{-10} (3.1×10^{-10})	–	3.9×10^{-8} (1.4×10^{-8})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

Table 4.3.4.2.9–8. Ceramic Immobilization Alternative Accident Impacts at Oak Ridge Reservation

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	7.3×10^{-14} (2.5×10^{-14})	7.3×10^{-10}	1.6×10^{-14} (5.6×10^{-15})	1.6×10^{-10}	1.4×10^{-11} (4.9×10^{-12})	1.4×10^{-7}	1.0×10^{-5}
Glovebox fire	7.3×10^{-14} (2.5×10^{-14})	7.3×10^{-10}	1.6×10^{-14} (5.6×10^{-15})	1.6×10^{-10}	1.4×10^{-11} (4.9×10^{-12})	1.4×10^{-7}	1.0×10^{-5}
Glovebox criticality	1.3×10^{-10} (4.5×10^{-11})	1.3×10^{-6}	2.9×10^{-11} (1.0×10^{-11})	2.9×10^{-7}	6.3×10^{-9} (2.2×10^{-9})	6.3×10^{-5}	1.0×10^{-5}
Mixing tank criticality	1.3×10^{-9} (4.5×10^{-10})	1.3×10^{-5}	2.9×10^{-10} (1.0×10^{-10})	2.9×10^{-6}	6.3×10^{-8} (2.2×10^{-8})	6.3×10^{-4}	1.0×10^{-5}
Bellows drop	5.5×10^{-15} (1.9×10^{-15})	5.5×10^{-13}	1.2×10^{-15} (4.2×10^{-16})	1.2×10^{-13}	1.1×10^{-12} (3.8×10^{-13})	1.1×10^{-10}	1.0×10^{-3}
Cesium capsule drop	1.2×10^{-11} (4.2×10^{-12})	1.2×10^{-9}	2.4×10^{-12} (8.4×10^{-13})	2.4×10^{-10}	3.1×10^{-9} (1.1×10^{-9})	3.1×10^{7}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	1.3×10^{-15} (4.5×10^{-16})	2.5×10^{-15}	2.8×10^{-16} (9.8×10^{-17})	5.7×10^{-16}	2.4×10^{-13} (8.4×10^{-14})	4.8×10^{-13}	0.05
Calciner feed spill	8.6×10^{-15} (3.0×10^{-15})	1.7×10^{-14}	1.8×10^{-15} (6.3×10^{-16})	3.7×10^{-15}	1.8×10^{-12} (6.3×10^{-13})	3.5×10^{-12}	0.05

Table 4.3.4.2.9–8. Ceramic Immobilization Alternative Accident Impacts at Oak Ridge Reservation—Continued

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Calciner product spill	2.4×10^{-12} (8.4×10^{-13})	4.8×10^{-12}	5.2×10^{-13} (1.8×10^{-13})	1.0×10^{-12}	4.9×10^{-10} (1.7×10^{-10})	9.9×10^{-10}	0.05
Cesium fire	3.8×10^{-15} (1.3×10^{-15})	3.8×10^{-10}	7.7×10^{-16} (2.7×10^{-16})	7.7×10^{-11}	9.9×10^{-13} (3.5×10^{-13})	9.9×10^{-8}	1.0×10^{-6}
Process cell fire	5.3×10^{-16} (1.8×10^{-16})	5.3×10^{-11}	1.2×10^{-16} (4.2×10^{-17})	1.2×10^{-11}	1.0×10^{-13} (3.5×10^{-14})	1.0×10^{-8}	1.0×10^{-6}
Criticality	3.8×10^{-9} (1.3×10^{-9})	3.8×10^{-4}	8.6×10^{-10} (3.0×10^{-10})	8.6×10^{-5}	1.9×10^{-7} (6.6×10^{-8})	0.019	1.0×10^{-6}
Uncontrolled chemical reaction	3.4×10^{-16} (1.2×10^{-16})	3.4×10^{-11}	7.4×10^{-17} (2.6×10^{-17})	7.4×10^{-12}	7.1×10^{-14} (2.5×10^{-14})	7.1×10^{-9}	1.0×10^{-6}
Expected risk[d]	5.2×10^{-9} (1.8×10^{-9})	–	1.2×10^{-9} (4.2×10^{-10})	–	2.6×10^{-7} (9.1×10^{-8})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

Table 4.3.4.2.9–9. Ceramic Immobilization Alternative Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	5.2×10^{-14} (1.8×10^{-14})	5.2×10^{-10}	1.3×10^{-15} (4.5×10^{-16})	1.3×10^{-11}	6.2×10^{-12} (2.2×10^{-12})	6.2×10^{-8}	1.0×10^{-5}
Glovebox fire	5.2×10^{-14} (1.8×10^{-14})	5.2×10^{-10}	1.3×10^{-15} (4.5×10^{-16})	1.3×10^{-11}	6.2×10^{-12} (2.2×10^{-12})	6.2×10^{-8}	1.0×10^{-5}
Glovebox criticality	9.1×10^{-11} (3.2×10^{-11})	9.1×10^{-7}	2.0×10^{-12} (7.0×10^{-13})	2.0×10^{-8}	2.0×10^{-9} (7.0×10^{-10})	2.0×10^{-5}	1.0×10^{-5}
Mixing tank criticality	9.1×10^{-10} (3.2×10^{-10})	9.1×10^{-6}	2.0×10^{-11} (7.0×10^{-12})	2.0×10^{-7}	2.0×10^{-8} (7.0×10^{-9})	2.0×10^{-4}	1.0×10^{-5}
Bellows drop	3.9×10^{-15} (1.4×10^{-15})	3.9×10^{-13}	9.3×10^{-17} (3.2×10^{-17})	9.3×10^{-15}	5.1×10^{-13} (1.8×10^{-13})	5.1×10^{-11}	1.0×10^{-3}
Cesium capsule drop	8.4×10^{-12} (2.9×10^{-12})	8.4×10^{-10}	1.9×10^{-13} (6.6×10^{-14})	1.9×10^{-11}	1.5×10^{-9} (5.2×10^{-10})	1.5×10^{7}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	8.9×10^{-16} (3.1×10^{-16})	1.8×10^{-15}	2.2×10^{-17} (7.7×10^{-18})	4.4×10^{-17}	1.1×10^{-13} (3.8×10^{-14})	2.1×10^{-13}	0.05
Calciner feed spill	6.1×10^{-15} (2.1×10^{-15})	1.2×10^{-14}	1.5×10^{-16} (5.2×10^{-17})	2.9×10^{-16}	8.1×10^{-13} (2.8×10^{-13})	1.6×10^{-12}	0.05

Table 4.3.4.2.9–9. Ceramic Immobilization Alternative Accident Impacts at Savannah River Site—Continued

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Calciner product spill	1.7×10^{-12} (5.9×10^{-13})	3.4×10^{-12}	4.1×10^{-14} (1.4×10^{-14})	8.2×10^{-14}	2.2×10^{-10} (7.7×10^{-11})	4.5×10^{-10}	0.05
Cesium fire	2.7×10^{-15} (9.4×10^{-16})	2.7×10^{-10}	6.1×10^{-18} (2.1×10^{-18})	6.1×10^{-12}	4.7×10^{-13} (1.6×10^{-13})	4.7×10^{-8}	1.0×10^{-6}
Process cell fire	3.7×10^{-16} (1.3×10^{-16})	3.7×10^{-11}	9.1×10^{-18} (3.2×10^{-18})	9.1×10^{-13}	4.4×10^{-14} (1.5×10^{-14})	4.4×10^{-9}	1.0×10^{-6}
Criticality	2.7×10^{-9} (9.4×10^{-10})	2.7×10^{-4}	6.0×10^{-11} (2.1×10^{-11})	6.0×10^{-6}	6.1×10^{-8} (2.1×10^{-8})	6.1×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	2.4×10^{-16} (8.4×10^{-17})	2.4×10^{-11}	5.9×10^{-18} (2.1×10^{-18})	5.9×10^{-13}	3.2×10^{-14} (1.1×10^{-14})	3.2×10^{-9}	1.0×10^{-6}
Expected risk[d]	3.7×10^{-9} (1.3×10^{-9})	–	8.3×10^{-11} (2.9×10^{-11})	–	8.5×10^{-8} (3.0×10^{-8})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

4.3.4.2.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of a ceramic immobilization facility. There is no spent nuclear fuel or HLW associated with the operation of the ceramic immobilization facility; however, the facility does generate as its product output a stabilized ceramic form spiked with cesium radionuclides that would require interim storage. The ceramic immobilization facility would provide the necessary storage of the immobilized Pu in ceramic form until entry into the Federal Waste Management System for final disposition. Table 4.3.4.2.10–1 provides the estimated operational waste volumes projected to be generated at the sites analyzed as a result of the ceramic immobilization facility. Facilities that would support the ceramic immobilization facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the ceramic immobilization facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.5. A detailed description of the waste management activities that would be required to support the ceramic immobilization facility can also be found in Section E.3.3.5.

Construction and operation of a ceramic immobilization facility would impact existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater and solid nonhazardous and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to a commercial RCRA-permitted treatment and disposal facility. No soil contaminated with hazardous or radioactive constituents is expected to be generated

Table 4.3.4.2.10–1. Estimated Annual Generated Waste Volumes for the Ceramic Immobilization Alternative[a]

		Hanford	NTS	INEL	Pantex	ORR	SRS
Category	New Facility (m^3)	No Action (m^3)	No Action (m^3)	No Action (m^3)	No Action (m^3)	No Action (m^3)	No Action (m^3)
Transuranic							
Liquid	75[b]	None	None	None	None	None	None
Solid	99	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	0.7	98	None	Included in TRU	None	None	Included in TRU
Low-Level							
Liquid	7[b]	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	14	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-Level							
Liquid	0	3,760	None	4	4	87,600	1,330
Solid	0.15	1,505	50	170	46	432	7,700

Table 4.3.4.2.10–1. Estimated Annual Generated Waste Volumes for the Ceramic Immobilization Alternative[a]—Continued

Category	New Facility (m^3)	Hanford No Action (m^3)	NTS No Action (m^3)	INEL No Action (m^3)	Pantex No Action (m^3)	ORR No Action (m^3)	SRS No Action (m^3)
Hazardous							
Liquid	38	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	19	560	212	1,200	31	26	15,100
Nonhazardous (Sanitary)							
Liquid	34,000	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	920	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	170,000	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	15[c]	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

[a] The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1. Incremental waste generation volumes for ceramic immobilization facility are from Table E.3.3.5–1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.3.5–1.

[b] Liquid TRU and LLW would be treated and solidified prior to disposal.

[c] Recyclable wastes.

during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Following treatment and volume reduction, approximately 99 m^3 (130 yd^3) of TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and sludge from liquid TRU treatment would require treatment and repackaging to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the ceramic immobilization facility if sited at ORR, Pantex, and NTS. A small quantity (0.7 m^3 [0.9 yd^3]) of mixed TRU waste would require processing and packaging to meet the current planning-basis WIPP WAC of alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), 12 additional truck shipments per year or, if applicable, 6 regular train shipments per year or 2 dedicated train shipments per year would be required. [Text deleted.]

All of the sites analyzed have existing or planned facilities that could manage the small quantities of LLW. After treatment and volume reduction, approximately 11 m^3 (14 yd^3) of LLW from solidified liquid LLW, protective clothing, soil, and small equipment would require disposal. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.003 ha/yr (0.008 acres/yr) at Hanford and ORR, 0.002 ha/yr (0.004 acres/yr) at NTS and INEL, and 0.001 ha/year (0.003 acres/yr) at SRS. With no onsite LLW disposal

capability, Pantex would require one additional LLW shipment per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

A small quantity (0.15 m^3 [0.2 yd^3]) of solid mixed LLW consisting of contaminated solvent rags and equipment that have been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party Agreement for Hanford and the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

An estimated 38 m^3 (10,000 gal) of liquid and 19 m^3 (25 yd^3) of solid hazardous wastes would be generated annually. Hazardous wastes would consist primarily of analytical solutions and solvent rags contaminated with methylene chloride, acetonitrile, and acetone. Other hazardous wastes would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous wastes would be staged in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately 34,000 m^3 (9 million gal) of liquid nonhazardous sanitary and industrial wastewater and 170,000 m^3 (45 million gal) of steam plant blowdown and estimated stormwater runoff would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required for some of the DOE sites. The Preferred Alternative, construction of sanitary, utility, and process wastewater treatment systems may not be required because approximately 30 percent of the surplus Pu would be immobilized. The construction of these treatments systems would be determined in further tiered NEPA documentation. The 920 m^3 (1,200 yd^3) of solid nonhazardous wastes such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.4.3 Electrometallurgical Treatment Alternative

The environmental impacts described in the following sections are based on the analysis of the electrometallurgical treatment facility described in Section 2.4.4.3. The ANL-W at INEL is used as a representative site for this alternative. If this alternative is selected in the ROD and if a different site were ultimately selected, the impacts described in this section could be different. With respect to public and occupational health and safety, and waste, these impacts are not anticipated to differ significantly from those discussed in this section. DOE would analyze such different impacts in subsequent tiered, site-specific NEPA documentation if this alternative were selected.

4.3.4.3.1 *Land Resources*

Land Use. As discussed in Section 4.3.4.3.2, the Pu disposition effort would require the installation of additional equipment within existing buildings, however, no major modifications are anticipated. Therefore, no additional land area would be disturbed, used during operations, or required for a buffer zone. Utilization of existing facilities would not change land use and the alternative would likely be consistent with existing site use. Therefore, there would be no direct land use impacts during operations.

Operation of the facility would likely be consistent with Federal and local land-use plans, policies, and controls. Other onsite or offsite land uses would not be affected. Prime farmlands would not be affected. As discussed in Section 4.3.4.3.8, no in-migration would be anticipated during operations. Therefore, no indirect impacts to offsite land use would occur.

Visual Resources. There would be no new impacts to visual resources caused by operations. The visual environment would be consistent with the existing industrialized landscape character. The alternative would be anticipated to be consistent with the current VRM designation of the developed area of the site, likely a Class 5.

4.3.4.3.2 *Site Infrastructure*

The existing site infrastructure resources at the INEL site, and in particular the ANL-W facilities, are considered adequate to accommodate Pu disposition. The Pu disposition effort would require the use of some equipment that is not currently installed in existing buildings. The power and fuel resources that would be required to install this equipment are shown in Appendix C. No major modifications to existing facilities are anticipated due the addition of Pu disposition activities.

The site infrastructure resources to be utilized during operation of the electrometallurgical treatment process are presented in Appendix C. As shown in Table 4.3.4.3.2–1, the effect of this added resource consumption would be within the capacity available at INEL.

Table 4.3.4.3.2–1. Additional Site Infrastructure Needed for the Operation of the Electrometallurgical Treatment Alternative at Idaho National Engineering Laboratory (Annual)[a]

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	0	0	2,400	0.008	0	0	0
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage (without facility)	445	48	232,500	42	5,820,000	0	11,340
Projected usage (with facility)	445	48	234,900	42	5,820,000	0	11,340
Amount required in excess to site availability	0	0	0	0	0	0	0

[a] Values in this table represent the incremental site infrastructure values allocated to operating this alternative at INEL.

Source: INEL 1995a:1; LLNL 1996b.

4.3.4.3.3 *Air Quality and Noise*

Air quality or noise effects from the required facility modifications for electrometallurgical treatment would be localized, short-term, and minor. Operation of this facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines. Impacts from radiological airborne emissions are discussed in Section 4.3.4.3.9.

Due to the limited additional equipment required for Pu disposition activities, incremental noise impacts during operation are expected to be low relative to sitewide baseline operations for INEL. Air quality and noise impacts for this facility are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

The electrometallurgical treatment would result in the emission of some criteria pollutants. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

Emission rates for operation of the electrometallurgical treatment facility are presented in Table F.1.3–11. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers or operation of new boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]
- Small quantities of toxic/hazardous pollutant emissions from facility processes and laboratories

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for operation of this facility plus the No Action concentrations are presented in Table 4.3.4.3.3–1. Pollutant concentrations, combined with No Action, would be in compliance with Federal and State standards.VOCs are the only toxic/hazardous emissions and were not modeled for this PEIS.

NOISE

The location of the ANL-W facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during facility modifications and operations may include slightly increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring materials, equipment and workers to the site.

Nontraffic noise sources associated with operation of this alternative facility include ventilation systems, diesel generators and other sources. These noise sources are located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from equipment and other site operations would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

Table 4.3.4.3.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Electrometallurgical Treatment Alternative and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	INEL	
			No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)
Criteria Pollutants				
Carbon monoxide	8-hour	10,000	284	284
	1-hour	40,000	614	614
Lead	Calendar Quarter	1.5	0.001	0.001
Nitrogen dioxide	Annual	100	4	4
Ozone	1-hour	235	[b]	[b]
Particulate matter less than or equal to 10 microns in diameter	Annual	50	5	5
	24-hour	150	80	80
Sulfur dioxide	Annual	80	6	6
	24-hour	365	135	135
	3-hour	1,300	579	579
Mandated by Idaho				
Total suspended particulates	Annual	60	5	5
	24-hour	150	80	80
Hazardous and Other Toxic Compounds [c]	–	–	–	–

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Ozone, as a criteria pollutant is not directly emitted nor monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[c] Emissions of volatile organic compounds were not modeled.

[Text deleted.]

Note: Total concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from non-facility sources. Concentrations for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LLNL 1996b.

4.3.4.3.4 *Water Resources*

Water resource requirements and discharges provided in Tables C.1.1.3–6 and C.2.1.3–6 and Table E.3.3.6–1 were used to assess impacts to surface water and groundwater.

Surface Water. No surface water would be withdrawn for any facility modifications or operational activities associated with the electrometallurgical facility; consequently, no impacts to surface water availability or surface water quality are expected. [Text deleted.]

During operation, no effluent would be discharged to natural surface waters. Sanitary wastewater from the facility would be treated prior to discharge to lined evaporation ponds. However, cooling system blowdown and nonhazardous industrial wastewater would be discharged to the industrial waste pond. Treated effluents would be monitored to comply with discharge requirements. The extent to which treated effluent or stormwater would be recycled for reuse within the plant would be determined during site-specific studies.

The facility for the proposed electrometallurgical demonstration is located outside the flood zone of the Big Lost River that could develop as a result of the failure of MacKay Dam during a probable maximum flood. The flood event would be more critical than either the 100- or 500-year floodplain.

Groundwater. Groundwater required to support site activities during facility modifications (15 million l/yr [4 million gal/yr]) would represent approximately a 0.02-percent maximum increase over the projected groundwater withdrawal, and would be less than 0.003-percent of INEL current allotment. Thus, no additional allotments or permits would be required; it would not cause depletion of the aquifer or affect recharge. Groundwater required during operation of the facility (17.4 million l/yr [4.6 million gal/yr]) would be less than 0.04-percent of INEL's current allotment. As discussed in Section 3.4.4, a groundwater allotment, not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). Operating an electrometallurgical facility would not exceed current groundwater allotments.

During construction, no water would be discharged directly to the environment and thus would not be expected to contribute to existing near-surface contamination. During operation, sanitary wastewater would be treated and discharged to evaporation ponds. Therefore, no impacts to ground water quality would be anticipated.

4.3.4.3.5 *Geology and Soils*

The ANL-W at INEL is used as a representative site for this alternative. If this alternative is selected in the ROD, construction would be required for any site other than INEL. Additional tiered NEPA documentation would be completed, as appropriate.

As discussed in Section 4.3.4.3.2, the Electrometallurgical Treatment Alternative could be implemented at INEL utilizing existing site infrastructure. The Pu disposition effort would require the installation of additional equipment within existing buildings; however, no major modifications are anticipated. As a result, no new ground-breaking construction activities would be associated for this alternative. Therefore, no construction or operational impacts to geologic and soil resources are anticipated and no direct or indirect impacts to geologic or soil resources are anticipated.

4.3.4.3.6 *Biological Resources*

For analytical purposes it is assumed that immobilization of surplus Pu through electrometallurgical treatment would take place within existing facilities at ANL-W. Since existing facilities would be used, including those for wastewater treatment, no additional disturbance of land area or habitat would occur, and impacts to biological resources at INEL would not be expected.

4.3.4.3.7 *Cultural and Paleontological Resources*

No new construction would be required for the electrometallurgical treatment alternative and only minor modifications would be required for the HFEF and the ZPPR. Both of these structures were built in the 1970s, and the FCF was refurbished and upgraded in 1994. None of these facilities are NRHP eligible. No acreage would be disturbed if this alternative is chosen. Therefore, no cultural or paleontological resources would be affected.

4.3.4.3.8 *Socioeconomics*

This section analyzes the socioeconomic effects of the electrometallurgical facility for INEL. The effects at INEL are found in the Supplemental Socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Construction is not required for this alternative. The electrometallurgical facility's operation would require an additional 83 workers. Operating this facility would generate an additional 223 indirect jobs in the INEL REA. Unemployment would drop to 5.2 percent from the No Action projection of 5.4 percent during operation. These new jobs would be filled by workers from within the region. Operation of the electrometallurgical facility at INEL would very slightly increase regional per capita income above the No Action projection.

Population and Housing, Community Services, and Local Transportation. The new jobs would be filled by the existing regional labor force, and there would be no project-related population impacts on housing, community services, or local transportation beyond the No Action projections.

4.3.4.3.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated health and safety impacts resulting from either normal operations or accidents involved with the immobilization of Pu using the electrometallurgical treatment. The section first describes the impacts from normal facility operation at the INEL site, followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 10-year campaign time are presented in Tables 4.3.4.3.9–1 and 4.3.4.3.9–2, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.4.3.9–3. Additional information is provided in Appendix M.

Normal Operation. There would be no radiological releases associated with modifying the facility for the treatment of Pu. Workers involved with the modifications would be limited in their exposure to material potentially contaminated with radioactivity. This would assure that their doses are maintained as low as reasonably achievable. Towards this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as the result of activities associated with the installation of additional equipment. Onsite and offsite concentrations resulting from releases would be within the regulated exposure limits.

During the normal operation of the treatment process to immobilize the Pu, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the treatment process to immobilize Pu are presented in Table 4.3.4.3.9–1. The impacts from all site operations, including the treatment process, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the maximally exposed member of the public from annual operation of the electrometallurgical treatment process would be 7.6×10^{-4} mrem. The associated fatal cancer risk to this individual from 10 years of operation would be 3.8×10^{-9}. The impacts to the average individual would be even smaller. The annual dose to the population within 80 km (50 mi) would be 0.016 person-rem, which could result in 8.0×10^{-5} fatal cancers in this population from 10 years of operation.

The dose to the maximally exposed member of the public from annual total site operations would be maintained within the radiological limits specified by NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 0.019 mrem. From 10 years of operation, the corresponding risk of fatal cancers to this individual would be 9.5×10^{-8}. The impacts to the average individual would be even smaller. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operations, the annual population dose would be within the limit in proposed 10 CFR 834, and would be 2.4 person-rem. The corresponding number of potential fatal cancers in this population from 10 years of operation would be 0.012.

Doses to onsite workers from normal operations are given in Table 4.3.4.3.9–2. Included are involved workers directly associated with the electrometallurgical treatment of Pu, noninvolved workers, and the entire workforce at INEL. All doses fall within regulatory limits.

The annual dose to the average worker involved with the electrometallurgical treatment of Pu would be 40 mrem; the dose to the entire Pu treatment workforce would be 2.9 person-rem. The annual dose to the total

Table 4.3.4.3.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Electrometallurgical Treatment Alternative at Idaho National Engineering Laboratory

Receptor	Electrometallurgical Treatment Facility	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]		
Atmospheric release pathway (mrem)	7.6×10^{-4}	0.019
Drinking water pathway (mrem)	0	0
Total liquid release pathway (mrem)	0	0
Atmospheric and liquid release pathways combined (mrem)	7.6×10^{-4}	0.019
Percent of natural background[c]	2.2×10^{-4}	5.6×10^{-3}
10-year fatal cancer risk	3.8×10^{-9}	9.5×10^{-8}
Annual Population Dose Within 80 Kilometers[d]		
Atmospheric release pathway (person-rem)	0.016	2.4
Total liquid release pathway (person-rem)	0	0
Atmospheric and liquid release pathways combined (person-rem)	0.016	2.4
Percent of natural background[c]	3.1×10^{-5}	4.7×10^{-3}
10-year fatal cancers	8.0×10^{-5}	0.012
Annual Dose to the Average Individual Within 80 Kilometers[e]		
Atmospheric and liquid release pathways combined (mrem)	1.1×10^{-4}	0.016
10-year fatal cancer risk	5.5×10^{-10}	8.0×10^{-8}

[a] Includes impacts from No Action facilities. The location of the MEI may be different under No Action than for operation of the electrometallurgical treatment process. Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from total site operation are 10 mrem from the air pathways, as required by the NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation level at INEL is 338 for the average individual; the population within 80 km receives 90,800 person-rem.

[d] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[e] Obtained by dividing the population dose by the number of people projected to live within 80 km of INEL (269,000).

Note: Impacts from the electrometallurgical treatment are assumed to be 20 percent of the impacts associated with ANL-W. This is based on an estimate of the additional amount of material that would have to be processed by the electrometallurgical treatment facility to accommodate the immobilization of the Pu under this alternative.

Source: LLNL 1996b and model results (refer to Section M.2).

site workforce would be 223 person-rem. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.4.3.9–2.

Hazardous Chemical Impacts. The hazardous chemical impacts from normal operation of the electrometallurgical treatment subalternative at INEL are presented in Table 4.3.4.3.9–3. Included are the impacts due to operation of the electrometallurgical treatment facility only to immobilize Pu, and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected, and the risk of cancer due to the total chemical exposures. All supporting impact analyses are provided in Section M.3.

The HI to the MEI due to the facility operation would be 1.8×10^{-6} at INEL. The cancer risk from hazardous chemicals to the MEI would be zero (because no carcinogens are released from hazardous chemicals) at INEL.

Table 4.3.4.3.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Electrometallurgical Treatment at Idaho National Engineering Laboratory

Receptor	Impact
Involved Workforce[a]	
Average worker dose (mrem/yr)[b]	40
10-year risk of fatal cancer	1.6×10^{-4}
Total dose (person-rem/yr)	2.9
10-year fatal cancers	0.012
Noninvolved Workforce[c]	
Average worker dose (mrem/yr)[b]	30
10-year risk of fatal cancer	1.2×10^{-4}
Total dose (person-rem/yr)	220
10-year fatal cancers	0.88
Total Site Workforce[d]	
Dose (person-rem/yr)	223
10-year fatal cancers	0.89

[a] The involved worker is a worker associated with operations of the electrometallurgical treatment process to immobilize Pu.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is a worker onsite but not associated with electrometallurgical treatment operations. The noninvolved workforce is equivalent to the No Action workforce.

[d] The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: LLNL 1996b.

Table 4.3.4.3.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Electrometallurgical Treatment Alternative at Idaho National Engineering Laboratory

	INEL	
Receptor	Facility[a]	Total Site[b]
Maximally Exposed Individual (Public)		
Hazard index[c]	1.8×10^{-6}	0.015
Cancer risk[d]	0	3.6×10^{-6}
Worker Onsite		
Hazard index[e]	1.6×10^{-5}	0.22
Cancer risk[f]	0	7.7×10^{-4}

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=Sum of Individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer Risk for MEI=(Emissions Concentrations) x (0.286[converts concentrations to doses]) x (Slope Factor (SF)). Where there are no known carcinogens among chemicals emitted, the cancer risk value is 0.

[e] Hazard Index for Workers=Sum of Individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer Risk for Workers=(Emissions for 8-hr) x (0.286[converts concentrations to doses]) x (0.237[Fraction of year exposed]) x (0.571[Fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted, there are no slope factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Table M.3.4-60.

The HI to the onsite worker would be $1.6x10^{-5}$ at INEL, and the cancer risk to the onsite worker would be zero (because no carcinogens are released from hazardous chemicals) at INEL. The total HI to the MEI is $1.5x10^{-2}$ and to the workers is 0.22. The total cancer risk to the MEI is $3.6x10^{-6}$ and to the workers is $7.7x10^{-4}$.

Facility Accidents. Potential accidents associated with electrometallurgical treatment at the FCF at INEL have been analyzed and documented in an Environmental Assessment (IN DOE 1996c:83-94). The analysis includes both design-basis and beyond design-basis accidents associated with the treatment of spent nuclear fuels but does not explicitly analyze the effects of integrating plutonium in with the spent fuel being processed. Since the FCF is used for the treatment of a variety of DOE reactor fuels, many process uncertainties exist; these include the types and quantities of materials at risk within the argon cell. As a result, the safety analyses are based on conservative assumptions that are expected to bound any campaign that may be conducted during the DOE spent fuel treatment program. For comparison, the materials-at-risk considered for the FCF SAR (IN ANL 1995a:Ch 9) and addressed in the EA and another study on the immobilization of surplus fissile material through electrometallurgical treatment of spent fuel (LLNL 1996b:8-1) are based on a process for the treatment of EBR-II fuel. This provides a basis for extrapolation of the accident consequences for the proposed surplus plutonium immobilization program since the electrometallurgical processes are essentially the same and the bounding accidents evolve in the same way. The processes to produce metal immobilization forms (bounding case) are considered in theses analyses, because they result in the largest accident impacts attributable to immobilization operations (LLNL 1996b:8-1).

The accidents analyzed in the FCF SAR were screened using three criteria (LLNL 1996b:8-3) to select a subset of accidents that would reflect the additional risk associated with surplus Pu immobilization program. The accident in the subset with the highest impacts is a breach in the argon cell that would be initiated by a design-basis earthquake. This accident has an estimated probability in the range $1.0x10^{-6}$ to $1.0x10^{-4}$ per year and, if it were to occur, would result in a $5.2x10^{-7}$ increased likelihood of latent cancer fatality to an uninvolved worker located about 230 m (750 ft) from the accident. For the MEI, the accident would result in a $3.5x10^{-8}$ increased likelihood of latent cancer fatality and a corresponding risk over the 10-year campaign of $3.5x10^{-11}$. The estimated number of latent cancer fatalities in the offset population within 80 km (50 mi) would be $3.7x10^{-6}$ and the corresponding risk of latent cancer fatalities over a 10-year campaign would be $3.7x10^{-9}$ (IN DOE 1996c:89-90).

The beyond design-basis accident with the highest impacts would be a metal fire due to an earthquake induced breach in the argon cell concurrent with HEPA filter failure and an unfiltered release. This scenario is similar to the design-basis accident with the highest impacts except in this more severe accident, the release to the environment is unfiltered. This accident has an estimated probability of $1.0x10^{-6}$ per year or less and, if it occurred, would result in a $5.2x10^{-3}$ increased likelihood of latent cancer fatality to a worker located about 230 m (750 ft) from the accident. For the MEI, the accident would result in a $3.5x10^{-4}$ increased likelihood of latent cancer fatality and a corresponding risk over the 10-year campaign of $3.5x10^{-9}$. The estimated number of latent cancer fatalities in the offsite population within 80 km (50 mi) would be 0.037 and the corresponding risk of latent cancer fatalities over a 10-year campaign would be $3.7x10^{-7}$ (IN DOE 1996c:91-93).

4.3.4.3.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of electrometallurgical treatment for the immobilization of surplus fissile material in existing ANL-W facilities at INEL. Table 4.3.4.3.10–1 provides the estimated operational waste volumes projected to be generated at INEL, as a result of the electrometallurgical treatment of surplus fissile material. Facilities that would support the electrometallurgical treatment facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the electrometallurgical treatment facility

Table 4.3.4.3.10–1. Estimated Annual Generated Waste Volumes for the Electrometallurgical Treatment Alternative

Category	INEL	
	No Action[a] (m^3)	Pu Disposition (m^3)
Transuranic		
Liquid	0	None
Solid	3.5	6
Mixed Transuranic		
Liquid	0	None
Solid	Included in TRU	0.8
Low-Level		
Liquid	0	2
Solid	7,200	55
Mixed Low-Level		
Liquid	4	None
Solid	170	0.8
Hazardous		
Liquid	Included in solid	None
Solid	1,200	0.8
Nonhazardous (Sanitary)		
Liquid	Not reported separately, included in solid	1,550
Solid	52,000	1,500
Nonhazardous (Other)		
Liquid	0	2,990[b]
Solid	Included in sanitary	0.8[c]

[a] The No Action volumes are from Table 4.2.3.10–1. Incremental waste generation volumes for electrometallurgical treatment facility are from Table E.3.3.6–1. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.3.6–1.

[b] Includes recyclable wastes.

[c] Recyclable wastes.

and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.6. A detailed description of the waste management facilities that would be required to support the electrometallurgical treatment facility can also be found in Section E.3.3.6.

Operation of an electrometallurgical treatment facility would impact existing waste management activities at INEL, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during modifications to existing facilities would consist of approximately 2,780 m^3 (735,000 gal) of sanitary wastewater, 2,840 m^3 (750,000 gal) of other wastewater and 5,730 m^3 (7,500 yd^3) of solid sanitary wastes. These wastes would have minimal impact and can be easily handled within existing facilities.

The Electrometallurgical Treatment Facility would not generate any high-level waste as a waste stream from processing Pu. However, the Electrometallurgical Treatment Facility would produce an immobilized GBZ product that would require acceptance at a HLW repository. Electrometallurgical treatment for Pu disposition would annually produce an additional 37 m^3 (49 yd^3) of immobilized GBZ product (LLNL 1996b:7-3). This immobilized GBZ product would require interim storage onsite until acceptance at a HLW repository.

For Pu disposition, approximately 6 m^3 (8 yd^3) of additional TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and sludge from liquid TRU treatment would require treatment and repackaging in a radwaste facility to meet the WIPP WAC or alternative treatment level. INEL has existing and planned TRU waste facilities that could be utilized. A small quantity (0.8 m^3 [1 yd^3]) of mixed TRU solid waste would require treatment and packaging to meet the WIPP WAC or alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), one additional truck shipment per year or, if applicable, one regular train shipment every other year, or one dedicated train shipment every 8 years, would be required. [Text deleted.]

INEL has existing facilities that could manage the small quantities of LLW. As a result of Pu disposition, approximately 55 m^3 (72 yd^3) of additional LLW from solidified liquid LLW, protective clothing, and small equipment would require disposal. Using the land usage factor from Section E.1.4, the area required for LLW disposal at INEL would be 0.009 ha/yr (0.02 acres/yr). The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

For Pu disposition, a small quantity (0.8 m^3 [1 yd^3]) of additional mixed LLW consisting of solvent rags and equipment that have been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the INEL Site Treatment Plan that was developed to comply with the *Federal Facility Compliance Act*.

Hazardous wastes would consist primarily of analytical solutions and solvent rags. Other hazardous wastes would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous wastes would be stored in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

As a result of Pu disposition, approximately 1,550 m^3 (410,000 gal) of additional liquid nonhazardous sanitary and 2,990 m^3 (790,000 gal) of additional cooling tower blowdown and industrial wastewater would require treatment in accordance with INEL site practice and discharge permits. The 1,500 m^3 (2,000 yd^3) of additional solid nonhazardous wastes such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practices at INEL.

4.3.5 REACTOR CATEGORY

The following sections describe four reactor alternatives for the disposition of surplus Pu: Existing LWR Alternative, Partially Completed LWR Alternative, Evolutionary LWR Alternative, and the CANDU Reactor Alternative. A common activity for each reactor alternative is the MOX fuel fabrication facility, which is also described. The impacts for each reactor alternative would need to include those shown for the MOX fuel fabrication activity. Depending on the alternative, impacts on the following representative DOE sites may be described: Hanford, NTS, INEL, Pantex, ORR, SRS, and a generic range of site conditions within the United States. The sections describe the construction and operational impacts of the Reactor Alternative facilities on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomic, public and occupational health and safety, and waste management. For the CANDU reactor, effects within the United States and Canada are analyzed. Impacts described in these sections are in addition to those associated with the pit disassembly/conversion facility (Section 4.3.1) and the Pu conversion facility (Section 4.3.2).

4.3.5.1 Mixed Oxide Fuel Fabrication Facility

The environmental impacts described in the following sections are based on the analysis of the MOX fuel fabrication facility for the Reactor Category of Alternatives and is described in Section 2.4.5.1. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS. Environmental impacts for a representative commercial facility are also described in the context of a generic range of conditions that could exist at potential locations.

In accordance with the Preferred Alternative for surplus Pu disposition, the MOX fuel fabrication facility could be located at either Hanford, INEL, Pantex, or SRS. As a result of implementing a multiple technology disposition strategy, for analysis purposes, approximately 70 percent of the surplus Pu would be fabricated into MOX fuel. Further tiered NEPA review will be conducted to examine alternative locations, including new and existing facilities, at these four sites should the Preferred Alternative be selected at the ROD.

4.3.5.1.1 *Land Resources*

The MOX fuel fabrication facility may be located at Hanford, NTS, INEL, Pantex, ORR, SRS, or a commercial MOX fuel fabrication site. At all sites, the MOX fuel fabrication facility would disturb 121 ha (300 acres) of land during construction of which 81 ha (200 acres) would be used during operations. At any of these sites, the MOX fuel fabrication facility would be a stand-alone operation. The facility would be sited in a 1.6-km (1-mi) buffer zone for a total land area of 890 ha (2,200 acres). The buffer zone would be contained within the boundary of all analysis sites except at ORR, where the buffer zone would be less than 1.6 km (1 mi).

Construction and operation of the MOX fuel fabrication facility would not cause indirect land-use impacts at the analysis sites. As discussed in Section 4.3.5.1.8, in-migration of workers would be required at INEL only during the construction phase and at all analysis sites except ORR during the operational phase. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at each site. Therefore, offsite land use at the representative sites would not be affected.

Hanford Site

Land Use. The potential site for the MOX fuel fabrication facility would utilize vacant land in the 200 Area adjacent to 200 East. Construction of the MOX fuel fabrication facility would be in conformance with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land use planning process. According to the *Hanford Site Development Plan*, 200 Area's land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operations would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. The proposal would be consistent with State and local (Benton, Franklin, and Grant Counties and the City of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction would be consistent with the industrialized landscape character of the 200 Area and Hanford VRM Class 5 designation of the potential site. A potential visual impact during operation would be from the new stack plumes which could be visible from viewpoints with high sensitivity levels, including State Highways 24 and 240 and the city of Richland; however, because of viewing distance and compatibility of the proposal with existing industrial character, visual impacts would not occur.

Nevada Test Site

Land Use. The potential location for the MOX fuel fabrication facility would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as nonnuclear test area. However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The MOX fuel fabrication facility would be located in or adjacent to the ICPP security area. New construction would be required. Construction and operation of the facility would be in conformance with the current *Idaho National Engineering Laboratory Site Development Plan,* which designates the ICPP as situated within the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction would not be in conflict with local land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation would be compatible with the present visual character of INEL, which consists of large industrial facilities and stack plumes. Potential visual impacts could occur from the additional stack plumes; however, the proposal would be consistent with the existing VRM Class 5 industrial landscape character of the ICPP.

Pantex Plant

Land Use. The MOX fuel fabrication facility would be located on undeveloped land in Zone 11. The master plan of the current *Pantex Site Development Plan* designates Zone 11 for applied technology (PX DOE 1995g:16). However, Pantex could revise the site development plan should DOE decide to construct a MOX fuel fabrication facility in Zone 11.

Construction would not affect other site land uses. As discussed in Section 3.5.1, there would be no onsite impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] Potential impacts could occur during operations from the additional stack plumes; however, the visual environment would be consistent with the industrialized landscape character and current VRM Class 5 designation of Zone 11.

Oak Ridge Reservation

Land Use. The MOX fuel fabrication facility would be located on undeveloped land at or adjacent to Y–12. Weapons component manufacturing and development is among the future land uses designated for Y–12 by the future land-use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* (OR DOE 1989a:5-6,5-7). However, ORR could revise the site development plan should DOE decide to construct the facility at ORR.

The MOX fuel fabrication facility would not affect other ORR or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with city of Oak Ridge land-use plans, policies, and controls since the *Oak Ridge Area Land Use Plan* designates the potential site for industrial and/or Public use (depending upon the exact location chosen).

Visual Resources. [Text deleted.] Potential visual impacts could occur during operation from the new stack plumes; however, the visual environment would be consistent with the industrialized landscape character and existing VRM Class 5 designation of Y–12.

Savannah River Site

Land Use. The MOX fuel fabrication facility would be located on undeveloped land approximately 1.6 km (1 mi) north of the P-Reactor Area on the east side of SRS Route F. Facility construction and operation would be in conformance with future land use as designated by the current *Savannah River Site Development Plan*. According to the Plan, the future land-use category for the proposed development site is primary industrial mission (SR DOE 1994d:11,12). However, construction of the facility would convert undeveloped, forested land, and a very small portion of NERP lands.

Construction would not affect other SRS or offsite land uses at SRS. There are no prime farmland on SRS. Construction and operation would not be in conflict with the land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] Construction and operation of the facility would change the current VRM Class 4 designation to Class 5. Potential visual impacts could occur during operation from additional stack plumes. However, because of hilly terrain, impacts to State Highway 125 and SRS Route 1 would not occur.

Generic Site

Land Use. The site chosen for the commercial facility would likely contain adequate land area to accommodate MOX fuel fabrication facility and surrounding undeveloped land area. Construction of the facility could change existing land use. It is anticipated that the facility would be in conformance with site development/facility utilizations plans as well as land use plans, policies, and controls at the Federal, State, and local levels. If site development is not in conformance, it could be possible for land use plans, policies, and controls to be revised. Revisions could include a change in zoning classification of the site. The use of special status lands and prime farmland could be affected.

Visual Resources. It is anticipated that the facility would be relatively visually unobtrusive to adjacent lands due to sensitive site design, earthwork, and landscaping. However, the existing VRM classification could change due to facility construction and operations. It is likely that the existing VRM classification would be Class 4 or 5. Visual impacts to adjacent lands with high sensitivity levels, such as public roads, residential areas, and recreational/scenic areas could be reduced by the 1.6-km (1-mi) buffer zone.

[Text deleted.]

4.3.5.1.2 *Site Infrastructure*

A MOX fuel fabrication facility is required to support the various reactor alternatives for Pu disposition. The environmental consequences of this MOX fuel fabrication activity is additive to the consequences for each of the reactor alternatives discussed in Sections 4.3.5.2 through 4.3.5.5.

The options considered for the production of MOX fuel include the construction of a facility at a representative site (Hanford, NTS, INEL, Pantex, ORR, or SRS) and the production of MOX fuel assemblies by a commercial nuclear fuel vendor at a generic domestic facility.

Changes to the existing infrastructure at representative sites due to the construction and operation of a facility for the production of MOX fuel are presented in Tables 4.3.5.1.2–1 and 4.3.5.1.2–2, respectively. Construction is estimated to require 6 years to complete.

Table 4.3.5.1.2–1. Additional Site Infrastructure Needed for the Construction of the Mixed Oxide Fuel Fabrication Facility (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	833	1	126,180	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Project usage with facility	346,333	59	9,460,980	21,039,531	0
Amount required in excess of site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Project usage with facility	125,773	26	5,842,180	0	0
Amount required in excess of site availability	0	0	126,180[a]	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Project usage with facility	233,333	43	5,946,180	0	11,340
Amount required in excess of site availability	0	0	0	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Project usage with facility	47,099	11	921,346	7,200,000	0
Amount required in excess of site availability	0	0	0	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Project usage with facility	726,833	111	505,180	95,000,000	16,300
Amount required in excess of site availability	0	0	89,180[a]	0	0

Table 4.3.5.1.2–1. Additional Site Infrastructure Needed for the Construction of the Mixed Oxide Fuel Fabrication Facility (Annual)—Continued

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Project usage with facility	795,700	119	28,516,680	0	221,352
Amount required in excess of site availability	0	0	126,180[a]	0	0
Generic Site					
Range of resource availability	49,500-72,000	0.5-10	0-9,130,000	0-102,800,000	0-208,700
Amount required in excess of site availability (lowered)	0	0.5	126,180[a]	0	0

[a] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: CFFF 1995a:1; GE 1995a:1; HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SPC 1995a:1; SRS 1995a:2.

Table 4.3.5.1.2–2. Additional Site Infrastructure Needed for the Operation of the Mixed Oxide Fuel Fabrication Facility (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	<5	0	13,000	5	20,000	2,350,000	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Project usage with facility	425	204	358,500	63	4,354,800	23,389,531	0
Amount required in excess of site availability	<5	0	0	0	0	2,350,000[a]	0
NTS							
Site availability	1,100[b]	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Project usage with facility	650	0	137,940	30	5,736,000	2,350,000	0
Amount required in excess of site availability	0	0	0	0	20,000[c]	2,350,000[a]	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Project usage with facility	450	48	245,500	47	5,840,000	2,350,000	11,340
Amount required in excess of site availability	<5	0	0	0	0	2,350,000[a]	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Project usage with facility	81	27	59,266	15	815,166	9,550,000	0
Amount required in excess of site availability	<5	0	0	0	0	0	0

Table 4.3.5.1.2–2. Additional Site Infrastructure Needed for the Operation of the Mixed Oxide Fuel Fabrication Facility (Annual)—Continued

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Project usage with facility	76	27	739,000	115	399,000	97,350,000	16,300
Amount required in excess of site availability	<5	0	0	0	0	0	0
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Project usage with facility	235	103	807,000	121	28,410,500	2,350,000	221,352
Amount required in excess of site availability	<5	0	0	0	20,000[c]	2,350,000[a]	0
Generic Site							
Range of availability	3-9	0-4.3	49,500-72,000	0.5-10	0-9,130,000	0-102,800,000	0-208,700
Amount required in excess of site availability (lowered)	<2	0	0	4.5	20,000[c]	2,350,000[a]	0

[a] Facility would be adapted to use fuel oil instead of natural gas.

[b] Includes paved and unpaved roads.

[c] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: CFFF 1995a:1; GE 1995 a:1; HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SPC 1995a:1; SRS 1995a:2.

Hanford Site

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total requirements during construction would be within site availability. Impacts during operation would be greatest for natural gas which would require a 2,350,000 m^3/yr (82,990,250 ft^3/yr) increase over availability. This natural gas could be procured through normal contractual means. Total requirements for electrical energy, peak load, and oil would be less than that already available at the site.

Nevada Test Site

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total electrical energy required at NTS during the 6-year construction period would be less than site availability, and total oil requirements would be above site availability. Additional oil required could be procured through normal contractual means. Impacts during operation would be greatest for natural gas which is not currently used at NTS; however, oil-based utilities could be used to meet the need in lieu of natural gas. Peak electrical power load would be higher than projected usage without the facility but under current site availability. Projected total electrical energy usage with the facility would be more than projected usage without the facility, but would be less than site availability. Oil consumption would increase slightly above site availability and would be procured through normal contractual means.

Idaho National Engineering Laboratory

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Impacts during operation would be greatest for natural gas which is not currently

used at INEL; however, oil based utilities could be modified to meet the need. Total requirement for electrical energy would be within site availability, and the total requirement for oil would be within current site availability.

Pantex Plant

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total requirement for both electrical energy and oil would be less than current site availability. Requirements during operation for natural gas would be more than projected usage without the facility but less than site availability. The total electrical energy requirement and the total oil requirement would be less than current availability. Adequate electrical energy is available from the regional power grid.

Oak Ridge Reservation

Available reserves would accommodate the additional electrical energy requirement for construction of the MOX fuel fabrication facility. The requirement for oil would be more than current site availability but could be procured through normal contractual means. Site infrastructure impacts during operation would be minor compared with available resources. Onsite access to the MOX facilities would require less than 5 km (3 mi) of new roadway. Peak electrical power load would be greater than projected peak load without the facility, but would be less than current availability. The total requirement for oil with the MOX fuel fabrication facility would be slightly less than site availability. The total requirement for natural gas would be well within site availability.

Savannah River Site

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total requirement for oil would be slightly higher than site availability but could be procured through normal contractual means. Impacts during operation would be greatest for natural gas which is not currently used at SRS; however, fuel oil based utilities could be modified to meet the need. Peak electrical power load would be slightly greater than projected peak load without the facility, but well under availability. The total requirement for electrical energy with the facility would be well under site availability, and the total requirement for oil would be slightly above site availability but would be handled as stated above.

Generic Site

Since no domestic site exists for the fabrication of MOX fuel, the site infrastructure impact analysis for construction and operation of the facility compares the requirements shown in the appendices with the generic fuel fabrication facility site described in Section 3.10.2. It is possible that construction requirements for peak electric load and oil would exceed availability for an actual domestic site at the low-end range of available resources. Site infrastructure resources required for operation of a MOX fuel fabrication facility would exceed availability of peak electric load, oil, and natural gas at the low-end range of available resources at a generic domestic site. These additional resource requirements could require new electrical transmission lines, oil storage tanks, and gas transfer pipelines. The generic regional power pool (Table 3.10.2–2) shows that there is sufficient reserve capacity to support the additional load. Oil could be obtained from existing commercial sources. Natural gas may not be available, but oil-based utilities could substitute.

4.3.5.1.3 *Air Quality and Noise*

Construction and operation of the MOX fuel fabrication facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.5.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for this facility are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction.

The MOX fuel fabrication process involves pure Pu materials that would require minimal chemical processing. The emissions estimates for the facility are based on operational experience at European MOX facilities, the glovebox ventilation system design, and the actual process. Feed material preparation and fabrication of fuel pellets would be done in gloveboxes to control contamination for normal operations. The ventilation system for the MOX fuel fabrication facility would be used specifically for contamination control and would use a large volume of air to assure contamination control. There would be essentially four stages of HEPA filters on the glovebox exhaust that would eliminate (or reduce below detection limits) a minimum of 99.95 percent of nonradioactive particulates. Radioactive particulate emissions are discussed in Section 4.3.5.1.9. The glovebox exhaust would be mixed with room air exhaust, which also has two stages of HEPA filters for further filtration before release to the environment. The use of HEPA filters would not reduce VOC emissions because VOCs are not in a particulate form. There would also be process-specific scrubbers, vacuum traps, and filters that reduce the chance of criteria or toxic/hazardous pollutant releases from occurring. Because of the processing technology (which does not create some of the criteria pollutants), the defense-in-depth for Pu processing systems, and the extensive HEPA filtration (which removes the remaining criteria pollutants), emissions for criteria pollutants other than VOCs are expected to be below detection limits. VOC emissions of 1,000 kg/yr (2,200 lbs/yr), are shown in Table F.1.3–6, and would give trace concentrations at the site boundaries.

NOISE

The location of the facilities associated with the MOX fuel fabrication facility relative to the site boundary and sensitive receptors was examined for each of the seven sites to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Nontraffic noise sources associated with operation of a MOX fuel fabrication facility include ventilation systems, cooling systems, and diesel generators. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the analyzed sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.5.1.4 *Water Resources*

The construction and operation of a MOX fuel fabrication facility would affect water resources. Water resource requirements and discharges provided in Tables C.1.1.2–3 and C.2.1.2–3 and Table E.3.2.3–1, were used to assess impacts to surface and groundwater. The discussion of impacts is provided for each site separately. Table 4.3.5.1.4–1 presents No Action surface and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of a MOX fuel fabrication facility.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the MOX fuel fabrication facility. During construction, the quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent a 0.01-percent increase over the projected annual surface water withdrawal. During operation, the total annual water requirement for the facility would be approximately 56.8 million l/yr (15 million gal/yr), which would represent a 0.4-percent increase over the existing surface water withdrawal and approximately 0.00005 percent of the annual average flow rate of the Columbia River (3,360 m^3/s [118,642 ft^3/s]). These additional withdrawals would have minimal affects on surface water availability.

[Text deleted.]

During construction of the MOX fuel fabrication facility, sanitary and other nonhazardous wastewater (1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to an existing wastewater treatment system. During operation, approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. This would represent a 17.7-percent increase in the wastewater discharged annually at Hanford. All discharges would be monitored to comply with discharge requirements. Negligible impacts are expected.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be collected, monitored for radioactivity, and, if uncontaminated, discharged to evaporation/infiltration ponds or to local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, discharged to evaporation/infiltration ponds or to local drainage channels.

The MOX fuel fabrication facility would be located outside of the Columbia River floodplain and the area of the probable maximum flood. The maximum probable flood is greater than the 500-year flood.

Groundwater. No groundwater would be used during construction or operation of the MOX fuel fabrication facility; therefore, there would be no impacts to groundwater availability. No wastewater would be discharged directly to groundwater; therefore, groundwater quality should not be affected. Treated wastewater discharged to evaporation/infiltration ponds that does not evaporate, however, would percolate downward toward the groundwater. This wastewater would be monitored and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Table 4.3.5.1.4–1. Potential Changes to Water Resources Resulting From the Mixed Oxide Fuel Fabrication Facility

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	Generic
Water Source	Surface	Ground	Ground	Ground	Surface	Ground	Ground
No Action water requirements (million l/yr)	13,511	2,400	7,570	249	14,760	13,247	0
No Action wastewater discharge (million l/yr)	246	82	540	141	2,277	700	0
Construction							
Water Availability and Use							
Total water requirement (million l/yr)	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Percent increase in projected water use[a]	0.01	0.08	0.03	0.8	0.01	0.01	NA
Water Quality							
Total wastewater discharge (million l/yr)	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Percent change in wastewater discharge[b]	0.8	2.3	0.4	1.3	0.08	0.3	NA
Percent change in streamflow	neg	NA	NA	NA	0.004[c]	0.04[d]	NA
Operation							
Water Availability and Use							
Total water requirement (million l/yr)	56.8	56.8	56.8	56.8	56.8	56.8	56.8
Percent increase in projected water use[e]	0.4	2.4	0.8	5.1	0.4	0.4	NA
Water Quality							
Total wastewater discharge (million l/yr)	43.5	43.5	43.5	43.5	43.5	43.5	43.5
Percent change in wastewater discharge[f]	17.7	53	8.1	30.9	1.9	6.2	NA
Percent change in streamflow	neg	NA	NA	NA	0.02[c]	0.9[d]	NA

Table 4.3.5.1.4–1. Potential Changes to Water Resources Resulting From the Mixed Oxide Fuel Fabrication Facility—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	Generic
Floodplain							
Is actions in 100-year floodplain?	No	No	No	No	No	No	No
Is critical action in 500-year floodplain?	No	Uncertain	Uncertain	No	No	Uncertain	Uncertain

[a] Percent increases in water requirements during construction MOX fuel fabrication facility are calculated by dividing water requirements for the facility (1.9 million l/yr) with that for No Action water requirements each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), SRS (13,247 million l/yr), and generic site (0 million l/yr).

[b] Percent changes in wastewater discharged during construction for the MOX fuel fabrication facility are calculated by dividing wastewater discharges for the facility (1.9 million l/yr) with that for No Action discharges at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), SRS (700 million l/yr), and generic site (0 million l/yr).

[c] Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for the East Fork Poplar Creek is shown in the table.

[d] Percent changes in stream flow from wastewater discharge are calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).

[e] Percent increases in water requirements during operation of the MOX fuel fabrication facility are calculated by dividing water requirements for the Facility (56.8 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), SRS (13,247 million l/yr), and generic site (0 million l/yr).

[f] Percent changes in wastewater discharged during operation of the MOX fuel fabrication facility are calculated by dividing wastewater discharges for the facility (43.5 million l/yr) with that for No Action discharges at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), SRS (700 million l/yr), and generic site (0 million l/yr).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1991a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with any of the proposed facilities; groundwater would be used as the water source for the MOX fuel fabrication facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the MOX fuel fabrication facility, sanitary wastewater (1.9 million l/yr [0.5 million gal/yr]) would be generated. During operation, a maximum of approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity and, if uncontaminated, recycled or discharged to natural drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, discharged to natural drainage channels or be available to recycle.

No studies have been conducted to assess the 500-year floodplain boundaries at NTS. An assessment of the 500-year floodplain at NTS could be developed in future environmental studies. Studies of the 100-year floodplain have shown it to be confined to the Jackass Flats and Frenchman Lake areas. The proposed site for the MOX fuel fabrication facility is not located in either of these areas. However, since the NTS is in a region where most flooding occurs from locally intense thunderstorms that can create brief (less than 6 hours) flash floods, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater. Annual construction water requirements for the facilities (1.9 million l/yr [0.5 million gal/yr]) represent approximately 0.005 percent of the minimum estimated annual recharge (38 billion l/yr [10 billion gal/yr]) to the regional aquifer under NTS. As shown in Table 4.3.5.1.4–1, the quantity of water required for construction of the facility would represent approximately a 0.08-percent increase over the projected No Action groundwater usage. Withdrawal of this additional quantity should not impact groundwater availability. Operating the facility at NTS would require 56.8 million l/yr (15 million gal/yr), which is approximately 2.4 percent of the projected No Action groundwater usage. This additional withdrawal represents less than 0.2 percent of the estimated annual recharge. Minimal impacts to groundwater availability are expected.

Construction and operation of a MOX fuel fabrication facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward into the groundwater of the Valley-Fill Aquifer. This water would be monitored prior to discharge and would not be discharged until contaminant levels were within the limits specified in the State of Nevada permit. Impacts to groundwater quality are, therefore, not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for a MOX fuel fabrication facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of a MOX fuel fabrication facility, sanitary wastewater (1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the existing wastewater treatment system at the ICPP Area. This amount would represent a 0.4-percent increase in the effluent discharged at INEL. During operation, a maximum of approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. This amount represents a 8.1-percent increase in INEL's annual effluent. After treatment, all wastewater generated during construction and operation would be available to recycle or would then be allowed to evaporate to the atmosphere, and/or infiltrate to the subsurface. All discharges would be monitored to comply with discharge requirements.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity and, if uncontaminated, discharged to infiltration/evaporation ponds or to local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, discharged to local drainage channels or evaporation/ infiltration ponds.

The potential location for a MOX fuel fabrication facility is not located in an area historically prone to flooding, but is within the flood zone that could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. As shown in Table 4.3.5.1.4–1, construction and operation water requirements for the facility (1.9 million l/yr [0.5 million gal/yr]), and 56.8 million l/yr (15 million gal/yr), respectively, would represent 0.03- and 0.8-percent increases over the projected annual groundwater usage. These withdrawals would increase the total projected amount to be pumped at INEL to 17.6 percent of the total allotment during construction and 17.7 percent of the allotment during operation. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). These additional withdrawals would not impact groundwater availability.

Construction and operation of a MOX fuel fabrication facility would not result in direct discharges to groundwater. Treated wastewater that is discharged to disposal ponds but does not evaporate, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are, therefore, not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the MOX fuel fabrication facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of a MOX fuel fabrication facility, sanitary wastewater (1.9 million l/yr [0.5 million gal]) would be generated and discharged to the existing wastewater treatment systems north of Zone 12. During operation, a maximum of approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary wastewater and other wastewater would be discharged to either of these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would be discharged to the playa lakes or would be available for

recycle. In 1994, Pantex averaged approximately 1.4 million l/day (370,000 gal/day) of wastewater discharged to the playas. This quantity is expected to decrease in the future. The expected quantity of additional wastewater potentially discharged to the playas during operation (0.12 million l/day [31,704 gal/day]) should not cumulatively cause any exceedances of the monthly average limit of 2.46 million l/day (0.65 million gal/day).

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity and, if uncontaminated, discharged to local drainage channels or the playas. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, available for recycle or discharged to local drainage channels or the playas.

The potential site for the MOX fuel fabrication facility would be located in Zone 11. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 11, there would be no impacts to floodplains. However, flooding in other areas of Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system which obtains water from the Ogallala aquifer or possibly from the Hollywood Road Wastewater Treatment Plant. Construction water requirements for a MOX fuel fabrication facility would be small relative to the recoverable water in aquifer storage which for the year 2010 was estimated to be 287 trillion l (76 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.5.1.4–1, construction of the facility would require 1.9 million l/yr (0.5 million gal/yr) of water, which represents approximately a 0.8-percent increase over Pantex's projected annual groundwater usage and would be approximately 0.1 percent of the capacity of the groundwater system (1,900 million l/yr [502 million gal/yr]). Water required for operations would increase projected water requirements for Pantex by 5.1 percent. Previous studies have shown that, when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala aquifer, an average of 1.8-m/yr (5.9-ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the facility at Pantex would require 56.8 million l/yr (15 million gal/yr), resulting in a small drawdown representing approximately 2.9 percent of the available groundwater. Although this additional groundwater withdrawal would add to the existing decline in water levels of the Ogallala Aquifer, the estimated degree is not substantial. The total groundwater withdrawal including this facility would be 305 million l/yr (80.9 million gal/yr) which, because of expected cutbacks in other programs, would be 63 percent less than what is currently being withdrawn (836 million l/yr [221 million gal/yr]) from wells at Pantex.

Construction and operation of a MOX fuel fabrication facility would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operational of a MOX fuel fabrication facility would be provided via existing distribution systems. The source of this water is the Clinch River and its tributaries. During construction, the quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent a 0.01-percent increase over the projected no action annual surface water withdrawal. During operation, water requirements would be approximately 56.8 million l (15 million gal) annually. This represents a 0.4-percent increase in the projected annual surface water withdrawal for ORR. These additional water withdrawals from the Clinch River should cause minimal impacts to surface water availability.

During construction of the MOX fuel fabrication facility, sanitary wastewater (approximately 1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the existing wastewater treatment system in the Y–12 area. This would cause a less than 1-percent increase in the effluent from the Y–12 area. During operation, a total of 43.5 million l/yr (11.5 million gal/yr) of wastewater would be generated by the facility. This would cause a 1.9-percent increase in the effluent discharged from the Y–12 area. All discharges would be monitored to comply with discharge requirements. No impacts would be expected. Fire sprinkler water and truck hosedown water would be collected in tanks, monitored for radioactivity, and then transferred by pipeline or tanker to treatment facilities as required. Uncontaminated water would be pumped to storm drains.

Since the MOX fuel fabrication facility would be located outside both the 500- and 100-year floodplains no impact to floodplains is expected.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water withdrawals would be made; groundwater would be used for construction and operation of a MOX fuel fabrication facility. During construction of a MOX fuel fabrication facility, sanitary wastewater (approximately 1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modification. This amount would represent a 0.3-percent increase in the estimated annual flow to this system and could be handled within the existing capacity. During operation, a total of 43.5 million l/yr (11.5 million gal/yr) of wastewater would be generated by the facility, representing a 6.2-percent increase for SRS. This additional quantity would represent approximately 0.9 percent of the Fourmile Branch's minimum flow. [Text deleted.]

Cooling system blowdown is another non-hazardous wastewater stream generated by this facility. The facility would release approximately 0.04 million l (11,200 gal) of treated blowdown water over an 8-hour period, 250 days/yr. All discharges to surface waters would be monitored to comply with discharge requirements.

Fire sprinkler water and truck hosedown water would be collected in tanks, monitored for radioactivity, and then transferred by pipeline or tanker to treatment facilities as required. Uncontaminated water would be pumped to storm drains.

The potential location of a MOX fuel fabrication facility would be located outside the 100-year floodplain. Information on the location of the 500-year floodplain boundary could be developed in future environmental studies.

Groundwater. During construction, the quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent a 0.01-percent increase over the existing projected annual groundwater withdrawal. During operation, water requirements would be approximately 56.8 million l/yr

(15 million gal/yr) and would represent a 0.4-percent increase in groundwater withdrawals. Minimal impacts to groundwater availability are expected. No wastewater would be discharged directly to groundwater; therefore, groundwater quality should not be affected.

Generic Site

Utilizing an existing fuel fabrication facility should not cause any impacts to water resources outside of those identified in the site-specific environmental impact statements which have been prepared for these facilities. There would be no noticeable changes to current use of water resources. The facilities would continue to obtain raw water from either surface or groundwater sources which have an adequate supply to support them. Wastewater would continue to be treated, monitored, and discharged under permit requirements.

[Text deleted.]

4.3.5.1.5 *Geology and Soils*

This section discusses the environmental impacts to the geologic and soil resource as related to the construction and operation of the MOX fuel fabrication facility proposed for the Hanford, INEL, Pantex, SRS, NTS, ORR, and at an existing commercial uranium fuel fabrication facility, generic environment. A MOX fuel fabrication facility, at any of the representative sites, will involve some ground-disturbing construction activities (121 ha [300 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. Specifically, the relative annual amount of precipitation is greater at many eastern areas relative to most western areas. Specifically, ORR and SRS receive a greater relative amount of precipitation than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on geologic resources are anticipated. Neither facility construction and operational activities or site infrastructure improvements will restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is relatively low for many western areas, including Pantex, Hanford, INEL, and NTS. The soil erosion potential for many eastern areas including ORR and SRS during construction and operational activities is moderate due primarily to greater relative annual precipitation. The generic MOX fabrication facility could be located in either a low precipitation area or an area with a greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction activities (foundation preparation) and associated building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increased wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal.

[Text deleted.]

4.3.5.1.6 *Biological Resources*

Construction of the MOX fuel fabrication facility would require 121 ha (300 acres) of land at each of the DOE sites analyzed and at the generic site. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

For analytical purposes it is assumed that the MOX facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility would result in the disturbance of terrestrial habitat equaling about 0.08 percent of Hanford. This includes areas on which plant facilities would be constructed as well as areas revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the MOX facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the MOX facility. These disturbance may cause some species to move from the area. Disturbances to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the MOX facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a MOX facility at Hanford would not impact aquatic resources since there are no surface water bodies sufficiently near the assumed facility location that would be directly affected by construction activities or indirectly affected by runoff. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entrainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharge to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would likely be affected by construction and operation of the MOX facility; however, sagebrush habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-

listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the MOX facility would be located in the Frenchman Flat area of the NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility at NTS would result in the disturbance of terrestrial resources equaling about 0.03 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the assumed project area, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the MOX facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise could cause larger mammals and birds in construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the proposed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the MOX facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the MOX facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The desert tortoise is a federally listed threatened species that could be affected by construction of the MOX facility at NTS. Construction activities such as land-clearing operations, trenches, and excavation could pose a threat to the tortoise. Measures from previous projects at NTS designed to avoid impacts to the desert tortoise have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training, putting restrictions on vehicle speeds and off-road movement, conducting clearance surveys prior to surface disturbance, approving stop work authority if tortoises are found within work areas, removing tortoises from roadways and work areas, placing permanent and temporary tortoise proof fencing around trenches, landfills, and treatment ponds, inspecting trenches, and having biologists survey when heavy equipment is in use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the MOX facility.

[Text deleted.]

Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land clearing activities. Preactivity surveys would be required prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicle traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the MOX facility (Section 4.3.5.1.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the MOX fuel fabrication facility would be located adjacent to the ICPP. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the MOX fuel fabrication facility would result in the disturbance of terrestrial habitat equaling about 0.05 percent of INEL. This includes areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. Big sagebrush is the dominant plant within the site. Plant communities in which big sagebrush is the dominant overstory species are well represented on INEL, but are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture.

Construction of the MOX fuel fabrication facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would be lost during land-clearing activities. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they move was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. The closest pronghorn wintering area is located 4.8 km (3 mi) from the assumed site, therefore, wintering pronghorn should not be affected (IN DOE 1978a:222). Nests and young animals living within the project area could be lost during construction. The assumed site would be surveyed as necessary for the nests of migratory birds before construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the MOX fuel fabrication facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the MOX fuel fabrication facility would not affect wetlands since there are no wetlands on the assumed site. Wetlands associated with the Big Lost River are located about 1.6 km (1 mi) from the facility location; therefore, impacts to these wetlands are not expected.

Aquatic Resources. Construction and operation of the MOX fuel fabrication facility would not impact aquatic resources since there are no surface water bodies on the assumed site. The nearest surface water body is in the Big Lost River which is located 1.6 km (1 mi) from the facility location.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species would be affected by construction of the MOX fuel fabrication facility on INEL, but several State-listed status species may be affected. [Text deleted.] Burrows and foraging habitat for the pygmy rabbit would be lost. Bat

species such as the Townsend's western big-eared bat may roost in caves and forage throughout the assumed site. One State-listed sensitive plant species could potentially be affected by construction of the facility. The plant species, tree-like oxytheca, has been collected at eight sites on INEL and at only two other sites in Idaho. If present, individual plants of this species could be destroyed during land clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of these species in the area to be disturbed. No impacts to threatened and endangered species are expected due to facility operation.

Pantex Plant

It is assumed that the MOX facility would be located within Zone 11, which is a developed area that lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed facility location; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the MOX facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional water could lead to a minor increase in open water near the outfall, as well as a change in plant species composition. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of the MOX facility. Although the site has already been disturbed, it is possible that the State-listed Texas horned lizard could still be present. Preactivity surveys would be conducted as appropriate prior to construction.

Oak Ridge Reservation

It is assumed that the MOX fabrication facility would be located adjacent to the Y–12 Area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility at ORR would result in the disturbance of terrestrial habitat equaling about 0.9 percent of ORR. This acreage includes areas on which the facility would be constructed, as well as areas used for constructing laydown. Vegetation within the area to be developed would be destroyed during land clearing. The area immediately adjacent to Y–12 is largely grassland or disturbed land; it is in turn bordered by oak-hickory forest or pine and pine-hardwood forest (Figure 3.6.6–1). While grassland and disturbed land would be affected most by construction, both forest types could also be impacted. None of the community types that could be disturbed are considered rare within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals with the proposed project area, such as amphibians, reptiles, and smaller mammals, would be lost during land-clearing activities. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site could be lost during construction. The site would be surveyed as necessary for the nests of migratory birds before construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediments control

measures would control secondary impacts. Since existing intake and discharge structures would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River or East Fork Poplar Creek. Any unavoidable impact to wetlands would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with the requirements of a COE permit.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impacts on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the MOX facility could cause water quality changes (primarily sediments leading and resulting turbidity) to Bear Creek or East Fork Poplar Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since existing intake and discharge structures would be used, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little affect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river.

During construction and operation, wastewater would be discharge to West Fork Poplar Creek. The small volume of wastewater discharged to the stream would be expected to have negligible impacts on aquatic resources during either construction or operation. In addition, NPDES-permit requirements would be met.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the MOX facility. The Tennessee dace is sensitive to sedimentation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility.

Savannah River Site

It is assumed that the MOX fuel fabrication facility would be located about 1.6 km (1 mi) north of the P–Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility would result in the disturbance of terrestrial habitat equaling about 0.15 percent of SRS. Vegetation within the assumed facility location, which would be lost during land-clearing activities, consists of loblolly, longleaf, and slash pine. This community type is common on SRS and throughout the region.

Construction of the MOX facility would affect animal populations. Less mobile animals within the project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site will be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most types of wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Since the majority of the assumed site is upland, the facility could be located to avoid direct impacts to wetlands. Implementation of soil erosion and sediment control measures would control secondary impacts. Due to the relatively small amount of water required during both construction and operation, existing intake and discharge structures would be used. It would not be necessary to disturb wetlands along site streams. Any unavoidable impacts to wetlands would be mitigated. Wastewater discharge from construction and operation would be minimal and would not be expected to affect wetlands associated with the receiving stream. All wastewater discharges would be treated as necessary to comply with NPDES-permit requirements.

Aquatic Resources. Stormwater runoff during construction of a MOX fuel fabrication facility at SRS could cause temporary water quality changes in local tributaries to Par Pond. Water requirements during construction would be met by existing site sources. Since new intake and discharge structures would not be required, direct disturbance to aquatic resources in site water bodies would not occur. Wastewater discharges during construction would be minimal and would not be expected to affect aquatic resources.

Operation of the MOX fuel fabrication facility would necessitate water withdrawal from the Savannah River. Water would be withdrawn through existing intake structures. The small volume of water required would not affect the river's flow (Section 4.3.5.1.4), nor increase the entrainment and impingement of fish; thus, fish populations should not be affected. In compliance with the *Anadromous Fish Conservation Act* (16 USC 757a), populations of anadromous fish species on or near SRS would be sustained and their movement unobstructed by project construction and operation. During operation, nonhazardous wastewater would be discharged to local drainage channels. Flow increases are not expected to impact stream hydrology or aquatic resources. All discharges would be required to meet NPDES-permit requirements.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species are expected to be affected by construction or operation of a MOX fuel fabrication facility. Although bald eagles have been sighted in the vicinity of the assumed facility location, it is unlikely that construction and operation of the MOX fuel fabrication facility would affect this species. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site that this species would not be directly affected by the MOX facility. Preactivity surveys would be conducted as appropriate before construction to determine the presence of any special status species on the proposed site.

Generic Site

For analytical purposes it is assumed that a MOX fuel fabrication facility could be located at an unspecified location within the deciduous forest, southeast evergreen forest, or grassland principal vegetation type. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of a MOX fuel fabrication facility would result in the direct disturbance of terrestrial resources. Surrounding areas could be indirectly affected by erosion and sedimentation. Construction of the facility would affect animal populations. Specific impacts would vary with the particular site chosen; however, certain general types of impacts could be expected regardless of location. Less mobile animals within the project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed facility location may not survive. The

location will be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most types of wildlife because they would be maintained as landscaped areas.

Disturbances associated with both construction and operation, such as noise and human presence, could affect wildlife living adjacent to the facility. These disturbances could cause some species to move form the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

It is not possible to identify the particular vegetative communities to be disturbed since the location of the facility is not known; however, development could take place within the deciduous forest, southeast evergreen forest, or grassland principal vegetation type (Section 3.11.6). Due to previous disturbance, vegetation found at a particular location could vary considerably from that which may have once occurred. In fact, the presence of natural climax communities in certain areas could be considered uncommon and, thus, sensitive to development. For example, little native grassland exists due to the extensive conversion of this community to agriculture use. Tiered NEPA documentation will address site-specific impacts.

Wetlands. Wetlands could be affected either directly or indirectly by construction of a MOX fuel fabrication facility. Clearing and grading operations could result in the direct loss of wetlands, although proper placement of the facility within the overall site would eliminate or reduce the potential for such loss. Where direct impact is unavoidable, mitigation measures would be developed consistent with 10 CFR 1022 and in accordance with the conditions of a COE permit, if applicable. This would limit the disturbance to the smallest possible area, and mitigation measures would offset wetland loss.

Indirect impacts to wetlands from a MOX fuel fabrication facility could occur as a result of stormwater runoff carrying sediments to wetlands adjacent to disturbed areas. Changes in hydrology and soils could occur as a result of alterations in water levels and the buildup of sediments. These changes could, in turn, change the vegetative composition of the wetland.

The potential to affect wetlands would depend on where the facility was located. Although wetlands occur in each of the principal vegetation types within which a MOX fuel fabrication facility could be located, they are most prevalent in the southeastern evergreen forest, southwestern and northwestern portions of the deciduous forest, and the northern portion of grassland community regions of the site area. Thus, if the commercial MOX fuel fabrication facility were constructed in one of these areas, there would be a greater potential to impact wetlands. However, even within these regions, wetlands could be largely avoided during the siting process. Site-specific impacts will be addressed in tiered NEPA documentation.

Aquatic Resources. During construction of a MOX fuel fabrication facility, potential impacts to aquatic resources could result from stormwater runoff. Runoff could alter flow rates, increase turbidity, and result in sedimentation of stream beds. These impacts could, in turn, cause temporary and permanent changes in species composition and density, and could alter breeding habitats. Operational impacts to aquatic resources would be expected to be minimal since wastewater volumes would be minimal and would be discharged through an NPDES-permitted outfall. As discussed in Section 3.11.6, a wide variety of aquatic resources occur within the principal vegetation types within which this facility could be located. Since a site has not been selected for the commercial MOX fuel fabrication facility, it is not possible to determine which aquatic resources would be affected. Site-specific impacts will be determined in tiered NEPA documentation.

Threatened and Endangered Species. Construction and operation of the MOX fuel fabrication facility would have the potential to impact threatened and endangered species. Sources of impacts would be similar to those discussed above for terrestrial resources, wetlands, and species (and critical habitats) that are sensitive to disturbance and whose existence may be threatened by development. During the siting process, concern for

these species would be a primary consideration. Further, once a site was chosen, consultation with the USFWS and the appropriate State agency(s) would take place to ensure that threatened and endangered species would be protected. Potential impacts to individual species, necessary consultation, and protective measures will be addressed in site-specific NEPA documentation.

4.3.5.1.7 *Cultural and Paleontological Resources*

This section discusses impacts to cultural and paleontological resources that may result from construction and operation of the MOX fuel fabrication facility at each of the representative sites analyzed, and a generic site. The land to be disturbed during construction would be 121 ha (300 acres) of which 81 ha (200 acres) would be used during operations. A 1.6-km (1-mi) reduced-access buffer zone would be created around the facility at all sites except ORR, where the buffer zone would be smaller. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. If sites were identified, efforts would be made to avoid them. Operations would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified in close proximity to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The MOX fuel fabrication facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction of the proposed facility. Operation would not result in additional impact as it does not involve ground disturbance or increased activity.

The CGTO has conducted surveys over portions of Frenchman Flat and identified at least 20 plant species of importance to Native Americans. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from facility construction and operation. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The facility would be constructed adjacent to the existing ICPP security area. A surface survey of the area identified no sites within the proposed project area. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites are located adjacent to the ICPP—one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have a visual or auditory impact on traditional use areas or sacred sites. Such resources can be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain which have produced fossilized remains.

Pantex Plant

The MOX fuel fabrication facility would be constructed in Zone 11 of Pantex. Areas to be disturbed by development have not been systematically surveyed for archaeological or paleontological resources. Prior to construction, additional survey work may be necessary. Because Zone 11 is disturbed, it is unlikely to contain intact subsurface prehistoric or historic remains. Should any subsurface remains be discovered during construction, appropriate mitigation, documentation, and/or preservation measures would be conducted as necessary. Operation would not have additional impact to archaeological resources as it does not result in additional ground disturbance.

Facility construction may have an impact on historic structures at Pantex. The original buildings at Pantex were constructed between 1942 and 1945 to produce general purpose bombs. Zone 11 contains buildings, ramps, and landscape features which clearly illustrate the historic layout of a World War II bomb manufacturing line. Only two buildings within Zone 11 have been determined ineligible for listing on the NRHP. Construction may obscure the spatial relationship between these buildings, thereby compromising their historic significance. Operation of the facility is not expected to affect historic structures.

DOE has recently initiated consultation with Native American groups that have expressed interest in Pantex lands. To date, no Native American resources have been identified within Zone 11. Some resources may be identified through additional consultation. Although no mortuary remains have been discovered at Pantex to date, it is possible that some exist within the land to be disturbed by development. Burials are considered important Native American resources. Also, construction and operation may have an impact on traditionally used plant and animal species.

Important paleontological remains, such as bison and camel bones, have been found in other areas of the High Plains. The land to be disturbed during construction may contain some paleontological remains. Operation would not have an additional effect on paleontological remains.

Oak Ridge Reservation

The MOX fuel fabrication facility would be constructed adjacent to Y–12. This area has not been systematically surveyed. Although some of the land is disturbed, it may contain prehistoric or historic resources. Recorded prehistoric sites at ORR include villages, burial mounds, lithic workshops, and quarries. Historic sites recorded at ORR include both archaeological remains and standing structures. One prehistoric site, (40AN6), a lithic scatter, has been identified to the east of the Y–12 fences, near Scarboro Road. Additional prehistoric or historic

resources may occur in the project area, and these could be affected by construction. Operation, because it does not involve additional ground disturbance, is not expected to affect any prehistoric or historic resources.

Although none have been identified near Y–12 to date, facility construction and operation could have an impact on some Native American resources. For example, archaeological sites, which can be affected by construction, are sometimes considered Native American resources. In addition, the presence of a facility may create a visual intrusion into sacred or ceremonial space.

Fossilized remains occurring at ORR have little research value, so impacts to paleontological remains would be considered negligible.

Savannah River Site

The MOX fuel fabrication facility would be located approximately 1.6 km (1 mi) north of the P-Reactor Area on the east side of SRS Route F. To date, seven prehistoric sites have been located within 0.5 km (0.3 mi) of this area, so the potential for archaeological sites is moderate to high, and some NRHP-eligible resources may occur within the acreages that would be disturbed by construction. Prehistoric site types that may occur at SRS include villages, base camps, limited activity sites, quarries, and workshops. Historic site types that may occur at SRS include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farming dikes, cattle pens, dams, towns, churches, cemeteries, trash scatters, and roads.

Some Native American resources such as remains of villages, traditional plant gathering areas, cemeteries, and isolated burials may be affected by construction and operation of the facility.

No scientifically valuable fossil remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

Generic Site

This facility involves the use of an area adjacent to an existing fuel fabrication facility. No impacts to prehistoric, historic, or paleontological resources are anticipated because construction would occur on previously disturbed ground. Operation could affect some Native American resources. For example, the facility could create auditory intrusion into important Native American ceremonial or sacred sites. Increased security may result in reduced access to traditional use areas. Native American resources can be identified through project-specific consultation with potentially affected tribes.

[Text deleted.]

4.3.5.1.8 *Socioeconomics*

This section analyzes the socioeconomic effects of the MOX Fuel Facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all of the candidate sites are found in the Supplemental Socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Constructing a MOX fuel facility at any of the DOE sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 475 workers in the peak year of construction at any site. The largest increase in regional employment (less than 1 percent) among the sites analyzed would be at INEL. A total of 964 new jobs (475 direct and 489 indirect) would be generated and regional unemployment would fall from 5.4 percent to 4.8 percent (Socio 1996a). The largest increase in per capita income would occur if the facility is constructed at INEL, but the increase would be much less than 1 percent.

A workforce of 500 would be required for fuel operation at any site. Operating the facility at INEL would generate the largest changes in regional employment (about 1 percent) while the largest increase in per capita income (less than 1 percent) would also occur at INEL. A total of 1,841 new jobs (500 direct and 1,341 indirect) would be generated the operational activities, and regional unemployment would fall to 4.4 percent in the INEL REA (Socio 1996a).

Population and Housing. At all of the sites analyzed, except INEL, construction requirements would be met by the available resident labor force. However, some in-migrating workers would be needed to fill specialized positions during operation at all of the sites analyzed. Increases to the population from in-migration during construction or operation would be less than 1 percent over No Action projections. Housing units, in excess of existing vacancies, would be required in the INEL ROI during construction of the project. Additional housing construction would also be required at all of the sites analyzed, except NTS and ORR, during operation to accommodate the in-migrating population. During both phases, the greatest increase in housing requirements (much less than 1 percent) would be in the INEL ROI. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at all of the sites analyzed (Socio 1996a).

Community Services. Constructing the MOX fuel facility would increase demand for community services at INEL, but not at the other sites analyzed. However, operation of the facility would slightly increase the demand for community services at all of the sites analyzed. The effects of population growth due to in-migrating workers during construction or operation on community services at any of the sites analyzed would be minor. The following discussion focuses on the INEL and Pantex ROIs where the greatest increases in demand for community services is expected to occur.

To maintain the No Action student-to-teacher ratio of 18.5:1 at INEL, only one new teacher would be needed during construction. Nine additional teachers would be needed during operation in the Pantex ROI to maintain the No Action student-to-teacher ratio of 16.3:1 (Socio 1996a).

No additional police officers or firefighters would be needed to maintain No Action service levels at any of the sites analyzed during construction. One additional police officer and 3 additional firefighters would be necessary during operation to maintain the No Action level of service of 2.3 police officers and 2.3 firefighters per 1,000 persons in the Pantex ROI (Socio 1996a).

Projected hospital occupancy rates would increase slightly over the No Action levels at each site analyzed. Projected capacities would be capable of accommodating these small increases in patient load. No additional physicians would be needed at any of the sites analyzed during construction, however, 1 additional physician would be needed at INEL during operation to maintain the No Action service level of 1.2 physicians per 1,000 persons (Socio 1996a).

Local Transportation. There would be minor effects to the road networks due to construction and operation of a MOX fuel fabrication facility, but no drop in level of service. No new roads or improvements to existing roads would be needed (Socio 1996a).

Generic Site

Regional Economy Characteristics. The commercial site would require 475 and 500 workers for construction and operation of the facility, respectively. Project-related increases in per capita income and employment would be relatively small when compared to the regional economies in each REA. An analysis of the resident labor force in the REA surrounding each of the representative sites indicates that sufficient labor is available to fill these newly created positions.

Population and Housing, Community Services, and Local Transportation. There would be little or no population growth from in-migrating workers related to this project. Effects on housing, community services, and local transportation are expected to be similar to No Action projections.

4.3.5.1.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the MOX fuel fabrication facility, whose activities are associated with Pu disposition alternatives that utilize nuclear reactors. The section first describes the impacts from normal facility operation at each potential site, followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation are presented in Tables 4.3.5.1.9–1 and 4.3.5.1.9–2, respectively; impacts associated with the longer of the two assumed campaign times (17 years) are presented in the text. Impacts from hazardous chemicals to these same groups are given in Table 4.3.5.1.9–3. Summaries of impacts associated with postulated accidents are given in Table 4.3.5.1.9–4 through Table 4.3.5.1.9–9. Detailed results are presented in Appendix M.

The Preferred Alternative for disposition of surplus Pu is a dual technology strategy including immobilization and burning Pu as MOX fuel in existing reactors. For analysis purposes, approximately 70 percent of the surplus Pu was identified to be in forms suitable for MOX fuel fabrication. Summaries of the radiological and hazardous chemical impacts to the public and to workers associated with normal operations and with postulated accidents in this section are presented for an assumed 17-year operational campaign for the disposition of 50 t (55.1 tons) of surplus Pu and for an assumed 11-year operational campaign for the analyzed case (70 percent).

The Preferred Alternative for disposition through the utilization of existing reactors would require a shorter reactor campaign to dispose of less material with the utilization of additional reactors. The impacts and risks associated with MOX fuel fabrication would therefore be reduced since the duration of operations would coincide with the reactor campaign.

Normal Operation. There would be no radiological releases associated with the construction of a MOX fuel fabrication facility at any of the sites. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the MOX fuel fabrication facility at each of the sites are presented in Table 4.3.5.1.9–1. The impacts from all site operations, including the MOX fuel fabrication facility, are also given in the table. Comparisons with natural background radiation doses are included. Health effect values for operational periods of 11 and 17 years are presented in the table.

The doses to the MEI due to annual MOX facility operation at the identified DOE sites would range from 6.8×10^{-5} mrem at the NTS site to 6.8×10^{-3} mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancer to this individual would range from 5.8×10^{-10} to 5.8×10^{-8}. The impacts to the average individual would be less. As a result of annual facility operation, the population doses would range from 1.4×10^{-4} person-rem at the NTS site to 0.048 person-rem at the ORR site. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 1.2×10^{-6} to 4.1×10^{-4}. For the generic site, the dose to the maximally exposed member of the public would be 0.015 mrem. From 17 years of operation, the corresponding risk of fatal cancer to this individual would be 1.3×10^{-7}. The annual population dose would

Table 4.3.5.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Mixed Oxide Fuel Fabrication Facility

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS		Generic Site	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site
Annual Dose to the Maximally Exposed Individual Member of the Public[b]														
Atmospheric release pathway (mrem)	1.4×10^{-4}	4.4×10^{-3}	6.8×10^{-5}	4.2×10^{-3}	8.8×10^{-5}	0.018	5.2×10^{-4}	5.3×10^{-4}	6.8×10^{-3}	1.5	1.5×10^{-3}	0.42	0.015	0.073 to 0.52
Drinking water pathway	0	0	0	0	0	0	0	0	0	0.10	0	0.081	0	<1.0
Total liquid release pathway (mrem)	0	9.5×10^{-4}	0	0	0	0	0	0	0	1.7	0	0.37	0	0.002 to 1.0
Atmospheric and liquid release pathways combined (mrem)	1.4×10^{-4}	5.4×10^{-3}	6.8×10^{-5}	4.2×10^{-3}	8.8×10^{-5}	0.018	5.2×10^{-4}	5.3×10^{-4}	6.8×10^{-3}	3.2	1.5×10^{-3}	0.79	0.015	0.52 to 1.1
Percent of natural background[c]	4.7×10^{-5}	1.8×10^{-3}	2.2×10^{-5}	1.3×10^{-3}	2.6×10^{-5}	5.3×10^{-3}	1.6×10^{-4}	1.6×10^{-4}	2.3×10^{-3}	1.1	5.0×10^{-4}	0.27	4.9×10^{-3}	0.18 to 0.37
17-year fatal cancer risk	1.2×10^{-9}	4.6×10^{-8}	5.8×10^{-10}	3.6×10^{-8}	7.5×10^{-10}	1.5×10^{-7}	4.4×10^{-9}	4.5×10^{-9}	5.8×10^{-8}	2.8×10^{-5}	1.3×10^{-8}	6.7×10^{-6}	1.3×10^{-7}	4.4×10^{-6} to 9.5×10^{-6}
11-year fatal cancer risk[d]	7.8×10^{-10}	3.0×10^{-8}	3.8×10^{-10}	2.3×10^{-8}	4.9×10^{-10}	9.7×10^{-8}	2.8×10^{-9}	2.9×10^{-9}	3.8×10^{-8}	1.8×10^{-5}	8.4×10^{-8}	4.3×10^{-6}	8.4×10^{-8}	2.8×10^{-6} to 6.1×10^{-6}
Annual Population Dose Within 80 Kilometers[e]														
Atmospheric release pathway (person-rem)	6.2×10^{-3}	0.47	1.4×10^{-4}	3.9×10^{-3}	9.7×10^{-4}	2.4	2.8×10^{-3}	3.1×10^{-3}	0.048	29	0.044	41	0.14	0.44 to 11.2
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6	0	0.050 to 0.48
Atmospheric and liquid release pathways combined (person-rem)	6.2×10^{-3}	1.6	1.4×10^{-4}	3.9×10^{-3}	9.7×10^{-4}	2.4	2.8×10^{-3}	3.1×10^{-3}	0.048	34	0.044	44	0.14	0.49 to 11.7
Percent of natural background[c]	3.3×10^{-6}	8.4×10^{-4}	1.5×10^{-6}	4.2×10^{-5}	1.1×10^{-6}	2.7×10^{-3}	2.4×10^{-6}	2.6×10^{-6}	1.3×10^{-5}	9.0×10^{-3}	1.7×10^{-5}	0.017	6.7×10^{-5}	2.3×10^{-4} to 5.6×10^{-3}
17-year fatal cancers	5.3×10^{-5}	0.014	1.2×10^{-6}	3.3×10^{-5}	8.3×10^{-6}	0.020	2.4×10^{-5}	2.6×10^{-5}	4.1×10^{-4}	0.29	3.7×10^{-4}	0.37	1.2×10^{-3}	4.1×10^{-3} to 0.095
11-year fatal cancers[d]	3.4×10^{-5}	9.0×10^{-3}	7.8×10^{-7}	2.1×10^{-5}	5.4×10^{-6}	0.013	1.6×10^{-5}	1.7×10^{-5}	2.7×10^{-4}	0.19	2.4×10^{-4}	0.24	7.8×10^{-3}	2.7×10^{-3} to 0.061

Table 4.3.5.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Mixed Oxide Fuel Fabrication Facility—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS		Generic Site	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site
Annual Dose to the Average Individual Within 80 Kilometers[f]														
Atmospheric and liquid release pathways combined (mrem)	1.0×10^{-5}	2.6×10^{-3}	4.8×10^{-6}	1.3×10^{-4}	3.6×10^{-6}	8.9×10^{-3}	8.0×10^{-6}	8.9×10^{-6}	3.7×10^{-5}	0.026	4.9×10^{-5}	0.049	2.1×10^{-4}	8.9×10^{-4} to 0.014
17-year fatal cancer risk	8.5×10^{-11}	2.2×10^{-8}	4.0×10^{-11}	1.1×10^{-9}	3.1×10^{-11}	7.6×10^{-8}	6.8×10^{-11}	7.5×10^{-11}	3.2×10^{-10}	2.2×10^{-7}	4.2×10^{-10}	4.2×10^{-7}	1.8×10^{-9}	7.6×10^{-9} to 1.2×10^{-7}
11-year fatal cancer risk[d]	5.5×10^{-11}	1.4×10^{-8}	2.6×10^{-11}	7.1×10^{-10}	2.0×10^{-11}	4.9×10^{-8}	4.4×10^{-11}	4.9×10^{-11}	2.1×10^{-10}	1.4×10^{-7}	2.7×10^{-10}	2.7×10^{-7}	1.2×10^{-9}	4.9×10^{-9} to 7.7×10^{-8}

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9 for the DOE sites and Section 3.10.9 for the generic site). The location of the MEI may be different under No Action than for operation of the MOX fuel fabrication facility. Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR Part 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem, (7) Generic Site: the average individual receives a dose that could range from 281 to 311 mrem; the population within 80 km receives 155,000 to 251,000 person-rem.

[d] For the Preferred Alternative, for analysis purposes approximately 70 percent of the total Pu was assumed to be used for MOX fuel. As a result, the 17-year campaign for total Pu would be reduced to about an 11-year campaign for the Preferred Alternative.

[e] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[f] Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford; 29,400 at NTS; 269,000 at INEL; 350,000 at Pantex; 1,285,000 at ORR; 893,000 at SRS; and a range of 550,000 to 807,000 at the generic site).

Note: Since the Preferred Alternative would result in the disposition of approximately 70 percent of the surplus Pu using MOX-fueled LWRs, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced.

Source: Section M.2 for DOE sites. Refer to Section 3.10.9 for ranges associated with the generic site.

be 0.14 person-rem. The corresponding number of fatal cancers in this population from 17 years of operation would be 1.2×10^{-3}.

The doses to the MEI due to annual total site operations at the identified DOE sites are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The doses would range from 4.2×10^{-3} mrem at the NTS site to 3.2 mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.6×10^{-8} to 2.8×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population doses would be within the limit in proposed 10 CFR 834, and would range from 3.1×10^{-3} person-rem at the Pantex site to 44 person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 2.6×10^{-5} to 0.37. For the generic site, the doses to the maximally exposed member of the public from annual total site operations are within radiological limits and would range from 0.52 to 1.1 mrem. From 17 years of operation, the corresponding risks of fatal cancer to this individual would range from 4.4×10^{-6} to 9.5×10^{-6}. As a result of annual total site operation, the population doses are within the proposed reporting limit and would range from 0.49 to 11.7 person-rem. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 4.1×10^{-3} to 0.095.

The radiological impacts to the public that are associated with the generic site are included in Table 4.3.5.1.9–1.

Doses to onsite workers from normal operations are given in Table 4.3.5.1.9–2. Included are involved workers directly associated with the MOX fuel fabrication facility, workers who are not involved with the MOX fuel fabrication facility and the entire workforce at each site. All doses fall within regulatory limits. Health effects are given for 11 and 17 years of facility operations.

The annual dose to MOX fuel fabrication facility workers is site-independent and would be 250 mrem to the average facility worker and 31 person-rem to the entire facility workforce. The annual dose to the average noninvolved worker would range from 2.6 mrem at the ORR site to 159 mrem at the generic site. The annual total dose to all noninvolved workers would range from 3.0 person-rem at the NTS site to 250 person-rem at Hanford. The annual dose to the total site workforces would range from 34 person-rem at the NTS site to 281 person-rem at the Hanford site. The risks and numbers of fatal cancers among the different workers from 11 and 17 years of operations are included in Table 4.3.5.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these litigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts from normal operation of the MOX fuel fabrication facility at several sites and a generic commercial site are presented in Table 4.3.5.1.9–3. Included are the impacts due to operation of the MOX fuel fabrication facility only, and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected, and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI due to the facility operation ranges from 4.9×10^{-6} at the NTS site to 1.9×10^{-4} at the Pantex, ORR, and generic sites. The cancer risk from hazardous chemicals to the MEI is zero (because no carcinogens are released) at all sites. The HI to the onsite worker ranges from 8.0×10^{-4} at Pantex to 1.7×10^{-3} at the ORR and generic sites, and the cancer risk to the onsite worker is zero (because no carcinogens are released hazardous chemicals) at all sites.

Table 4.3.5.1.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Mixed Oxide Fuel Fabrication Facility

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS	Generic Site
Involved Workforce[a]							
Average worker dose (mrem/yr)[b]	250	250	250	250	250	250	250
17-year fatal cancer risk	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}
11-year fatal cancer risk[c]	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}
Total dose (person-rem/yr)	31	31	31	31	31	31	31
17-year fatal cancers	0.21	0.21	0.21	0.21	0.21	0.21	0.21
11-year fatal cancers[c]	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Noninvolved Workforce[d]							
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32	33 to 159
17-year fatal cancer risk	1.8×10^{-4}	3.4×10^{-5}	2.0×10^{-4}	6.8×10^{-5}	1.8×10^{-5}	2.2×10^{-4}	2.2×10^{-4} to 1.1×10^{-3}
11-year fatal cancer risk[c]	1.2×10^{-4}	2.2×10^{-5}	1.3×10^{-4}	4.4×10^{-5}	1.2×10^{-5}	1.4×10^{-4}	1.4×10^{-4} to 7.1×10^{-4}
Total dose (person-rem/yr)	250	3.0	220	14	44	226	7.0 to 98
17-year fatal cancers	1.7	0.020	1.5	0.095	0.30	1.5	0.048 to 0.67
11-year fatal cancers	1.1	0.013	0.97	0.061	0.19	0.97	0.031 to 0.43
Total Site Workforce[e]							
Dose (person-rem/yr)	281	34	251	45	75	257	38 to 129
17-year fatal cancers	1.9	0.23	1.7	0.31	0.51	1.7	0.26 to 0.88
11-year fatal cancers[c]	1.2	0.15	1.1	0.20	0.33	1.1	0.17 to 0.57

[a] The involved worker is a worker associated with operations of the proposed action.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] For the Preferred Alternative, for analysis purposes approximately 70 percent of the total Pu was assumed to be used for MOX fuel. As a result, the 17-year campaign for total Pu would be reduced to about an 11-year campaign for the Preferred Alternative.

[d] The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The noninvolved workforce is equivalent to the No Action workforce.

[e] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Note: Since the Preferred Alternative would result in the disposition of approximately 70 percent of the surplus Pu using MOX-fueled LWRs, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced.

Source: NRC 1995b; Section M.2.

Table 4.3.5.1.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Mixed Oxide Fuel Fabrication Facility

	Hanford		NTS		INEL		Pantex		ORR		SRS		Generic Site	
Receptor	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]
Maximally Exposed Individual (Public)														
Hazard Index[c]	3.3×10^{-5}	9.5×10^{-5}	4.9×10^{-6}	4.9×10^{-6}	7.1×10^{-5}	0.015	1.9×10^{-4}	5.8×10^{-3}	1.9×10^{-4}	0.040	9.0×10^{-6}	5.2×10^{-3}	1.9×10^{-4}	1.9×10^{-4}
Cancer risk[d]	0	0	0	0	0	3.6×10^{-6}	0	1.1×10^{-8}	0	0	0	1.3×10^{-7}	0	0
Worker Onsite														
Hazard Index[e]	1.6×10^{-3}	5.6×10^{-3}	8.2×10^{-4}	8.2×10^{-4}	1.6×10^{-3}	0.22	8.0×10^{-4}	6.9×10^{-3}	1.7×10^{-3}	0.16	1.4×10^{-3}	1.2	1.7×10^{-3}	1.7×10^{-3}
Cancer risk[f]	0	0	0	0	0	7.7×10^{-4}	0	4.5×10^{-7}	0	0	0	1.9×10^{-4}	0	0

[a] Facility=Contribution from the proposed new facility operation only. For the generic site, the data from the DOE site with maximum emissions and exposure was chosen.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation. For generic site, no hazardous chemical emission is assumed.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancerous health effects) for MEI.

[d] Cancer risk for MEI=(emissions concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted, therefore the calculated cancer risk value is 0.

[e] Hazard Index for workers=sum of individual Hazard Quotients (noncancerous health effects) for workers.

[f] Cancer risk for workers: (emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted there are no slope factors, therefore the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4–61 through M.3.4–67.

Facility Accidents. A set of potential accidents have been postulated for a MOX fuel fabrication facility for which there may be releases of radioactivity that may impact onsite workers and the offsite population.

The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.5.1.9–4 through 4.3.5.1.9–9 for Hanford, NTS, Pantex, ORR, INEL, and SRS. For a generic site, the accident impacts and risk at DOE sites are presented in Tables 4.3.5.1.9–4 through 4.3.5.1.9–9 and would be representative of a generic site due to the range of meteorological conditions and population densities across the analyzed DOE sites. In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 2.3 at ORR for the beyond design basis explosion accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 17-year facility lifetime risk form the same accident scenario for the population, maximum offsite individual, and worker at 801 m (2,630 ft), would be 3.9×10^{-6}, 2.3×10^{-8}, and 1.8×10^{-8}, respectively. The maximum population 17-year facility lifetime risk would be 3.2×10^{-4} (that is, one fatality in over 50,000 years) at ORR for the design basis fire accident scenario with a probability of 5.0×10^{-4} per year. The corresponding maximum offsite individual and worker 17-year facility lifetime risks would be 1.6×10^{-6} and 1.3×10^{-6}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.5.1.9–4 through 4.3.5.1.9–9. [Text deleted.] The 17-year facility lifetime risks would range from 4.4×10^{-7} to 1.3×10^{-6} for noninvolved workers, 1.1×10^{-8} to 1.6×10^{-6} for the maximally exposed individual, and 1.8×10^{-6} to 3.2×10^{-4} for the population within 80 km, respectively. The disposition of approximately 70 percent of the surplus Pu using MOX-fueled existing LWRs would decrease the operational campaign length. As a result, the impacts for 50 t (55.1 tons) for the assumed 17-year existing LWR campaign would be proportionately reduced.

[Text deleted.]

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Before construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is a possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude of the impacts of an aircraft crash into a MOX fuel fabrication facility is given by the earthquake scenario. The earthquake and aircraft scenarios are similar in that they both result in major structural damage and the release of plutonium directly to the environment. They differ in that an earthquake-induced fire is based on limited combustible materials while the aircraft crash has the potential for major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive serious or fatal injuries.

Table 4.3.5.1.9–4. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	1.1×10^{-6} (7.1×10^{-7})	1.3×10^{-4}	4.4×10^{-8} (2.9×10^{-8})	5.1×10^{-6}	8.1×10^{-5} (5.3×10^{-5})	9.3×10^{-3}	5.0×10^{-4}
Fire in a process cell	1.3×10^{-12} (8.4×10^{-13})	7.6×10^{-10}	5.2×10^{-14} (3.4×10^{-14})	3.0×10^{-11}	9.6×10^{-11} (6.2×10^{-11})	5.5×10^{-8}	1.0×10^{-4}
Impact-induced spill	2.1×10^{-16} (1.4×10^{-16})	2.7×10^{-13}	8.1×10^{-17} (5.3×10^{-17})	1.1×10^{-14}	1.5×10^{-14} (9.7×10^{-15})	1.9×10^{-11}	4.5×10^{-5}
Deflagration inside a glovebox	2.7×10^{-10} (1.7×10^{-10})	1.6×10^{-7}	1.1×10^{-11} (7.1×10^{-12})	6.4×10^{-9}	2.0×10^{-8} (1.3×10^{-8})	1.2×10^{-5}	1.0×10^{-4}
Nuclear criticality	3.5×10^{-13} (2.3×10^{-13})	2.1×10^{-7}	1.4×10^{-14} (9.1×10^{-15})	8.4×10^{-9}	2.9×10^{-12} (1.9×10^{-12})	1.7×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	8.9×10^{-12} (5.8×10^{-12})	5.4×10^{-6}	3.7×10^{-13} (2.4×10^{-13})	2.2×10^{-7}	6.7×10^{-10} (4.3×10^{-10})	3.9×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	1.6×10^{-8} (1.0×10^{-8})	9.4×10^{-3}	5.4×10^{-10} (3.5×10^{-10})	1.7×10^{-4}	9.6×10^{-7} (6.2×10^{-7})	0.58	1.0×10^{-7}
Beyond evaluation basis earthquake	7.0×10^{-9} (4.5×10^{-9})	4.1×10^{-3}	2.7×10^{-10} (1.7×10^{-10})	1.6×10^{-4}	4.9×10^{-7} (3.2×10^{-7})	0.29	1.0×10^{-7}
Expected risk[d]	1.1×10^{-6} (7.1×10^{-7})	-	4.4×10^{-8} (2.9×10^{-8})	-	8.1×10^{-5} (5.3×10^{-5})	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table 4.3.5.1.9–5. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	7.4×10^{-7} (4.8×10^{-7})	8.7×10^{-5}	1.7×10^{-8} (1.1×10^{-8})	2.0×10^{-6}	1.8×10^{-6} (1.2×10^{-6})	2.1×10^{-4}	5.0×10^{-4}
Fire in a process cell	8.9×10^{-13} (5.8×10^{-13})	5.2×10^{-10}	2.1×10^{-14} (1.4×10^{-14})	1.2×10^{-11}	2.1×10^{-12} (1.4×10^{-12})	1.3×10^{-9}	1.0×10^{-4}
Impact-induced spill	1.4×10^{-16} (9.1×10^{-17})	1.9×10^{-13}	3.3×10^{-18} (2.1×10^{-18})	4.3×10^{-15}	3.4×10^{-16} (2.2×10^{-16})	4.5×10^{-13}	4.5×10^{-5}
Deflagration inside a glovebox	1.8×10^{-10} (1.2×10^{-10})	1.1×10^{-7}	4.3×10^{-12} (2.8×10^{-12})	2.5×10^{-9}	4.4×10^{-10} (2.9×10^{-10})	2.6×10^{-7}	1.0×10^{-4}
Nuclear criticality	2.7×10^{-13} (1.7×10^{-13})	1.5×10^{-7}	5.5×10^{-15} (3.6×10^{-15})	3.3×10^{-9}	5.6×10^{-14} (3.6×10^{-14})	3.3×10^{-8}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	6.3×10^{-12} (4.1×10^{-12})	3.7×10^{-6}	1.5×10^{-13} (9.8×10^{-14})	8.6×10^{-8}	1.5×10^{-11} (9.7×10^{-12})	8.9×10^{-6}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	1.0×10^{-8} (6.5×10^{-9})	6.3×10^{-3}	2.1×10^{-10} (1.4×10^{-10})	1.3×10^{-4}	2.2×10^{-8} (1.4×10^{-8})	0.013	1.0×10^{-7}
Beyond evaluation basis earthquake	4.6×10^{-9} (3.0×10^{-9})	2.7×10^{-3}	1.0×10^{-10} (6.5×10^{-11})	6.3×10^{-5}	1.1×10^{-8} (7.1×10^{-9})	6.5×10^{-3}	1.0×10^{-7}
Expected risk[d]	7.4×10^{-7} (4.8×10^{-7})	-	1.8×10^{-8} (1.2×10^{-8})	-	1.8×10^{-6} (1.2×10^{-6})	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table 4.3.5.1.9–6. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatality[b]	Population to 80 km: Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]	Population to 80 km: Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	1.0×10^{-6} (6.5×10^{-7})	1.2×10^{-4}	1.1×10^{-8} (7.1×10^{-9})	1.3×10^{-6}	2.4×10^{-5} (1.6×10^{-5})	2.8×10^{-3}	5.0×10^{-4}
Fire in a process cell	1.2×10^{-12} (7.8×10^{-13})	7.1×10^{-10}	1.3×10^{-14} (8.4×10^{-15})	7.7×10^{-12}	2.8×10^{-11} (1.8×10^{-11})	1.7×10^{-8}	1.0×10^{-4}
Impact-induced spill	1.9×10^{-16} (1.2×10^{-16})	2.5×10^{-13}	2.1×10^{-8} (1.4×10^{-8})	2.7×10^{-15}	4.5×10^{-15} (2.9×10^{-15})	5.9×10^{-12}	4.5×10^{-5}
Deflagration inside a glovebox	2.5×10^{-10} (1.6×10^{-10})	1.5×10^{-7}	2.7×10^{-12} (1.7×10^{-12})	1.6×10^{-9}	5.9×10^{-9} (3.8×10^{-9})	3.5×10^{-6}	1.0×10^{-4}
Nuclear criticality	3.4×10^{-13} (2.2×10^{-13})	2.0×10^{-7}	3.3×10^{-15} (2.1×10^{-15})	1.9×10^{-9}	7.2×10^{-13} (4.7×10^{-13})	4.3×10^{-7}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	8.9×10^{-11} (5.8×10^{-11})	5.1×10^{-6}	9.6×10^{-14} (6.2×10^{-14})	5.5×10^{-8}	2.0×10^{-10} (1.3×10^{-10})	1.2×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	1.6×10^{-8} (1.0×10^{-8})	9.2×10^{-3}	1.3×10^{-10} (8.4×10^{-11})	8.0×10^{-5}	3.0×10^{-7} (1.9×10^{-7})	0.17	1.0×10^{-7}
Beyond evaluation basis earthquake	6.3×10^{-9} (4.1×10^{-9})	3.7×10^{-3}	6.8×10^{-11} (4.4×10^{-11})	4.0×10^{-5}	1.5×10^{-7} (9.7×10^{-8})	0.086	1.0×10^{-7}
Expected risk[d]	1.0×10^{-6} (6.5×10^{-7})	-	1.1×10^{-8} (7.1×10^{-9})	-	2.4×10^{-5} (1.6×10^{-5})	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table 4.3.5.1.9–7. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	4.4×10^{-7} (2.9×10^{-7})	5.1×10^{-5}	1.7×10^{-7} (1.1×10^{-7})	2.0×10^{-5}	2.7×10^{-5} (1.7×10^{-5})	3.2×10^{-3}	5.0×10^{-4}
Fire in a process cell	5.2×10^{-13} (3.4×10^{-13})	3.1×10^{-10}	1.8×10^{-13} (1.8×10^{-13})	1.2×10^{-10}	3.2×10^{-11} (2.1×10^{-11})	1.9×10^{-8}	1.0×10^{-4}
Impact-induced spill	8.1×10^{-17} (5.3×10^{-17})	1.1×10^{-13}	3.3×10^{-17} (2.1×10^{-17})	4.3×10^{-14}	5.1×10^{-15} (3.3×10^{-15})	6.7×10^{-12}	4.5×10^{-5}
Deflagration inside a glovebox	1.1×10^{-10} (7.1×10^{-11})	6.4×10^{-8}	4.4×10^{-11} (2.9×10^{-11})	2.6×10^{-8}	6.7×10^{-9} (4.3×10^{-9})	3.9×10^{-6}	1.0×10^{-4}
Nuclear criticality	1.6×10^{-13} (1.0×10^{-13})	9.7×10^{-8}	8.1×10^{-14} (5.3×10^{-14})	4.6×10^{-8}	1.9×10^{-12} (1.2×10^{-12})	1.1×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	3.7×10^{-12} (2.4×10^{-12})	2.2×10^{-6}	1.5×10^{-12} (9.7×10^{-13})	8.7×10^{-7}	2.3×10^{-10} (1.5×10^{-10})	1.3×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	5.6×10^{-9} (3.6×10^{-9})	3.3×10^{-3}	2.1×10^{-9} (1.4×10^{-9})	1.3×10^{-3}	3.3×10^{-7} (2.1×10^{-7})	0.20	1.0×10^{-7}
Beyond evaluation basis earthquake	2.7×10^{-9} (1.7×10^{-9})	1.6×10^{-3}	1.1×10^{-9} (7.1×10^{-10})	6.4×10^{-4}	1.6×10^{-7} (1.0×10^{-7})	0.098	1.0×10^{-7}
Expected risk[d]	4.4×10^{-7} (2.9×10^{-7})	-	1.8×10^{-7} (1.2×10^{-7})	-	2.7×10^{-5} (1.7×10^{-5})	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table 4.3.5.1.9–8. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 801 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	1.3×10^{-6} (8.4×10^{-7})	1.4×10^{-4}	1.6×10^{-6} (1.0×10^{-6})	1.8×10^{-4}	3.2×10^{-4} (2.1×10^{-4})	0.037	5.0×10^{-4}
Fire in a process cell	1.5×10^{-12} (9.7×10^{-13})	8.7×10^{-10}	1.8×10^{-12} (1.2×10^{-12})	1.1×10^{-9}	3.8×10^{-10} (2.5×10^{-10})	2.2×10^{-7}	1.0×10^{-4}
Impact-induced spill	2.4×10^{-16} (1.6×10^{-16})	3.1×10^{-13}	3.0×10^{-16} (1.9×10^{-16})	3.8×10^{-13}	6.0×10^{-14} (3.9×10^{-14})	7.9×10^{-11}	4.5×10^{-5}
Deflagration inside a glovebox	3.1×10^{-10} (2.0×10^{-10})	1.8×10^{-7}	3.8×10^{-10} (2.5×10^{-10})	2.3×10^{-7}	8.1×10^{-8} (5.3×10^{-8})	4.6×10^{-5}	1.0×10^{-4}
Nuclear criticality	3.9×10^{-10} (2.5×10^{-10})	2.3×10^{-7}	4.9×10^{-13} (3.2×10^{-13})	2.9×10^{-7}	3.4×10^{-11} (2.2×10^{-11})	2.0×10^{-5}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	1.0×10^{-11} (6.5×10^{-12})	6.2×10^{-6}	1.3×10^{-11} (8.4×10^{-12})	7.7×10^{-6}	2.7×10^{-9} (1.7×10^{-9})	1.6×10^{-3}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	1.8×10^{-8} (1.2×10^{-8})	0.011	2.3×10^{-8} (1.5×10^{-8})	0.013	3.9×10^{-6} (2.5×10^{-6})	2.3	1.0×10^{-7}
Beyond evaluation basis earthquake	7.4×10^{-9} (4.8×10^{-9})	4.5×10^{-3}	9.6×10^{-9} (6.2×10^{-9})	5.6×10^{-3}	1.9×10^{-6} (1.2×10^{-6})	1.2	1.0×10^{-7}
Expected risk[d]	1.3×10^{-6} (8.4×10^{-7})	-	1.6×10^{-6} (1.0×10^{-6})	-	3.2×10^{-4} (2.1×10^{-4})	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 801 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [801 m for the facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table 4.3.5.1.9–9. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 17 yr (per 11 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Fire on the loading dock	7.1×10^{-7} (4.6×10^{-7})	8.4×10^{-5}	2.5×10^{-8} (1.6×10^{-8})	2.9×10^{-6}	8.1×10^{-5} (5.3×10^{-5})	9.9×10^{-3}	5.0×10^{-4}
Fire in a process cell	8.9×10^{-13} (5.8×10^{-13})	5.0×10^{-10}	3.0×10^{-14} (1.9×10^{-14})	1.8×10^{-11}	1.0×10^{-10} (6.5×10^{-11})	5.9×10^{-8}	1.0×10^{-4}
Impact-induced spill	1.3×10^{-16} (8.4×10^{-17})	1.8×10^{-13}	4.7×10^{-18} (3.0×10^{-18})	6.2×10^{-15}	1.6×10^{-14} (1.0×10^{-14})	2.1×10^{-11}	4.5×10^{-5}
Deflagration inside a glovebox	1.8×10^{-10} (1.8×10^{-10})	1.0×10^{-7}	6.2×10^{-12} (4.0×10^{-12})	3.7×10^{-9}	2.1×10^{-8} (1.4×10^{-8})	1.2×10^{-5}	1.0×10^{-4}
Nuclear criticality	2.4×10^{-13} (1.5×10^{-13})	1.4×10^{-7}	7.4×10^{-15} (4.8×10^{-15})	4.5×10^{-9}	3.8×10^{-12} (2.5×10^{-12})	2.3×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	6.1×10^{-12} (4.0×10^{-12})	3.6×10^{-6}	2.1×10^{-13} (1.4×10^{-13})	1.2×10^{-7}	7.2×10^{-10} (4.7×10^{-10})	4.2×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	9.6×10^{-9} (6.2×10^{-9})	5.8×10^{-3}	3.1×10^{-10} (2.0×10^{-10})	1.8×10^{-4}	1.0×10^{-6} (6.5×10^{-7})	0.62	1.0×10^{-7}
Beyond evaluation basis earthquake	4.7×10^{-9} (3.0×10^{-9})	2.8×10^{-3}	1.6×10^{-10} (1.0×10^{-10})	9.1×10^{-5}	5.2×10^{-7} (3.4×10^{-7})	0.31	1.0×10^{-7}
Expected risk[d]	7.2×10^{-7} (4.7×10^{-7})	-	2.5×10^{-8} (1.6×10^{-8})	-	8.9×10^{-5} (5.8×10^{-5})	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual)) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

4.3.5.1.10 *Waste Management*

This section summarizes the impacts for the construction and operation of a MOX fuel fabrication facility. There is no spent nuclear fuel or HLW associated with a MOX fuel fabrication facility. Table 4.3.5.1.10–1 provides the estimated operational waste volumes projected to be generated at the DOE sites analyzed and a generic site as a result of the MOX fuel fabrication facility. Facilities that would support the MOX fuel fabrication facility would treat and package all generated waste into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes at DOE sites could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed on in accordance with current site practice. The projected incremental waste volumes generated from a MOX fuel fabrication facility and the resultant waste effluent that was used for the waste impact analysis can be found in Section E.3.2.3. A detailed description of the waste management activities that would be required to support the MOX fuel fabrication facility can also be found in Section E.3.2.3.

Construction and operation of a MOX fuel fabrication facility would impact existing waste management activities at each of the DOE sites analyzed and a generic commercial site, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, and solid nonhazardous and liquid hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Transuranic and mixed TRU wastes would be generated from Pu oxide purification, fuel fabrication, and material recycle. Following treatment and volume reduction, approximately 306 m^3 (400 yd^3) of TRU and 4 m^3 (5 yd^3) mixed TRU wastes consisting of filters, resins, job control waste, process equipment, and sweepings would require treatment and packaging to meet the current planning-basis WIPP WAC. This waste would be treated and packaged in a facility constructed with the MOX plant at ORR, NTS, Pantex, and the commercial MOX facility, or in an expanded central facility at the Hanford, INEL, or SRS sites. This waste would also require storage facilities where it could be staged until it would be shipped to WIPP or an alternate facility for disposal. To transport TRU waste to WIPP or an alternate facility, 36 additional truck shipments per year or, if applicable, 18 regular train shipments or 6 dedicated train shipments per year would be required.

All the sites analyzed have facilities to handle LLW. The approximately 153 m^3 (200 yd^3) of LLW generated in materials purification, uranium and Pu oxide processing and preparation, and rod pressing and processing would consist of contaminated job control waste, filters, and process equipment. This waste quantity is small in comparison to the No Action waste volumes disposed of at Hanford, INEL, NTS, ORR, and SRS. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.05 ha/yr (0.1 acre/yr) at Hanford and ORR, 0.03 ha/yr (0.06 acre/yr) at INEL and NTS, and 0.02 ha/yr (0.04 acre/yr) at SRS. Pantex and the generic commercial MOX facility would require nine LLW shipments per year to NTS or a commercial disposal facility, respectively. A commercial LLW disposal facility would require approximately 0.01 ha/yr (0.02 acre/yr) to dispose of this waste. For DOE sites, the ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

Less than 1 m^3 (200 gal) of liquid and 38 m^3 (50 yd^3) of solid mixed LLW is estimated to be generated in the MOX fuel fabrication facility. Mixed LLW would consist of radioactively-contaminated solvents, lead, and scintillation vials. All the sites analyzed have the capacity to treat mixed LLW. [Text deleted.] Mixed LLW

Table 4.3.5.1.10–1. Estimated Annual Generated Waste Volumes for the Mixed Oxide Fuel Fabrication Facility[a]

Category	New Facility (m^3)	Hanford No Action (m^3)	NTS No Action (m^3)	INEL No Action (m^3)	Pantex No Action (m^3)	ORR No Action (m^3)	SRS No Action (m^3)	Generic Site No Action (m^3)
Transuranic								
Liquid	0	None	None	None	None	None	None	None
Solid	306	271	None	3.5	None	119	338	None
Mixed Transuranic								
Liquid	0	None	None	None	None	None	None	None
Solid	4	98	None	Included in TRU	None	None	Included in TRU	None
Low-Level								
Liquid	4[b]	None	Dependent on restoration activities	None	8	2,970	74,000	4
Solid	153	3,390	15,000	7,200	32	7,320	16,400	41
Mixed Low-Level								
Liquid	0.8	3,760	None	4	4	87,600	1,330	0.8
Solid	38	1,505	50	170	46	432	7,700	2
Hazardous								
Liquid	4	Included in solid	Included in solid	Included in solid	2	6,460	1,260	4
Solid	153	560	212	1,200	31	26	15,100	153
Nonhazardous (Sanitary)								
Liquid	43,300	414,000	Not reported separately; included in solid	Not reported separately; included in solid	141,000	550,000	703,000	6,910
Solid	76	5,107	2,120	52,000	339	53,100	61,200	246
Nonhazardous (Other)								
Liquid	227	Included in sanitary	None	None	Included in sanitary	650,000	Included in sanitary	264
Solid	84[c]	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary	84[c]

[a] The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1, and Section 3.10.10. Incremental waste generation volumes for MOX Fuel Fabrication facility are from Table E.3.2.3–1. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.2.3–1.

[b] Liquid LLW would be treated and solidified prior to disposal.

[c] Includes recyclable wastes.

would be managed in accordance with the Tri-Party Agreement for Hanford, and the respective site treatment plans that were developed to comply with the *Federal Facility Compliance Act* for the remainder of the DOE sites. Mixed LLW would be managed in accordance with the NRC license conditions and other applicable requirements for the generic commercial site.

Approximately 4 m^3 (1,000 gal) of liquid and 153 m^3 (200 yd^3) of solid hazardous waste would be generated in the MOX fuel fabrication facility from the use of chemical and organic lubricants, coolants, solvents, and paints. Accommodation in existing facilities is feasible at Hanford, INEL, and ORR, though expansion may be required. Additional RCRA-permitted staging facilities would be required at NTS, Pantex, SRS, and the generic facility, where the hazardous waste would be stored pending onsite or offsite treatment at a RCRA-permitted facility.

Approximately 43,500 m^3 (11.5 million gal) of liquid nonhazardous sanitary, industrial, and other wastewater would require treatment in accordance with site practice and discharge permits. This waste would require a separate treatment facility at Hanford, INEL, and NTS, since these sites do not have centralized nonhazardous wastewater treatment facilities. At ORR, Pantex, and SRS, the plant or central wastewater facilities have the capacity to accommodate this increased flow. The generic MOX fuel fabrication facility may require expansion of the wastewater treatment facilities to handle this flow, or it may be possible to accommodate the increase in a public treatment facility. The approximately 76 m^3 (100 yd^3) of solid sanitary and industrial nonhazardous waste, and 84 m^3 (110 yd^3) of other nonhazardous waste generated by the MOX fuel fabrication facility is a small fraction of the solid nonhazardous wastes normally handled at any of the sites analyzed for this action, and would be recycled or shipped to onsite or offsite disposal facilities in accordance with site-specific practice.

4.3.5.2 Existing Light Water Reactor Alternative

The environmental impacts described in the following sections are based on the analysis of the existing LWR facility for the Existing LWR Alternative described in Section 2.4.5.2. This alternative would require the operation of a minimum of three LWRs, which could be located at the same or different sites. Environmental impacts for this facility are described in the context of a generic range of conditions that could exist at potential locations.

In accordance with the Preferred Alternative for surplus Pu disposition, three to five existing LWRs could be selected to disposition the surplus Pu. As a results of implementing a multiple technology disposition strategy, for analysis purposes, approximately 70 percent of the surplus would be used as MOX fuel in existing LWRs. As many as five sites with one reactor each or as few as one site with three reactors could be used for Pu disposition. If there are multiple reactors at a site, the impacts in the Sections 4.3.5.2.1 through 4.3.5.2.10 would be approximately doubled for two reactors or tripled for three reactors.

4.3.5.2.1 *Land Resources*

Land Use. No additional direct impacts to land use would occur from operations. As discussed in Section 4.3.5.2.2, a small addition to the fuel receiving and storage buildings may be required for the existing LWR to properly handle MOX fuel. If required, this addition would be a minor change to the plant profile and would be anticipated to utilize land area previously disturbed. Therefore, any new construction would be inconsequential. Additional land area would not be required for a buffer zone and there would be no change in land use. Site development would be in conformance with site development/facility utilization plans as well as land-use plans, policies, and controls at the Federal, State, and local levels.

The use of MOX fuel in an existing LWR would not affect the use of other onsite lands (for example, buffer/undeveloped land areas would not be encroached upon). Site land use would be compatible with offsite land uses, including the use of special status land. Prime farmland would also not be affected. As discussed in Section 4.3.5.2.8, no in-migration of workers would occur during operations. Therefore, no indirect impacts to offsite lands would occur.

Visual Resources. No additional impacts to visual resources would occur from operations. Current VRM classification of the developed area of the site would be maintained and would likely be a Class 5. Facility operations, such as stack plumes, could continue to be visible from lands with high sensitivity levels, such as public roadways, urbanized areas, and recreational/scenic areas. However, this would not represent a change (that is, increase in magnitude or extent) from the existing condition.

4.3.5.2.2 *Site Infrastructure*

The existing LWR site infrastructure would remain essentially unchanged from the conditions described in Section 3.11.2 (see Table 4.3.5.2.2–1). A small addition to the fuel receiving and storage buildings may be required for the existing LWR to properly handle the MOX fuel. However, because this is only a minor change to the plant profile, existing LWR site infrastructure would not be impacted by the change to MOX fuel. The site is served with water and an existing power distribution system that would adequately support the power demands of plant equipment and employee facilities.

Table 4.3.5.2.2–1. Additional Site Infrastructure Needed for the Operation of One Existing Light Water Reactor (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	5 to 20	0 to 12	700,000 to 1,100,000	96 to 140	Approximately 757,000	0	0
Range of resource availability[a]	5 to 20	0 to 12	700,000 to 1,100,000	96 to 140	Approximately 757,000	0	0
Amount required in excess of low-end range of available resources	0	0	0	0	0	0	0

[a] The existing site infrastructure would remain essentially unchanged.

Source: ORNL 1995b.

4.3.5.2.3 *Air Quality and Noise*

Operations related to the existing LWR facility would continue to generate criteria pollutants. Impacts for radiological airborne emissions are discussed in Section 4.3.5.2.9.

Noise impacts during operation are expected to be low. Air quality and noise impacts for this disposition alternative are described separately. Supporting data for the air quality and noise analyses are presented in Appendix F.

AIR QUALITY

The operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

Emission rates for operation of the existing LWR are presented in Table F.1.3–12. Air pollutant emissions sources associated with operations include:

- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]
- Small quantities of toxic/hazardous pollutant emissions from facility operations

During operation, concentrations of criteria and toxic/hazardous air pollutants are expected to continue to be in compliance with Federal, State, and local air quality regulations or guidelines. No additional operation or testing of diesel generators or emissions from support facilities would be expected to occur from the use of MOX fuel. Pollutant concentrations from operating an existing LWR with a MOX core rather than a uranium core would not change, as shown in Table F.1.3–12. The process would remain the same, and criteria and toxic/hazardous emissions are not related to the type of fuel being used (NRC 1996b:2-22).

NOISE

The location of the facilities associated with the existing LWR facility relative to the site boundary and sensitive receptors was examined in order to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts.

Non-traffic noise sources associated with reactor operation of these facilities include ventilation systems, cooling systems, vents, pumps, motors, emergency diesel generators, transformers, paging systems, and material handling equipment. There would be no discernible increase in noise levels as a result of operating an existing LWR with a MOX core rather than a uranium core.

4.3.5.2.4 *Water Resources*

Utilizing excess Pu as fuel in an existing commercial LWR should not cause any impacts to water resources outside of those identified in the site-specific environmental impact statements which have been prepared for these facilities. There would be no noticeable changes to current use of water resources. The facilities would continue to obtain raw water from either surface or groundwater sources that have an adequate supply to support them. Wastewater would continue to be treated, monitored, and discharged.

4.3.5.2.5 *Geology and Soils*

There would be no impacts to the geologic and soil resources resulting from the utilization of existing LWRs. A range of conditions from applicable sites were evaluated and used as the basis for this assessment. No ground-disturbing construction activities are proposed for this alternative although there would be modification of an existing building. Therefore, no construction or operational effects to the geologic and soil resource are anticipated, and no direct or indirect effects to the geologic or soil resource are anticipated.

4.3.5.2.6 *Biological Resources*

Representative existing LWR sites that could be utilized for the disposition of Pu in a MOX-fueled reactor are located within a number of the principal vegetation types, including deciduous forest, grassland, desert, and southeast evergreen forest. These principal vegetation types are described in Sections 3.10.6 and 3.11.6.

The use of an existing LWR to burn MOX fuel would not be expected to result in any additional impacts to biological resources at the selected site. This is the case since the reactor and all associated facilities are in place and operational. Although an addition to the fuel receiving and storage building may be required, construction would take place within a previously disturbed area of the site. Also, the design and operation of cooling and auxiliary water systems would not be affected by the use of MOX fuel. Thus, entrainment, impingement, and thermal impacts to aquatic organisms, or salt drift impacts to vegetation and soil, would not be expected to increase. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate.

4.3.5.2.7 *Cultural and Paleontological Resources*

This section discusses impacts to cultural and paleontological resources potentially resulting from the use of an existing LWR. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Utilization of an existing LWR is not expected to affect cultural or paleontological resources. Minor building modifications and ground-breaking activities are proposed, but new construction would be adjacent to existing facilities on previously disturbed ground. It is unlikely that the area contains NHRP-eligible or paleontological resources. No impacts to Native American resources are expected.

4.3.5.2.8 *Socioeconomics*

This section describes the potential socioeconomic effects resulting from the use of MOX as fuel in existing light water reactors. Representative sites, varying in size from one to three reactors, were selected for analysis.

Regional Economy Characteristics. Operation activities at these sites would create between 40 and 105 total new jobs (direct and indirect) for each reactor. Positions required during operation of any of these facilities would be filled by the REA's existing workforce, and there should not be any in-migration to the ROI as a result of this alternative. There would be a negligible increase in the REA's local economy and per capita income, and unemployment rates would decrease minimally (Socio 1996a).

Population and Housing, Community Services, and Local Transportation. There would be no in-migrating workers and therefore no impacts to population and housing or community services. There would also be no impacts to the local transportation networks.

4.3.5.2.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with an existing commercial LWR whose core would be fueled with MOX instead of uranium oxide alone. The section first describes the impacts from normal facility operation of the MOX fueled reactor for a representative sample of existing commercial LWR sites followed by a description of impacts from reactor accidents at a generic site. The impacts associated with the ultimate disposal of the spent nuclear fuel form in a HLW repository are presented separately in technical documents that specifically address repository operations.

Summaries of the radiological impacts to the public and to workers associated with normal operation are presented in Tables 4.3.5.2.9–1 and 4.3.5.2.9–2, respectively; impacts associated with the applicable time duration (17 years, the assumed campaign time or 11 years for the Preferred Alternative) are presented in the text. Summaries of impacts associated with postulated accidents are given in Tables 4.3.5.2.9–3 and 4.3.5.2.9–4. Detailed results are presented in Appendix M.

The Preferred Alternative for disposition of surplus Pu is a dual technology strategy including immobilization and burning Pu as MOX fuel in existing reactors. Approximately 70 percent of the surplus Pu was identified to be in forms suitable for MOX fuel fabrication. Summaries of the radiological and hazardous chemical impacts to the public and to workers associated with normal operations and with postulated accidents in this section are presented for an assumed 17-year operational campaign for the disposition of 50 t (55.1 tons) of surplus Pu and for an assumed 11-year operational campaign for the analyzed case (70 percent).

The Preferred Alternative for disposition through the utilization of existing reactors would require a shorter reactor campaign to dispose of less material with the utilization of additional reactors. The impacts and risks associated with MOX fuel fabrication would therefore be reduced since the duration of operations would coincide with the reactor campaign.

Normal Operation. During normal operation of an existing LWR with a MOX core, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Table 4.3.5.2.9–1 presents the reported radiological impacts to the general public resulting from operation of the existing LWRs with uranium cores in 1994. Impacts involved in changing the core from a uranium core to a MOX core are also presented. To put the operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses and resulting fatal cancer risks to both the average and the maximally exposed member of the public, and also to the population, from annual commercial LWR operation with a MOX-fueled core would not be significantly different than present operations with a uranium core.

The dose to the maximally exposed member of the public from annual total site operations would be maintained within the radiological limits specified in Appendix I to 10 CFR 50 and 40 CFR 190 (if the reactor is licensed by NRC). This dose is estimated to be less than 0.17 mrem from all pathways. From 17 years of operation, the corresponding fatal cancer risk for this individual would be less than 1.5×10^{-6}. The impacts to the average individual would be much less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population dose would be less than 2.0 person-rem. The corresponding number of fatal cancers in this population from 17 years of operation would be less than 0.017.

Table 4.3.5.2.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Existing Light Water Reactor

Receptor	No Action (Reactors Using UO_2 Core)[a]	Reactor Using MOX Core	
		Increment[b]	Total Site[c]
Annual Dose to the Maximally Exposed Individual Member of the Public[d]			
Atmospheric release pathway (mrem)	$4.2x10^{-4}$ to 0.091	$2.5x10^{-5}$ to 0.023	$4.4x10^{-4}$ to 0.10
Total liquid release pathway (mrem)	$8.6x10^{-4}$ to 0.095	-0.020 to $-2.8x10^{-4}$	$2.8x10^{-4}$ to 0.075
Atmospheric and liquid release pathways combined (mrem)	$1.3x10^{-3}$ to 0.19	$-1.1x10^{-2}$ to 0.020	$7.2x10^{-4}$ to 0.17
Percent of natural background[e]	$4.3x10^{-4}$ to 0.063	$-3.8x10^{-3}$ to $6.8x10^{-3}$	$2.4x10^{-4}$ to 0.059
17-year fatal cancer risk	$1.1x10^{-8}$ to $1.6x10^{-6}$	$-9.6x10^{-8}$ to $1.7x10^{-7}$	$5.9x10^{-9}$ to $1.5x10^{-6}$
11-year fatal cancer risk[f]	$7.1x10^{-9}$ to $1.0x10^{-6}$	$-6.2x10^{-8}$ to $1.1x10^{-7}$	$3.7x10^{-4}$ to $9.7x10^{-7}$
Annual Population Dose Within 80 Kilometers			
Atmospheric release pathway (person-rem)	0.021 to 1.4	$1.3x10^{-3}$ to 0.20	0.022 to 1.6
Total liquid release pathway (person-rem)	0.0 to 2.2	-0.48 to 0.0	0.0 to 1.7
Atmospheric and liquid release pathways combined (person-rem)	0.021 to 2.5	-0.046 to 0.20	0.022 to 2.0
Percent of natural background[e]	$4.0x10^{-6}$ to $3.2x10^{-4}$	$-6.0x10^{-5}$ to $3.4x10^{-5}$	$4.3x10^{-6}$ to $2.6x10^{-4}$
17-year fatal cancers	$1.8x10^{-4}$ to 0.021	$-3.8x10^{-3}$ to $1.7x10^{-4}$	$1.8x10^{-4}$ to 0.017
11-year fatal cancers[f]	$1.2x10^{-4}$ to 0.014	$-2.5x10^{-3}$ to $1.1x10^{-4}$	$1.2x10^{-4}$ to 0.011
Annual Dose to the Average Individual Within 80 Kilometers[g]			
Atmospheric and liquid release pathways combined (mrem)	$1.2x10^{-5}$ to $9.6x10^{-4}$	$-1.8x10^{-4}$ to $1.0x10^{-4}$	$1.3x10^{-5}$ to $7.8x10^{-4}$
17-year fatal cancer risk	$1.0x10^{-10}$ to $8.1x10^{-4}$	$-1.5x10^{-9}$ to $8.9x10^{-10}$	$1.0x10^{-10}$ to $6.7x10^{-9}$
11-year fatal cancer risk[f]	$6.5x10^{-11}$ to $5.2x10^{-9}$	$-9.7x10^{-10}$ to $5.8x10^{-10}$	$6.5x10^{-11}$ to $4.3x10^{-9}$

[a] The No Action doses are based on 1994 reported doses from operation of all reactors at a site.

[b] Incremental doses represent the change in doses involved in changing from a uranium core to a MOX core.

[c] Combined or total impacts do not necessarily equal the sum of the individual components because different sites may be involved.

[d] The standards for individual members of the public are given in Appendix I to 10 CFR 50 and 40 CFR 190 for NRC licensed reactors. As discussed in Appendix I, 5 mrem/yr is the airborne emission guideline and 3 mrem/yr per reactor is the liquid release guideline. Meeting these guideline values serves as a numerical demonstration that doses are as low as reasonably achievable. A total dose of 25 mrem/yr is the limit from all pathways combined, as given in 40 CFR 190. If the reactor is owned by DOE, the applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR Part 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[e] Annual natural background radiation levels: the average individual receives a dose that could range from 296 to 299 mrem; the population within 80 km in the year 1994 received a dose that could have ranged from 130,000 to 760,000 person-rem.

[f] For the Preferred Alternative, for analysis purposes approximately 70 percent of the total surplus Pu was assumed to be used in existing LWRs. As a result, the 17-year campaign for the total Pu would be reduced to about an 11-year campaign for the Preferred Alternative.

[Text deleted.]

[g] Obtained by dividing the population dose by the number of people living within 80 km of the site (450,000 to 2,600,000).

Source: Section M.2.

Table 4.3.5.2.9–2. Potential Radiological Impacts to the Workers During Normal Operation of the Existing Light Water Reactor

Receptor	No Action (Reactor Using UO_2 Core)[a]	Reactor Using MOX Core	
		Increment[b]	Reactor Total[c]
Commercial LWR Workforce			
Average worker dose (mrem/yr)[d]	280 to 540	1.3 to 2.7	281 to 543
17-year risk of fatal cancer	1.9×10^{-3} to 3.7×10^{-3}	8.9×10^{-6} to 1.8×10^{-5}	1.9×10^{-3} to 3.7×10^{-3}
11-year risk of fatal cancer[e]	1.2×10^{-3} to 2.4×10^{-4}	5.8×10^{-6} to 1.2×10^{-5}	1.2×10^{-3} to 2.4×10^{-3}
Total dose (person-rem/yr)	170 to 600	1.6	172 to 602
17-year fatal cancers	1.2 to 4.1	0.011	1.2 to 4.1
11-year risk of fatal cancer[e]	0.78 to 2.7	7.1×10^{-3}	0.78 to 2.7
Total Site Workforce[f]			
Total dose (person-rem/yr)	327 to 1,190	1.6 to 4.8	331 to 1,193
17-year risk of fatal cancer	2.2 to 8.1	0.011 to 0.033	2.2 to 8.1
11-year fatal cancers[e]	1.4 to 5.2	7.1×10^{-3} to 0.021	1.4 to 5.2

[a] The No Action doses are based on measured doses from 1988 to 1993.

[b] The incremental doses represent the estimated increase in worker doses involved in changing from a uranium core to a MOX core.

[c] Combined or total impacts do not necessarily equal the sum of the individual components because different sites may be involved. [Text deleted.]

[d] The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 20).

[e] For the Preferred Alternative, for analysis purposes approximately 70 percent of the total surplus Pu was assumed to be used in existing LWRs. The 17-year campaign for the total surplus Pu would be reduced to about an 11-year campaign.

[f] The impact to the total site workforce is the result of conversion of all reactors at the site to the burning of MOX fuel. [Text deleted.]

Note: The number of significant figures used in the impact values is dictated by the addition of small incremental values to relatively large No Action values.

Source: Section M.2.

Doses to onsite workers from normal operations with a uranium-fueled core are given in Table 4.3.5.2.9–2. Estimated incremental and total impacts to onsite workers resulting from a MOX core instead of a uranium core are also given. Included are involved workers directly associated with the operation of one MOX-fueled reactor, and the entire workforce if all the reactors at a generic site were converted to burn MOX fuel. All doses fall within regulatory limits. [Text deleted.]

The annual dose from operation of a reactor with a MOX core would range from 281 to 543 mrem to the average reactor worker and from 172 to 602 person-rem to the entire reactor workforce. The annual dose to the total site workforce would range from 331 to 1,193 person-rem. The risks and numbers of fatal cancers among the different workers from 17 years and 11 years of operation are included in Table 4.3.5.2.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also worker rotations. As a result of the implementation of these mitigation measures, the potential fatal cancers for the operation of this facility would be lower than calculated.

Hazardous Chemical Impacts. Existing commercial light reactors are currently in operation. If a change were made from burning uranium-based fuel to burning MOX fuel, which is part U and part Pu, the nonradiological chemical emissions would not change. Therefore the HIs and cancer risks would not change, which means the incremental HIs and cancer risks would be zero. There would be no incremental increase in the potential hazardous chemical impact to the public and workers from normal operations of existing commercial light water reactors would be lower than calculated.

Facility Accidents. The risks associated with existing commercial LWRs has been studied by the operating organizations in accordance with NRC guidance. The safety of these reactors has been analyzed and reported

by plant operators in such documents as SARs and probabilistic risk assessments. In addition, the NRC has conducted probabilistic risk assessments on five existing reactors and issued the report *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants* (NUREG-1150). According to this report, the estimated mean core damage frequencies would range from 4.0×10^{-6} to 3.4×10^{-4} caused by internal events (not including natural phenomena). Should such core damage occur, the potential consequences would range from 71 to 1,022 latent cancer fatalities for the offsite population according to this NRC report. The estimated risks to the offsite population from these accidents would range from 9.6×10^{-4} to 2.4×10^{-2}.

Reactor safety issues regarding the use of MOX fuel in existing LWRs are addressed in a recent report by the NAS. The report indicates that the potential influences on the safety of the use of MOX fuel in LWRs has been extensively studied in the United States in the 1970s. These influences on safety have also been extensively studied in Europe, Japan, and Russia. Regarding effects of MOX on accident probabilities, the report states,"... no important overall adverse impact of MOX use on the accident probabilities of the LWRs involved will occur; if there are adequate reactivity and thermal margins in the fuel, as licensing review should ensure, the main remaining determinants of accident probabilities that will involve factors not related to fuel composition and hence unaffected by the use of MOX rather than LEU fuel" (NAS 1995a:352). Regarding the effects of MOX on accident consequences, the report states, "... it seems unlikely that the switch from uranium-based fuel could worsen the consequences of a postulated (and very improbable) severe accident in a LWR by more than 10 to 20 percent. The influence on the consequence of less severe accidents, which probably dominate the spectrum value of population exposure per reactor-year of operation would be even smaller, because less severe accidents are unlikely to mobilize any significant quantity of plutonium at all" (NAS 1995a:355).

Analysis described in Appendix M.5 has been performed using the MACCS code to determine the effects of the use of MOX fuel in an existing LWR. The accident assumed conditions including a large population distribution near the existing LWR, and meteorology conditions for dispersal leading to large doses, and would not necessarily be reflective of actual site conditions. A sample of severe accident scenarios is illustrated in Table 4.3.5.2.9–3. The data shown are derived from a range of severe accidents that make up the release scenarios. Some accidents have frequencies much less than 1×10^{-8}/yr and large releases. These low frequency/high release accidents were included to reflect severe accident conditions leading to core damage and release of radioactive materials in order to obtain an estimate on the effects of using MOX fuel versus uranium fuel, as indicated by the ratios. To perform a comparison of existing commercial LWR impacts with other disposition alternatives, reactor accidents with frequencies less than 1×10^{-7}/yr would need to be done with site-specific meteorology, receptor, and population data.

Impacts are calculated in units of probability of cancer fatality for the maximum exposed individual and the worker and the number of cancer fatalities for the offsite population. The fatality data shown does not reflect site conditions and would differ if site-specific meteorology and population were used. The ratios of accident fatalities for MOX and UO_2 fueled LWRs are given in Table 4.3.5.2.9–4 only for the purpose of showing the relative impacts because the ratios would not be affected by meteorological or population data. Each scenario is based on releases taken from an existing commercial LWR probabilistic risk assessment of severe accidents. The releases were modeled using the MACCS code based on a large population distribution near a generic LWR and meteorological conditions for dispersal leading to large doses and would not necessarily be reflective of actual site conditions. Further site-specific NEPA and safety reviews would be performed should the Existing LWR Alternative be selected at the ROD.

Table 4.3.5.2.9–3. Accident Impacts for Existing Light Water Reactor with Mixed Oxide Fuels

	Worker at 1,000 m				Maximum Offsite Individual			Population Within 80 km		
Accident Release Scenarios[a]	Accident Category Frequency[b] (per year)	Probability of Latent Cancer Fatality	Risk of Latent Cancer Fatality (per year)	Risk of Latent Cancer Fatality per 17 yr (per 11 yr)	Probability of Latent Cancer Fatality	Risk of Latent Cancer Fatality (per year)	Risk of Latent Cancer Fatality per 17 yr (per 11 yr)	Number of Latent Cancer Fatalities	Risk of Latent Cancer Fatalities (per year)	Risk of Latent Cancer Fatalities per 17 yr[c] (per 11 yr)
Steam generator tube rupture	1.5×10^{-6}	1.0	1.5×10^{-6}	2.6×10^{-5} (1.7×10^{-5})	1.0	1.5×10^{-6}	2.6×10^{-5} (1.7×10^{-5})	5.9×10^{3}	0.0089	0.15 (0.098)
Large late containment failure-high RCS pressure	8.1×10^{-6}	0.79	6.4×10^{-6}	1.1×10^{-4} (7.2×10^{-5})	0.86	7.0×10^{-6}	1.2×10^{-4} (7.8×10^{-5})	1.3×10^{2}	0.0011	0.018 (0.012)
Large early containment failure-medium/low RCS pressure	7.0×10^{-7}	1.0	7.0×10^{-7}	1.2×10^{-5} (7.8×10^{-6})	1.0	7.0×10^{-7}	1.2×10^{-5} (7.8×10^{-6})	2.3×10^{3}	0.0016	0.027 (0.018)
Large early containment failure-high RCS pressure	8.7×10^{-7}	1.0	8.7×10^{-7}	1.5×10^{-5} (9.8×10^{-6})	1.0	8.7×10^{-7}	1.5×10^{-5} (9.8×10^{-6})	1.6×10^{3}	0.0014	0.024 (0.016)
Interfacing system loss of cooling accident	1.3×10^{-7}	1.0	1.3×10^{-7}	2.2×10^{-6} (1.4×10^{-6})	1.0	1.3×10^{-7}	2.2×10^{-6} (1.4×10^{-6})	7.3×10^{3}	0.00095	0.016 (0.010)
Small early containment failure	2.4×10^{-6}	1.0	2.4×10^{-6}	4.1×10^{-5} (2.7×10^{-5})	1.0	2.4×10^{-6}	4.1×10^{-5} (2.7×10^{-5})	1.2×10^{3}	0.0029	0.049 (0.032)

[a] Each release scenario is based on existing commercial LWR probabilistic risk assessment of severe accidents. The release scenarios were modeled using the MACCS code based on large population distribution near a generic site and meteorological conditions leading to large doses. Therefore, the fatality data shown are not relevant to nor indicative of fatalities that would be calculated if site-specific meteorological and population data were used in the model.

[b] A release scenario typically will contain many accident sequences that have a common outcome (for example a steam generator tube rupture). Each accident sequence has a frequency of occurrence that is derived from an event tree analysis and will include sequences with frequencies that are below those used in typical EISs.

[c] The population risk of latent cancer fatality, when compared with similar risk from the use of LEU reactor fuel, yields correct latent cancer fatality ratios of MOX-fuel relative to LEU-fuel. The accident conditions include a large population distribution near the existing LWR and meteorology conditions for dispersal leading to large doses and would not necessarily be reflective of actual site conditions. Further site-specific NEPA and safety documentation would be completed if the Existing LWR Alternative is selected.

Note: RCS = Reactor Coolant System. For the Preferred Alternative, for analysis purposes, approximately 70 percent of the Pu was assumed to be used for MOX fuel. The impacts projected for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced to those for an 11-year campaign; all values are mean values.

Source: HNUS 1996a.

Table 4.3.5.2.9–4. Ratio of Accident Impacts for Mixed Oxide Fueled and Uranium Fueled Reactors for Typical Severe Accidents (Mixed Oxide Impacts/Uranium Impacts)[a]

Accident Release Scenarios[b]	Worker at 1,000 m	Maximum Offsite Individual	Population Within 80 km
Steam generator tube rupture	0.94	0.94	0.94
Large late containment failure-high RCS pressure	1.08	1.07	1.08
Large early containment failure-medium/low RCS pressure	0.93	0.93	0.93
Large early containment failure-high RCS pressure	0.97	0.96	0.97
Interfacing system loss of cooling accident	0.93	0.92	0.93
Small early containment failure	0.96	0.95	0.96

[a] The ratio of accident fatalities for MOX- and UO_2-fueled LWRs are shown for the purposes of showing relative impacts. For example, 0.94 indicates that the impacts of the accident would be lower for a reactor with MOX fuel.

[b] Each release scenario is based on existing commercial LWR probabilistic risk assessment of severe accidents. The release scenarios were modeled using the MACCS code based on large population distribution near a generic site and meteorological conditions for dispersal leading to large doses. Therefore, the fatality data shown are not relevant to nor indicative of fatalities that would be calculated if site-specific meteorological and population data were used in the model.

Note: RCS=Reactor Coolant System.

Source: HNUS 1996a.

4.3.5.2.10 *Waste Management*

This section summarizes the waste management impacts resulting from the burning of MOX fuel in existing commercial pressurized LWRs. There would be no high-level or TRU wastes associated with the burning of MOX fuel in an LWR. Facilities that would support the existing commercial LWR would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with NRC regulations, RCRA, and other applicable statutes as outlined in section E.1.2.

Operation of the existing commercial light water reactors to include burning of MOX fuel is not expected to increase the amount or change the content of waste generated (ORNL 1995b:B-8). The use of a MOX fuel core results in a somewhat different distribution of fission products. Consequently, the details or radionuclide distribution would be different. However, system modifications are not expected to be needed in order to comply with current regulatory requirements.

Operation of the existing commercial LWR would generate spent nuclear fuel. The MOX fuels designed for serving Pu disposition would not stay in the reactors' cores so as to recover their full economic values. For this analysis it was assumed that the MOX fuel bundles would be removed as soon as the fuel had been irradiated to the point where it had met the Spent Fuel Standard. Therefore the MOX fuel cycle for each refueling would be shorter than the current typical commercial nuclear plant. This assumption was used in order to bound the impacts for spent fuel generation and to dispose of the excess weapons-usable fissile material as quickly as possible. Since the number of assemblies discharged per year for the MOX cycles is greater than that of the average LEU cycle, the amount of wet or dry storage required for the MOX cycles would be more than for the average of the LEU cycles. Data from existing PWR commercial reactors shows that the average number of assemblies discharged annually is 48. Assuming 0.43 t (0.47 tons) per assembly for PWRs, this equates to 21 t (23 tons) of residual heavy metal content. The increase in the number of assemblies discharged annually due to the burning of MOX fuel in a PWR would be approximately 32 assemblies on the average. This would result in an additional 14 t (15 tons) of residual heavy metal. Based on this average, an additional two rail or eight truck shipments of spent fuel would be required annually. The actual incremental increase would depend on the specific reactor selected. Data from existing BWR commercial reactors shows that the average number of assemblies discharged annually is 127. Assuming 0.18 t (0.20 tons) per assembly for BWRs, this equates to 23 t (25 tons) of residual heavy metal content. The increase in the number of assemblies discharged annually due to the burning of MOX fuel in a BWR would be approximately 15 on the average (ORNL 1995b:B-11). This would result in an additional 3 t (3.3 tons) of residual heavy metal annually. Based on this average, an additional one rail or two truck shipments of spent fuel would be required. As noted earlier, the actual incremental increase would depend on the specific reactor selected. The decay heat rate of discharged fuel assemblies initially charged with weapon-grade Pu is within a few percent of current LEU discharged fuel (ORNL 1995b:B-10). Consequently, there would be minimal negative impact on the cooling needed for irradiated fuel element storage due to the substitution of MOX fuel for LEU fuel. Spent nuclear fuel would have to be stored onsite until a Federal geologic repository is available. Spent nuclear fuel would be maintained in the spent fuel storage pool for a minimum of 10 years to allow for sufficient cooling. The annual increase of MOX spent nuclear fuel assemblies could necessitate an increase in the size of the storage pools to accommodate the number of additional assemblies. However, all of the plants considered have sufficient spent fuel pool capacity to accommodate additional assemblies resulting from the use of MOX fuel. Additionally, dry storage onsite would alleviate pool crowding until shipment of the spent fuel to a repository (ORNL 1995b:B-10). There could be design/safety and transportation impacts associated with packaging and shipping the increased volumes of spent nuclear fuel to another offsite location.

4.3.5.3 Partially Completed Light Water Reactor Alternative

The environmental impacts described in the following sections are based on the analysis of the partially completed LWR facility for the Partially Completed LWR Alternative described in Section 2.4.5.3. This alternative would require the operation of a minimum of two LWRs, which could be located at the same or different sites. Environmental impacts for this facility are described in the context of a generic range of conditions that could exist at potential locations.

In accordance with this alternative for surplus Pu disposition, two partially completed LWRs would be needed. The two LWRs could be at one site, or the reactors could be at two sites. If there are two reactors at one site, the impacts in Sections 4.3.5.3.1 through 4.3.5.3.10 would be approximately doubled unless otherwise indicated (for example, direct workers).

4.3.5.3.1 *Land Resources*

Land Use. Because this is an existing site, direct impacts to land use are not anticipated during completion of construction and during operation. Existing land use would not change; additional land area would not be disturbed for the facility nor required for a buffer zone. Since the reactor facility is partially completed, land use should be in conformance with site development/facility plans for the representative site. Additionally, development should be in conformance with land-use plans, policies, and controls at the Federal, State, and local levels. As discussed in Section 4.3.5.3.8, nonhousing units in excess of existing vacancies would be required to accommodate in-migration that would occur during both the construction and operational phases. No offsite land use would be affected during construction; therefore, indirect impacts would not occur.

Visual Resources. No impacts to visual resources would be caused by completion of the facility. The existing VRM classification would reflect that of a developed industrial facility (Class 5). It is unlikely that visual impacts would be caused by completion of construction. Facility operations could cause an increase in visual impacts to adjacent lands. An increase in visible stack plumes could impact viewpoints with high sensitivity levels including water-based recreational use urbanized areas, residential areas, and public roadways within the viewshed depending on distance, atmospheric conditions, and level of screening provided by vegetation and terrain.

[Text deleted.]

4.3.5.3.2 *Site Infrastructure*

The site infrastructure of the partially completed LWR would conform to the conditions described in Section 3.12.2. A site infrastructure at the partially completed site is already in place to support completion of the construction project. This includes roads, parking and facilities to accommodate approximately 4,500 site employees. The infrastructure would require only minor upgrades to accommodate the workforce needed to complete the project (see Table 4.3.5.3.2–1). The reactors would be completed essentially as if they were to be fueled with LEU fuel. The change to MOX fuel would have minimal impact on the partially completed LWR and would not affect the site infrastructure. The site is served with water and an existing power distribution system that would adequately support the power demands of plant equipment and employee facilities.

Table 4.3.5.3.2–1. Additional Site Infrastructure Needed for the Operation of the Partially Completed Light Water Reactor (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	<8	<6	700,000 to 1,100,000	96 to 140	Approximately 757,000	0	0
Range of resource availability	<8	<6	700,000 to 1,100,000	96 to 140	Approximately 757,000	0	0
Amount required in excess of low-end range of available resources	0	0	0	0	0	0	0

Source: LLNL 1996g; TVA 1995b:1.

4.3.5.3.3 *Air Quality and Noise*

Construction and operation of the partially completed LWR facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal standards. Impacts for radiological airborne emissions are discussed in Section 4.3.5.3.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Remaining construction and operation of the facility would result in the emission of some pollutants at the representative sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during completion of construction include the following:

- Fugitive dust from wind erosion of exposed ground surfaces
- Exhaust from and road dust raised by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

Appropriate control measures would be followed. It is expected that the site will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of partially completed LWR are presented in Table F.1.3–13. Air pollutant emissions sources associated with operations include the following:

- Operation of auxiliary steam generators
- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]
- Small quantities of toxic/hazardous pollutant emissions from various facility maintenance activities

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal regulations. The estimated pollutant concentrations for operation of this facility are presented in Table 4.3.5.3.3–1.

NOISE

The location of the facilities associated with the partially completed LWR facility relative to the site boundary and sensitive receptors was examined for a partially completed reactor site. The potential contribution to noise levels at the site boundary was evaluated.

Noise sources during completion of construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along major offsite transportation routes used to bring construction material and workers to the site. Noise impacts associated with increased traffic on access routes were not evaluated.

Table 4.3.5.3.3–1. Estimated Incremental Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Partially Completed Reactor

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] ($\mu g/m^3$)	Representative Site[b] ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000	<0.01
	1-hour	40,000	<0.01
Lead	Calendar Quarter	1.5	[c]
Nitrogen dioxide	Annual	100	0.05
Ozone	1-hour	235	[d]
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01
	24-hour	150	0.015
Sulfur dioxide	Annual	80	0.04
	24-hour	365	0.15
	3-hour	1,300	0.35
Hazardous and Other Toxic Compounds[e]			
[Text deleted.]			

[a] The Federal standards are presented.

[b] The concentration represents the alternative contribution only. No Action concentrations at a generic site cannot be determined since there is a range of possible pollutants and conditions that could be found at a potential site.

[c] No sources of this pollutant have been identified.

[d] Ozone, as a criteria pollutant, is not directly emitted or monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

[e] Emissions of unspecified hydrocarbons were not modeled.

Note: Concentrations are based on site contribution and do not include the contribution from nonfacility sources.

Source: 40 CFR 50; TVA 1974b.

Nontraffic noise sources associated with operation of this facility include ventilation systems, cooling systems, circuit breakers, pumps, motors, vents, diesel generators, transformers, paging systems, and material handling equipment. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would be small (TVA 1974b:2.6-14,8.2-13). Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

4.3.5.3.4 *Water Resources*

Utilizing excess Pu as fuel would have impacts from completion of construction and the operation of a partially completed LWR. Water resources requirements, provided in Table C.1.1.3–7, were used to assess impacts to surface water. The water requirements to complete the construction of both units would be 440 million l/yr (116 million gal/yr). The average water requirement for construction of a single partially completed LWR would be 220 million l/yr (58.1 million gal/yr). Impacts to the river flow would be negligible. [Text deleted.]

During operations, approximately 138,167 million l/yr (36,500 million gal/yr) of water would be required for the operation of both reactors (TVA 1974b:2.9-11). The average water withdrawal from the operation of a single partially completed LWR would be 69,084 million l/yr (18,250 million gal/yr) which is 0.2 percent of the average flow of the river (89 billion l/day [23.5 billion gal/day]). This withdrawal is not anticipated to have any impacts on downstream users. This amount would not curtail known or projected industrial water uses or affect the average flow by the site each day. Operational impacts have been identified in the site-specific EIS that has been prepared for these facilities.

During operations, sanitary wastewater would be discharged at the site. However, at a wet site, unlike water waste effluent from treatment facilities which is released on a continuous basis, cooling system blowdown activities would also occur. The normal blowdown rate from the cooling towers from both reactors would be approximately 2.09 m^3/s (74 ft^3/s) during periods of high evaporation (TVA 1974b:2.5-1). The average blowdown from the operation of a single partially completed LWR would be 1.05 m^3/s (37 ft^3/s) which is 0.1 percent of the average flow of the river (1,029 m^3/s [36,359 ft^3/s]). This blowdown is not anticipated to have any impacts on downstream users. Blowdown will be returned to the river through a diffuser system designed to provide good diffusion and to minimize environmental impacts due to the disturbance of aquatic life during construction and operation of the reactor (TVA 1974b:2.5-1).

Impacts to floodplains from the partially completed LWR (for both construction and operation) were not elevated in the site-specific EIS for the partially completed LWR because although the Bellefont site was used for analyses purposes, specific sites for floodplain analysis are not proposed at this time. If this alternative is selected for further consideration as a method of disposition, site-specific floodplain evaluations would be conducted in future tiered NEPA documents, as appropriate.

4.3.5.3.5 *Geology and Soils*

Effects to the geologic and soil resource as a result of construction and operational activities at a partially completed LWR for the final disposition of Pu are assessed for the representative site.

No direct or indirect effects from restricted access to potential geologic resources as a result of facility or site infrastructure improvements are anticipated because the site is partially completed and no new ground-disturbing construction is anticipated.

Implementation of this alternative would not involve ground-disturbing construction activities that will affect the soil erosion potential. Operational impacts to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Areas previously without ground cover would have some type of improvements (buildings, roads and landscapes). Soil erosion from stormwater runoff and wind action could occasionally occur during operation but are anticipated to be minimal.

4.3.5.3.6 *Biological Resources*

Terrestrial Resources. The assumed representative partially completed reactor site that could be utilized for the disposition of surplus Pu is located within the deciduous forest principal vegetation type. Although numerous construction activities would be required to complete the plant, such activities would generally take place on previously disturbed land. Construction could cause some disturbance to wildlife living immediately adjacent to the facility. During operation of the completed reactor, noise and human presence could continue to discourage some species from living nearby. Depending upon the type of cooling system used, operational impacts to vegetation are possible from salt drift.

Wetlands. Direct impacts to wetlands are unlikely since construction activities would generally take place on previously disturbed land. Indirect impacts from erosion and subsequent sedimentation could occur. However, implementation of a soil erosion and sedimentation control plan would limit such impacts. During operation, wastewater discharges could impact wetlands in the immediate vicinity of the outfall. Also depending upon the type of cooling system used, salt drift from cooling towers could impact wetland areas.

Aquatic Resources. Impacts from construction activities to aquatic species could result from sedimentation of nearby waterbodies. Effective erosion control would prevent damage to aquatic resources.

Operation of the LWR could lead to an increase in the impingement and entrainment of aquatic organisms. The extent to which this would impact local fish populations would be dependent upon the stream size, intake and discharge volumes, intake and discharge structure design, and the susceptibility of individual species to impingement and entrainment. Thermal impacts resulting from the discharge of cooling tower blowdown are possible. Thermal impacts would be controlled by the conditions of an NPDES permit.

Threatened and Endangered Species. Construction activities associated with completion of a reactor are unlikely to impact threatened and endangered species. This is the case since little or no additional habitat would be disturbed. Operational impacts, such as from operation of the cooling system, are possible but depend on the specific species present. Preactivity surveys and consultation with the USFWS and the appropriate State agency would be completed as necessary prior to construction or operation of the reactor.

4.3.5.3.7 *Cultural and Paleontological Resources*

This section discusses impacts to cultural and paleontological resources that may result from the construction and operation of a partially completed LWR. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Prehistoric resources that may occur in the vicinity of the partially completed LWR include remains of villages, cemeteries, and hunting and butchering sites. Historic sites may include cemeteries, remains of residential or commercial structures, or road traces. It is possible but unlikely that resources may be affected by the completion of the facility. Operation would not cause additional effects. Some Native American resources such as archaeological sites or traditional use areas may also occur in the areas.

No paleontological resources have been identified in the vicinity of the partially completed LWR. Cultural and paleontological resources may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project into the historic setting or environmental context of historic sites, visual and audio intrusions into Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism. Minor modifications to existing facilities would be necessary under this alternative. Some infrastructure improvements may also be necessary. Specific concerns about the presence, type, and location of Native American resources would be addressed through consultation with the potentially affected Native American tribes.

4.3.5.3.8 *Socioeconomics*

Regional Economy Characteristics. Finishing the construction of the partially completed reactor would generate employment and income increases within the affected region. Facility construction would create 2,848 total jobs (1,525 direct and 1,323 indirect) for one reactor and 4,305 (2,305 direct and 2,000 indirect) for two. However, total employment and per capita income in the representative site's REA would increase by less than 1 percent under either scenario. Operation of one reactor would generate about 2,200 total jobs in the REA (847 direct and 1353 indirect) and 3,311 total jobs (1,275 direct and 2,036 indirect) would be created with the operation of two reactors. Operation of one or two reactors would increase employment in the REA by less than 1 percent over No Action projections. The unemployment rate would decrease slightly and there would be small increases in per capita income (Socio 1996a). Only the Two-Reactor Option is analyzed for population, housing, and community service because it would have a greater impact on the region.

Population and Housing. The resident labor force would not be sufficient to fill all of the newly created jobs during the construction and operation phases of the project. In-migrating workers and their families would increase population in the ROI during both phases of the project. About 180 construction-related workers would in-migrate, and population would increase by much less than 1 percent over to No Action population projections. During operation of the facility, approximately 300 workers would in-migrate to the ROI. Population growth would be less than 1 percent over No Action projections. No housing units, in excess of existing vacancies, would be required in the ROI during construction and operation of the project (Socio 1996a).

Community Services. Constructing and operating the partially completed LWR would slightly increase the demand for community services at the representative site.

School enrollments would increase in the representative ROI during construction and operation of the facility. To maintain the No Action student-to-teacher ratio of 15.5:1, two new teachers would be needed during peak construction of the two-reactor facility, and eight additional teachers would be needed during operation. The increase in teacher requirements would be distributed over several school districts in the ROI; therefore, no single school district would be significantly affected (Socio 1996a).

Only 1 additional police officer would be needed during both the construction and operation phases of the two-reactor facility to maintain the No Action service level of 1.5 officers per 1,000 persons in the representative site's ROI. One new firefighter would be needed during construction, and only 3 new firefighters would be needed during operation to maintain the current service level of 4.1 firefighters per 1,000 persons (Socio 1996a).

Projected hospital occupancy rates during peak construction and full operation would increase slightly over No Action levels, with existing hospital capacities capable of accommodating the small increase in patient load. No additional physicians would be needed during construction, and only one new physician will be needed during operation of the two-reactor facility (Socio 1996a).

Local Transportation. The two-reactor option's construction and operation may cause a decline in the level of service on some roads around the representative site. Some road improvements may be required (Socio 1996a).

4.3.5.3.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal performance or accidents involved with the operation of an LWR that is presently only partially completed. The section first describes the impacts from normal facility operation followed by a description of impacts from reactor accidents. The impacts associated with the ultimate disposal of the spent fuel in a high level waste repository are presented separately in technical documents that specifically address repository operations.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 17-year campaign time are presented in Tables 4.3.5.3.9–1 and 4.3.5.3.9–2, respectively. Detailed results are presented in Appendix M.

Normal Operation. There would be no radiological releases associated with the construction needed to complete the reactor. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as the result of construction activities. However, concentrations would be within the regulated exposure limits.

During normal reactor operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the reactor and its support facilities are presented in Table 4.3.5.3.9–1. Since there are no other nuclear activities at the site, the impacts from total site operations would be the same as the reactor facility impacts. The doses to the maximally exposed member of the public from annual operations are within the radiological limits specified in Appendix I to 10 CFR 50 and 40 CFR 190 (if the reactor is licensed by NRC). The dose would be 0.57 mrem from all pathways. From 17 years of operation, the associated risk of fatal cancer to this individual would be 4.9×10^{-6}. The impacts to the average individual would be less. this activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population dose would be 0.61 person-rem and the number of fatal cancers in the population from 17 years of operation would be 5.2×10^{-3}. To put the operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

Doses to onsite workers from normal operations are given in Table 4.3.5.3.9–2. The annual average dose to the site worker would be 360 mrem. The dose to the entire workforce would be 380 person-rem. The risk and number of fatal cancers among the workers from 17 years of operation are included in Table 4.3.5.3.9–2.

Hazardous Chemical Impacts. There would be no increase in the potential hazardous impact to the public and workers from construction of the partially completed LWRs. The potential impacts of chemical emissions from operation would be as stated in the Bellefonte Final EIS dated May 1974. The source of chemicals and chemical quantities were reviewed and updated in connection with the renewal of the NPDES permit in 1992 (TVA 1993a:7). The computations and assumptions used for this review were consistent with those in this PEIS and potential impacts are still expected to be insignificant. This is confirmed by voluntary toxicant testing which is conducted on a semiannual basis. The *Letter Report FMDP LWR PEIS Data Report* (ORNL/MD/LTR-9, February 28, 1995) indicates that if a change were made from burning uranium-based fuel to burning MOX fuel in an LWR, the nonradiological chemical emissions would not change. Therefore the potential health impacts to the public and workers from hazardous chemicals emitted from the partially completed LWRs alternative facility would not change from the LWRs using UO_2 fuels.

Table 4.3.5.3.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Partially Completed Light Water Reactor

Receptor	Generic Site	
	Reactor	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]		
Atmospheric release pathway (mrem)	0.56	0.56
Drinking water pathway (mrem)	1.4×10^{-3}	1.4×10^{-3}
Total liquid release pathway (mrem)	5.4×10^{-3}	5.4×10^{-3}
Atmospheric and liquid release pathways combined (mrem)	0.57	0.57
Percent of natural background[c]	0.19	0.19
17-year fatal cancer risk	4.9×10^{-6}	4.9×10^{-6}
Annual Population Dose Within 80 Kilometers		
Atmospheric release pathway (person-rem)	0.47	0.47
Total liquid release pathway (person-rem)	0.14	0.14
Atmospheric and liquid release pathways combined (person-rem)	0.61	0.61
Percent of natural background[c]	1.6×10^{-4}	1.6×10^{-4}
17-year fatal cancer risk	5.2×10^{-3}	5.2×10^{-3}
Annual Dose to the Average Individual Within 80 Kilometers[d]		
Atmospheric and liquid release pathways combined (mrem)	4.5×10^{-4}	4.5×10^{-4}
17-year fatal cancer risk	3.8×10^{-9}	3.8×10^{-9}

[a] Since there are no other nuclear activities at the site, the total site impacts are the same as the incremental impacts.

[b] The standards for individual members of the public are given in Appendix I to 10 CFR 50 and 40 CFR 190 for NRC licensed reactors. As discussed in Appendix I, 5 mrem/yr is the airborne emission guideline and 3 mrem/yr per reactor is the liquid release guideline. Meeting these guideline values serves as a numerical demonstration that doses are ALARA. A total dose of 25 mrem/yr is the limit from all pathways combined, as given in 40 CFR 190. If the reactor is owned by DOE, the applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] Annual natural background radiation levels: the average individual receives 298 mrem; the population within 80 km receives 407,000 person-rem.

[Text deleted.]

[d] Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (1,365,000).

Source: Section M.2.

Table 4.3.5.3.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Partially Completed Light Water Reactor

Receptor	Generic Site
Involved workforce[a]	
Average worker dose (mrem/yr)[b]	360
17-year risk of fatal cancer	2.4×10^{-3}
Total dose (person-rem/yr)	380
17-year fatal cancers	2.6

[a] An involved worker is a worker associated with operations of the proposed action.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 20).

[Text deleted.]

Source: NRC 1995b; ORNL 1995b.

Facility Accidents. For the partially completed commercial LWR, a Preliminary Safety Analysis Report (PSAR) has been prepared for the representative reactor in accordance with NRC Requirements. The PSAR does not reflect the potential effects on public and worker safety of using MOX fuel. An analysis, described in Section M.5, has been performed which indicates that the use of MOX fuel in a commercial LWR would have small effects. This can be seen from the information provided in Tables 4.3.5.2.9–3 and 4.3.5.2.9–4. For each of the three reactor cases of severe accidents listed, the MACCS code was run for the severe accidents identified based on a uranium-fueled core and a MOX-fueled core. Although the sets of severe accidents are not specifically for the partially completed reactors applicable to this alternative, the results of the MACCS code analysis are considered relevant. Each entry in the table is the ratio of impacts of severe accidents for a MOX-fueled reactor and a uranium-fueled reactor. The results indicate that the use of MOX fuel in place of uranium fuel in a LWR would have an effect on accident impacts ranging from an 8-percent decrease to an 8-percent increase depending on the accident that occurs.

4.3.5.3.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation resulting from the burning of MOX fuel in a partially completed commercial LWR. There is no high-level or TRU waste associated with the burning of MOX fuel in a LWR. Table 4.3.5.3.10–1 provides the total estimated operational waste volumes projected to be generated per reactor for burning MOX fuel in a partially completed commercial LWR. Waste generation volumes under No Action are from maintenance activities and the limited engineering design work. Facilities that would support the partially completed commercial LWR would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with NRC regulations, RCRA, and other applicable statutes as outlined in Section E.1.2.

Construction and operation of the partially completed commercial LWR would impact existing waste management activities at the site, by initiating the generation of spent nuclear fuel, LLW, and mixed LLW, and increasing the generation of hazardous and nonhazardous wastes. Wastes generated during construction would consist of wastewater and hazardous, low-level, and nonhazardous solid wastes. A small amount of solid LLW, 0.5 m^3 (0.7 yd^3) composed mainly of radioactive sources, would be generated during construction. Inert construction and demolition wastes ranging from 211 m^3 (276 yd^3) to 392 m^3 (513 yd^3) for concrete; 88 t (97 tons) to 208 t (229 tons) for steel; and 21,000 m^3 (27,500 yd^3) to 49,000 m^3 (64,100 yd^3) for block, brick, gravel, asphalt, gypsum board, and other materials, would be placed in dumpsters for disposal by the solid waste disposal contractor at an offsite permitted landfill or recycled if appropriate. Construction sanitary wastewater from the main plant (based on data from similar plants) range from 127,000 m^3 (33,500,000 gal) to 274,600 m^3 (72,500,000 gal) and would be routed to the local municipal sewage treatment system. Typical hazardous waste generated during construction of a partially completed reactor site (based on data from a similar plant) include paints, solvents, acids, oils, radiographic wastes and degreasers, and range from 3.4 t (3.7 tons) to 6.3 t (6.9 tons) for solid hazardous wastes and 30.6 m^3 (8,080 gal) to 56.7 m^3 (15,000 gal) for liquid hazardous wastes. The only waste treatment performed for construction waste onsite would be neutralization of acids. Hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities (TVA 1995b:1).

Operation of the partially completed commercial LWR would generate spent nuclear fuel. The MOX fuels designed for serving Pu disposition would not stay in the reactors' cores for recovering their full economic values. For this analysis it was assumed that the MOX fuel bundles would be removed as soon as the fuel has been irradiated to the point where it had met the Spent Fuel Standard. Therefore the MOX fuel cycle for each refueling would be shorter than the original design. This assumption was used in order to bound the impacts for spent fuel generation and storage plus it would dispose of the excess weapons-usable fissile material as quickly as possible. Spent nuclear fuel would have to be stored onsite until a Federal geologic repository is available. Data from existing PWR commercial reactors of the same size show that the number of assemblies discharged annually could range from 50.7 to 108.5 (an average of 80 assemblies). Assuming 0.43 t (0.47 tons) per fuel assembly, the residual heavy metal content would range from 22 to 47 t (24 to 52 tons). The original onsite design capacity/availability of pool storage, or above-ground dry storage could be challenged due to the shorter fuel cycle.

Liquid LLW would be treated in an onsite radwaste treatment facility. Compactible solid LLW would either be taken offsite or remain onsite for volume reduction, prior to disposal. For disposal, all LLW would be transported in a solid form. Based on data from 8 existing PWR plants, a range of from 57 m^3 (75 yd^3) to 637 m^3 (833 yd^3) of LLW would be shipped offsite for disposal, as frequently as from 6 to 31 times each year. Assuming the LLW would be transported to a site within the DOE complex for disposal, land usage factors may vary from 3,300 m^3/ha (1,700 yd^3/acre) to 8,600 m^3/ha (4,500 yd^3/acre). Consequently, this would require a range of 0.01 ha/yr (0.03 acres/yr) to 0.07 ha/yr (0.2 acres/yr) of LLW disposal area. If the LLW is taken to a NRC or State disposal site, transportation impacts and land usage LLW disposal factors would vary according to the disposal site.

Table 4.3.5.3.10–1. Estimated Annual Waste Volumes Generated Per Reactor for Mixed Oxide Fuel in Partially Completed Light Water Reactors

Category	With MOX Fuel (m^3)	No Action (m^3)
Spent Nuclear Fuel	50.7 to 108.5[a] assemblies	None
Low-Level		
Liquid	18,930[b]	None
Solid	57 - 637	None
Mixed Low-Level		
Liquid	0	None
Solid	102	None
Hazardous		
Liquid	Included in solid	Included in solid
Solid	27	2
Nonhazardous (Sanitary)		
Liquid	341,000	3,780[c]
Solid	5,280	51[d]
Nonhazardous (Other)		
Liquid	Included in sanitary	None
Solid	4,430[e]	1.8-3.6[f]

[a] Residual heavy metal content of 22 to 47 t, assuming 0.43 t per assembly for PWR.

[b] Liquid LLW would be treated and solidified prior to disposal.

[c] Estimate based on 80 employees, 189 l/day/employee and 250 days per year of operations.

[d] Estimate based on 80 employees, 0.0085 m^3/day/employee and 250 days per year of operations.

[e] Recyclable wastes.

[f] One to two tons of desiccants. Estimate based on density at 500 kg/m^3.

Source: DOE 1995f; ORNL 1995b; TVA 1995b:2.

Approximately 102 m^3 (133 yd^3) of mixed LLW, consisting primarily of decontamination wastes and ion exchange resins, would be stored onsite until treatment and disposal is available at an offsite RCRA-permitted facility, or shipped to another facility in the DOE complex for treatment and disposal; in accordance with their site treatment plan that was developed pursuant to the requirements of the *Federal Facility Compliance Act*. Hazardous and nonhazardous waste would be managed in accordance with site practice.

4.3.5.4 Evolutionary Light Water Reactor Alternative

The environmental impacts described in the following sections are based on the analysis of the evolutionary LWR facility for the Evolutionary LWR Alternative as described in Section 2.4.5.4. This alternative would require the operation of two to four LWRs, which could be located at the same or different sites. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS. Multiple reactors could be located at a site, or multiple sites could have one reactor. If there are multiple reactors at a site than the total reactor impacts would be approximately the impacts in Section 4.3.5.4.1 through 4.3.5.4.10 times the number of reactors at the site (for example, land use or direct workers).

4.3.5.4.1 *Land Resources*

This section describes the impacts of constructing and operating the evolutionary LWR. The evolutionary LWR could be constructed in either a large or small reactor option. During construction, 284 ha (700 acres) of land would be disturbed for a two-unit large or small evolutionary LWR. A one-unit large or small evolutionary LWR would disturb 142 ha (350 acres) of land during construction. Total land area requirements during operation for the large or small two-unit evolutionary LWR would be 138 ha (340 acres). Increasing the facility to four units (small reactor option) would increase the operation land area requirement to 227 ha (560 acres). Buffer zones would be established in accordance with applicable NRC regulations. Land-use impacts would be similar for the two-unit large or small reactor options, however, visual impacts for the two-unit large reactor option could be greater because the increased magnitude and extent of site development. Land resources impacts from the four-unit facility would be anticipated to be greater than either of the two-unit options.

Construction and operation of the evolutionary LWR would not cause indirect land-use impacts at the analysis sites. As discussed in Section 4.3.5.4.8, in-migration of workers would be required during both the construction and operational phases. Historic housing construction rates indicate there would be sufficient housing units available to accommodate in-migrating population at each site. Therefore, offsite land use would not be affected.

Hanford Site

Land Use. Vacant land adjacent to the site of the 65-percent complete WNP-1 reactor and the operating WNP-2 reactor on the WPPSS lease would be the potential location for the evolutionary LWR. Operation of the facility would be consistent with existing and proposed land uses pursuant to the current *Hanford Site Development Plan*, which designates this area for reactor operations (HF DOE 1993c:13,14). Therefore, direct impacts to land use would not occur.

The alternative would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction and operation would be consistent with State and local (Benton, Franklin, and Grant Counties and the City of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation of the evolutionary LWR would be compatible with the industrial landscape character and VRM Class 5 designation of the existing WNP reactor area. A potential visual impact during operations would be from the additional stack plumes. However, due to the existing reactor activities, the visual impact would not occur.

Nevada Test Site

Land Use. A potential location for the evolutionary LWR would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area.

However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8, 3-9; NT DOE 1996e:4-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of the counties or municipalities currently undertakes land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. [Text deleted.] Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountains terrain.

Idaho National Engineering Laboratory

Land Use. The proposed evolutionary LWR would be located on undeveloped land northwest of the Power Burst Facility (PBF) in the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). This zone designation applies to land most suitable for development due to an absence of physical constraints and because of the land's proximity to site infrastructure. [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction and operation would not be in conflict with the land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operations, including the additional stack plumes, would be compatible with the existing visual character of the Prime Development Land Zone. The proposal would be consistent with the existing VRM Class 5 classification.

Pantex Plant

Land Use. The evolutionary LWR would be located on land in agricultural use in the northwest portion of Pantex, west of the Burning Ground and Zone 5. Construction of the evolutionary LWR would change current agricultural land use. A service agreement allows Texas Tech University to use any DOE land for agricultural use if it is not being used for defense purposes. The DOE-owned acreage used for agricultural purposes is variable and subject to periodic changes; therefore, no impact would be anticipated (PX DOE 1995i:2-5).The master plan of the current *Pantex Site Development Plan* designates this area for tritium production (PX DOE 1995g:16). Tritium production is no longer an option at Pantex. However, Pantex could revise the site development plan should Pantex be selected for this alternative.

Construction would not affect other Pantex or offsite land uses. There would be no impacts to prime farmland. The alternative would not be in conflict with City of Amarillo land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. Construction and operation could cause potential impacts, including additional stack plumes. The current VRM Class 4 designation of proposed site would change to Class 5.

Oak Ridge Reservation

Land Use. [Text deleted] The evolutionary LWR is proposed to be located on undeveloped land south of Bear Creek Road along the Clinch River. The potential site is not within the ORR boundary, but it is owned by the TVA. An agreement between DOE and TVA has reserved the site for a nuclear application and it is anticipated

that the land area would be transferred from TVA to DOE. Nonetheless, the future land-use plan of the current *ORR Site Development and Facilities Utilization Plan* designates the site as a major waste management area (OR DOE 1991f:1-7). The site development plan could be revised in accordance with the proposal. The proposed action would be in compliance if this change is approved. However, ownership of the potential site could be a potential impact.

Construction would not affect other ORR land uses. No prime farmlands exist onsite. The evolutionary LWR would not be in conflict with the City of Oak Ridge land-use plans, policies, and controls since the *Oak Ridge Area Land Use Plan* designates the potential site for Industrial and Public land use. Offsite land use would not be affected.

Visual Resources. [Text deleted.] Construction and operation activities would change the current VRM classification of the potential site from Class 3 to Class 5. Visual impacts would occur to Watts Bar Lake, Clinch River, and low density residential development on the opposite side of the Clinch River. Additionally, stack plumes could be visible from I-40, a public roadway with a high sensitivity level. Visual impact would not occur to Clark Center Recreational Park and other public/quasi-public lands (cemeteries and water treatment facilities), forest management area, Melton Hill Lake, and Clinch River Bluffs because of viewing distance, hilly terrain, and forested areas.

Savannah River Site

Land Use. The evolutionary LWR would be located northeast of the N-Area on land presently forested/ undeveloped. Facility construction would be in conformance with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the plan, the future land-use category for the proposed site is primary industrial mission (SR DOE 1994d:11,12). [Text deleted.]

Construction would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction would not be in conflict with the land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. Potential impacts to visual resources including additional stack plumes would be anticipated. The current VRM Class 4 designation of the proposed site would change to Class 5. However, views from State Highway 125 and U.S. Highway 278 would be blocked by heavy vegetation, forested cover, and hilly terrain.

[Text deleted.]

4.3.5.4.2 *Site Infrastructure*

The representative evolutionary LWR sites would require an infrastructure similar to that described in Section 2.4.5.4 for large or small evolutionary LWRs. The length of the Pu disposition campaign and reactor capacities will determine the number of reactors required. At a specific site, existing infrastructure such as roads, railroads, and power line rights-of-way would determine additional requirements for connectivity. Site characteristics such as the availability of water and its bearing on reactor cooling, would also affect site infrastructure.

Changes to the existing infrastructure at representative sites due to the construction and operation of an evolutionary LWR are presented in Tables 4.3.5.4.2–1, 4.3.5.4.2–2, and 4.3.5.4.2–3. The site infrastructure changes associated with locating a single large or small evolutionary LWR at a DOE site follow.

Hanford Site

Electrical, fuel, and water requirements for construction would represent a small percentage of site usage. Transmission lines would be constructed and upgraded for the increased and redistributed electrical load. Additional primary and secondary access roads as well as railroad right-of-way would be required. The requirements can be accommodated with minimal site impact over the 6-year construction period. Operational electrical requirements increase significantly, but are within the capacity of the sub-regional power pool. New and upgraded transmission lines would be put in place for the increased and redistributed electrical load as part of the construction phase. Fuel requirements would not exceed current site availability. Required primary and secondary access roads and railroad right-of-way would be available. Facility requirements can be accommodated without significant site impact.

Nevada Test Site

Electrical requirements for construction would double the projected site usage. Transmission lines would be constructed and upgraded for the increased and redistributed electrical load. Increased fuel requirements can be easily met. Additional fuel required for construction could easily be obtained through contractual means. Additional primary and secondary access roads would also be required. The shipment of large and outsize components would pose a significant problem because of the lack of railroad service. Construction requirements, unique in some cases, can be accommodated over the 6-year construction period. Operational electrical requirements increase significantly over site availability, but are within the capacity of the sub-regional power pool. New and upgraded transmission lines would be put in place for the increased and redistributed electrical load as part of the construction phase. Fuel oil requirements would exceed current site availability, but can be accommodated through normal contractual means. Required primary and secondary access roads would be available. There would not be railroad service available.

Idaho National Engineering Laboratory

Electrical requirements for construction would not exceed site availability. [Text deleted.] Additional primary and secondary access roads as well as railroad right-of-way would be required. These requirements can be accommodated with moderate site impact over the 6-year construction period. Operational electrical requirements increase over site availability, but are within the capacity of the sub-regional power pool. New and upgraded transmission lines would be put in place for the increased and redistributed electrical load as part of the construction phase. Required primary and secondary access roads and railroad rights-of-way would be available.

Table 4.3.5.4.2–1. Additional Site Infrastructure Needed for the Construction of the Large or Small Evolutionary Light Water Reactor (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirements	20,000	20	946,000	0	0
Hanford Site					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	365,500	78	10,280,800	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0
Nevada Test Site					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Projected usage with facility	144,940	45	6,662,000	0	0
Amount required in excess to site availability	0	0	946,000[a]	0	0
Idaho National Engineering Laboratory					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Projected usage with facility	252,500	62	6,776,000	0	11,340
Amount required in excess to site availability	0	0	0	0	0
Pantex Plant					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Projected usage with facility	66,266	30	1,741,166	7,200,000	0
Amount required in excess to site availability	0	7	0	0	0
Oak Ridge Reservation					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	746,000	130	1,325,000	95,000,000	16,300
Amount required in excess to site availability	0	0	909,000[a]	0	0
Savannah River Site					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Projected usage with facility	814,000	136	29,336,500	0	221,352
Amount required in excess to site availability	0	0	946,000[a]	0	0

[a] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996g; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Table 4.3.5.4.2–2. Additional Site Infrastructure Needed for the Operation of the Large Evolutionary Light Water Reactor (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Rail-roads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirements	< 5	< 5	1,100,000	140	757,000	0	0
Hanford Site							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	1,445,500	198	10,091,800	21,039,531	0
Amount required in excess to site availability	< 5	< 5	0	0	0	0	0
Nevada Test Site							
Site availability	1,100[a]	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	0	1,224,940	165	6,473,000	0	0
Amount required in excess to site availability	<5	0	1,048,096	120	757,000[b]	0	0
Idaho National Engineering Laboratory							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	1,332,500	182	6,577,000	0	11,340
Amount required in excess to site availability	< 5	< 5	938,300	58	0	0	0
Pantex Plant							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	1,146,266	150	1,552,166	7,200,000	0
Amount required in excess to site availability	< 5	< 5	944,786	127	0	0	0
Oak Ridge Reservation							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	76	32	1,826,000	250	1,136,000	95,000,000	16,300
Amount required in excess to site availability	< 5	< 5	0	0	720,000[b]	0	0
Savannah River Site							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	1,894,000	256	29,147,500	0	221,352
Amount required in excess to site availability	< 5	< 5	222,000	0	757,000[b]	0	0

[a] Includes paved and unpaved roads.

[b] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996g; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Table 4.3.5.4.2–3. Additional Site Infrastructure Needed for the Operation of the Small Evolutionary Light Water Reactor (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Rail-roads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirements	< 5	< 5	580,000	75	416,000	0	0
Hanford Site							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	925,500	133	9,750,800	21,039,531	0
Amount required in excess to site availability	< 5	< 5	0	0	0	0	0
Nevada Test Site							
Site availability	1,100[a]	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	0	704,940	100	6,132,000	0	0
Amount required in excess to site availability	0	0	528,096	55	416,000[b]	0	0
Idaho National Engineering Laboratory							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	812,500	117	6,236,000	0	11,340
Amount required in excess to site availability	< 5	< 5	418,300	0	0	0	0
Pantex Plant							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	626,266	85	1,211,166	7,200,000	0
Amount required in excess to site availability	< 5	< 5	424,786	62	0	0	0
Oak Ridge Reservation							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,330
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,330
Projected usage with facility	76	32	1,306,000	185	795,000	95,000,000	16,330
Amount required in excess to site availability	< 5	< 5	0	0	379,000[b]	0	0
Savannah River Site							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	1,374,000	191	28,806,500	0	221,352
Amount required in excess to site availability	< 5	< 5	0	0	416,000[b]	0	0

[a] Includes paved and unpaved roads.

[b] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996g; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Pantex Plant

Electrical requirements for construction would require transmission lines to be constructed and upgraded for the increased and redistributed electrical load. Additional primary and secondary access roads as well as railroad right-of-way would be needed. These requirements can be accommodated with minimal site impact over the 6-year construction period. Electrical requirements for operations increase over site availability, but are within the capacity of the sub-regional power pool. New and upgraded transmission lines would be put in place for the increased and redistributed electrical load as part of the construction phase. [Text deleted.] Required primary and secondary access roads and railroad right-of-way would be available.

Oak Ridge Reservation

[Text deleted.] Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contracts or the construction companies could provide for this additional oil from local suppliers from construction use. Required primary and secondary access roads and railroad rights-of-way would be available.

Savannah River Site

Fuel oil requirements for construction would represent a small percentage of site usage. [Text deleted.] Additional primary and secondary access roads as well as railroad rights-of-way would be required. These added requirements can be accommodated with minimal site impact over the 6-year construction period. Electrical requirements for large LWR, but not small LWR, operations would increase over site availability, but are within the capacity of the sub-regional power pool. New and upgraded transmission lines would be put in place for the increased and redistributed electrical load as part of the construction phase. Fuel oil requirements would exceed current site availability, but can be accommodated through normal contractual means. Required primary and secondary access roads and railroad rights-of-way would be available. Facility requirements could be accommodated without site impact.

4.3.5.4.3 *Air Quality and Noise*

Construction and operation of an evolutionary LWR would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.5.4.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of the evolutionary LWR are presented in Table F.1.3–14. Air pollutant emissions sources associated with operations include the following:

- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]
- Small quantities of toxic/hazardous pollutant emissions from facility operations

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations from reactor operations plus the No Action concentrations are presented in Table 4.3.5.4.3–1. There are no toxic/hazardous chemical emissions associated with this facility.

NOISE

The location of the facilities associated with the evolutionary LWR facility relative to the site boundary and sensitive receptors was examined for each site to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Nontraffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, vents, pumps, motors, emergency diesel generators, transformers, paging systems, and material

Table 4.3.5.4.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Evolutionary Light Water Reactor and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total[b] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Total ($\mu g/m^3$)
Criteria Pollutants														
Carbon monoxide	8-hour	10,000	0.08	0.09	2,290	2,290.01	284	284.02	602	602.07	5	5	22	22.06
	1-hour	40,000	0.3	0.36	2,748	2,748.04	614	614.05	2,900	2,900.36	11	11	171	171.29
Lead	Calendar Quarter	1.5	<0.01	<0.01	[b]	[b]	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01
	24-hour	0.5	<0.01	<0.01	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
Nitrogen dioxide	Annual	100	0.03	0.04	[b]	<0.01[d]	4	4.02	2.15	2.23	3	3	5.7	5.7
Ozone	1-hour	235	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01	<0.01	9.4	9.4	5	5	8.73	8.73	1	1	3	3
	24-hour	150	0.02	0.02	106	106	80	80	88.5	88.5	2	2	50.6	50.6
Sulfur dioxide	Annual	52	<0.01	<0.01	8.4	8.4	6	6	<0.01	0.01	2	2	14.5	14.51
	24-hour	260	<0.01	0.03	94.6	94.6	135	135.07	<0.01	0.24	32	32	196	196.22
	3-hour	1,300	0.01	0.2	725	725	579	579.28	<0.01	1.35	80	80.02	823	824.39
	1-hour	1,018	0.02	0.59	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	1-hour	655[f]	0.02	0.59	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
	30-minute	1,045	[c]	[c]	[c]	[c]	[c]	[c]	<0.01	3.63	[c]	[c]	[c]	[c]
Mandated by State														
Hydrogen fluorides (as HF)	30-day	0.8	[b]	[b]	[c]	[c]	[c]	[c]	<0.75	<0.75	0.2	0.2	0.09	0.09
	7-day	1.6	[b]	[b]	[c]	[c]	[c]	[c]	<0.75	<0.75	0.3	0.3	0.39	0.39
	24-hour	2.9	[b]	[b]	[c]	[c]	[c]	[c]	0.75	0.75	0.6[g]	0.6[g]	1.04	1.04
	12-hour	3.7	[b]	[b]	[c]	[c]	[c]	[c]	1.05	1.05	0.6[g]	0.6[g]	1.99	1.99

Table 4.3.5.4.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Evolutionary Light Water Reactor and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total[b] (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)
Hydrogen fluoride (as HF) (continued)														
	8-hour	250	b	b	c	c	c	c	c	c	0.6	0.6	c	c
	3-hour	4.9	b	b	c	c	c	c	4.21	4.21	c	c	c	c
Hydrogen sulfide	1-hour	112	c	c	b	b	c	c	c	c	c	c	c	c
	30-minute	111	c	c	c	c	c	c	b	b	c	c	c	c
Total suspended particulates	Annual	60	<0.01	<0.01	c	c	5	5	c	c	c	c	12.6	12.6
	24-hour	150	0.02	0.02	c	c	80	80	c	c	2	2	c	c
	3-hour	200	c	c	c	c	c	c	b	<0.01[d]	c	c	c	c
	1-hour	400	c	c	c	c	c	c	b	<0.01[d]	c	c	c	c

[Text deleted.]

[a] The more stringent of the Federal and State standards is presented for the averaging time.

[b] No sources of this pollutant have been identified.

[c] No State standard for indicated averaging time.

[d] The concentration represents the alternative contribution only.

[e] Ozone, as a criteria pollutant, is not directly emitted nor monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

[f] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.

[g] Eight-hour averaging time concentration was used.

Note: Total concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from nonfacility sources. Concentration for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LLNL 1996g; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

handling equipment. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.5.4.4 *Water Resources*

The construction and operation of an evolutionary LWR would affect water resources. Water resource requirements, and discharges provided in Tables C.1.1.3–8 and C.2.1.3–7 and Tables E.3.3.7–1 and E.3.3.7–2. were used to assess impacts to surface and groundwater. The discussion of impacts are provided for each site separately. Tables 4.3.5.4.4–1 and 4.3.5.4.4–2 present projected No Action surface and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the proposed large or small evolutionary LWR.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the evolutionary LWRs. During construction, the quantity of water required for large and small LWRs would be approximately 126 million l/yr (33 million gal/yr) and 76 million l/yr (20 million gal/yr), respectively, which would represent less than 0.9- and 0.6-percent increases, respectively, over the projected No Action surface water withdrawal. These amounts would also be approximately 0.001 percent and 0.0007 percent, respectively, of the average flow of the Columbia River (3,360 m^3/s [118,642 ft^3/s]). These additional withdrawals would have negligible impacts on surface water availability.

During operation, annual water requirements for the large and small evolutionary LWRs would be approximately 60,560 million l/yr (15,988 million gal/yr) and 27,252 million l/yr (7,199 million gal/yr), respectively, which would represent 448- and 202-percent increases, respectively, over the projected annual No Action surface water withdrawals. The larger of these withdrawals would increase Hanford's total withdrawals to 0.05-percent of the annual average flow of the Columbia River (3,360 m^3/s [118,642 ft^3/s]); minimal impacts would occur to surface water availability.

[Text deleted.]

During construction of the evolutionary LWRs, sanitary wastewater from large or small reactors (104 million l/yr [27.5 million gal/yr] and 59 million l/yr [15.6 million gal/yr], respectively) would be generated and discharged to the Columbia River. The larger of these annual quantities would be 0.001 percent of the average minimum daily flow of the Columbia River. All discharges would be monitored to comply with NPDES permit limits and other discharge requirements. [Text deleted.] During operation, approximately 341 million l/yr (90 million gal/yr) and 189 million l/yr (50 million gal/yr) of sanitary and other wastewater effluent from the large or small reactor, respectively, would be recycled to the greatest extent possible and the remainder would be discharged to the Columbia River. All discharges would be monitored to comply with NPDES permit limits and other discharge requirements.

Unlike wastewater effluent from treatment facilities, which is released on a continuous basis, cooling system blowdown activities discharge greater quantities over a shorter period of time. The large or small reactor would release approximately 97.8 million l (25.8 million gal) or 44.2 million l (11.7 million gal), respectively, of treated blowdown water once a day over a 1-hour period. Without engineering measures such as those described below, these blowdown releases would increase the average flow rate of the receiving river (Columbia River) by 0.02 and 0.01 percent, respectively. Although these increases are small, the velocity of the discharges could cause erosion of the channel and increased turbidity. In addition to the impacts from the discharge velocity of the blowdown, the high temperature of the releases could also affect receiving waters. In addition, treatment of the water to be returned to the Columbia River is necessary even if the plant does not add anything. Agricultural runoff along the path of the river creates higher than "allowed" levels of nitrate and phosphate. These alone must be reduced before the water (as taken from the river) could be returned. Engineering measures incorporated in technology design adapted to site conditions could significantly reduce these impacts. Various cooling system

Table 4.3.5.4.4–1. Potential Changes to Water Resources Resulting From the Large Evolutionary Light Water Reactor

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	SRS
Water Source	Surface	Ground	Ground	Ground	Surface	Surface	Ground
No Action water requirements (million l/yr)	13,511	2,400	7,570	249	14,760	127,000	13,247
No Action wastewater discharge (million l/yr)	246	82	540	141	2,277	700	0
Construction							
Water Availability and Use							
Total water requirement (million l/yr)	126	126	126	126	126	NA	126
Percent increase in projected water use[a]	0.9	5.3	1.7	50.6	0.9	NA	1.0
Water Quality							
Total wastewater discharge (million l/yr)	104	104	104	104	104	104	NA
Percent change in wastewater discharge[b]	42	127	19.4	96.7	4.5	15	NA
Percent change in streamflow	neg	NA	NA	NA	0.23[c]	24[d]	NA
Operation							
Water Availability and Use							
Total water requirement (million l/yr)	60,560	341	341	341	60,560	60,219	341
Percent increase in projected water use[e]	448	14.2	4.5	137	410	47.4	2.6
Water Quality							
Total sanitary wastewater discharge (million l/yr)	341[f]	341	341	341	341[f]	341[f]	NA
Percent change in wastewater discharge[g]	138.6	415.9	63.1	241.8	15.0	48.7	NA
Percent change in streamflow from wastewater discharge	NA	NA	NA	NA	0.7[c]	6.8[d]	NA
Blowdown discharge to surface waters (million l/yr)[h]	23,470	NA	NA	NA	23,470	23,470	NA
Percent change in annual streamflow from blowdown water discharge	0.02[i]	NA	NA	NA	49.6[c]	465[d]	NA

Table 4.3.5.4.4–1. Potential Changes to Water Resources Resulting From the Large Evolutionary Light Water Reactor—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	SRS
Floodplain							
Is action in 100-year floodplain?	No	No	No	No	No	NA	No
Is critical action in 500-year floodplain?	No	Uncertain	No	No	Uncertain	Uncertain	Uncertain

[a] Percent increases in water requirements during construction of an evolutionary LWR are calculated by dividing water requirements for the facility (126 million l/yr) with that for each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[b] Percent changes in wastewater discharged during construction of an evolutionary LWR are calculated by dividing wastewater discharge of the facility (104 million l/yr) with that for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

[c] Percent changes in stream flow from wastewater/blowdown discharges are calculated from the average flow of Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for East Fork Poplar Creek is shown in the table.

[d] Percent changes in stream flow from wastewater/blowdown discharges are calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).

[e] Percent increases in water requirements during operation of an evolutionary LWR are calculated by dividing water requirements (341 million l/yr) for a dry site; and (60,560 million l/yr) for a wet site with that for each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr) of groundwater and 127,000 million l/yr of surface water. At SRS, only cooling water make-up will be supplied from surface water.

[f] Does not include cooling tower blowdown that would be treated and discharged to the river.

[g] Percent changes in wastewater discharged during operation of an evolutionary LWR are calculated by dividing wastewater discharge rate for the new facility (341 million l/yr) with that for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

[h] Blowdown is expected to occur once a day over a 1-hour period, rather than continuously over the course of the day. As such, the discharge rate would be much greater for a shorter period of time.

[i] Percentage change from blowdown is calculated from the annual average flow of the Columbia River (3,360 m^3/s).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996g; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Table 4.3.5.4.4–2. Potential Changes to Water Resources Resulting From the Small Evolutionary Light Water Reactor

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	SRS
Water Source	Surface	Ground	Ground	Ground	Surface	Surface	Ground
No Action water requirements (million l/yr)	13,511	2,400	7,570	249	14,760	127,000	13,247
No Action wastewater discharges (million l/yr)	246	82	540	141	2,277	700	NA
Construction							
Water Availability and Use							
Total water requirement (million l/yr)	76	76	76	76	76	NA	76
Percent increase in projected water use[a]	0.6	3.2	1.0	30.5	0.5	NA	0.6
Water Quality							
Total wastewater discharge (million l/yr)	59	59	59	59	59	59	NA
Percent change in wastewater discharge[b]	24	72	10.9	41.8	2.6	8.4	NA
Percent change in streamflow	neg	NA	NA	NA	0.1[c]	1.2[d]	NA
Operation							
Water Availability and Use							
Total water requirement (million l/yr)	27,252	189.3	189.3	189.3	27,252	27,063	189.3
Percent increase in projected water use[e]	202	7.9	2.5	75.9	185	21.3	1.4
Water Quality							
Total sanitary wastewater discharge (million l/yr)	189[f]	189	189	189	189[f]	189[f]	NA
Percent change in wastewater discharge[g]	77	230	35	134	8.3	27	NA
Percent change in streamflow	NA	NA	NA	NA	0.4[c]	3.7[d]	NA
Blowdown discharge to surface waters (million l/yr)[h]	10,598	NA	NA	NA	10,598	10,598	NA
Percent change in annual streamflow from blowdown water discharge	0.01[i]	NA	NA	NA	22.4[c]	210[d]	NA

Table 4.3.5.4.4–2. Potential Changes to Water Resources Resulting From the Small Evolutionary Light Water Reactor—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	SRS
Floodplain							
Is action in 100-year floodplain?	No	No	No	No	No	No	NA
Is critical action in 500-year floodplain?	No	Uncertain	No	No	Uncertain	Uncertain	Uncertain

[a] Percent increases in water requirements during construction of an evolutionary LWR are calculated by dividing water requirements (76 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL, (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[b] Percent changes in wastewater discharged during construction of an evolutionary LWR are calculated by dividing water discharges (59 million l/yr) with that for No Action water requirements at each site: Hanford (246 million l/yr), NTS (recycled 82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (1,657 million l/yr), and SRS (700 million l/yr).

[c] Percent changes in stream flow from wastewater/blowdown discharges are calculated from the average flow of Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for the East Fork Poplar Creek is shown in the table.

[d] Percent changes in stream flow from wastewater/blowdown discharges are calculated from the minimum flow of Fourmile Branch (0.16 m^3/s).

[e] Percent increases in water requirements during operation of an evolutionary LWR are calculated by dividing water requirements (189.3 million l/yr for a dry site; 27,252 million l/yr for a wet site) with that for each No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr of groundwater and 127,000 million l/yr of surface water). At SRS, only cooling water make-up will be supplied from surface water.

[f] Does not include cooling tower blowdown that would be treated and discharged to the river.

[g] Percent changes in wastewater discharged during operation of an evolutionary LWR are calculated by dividing water discharges (189 million l/yr) with that for No Action discharge at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

[h] Blowdown is expected to occur once a day over a 1-hour period, rather than continuously over the course of the day. As such, the discharge rate would be much greater for a shorter period of time.

[i] Percent change from blowdown is calculated from the annual average flow of the Columbia River (3,360 m^3/s).

Note: NA=not applicable; neg=negligible; construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996g; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

blowdown disposal options would be evaluated in detail in the future site-specific documents. All discharges to surface waters would be monitored to comply with discharge requirements.

The evolutionary LWRs would be located near the WNP-1, an area which is above the 100-year, 500-year, and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for construction or operation of the evolutionary LWRs; therefore there would be no impact to groundwater availability.

Construction and operation of the evolutionary LWRs would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds which does not evaporate, however, could percolate downward into the near surface aquifer groundwater. This water would be monitored and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors limiting potential impacts to groundwater quality are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

[Text deleted.] Although the Columbia River is composed of fresh water, it does contain very small quantities of naturally occurring salts. These salts would be concentrated in a wet cooling tower and released with stream emissions from the tower. This is known as salt drift and may damage vegetation in a small area near the facility. Because rainfall at Hanford is minimal, these salts may not be adequately flushed from the soil column. Impacts would be analyzed in future tiered, site-specific NEPA documents, as appropriate.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the evolutionary LWRs. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the large and small evolutionary LWRs, sanitary wastewater (104 million l/yr [27.5 million gal/yr] and 59 million l/yr [15.6 million gal/yr], respectively) would be generated. During operation, approximately 341 million l/yr (90 million gal/yr) and 189 million l/yr (50 million gal/yr) of sanitary and other wastewater from the large or small reactors, respectively, would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle as makeup to the cooling tower or boiler.

There have been no studies conducted to assess the 500-year floodplain boundaries at NTS. Studies of the 100-year floodplain showed it to be confined to the Jackass Flats and Frenchman Lake areas. The proposed site for the evolutionary LWRs is not located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms which can create brief (less than 6 hours) flash floods, the facilities would be designed to withstand such flooding. An assessment of the 500-year floodplain at NTS could be accomplished in future environmental studies.

Groundwater. All water required for construction and operation would be supplied from groundwater. Construction water requirements for the large and small reactors (126 million l/yr [33 million gal/yr] and 76 million l/yr [20 million gal/yr], respectively) would represent 5.3- and 3.2-percent increases over the projected annual groundwater usage. Annual operation water requirements for the large and small reactors (341 million l/yr [90 million gal/yr] and 189.3 million l/yr [50 million gal/yr], respectively) would represent approximately 14.2- and 7.9-percent increases over the projected groundwater usage, respectively.

Based on the minimum estimated recharge (38 billion l/yr [10 billion gal/yr]), the increases in groundwater withdrawal attributed to operation of the large and small reactors would be 0.9- and 0.5-percent of the estimated annual recharge, respectively. Either of these additional withdrawals would not have any impact on groundwater availability.

Construction and operation of the evolutionary LWRs would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged to the ponds until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Because dry cooling towers would be used, salt would not be released from the cooling tower. Blowdown recycle would couple reverse osmosis with an evaporator and crystallizer system that would remove the dissolved solids from blowdown so the water could be recycled to the cooling tower. This system would reduce requirements for makeup water, and discharge would not require disposal. The solids from the crystallization processes would be disposed of as solid waste. This system would reduce the salt from blowdown.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the evolutionary LWRs. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the large and small evolutionary LWRs, sanitary wastewater (104 million l/yr [27.5 million gal/yr] and 59 million l/yr [15.6 million gal/yr]), respectively, would be generated, treated, and discharged to evaporation/percolation ponds, or be available for recycle. During operation, approximately 341 million l/yr (90 million gal/yr) and 189 million l/yr (50 million gal/yr) of sanitary and other wastewater from the large or small reactors, respectively, would be discharged to this wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle as makeup to the cooling tower or boiler. If not recycled, all discharges would be monitored to comply with discharge limits.

The potential site for the evolutionary LWRs is not located in an area historically prone to flooding or within the flood zone which could occur as a result of the failure of the MacKay Dam during a maximum probable flood which would be more critical than either the 100- or 500-year flood. However, because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. As shown in Tables 4.3.5.4.4–1 and 4.3.5.4.4–2, construction water requirements for the large and small reactors (126 million l/yr [33 million gal/yr] and 76 million l/yr [20 million gal/yr], respectively) would represent 1.7- and 1.0-percent increases over the projected annual No Action groundwater usage and are within INEL's permitted allotment. Operation water requirements for the large and small reactors (341 million l/yr [90 million gal/yr] and 189.3 million l/yr [50 million gal/yr], respectively) would represent 4.5- and 2.5-percent increases over the projected annual No Action groundwater usage, respectively. The larger of these withdrawals would increase the total projected amount to be pumped at INEL to 18.4-percent of the allotment during operation; INEL would still be well within the total groundwater allotment. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73).

Construction and operation of the evolutionary LWRs would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater discharged to disposal ponds, however, would percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Because dry cooling towers would be used, salt would not be released from the cooling tower. Blowdown recycle would couple reverse osmosis with an evaporator and crystallizer system that would remove the dissolved solids from blowdown so the water could be recycled to the cooling tower. This system would reduce requirements for makeup water, and discharge would not require disposal. The solids from the crystallization processes would be disposed of as solid waste. This system would reduce the salt from blowdown.

Pantex Plant

Surface Water. All water required for construction or operation of a large or small evolutionary LWR would be supplied from either groundwater or possibly reclaimed wastewater. If reclaimed wastewater from the city of Amarillo Hollywood Road Wastewater Treatment Plant is used to accommodate water requirements at Pantex, the available reclaimed wastewater is anticipated to increase from 9,671 million l/yr (2,555 million gal/yr) to 16,580 million l/yr (4,380 million gal/yr) by the year 2010.

All wastewater would be treated and either recycled for cooling system make-up or released to playa lakes. No wastewater would be discharged to surface water during operation of the facilities. During construction, treated sanitary wastewater would be discharged to playa lakes. [Text deleted.] Nonhazardous wastewater discharges would range from 104 million l/yr (27.5 million gal/yr) for the large and 59 million l/yr (15.6 million gal/yr) for the small evolutionary LWR. Discharge of wastewater generated during construction of these facilities to playas would not result in an exceedance of the monthly average limit of 2.46 million l/day (0.65 million gal/day).

During operation, utility, process and sanitary wastewater for the small and large evolutionary LWR not recycled would be treated prior to discharge into the playas. Treated effluent would be monitored to comply with discharge requirements. The extent to which treated effluent or stormwater would be recycled for reuse within the plant would be determined during site-specific studies.

The proposed location for the evolutionary LWR is in the northwest corner of the Pantex facility, west of the burning grounds. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in this area, there would be no impacts to floodplains. However, flooding in other areas of Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. Either groundwater or reclaimed wastewater would be used for construction and operation of the facility. The city of Amarillo is currently considering supplying Pantex with tertiary treated sanitary wastewater from the city of Amarillo Hollywood Road Wastewater Treatment Plant. Although not strictly groundwater or surface water, the reclaimed wastewater is discussed in this section because Pantex would still be withdrawing approximately 249 million l/yr (65.8 million gal/yr) from the aquifer in 2005.

As shown in Tables 4.3.5.4.4–1 and 4.3.5.4.4–2, construction of either a large LWR or a small LWR would represent a 50.6 and 30.5 percent increase in the projected water use, which would be 6.6 and 4.0 percent of the capacity of the groundwater system (1,900 million l/yr [502 million gal/yr]) or less than 0.76 and 0.46 percent of the projected available reclaimed wastewater (16,580 million l/yr [4,380 million gal/yr]). Operation of either a large or small evolutionary LWR would increase groundwater withdrawals by 137 and 75.9 percent, respectively, which would represent 17.9 and 9.9 percent, respectively, of the capacity of the groundwater system, or approximately 2.0 and 1.3 percent, respectively, if reclaimed wastewater were used as the water

source. Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala aquifer, an average of 1.8 m/yr (5.9 ft/yr) decline in the water table occurred over a 10-year period. Operating the large or small evolutionary LWR at Pantex would result in minor drawdowns. Either of these additional groundwater withdrawals would add to the existing decline in water levels of the Ogallala Aquifer. However, there should be no regional impacts to groundwater levels from either of these additional water withdrawals. The total groundwater withdrawal including this facility at Pantex would be 590 million l/yr (156 million gal/yr) for a large evolutionary LWR and 438 million l/yr (116 million gal/yr) for a small evolutionary LWR. Because of expected cutbacks in other programs, the amounts for either a large or small evolutionary LWR would be 29.5 and 47.6 percent, respectively, less than what is currently being withdrawn (836 million l/yr [221 million gal/yr]) from wells at Pantex.

Construction and operation of the evolutionary LWRs would not result in direct discharges to groundwater. As discussed previously, treated wastewater discharged to playas could, however, percolate downward toward the groundwater of the near surface aquifer. All contaminants that have entered the near surface aquifer are expected to move downgradient to the north, away from existing facilities. Because no groundwater would be withdrawn for the project from the perched aquifer, no effect on plume migration would occur. Pantex will continue to evaluate groundwater contamination in both the perched and Ogallala Aquifers.

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered, including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. in addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Because dry cooling towers would be used, salt would not be released from the cooling tower. Blowdown recycle would couple reverse osmosis with an evaporator and crystallizer system that would remove the dissolved solids from blowdown so the water could be recycled to the cooling tower. This system would reduce requirements for makeup water, and discharge would not require disposal. The solids from the crystallization processes would be disposed of as solid waste. This system would reduce the salt from blowdown.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the evolutionary LWRs would be obtained from the Clinch River and its tributaries. [Text deleted.]

During construction of the large and small evolutionary LWRs, the quantity of water required would be approximately 126 million l/yr (33 million gal/yr) and 76 million l/yr (20 million gal/yr), respectively. These quantities would represent 0.9- and 0.5-percent increases over the projected No Action surface water withdrawal. The largest increase would cause the total ORR withdrawals to increase to 0.4-percent of the average flow of the Clinch River. Minimal impacts to surface water availability would occur. During operation of the large and small reactors, water requirements would be approximately 60,560 million l/yr (16,000 million gal/yr) and 27,252 million l/yr (7,200 million gal/yr), respectively. These quantities would represent 410- and 185-percent increases over the projected annual No Action water withdrawal. The largest increase would cause the total ORR withdrawals to increase to 1.8-percent of the average flow of the Clinch River (132 m^3/s [4,647 ft^3/s]). Minimal impacts to surface water availability would occur.

During construction of the large and small evolutionary LWRs, sanitary wastewater (approximately 104 million l/yr [27.5 million gal/yr] and 59 million l/yr [15.6 million gal/yr], respectively) would be generated. During operation, 341 million l/yr (90 million gal/yr) and 189 million l/yr (50 million gal/yr), respectively, of

wastewater effluent would be generated by the facility. The total quantity of wastewater discharged to the Clinch River from ORR would increase to a maximum of 0.008 percent of the Clinch River's average flow and 0.7 percent of the East Fork Poplar Creek flow. No impacts are expected. All discharges would be monitored to comply with discharge requirements.

Unlike wastewater effluent from treatment facilities, which is released on a continuous basis, cooling system blowdown activities discharge greater quantities over a shorter period of time. The large and small reactors would release approximately 97.8 million l/day (25.8 million gal/day) and 44.2 million l/day (11.7 million gal/day), respectively, of blowdown water once a day over a 1-hour period or 23,470 million l/yr (6,200 million gal/yr) and 10,598 million l/yr (2,800 million gal/yr). Without engineering measures such as those described below, the blowdown releases from the large reactor would temporarily increase the average flow rate of the receiving streams by approximately 20 percent (Clinch River) and 1,880 percent (East Fork Poplar Creek). Increases from the small reactor blowdown would be approximately 9.3 percent (Clinch River) and 820 percent (East Fork Poplar Creek). These discharges would cause scouring of the streambeds, erosion of stream channels, increased turbidity, and potential flooding of areas. In addition to impacts from the discharge velocity of the blowdown, the high temperature of the releases could also affect receiving waters. As discussed in Section 3.6.4, DOE is currently involved with remediation of East Fork Poplar Creek under CERCLA. Any discharges including cooling tower blowdown, that may potentially impact East Fork Poplar Creek would require engineering design mitigation measures to avoid interference with the goals of the remediation effort. Engineering measures incorporated in technology design adapted to site conditions could significantly reduce these impacts. Various cooling system blowdown disposal options would be evaluated in detail in future site-specific documents. All discharges to surface waters would be monitored to comply with discharge requirements.

The evolutionary LWRs would be located outside the 100-year floodplain; there would be no impact to the floodplain. The 500-year floodplain has not been determined in this area but could developed in future studies.

Groundwater. All water for construction and operation would be taken from the Clinch River; groundwater availability would not be affected. All process, utility and sanitary wastewater would be treated prior to discharge into East Fork Poplar Creek. Minimal impact to groundwater quality is expected.

Any salt coming from the cooling towers would have originated from the Clinch River. Because the salt is concentrated in a wet cooling tower, it can potentially damage vegetation in a small area near the facility. At ORR, there is adequate rainwater and groundwater flow such that the salt generated from the cooling tower would be flushed into the groundwater and diluted. The groundwater and surface water systems are connected such that the salt originating from the Clinch River and reaching the groundwater will eventually return to the river, with no net change in the total amount of salt in the ecological system.

Savannah River Site

Surface Water. Groundwater would be used for construction and operation of the evolutionary LWRs and surface water from the Savannah River would be used for cooling water makeup. Operation of a large and small evolutionary LWR would require approximately 60,219 million l/yr (15,908 million gal/yr) and 27,063 million l/yr (7,150 million gal/yr) of cooling water. These amounts would represent a 47.4- and a 21.3-percent increase, respectively, over the projected no action surface water use at SRS. These amounts are also approximately 1.2- and 0.6-percent, respectively, of the Savannah River's minimum flow, and would not be expected to affect downstream users. [Text deleted.]

During construction of the large and small evolutionary LWRs, sanitary wastewater (approximately 104 million l/yr [27.5 million gal/yr] and 59 million l/yr [15.6 million gal/yr], respectively) would be generated and discharged to the sitewide wastewater treatment system. During operation, a total of 341 million l/yr (90 million gal/yr) and 189 million l/yr (50 million gal/yr) of wastewater would be generated by the new large

and small facilities, respectively, causing increases of up to 48.7 and 27 percent in the discharge from the site-wide wastewater treatment system. The possibility of these increases causing exceedance of the NPDES-permitted maximum discharge would be addressed in site-specific NEPA documents, as appropriate.

Unlike wastewater effluent from treatment facilities, which is released on a continuous basis, cooling system blowdown activities discharge greater quantities over a shorter period of time. The large or small reactor would release approximately 97.8 million l (25.8 million gal) or 44.2 million l (11.7 million gal), respectively, of blowdown water once a day over a 1-hour period. Without engineering measures such as those described below, these blowdown releases would increase the average flow rate of the receiving stream (Fourmile Branch) by over 17,000 and 7,600 percent, respectively. These discharges would cause scouring of the streambeds, erosion of stream channels, increased turbidity, and potential flooding of areas. In addition to impacts from the discharge velocity of the blowdown, the high temperature of the releases could also affect receiving waters. Engineering measures incorporated in technology design adapted to site conditions could significantly reduce these impacts. Various cooling system blowdown disposal options would be evaluated in detail in future site-specific documents. All discharges to surface waters would be monitored to comply with discharge requirements.

As an alternative to discharging blowdown water to Fourmile Branch, water from cooling tower blowdown could be discharged to Par Pond via pre-cooling ponds (that is, Pond 2, Pond 5, and Pond C). Makeup water currently is pumped into Par Pond from the Savannah River to maintain its level and the proper rate of flow in Lower Three Runs Creek (DOE 1992e:5-216). If blowdown water from the reactor were sent to Par Pond, no impacts to wetlands would be anticipated since there would be no change in the level of Par Pond or the flow rate of Lower Three Runs Creek.

Fire sprinkler water and truck hose-down water would be collected in tanks, monitored for radioactivity, and then transferred by pipeline or tanker to treatment facilities as required. Uncontaminated water would be pumped to storm drains.

The evolutionary LWRs would not be located in the 100-year floodplain. Information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas. Information on the 500-year floodplain could be developed in future environmental studies.

Groundwater. Groundwater from the Cretaceous aquifer would be used as the water source for construction and operation of the new evolutionary LWRs. During construction, the quantity of water required for the large and small reactors would be approximately 126 million l/yr (33 million gal/yr) and 76 million l/yr (20 million gal/yr), respectively, which would represent 1.0- and 0.6-percent increases over the projected No Action groundwater withdrawal. Neither of these additional withdrawals would impact groundwater availability.

Water requirements during operation for the large and small reactors would be approximately 341 million l/yr (90.0 million gal/yr) and 189.3 million l/yr (50 million gal/yr), respectively. These increases would represent 2.6- and 1.4-percent increases in the projected groundwater usage at SRS. The water withdrawals from groundwater would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals from the Cretaceous aquifer up to 6 times greater than that required for the large reactor indicate drawdown of almost 2.1 m (6.9 ft) at the well head, but smaller in overlying aquifers and not extending beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that the withdrawals attributed to the large reactor would cause a small drawdown at the well head and would not impact any aquifers in the area. Withdrawals attributed to the small reactor would cause slightly less drawdown at the well head. No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

Any potential salt coming from the cooling tower would have originated from the Savannah River. Because the salt is concentrated in a wet cooling tower, it may damage vegetation in a small area near the facility. At SRS,

there is adequate rainwater and groundwater flow such that any salt concentrations from the cooling tower would be flushed into the groundwater and diluted. The groundwater and surface water systems are connected such that the salt originating from the Savannah River and reaching the groundwater would eventually return to the river, with no net change in the total amount of salt in the ecological system.

[Text deleted.]

4.3.5.4.5 *Geology and Soils*

This section discusses the environmental impacts to the geologic and soil resource as related to the construction and operation of an evolutionary LWR. An evolutionary LWR, at any of the sites analyzed, would involve some ground-disturbing construction activities (284 ha [700 acres]) for two unit large or small, and 142 ha [350 acres] for one unit large or small) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. Specifically, the relative annual amount of precipitation (rain) is greater at ORR and SRS than at Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe. Implementation of this alternative requires that a greater amount of land be disturbed relative to the other reactor alternatives. Therefore, this alternative has the greater relative impact to the soil erosion potential.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities nor site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction activities (foundation preparation) and associated building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on wind velocities (increased wind velocities and durations increase potential soil erosion), the frequency and severity of rain, and the size and location of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal, assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal.

[Text deleted.]

4.3.5.4.6 *Biological Resources*

Construction of the evolutionary LWR would require 284 ha (700 acres) of land for two units large or small, and 142 ha (350 acres) for one unit large or small at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that either the large or small evolutionary LWR would be located near the WNP-1 and WNP-2 sites. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Use of the existing WNP-1 site for either the large or small evolutionary LWR would result in some impact to terrestrial resources at Hanford. Less mobile animals, such as reptiles and small mammals, would not be expected to survive while more mobile animals, such as larger mammals and birds, could move from the area. The survival of the latter group of animals would depend on the carrying capacity of surrounding areas. Nests and young animals living within disturbed areas may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction.

The operation of cooling towers associated with either the large or small evolutionary LWR would create salt drifts that could, if deposited at a high enough rate, affect plants growing in the vicinity of the towers. Previous studies of a tritium production LWR at the WNP-1 site predicted that up to about 13 ha (32 acres) could be affected by deposition rates of 17.1 kg/ha (15.2 lb/acre) per month (DOE 1992e:5-55). This is the rate at which salt stress symptoms can become visible in sensitive plant species. Salt drift impacts which may be associated with either evolutionary LWR option will be evaluated in site-specific NEPA documentation.

Wetlands. Impacts to wetlands from either the large or small evolutionary LWR would not be expected since the WNP-1 site is not located near wetlands and the intake and discharge lines for this facility are already built.

Aquatic Resources. Although no aquatic habitat occurs on the WNP-1 site, past studies of a tritium production LWR at the site suggest the operation of the water intake and discharge structures could impact aquatic organisms and habitats associated with the Columbia River (DOE 1992e:5-58). Impacts from the small evolutionary LWR would be less than for the large reactor since water requirements are lower. Removal of cooling water from the river would cause the entrainment and subsequent mortality of planktonic organisms, including the eggs and larvae of certain fish species. Fish species in the Hanford Reach of the Columbia River that have planktonic egg and larval stages, and thus would be most affected by entrainment, include minnows, suckers, and mountain white fish. Eggs and fry of salmonid species are less likely to be entrained because they are not planktonic. It is not expected that free swimming salmon fry would be entrained because they typically occupy shallow, gravel areas near the stream bank away from the intake structure, which would be located away from the shore. Because a relatively small percentage of the total water volume passing the site would enter the intake, entrainment losses would not be expected to affect the viability of any populations of aquatic organisms in the Hanford Reach.

Larger fish in the immediate vicinity of the intake structure could be impinged and killed on the water intake screens. Past experience indicates that operation of the WNP-2 reactor at Hanford has resulted in only minimal loss of fish from impingement (DOE 1992e:5-58).

An additional potential source of impact to aquatic resources is the discharge of cooling tower blowdown to the Columbia River. Impacts to aquatic organisms from this source would likely be limited since thermal limits would be established as part of the NPDES permit and because heat (and chemicals) would be readily dissipated

as the discharge plume mixed with river water. Past studies associated with the WNP-2 Plant have indicated that temperatures were within 0.7 °C (1.9 °F) of the ambient river temperature at all monitoring stations downstream of the outfall. It would be expected that relatively immobile organisms, such as benthic macroinvertebrates, would be most affected. Studies of Chinook salmon and steelhead trout migrating past Hanford reactor discharge outfalls suggest that thermal discharges to the Columbia River would not affect fish. These studies have demonstrated that (1) the spawning run was unaffected by either on-shore or mid-river thermal discharges, (2) migration was unaffected when fish encountered warmer waters, and (3) salmonids were able to avoid areas with adverse temperatures and continue their migratory runs (DOE 1992e:5-58,5-59). Potential impingement, entrainment, and thermal impacts will be analyzed in detail in site-specific NEPA documentation if the Hanford site is chosen for the evolutionary LWR.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of either the large or small evolutionary LWR near the existing WNP-1 site. Most new construction would take place in previously disturbed areas for the WNP-1 site. However, if sagebrush habitat is disturbed, several State-listed and candidate species could lose breeding and foraging habitat, including the ferruginous hawk, loggerhead shrike, pygmy rabbit, sage sparrow, sage thrasher, western burrowing owl, and western sage grouse. Preactivity surveys would be completed as appropriate prior to construction to determine the existence of special status plant or animal species in the area to be disturbed. Since existing intake and discharge facilities would be used, special status species found on or near the Columbia River would not be impacted by construction activities.

During operation, water withdrawals and discharge may cause impacts to several special status species. Water withdrawal from existing intake structures could cause entrainment and impingement impacts to several State-monitored fish species. The discharge of heated effluent could cause the great Columbia River spire snail and giant Columbia River limpet to avoid the immediate area of the discharge. The potential for these impacts would be less for the small evolutionary LWR since its water requirements would be less.

Nevada Test Site

It is assumed that either the large or small evolutionary LWR would be located in the Frenchmen Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed. Impacts described below would be similar for either reactor alternative since the land area disturbed would be the same for both and each would use a dry cooling system.

Terrestrial Resources. Construction and operation of the evolutionary LWR at NTS would result in the disturbance of terrestrial habitat equaling about 0.08 percent of NTS. This includes areas on which plant facilities would be constructed as well as areas revegetated following construction. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the evolutionary LWR would affect animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise could cause larger mammals and birds in construction and adjacent areas and would move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction but not occupied by facility structures would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas. Impacts to vegetation from salt drift would not occur since a closed cycle cooling system would be used.

Wetlands. Construction and operation of the evolutionary LWR would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the evolutionary LWR would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location. Temporary aquatic habitat may develop in evaporation and retention ponds, as well as in natural channels in the immediate vicinity of NPDES-permitted outfalls.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the evolutionary LWR at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicle traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training; putting restrictions on vehicle speeds and off-road movement; conducting clearance surveys prior to surface disturbance; approving stop work authority if tortoises are found within work areas; removing tortoises from roadways and work area; placing permanent and temporary tortoise-proof fencing around trenches, landfills, and treatment ponds; inspecting trenches; and having biologists survey when heavy equipment is in use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the evolutionary LWR.

[Text deleted.] Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be completed as appropriate prior to construction to determine the existence of these species in the area to be disturbed.

During facility operation, vehicle traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the evolutionary LWR (Section 4.3.5.4.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that either the large or small evolutionary LWR would be located in the south central part of INEL, 3.2 km (2 mi) northeast of the ICPP. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed. Impacts described below would be similar for either reactor alternative since the land would be the same for both and each would use a dry cooling system.

Terrestrial Resources. Construction and operation of the evolutionary LWR would result in the disturbance of terrestrial habitat equaling about 0.1 percent of INEL. Vegetation within the assumed site would be destroyed during land clearing operations. Big sagebrush is the dominant plant within the proposed site. Plant communities in which big sagebrush is the dominant overstory species are well represented on INEL, but are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture.

Construction of the evolutionary LWR would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise

would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Because pronghorn use of the assumed site is relatively low, the facility should not have a lasting impact on these species. Nests and young animals living within the project area may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction but not occupied by facility structures would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the evolutionary LWR. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering disturbed areas. Impacts to vegetation from salt drift would not occur since dry cooling towers would be used.

Wetlands. Construction and operation of the evolutionary LWR would not affect wetlands since there are no wetlands near the assumed facility location. Wetlands associated with the Big Lost River are located 2.4 km (1.5 mi) from the site; therefore, impacts to these wetlands are not expected.

Aquatic Resources. Construction and operation of the evolutionary LWR would not impact aquatic resources since there are no surface water bodies near the assumed facility location. The nearest surface water body is in the Big Lost River which is located 2.4 km (1.5 mi) from the facility location. Temporary aquatic habitat may develop in evaporation and retention ponds, as well as in natural channels in the immediate vicinity of NPDES permitted outfalls.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species would be affected by construction of the evolutionary LWR, but several State-status species may be affected. [Text deleted.] Burrows and foraging habitat for the pygmy rabbit would be lost. Bat species, such as the Townsend's western big-eared bat, may roost in caves and forage throughout the proposed site. One State-listed sensitive plant species could potentially be affected by construction of the facility. The plant species, tree-like oxytheca, has been collected at eight sites on INEL and at only two other sites in Idaho (IN DOE 1984a:34,36). If present, individual plants of this species could be destroyed during land clearing activities. Preactivity surveys would be completed as appropriate prior to construction to determine the existence of these species in the area to be disturbed.

During operation of the new facility, several bat species could forage at evaporation and stormwater retention ponds. No impacts to threatened and endangered species are expected due to facility operation.

Pantex Plant

It is assumed that the potential site for the evolutionary LWR is located in the northwest portion of Pantex. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of either the large or small evolutionary LWR at Pantex would result in the disturbance of terrestrial habitat equaling about 8.0 percent of the site. Land on which the facility would be built is presently used for agricultural purposes.

Construction of either the large or small evolutionary LWR would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction area and adjacent

areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests of migratory birds and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas that would be reestablished as farmland or revegetated upon completion of construction would be recolonized by animal species present in nearby, undisturbed habitats.

Activities associated with facility operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas. Impacts to vegetation from salt drift would not occur since dry cooling towers would be used.

Wetlands. Impacts to wetlands may result from land disturbances and treated wastewater disposal during construction. Construction-related ground disturbance may increase the potential for sediment runoff to the playa wetlands. This impact would be controlled through the implementation of standard soil erosion and sediment control measures. Site playas would be avoided during construction. A small area designated as a pristine wetland on NWI maps is located in the site area. If this area is determined to be a jurisdictional wetland, any potential impacts would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with COE permit requirements.

During construction and operation, treated wastewater would be discharged to the playas. Although part of the discharged water would be lost to the atmosphere due to high evapotranspiration rates, it could cause shifts in the composition of wetland plant communities and increases in the area of open water. The plant community shifts would favor plants tolerant of longer and deeper inundation. Furthermore, disturbed plant communities provide an opportunity for establishment of invasive exotic plant species. The potential for these impacts would be less for a small evolutionary LWR since less water would be discharged to site playas. All wastewater discharges would be treated as necessary to meet NPDES-permit requirements.

Aquatic Resources. Construction and operation of either the large or small evolutionary LWR facility would result in discharges of wastewater to the playas. As discussed for wetlands, the discharges could potentially result in an increase in open water area which would provide some additional aquatic habitat. Playas could also be affected by sediment runoff during construction; however, this impact would be controlled through the use of soil erosion and sediment control measures.

Threatened and Endangered Species. The bald eagle is a consistently occurring federally listed species at Pantex that has the potential to be affected by construction or either the large or small evolutionary LWR. Bald eagles avoid areas where humans are active; thus, wintering eagles observed at Pantex would be disturbed by increased activity.

Several Federal candidate or State-listed species may be affected by construction activities. Similar to the bald eagle, white-faced ibis may be discouraged from foraging at site playas during construction. [Text deleted.] The swift fox would also lose potential foraging and denning habitat. During operation, the swift fox would not use areas in proximity to the operating plant. The Texas horned lizard is less mobile and would be lost during land-clearing activities. Preactivity surveys would be completed, as appropriate, prior to construction to determine the existence of these species in the area to be disturbed. Consultation with USFWS would occur as required and, if necessary, a detailed mitigation plan would be developed.

[Text deleted.]

Oak Ridge Reservation

For analytical purposes it is assumed that either the large or small evolutionary LWR would be located at the former breeder reactor site. Impacts to terrestrial resources, wetlands, aquatics resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Although the assumed evolutionary LWR site is located within an area that has been designated as pine and pine hardwood forest (Figure 3.6.6–1), it was disturbed in the past by clearing and grading activities for the breeder reactor. Presently, the site could be classified as an old field. Construction of evolutionary LWR would result in this area being redisturbed. It is also possible that some undisturbed vegetation, primarily pine and pine hardwood forest, immediately surrounding the site would also be cleared.

Salt drift from wet cooling towers associated with either the large or small evolutionary LWR could cause salt deposition on surrounding land areas and vegetation. At present, the reactor design has not advanced sufficiently to predict the area that could be affected by salt drift at ORR; however, previous studies for a proposed tritium reactor at SRS, which was designed for the southeastern United States, would be expected to be applicable to ORR. The proposed SRS reactor was predicted to impact 5 ha (12 acres) at a deposition rate of 17.1 kg/ha/month (15.2 lb/acre/month) (DOE 1992e:5-213). This is the level at which salt stress symptoms could become evident on sensitive plants. Salt drift impacts which may be associated with either evolutionary LWR option will be evaluated in site-specific NEPA documentation.

Construction of the proposed facility would affect animal populations. Less mobile animals within the proposed project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with facility operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the land in the site area is upland, it is expected that direct impacts to wetlands from construction of either a large or small evolutionary LWR could largely be avoided. Minor impacts could occur from the construction of rights-of-way. Indirect impacts to wetlands from stormwater runoff during construction and operation are possible. Impacts on wetlands would not be expected from salt deposition due to the limited area that would likely be affected. It may be necessary to cross wetlands when constructing intake or outfall structures; however, impacts would be temporary. Any unavoidable impacts to wetlands would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with the COE permit requirements.

Construction-related discharges (for example, from foundation dewatering) would be directed to the Clinch River. Discharges to the Clinch River would have minimal impact on the flow of the river and would not be expected to affect associated wetlands.

During operation, blowdown water from the cooling system would also be discharged to the Clinch River. Discharges to the Clinch River, which for the large evolutionary LWR option would represent up to 20 percent

of the flow of the river during each discharge period, could lead to streambed scouring in the vicinity of the outfall and subsequent downstream sedimentation. This could alter wetlands present in the vicinity of the outfall, as well as those located downstream. The use of detention ponds and engineered energy dissipating structures would reduce impacts of discharges. Thermal impacts to wetland vegetation could occur with the release of large volumes of cooling tower blowdown. All wastewater discharges would be treated as necessary to meet NPDES-permit requirements.

Aquatic Resources. Construction of either the large or small evolutionary LWR could cause water quality changes, primarily sediment loading and resulting turbidity, to the Clinch River. These potential impacts would be reduced by implementing a soil erosion and sediment control plan. Construction water withdrawal would represent a very small percentage of the average flow of the Clinch River and, thus, would have little affect on its flow. Impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the Clinch River. During construction, dewatering discharges would be directed to the Clinch River. Impacts to the river would be expected to be minimal.

During operation, water withdrawals could increase entrainment and impingement of fish in the Clinch River. However, the volume of the water withdrawn for either reactor alternative would comprise a small percentage of the flow of the river and is unlikely to affect fish populations. Further, intake structures would be designed to reduce intake flow rates, thereby reducing impingement and entrainment losses.

Blowdown water from the cooling system of the evolutionary LWR would be released to the Clinch River. Discharge to the river from the large evolutionary LWR would represent about 20 percent of the flow of the river during each discharge period. This could result in streambed scouring in the vicinity of the outfall and subsequent downstream sedimentation. Although fish would likely return to the disturbed area between periods of discharge, this would not be possible for benthic organisms. Thermal impacts may also occur as the result of the release of large intermittent volumes of cooling water. Detention ponds may be necessary to reduce peak flows to the Clinch River. Chemical constituents and temperature of the discharges would be required to meet NPDES permit limits.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of either the large or small evolutionary LWR at the former breeding reactor site on ORR. Since this site is located within previously disturbed habitat, there is less potential for impact to special status species. Any special status plant species found in the pine and pine hardwood forest habitat adjacent to the disturbed site area could be destroyed if additional land is required. Prior to development, a survey would be conducted to determine the occurrence of listed plant species. Small, relatively immobile animal species, such as the Allegheny woodrat and southeastern shrew, could be destroyed during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the existence of these and other special status species.

Savannah River Site

It is assumed that either the large or small evolutionary LWR would be constructed just to the northeast of the N-Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the evolutionary LWR at SRS would result in the disturbance of terrestrial habitat equaling about 0.4 percent of the site. Since the majority of the site is covered by pine plantations, it is this vegetation type that would be most affected. However, other upland types, such as old-field, and mixed forest and grassland could also be impacted. Bottomland hardwoods and wetlands would be avoided to the extent possible.

Salt drift from wet cooling towers associated with either the large or small evolutionary LWR could cause salt deposition on surrounding land areas and vegetation. At present, the reactor design has not advanced sufficiently to predict the area that could be affected by salt drift at SRS; however, previous studies for a proposed tritium reactor at SRS predicted that 5 ha (12 acres) would be affected at a deposition rate of 17.1 kg/ha/month (15.2 lb/acre/month) (DOE 1992e:4-126). This is the level at which salt stress symptoms could become evident on sensitive plants. Salt drift impacts which may be associated with either evolutionary LWR option will be evaluated in site-specific NEPA documentation.

Construction of an evolutionary LWR would affect animal populations. Less mobile animals, such as amphibians, reptiles, and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests of migratory birds and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most types of wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Since the majority of the assumed evolutionary LWR site is upland, it is expected that direct impacts to wetlands from construction of either reactor alternative could be largely avoided. Implementation of soil erosion and sediment control measures would control secondary impacts. Impacts to wetlands resulting from the construction of intake or outfall structures would be temporary. Any unavoidable impacts to wetlands would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with COE permit requirements. Construction wastewater discharge to Fourmile Branch would be minimal and would not be expected to affect wetlands associated with the stream.

Cooling system blowdown would be directed to either Fourmile Branch or Par Pond. Intermittent discharges of large volumes of water from cooling system blowdown to Fourmile Branch could impact wetlands bordering the stream and the Savannah River Swamp. Sediment build up in the Savannah River Swamp resulting from streambed scouring could result in swamp forest vegetation being replaced by scrub/shrub or emergent vegetation. Also, erosion of stream banks could result in the loss of wetland vegetation. These impacts would be less for the small evolutionary LWR since a smaller discharge volume is involved. The use of detention ponds and engineered energy dissipating structures would reduce impacts of discharges. Thermal impacts to wetlands were not predicted for a previous tritium reactor planned for SRS (DOE 1992e:5-215); such impacts are also not expected for the proposed reactor. All wastewater discharges would be treated as necessary to comply with NPDES-permit requirement.

As an alternative to discharging blowdown water to Fourmile Branch, water from cooling tower blowdown could be discharged to Par Pond via pre-cooling ponds (that is, Pond 2, Pond 5, and Pond C). Makeup water currently is pumped into Par Pond from the Savannah River to maintain its level and the proper rate of flow in Lower Three Runs Creek (DOE 1992e:5-216). If blowdown water from either reactor alternative were sent to Par Pond, no impacts to wetlands would be anticipated since there would be no change in the level of Par Pond or the flow rate of Lower Three Runs Creek.

Aquatic Resources. Stormwater runoff during construction of either the large or small evolutionary LWR could cause temporary water quality changes in Fourmile Branch and Pen Branch. Increased turbidity could impact

some fish spawning and feeding habitat. Fish populations would probably move to less disturbed areas of the stream and recolonize disturbed areas shortly after construction is complete and water quality improves. Construction of intake and discharge facilities would result in the temporary loss of habitat in the affected waterbodies. During construction, wastewater would be discharged to Fourmile Branch. These discharges would be minimal and would not be expected to affect aquatic resources.

During operation of either Evolutionary LWR Alternative, water would be withdrawn from the Savannah River. For both alternatives, the volume of water withdrawn represents a small percentage of the average flow of the river and would not affect its flow. However, an increase in entrainment and impingement of fish could occur. Based on previous studies for a tritium production reactor at SRS (DOE 1992e:5-218) and monitoring of past SRS operations (WSRC 1989e:4-506), fish populations should not be affected by entrainment losses from operation of the evolutionary LWR. Similarly, impingement losses should not impact fish populations. Impacts to anadromous fish (for example, striped bass and several species of shad) due to entrainment and impingement, would also be relatively low and would not affect their populations. In compliance with the *Anadromous Fish Conservation Act*, populations of anadromous fish species would be sustained and their movement unobstructed by project construction and operation.

During operation, blowdown from the cooling system of either the large or small evolutionary LWR would be released to either Fourmile Branch or Par Pond. Impacts would be less for the small evolutionary LWR since it would discharge a smaller volume of water. Intermittent discharges of large volumes of water from blowdown would greatly increase the flow rate of Fourmile Branch which would cause flooding and stream bed scouring. This could alter the aquatic ecosystem by displacing existing plant and animal communities. Previous studies for a tritium production reactor at SRS indicated that water temperatures of discharges were expected to be within the thermal tolerance limits of native warmwater fish species. The temperature of water from blowdown discharges was also expected to be within normal water temperatures of each season and were not expected to alter the distribution or abundance of aquatic organisms in receiving waters. However, the temperature of blowdown water discharged to Fourmile Branch was predicted to exceed the maximum temperature differential of 2.8 °C (7.5 °F) between effluent and receiving stream during the cooler months of the year. Such an exceedance would require a Section 316(a) demonstration of balanced biotic community (DOE 1992e:5-218, 5-219).

Discharge to Par Pond would have no flow impacts since it currently receives makeup water to maintain its level. In fact, projected discharges would reduce the need to pump makeup water to Par Pond. Thermal impacts to Par Pond would not be expected since discharged water would pass through a series of precooling ponds designed to meet the State of South Carolina requirements for thermal releases to Class B waters; however, the recovery of the precooling ponds from past thermal discharges would be affected.

Threatened and Endangered Species. The only federally listed threatened or endangered species that could be affected by construction of either the large or small evolutionary LWR at SRS is the smooth purple coneflower. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the assumed site that this species would not be directly impacted by the reactor. Other special status species that would potentially be impacted by construction activities include the green-fringed orchid, eastern tiger salamander, Florida false loosestrife, beak-rush, star-nosed mole, and Cooper's hawk. If present, individuals of each of these species could be destroyed, except the hawk which could be temporarily displaced during construction.

During operation, there is potential for impacts to the federally listed short nose sturgeon and wood stork. The short nose sturgeon has been observed in the Savannah River where cooling water would be withdrawn. However, sturgeon eggs tend to sink and are strongly adhesive and gelatinous, which limits their downstream transport and dispersal through the water column. Thus, sturgeon eggs do not have a high entrainment risk. The preference of sturgeon larva for benthic habitat and the ability of juvenile and adult sturgeon to attain swimming speeds above the water intake velocity demonstrate the unlikelihood of impingement losses of this species

(DOE 1992e:5-222). Cooling system blowdown discharged to Fourmile Branch from either reactor alternative could cause an increase in stream depth which could disrupt the foraging activities of the wood stork. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrences of these and other special status species within the construction and water discharge areas. Consultation with USFWS would occur as required and, if necessary, a detailed mitigation plan would be developed.

4.3.5.4.7 *Cultural and Paleontological Resources*

This section discusses construction and operational impacts to cultural and paleontological resources that may result from the Evolutionary LWR Alternative at each of the representative sites analyzed. Land to be disturbed during construction of the large or small two-unit evolutionary LWR totals 284 ha (700 acres). Construction of a large or small one-unit evolutionary LWR would disturb 142 ha (350 acres). Total land area requirement during operation for the large or small two-unit evolutionary LWR would be 138 ha (340 acres), and increasing the facility to four units (small) would increase operation land area to 227 ha (560 acres). [Text deleted.]

Because there is no difference in plant footprint or land disturbance between the large and small reactors, impacts to cultural and paleontological resources would not differ. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the proposed sites may be affected directly through ground disturbance during construction, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The evolutionary LWR would be constructed adjacent to the WNP-1 and WNP-2 reactors. An archaeological surface survey was completed in the area of the WNP-1 reactor, including the staging area and pumphouse site, in 1974 and no archaeological sites were identified. However, archaeological monitoring during construction identified historic and prehistoric artifacts (HF WPPSS 1983a:66,68). Prehistoric resources that may occur at Hanford include remains of campsites, burials, and hunting/kill sites. Historic resources may include remains of ranches, homesteads, or trash dumps.

Native American resources potentially affected by the construction and operation of the proposed facility would be identified through consultation with interested parties. Impacts may include disturbance of important Native American plant communities, reduced access to traditional use areas, or visual and audio intrusion into sacred spaces.

Construction may affect some paleontological remains. Pliocene and Late Pleistocene remains have been found in and around Hanford. These remains have high research potential. There would be no additional impacts to paleontological resources from operation as it does not involve additional ground disturbance.

Nevada Test Site

The evolutionary LWR would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site, and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed land necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction of the proposed facility. Operation would not result in additional impacts as it does not involve ground disturbance or increased activity.

The CGTO has conducted surveys over portions of Frenchman Flat and identified at least 20 plant species of importance to Native Americans. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from the construction and operation of the facility. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The facility would be constructed northwest of the PBF in the Central Core Area/Prime Development Land Zone of INEL. This area has been developed and disturbed and the probability of finding NRHP-eligible archaeological sites or paleontological remains is low, but possible. Construction and operation are not expected to have an effect on these resources. Some Native American resources such as traditional use areas and sacred space may be affected by the construction and operation of the facility. Some paleontological remains may be affected by construction. There are 31 known fossil localities at INEL. Operation would not have an additional effect on these resources.

Pantex Plant

The evolutionary LWR would be constructed in the northwest portion of Pantex, west of the burning ground. This area is currently used for agriculture. Some NRHP-eligible resources may be affected by the construction of this facility. Any resources would be identified during the NHPA Section 106 compliance process. There would be no operational impacts to archaeological remains because operation does not involve additional ground disturbance. Construction and operation of these facilities may affect some Native American resources. Native American resources would be identified through project-specific consultation with potentially affected groups. Some paleontological resources may occur in the area to be affected by construction. Operation would not have an additional impact.

Oak Ridge Reservation

This facility would be constructed in the western portion of ORR, south of Bear Creek Road along the Clinch River. A portion of this area was reviewed for archaeological and historic resources as part of the EIS for construction of the proposed Clinch River Breeder Reactor. At that time four historic sites, five archaeological sites, and one cemetery were identified (OR NRC 1977a:2-7). One of the archaeological sites was a prehistoric burial mound. Additional resources may be identified through the NHPA Section 106 compliance process. Construction poses the greatest threat to archaeological resources. Operation would not directly affect these resources.

Construction and operation could have an effect on Native American resources by disturbing traditional plant and animal communities through construction and by reducing access to traditional use areas during operation. These resources could be identified through project-specific consultation with potentially affected tribes.

Paleontological resources could also be affected through new construction, however, those known to occur at ORR are relatively common fossils with low research potential. Operation would not have an impact on these resources.

Savannah River Site

The evolutionary LWR would be located east of the N-Area on undeveloped/forested land previously assessed for the New Production Reactor. This tract contains three NRHP-eligible historic sites. Additional NRHP-eligible resources may occur within unsurveyed areas to be disturbed by construction. Prehistoric site types that may occur at SRS include villages, base camps, limited activity sites, quarries, and workshops. Historic site types that may occur at SRS include cattle ranches, farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farming dikes, cattle pens, dams, towns, churches, cemeteries, trash scatters and roads. In addition, some Native American resources such as remains of villages, traditional plant gathering areas,

cemeteries, and isolated burials may be affected by construction and operation of the facility. No scientifically valuable fossil remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

[Text deleted.]

4.3.5.4.8 *Socioeconomics*

This section analyzes the socioeconomic effects of the Evolutionary LWR for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all of the candidate sites are found in the Supplemental Socioeconomic Data Report (Socio 1996a). The large-reactor option will be analyzed in this section because it would have a greater impact on the region than the smaller-reactor option.

Regional Economy Characteristics. Constructing an evolutionary LWR at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 3,500 workers in the peak year of construction at any site. The largest increases in regional employment (about 4 percent) would occur at INEL while the largest increase in regional per capita income (less than 1 percent) would occur at ORR. A total of 7,106 new jobs (3,500 direct and 3,606 indirect) would be generated and regional unemployment would fall from 5.4 to 3.0 percent at INEL (Socio 1996a).

A workforce of 830 would be required to operate the facility at any site. Operating the facility at Pantex would generate the greatest change in regional employment (approximately 1 percent). A total of 3,540 new jobs (830 direct and 2,710 indirect) would be created by the operational activities, and regional unemployment would fall to 3.7 percent. The largest increase in regional per capita income would occur as a result of operating the facility at INEL, but the increase would still be less than 1 percent over No Action (Socio 1996a).

Population and Housing. At all of the sites analyzed, workers would in-migrate to fill some of the newly created positions during both construction and operation. Project-related population increases would be greatest at INEL during construction of the reactor. Population in the ROI would increase by approximately 3 percent during this period. Pantex would require the largest number of in-migrating workers during operation; however, the population increase would be less than 1 percent. During construction, housing units, in excess of existing vacancies, would be required at all of the sites analyzed, except NTS. Additional housing construction would also be required during operation at all of the sites analyzed, except NTS and ORR, to accommodate the in-migrating population. The greatest increase in housing requirements (approximately 3 percent during construction and much less than 1 percent during operation) would be in the INEL ROI. Historic housing construction rates indicate there would be sufficient housing units available to accommodate the in-migrating population at all of the sites analyzed. (Socio 1996a).

Community Services. Constructing an evolutionary LWR would increase demand for community services at all the sites analyzed. The effects of population increases due to in-migrating workers during construction or operation on community services at any of the sites analyzed would be minor. The following discussion focuses on the Pantex and INEL ROIs where the greatest increased demand for community services would occur.

School districts in the Pantex ROI would need an additional 85 teachers during peak construction, and Pantex school districts would also require 21 additional teachers during operations to maintain the Pantex ROI No Action level of service. However, the additional teachers would be distributed over several school districts in the ROI; therefore, no single district would be significantly affected (Socio 1996a).

Twelve additional sworn police officers would be required in the INEL ROI during construction to maintain the No Action service level of 1.6 police officers per 1,000 persons, while 2 additional police officers would be required during operation. Eighteen additional firefighters would be required in the Pantex ROI during construction to maintain the No Action service level of 2.3 firefighters per 1,000 persons, while 3 additional firefighters would be required during operation (Socio 1996a).

Projected hospital occupancy rates during construction and operation would increase slightly over the No Action levels at all the sites analyzed. Projected capacities would be capable of accommodating the increase in patient load. Eleven additional physicians would be needed to maintain the No Action service level of 1.2 physicians

per 1,000 persons in the INEL ROI during construction, while 2 would be needed during operation at Pantex to maintain the No Action service level of 2.0 (Socio 1996a).

Local Transportation. The ORR local transportation network would experience the most noticeable effects from siting the evolutionary LWR. A total of 6,720 and 1,594 vehicle trips per day would be generated during the construction and operation phases, respectively. Vehicle traffic during construction would cause changes in four local road segments. I-275 from I-40 at Knoxville to I-75/640 at Knoxville as well as from I-75 at Knoxville to I-40 would both experience a drop in level of service from D to E. U.S. 70 from U.S. 321 to U.S. 11 would experience a drop in level of service from B to C. Tennessee State Route 58 from Tennessee State Region 95 to I-40 would experience a drop in level of service from E to F. Finally, Tennessee State Route 62 from Tennessee State Route 95 at Oak Ridge to Tennessee State Route at 170 would experience a significant increase in its volume-to-capacity ratio while operating at level of service F.

Drops in level of service for local roads would also occur at Hanford, NTS, INEL, Pantex, and SRS during construction. The INEL local transportation network would experience the most noticeable effects from operations of the evolutionary LWR. One thousand five hundred ninety-four vehicle trips per day would be generated during the operations phase at INEL. US 20 from US 26/91 at Idaho Falls to US 26 East would experience a drop in level of service from D to E. US 20/26 from US 26 East to ID State Route 22/33 would experience a drop in level of service from B to C (Socio 1996a).

4.3.5.4.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the evolutionary LWRs. The section first describes the impacts from normal reactor operation at each potential site followed by a description of impacts from reactor accidents. The impacts associated with the ultimate disposal of the spent fuel in a HLW repository are presented separately in technical documents that specifically address repository operations.

Summaries of the radiological impacts to the public associated with normal operation during the assumed 17-year campaign time are presented in Tables 4.3.5.4.9–1 and 4.3.5.4.9–2 for a single large and small evolutionary LWRs, respectively. Summaries of radiological impacts to workers are given in Tables 4.3.5.4.9–3 and 4.3.5.4.9–4 for large and small evolutionary LWRs, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.5.4.9–5. Summaries of impacts associated with postulated accidents are given in Table 4.3.5.4.9–6 through Table 4.3.5.4.9–11. Detailed results are presented in Appendix M.

Normal Operation. There would be no radiological releases associated with the construction of an evolutionary LWR at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the large and small evolutionary LWRs at each of the sites are presented in Tables 4.3.5.4.9–1 and 4.3.5.4.9–2, respectively. The impacts from all site operations, including the evolutionary LWR, are also given in these tables. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the tables.

The dose to the maximally exposed member of the public from annual large evolutionary LWR operation would range from 0.034 mrem at the NTS site to 4.8 mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancer to this individual would range from 2.9×10^{-7} to 4.1×10^{-5}. The impacts to the average individual would be less. As a result of annual operations, the population dose would range from 0.032 person-rem at NTS to 32 person-rem at SRS. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 2.7×10^{-4} to 0.27.

The doses to the maximally exposed member of the public from annual total site operations, including the large evolutionary LWR, are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 0.035 mrem at NTS to 6.7 mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.0×10^{-7} to 5.7×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are as ALARA. As a result of annual total site operations, the population doses would be within the limit in proposed 10 CFR 834 and would range from 0.036 person-rem at the NTS site to 76 person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 3.0×10^{-4} to 0.65.

The dose to the maximally exposed member of the public from annual small evolutionary LWR operation would range from 0.025 mrem at NTS to 2.8 mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancer to this individual would range from 2.1×10^{-7} to 2.4×10^{-5}. The impacts to the average

Table 4.3.5.4.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Large Evolutionary Light Water Reactor

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]												
Atmospheric release pathway (mrem)	0.33	0.33	0.034	0.035	0.046	0.053	1.5	1.5	4.8	5.0	0.26	0.61
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	1.0×10^{-3}	0.10	4.3×10^{-4}	0.081
Total liquid release pathway (mrem)	0.014	0.015	0	0	0	0	0	0	0.060	1.8	0.015	0.39
Atmospheric and liquid release pathways combined (mrem)	0.34	0.35	0.034	0.035	0.046	0.053	1.5	1.5	4.9	6.7	0.27	1.0
Percent of natural background[c]	0.11	0.12	0.011	0.011	0.014	0.016	0.45	0.45	1.6	2.3	0.092	0.34
17-year fatal cancer risk	2.9×10^{-6}	2.9×10^{-6}	2.9×10^{-7}	3.0×10^{-7}	3.9×10^{-7}	4.5×10^{-7}	1.3×10^{-5}	1.3×10^{-5}	4.1×10^{-5}	5.7×10^{-5}	2.3×10^{-6}	8.5×10^{-6}
Annual Population Dose Within 80 Kilometers[d]												
Atmospheric release pathway (person-rem)	30	30	0.032	0.036	9.6	12.0	8.9	8.9	5.1	34	32	72
Total liquid release pathway (person-rem)	1.5	2.6	0	0	0	0	0	0	0.078	4.8	0.096	3.7
Atmospheric and liquid release pathways combined (person-rem)	32	33	0.032	0.036	9.6	12.0	8.9	8.9	5.2	39	32	76
Percent of natural background[c]	0.017	0.018	3.5×10^{-4}	3.9×10^{-4}	0.011	0.013	7.6×10^{-3}	7.6×10^{-3}	1.4×10^{-3}	0.010	0.012	0.029
17-year fatal cancers	0.27	0.28	2.7×10^{-4}	3.0×10^{-4}	0.082	0.10	0.076	0.076	0.044	0.33	0.27	0.65

Table 4.3.5.4.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Large Evolutionary Light Water Reactor—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]
Annual Dose to the Average Individual Within 80 Kilometer[e]												
Atmospheric and liquid release pathways combined (mrem)	0.052	0.053	1.1×10^{-3}	1.2×10^{-3}	0.036	0.045	0.025	0.025	4.0×10^{-3}	0.030	0.036	0.085
17-year fatal cancer risk	4.4×10^{-7}	4.5×10^{-7}	9.3×10^{-9}	1.0×10^{-8}	3.0×10^{-7}	3.8×10^{-7}	2.2×10^{-7}	2.2×10^{-7}	3.4×10^{-8}	2.6×10^{-7}	3.0×10^{-7}	7.2×10^{-7}

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the MEI may be different under No Action than for operation of the reactor. Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km receives 186,400 person-rem; at NTS is 313 mrem for the average individual; the population within 80 km receives 9,190 person-rem; at INEL is 338 mrem for the average individual; the population within 80 km receives 90,800 person-rem; at Pantex is 334 mrem for the average individual; the population within 80 km receives 116,900 person-rem; at ORR is 295 mrem for the average individual; the population within 80 km receives 379,000 person-rem; at SRS is 298 mrem for the average individual; the population within 80 km receives 266,000 person-rem.

[d] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[e] Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford; 29,400 at NTS; 269,000 at INEL; 350,000 at Pantex; 1,285,000 at ORR; and 893,000 at SRS).

Source: Section M.2.

Table 4.3.5.4.9–2. Potential Radiological Impacts to the Public During Normal Operation of the Small Evolutionary Light Water Reactor

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]												
Atmospheric release pathway (mrem)	0.23	0.23	0.025	0.026	0.033	0.041	1.0	1.0	2.3	2.5	0.16	0.54
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0.011	0.11	4.9×10^{-3}	0.086
Total liquid release pathway (mrem)	0.024	0.025	0	0	0	0	0	0	0.47	2.2	0.067	0.44
Atmospheric and liquid release pathways combined (mrem)	0.25	0.26	0.025	0.026	0.033	0.041	1.0	1.0	2.8	4.7	0.23	0.98
Percent of natural background[c]	0.085	0.085	8.0×10^{-3}	8.4×10^{-3}	9.8×10^{-3}	0.012	0.30	0.30	0.94	1.6	0.076	0.33
17-year fatal cancer risk	2.1×10^{-6}	2.2×10^{-6}	2.1×10^{-7}	2.2×10^{-7}	2.8×10^{-7}	3.5×10^{-7}	8.5×10^{-6}	8.5×10^{-6}	2.4×10^{-5}	4.0×10^{-5}	1.9×10^{-6}	8.3×10^{-6}
Annual Population Dose Within 80 Kilometers[d]												
Atmospheric release pathway (person-rem)	20	20	0.022	0.026	6.9	9.3	7.4	7.4	2.8	32	24	64
Total liquid release pathway (person-rem)	2.6	3.7	0	0	0	0	0	0	0.50	5.2	0.39	4.0
Atmospheric and liquid release pathways combined (person-rem)	23	24	0.022	0.026	6.9	9.3	7.4	7.4	3.3	37	24	68
Percent of natural background[c]	0.012	0.013	2.4×10^{-4}	2.8×10^{-4}	7.6×10^{-3}	0.010	6.3×10^{-3}	6.3×10^{-3}	8.7×10^{-4}	9.8×10^{-3}	9.2×10^{-3}	0.026
17-year fatal cancers	0.19	0.20	1.9×10^{-4}	2.2×10^{-4}	0.059	0.079	0.063	0.063	0.028	0.32	0.21	0.58

Table 4.3.5.4.9–2. Potential Radiological Impacts to the Public During Normal Operation of the Small Evolutionary Light Water Reactor—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]	Reactor	Total Site[a]
Annual Dose to the Average Individual Within 80 Kilometers[e]												
Atmospheric and liquid release pathways combined (mrem)	0.037	0.039	7.5×10^{-4}	8.8×10^{-4}	0.026	0.035	0.021	0.021	2.6×10^{-3}	0.029	0.027	0.076
17-year fatal risk	3.1×10^{-7}	3.3×10^{-7}	6.4×10^{-9}	7.5×10^{-9}	2.2×10^{-7}	2.9×10^{-7}	1.8×10^{-7}	1.8×10^{-7}	2.2×10^{-8}	2.4×10^{-7}	2.3×10^{-7}	6.5×10^{-7}

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9).

[b] The applicable radiological limits for an individual member of the public from site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km receives 186,400 person-rem; at NTS is 313 mrem for the average individual; the population within 80 km receives 9,190 person-rem; at INEL is 338 mrem for the average individual; the population within 80 km receives 90,800 person-rem; at Pantex is 334 mrem for the average individual; the population within 80 km receives 116,900 person-rem; at ORR is 295 mrem for the average individual; the population within 80 km receives 379,000 person-rem; at SRS is 298 mrem for the average individual; the population within 80 km receives 266,000 person-rem.

[d] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[e] Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford; 29,400 at NTS; 269,000 at INEL; 350,000 at Pantex; 1,285,000 at ORR; and 893,000 at SRS).

Source: Section M.2.

individual would be less. The population dose would range from 0.022 person-rem at NTS to 24 person-rem at SRS. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 1.9×10^{-4} to 0.21.

The doses to the maximally exposed member of the public from annual total site operations, including the small evolutionary LWR, are also all within radiological limits and would range from 0.026 mrem at the NTS site to 4.7 mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancers to this individual would range from 2.2×10^{-7} to 4.0×10^{-5}. The impacts to the average individual would be less. As a result of annual total site operations, the population doses are also within the proposed reporting limit, and would range from 0.026 person-rem at NTS to 68 person-rem at SRS. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 2.2×10^{-4} to 0.58.

Doses to onsite workers from normal operations are given in Tables 4.3.5.4.9–3 and 4.3.5.4.9–4 for the large and small evolutionary LWRs, respectively. Included are involved workers directly associated with the evolutionary LWR, workers who are not involved with the reactor and the entire workforce at each site. All doses fall within regulatory limits.

For the large evolutionary LWR alternative, the annual dose to reactor workers is site-independent and would be 810 mrem to the average worker associated with the evolutionary LWR and 170 person-rem to entire evolutionary LWR workforce. The annual average dose to the noninvolved worker would range from 2.6 mrem at ORR to 32 mrem at SRS. The annual total dose to all noninvolved workers would range from 3.0 person-rem at the NTS site to 250 person-rem at the Hanford site. The annual dose to the total site workforces would range from 173 person-rem at the NTS site to 420 person-rem at the Hanford site.

For the small evolutionary LWR alternative, the annual incremental dose to reactor workers is site-independent and would be 800 mrem to the average worker associated with the evolutionary LWR and 100 person-rem to entire evolutionary LWR workforce. The annual average dose to the noninvolved worker would range from 2.6 mrem at ORR to 32 mrem at SRS. The annual total dose to all noninvolved workers would range from 3.0 person-rem at NTS to 250 person-rem at Hanford. The annual dose to the total site workforces would range from 103 person-rem at NTS to 350 person-rem at Hanford.

The risks and numbers of fatal cancers among the different workers from 17 years of operation are included in Tables 4.3.5.4.9–3 and 4.3.5.4.9–4 for the large and small evolutionary LWRs, respectively. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also worker rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the large and small evolutionary LWR facilities at each of several sites are presented in Table 4.3.5.4.9–5. Included is the impact due only to operation of the evolutionary LWR facilities and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

For the large or small evolutionary LWR facilities, exposure data are identical and the HIs to the MEIs range from 2.8×10^{-8} at NTS to 1.1×10^{-6} at ORR and Pantex. The incremental cancer risk from hazardous chemicals to the MEI is 0 at all sites. The HI to the onsite worker ranges from 7.8×10^{-6} at Pantex to 1.6×10^{-5} at the Hanford, INEL, and ORR sites and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals) at all sites.

Table 4.3.5.4.9–3. Potential Radiological Impacts to Workers During Normal Operation of the Large Evolutionary Light Water Reactor

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce[a]						
Average worker dose (mrem/yr)[b]	810	810	810	810	810	810
17-year fatal cancer risk	5.5×10^{-3}	5.5×10^{-3}	5.5×10^{-3}	5.5×10^{-3}	5.5×10^{-3}	5.5×10^{-3}
Total dose (person-rem/yr)	170	170	170	170	170	170
17-year fatal cancers	1.2	1.2	1.2	1.2	1.2	1.2
Noninvolved Workforce[c]						
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32
17-year fatal cancer risk	1.8×10^{-4}	3.4×10^{-5}	2.0×10^{-4}	6.8×10^{-5}	1.8×10^{-5}	2.2×10^{-4}
Total dose (person-rem/yr)	250	3.0	220	14	44	226
17-year fatal cancers	1.7	0.020	1.5	0.095	0.30	1.5
Total Site Workforce[d]						
Dose (person-rem/yr)	420	173	390	184	214	396
17-year fatal cancers	2.9	1.2	2.7	1.3	1.5	2.7

[a] The involved worker is a worker associated with operations of the proposed action.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The noninvolved workforce is equivalent to the No Action workforce.

[d] The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Table 4.3.5.4.9–4. Potential Radiological Impacts to Workers During Normal Operation of the Small Evolutionary Light Water Reactor

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce[a]						
Average worker dose (mrem/yr)[b]	800	800	800	800	800	800
17-year fatal cancer risk	$5.4x10^{-3}$	$5.4x10^{-3}$	$5.4x10^{-3}$	$5.4x10^{-3}$	$5.4x10^{-3}$	$5.4x10^{-3}$
Total dose (person-rem/yr)	100	100	100	100	100	100
17-year fatal cancers	0.68	0.68	0.68	0.68	0.68	0.68
Noninvolved Workforce[c]						
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32
17-year fatal cancer risk	$1.8x10^{-4}$	$3.4x10^{-5}$	$2.0x10^{-4}$	$6.8x10^{-5}$	$1.8x10^{-5}$	$2.2x10^{-4}$
Total dose (person-rem/yr)	250	3.0	220	14	44	226
17-year fatal cancers	1.7	0.020	1.5	0.095	0.30	1.5
Total Site Workforce[d]						
Dose (person-rem/yr)	350	103	320	114	144	326
17-year fatal cancers	2.4	0.70	2.2	0.78	0.98	2.2

[a] The involved worker is a worker associated with operations of the proposed action.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The noninvolved workforce is equivalent to the No Action workforce.

[d] The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Table 4.3.5.4.9–5. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Large or Small Evolutionary Light Water Reactor

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]
Maximally Exposed Individual (Public)												
Hazard index[c]	1.9×10^{-7}	6.2×10^{-5}	2.8×10^{-8}	2.8×10^{-8}	4.1×10^{-7}	0.015	1.1×10^{-6}	5.7×10^{-3}	1.1×10^{-6}	0.040	5.2×10^{-8}	5.2×10^{-3}
Cancer risk[d]	0	0	0	0	0	0.036	0	1.1×10^{-8}	0	0	0	1.3×10^{-7}
Worker Onsite												
Hazard index[e]	1.6×10^{-5}	4.0×10^{-3}	8.0×10^{-6}	8.0×10^{-6}	1.6×10^{-5}	0.22	7.8×10^{-6}	6.1×10^{-3}	1.6×10^{-5}	0.15	1.4×10^{-5}	1.2
Cancer risk[f]	0	0	0	0	0	7.7×10^{-4}	0	4.5×10^{-7}	0	0	0	1.9×10^{-4}

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer Risk for MEI=(emissions concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor).

[e] Hazard Index for workers=sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer Risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor).

Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Large Evolutionary LWRs: Tables M.3.4–68 through M.3.4–73 and Small Evolutionary LWRs: Tables M.3.4–74 through M.3.4–79.

Facility Accidents. A set of potential accidents for evolutionary light water reactors for which there may be releases of radioactivity that may impact noninvolved onsite workers and the offsite population has been postulated. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km of the accident release point are summarized in Tables 4.3.5.4.9–6 through 4.3.5.4.9–11 for the candidate sites (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 22.0 at ORR for the large break loss of coolant and loss of core cooling accident scenario with a probability of 2.1×10^{-8} per year. The corresponding 17 year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 665 m (2,200 ft) would be 7.9×10^{-6}, 2.6×10^{-8}, and 2.1×10^{-8}, respectively. Appendix M.5 presents summary descriptions of the accident scenarios identified in Tables 4.3.5.4.9–6 through 4.3.5.4.9–11.

[Text deleted.] The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires and explosions could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is the possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

Table 4.3.5.4.9–6. Evolutionary Light Water Reactor Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Probability of Latent Cancer/ Prompt Fatality[b]	Risk of Latent Cancer/ Prompt Fatality (per 17 yr)[a]	Probability of Latent Cancer/ Prompt Fatality[b]	Risk of Latent Cancer/Prompt Fatalities (per 17 yr)[a]	Number of Latent Cancer/ Prompt Fatalities[c]	Accident Frequency (per yr)
Failure of small primary coolant line outside containment	3.8×10^{-8}/ 0	2.2×10^{-6}/ 0	4.8×10^{-9}/ 0	2.8×10^{-7}/ 0	8.9×10^{-7}/ 0	5.2×10^{-5}/ 0	1.0×10^{-3}
Scram system piping break outside containment	4.2×10^{-9}/ 0	2.5×10^{-5}/ 0	5.3×10^{-10}/ 0	3.1×10^{-6}/ 0	9.4×10^{-8}/ 0	5.5×10^{-4}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	1.1×10^{-10}/ 0	6.7×10^{-7}/ 0	1.4×10^{-11}/ 0	8.4×10^{-8}/ 0	3.1×10^{-9}/ 0	1.8×10^{-5}/ 0	1.0×10^{-5}
Fuel handling	4.8×10^{-9}/ 0	2.8×10^{-5}/ 0	7.3×10^{-10}/ 0	4.3×10^{-6}/ 0	1.7×10^{-7}/ 0	1.0×10^{-3}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	4.7×10^{-8}/ 0	0.021/ 0	5.9×10^{-9}/ 0	2.7×10^{-3}/ 0	1.8×10^{-6}/ 0	0.82/ 0	1.7×10^{-7}
Large break loss of coolant accident and loss of core cooling	3.2×10^{-8}/ 1.4×10^{-7}	0.089/ 0.040	2.9×10^{-8}/ 3.5×10^{-9}	0.082/ 9.7×10^{-3}	2.1×10^{-6}/ 0	5.9/ 0	2.1×10^{-8}
Expected risk[d]	1.3×10^{-7}/ 1.4×10^{-7}	–	4.1×10^{-8}/ 3.5×10^{-9}	–	5.1×10^{-6}/ 0	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

[b] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

Table 4.3.5.4.9–7. Evolutionary Light Water Reactor Accident Impacts at Nevada Test Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Probability of Latent Cancer/ Prompt Fatality[b]	Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Probability of Latent Cancer/ Prompt Fatality[b]	Risk of Latent Cancer/Prompt Fatalities (per 17 yr)[a]	Number of Latent Cancer/ Prompt Fatalities[c]	Accident Frequency (per yr)
Failure of small primary coolant line outside containment	2.7×10^{-8}/ 0	1.6×10^{-6}/ 0	7.0×10^{-10}/ 0	4.1×10^{-8} 0	2.7×10^{-8}/ 0	1.6×10^{-6}/ 0	1.0×10^{-3}
Scram system piping break outside containment	2.9×10^{-9}/ 0	1.7×10^{-5}/ 0	7.7×10^{-11}/ 0	4.5×10^{-7}/ 0	2.8×10^{-9}/ 0	1.7×10^{-5}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	7.9×10^{-11}/ 0	4.6×10^{-7}/ 0	2.1×10^{-12}/ 0	1.2×10^{-8}/ 0	9.6×10^{-11}/ 0	5.6×10^{-7}/ 0	1.0×10^{-5}
Fuel handling	3.3×10^{-9}/ 0	1.9×10^{-5}/ 0	1.3×10^{-10}/ 0	7.6×10^{-7}/ 0	4.3×10^{-9}/ 0	2.6×10^{-5}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	3.0×10^{-8}/ 0	0.014/ 0	1.1×10^{-9}/ 0	5.0×10^{-4}/ 0	5.6×10^{-8}/ 0	0.026/ 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	3.1×10^{-8}/ 8.9×10^{-8}	0.087/ 0.25	5.4×10^{-9}/ 8.4×10^{-11}	0.015/ 2.4×10^{-4}	2.1×10^{-8}/ 0	0.059/ 0	2.1×10^{-8}
Expected risk[d]	9.4×10^{-8}/ 8.9×10^{-8}	– –	7.4×10^{-9}/ 8.4×10^{-11}	– –	1.1×10^{-7}/ 0	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

[b] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

Table 4.3.5.4.9–8. Evolutionary Light Water Reactor Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Probability of Latent Cancer/ Prompt Fatality[b]	Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Probability of Latent Cancer/ Prompt Fatality[b]	Risk of Latent Cancer/Prompt Fatalities (per 17 yr)[a]	Number of Latent Cancer/ Prompt Fatalities[c]	Accident Frequency (per yr)
Failure of small primary coolant line outside containment	3.8×10^{-8}/ 0	2.2×10^{-6}/ 0	4.3×10^{-10}/ 0	2.5×10^{-8}/ 0	3.7×10^{-7}/ 0	2.2×10^{-5}/ 0	1.0×10^{-3}
Scram system piping break outside containment	4.1×10^{-9}/ 0	2.4×10^{-5}/ 0	4.6×10^{-11}/ 0	2.7×10^{-7}/ 0	3.8×10^{-8}/ 0	2.3×10^{-4}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	1.1×10^{-10}/ 0	6.6×10^{-7}/ 0	1.3×10^{-12}/ 0	7.6×10^{-9}/ 0	1.3×10^{-9}/ 0	7.6×10^{-6}/ 0	1.0×10^{-5}
Fuel handling	4.7×10^{-9}/ 0	2.7×10^{-5}/ 0	8.7×10^{-11}/ 0	5.1×10^{-7}/ 0	5.5×10^{-8}/ 0	3.3×10^{-4}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	4.4×10^{-8}/ 0	0.020/ 0	7.3×10^{-10}/ 0	3.3×10^{-4}/ 0	7.6×10^{-7}/ 0	0.34/ 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	2.5×10^{-8}/ 1.3×10^{-7}	0.071/ 0.36	3.7×10^{-9}/ 0	0.010/ 0	2.0×10^{-7}/ 0	0.57/ 0	2.1×10^{-8}
Expected risk[d]	1.2×10^{-7}/ 1.3×10^{-7}	–	5.0×10^{-9}/ 0	–	1.4×10^{-6}/ 0	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

[b] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

Table 4.3.5.4.9–9. Evolutionary Light Water Reactor Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m: Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Worker at 1,000 m: Probability of Latent Cancer/Prompt Fatality[b]	Maximum Offsite Individual: Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Maximum Offsite Individual: Probability of Latent Cancer/Prompt Fatality[b]	Population to 80 km: Risk of Latent Cancer/Prompt Fatalities (per 17 yr)[a]	Population to 80 km: Number of Latent Cancer/Prompt Fatalities[c]	Accident Frequency (per yr)
Failure of small primary coolant line outside containment	1.5×10^{-8}/ 0	8.8×10^{-7}/ 0	1.3×10^{-8}/ 0	7.9×10^{-7}/ 0	5.4×10^{-7}/ 0	3.2×10^{-5}/ 0	1.0×10^{-3}
Scram system piping break outside containment	1.6×10^{-9}/ 0	9.7×10^{-6}/ 0	1.5×10^{-9}/ 0	8.7×10^{-6}/ 0	5.7×10^{-8}/ 0	3.4×10^{-4}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	4.5×10^{-11}/ 0	2.6×10^{-7}/ 0	4.0×10^{-11}/ 0	2.3×10^{-7}/ 0	1.8×10^{-9}/ 0	1.1×10^{-5}/ 0	1.0×10^{-5}
Fuel handling	1.9×10^{-9}/ 0	1.1×10^{-5}/ 0	1.7×10^{-9}/ 0	9.9×10^{-6}/ 0	8.3×10^{-8}/ 0	4.9×10^{-4}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	1.6×10^{-8}/ 0	7.2×10^{-3}/ 0	1.4×10^{-8}/ 0	6.5×10^{-3}/ 0	9.0×10^{-7}/ 0	0.41/ 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	3.4×10^{-8}/ 2.9×10^{-8}	0.095/ 0.080	3.6×10^{-8}/ 1.7×10^{-8}	0.10/ 0.047	8.4×10^{-7}/ 0	2.3/ 0	2.1×10^{-8}
Expected risk[d]	6.8×10^{-8}/ 2.9×10^{-8}	–	6.7×10^{-8}/ 1.7×10^{-8}	–	2.4×10^{-6}/ 0	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

[b] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

Table 4.3.5.4.9–10. Evolutionary Light Water Reactor Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 665 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Probability of Latent Cancer/ Prompt Fatality[b]	Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Probability of Latent Cancer/ Prompt Fatality[b]	Risk of Latent Cancer/Prompt Fatalities (per 17 yr)[a]	Number of Latent Cancer/ Prompt Fatalities[c]	Accident Frequency (per yr)
Failure of small primary coolant line outside containment	4.7×10^{-8}/ 0	2.8×10^{-6}/ 0	5.9×10^{-8}/ 0	3.5×10^{-6}/ 0	3.7×10^{-6}/ 0	2.2×10^{-4}/ 0	1.0×10^{-3}
Scram system piping break outside containment	5.2×10^{-9}/ 0	3.0×10^{-5}/ 0	6.4×10^{-9}/ 0	3.8×10^{-5}/ 0	3.9×10^{-7}/ 0	2.3×10^{-3}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	1.4×10^{-10}/ 0	8.3×10^{-7}/ 0	1.8×10^{-10}/ 0	1.0×10^{-6}/ 0	1.3×10^{-8}/ 0	7.4×10^{-5}/ 0	1.0×10^{-5}
Fuel handling	5.8×10^{-9}/ 0	3.4×10^{-5}/ 0	7.3×10^{-9}/ 0	4.3×10^{-5}/ 0	6.6×10^{-7}/ 0	3.9×10^{-3}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	6.1×10^{-8}/ 0	0.028/ 0	7.7×10^{-8}/ 0	0.035 0	6.9×10^{-6}/ 0	3.1/ 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	2.1×10^{-8}/ 2.0×10^{-7}	0.058/ 0.56	2.6×10^{-8}/ 2.0×10^{-7}	0.073/ 0.56	7.9×10^{-6}/ 0	22/ 0	2.1×10^{-8}
Expected risk[d]	1.4×10^{-7}/ 2.0×10^{-7}	–	1.8×10^{-7}/ 2.0×10^{-7}	–	2.0×10^{-5}/ 0	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 665 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

[b] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [665 m for the facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

Table 4.3.5.4.9–11. Evolutionary Light Water Reactor Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Probability of Latent Cancer/ Prompt Fatality[b]	Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Probability of Latent Cancer/ Prompt Fatality[b]	Risk of Latent Cancer/Prompt Fatality (per 17 yr)[a]	Number of Latent Cancer/ Prompt Fatalities[c]	Accident Frequency (per yr)
Failure of small primary coolant line outside containment	2.4×10^{-8}/ 0	1.4×10^{-6}/ 0	3.5×10^{-10}/ 0	2.1×10^{-8}/ 0	1.3×10^{-6}/ 0	7.5×10^{-5}/ 0	1.0×10^{-3}
Scram system piping break outside containment	2.6×10^{-9}/ 0	1.6×10^{-5}/ 0	3.8×10^{-11}/ 0	2.3×10^{-7}/ 0	1.3×10^{-7}/ 0	7.9×10^{-4}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	7.2×10^{-11}/ 0	4.2×10^{-7}/ 0	1.1×10^{-12}/ 0	6.3×10^{-9}/ 0	4.5×10^{-9}/ 0	2.6×10^{-5}/ 0	1.0×10^{-5}
Fuel handling	3.0×10^{-9}/ 0	1.8×10^{-5}/ 0	6.6×10^{-11}/ 0	3.9×10^{-7}/ 0	2.1×10^{-7}/ 0	1.3×10^{-3}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	3.0×10^{-8}/ 0	0.013/ 0	5.8×10^{-10}/ 0	2.6×10^{-4}/ 0	2.5×10^{-6}/ 0	1.1/ 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	3.4×10^{-8}/ 7.4×10^{-8}	0.096/ 0.21	1.7×10^{-9}/ 0	4.9×10^{-3}/ 0	1.5×10^{-6}/ 0	4.3/ 0	2.1×10^{-8}
Expected risk[d]	9.3×10^{-8}/ 7.4×10^{-8}	–	2.8×10^{-9}/ 0	–	5.7×10^{-6}/ 0	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

[b] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

4.3.5.4.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of a new single unit large or small evolutionary LWR. There are no high-level or TRU wastes associated with the operation of a large or small evolutionary LWR. Tables 4.3.5.4.10–1 and 4.3.5.4.10–2 provide the estimated operational waste volumes projected to be generated at the sites analyzed as a result of a large or small evolutionary LWR. Facilities that would support the evolutionary LWR would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated on-site to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed on in accordance with current site practice. The incremental waste volumes generated from the evolutionary LWR and the resultant waste effluent used for the waste impacts can be found in Section E.3.3.7. A detailed description of the waste management activities that would be required to support the evolutionary LWR can also be found in Section E.3.3.7.

Construction and operation of a large or small evolutionary LWR would impact existing waste management activities at each of the sites analyzed, increasing the generation of spent nuclear fuel, low-level, mixed, hazardous, and nonhazardous wastes. Wastes generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

A new large or small evolutionary LWR would generate 10 m^3 (13 yd^3) or 5 m^3 (6.5 yd^3) of spent nuclear fuel annually per unit, resulting in impacts associated with spent nuclear fuel management and storage. The total residual heavy metal content for the entire disposition mission is estimated to be 1,300 t (1,430 tons) for the large reactor and 1,200 t (1,320 tons) for the small reactor. NTS and Pantex do not possess existing inventories of spent nuclear fuel. These sites would need to develop the necessary storage infrastructure for safe and efficient management of spent nuclear fuel. Hanford, INEL, ORR, and SRS each possess existing inventories of spent nuclear fuel, and both INEL and SRS will receive additional spent nuclear fuel from other offsite locations. The sites with existing inventories of spent nuclear fuel may or may not have adequate existing or planned facilities that could manage the additional spent nuclear fuel until a decision regarding its ultimate disposition is made and implemented.

For the large evolutionary LWR at wet or dry sites, following treatment and volume reduction, approximately 70 m^3 (92 yd^3) per reactor of LLW from solidified liquid LLW (from primary and secondary coolant systems, spent fuel pools, and laboratory operations), protective clothing, soil, and small equipment would require disposal annually. All of the sites analyzed except Pantex have existing or planned facilities that could manage the quantities of LLW. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.008 ha/yr (0.02 acre/yr) for SRS, 0.01 ha/yr (0.03 acre/yr) for INEL and NTS, and 0.02 ha/yr (0.05 acre/yr) for Hanford and ORR. With no onsite LLW disposal capability, Pantex would require 5 additional LLW shipments per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

For the small evolutionary LWR at wet or dry sites, following treatment and volume reduction, approximately 40 m^3 (52 yd^3) per reactor of LLW from solidified liquid LLW, protective clothing, soil, and small equipment would require disposal annually. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.005 ha/yr (0.01 acre/yr) for SRS, 0.006 ha/yr (0.02 acre/yr) for INEL and NTS, and

Table 4.3.5.4.10–1. Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes for the Large Evolutionary Light Water Reactor[a]

	Hanford		NTS	INEL	Pantex	ORR	SRS
Category	**New Facility (m^3)**	**No Action (m^3)**	**No Action (m^3)**	**No Action (m^3)**	**No Action (m^3)**	**No Action (m^3)**	**No Action (m^3)**
Spent Nuclear Fuel	10[b]	None	None	None (offsite receipts expected)	None	None	None (offsite receipts expected)
Low-Level							
Liquid	18,900[c]	None	Dependent on restoration activities	None	1	2,970	74,000
Solid	500	3,390	15,000	7,200	19	7,320	16,400
Mixed Low-Level							
Liquid	0	3,760	None	4	<1	87,600	1,330
Solid	5	1,510	50	170	4	432	7,700
Hazardous							
Liquid	Included in solid	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	27	560	212	1,200	31	26	15,100
Non-hazardous (Sanitary)							
Liquid	[d]	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	5,280	5,107	2,120	52,000	339	53,100	61,200
Non-hazardous (Other)							
Liquid	Included in sanitary	Included in sanitary	None	None	Included in sanitary	650,000	Included in sanitary
Solid	4,430[e]	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

[a] The No Action volumes are from Tables 4.2.1.10–1,4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1. Incremental waste generation volumes for evolutionary LWR (large) are derived from Table E.3.3.7–1 and are for one reactor. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.3.7–1.

[b] Spent nuclear fuel per unit. Total spent fuel for disposition mission (2 units) is 337 m^3. Residual heavy metal content in spent nuclear fuel is 38.2 t per reactor per year.

[c] Liquid LLW would be treated and solidified prior to disposal.

[d] For wet sites (Hanford, ORR, and SRS) the liquid nonhazardous waste generation is 23,900,000 m^3 and for dry sites (NTS, INEL, and Pantex) it is 342,000 m^3.

[e] Recyclable wastes.

Table 4.3.5.4.10–2. Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes for the Small Evolutionary Light Water Reactor[a]

Category	New Facility (m^3)	Hanford No Action (m^3)	NTS No Action (m^3)	INEL No Action (m^3)	Pantex No Action (m^3)	ORR No Action (m^3)	SRS No Action (m^3)
Spent Nuclear Fuel	5[b]	None	None	None (offsite receipts expected)	None	None	None (offsite receipts expected)
Low-Level							
Liquid	2,990[c]	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	270	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-Level							
Liquid	0	3,760	None	4	4	87,600	1,330
Solid	5	1,510	50	170	46	432	7,700
Hazardous							
Liquid	Included in solid	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	27	560	212	1,200	31	26	15,100
Nonhazardous (sanitary)							
Liquid	[d]	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	3,210	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	Included in sanitary	Included in sanitary	None	None	Included in sanitary	650,000	Included in sanitary
Solid	2,680[e]	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

[a] The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1. Incremental waste generation volumes for evolutionary LWR (small) are from Table E.3.3.7–2 and are for one reactor. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.3.7–2.

[b] Spent nuclear fuel per unit. Total spent fuel for disposition mission (4 units) is 338 m^3. Residual heavy metal content in spent nuclear fuel is 17.7 t per reactor per year.

[c] Liquid LLW would be treated and solidified prior to disposal.

[d] For wet sites (Hanford, ORR, and SRS) the liquid nonhazardous waste generation is 11,000,000 m^3 and for dry sites (NTS, INEL, and Pantex) it is 190,000 m^3.

[e] Recyclable wastes.

0.01 ha/yr (0.03 acre/yr) for Hanford and ORR. With no onsite LLW disposal capability, Pantex would require three additional LLW shipments per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD from the Waste Management PEIS.

An estimated 5 m^3 (7 yd^3) of solid mixed LLW per reactor consisting of solvent rags and equipment that has been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party Agreement for Hanford and the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

Approximately 27 m^3 (35 yd^3) of hazardous waste would consist primarily of analytical solutions and solvent rags contaminated with methylene chloride, acetonitrile, and acetone. Other hazardous waste would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous waste would be stored in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

For the large evolutionary LWR (wet site), approximately 23.9 million m^3 (6.32 billion gal) of liquid nonhazardous sanitary and industrial wastewater, cooling tower blowdown, and estimated stormwater runoff per reactor would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems would be required at Hanford, ORR, or SRS. At Hanford, only cooling tower blowdown would be discharged. All other wastewater would be recycled. For the large evolutionary LWR (dry site), approximately 342,000 m^3 (90.3 million gal) of liquid nonhazardous sanitary and industrial wastewater, and estimated stormwater runoff per reactor would require treatment in accordance with site practice and discharge permits. Construction of, or major upgrades to, sanitary, utility, and process wastewater treatment systems would be required at NTS, INEL, and Pantex. After volume reduction, 1,760 m^3 (2,300 yd^3) of solid nonhazardous wastes per reactor such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

For the small evolutionary LWR (wet site), approximately 11 million m^3 (2.91 billion gal) of liquid nonhazardous sanitary and industrial wastewater, cooling tower blowdown, and estimated stormwater runoff per reactor would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems would be required at Hanford, ORR, or SRS. At Hanford, only cooling tower blowdown would be discharged. All other wastewater would be recycled. For the small evolutionary LWR (dry site), approximately 190,000 m^3 (50.2 million gal) of liquid nonhazardous sanitary and industrial wastewater, and estimated stormwater runoff per reactor would require treatment in accordance with site practice and discharge permits. Construction of, or major upgrades to, sanitary, utility, and process wastewater treatment systems would be required at NTS, INEL, and Pantex. After volume reduction, 1,070 m^3 (1,400 yd^3) of solid nonhazardous wastes per reactor such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.5.5 Canadian Deuterium Uranium Reactor Alternative (Retained Under the Preferred Alternative)

Ontario Hydro operates 20 CANDU reactors capable of using MOX fuel at five nuclear generating stations in the Province of Ontario. The use of the CANDU reactors would be subject to the approval, policies, and regulations of the Canadian Federal and Provincial Governments. Eight of these units are located at the Bruce-A and Bruce-B Nuclear Generating Stations, a 930-ha (2,300-acre) site on Lake Huron about 300 km (186 mi) northeast of Detroit, Michigan. In addition, there is one CANDU reactor in the Province of Quebec and another CANDU reactor in New Brunswick. Ontario Hydro Bruce-A Nuclear Generating Station has been identified as a reference facility by the Government of Canada and is used as a representative site for evaluation of the CANDU Reactor Alternative and the CANFLEX fuel bundle. Other CANDU reactors could be used if the Canadian authorities choose to use a different site. Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion or Pu conversion facility, packaged, transported to the MOX fuel fabrication facility, and converted into MOX fuel.

The Bruce-A Nuclear Generating Station, which contains four 769 MWe electric reactors, a common powerhouse with four turbine generators, a heavy water plant, a process steam transformer plant, a central services area, pumphouses, standby generators, and other support facilities, is used as the reference site for the disposition alternative evaluation. One or up to four of these units could be used for Pu disposition for this alternative. The reference reactor MOX fuel cycle, adapting the standard CANDU fuel bundle in the four reactors, would dispose of approximately 2 t/yr (2.2 tons/yr) of Pu and eliminate the mining and refining of approximately 6,000 t/yr (6,600 tons/yr) of uranium ore.

An alternate fuel bundle design using uranium fuel (the CANFLEX fuel bundle), which is currently undergoing reactor qualification, might be used. This fuel bundle has smaller diameter elements in the outer rings that would operate at a lower linear power rating, permitting higher Pu concentrations. Both designs have essentially the same Pu disposition capacity. The design is expected to reduce the number of fuel bundles and waste volumes by half.

As in the U.S. LWR alternatives, no CANDU reactors are currently licensed to use MOX fuel, and favorable regulatory review of the safety of their operation in this mode would be required. While the CANDU reactor design is in principle even more easily adaptable to full-core MOX operation than most LWRs, at the same time the technical uncertainties concerning MOX use in CANDUs is considered somewhat larger than in the LWR case, given the lack of MOX operating experience in CANDU reactors. There are also considerable uncertainties concerning the economics, as no one has ever produced CANDU MOX fuel before. Gaining approval of the various Canadian institutions and the Canadian public would be a major hurdle for the CANDU option. Licensing reactor operations with Pu would probably be a less difficult issue than securing agreement on the basic approach. Licensing procedures and standards for Pu use in Canada, set by the Atomic Energy Control Board, are different from those used by the NRC. In general, the process in Canada relies more on cooperation between licensees and the board, and less on an adversarial process.

The distance over which Pu would have to be transported to be burned in CANDU reactors would be greater than that in using U.S. LWRs, even if all the CANDU reactors involved were at a single site. The attendant controversies and risks of theft would be correspondingly larger. Possibly more important in political terms than the sheer distances is the need for the material to be shipped across international borders, to a nonnuclear-weapon state.

The safeguards concerns regarding fuel fabrication are similar for LWRs and CANDU reactors. Because of the need to transport Pu over longer distances, transport risks would be somewhat greater for CANDU reactors, and because of the reactor's online refueling capability and the portability of the fuel elements, the risks of theft or diversion of fabricated fuel from the reactor could be somewhat greater as well. Both of these risks could be

reduced to very low levels with the application of sufficient resources. This alternative would make the Pu roughly as difficult to recover as the Pu in commercial spent fuel.

Because of the relatively low burnup (even when enriched with Pu) and small size of the CANDU MOX bundles, the gamma-radiation dose rates from them would be somewhat lower than those from LWR spent fuel of equal age. The surface dose rate 10 years after discharge from a single bundle irradiated to 9,700 MW-days/t is about 5,500 rem/hr, compared to a surface dose rate of 18,000 rem/hr at the same time for a pressurized-water reactor fuel bundle irradiated to 40,000 MW-days/t. The dose rate also falls off more rapidly with distance for the CANDU fuel bundle, because of its more compact size. The spent CANDU MOX, however, would have substantially higher dose rates for several decades than the large quantities of much older LWR spent fuel that will exist at the time the CANDU MOX spent fuel would be discharged.

Fuel can be removed from CANDU reactors at any time without shutdown of the reactor, and the fuel elements are substantially smaller and more portable than is the case for LWRs. Therefore, CANDUs require more intensive safeguarding than do LWRs. For fuel containing more Pu, still more intensive safeguarding would be needed. Both CANDU reactors and the fresh MOX fuel stored at either an LWR or a CANDU, however, require continuous safeguarding. In addition, the task of accounting for and securing complete fuel assemblies for either a CANDU reactor or an LWR is substantially easier than that of accounting for bulk Pu at a MOX fabrication plant. Therefore, the net additional security risks of using CANDU reactors for this mission compared to using LWRs would be relatively small (NAS 1995a:146,150–152).

4.3.5.5.1 *Effects Within the United States and Canada*

This section describes the environmental impacts of converting weapons-grade Pu to MOX fuel bundles for use in CANDU reactors. The impacts associated with transporting of the fuel bundles to the Canadian border are described in Section 4.4. The changes in CANDU reactor operations due to the use of MOX fuel are described in Appendix I.

MOX fuel rods would be manufactured in the United States for the four CANDU reactors located at the Bruce-A generating station in Ontario. Conversion of weapons-grade Pu to MOX fuel would require the availability of a pit disassembly/conversion facility, a Pu conversion facility, and a MOX fuel fabrication facility. Facilities with these capabilities are not currently available in the United States. The MOX fuel fabrication facility could be constructed at a DOE site (Hanford, NTS, INEL, Pantex, ORR, or SRS), or at a non-DOE site within the United States. [Text deleted.] Impacts associated with construction and operation of the pit disassembly/conversion facility, the Pu conversion facility, and a MOX fuel fabrication facility located within the United States are presented in Sections 4.3.1, 4.3.2, and 4.3.5.1, respectively. [Text deleted.]

Health and Safety. The intent of protecting the health and safety of workers and the public is the same in the United States and Canada. The Canadian Atomic Energy Control Board would ensure adequate protection is provided for the public and workers during the conversion and operation of MOX fueled CANDU reactors. Specific health and safety concerns regarding the use of MOX fuel in CANDU reactors is addressed in the following:

Worker Exposure. The radiological doses to workers at the reactor site would be the same, if not smaller, for a MOX-fueled CANDU reactor than for the natural uranium CANDU reactor. This is the result of the smaller annual gaseous and liquid releases to the environment predicted for a MOX core. The MOX core has a relatively smaller isotopic inventory and also a higher retardation for fission product migration that reduces the fraction of fission products that would reach the primary coolant (ORNL 1995a:14).

Public Exposure. As it is for workers, the radiological doses to the public during normal operations, for both the MEI and the population within 80 km (50 mi), are also expected to be somewhat smaller with a MOX core than with a natural uranium core.

Facility Accidents. The accident risks and consequences of operating the CANDU reactor are documented in safety reports prepared by the operating organization. Additional studies have been performed to assess any changes in risks and consequences that would be attributed to the use of MOX fuel in the event of both design basis and severe (beyond design basis) accidents (NAS 1995a:350-356; ORNL 1995a:17-21). These studies indicate that the dose consequence to members of the public and environmental impacts of accident releases from MOX-fueled reactors at Bruce-A will not differ significantly from the consequences of the same accident occurring in a natural uranium-fueled reactor.

Waste Management. Externally, MOX fuel and natural uranium fuel bundles are identical. The only difference, besides their fuel content, is the higher external radiation level of the MOX fuel bundle. The difference will not result in any increase in the quantity of waste produced, processes employed, or facilities required for interim storage or disposal.

The Bruce Nuclear Generating Station has facilities for the storage of low-, medium-, and high-level radioactive MOX wastes. Spent MOX bundles would be stored in CANDU wet storage spent fuel modules, equivalent to LWR spent fuel storage racks. Spent MOX fuel decay heat generation and fission product concentration would be similar to current CANDU fuel. The disposition of spent MOX fuel will be left to the discretion of the Canadian Government.

Transportation. Transport of fresh MOX fuel to Canada would be the responsibility of DOE Transportation Safeguards Division (TSD) and would be coordinated with the Canadian Federal and Provincial Governments. Transport would utilize a DOE SST to the United States border. Material transport within Canada would be done in a TSD SST or equivalent. Fresh MOX fuel bundles would be packaged in a standard stainless steel 208-l (55-gal) drum. The container would be capable of holding seven CANDU MOX fuel bundles. The container would have to be certified as a Type B package and approved for use within both Canada and the United States. The package would have to undergo certification by DOE, the NRC, and the DOT, as well as the Canadian Atomic Energy Control Board and the Canadian Ministry of Transport. While the above package has been approved for bulk shipment of Category 1 materials, it has not yet been approved for the transport of CANDU MOX fuel bundles. Based on the annual fuel requirement of 9,052 bundles, approximately 54 SST shipments per year would be required (slightly more than one per week) (ORNL 1995a:26). Under the Preferred Alternative, which would preserve the CANDU Alternative, the amount of surplus Pu dispositioned and the number of shipments of MOX fuel to Canadian reactors would likely be less.

In terms of transportation risks, the greater the distance travelled the higher the risk. The health impacts from the transport of MOX fuel from a fabrication site in the United States to a CANDU reactor site in Canada would be similar to the risk encountered from routine CANDU fuel transport operations covering the same distance. The estimated risk to transport MOX fuel hypothetical distances of 1,000, 2,000, and 4,000 km (621, 1,243, and 2,486 mi, respectively) is included in Section 4.4 of this PEIS. Potential intersite transportation impacts related to the transportation of MOX fuel could occur because of the increased risk of traffic accident fatalities. The highest number of potential fatalities, which includes both radioactive and nonradioactive impacts for normal operations and accident conditions, is 5.00. This represents the total fatalities for transportation with MOX fuel fabrication in the United States and shipped to the Canadian border based on a hypothetical distance of 4,000 km (2,486 mi). This does not include transportation impacts in Canada.

4.4 INTERSITE TRANSPORTATION OF FISSILE MATERIALS

For the storage and disposition alternatives, intersite transportation is the transport between sites with fissile and other radioactive materials (including waste) in truckload shipments by DOE SST or commercial conveyance. For overseas shipments of Pu to European fuel fabricators, port handling and ocean transport is included. [Text deleted.] Supporting analyses and information are contained in Appendix G. Intrasite transportation of pits between Zone 4 and Zone 12 at Pantex to support storage of RFETS pits for the Preferred Alternative is described in Appendix Q.

4.4.1 METHODOLOGY

The analysis for the storage and disposition alternatives evaluates the potential risks from transporting shippable forms of fissile materials (Pu and HEU) that have been stabilized and packaged for shipment at the originating site to meet DOT, NRC, and DOE requirements. Baseline information, the existing transportation serving each site, and the types of containers required for shipment of the materials are included in the analysis, as appropriate.

Actual and projected inventories provided by DOE were used for the transportation risk analysis. The health impacts from the transport of materials were estimated using an assumed homogeneous population along specific routes when sites were known, or along an assumed route distribution of 84 percent rural, 15 percent suburban, and 1 percent urban for generic sites; average container, truckload, or rail carload of material; and a unit measure for traffic fatalities (the risk per kilometer). The assessment provides the total potential fatalities over the life of the project for a comparison of transportation impacts for the alternatives considered.

The analysis to estimate health risks in terms of potential total fatalities due to transportation of fissile materials between the sites is accomplished by the method best suited for the alternative. The RADTRAN Version 4 computer code, developed and maintained by SNL at Albuquerque, NM, was used to estimate radiological health risks (SNL 1992b). Unit risk factors were developed for each type of material to estimate the potential risk of transporting truckload shipments by SST over intersite routes. These unit risk factors were used, in conjunction with distance and the number of shipments, to estimate potential radiological and nonradiological (from air pollution and highway accidents) impacts to transport crew members and the public. Transportation impacts, in terms of total potential fatalities, were calculated using the RADTRAN computer code with the projected inventories of fissile materials and their form (nuclide composition), under each alternative considered, and based on nearest routing between sites. Fatalities from potential air pollution were estimated using 1.0×10^{-7} cancer fatalities per urban kilometer. Highway accidents fatalities were estimated from national statistics using 1.5×10^{-8} rural, 3.7×10^{-9} suburban, and 2.1×10^{-9} urban for occupational risks per km, and 5.3×10^{-8} rural, 1.3×10^{-9} suburban, and 7.5×10^{-9} urban for nonoccupational risks per km (SNL 1986a:167). Transportation impacts, in terms of total potential fatalities, were calculated using the RADTRAN computer code with the projected inventories of fissile materials and their form (nuclide composition), under each alternative considered, and based on best direct routing between sites. The transportation accident model in RADTRAN assigns accident probabilities to a set of accident categories. For the truck analysis, the eight accident-severity categories defined in NRC's *Final Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes* (NUREG-0170, December 1977) were used. The least severe accident category (Category I) represents low magnitude of crush force, accident-impact velocity, fire duration, or puncture-impact speed. The most severe category (Category VIII) represents a large crush force, high accident-impact velocity, long fire duration, and high puncture-impact speed, such as 88-km/hr (55-mph) collision into the side of the vehicle, and a 982 °C (1,800 °F) fire lasting 1.5 hr to produce a release of material. The release fractions for Category VIII accidents were conservatively estimated to be 0.1 for the strictly controlled SST shipments and 1.0 for other shipments.

For facilities without a specific site, a bounding risk was established in order to estimate impacts for distances of 1,000 km (621 mi), 2,000 km (1,243 mi), and 4,000 km (2,486 mi), assuming rural, suburban, and urban

population distribution of 84, 15, and 1 percent, respectively. For generic representative sites, no specific highway routes were used in the transportation modeling process; the risks for three representative distances are presented for comparison purposes. Under the European MOX fuel fabrication option, the impacts were assessed for transporting Pu materials from DOE origins (that is, from storage, pit disassembly/conversion site, or Pu conversion site) to placement of the material aboard ship. Port handling risks were estimated and ocean transport impacts (global commons) were calculated from the U.S. port to the European port, using RADTRAN. Environmental analyses of overseas port handling, land transport, and handling at the overseas plant would be the responsibility of the European fuel fabrication recipient. The impacts from ocean transport of MOX fuel back to the United States and truck transport from the port to a reactor or storage site were also calculated. The potential health impacts are presented as bounding values equal to the maximum potential risk for both accident and accident-free scenarios.

4.4.2 AFFECTED ENVIRONMENT

4.4.2.1 Transportation Procedures and Practices

Congress has mandated uniform laws for the safe transport of hazardous materials. DOT is the principal Federal agency designated by Congress to implement the regulations, ensure compliance, and provide emergency response guidance.

The Department ships hazardous materials, including radioactive materials, in full compliance with Federal laws specifically covering the transport of these hazardous materials (49 CFR 171-178). These laws are applicable to, and cannot be preempted by, individual states. Although not required by law, DOE has a policy of coordinating the transport of certain hazardous materials, such as Pu and HEU, with State officials. The actual routes are classified; however, they are selected to circumvent populated areas, maximize the use of interstate highways, and avoid bad weather. Exceptional precautions are taken to ensure safe transport. Although DOE has experienced traffic accidents related to the interstate transport of radioactive materials, there has never been a traffic accident involving the release of radioactive material causing injury or death. DOE coordinates emergency preparedness plans and responses with involved states.

The safe, secure transportation of special nuclear materials includes special vehicles and special transportation operational procedures. The design of the vehicles and the transportation operating procedures are classified; however, there has never been a failure of this system to provide safe secure transportation during more than 20 years of operation (DOE 1993ff:1-4).

Special nuclear materials, which include Pu and HEU, require extra measures to ensure physical security and protection of the public from radiation during transportation. DOE's Transportation Safeguards Division (TSD), located in Albuquerque, New Mexico, has the responsibility to provide for the transport of these materials. The TSD was established in 1975 and has accumulated over 110 million km (70 million mi) of over-the-road experience with no accidents causing a fatality or release of radioactive material. DOE's transportation vehicle, the SST, is a specially designed part of an 18-wheel tractor-trailer truck that incorporates various deterrents to prevent unauthorized removal of the cargo. It would be difficult to distinguish these trucks from most other semi-trailer trucks operating on the nation's highways. However, there are significant differences. The SST is designed to protect the cargo in the event of an accident through superior structural characteristics and a highly reliable cargo tie down system similar to that used in aircraft. The thermal characteristics of the SST would allow the trailer to be totally engulfed in a fire without incurring damage to the cargo. The tractor-trailers and their escort vehicles are equipped with communications, radiological monitoring, and other equipment, which further enhance en route safety and security.

Armed nuclear materials couriers, who are Federal officers, accompany each shipment containing special nuclear material. These couriers are hand-picked and highly trained in tractor-trailer driving and electronic and communication systems operation, and are authorized by AEA to carry firearms and make arrests in the

performance of their duties. They drive the tractor-trailers and escort vehicles and operate the communications and other convoy equipment. The couriers must meet periodic qualification requirements for firearms, physical fitness, and driving proficiency. They also must pass an annual medical examination and are subject to random drug and alcohol testing.

The Department makes every effort to ensure that its convoys travel at safe speeds and do not travel during inclement weather. Should the convoys encounter adverse weather, provisions exist for them to seek secure shelter at previously identified facilities. A liaison program provides State and local law enforcement officers information on what actions to take to assist one of these vehicles should it be involved in an accident. A DOE control center maintains an emergency contact directory of Federal, State, and local response organizations located throughout the contiguous United States. [Text deleted.]

As further described in Appendix G, the vehicles and transport procedures are specifically designed and tested to prevent a radiological release under all credible accident scenarios. In addition, the packaging is designed and tested to prevent releases. DOE requires the use of highly sophisticated Type B packaging, which is designed to prevent the release of contents under all credible transportation accident conditions, for shipments of Pu and HEU. The testing requirements for these packagings are very demanding. For example, the drop test is equivalent to an impact on a hard surface at 322 km/hr (200 mph) without serious damage to the package or release of its radioactive contents. The containers used for shipping Pu and HEU must pass extremely rigid drop, puncture, thermal, and water immersion testing, and secure approval certification by DOT, NRC, and DOE.

4.4.2.2 Site Transportation Interfaces for Hazardous Materials

The existing transportation modes that serve each DOE site under consideration and the links to those modes for the intersite transport of hazardous materials are summarized in Table 4.4.2.2–1. Although hazardous materials could be transported by rail, truck, air, and barge modes, the materials (including hazardous materials) associated with storage and disposition would be transported only by truck and rail. Pu, including MOX fuel, and HEU would be transported exclusively by SST. Immobilized materials, blendstock for MOX fuel fabrication, TRU waste, and LLW would be transported by certified commercial truck carriers. Pu materials immobilized with highly radioactive isotopes would be transported by rail to a repository. Radioactive CsCl capsules would be shipped by commercial carriers or SST depending on the quantity, in accordance with DOE Order 5633.36. For this analysis, shipment by commercial carrier was assumed. There would be no barge or air shipments and, therefore, there would not be any impacts from transportation by these modes.

Table 4.4.2.2–1. Transportation Modes and Comparison Ratings by Site

Site	Onsite Railroad Service	Nearest Interstate Highway (km)	Distance to Airport for Cargo Shipments (km)	Barge Service	Possible Weather Delays[a]	Overall Level of Transport Service
Hanford	Yes	32	15	Yes	Yes	Good
NTS	No	97	105	No	No	Good
INEL	Yes	74	40	No	Yes	Good
Pantex	Yes	23	11	No	Minimal	Outstanding
ORR	Yes	6	61	Yes	Minimal	Good
SRS	Yes	48	32	Yes	Minimal	Good
RFETS	Yes	16	40	No	Yes	Satisfactory
[Text deleted.]						
LANL	No	66	177	No	Yes	Satisfactory

[a] DOE Transportation Safeguards System shipments.

Source: DOE 1991j; LANL 1992a:1; NTS 1992a:3; RFP 1992b:2.

In the *Nuclear Weapons Complex Reconfiguration Site Evaluation Panel Report,* five sites (Hanford, INEL, ORR, Pantex, and SRS) have been given a comparative rating based on the strengths and weaknesses of their transportation services (DOE 1991j:7). For consistency, the rating methodology and evaluation procedures established by the Nuclear Weapons Complex Reconfiguration Site Evaluation Panel were applied to the remaining DOE sites under consideration. Although DOE has experienced traffic accidents related to the intersite transport of radioactive materials, there has never been a traffic accident involving a release of radioactive material causing injury or death during transportation.

The Department's hazardous material (radioactive and nonradioactive) shipments are small compared to the large shipment volume from non-DOE hazardous material transported within the United States. DOT estimates that approximately 3.6 billion t/yr (4.0 billion tons/yr) of regulated hazardous materials are transported and that approximately 500,000 movements of hazardous materials occur each day (PL 101-615, Section 2[1]). There are approximately 2 million annual shipments of radioactive materials involving about 2.8 million packages, which represents about 2 percent of the annual hazardous materials shipments. Most radioactive shipments involve small or moderate quantities of material in relatively small packages. In comparison, the DOE Nuclear Weapons Complex ships about 6,200 radioactive packages (commercial and classified) annually among its sites. DOE's annual shipments of radioactive packages have represented less than 0.3 percent of all radioactive shipments in the United States. Up to a maximum of 603 shipments per year of radioactive material would be generated for any alternative in this PEIS. This is about 0.03 percent as compared to the total of 2 million shipments, although the size of each shipment may be larger than commercial shipments. Information on each site's historical transportation shipment records is included in Appendix G.

[Text deleted.]

4.4.2.3 Packaging

All Pu, HEU, and MOX fuel to be relocated under this PEIS would be packaged in DOT-approved Type B containers and transported by SST. Packaging refers to a container and all accompanying components or materials necessary to perform its containment function. Packagings used by the DOE for hazardous materials shipments are either certified to meet specific performance requirements or built to specifications described in the DOT hazardous materials regulations (49 CFR 171-180). For relatively low-level radioactive materials, strong, tight packagings or DOT specification Type A packagings are used. These packagings are designed to retain their contents under normal transportation conditions. Shipments of more sensitive radioactive materials require use of highly sophisticated Type B packaging, designed and tested to prevent the release of contents under all credible transportation accident conditions. Each Type B packaging must pass four extremely rigid regulatory tests (drop, puncture, thermal, and immersion) that cover essentially 100 percent of the probable and hypothetical accidents involving impact, puncture, fire, and water immersion. It is highly unlikely that all four accident scenarios would occur to the same package, thus the regulatory requirements are conservative.

Special nuclear material (Pu and HEU) and certain other radioactive materials or weapons components require special protection. In addition to meeting the stringent Type B containment and confinement requirements of NRC's 10 CFR 71 and DOT's 49 CFR, packaging for nuclear weapons and components must be certified separately by DOE. The DOE operates the Transportation Safeguards System for the intersite transport of weapons and components, including Pu and HEU. Specially designed SST are utilized to ensure high levels of safety and physical protection. The system for safe secure transport of Pu and HEU is described in Appendix G.

Typical packagings for the materials analyzed in this PEIS are the DOT specification 6M, Type B or equivalent packaging for the shipment of Pu and HEU; the AT-400A or FL, Type B packaging for Pu pits; the Westinghouse model MO-1, Type B packaging for new MOX fuel; the BUSS R-1 cask for CsCl capsules; the TRUPACT for TRU waste; and Type B truck and rail casks for immobilized materials and MOX spent nuclear fuel. Most other radioactive materials would be transported by commercial truck in Type A fissile packagings. As a representation, a typical testing sequence for the 6M, Type B packaging used for the shipment of Pu and HEU

is described in Appendix G. Table 4.4.2.3–1 presents a summary of the radioactive materials, packagings, and affected sites analyzed in this PEIS. [Text deleted.]

4.4.2.4 Transportation Routes and Emergency Preparedness Coordination Among Federal, State, and Local Agencies

Federal laws govern the transport of hazardous materials in the United States to ensure the safety of the public and security of the cargo. The DOT is the principal Federal agency designated by Congress to implement the regulations, ensure compliance, and provide emergency response guidance. Transportation of Pu and HEU, MOX fuel, and immobilized Pu radioactive materials covered by this PEIS would be transported through numerous States in full compliance with Federal laws (49 CFR) that are applicable to individual States. The actual routes would be classified; however, they are selected with input from State and local agencies to circumvent populated areas, maximize the use of interstate highways, and avoid adverse weather. The actual routes would not be designated until the time of transport. Exceptional precautions are taken to ensure safe transport. In addition, DOE has a liaison program through which it communicates with law enforcement and public safety agencies throughout the country, making them aware of these shipments and the exceptional precautions being taken to ensure safe transport through their state.

The packaging, vehicles, and transport procedures are specifically designed and tested to prevent a radiological release under all credible accident scenarios. However, if an emergency situation were to occur, Federal, State, and local emergency preparedness officials are trained and prepared to react to such an emergency. The FEMA is responsible for establishing policies for, and coordinating civil emergency management, planning, and interaction with Federal executive agencies that have emergency response functions in the event of a transportation incident. The FEMA coordinates Federal and State participation in developing emergency response plans and is responsible for the development of the interim *Federal Radiological Emergency Response Plan*. This plan is designed to coordinate Federal support to State and local governments, upon request, during the event of a radiological material transportation incident. FEMA also routinely identifies entities at the State and local levels with whom DOE officials should coordinate to ensure emergency preparedness for specific DOE transportation of Pu or HEU. DOE also has access to transportation coordinators in the Local Emergency Planning Councils and Area Planning Contingency Groups which are required to be formed at the regional and local levels under the *Emergency Planning and Community Right-To-Know Act* of 1986. DOE assists in the training of local emergency preparedness officials in how to respond to such emergencies and how to use certain monitoring equipment. FEMA, which runs the National Fire Academy, also conducts civil defense training of local firefighters. Since firefighters are often the first responders to any type of emergency, the FEMA training includes emergency response to radiological incidents.

4.4.3 Environmental Consequences

Weapons-usable fissile materials analyzed in this PEIS would be either dispositioned or placed into long-term storage. [Text deleted.] This section summarizes the health impacts from the intersite transportation of Pu, HEU, MOX fuel, Cs-137, and other radioactive materials, including waste, based on RADTRAN model results. Impacts are presented based on the movements of the total amount of materials considered under each storage and disposition alternative for the life of the project.

Normal operations associated with the storage and disposition of weapons-usable fissile materials could result in the exposure of transportation workers and the general public to toxic chemicals from vehicular emissions and radiation from the transport of radiological feed materials, products, and wastes generated to accomplish various storage and disposition alternatives. During normal operations (that is accident-free transportation), of radioactive and nonradioactive materials (that is, Pu, HEU, CsCl capsules, canisters of immobilized Pu with radionuclides, MOX fuel, spent nuclear fuel, and wastes), the general population living and traveling along the transport route has a risk of exposure to radioactive and non-radioactive materials (that is, a small amount of

Table 4.4.2.3–1. Transportation Summary of Radioactive Materials and Packagings for Alternatives

	Long-Term Storage				Disposition—Common Activities							
	Upgrade[a]	Consolidation	Collocation		Pit Disassembly/Conversion				Pu Conversion			
		Input	Input 1	Input 2	Input	Output 1	Output 2	Output 3	Input	Output 1	Output 2	Output 3
Materials	Pu	Pu	Pu	HEU	Pu	Pu	TRU waste	LLW	Pu	Pu	TRU waste	LLW
Form	Pits, metal, oxide	Pits, metal, oxide	Pits, metal, oxide	Canned sub-assemblies, metal or oxide	Pits	Metal or oxide	Solid	Solid	Metal or oxide	Metal or oxide	Solid	Solid
Quantity per year (kg)	27,000	27,000	27,000	15,080	2,000	2,000	15,000	12,000	1,000	661	35,890	308,162
Quantity per package[b] (kg)	4.5	4.5	4.5	5.2	45	4.5	980	2,200	4.5	4.5	980	2,200
Packages per shipment	35	35	35	35	35	35	3	5	35	35	3	5
Shipments per year	172	172	172	83	13	13	6	2	7	5	13	28
Packages (type)	AT-400A (B), FL (B) and 6M (B)	AT-400A (B), FL (B) and 6M (B)	AT-400A (B), FL (B) and 6M (B)	6M (B)	AT-400A (B) and FL (B)	6M (B)	TRUPACT (B)	Metal box (A)	6M (B)	6M (B)	TRUPACT (B)	Metal box (A)
Potential origins	RFETS LANL	Hanford INEL Pantex SRS RFETS LANL	Hanford INEL Pantex SRS RFETS LANL	Y–12 Plant	Pantex SRS RFETS	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS	Hanford INEL Pantex SRS RFETS LANL	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS
Potential destinations	Hanford INEL Pantex SRS	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex SRS	Hanford NTS INEL Pantex ORR SRS	Lag storage or disposition[c]	WIPP or alternative	LLW disposal site	Hanford NTS INEL Pantex ORR SRS	Lag storage or disposition[c]	WIPP or alternative	LLW disposal site
Mode	SST	SST	SST	SST	SST	SST	Truck	Truck	SST	SST	Truck	Truck

Table 4.4.2.3–1. Transportation Summary of Radioactive Materials and Packagings for Alternatives—Continued

	Immobilization								
	Vitrification			Ceramic Immobilization			Electrometallurgical Treatment		
	Input 1	Input 2	Output	Input 1	Input 2	Output	Input 1	Input 2	Output
Materials	Pu	Cs	Pu/ Cs glass[d]	Pu	Cs	Pu/Cs/Gd/ ceramic[d]	Pu	Cs	Pu/Cs/ TRU/ ceramic
Form	Metal, oxide, borosilicate glass	Salt	Glass	Metal or oxide	Salt	Disks	Metal or oxide	Salt	Glass-bonded zeolite
Quantity per year (kg)	5,000	64	100,800	5,000	64	42,000	5,000	47	104,000
Quantity per package[b] (kg)	4.5	5.72	1,680 (84 kg Pu)	4.5	5.72	656	4.5	4.71	5,200 (260 kg Pu)
Packages per shipment	35	1	1	35	1	1	35	1	1
Shipments per year	32	12	60	32	12	64	32	10	20
Packages (type)	6M (B)	BUSS cask (B)	Cask (B)	6M 114 l drum (B)	BUSS cask (B)	Cask (B)	6M 114 l drum (B)	BUSS cask (B)	Cask (B)
Potential origins	Current or lag storage site[c]	Hanford	New glass vitrification site	Current or lag storage site[c]	Hanford	Immobilization site	Current or lag storage site[c]	Hanford	INEL
Potential destinations	Immobilization site	Immobilization site	HLW repository	Immobilization site	Immobilization site	HLW repository	INEL	INEL	HLW repository
Mode	SST	Truck or SST	Rail	SST	Truck or SST	Rail	SST	Truck or SST	Rail

Table 4.4.2.3–1. Transportation Summary of Radioactive Materials and Packagings for Alternatives—Continued

	MOX Fuel Fabrication for Reactors			Deep Borehole: Direct Disposition	Deep Borehole: Immobilized Disposition	
	Input 1	**Input 2**	**Output**	**Input**	**Input**	**Output**
Materials	Pu	Uranium	MOX fuel	Pu	Pu	Pu-loaded ceramic coated pellets
Form	Oxide powder	Oxide powder	Reactor fuel bundles	Metal or oxide	Metal or oxide	Pellets
Quantity per year (kg)	3,000	129,600	132,600	5,000	5,000	500,000
Quantity per package[b] (kg)	4.5	2,200	382 (23 Pu, 359 UO_2)	4.5	4.5	510
Packages per shipment	35	5	2	35	35	5
Shipments per year	20	12	174	32	32	197
Packages (type)	6M (B)	Metal box (A)	MO-1 cask (B)	6M 114 l drum (B)	6M 114 l drum (B)	208 l drum (B)
Potential origins	Current or lag storage site[c]	Y–12 Plant	MOX fabrication site	Current or lag storage site[c]	Current or lag storage site[c]	Immobilization site
Potential destinations	MOX fabrication site	MOX fabrication site	Reactors	Deep borehole site	Immobilization site	Deep borehole site
Mode	SST	Truck	SST	SST	SST	Truck

[a] All HEU for this project is assumed to be located at the Y–12 Plant.

[b] Bounding values used for analysis purposes only.

[c] Lag storage is temporary storage at a disposition facility.

[Text deleted.]

[d] HLW could be combined with the immobilized Pu for the Vitrification or Ceramic Immobilization Alternatives.

Source: DOE 1996e; DOE 1996f; LANL 1996b; LLNL 1996a; LLNL 1996b; LLNL 1996c; LLNL 1996d; LLNL 1996e; LLNL 1996h; NT DOE 1996a; PX DOE 1996a.

additional vehicular emissions) from the passing shipments. Transportation workers could be similarly exposed to radioactive and non-radioactive materials. These are examples of causes of potential radiological and nonradiological fatalities resulting from normal transportation operations. Traffic accidents could have impacts to drivers, passengers, or pedestrians similar to any local or interstate traffic accident. In addition, there could be damage resulting in the releases from the hazardous cargo being transported. Appendix G describes the tests that the packages must withstand to be certified for transporting special nuclear materials. However, traffic accidents could theoretically cause radiological fatalities if there were a release of radioactive material as a result of the traffic accident, and nonradiological fatalities from the effects of vehicular crashes. Radiological and nonradiological fatalities resulting from traffic accidents could affect both the general population and the transportation workers.

Since the establishment of TSD in 1975, DOE has accumulated over 70 million miles of over-the-road experience transporting DOE owned cargo with no accidents causing a fatality or release of radioactive material. However, since there is a theoretical chance of fatalities, this PEIS modeled the potential fatalities from radiological effects of transportation (both normal operations and accident situation) and nonradiological effects of transportation (both normal operations and accident situation) for the various storage and disposition alternatives. [Text deleted.] The potential transportation risks, although small, are greatest for nonradiological traffic accidents compared to radiological risks for both normal operations and accident situations. Impacts are based on the total amount and types of materials moved, numbers of shipments, and the distances those shipments would travel.

The following sections present for each alternative the potential radiological and nonradiological fatalities to the general population and transportation workers. Transportation workers include both the driving crews and any transportation workers who load and unload the materials. Only total potential fatalities, which include radiological and nonradiological impacts for routine and accident conditions, are discussed in this section. The majority of the total impact is due to nonradiological accidents (traffic accidents), followed by radiological routine exposure, nonradiological routine exposure (air pollution), and radiological accidents. Radiological accidents typically have about 1 percent of the total fatalities.

4.4.3.1 No Action

Existing facilities would be used for continued which is the baseline case to which the transportation impacts for other alternatives is compared. Under No Action, there would be no transportation of materials as part of the proposed long-term storage and disposition alternatives, thus no transportation risks incurred.

As part of ongoing operations at the DOE sites, fissile materials may require movement and offsite transportation. These actions, however, would be addressed in separate site-specific environmental documentation, as appropriate.

[Text deleted.]

4.4.3.2 Long-Term Storage Alternatives

Upgrade Alternative

Preferred Alternative for Storage

For the Preferred Alternative for storage, all Pu would be shipped from RFETS. The Pu pit material would be shipped from RFETS to Pantex; the non-pit Pu material would be shipped from RFETS to SRS. Shipments from RFETS would begin in 1997. Pits at SRS are strategic reserve and would be stored according to the ROD for the Stockpile Stewardship and Management PEIS. For analysis of intersite transportation impacts of the Preferred Alternative, the only contributors to intersite transportation risks would be the requirement to ship Pu

pits from RFETS to Pantex and to ship non-pit Pu from RFETS to SRS. Intrasite transportation between Zone 4 and Zone 12 at Pantex would occur for the Preferred Alternative if pits are stored in Zone 4 before the upgrade facility is available. Analysis of this intrasite transportation is discussed in Appendix Q. HEU and non-RFETS Pu would remain at existing locations so there would be no additional contributors to transportation risks. All HEU is assumed at ORR. All nonsurplus HEU and surplus HEU pending disposition would be stored in upgraded facilities at ORR under the Preferred Alternative. Pu material currently at Hanford, INEL, Pantex, SRS, and LANL would remain onsite pending disposition (or lag storage at the disposition facilities). The impacts in terms of potential fatalities are based on risks from normal (accident-free) operations and from accidents, both radiological and nonradiological operations and accidents. The risks are based on quantities and types of Pu material as well as the distance, routes, and number of SST trips required. Potential fatalities from intersite transportation activities for the Preferred Alternative are summarized in Table 4.4.3.2–1. Nonradiological accidents are the dominant risk for the Preferred Alternative.

Table 4.4.3.2–1. Total Potential Fatalities From Intersite Transportation Activities for the Preferred Alternative for Storage[a]

Material	Ship From	Ship To	Total Potential Fatalities
Pu Pits	RFETS	Pantex	0.00636
Non-Pit Pu	RFETS	SRS	0.0602
Total Transportation Risk			0.0666

[a] Resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

Source: RADTRAN model results.

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Under this subalternative, four sites are considered for the upgrade of existing Pu storage facilities: Hanford, INEL, Pantex, and SRS. Pu material from RFETS and LANL included in this PEIS would remain at these two sites. HEU would continue to be stored at ORR. For this subalternative there would be no potential fatalities because intersite transportation would not occur.

Upgrade With Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Under this subalternative, four sites are considered for the upgrade of existing Pu storage facilities: Hanford, INEL, Pantex, and SRS. Pu material from RFETS and LANL included in this PEIS would be transported to one or more of these four sites. HEU would continue to be stored at ORR. The estimated potential impact from transporting the Pu materials from RFETS and LANL to each potential storage site is presented in Table 4.4.3.2–2. In the case where the RFETS and LANL Pu material would be distributed to more than one site for storage, the resulting number of total potential fatalities would be within the range of values, 0.031 to 0.087, shown in Table 4.4.3.2–2, and fatalities per site would be less than the maximum values shown. [Text deleted.] Nonradiological accidents are the dominant risk for the Upgrade With RFETS Pu and LANL Pu Subalternative.

Consolidation Alternative

Under this alternative, weapons-usable Pu would be transported from existing storage sites to one of five potential consolidated storage facilities located at Hanford, NTS, INEL, Pantex, or SRS (ORR is excluded as a Pu-only storage site). The total potential number of fatalities resulting from transporting Pu to each site under the

Table 4.4.3.2–2. Total Potential Fatalities From the Transportation of Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium for the Upgrade Alternative[a]

Candidate Sites[b]	Total Potential Fatalities[c]
Hanford	0.051
INEL	0.032
Pantex	0.031
SRS	0.087

[a] Resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

[b] Under the Upgrade Alternative, NTS and ORR are not potential storage sites for Pu, and HEU would remain at ORR.

[c] Effect of transporting all Pu from RFETS and LANL covered by this PEIS to one site.

Source: RADTRAN model results.

Consolidation Alternative is shown in Table 4.4.3.2–3. The highest number of potential fatalities, however, would not exceed 0.346, which is based on moving all Pu covered by this PEIS from existing sites to SRS. Nonradiological accidents are the dominant risk for the Consolidation Alternative.

Table 4.4.3.2–3. Total Potential Fatalities From the Transportation of Plutonium for the Consolidation Alternative[a]

Candidate Sites[b]	Potential Fatalities
Hanford	0.272
NTS	0.172
INEL	0.203
Pantex	0.079
SRS	0.346

[a] Resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

[b] Under this alternative, ORR is not a potential Pu storage site.

Source: RADTRAN model results.

Collocation Alternative

Under this alternative, weapons-usable Pu and HEU would be transported from existing storage sites to one of six potential collocation storage sites at Hanford, NTS, INEL, Pantex, ORR, or SRS. The transportation health effects were calculated individually for each fissile material going to each of the candidate sites, and then summed. The highest number of potential fatalities, however, would not exceed 1.070, which is based on moving all material to Hanford. The total potential number of fatalities resulting from transporting Pu and HEU under the Collocation Alternative are summarized in Table 4.4.3.2–4. Nonradiological accidents are the dominant risk for the Collocation Alternative.

For both the Consolidation and Collocation Alternatives, all the weapons-usable Pu stored at RFETS and surplus Pu materials currently stored at LANL are included in the analyses for intersite transportation. [Text deleted.]

Table 4.4.3.2–4. Total Potential Fatalities From the Transportation of Plutonium and Highly Enriched Uranium for the Collocation Alternative[a]

Candidate Sites	Potential Fatalities
Hanford	1.070
NTS	0.829
INEL	0.873
Pantex	0.458
ORR	0.285
SRS	0.495

[a] Resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

Source: RADTRAN model results.

Phaseout

If a site is selected for phaseout, the total potential fatalities impacts of relocating excess Pu or HEU to other DOE sites would be similar to the impacts calculated under the storage and disposition alternatives. [Text deleted.]

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

For each of the long-term storage alternatives where the strategic reserve and weapons R&D is not included as part of this program, the transportation health risks associated with the remaining fissile materials has been proportionally estimated from the risks calculated for the entire inventory. Since less material would be moved, the overall result would be potentially fewer fatalities for each alternative. Most of the material is surplus and therefore the reduction would be less than one half of the total fatalities with the strategic reserve.

4.4.3.3 Disposition Alternatives

Alternatives for disposition are intended to permanently prevent certain surplus Pu materials from being used to produce nuclear weapons. The alternative categories are Deep Borehole, Immobilization, and Reactor. Under these disposition alternatives, it is assumed that the surplus fissile materials have been placed in storable forms, suitable for shipment, at the facility of origin.

For the disposition alternatives, the following would apply:

- Almost all surplus Pu pits are located at Pantex, with a limited quantity at RFETS. Pu pits would be transported from existing storage, primarily at Pantex, to potential pit disassembly/conversion sites (unless pit disassembly/conversion is located at the existing storage site). For transportation analysis purposes, pit disassembly/conversion is assumed to be located at one of the following sites: Hanford, NTS, INEL, Pantex, ORR, or SRS, and all pits would be transported from Pantex.

- Non-pit Pu material would be transported from existing storage to a Pu conversion site. For transportation risk analysis purposes, it is assumed that the Pu conversion function would be located at one of six sites: Hanford, NTS, INEL, Pantex, ORR, or SRS. The material would be in a form suitable for shipment in compliance with DOT regulations (49 CFR).

- Surplus Pu at RFETS and at LANL is also being considered for disposition, therefore, is included in the intersite transportation analysis. RFETS and LANL are not being considered for any disposition functions, such as pit disassembly/conversion or immobilization of materials.

- For the disposition actions, the transport of surplus Pu would always originate at either the existing storage sites (Hanford, INEL, Pantex, SRS, RFETS, and LANL) or at the potential pit disassembly/conversion or Pu conversion site (Hanford, NTS, INEL, Pantex, ORR, or SRS).

Table 4.4.3.3–1 presents the total potential health impact from the transportation of Pu from existing storage sites to pit disassembly/conversion or Pu conversion sites. Included in the impact is the effect from the transport of LLW and TRU waste generated. Nonradiological accidents are the dominant risk for both the pit disassembly/conversion and Pu conversion alternatives.

Table 4.4.3.3–1. Total Potential Fatalities From the Transportation of Plutonium From Existing Storage Sites to a Pit Disassembly/Conversion or Plutonium Conversion Site[a]

Sites Analyzed	Pit Disassembly/ Conversion	Pu Conversion
Hanford	0.203	0.455
NTS	0.107	0.211
INEL	0.155	0.340
Pantex	0.033	0.293
ORR	0.155	0.557
SRS	0.190	0.635

[a] Includes effect from the transport of Pu, LLW, and TRU waste from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

Source: RADTRAN model results.

[Text deleted.]

The total potential fatalities presented in Table 4.4.3.3–1 are based on transporting 30 t (33.1 tons) of pits to the pit disassembly/conversion site and 20 t (22 tons) of Pu to the Pu conversion site. Should the amount of material be less than these amounts, the risk would be lower than these values.

Deep Borehole

Under the deep borehole category, surplus weapons-usable Pu would be in one of two forms: (1) containers of stabilized Pu would be directly emplaced in a borehole and (2) Pu-loaded, ceramic-coated pellets would be emplaced in a borehole. This category of alternatives requires surplus Pu to be transported from lag storage to the borehole site, or to an immobilization site and then to the borehole site. A specific borehole site has not been selected; therefore, for transportation analysis purposes, generic distances of 1,000, 2,000, and 4,000 km (621, 1,243, and 2,486 mi) were used. The amount of Pu to be transported is estimated to not exceed 5 t (5.5 tons) per year.

Under the Direct Disposition Alternative, Pu material would be packaged in 2.25-kg (5-lb) lots (in metal or oxide form) in metal cans at the pit disassembly/conversion site or Pu conversion site. Two cans of Pu (4.5 kg [10 lb]) would be placed into each DOT-specification 2R inner container, which, in turn, would be placed in DOT specification 6M, Type B packaging and shipped by SST to the borehole site. Each shipment (truckload) would contain 35 packages. There would be a total of 32 shipments per year. The shipping containers would be placed directly into metal emplacement canisters at the borehole site without additional handling of Pu material.

Under the Immobilized Disposition Alternative, Pu material would be packaged in 2.25-kg (5-lb) lots (in metal or oxide form) in metal cans, as described above. Two cans would be placed into each DOT-specification 6M, Type B packaging and shipped to a ceramic immobilization facility. There, the material would be converted into Pu-loaded,

ceramic-coated pellets (1-percent Pu). The Pu-loaded, ceramic-coated pellets would be shipped in Type B, 208-l (55-gal) drum packaging by SST or commercial truck to the deep borehole site. An estimated 500 t (551 tons) of Pu-loaded, ceramic-coated pellets would be transported per year. This would consist of transporting 510 kg (1,124 lb) of material per Type B package, five packages per SST or commercial truckload shipment, and 981 packages or 197 shipments per year.

The total potential number of fatalities resulting from the transportation of Pu for each of the deep borehole alternatives are shown in Table 4.4.3.3–2. These risks include: (1) the transport of material directly to a deep borehole site, and (2) the transport of material to an immobilization site and then the transport of ceramic pellets from the immobilization site to a deep borehole site. The impacts in Table 4.4.3.3–2 also include the maximum health effect from transporting Pu from existing storage to a pit disassembly/conversion site or Pu conversion site, as derived from Table 4.4.3.3–1. Nonradiological accidents are the dominant risk for the Deep Borehole Category of Alternatives. To calculate the maximum impacts in Table 4.4.3.3–2, 5 t (5.5 tons) of Pu would be transported annually from the farthest lag storage site.

Table 4.4.3.3–2. Total Potential Fatalities From the Transportation of Plutonium and Immobilized Materials for the Deep Borehole Category of Alternatives[a]

Alternative	Sites Analyzed	Total Potential Fatalities[b]
Direct Disposition	No immobilization	1.18
Immobilized Disposition	Hanford	1.95
	NTS	1.62
	INEL	1.79
	Pantex	1.62
	ORR	2.01
	SRS	2.12

[a] Resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

[b] Based on a distance of 4,000 km to a deep borehole site.

Source: RADTRAN model results.

Immobilization

Under the immobilization category, surplus Pu (in metal or oxide form) would be transported to one of six sites analyzed (Hanford, NTS, INEL, Pantex, ORR, or SRS). Regardless of the site or immobilization technology selected, the amount of Pu to be transported is estimated to not exceed 5 t (5.5 tons) per year.

It is estimated that for 5 t (5.5 tons) of Pu, 35 6M Type B packages would be shipped in each of 32 SST truckloads per year (a total of 1,111 6M packages per year). If the surplus Pu is immobilized with Cs-137, approximately 64 kg (141 lb) of CsCl capsules per year, in approximately 12 BUSS R-1 casks, would require shipment from Hanford to the immobilization site.

The immobilized Pu would be transported in NRC-certified packagings to the HLW repository program in one of two alternative forms; these are:[1]

- **Plutonium, Cesium, and Gadolinium in Vitrified Glass Logs.** Under the Vitrification Alternative, an estimated 101 t (111 tons) of material would be transported per year. This would consist of transporting approximately 1,680 kg (3,704 lb) of material (including 84 kg [185 lb] of Pu and

[1] A variant for both vitrification and ceramic immobilization is to use HLW in place of Cs-137. Use of this material for either alternative would have less total fatalities since HLW would be resident at the site already.

2.1 kg [4.6 lb] of Cs-137) per rail cask, 1 cask per rail shipment, and 60 casks or 60 shipments per year.

- **Plutonium, Cesium, and Gadolinium in Ceramic Disks.** Under the Ceramic Immobilization Alternative, an estimated 42 t (46 tons) of material would be transported per year. This would consist of transporting 656 kg (1,446 lb) of material per rail cask, one cask per rail shipment, and 64 casks or 64 shipments per year.

The total potential fatalities for the transportation of Cs-137 from Hanford to each of the immobilization sites analyzed would range from 0.024 to 0.086. If HLW is used for either the Vitrification or Ceramic Immobilization Alternative there would be 0 total potential fatalities because only HLW onsite where the facility is located would be used. For calculating transportation risks, the representative HLW repository site is assumed at Yucca Mountain, Nevada, for reasons described in Appendix H.

A summary of the maximum health effects from transportation of radiological materials under the immobilization alternative category is presented in Table 4.4.3.3–3. Impacts include the maximum health effects from transporting Pu from existing storage to a pit disassembly/conversion site or Pu conversion site. To calculate the impacts, 5 t (5.5 tons) of Pu would be transported annually from the lag storage[2] site farthest from each of the immobilization sites. Nonradiological accidents are the dominant risk for the Immobilization Category of Alternatives. Under the Preferred Alternative, for analysis purposes, 30 percent of the surplus Pu would be sent to the Pu conversion facility and then either to the vitrification or ceramic immobilization facility. Accordingly, the total potential fatalities for the Preferred Alternative would be lower than those shown in Table 4.4.3.3–3.

Table 4.4.3.3–3. Total Potential Fatalities From the Transportation of Plutonium and Immobilized Materials for the Immobilization Category of Alternatives[a]

Alternative	Sites Analyzed					
	Hanford	NTS	INEL	Pantex	ORR	SRS
Vitrification	0.96	0.49	0.75	0.70	1.25	1.40
Ceramic Immobilization	0.98	0.50	0.77	0.72	1.28	1.43

[a] The analysis assumed that the pit disassembly/conversion and Pu conversion would be collocated at the immobilization site. The analysis includes effect of transporting Cs-137 from Hanford to the immobilization site and the transportation of immobilized materials to a HLW repository site, resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

Note: Under the Preferred Alternative, for analysis purposes, 30 percent of the surplus Pu would be sent to the Pu conversion facility and then either to the vitrification or ceramic immobilization facility. Accordingly, the total potential fatalities for the Preferred Alternative would be lower than those shown in this table.

Source: RADTRAN model results.

Another immobilization alternative analyzed is electrometallurgical treatment. ANL-W has been analyzed as the representative site, although electrometallurgical treatment could be performed at any site and would give different transportation impacts. Under this alternative, using ANL-W as the representative site, all surplus Pu (in metal or oxide form) would be transported from SRS (the bounding site) to ANL-W located at INEL where it would be immobilized with spent nuclear fuel and Cs-137 at an electrometallurgical treatment facility to produce glass-bonded zeolite, vitrified in canisters as waste. Canisters of GBZ would then be shipped to a HLW repository program. The annual amount of Pu feed material for this process would be identical to that required for the other immobilization processes described above. Approximately 5 t (5.5 tons) of Pu (1,111 packages, 35 packages per SST, 32 SST loads) would be required per year. Pu would be shipped to INEL in DOT-approved 6M, Type B packaging (using 2R inner containers) with approximately 4.5 kg (10 lb) of Pu per package. For the

[2] Lag storage is temporary storage at a disposition facility.

transport of Cs-137 feed material from Hanford, approximately 64 kg/yr (141 lb/yr) of Cs-137, consisting of one rail cask per shipment, 10 shipments per year, would be required. To transport an estimated 104,000 kg/yr (229,278 lb/yr) of GBZ to a repository by rail would require approximately 20 shipments per year, each shipment consisting of one cask (20 casks/yr), or approximately 200 shipments (200 casks) over the 10-year life of the project. This assumes a repository is available and the shipments are made during the 10-year glass bonding production period; otherwise, the immobilized material would be stored onsite until the HLW program accepts the material. The total potential fatalities resulting from the transport of radioactive materials under this alternative is 0.923.

Mixed Oxide Fuel for Reactors

Surplus Pu (oxide powder) would be transported from the lag storage sites (after pit disassembly/conversion or Pu conversion) to domestic or foreign MOX fuel fabrication plants for blending into MOX nuclear reactor fuel. It is estimated that the maximum amount of Pu oxide to be transported per year from lag storage to a MOX fuel fabrication plant would not exceed 3 t (3.3 tons). For domestic MOX fuel fabrication, approximately 20 SST truckloads, consisting of 35 DOT-specification 6M, 113.6-l (30-gal) packages per SST, would be expected to move to the MOX fuel fabrication site each year. It is estimated that the maximum amount of UO_2 powder to be transported per year would be 130 t (143 tons). Approximately 12 truckloads, consisting of five DOT-specification Type A metal boxes per truckload, would also be transported to the MOX fuel fabrication site each year. Each metal box would contain about 2,200 kg (4,850 lb) of UO_2 material.

After processing the Pu at a domestic MOX fuel fabrication plant, a maximum of 133 t (147 tons) of MOX fuel (PuO_2 and UO_2), in reactor fuel bundles, would be transported in approximately 174 truckloads per year to a commercial reactor site or an approved DOE interim storage site. Each truckload contains approximately 2 packages. The Westinghouse Electric model MO-1 shipping cask (NRC Certificate 9069) is used for this analysis. Each cask would contain approximately 23 kg (51 lb) of PuO_2 and 359 kg (791 lb) of UO_2 with an average of 6-percent Pu. Based on an estimated 3,272 t (3,607 tons) of MOX fuel for the entire MOX fuel project, an estimated total of 4,283 truckloads would be required.

The final destination for the MOX fuel could be any reactor capable of using this fuel. After processing the oxides of Pu and uranium into MOX fuel, the fuel has not met the Spent Fuel Standard. However, Pu in the form of MOX fuel is less weapons-usable and much less susceptible to dispersion into the environment than Pu in the oxidized form prior to MOX fuel fabrication. MOX fuel is less weapons-usable because it would require some chemical processing to reclaim the Pu metal. Still, security measures must be implemented and similar measures are routinely in place in the U.S. domestic nuclear power industry for manufacturing and transporting uranium-based fuel to reactor sites. DOE would ensure that MOX fuel is protected by comparable security measures for point of fabrication through usage in a reactor. MOX fuel is less susceptible to dispersion in the environment because the Pu is contained in a pellet and the pellets are contained in a fuel rod. The structural integrity of the fuel rods make dispersion of even the pellets, much less the Pu inside the pellets, very unlikely. Because MOX fuel is less weapons-usable and less dispersable, after fabrication the MOX fuel would be transported by SST with appropriate security protection as described in Appendix G. To allow for comparison of the reactor alternatives, an estimated risk to transport MOX fuel from a MOX fabrication site to a reactor site within the United States or to the Canadian Border (hypothetical distance of 1,000, 2,000, or 4,000 km [621, 1,243, or 2,486 mi]) was used.

The total health risk impacts from transporting both Pu by SST and uranium oxide by truck to potential MOX fuel fabrication plants (hypothetically located 1,000, 2,000, or 4,000 km [621, 1,243, or 2,486 mi] from origin) and to an ocean terminal (hypothetically located at Sunny Point, NC, approximately 1,000, 2,000, or 4,000 km [621, 1,243, or 2,485 mi] from origin), are given in Table 4.4.3.3–4. For Pu destined for European MOX fabrication plant, the impacts include: transportation to the U.S. port; port handling at the U.S. port; ocean transport to European ports of Barrow, United Kingdom, and Cherbourg, France; ocean transport of MOX fuel back to the United States; and SST transport of MOX fuel from the port to either an existing (commercial)

reactor site or storage site in the United States. In selecting transportation routes, including any ports, the safety of the public and security of the cargo are of primary consideration. To ensure these primary considerations are achieved, DOE would evaluate the ports to be used based on a set of criteria that would include adequacy of harbor and dock characteristics to satisfy the Pu container carrying ship requirements; adequacy of facilities for safe receipt, handling, and transhipment of Pu and MOX fuel; overall port security; availability of safe and secure lag storage; adequacy of overland transportation systems from ports to the reactor and from the Pu site(s); availability of a skilled labor force with routine experience in safe and secure handling of hazardous cargo; emergency preparedness status and response capabilities at the port and the nearby communities; quality of intermodal access for truck or rail shipments to and from the port; proximity to the proposed pit disassembly/conversion and reactor sites; local restrictions or regulations on movement of hazardous cargo; absence of significant environmental restrictions for the port; and the size of human population at the ports and along transportation routes. Port handling and global commons risks associated with the European MOX fuel fabrication option are discussed in Appendix G. [Text deleted.] The maximum risk impacts from the transport of Pu oxide, uranium oxide, and MOX fuel under the reactor alternatives are summarized in Table 4.4.3.3–4. Nonradiological accidents are the dominant risk for the Reactor Category of Alternatives. The highest number of total potential fatalities from the transportation of materials from lag storage (after pit disassembly/conversion or Pu conversion) to fuel fabrication and then to a reactor site is 4.16 for MOX fuel fabrication in the United States and a 4,000-km (2,485-mi) representative distance for each segment. The transportation risk for shipping MOX fuel from a domestic fabricator to an existing LWR is approximately the same as the transportation risk for shipping uranium-based fuel from a domestic fabricator to an existing LWR. Since the MOX fuel replaces the uranium-based fuel, the incremental transportation risk for the Existing LWR Alternative is only the risk of shipping the oxides to the MOX fuel fabrication site. Assuming a 4,000-km (2,485-mi) representative distance for each segment, the total potential facilities is 0.55. As shown in Table 4.4.3.3–4, using MOX fuel fabricated abroad would increase the transportation risk for this alternative. Under the Preferred Alternative, for analysis purposes, 70 percent of the surplus Pu would be sent to the pit disassembly/conversion facility and then to the MOX Fuel Fabrication Facility. Accordingly, the total potential fatalities for the Preferred Alternative would be lower than those shown in Table 4.4.3.3–4.

Reactor facilities are designed to accommodate spent nuclear fuel onsite, as described under waste management. The impacts of the future transport of DOE spent nuclear fuel, including both incident-free and accident conditions, are addressed in the DOE *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F). That EIS concluded that the estimated number of fatalities from the operation of DOE spent nuclear fuel management facilities would not exceed 0.065 fatalities per year for transportation. Because the dominant risk in transporting radiological materials is nonradiological accidents, the fatalities from the transportation of spent LEU fuel assemblies will be similar to the transportation of spent MOX fuel assemblies. For analysis purposes in the Storage and Disposition PEIS, a maximum risk of 0.65 fatalities is used for transporting spent nuclear fuel to an HLW repository during the 10-year reactor operations period. This maximum risk for transportation of spent nuclear fuel has been added to each MOX total fatalities in Table 4.4.3.3–4.

Summary of Disposition Alternative Transportation Impacts.

A summary of the highest number of potential fatalities for each of the disposition alternatives is presented in Table 4.4.3.3–5. Based on the sites and environmental settings analyzed, none of the alternatives would exceed these values.

Table 4.4.3.3–4. Total Potential Fatalities From the Transportation of Plutonium Oxide, Uranium Oxide, and Mixed Oxide Fuel for the Reactor Category of Alternatives[a]

Representative Distance (km)	From Lag Storage Site to a U.S. MOX Fuel Fabrication Site	From Lag Storage Site to a European Port[b]	From a U.S. MOX Fuel Fabrication Site to a Reactor Site	From a European Port to a U.S. Reactor or Storage Site[b]
Plutonium Oxide				
1,000	0.102	0.132	NA	NA
2,000	0.188	0.218	NA	NA
4,000	0.359	0.389	NA	NA
Uranium Oxide				
1,000	0.060	0.087	NA	NA
2,000	0.104	0.131	NA	NA
4,000	0.193	0.221	NA	NA
Mixed Oxide Fuel				
1,000	NA	NA	1.07	1.47
2,000	NA	NA	1.91	2.31
4,000	NA	NA	3.61	4.01

[a] Resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

[b] Port handling is evaluated separately as a facility risk. For the Preferred Alternative, the total potential facilities would be less. For analysis purposes, 70 percent of the surplus Pu would be sent to the pit disassembly/conversion facility and then to the MOX Fuel Fabrication Facility.

Note: Under the Preferred Alternative, for analysis purposes, 70 percent of the surplus Pu would be sent to the pit disassembly/conversion facility and then to the MOX fuel fabrication facility. Accordingly, the total potential fatalities for the Preferred Alternative would be lower than those shown in this table. NA=not applicable.

Source: RADTRAN model results.

Table 4.4.3.3–5. Highest Number of Potential Fatalities From the Transportation of Materials for Each Disposition Alternative[a]

Alternative	Highest Number of Potential Fatalities
Deep Borehole	
Direct Disposition	1.18
Immobilized Disposition	2.12
Immobilization	
Vitrification[e]	1.40
Ceramic Immobilization[e]	1.43
Electrometallurgical Treatment	0.923
Reactor	
Existing LWR[e]	5.65[b]
Partially Completed LWR	5.65[c]
Evolutionary LWR	5.65[c]
CANDU Reactor	5.00[d e]

[a] Highest potential number of fatalities from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions. Includes effects from the transport of Pu from existing storage sites to the pit disassembly/conversion site and Pu conversion site.

[b] Represents total fatalities for transportation with MOX fuel fabricated in the United States, shipped to a reactor in the United States, and the spent fuel shipped to a HLW repository. Because an existing LWR already has LEU fuel shipped to the site and would have spent fuel shipped from the site, the net incremental increase is 1.38 fatalities.

[c] Represents total fatalities for transportation with MOX fuel fabricated in the United States, shipped to a reactor in the United States, and the spent fuel shipped to a HLW repository.

[d] Represents total fatalities for transportation with MOX fuel fabricated in the United States and shipped to the Canadian border and does not include transportation impacts in Canada.

[e] Under the Preferred Alternative, for analysis purposes, approximately 30 percent of the total surplus Pu would be immobilized by either vitrification or ceramic immobilization, and the remaining highest surplus Pu would be used as MOX fuel in existing reactors. Accordingly, the highest number of potential fatalities for the Preferred Alternative would be lower than those for all the Reactor Alternatives.

Source: RADTRAN model results.

4.5 ENVIRONMENTAL JUSTICE IN MINORITY AND LOW-INCOME POPULATIONS

Pursuant to Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations,* this section identifies and addresses any disproportionately high and adverse human health or environmental effects on minority and low-income populations from activities described in previous sections of the PEIS. DOE is in the process of finalizing its Environmental Justice guidance. Because DOE is still in the process of developing guidance, the approach taken in this analysis may differ somewhat from whatever final guidance is eventually issued, and from the approach taken in other NEPA documents.

4.5.1 METHODOLOGY

Potential environmental justice impacts are assessed using a phased approach. This approach establishes four thresholds for assessing whether environmental justice issues are likely to arise as a result of proposed DOE activities. As described in DOE's draft guidance on incorporating environmental justice into the NEPA process, the following four questions form the framework and establish the thresholds for the phased approach to environmental justice analysis:

- Are there any potential impacts to human populations?
- Are there any potential impacts to minority populations or low-income populations?
- Are potential impacts to minority populations or low-income populations disproportionately high and adverse?
- Are any potential disproportionately high and adverse impacts "significant?"

Environmental Justice guidance developed by the Council on Environmental Quality (CEQ) defines "minority" as individual(s) who are members of the following population groups: American Indian or Alaskan Native, Asian or Pacific Islander, Black, not of Hispanic origin, or Hispanic (CEQ 1996a). Minority populations are identified when either the minority population of the affected area exceeds 50 percent or the percentage of minority population in the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis. Low-income populations are identified using statistical poverty thresholds from the Bureau of Census' Current Population Reports, Series P-60 on Income and Poverty.

Environmental justice impacts become issues of concern if the proposed activities result in disproportionately high adverse human and environmental effects to minority and low-income populations. Disproportionately high and adverse human health effects are identified by assessing these three factors to the extent practicable:

- Whether the health effects, which may be measured in risks or rates, are significant (as employed by NEPA) or above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death;
- Whether the risk or rate of exposure by a minority population or low-income population to an environmental hazard is significant (as employed by NEPA) and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group; and
- Whether health effects occur in a minority population or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

Previous sections in Chapter 3 describe employment and income, population, housing, and community services surrounding each site. Income distribution is presented in this section. Impacts for each ROI from implementation of proposed alternatives are analyzed in Chapter 4. Selected ROI demographic characteristics for racial/ethnic minority groups and low income populations are presented in Tables 4.5.1–1 through 4.5.1–7. [Text deleted.]

Any disproportionately high and adverse human health or environmental effects on minority populations and low-income populations that could result from the storage and disposition alternatives being considered are assessed for an 80-km (50-mi) area surrounding each of the eight DOE sites. [Text deleted.] The shaded areas in Figures 4.5.1–1, 4.5.1–3, 4.5.1–5, 4.5.1–7, 4.5.1–9, 4.5.1–11, 4.5.1–13, and 4.5.1–15 show 1990 Census tracts for each DOE site where racial/ethnic minorities comprise 50 percent or more (simple majority) of the total population, or where minorities comprise less than 50 percent but greater than 25 percent of the total population in the Census tract. Figures 4.5.1–2, 4.5.1–4, 4.5.1–6, 4.5.1–8, 4.5.1–10, 4.5.1–12, 4.5.1–14, and 4.5.1–16 show low-income communities generally defined as those where 25 percent or more of the population is characterized as living in poverty (income of less than $8,076 for a family of two). Data on geographic distribution of low income and minority populations and prevailing wind conditions are used to assess whether toxic/hazardous pollutants and radiological releases from the proposed actions would be emitted disproportionately in the direction of these populations. This assessment is then used to identify whether any of the alternatives would cause disproportionately high and adverse effects to minority or low income populations in the vicinity of the sites.

Potential Impacts on Minority and Low-Income Populations From Subsistence Consumption of Fish and Wildlife

Section 4.4 of Executive Order 12898 directs Federal agencies, "whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence and that federal agencies communicate to the public the risks of these consumption patterns."

The potential environmental impacts of DOE activities on populations engaging in subsistence consumption could vary greatly depending on the precise location of a storage or disposition facility at a particular site, and the technology employed for the treatment or disposal of wastes at such a facility. In a prior NEPA review, incorporated herein by reference, DOE reviewed fish and wildlife consumption at Hanford, NTS, INEL, ORR, and SRS. At these sites, DOE found the potential impacts associated with the consumption of fish and wildlife to be small or to be no different than the potential impacts on the general population (DOE 1995v:5.20-11).

With regard to the impacts analyzed in this PEIS, and in the absence of subsistence consumption data by population sub-groups, DOE used the following criteria and assumptions, weighted in order of importance, to identify groups of sites that may be near minority and low-income populations potentially engaging in subsistence consumption:

- Proximity of Tribal Lands to DOE sites (the presence of Native Americans near DOE sites is assumed to create a greater possibility for subsistence consumption)
- Distance of the DOE site to major surface water bodies (populations nearer water are assumed to have a greater possibility of subsistence consumption of fish)
- Population density in the 80-km (50-mi) ROI around the site (rural residents are assumed to have a greater possibility of engaging in subsistence hunting and fishing)
- Proximity and concentration of minority and low-income populations to DOE sites (higher concentrations of minority and low-income populations are assumed to have a greater potential for subsistence consumption)

The eight DOE sites considered in this PEIS can be loosely categorized into three groups: those with the highest possibility for subsistence consumption, those with intermediate possibilities for subsistence consumption, and those with the lowest possibilities for subsistence consumption. Populations around more rural sites with recognized Native American groups are assumed more likely to engage in subsistence hunting and fishing. These sites include Hanford, INEL, LANL, and SRS. Although the areas around RFETS and NTS are more urban, these sites are of intermediate concern due to the presence of Native American populations or the presence of surface water onsite. ORR and Pantex are considered to have a lower possibility of populations who principally rely on fish and/or wildlife for subsistence, since there are no Federally recognized Native American groups around these two sites.

In order to assemble and disseminate information on subsistence hunting and fishing, DOE began publishing *A Department of Energy Environmental Justice Newsletter: Subsistence and Environmental Health* in the Spring of 1996. The three goals of the newsletter are (1) "to provide useful information about the health implications of consuming contaminated fish, wildlife, livestock products, or vegetation;" (2) "to provide information about projects and programs at DOE and other Federal and State agencies that address the problems associated with consuming contaminated fish, wildlife, livestock products, or vegetation;" and (3) "to receive relevant information from readers." In addition to the Newsletter, DOE has a new project underway to identify what information is being collected on subsistence consumption by other Federal agencies and to serve as a clearinghouse for such information.

In a recent article reviewing the literature on subsistence consumption, ANL found that (1) "the majority of the studies that have been conducted to date are focused on site- or region-specific exposure concerns...At present, it is unclear whether the findings of these studies are representative of consumption and exposure levels among minority populations at a national level;" (2) a large number of risk assessment studies focusing on fish and wildlife consumption examined whole populations without distinguishing between consumption and exposure patterns of specific ethnic (or other) subpopulations;" (3) "the vast majority of studies have focused on fish consumption as an exposure pathway. Few examined wildlife consumption and contamination, and even in such cases the studies were not motivated by minority exposure concerns;" and (4) "the majority populations to be significantly higher than for the population as a whole" (ANL 1994a:1).

Table 4.5.1–1. Selected Demographic Characteristics for the Hanford Site Region of Influence

Characteristics/Area	Benton County (number)	Franklin County (number)	Yakima County (number)	Total Region of Influence (number)	Total Region of Influence (percent)
Persons by Race/Ethnicity					
Non-Hispanic, White	99,778	23,784	132,147	255,709	75.5
Hispanic	8,624	11,316	45,114	65,054	19.2
Non-Hispanic, American Indian	792	217	7,695	8,704	2.6
Non-Hispanic, Black	1,054	1,251	1,785	4,090	1.2
Non-Hispanic, Asian/Pacific Islander	2,196	805	1,667	4,668	1.4
Non-Hispanic, Other	116	100	415	631	0.2
Total 1990 Population	112,560	37,473	188,823	338,856	
1989 Low Income					
Persons below poverty					
Number	12,402	8,491	37,486	58,379	
Percent[a]	11.1	23.0	20.2		17.4

[a] In calculating percentages, certain categories of individuals are not included as part of the county population, including inmates of institutions, armed forces members, and unrelated individuals under 15 years of age.

Note: May not total 100 percent due to rounding.

Source: Census 1993s; Census 1994o.

Table 4.5.1–2. Selected Demographic Characteristics for the Nevada Test Site Region of Influence

Characteristics/Area	Clark County (number)	Nye County (number)	Total Region of Influence (number)	Total Region of Influence (percent)
Persons by Race/Ethnicity				
Non-Hispanic, White	558,875	15,635	574,510	75.7
Hispanic	82,904	1,237	84,141	11.1
Non-Hispanic, American Indian	5,514	475	5,989	0.8
Non-Hispanic, Black	68,858	274	69,132	9.1
Non-Hispanic, Asian/Pacific Islander	24,483	148	24,631	3.2
Non-Hispanic, Other	825	12	837	0.1
Total 1990 Population	741,459	17,781	759,240	
1989 Low Income				
Persons below poverty				
Number	76,737	1,840	78,577	
Percent[a]	10.5	10.5		10.5

[a] In calculating percentages, certain categories of individuals are not included as part of the county population, including inmates of institutions, armed forces members, and unrelated individuals under 15 years of age.

Note: May not total 100 percent due to rounding.

Source: Census 1993s; Census 1994o.

Table 4.5.1–3. Selected Demographic Characteristics for the Idaho National Engineering Laboratory Region of Influence

Characteristics/Area	Bannock County (number)	Bingham County (number)	Bonneville County (number)	Butte County (number)	Jefferson County (number)	Total Region of Influence (number)	Total Region of Influence (percent)
Persons by Race/Ethnicity							
Non-Hispanic, White	60,626	31,412	67,879	2,791	15,219	177,927	91.1
Hispanic	2,740	3,614	3,010	101	1,155	10,620	5.4
Non-Hispanic, American Indian	1,509	2,209	343	21	109	4,191	2.1
Non-Hispanic, Black	415	31	286	0	3	735	0.4
Non-Hispanic, Asian/Pacific Islander	697	284	663	5	40	1689	0.9
Non-Hispanic, Other	39	33	26	0	17	115	0.1
Total 1990 Population	66,026	37,583	72,207	2,918	16,543	195,277	
1989 Low Income							
Persons below poverty							
Number	8,944	5,804	7,056	392	2,353	25,449	
Percent[a]	13.8	15.6	9.9	13.5	14.3		13.2

[a] In calculating percentages, certain categories of individuals are not included as part of the county population, including inmates of institutions, armed forces members, and unrelated individuals under 15 years of age.

Note: May not total 100 percent due to rounding.

Source: Census 1993s; Census 1994o.

Table 4.5.1–4. Selected Demographic Characteristics for the Pantex Plant Region of Influence

Characteristics/Area	Armstrong County (number)	Carson County (number)	Potter County (number)	Randall County (number)	Total Region of Influence (number)	Total Region of Influence (percent)
Persons by Race/Ethnicity						
Non-Hispanic, White	1,951	6,158	66,877	81,364	156,350	79.7
Hispanic	55	354	19,246	6,144	25,799	13.1
Non-Hispanic, American Indian	9	41	709	414	1,173	0.6
Non-Hispanic, Black	0	11	8,460	1,082	9,553	4.9
Non-Hispanic, Asian/Pacific Islander	5	9	2,431	626	3,071	1.6
Non-Hispanic, Other	1	3	151	43	198	0.1
Total 1990 Population	2,021	6,576	97,874	89,673	196,144	
1989 Low Income						
Persons below poverty						
Number	232	583	21,619	7,819	30,253	
Percent[a]	11.8	9.0	22.5	8.9		15.7

[a] In calculating percentages, certain categories of individuals are not included as part of the county population, including inmates of institutions, armed forces members, and unrelated individuals under 15 years of age.

Note: May not total 100 percent due to rounding.

Source: Census 1993s; Census 1994o.

Table 4.5.1–5. Selected Demographic Characteristics for the Oak Ridge Reservation Region of Influence

Characteristics/Area	Anderson County (number)	Knox County (number)	Loudon County (number)	Roane County (number)	Total Region of Influence (number)	Total Region of Influence (percent)
Persons by Race/Ethnicity						
Non-Hispanic, White	64,320	300,040	30,668	45,274	440,302	91.3
Hispanic	381	2,067	83	212	2,743	0.6
Non-Hispanic, American Indian	236	775	52	95	1,158	0.2
Non-Hispanic, Black	2,753	29,483	400	1,456	34,092	7.1
Non-Hispanic, Asian/Pacific Islander	537	3,263	49	186	4,035	0.8
Non-Hispanic, Other	23	121	3	4	151	0.0
Total 1990 Population	68,250	335,749	31,255	47,227	482,481	
1989 Low Income						
Persons below poverty						
Number	9,664	45,608	4,192	7,467	66,931	
Percent[a]	14.3	14.1	13.6	16.0		14.8

[a] In calculating percentages, certain categories of individuals are not included as part of the county population, including inmates of institutions, armed forces members, and unrelated individuals under 15 years of age.

Note: May not total 100 percent due to rounding.

Source: Census 1993s; Census 1994o.

Table 4.5.1–6. Selected Demographic Characteristics for the Savannah River Site Region of Influence

Characteristics/Area	South Carolina				Georgia		Total Region of Influence	
	Aiken County (number)	Allendale County (number)	Bamberg County (number)	Barnwell County (number)	Columbia County (number)	Richmond County (number)	(number)	(percent)
Persons by Race/Ethnicity								
Non-Hispanic, White	90,130	3,598	6,428	11,421	56,141	103,009	270,727	63.6
Hispanic	867	161	75	146	962	3,707	5,918	1.4
Non-Hispanic, American Indian	213	11	22	31	150	491	918	0.2
Non-Hispanic, Black	29,176	7,939	10,356	8,677	7,239	79,221	142,608	33.5
Non-Hispanic, Asian/Pacific Islander	528	7	20	17	1,518	3,186	5,276	1.2
Non-Hispanic, Other	26	6	1	1	21	105	160	0.0
Total 1990 Population	120,940	11,722	16,902	20,293	66,031	189,719	425,607	
1989 Low Income								
Persons below poverty								
Number	16,671	3,837	4,547	4,367	4,255	32,590	66,267	
Percent[a]	14.0	35.8	28.2	21.8	6.6	18.2		16.2

[a] In calculating percentages, certain categories of individuals are not included as part of the county population, including inmates of institutions, armed forces members, and unrelated individuals under 15 years of age.

Note: May not total 100 percent due to rounding.

Source: Census 1993s; Census 1994o.

Table 4.5.1–7. Selected Demographic Characteristics for the Rocky Flats Environmental Technology Site Region of Influence

Characteristics/Area	Adams County (number)	Arapahoe County (number)	Boulder County (number)	Denver County (number)	Jefferson County (number)	Total Region of Influence (number)	Total Region of Influence (percent)
Persons by Race/Ethnicity							
Non-Hispanic, White	198,710	334,225	201,617	287,162	394,946	1,416,660	79.2
Hispanic	49,179	21,743	15,195	107,382	30,791	224,290	12.5
Non-Hispanic, American Indian	1,824	1,790	1,092	3,761	2,019	10,486	0.6
Non-Hispanic, Black	8,445	22,653	1,879	57,793	3,014	93,784	5.2
Non-Hispanic, Asian/Pacific Islander	6,482	10,796	5,359	10,159	7,365	40,161	2.2
Non-Hispanic, Other	398	304	197	1,353	295	2,547	0.1
Total 1990 Population	265,038	391,511	225,339	467,610	438,430	1,787,928	
1989 Low Income							
Persons below poverty							
Number	27,267	22,973	23,738	78,515	24,926	177,419	
Percent[a]	10.4	5.9	11.0	17.1	5.8		10.1

[a] In calculating percentages, certain categories of individuals are not included as part of the county population, including inmates of institutions, armed forces members, and unrelated individuals under 15 years of age.

Note: May not total 100 percent due to rounding.

Source: Census 1993s; Census 1994o.

Table 4.5.1–8. Selected Demographic Characteristics for the Los Alamos National Laboratory Region of Influence

Characteristics/Area	Los Alamos County (number)	Rio Arriba County (number)	Santa Fe County (number)	Total Region of Influence (number)	Total Region of Influence (percent)
Persons by Race/Ethnicity					
Non-Hispanic, White	15,467	4,375	46,450	66,292	43.8
Hispanic	2,008	24,955	48,939	75,902	50.1
Non-Hispanic, American Indian	112	4,830	2,284	7,226	4.8
Non-Hispanic, Black	88	117	505	710	0.5
Non-Hispanic, Asian/Pacific Islander	421	40	439	900	0.6
Non-Hispanic, Other	18,115	34,365	98,928	151,408	100
Total 1990 Population					
1989 Low Income					
Persons below poverty					
Number	433	9,372	12,564	22,369	
Percent[a]	2.4	27.5	13	15.0	

[a] In calculating percentages, certain categories of individuals are not included as part of the county population, including inmates of institutions, armed forces members, and unrelated individuals under 15 years of age.

Note: May not total 100 percent due to rounding.

Source: Census 1993s; Census 1994o.

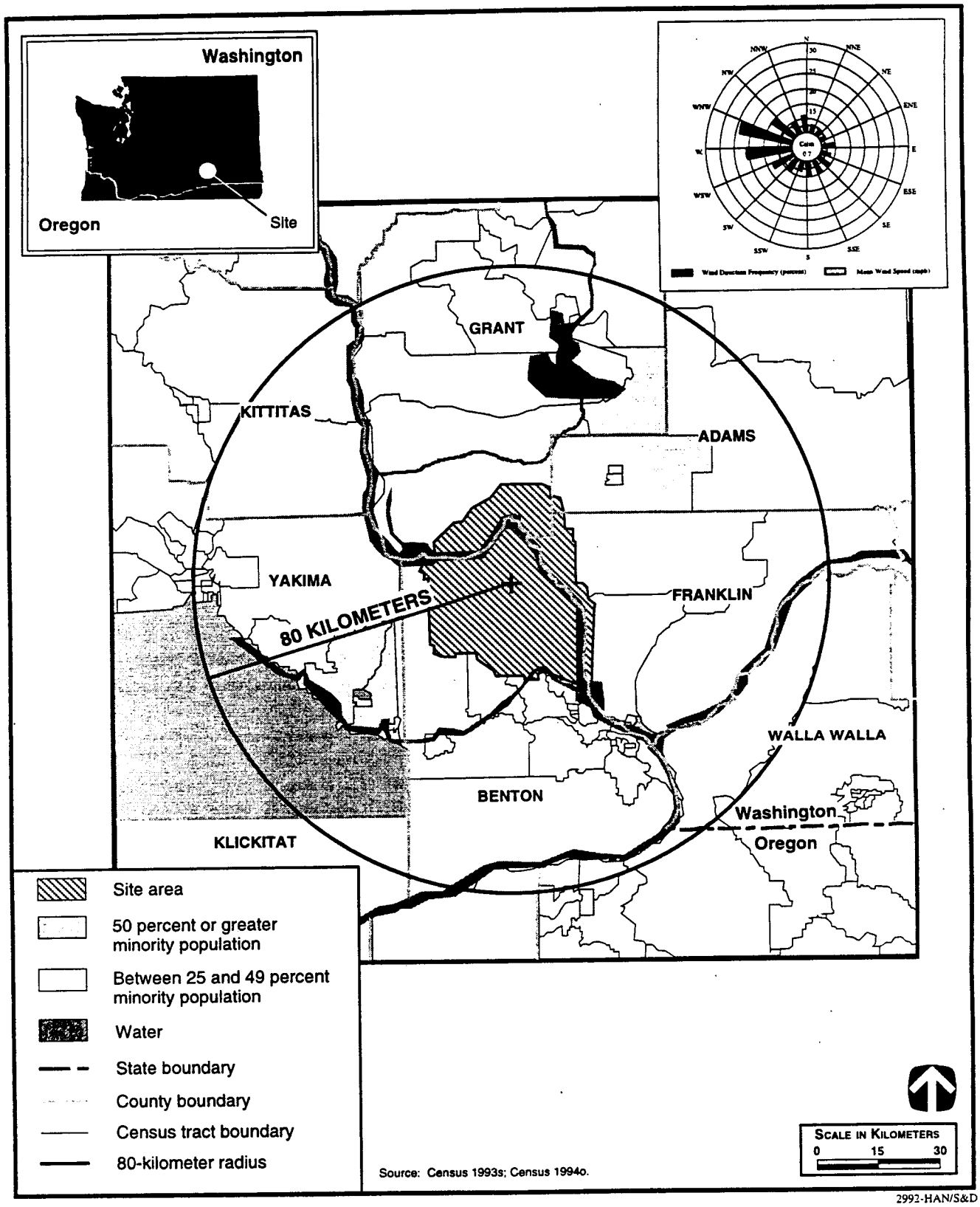

Figure 4.5.1–1. Minority Population Distribution for Hanford Site and Surrounding Area.

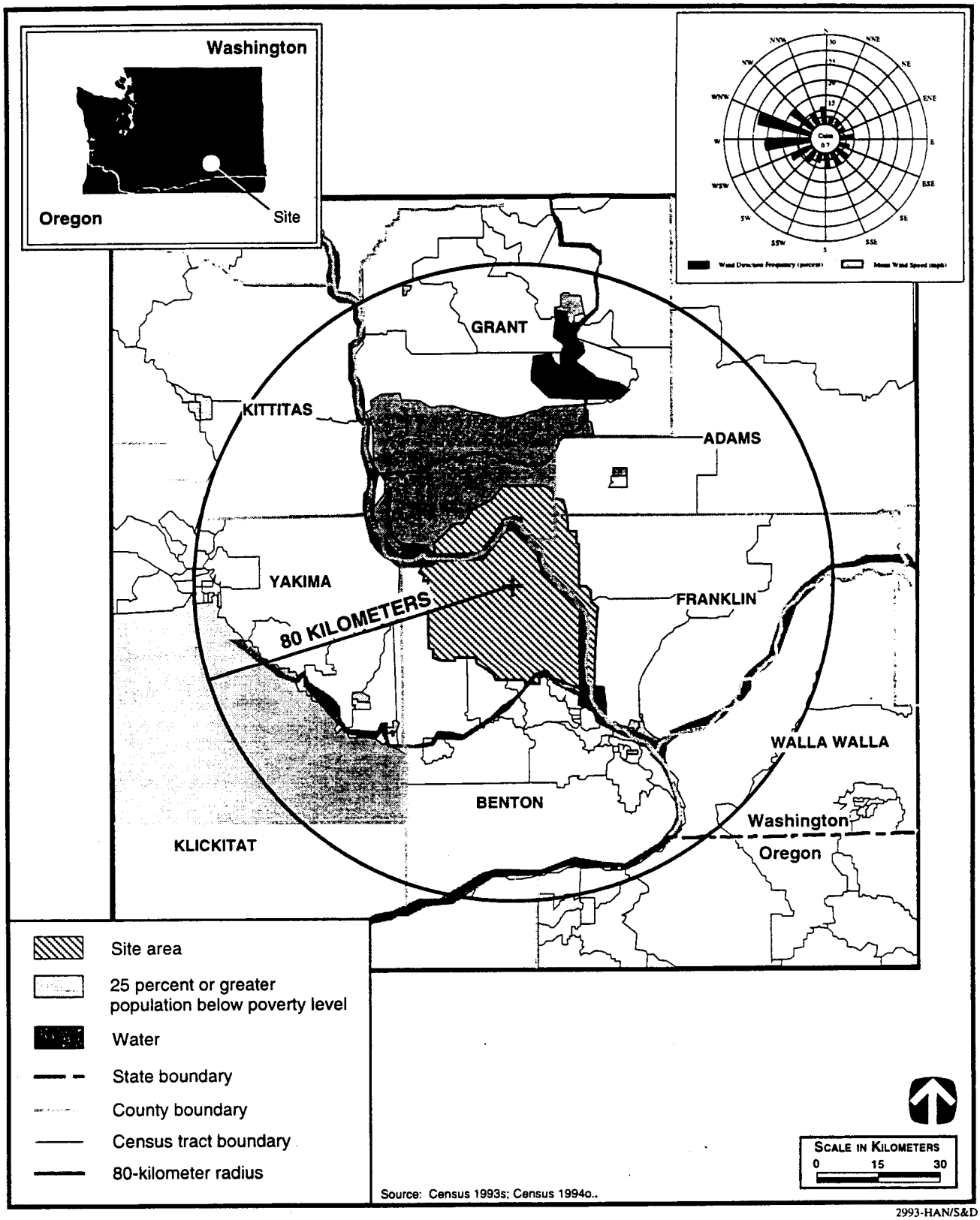

Figure 4.5.1–2. Low-Income Distribution by Poverty Status for Hanford Site and Surrounding Area.

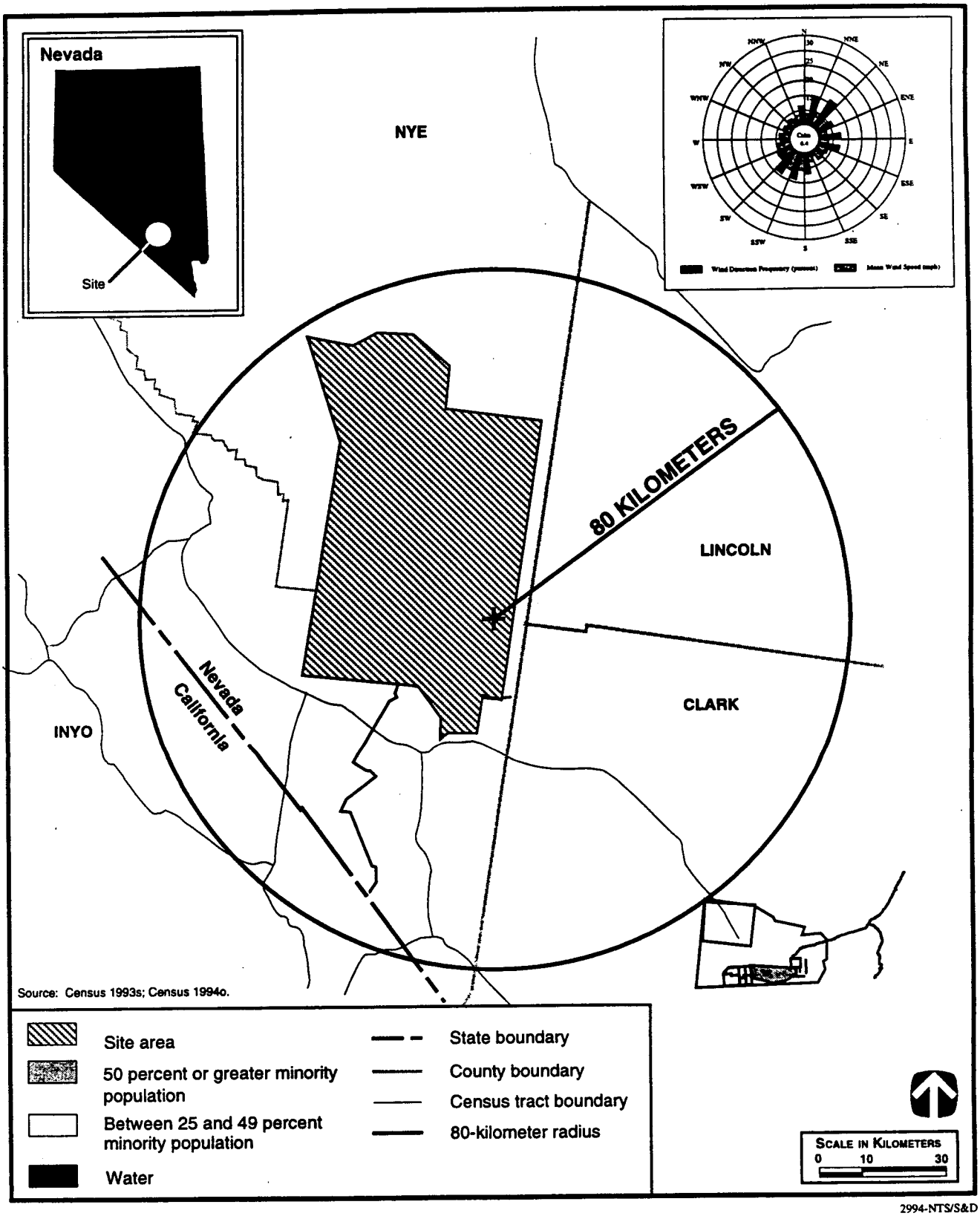

Figure 4.5.1–3. Minority Population Distribution for Nevada Test Site and Surrounding Area.

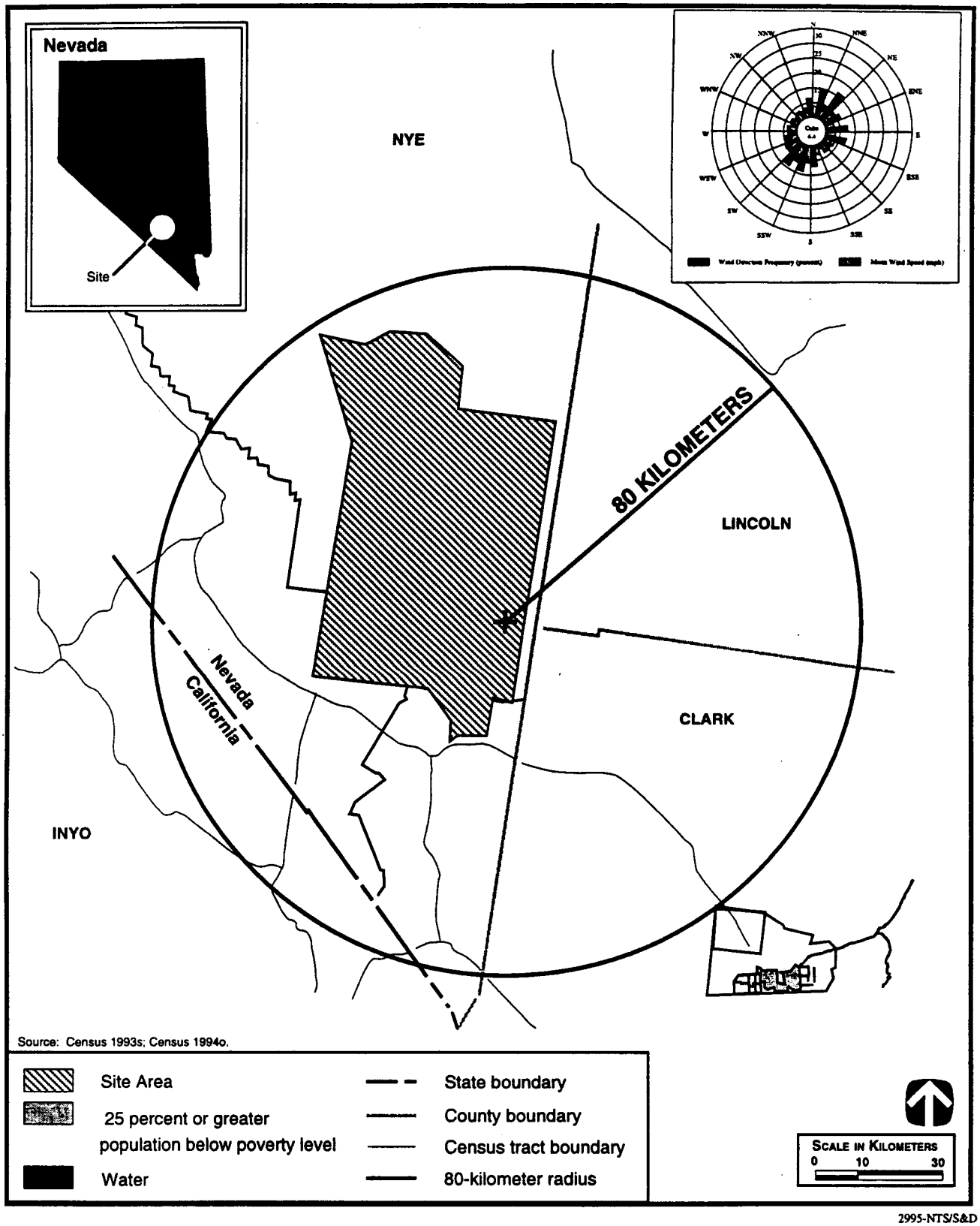

Figure 4.5.1–4. Low-Income Distribution by Poverty Status for Nevada Test Site and Surrounding Area.

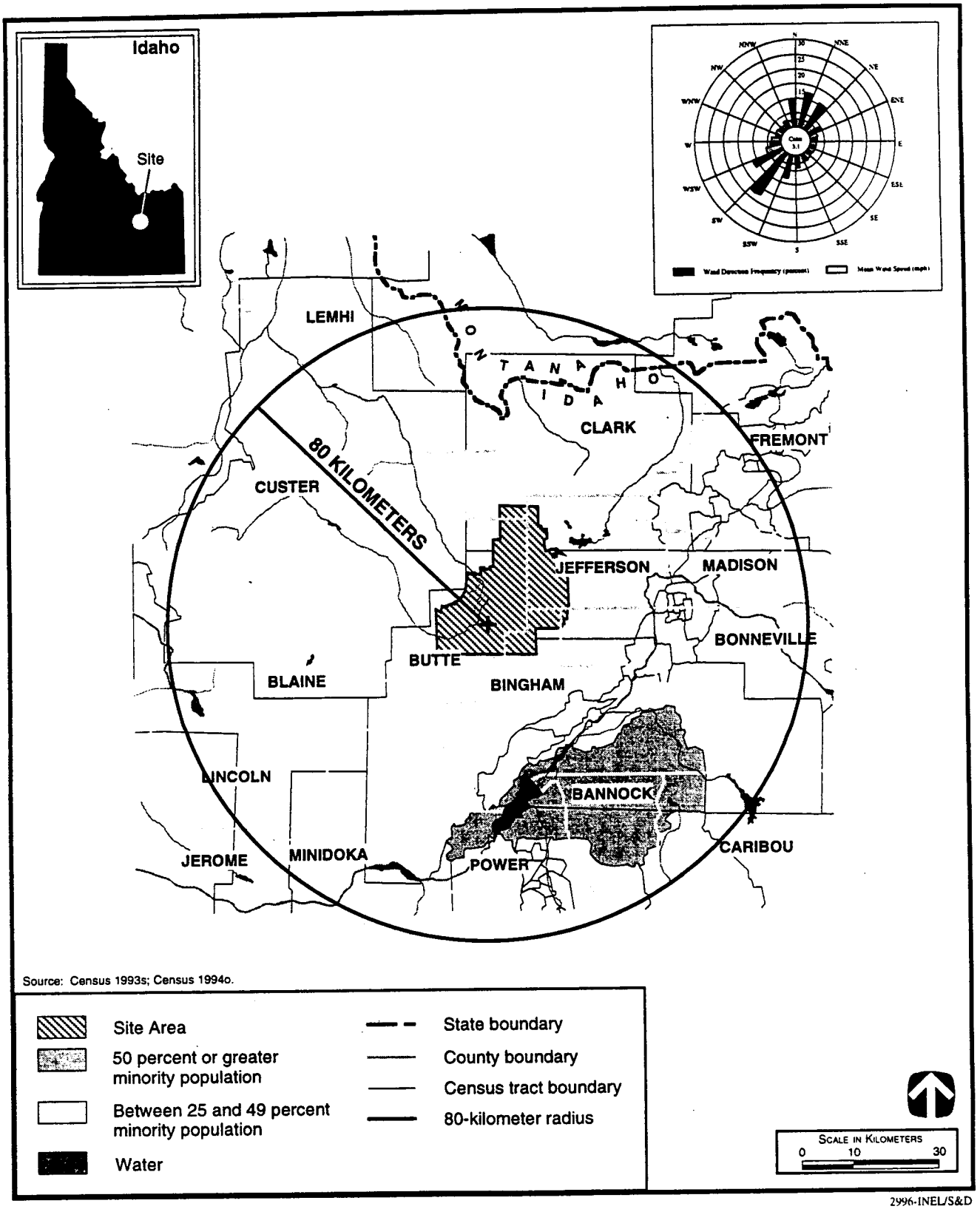

Figure 4.5.1–5. Minority Population Distribution for Idaho National Engineering Laboratory and Surrounding Area.

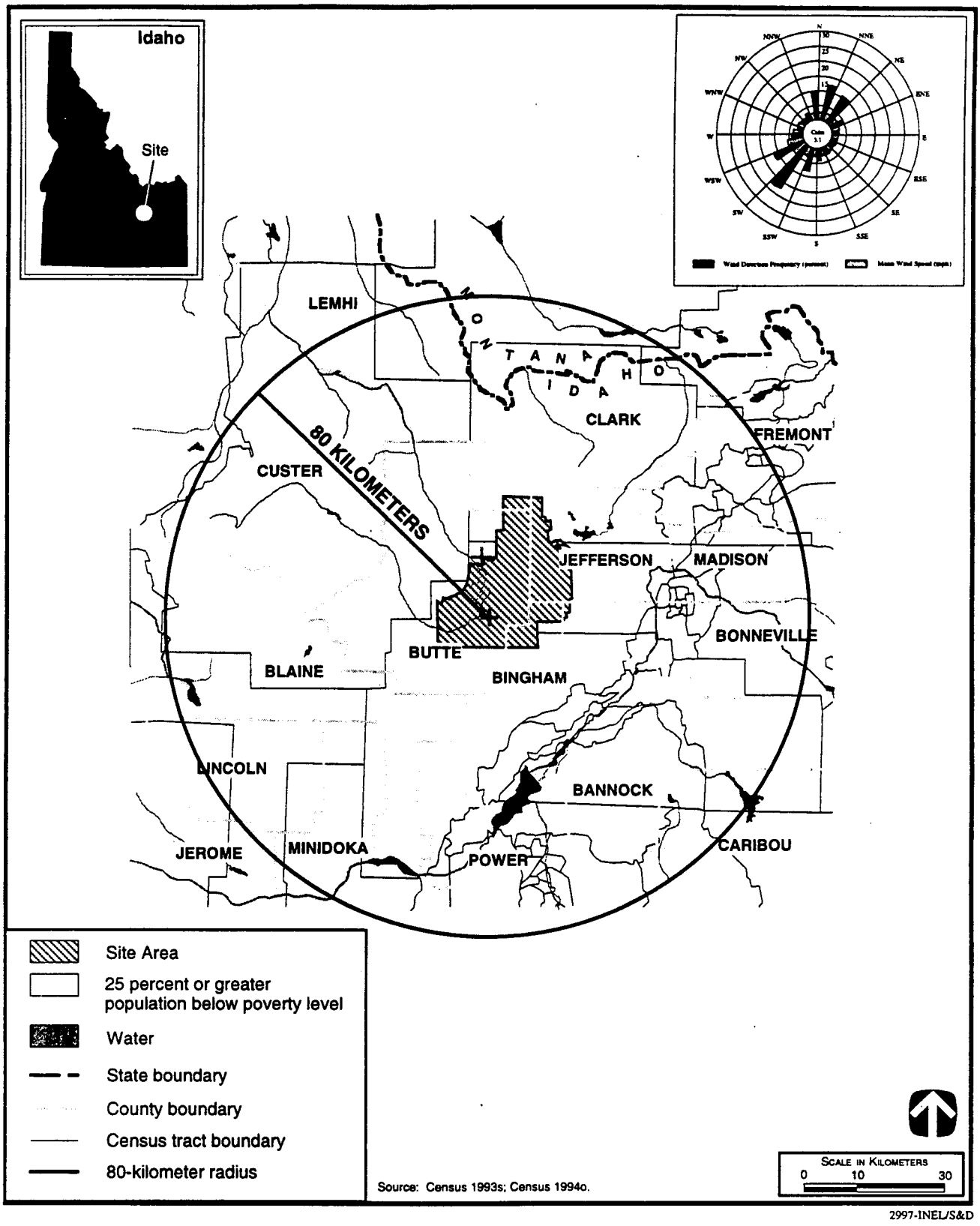

Figure 4.5.1–6. Low-Income Distribution by Poverty Status for Idaho National Engineering Laboratory and Surrounding Area.

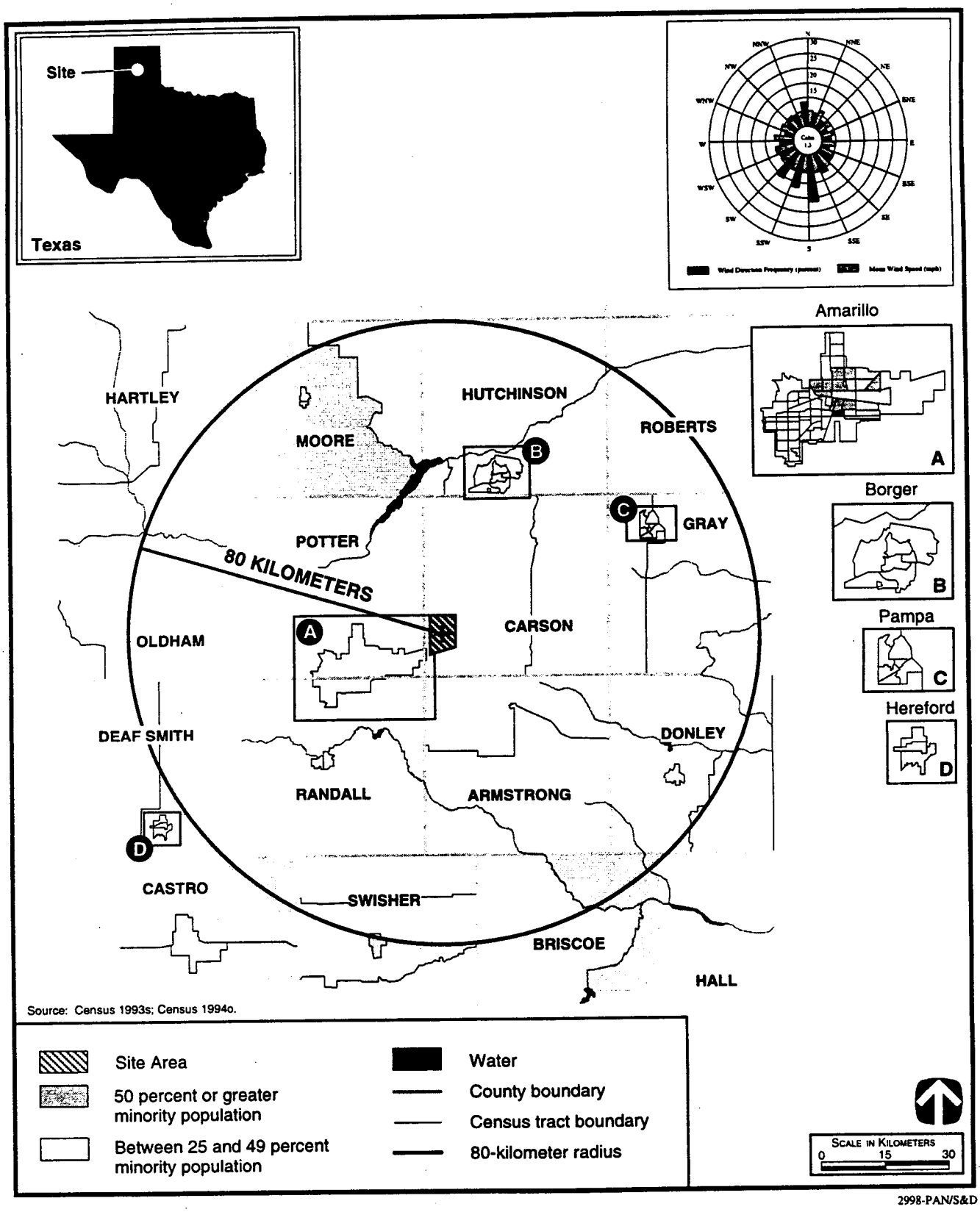

Figure 4.5.1–7. Minority Population Distribution for Pantex Plant and Surrounding Area.

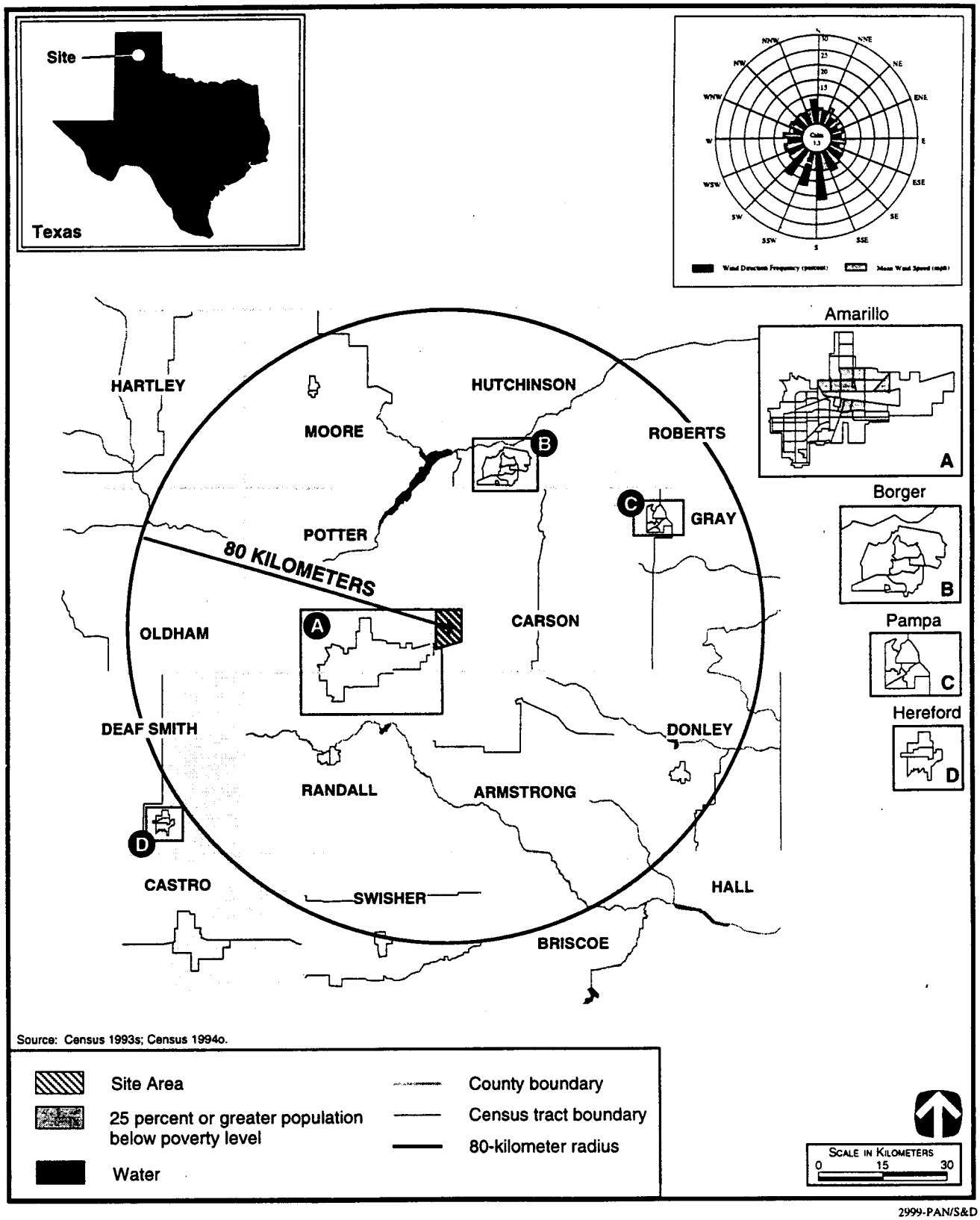

Figure 4.5.1–8. Low-Income Distribution by Poverty Status for Pantex Plant and Surrounding Area.

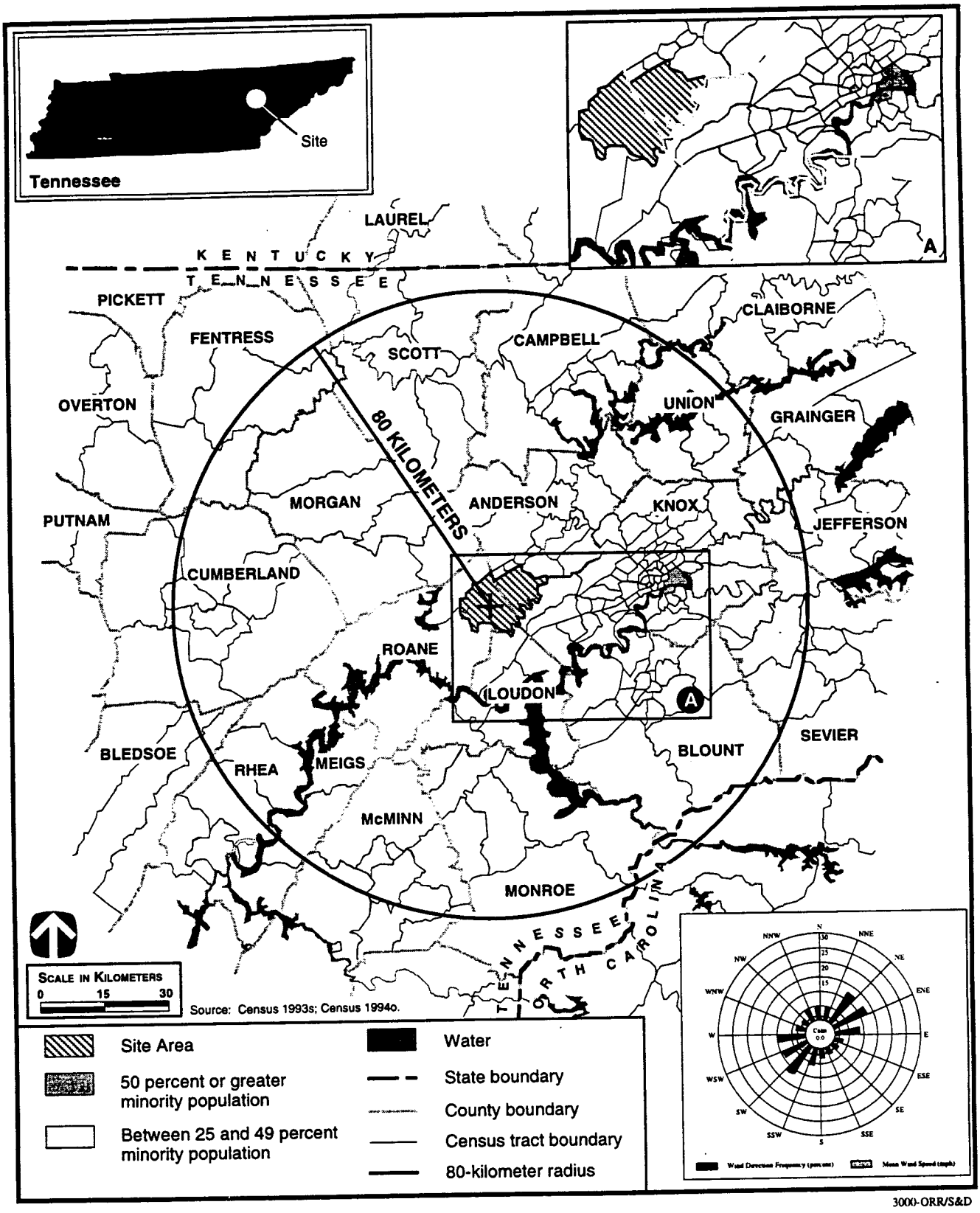

Figure 4.5.1–9. Minority Population Distribution for Oak Ridge Reservation and Surrounding Area.

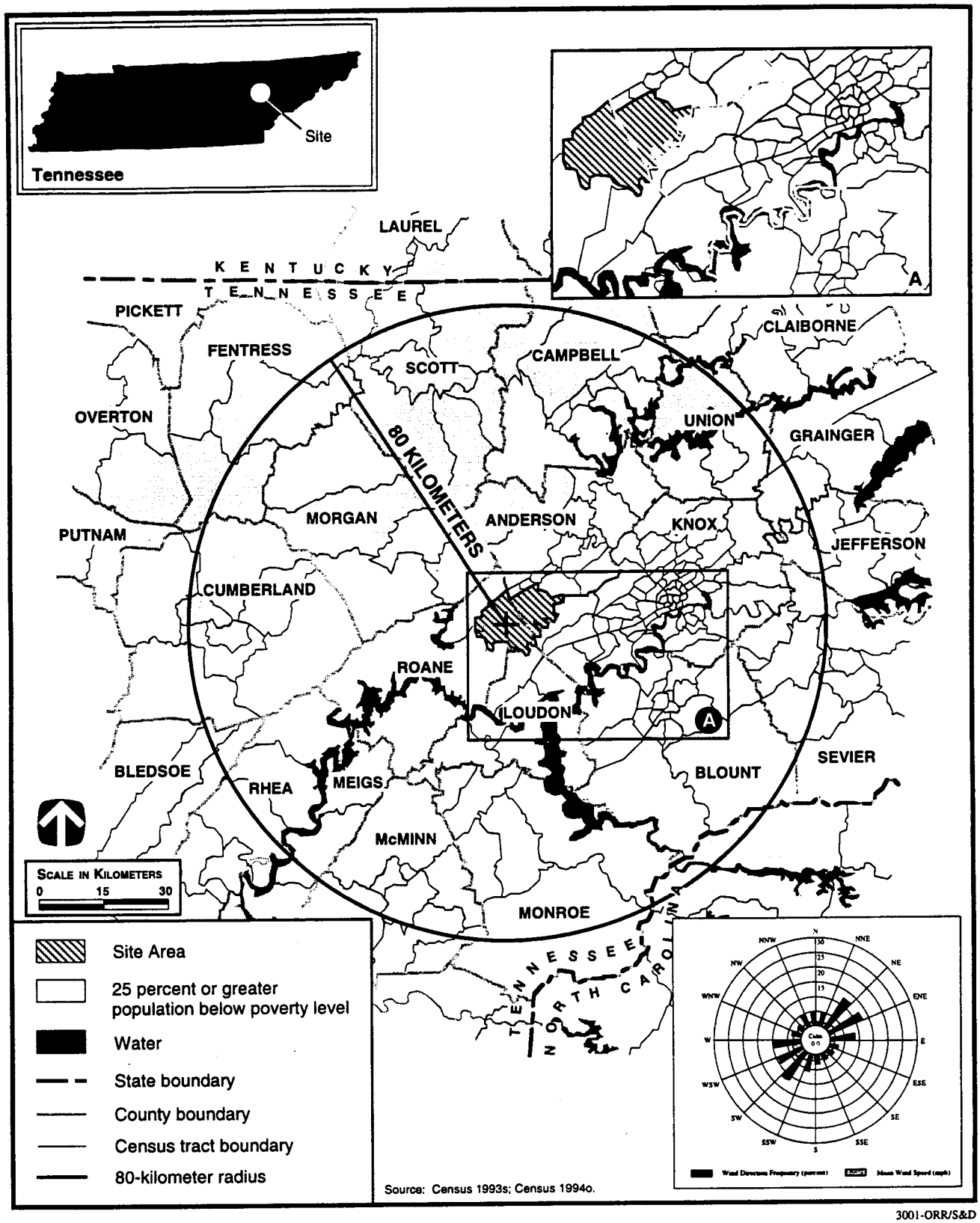

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Figure 4.5.1–10. Low-Income Distribution by Poverty Status for Oak Ridge Reservation and Surrounding Area.

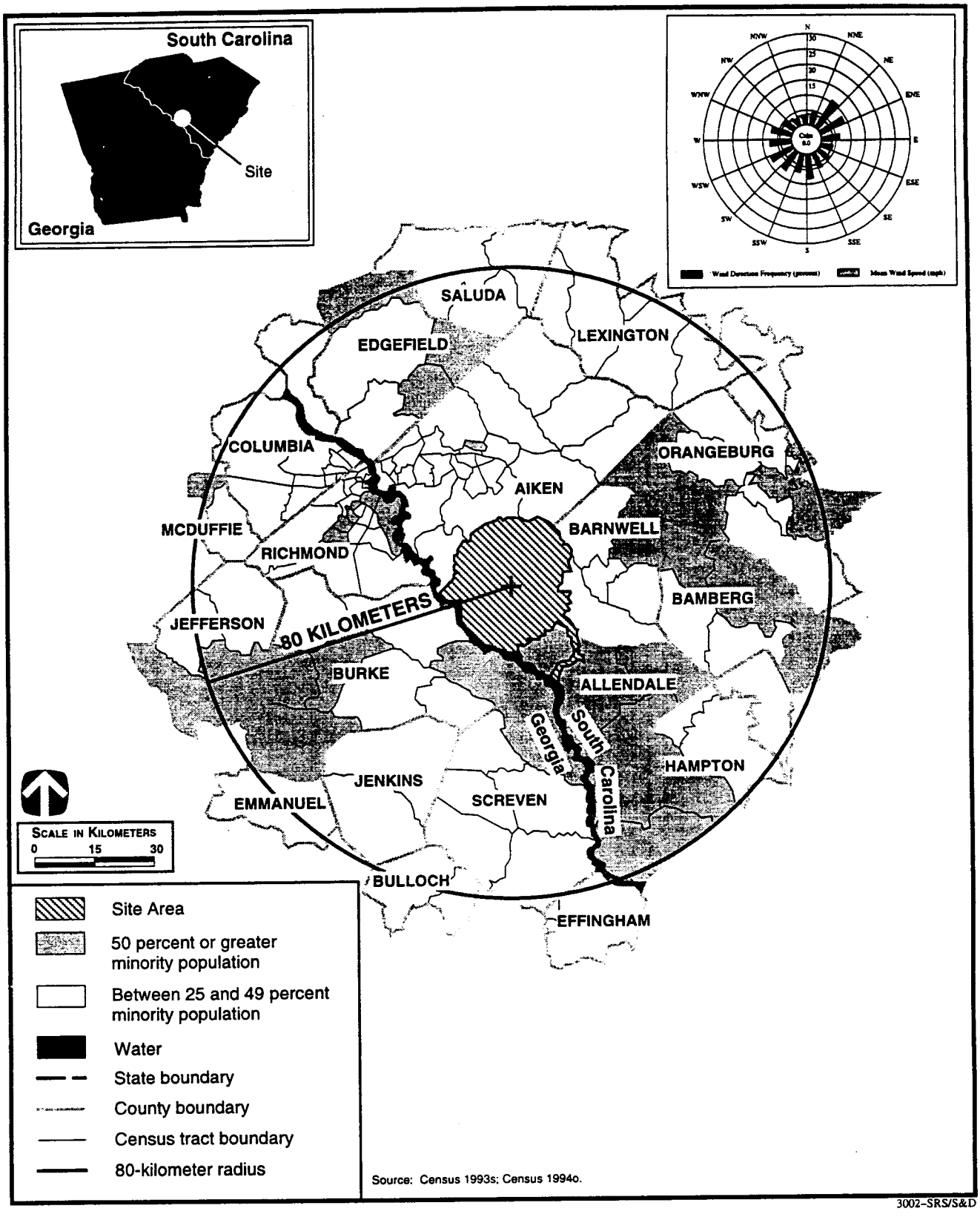

Figure 4.5.1–11. Minority Population Distribution for Savannah River Site and Surrounding Area.

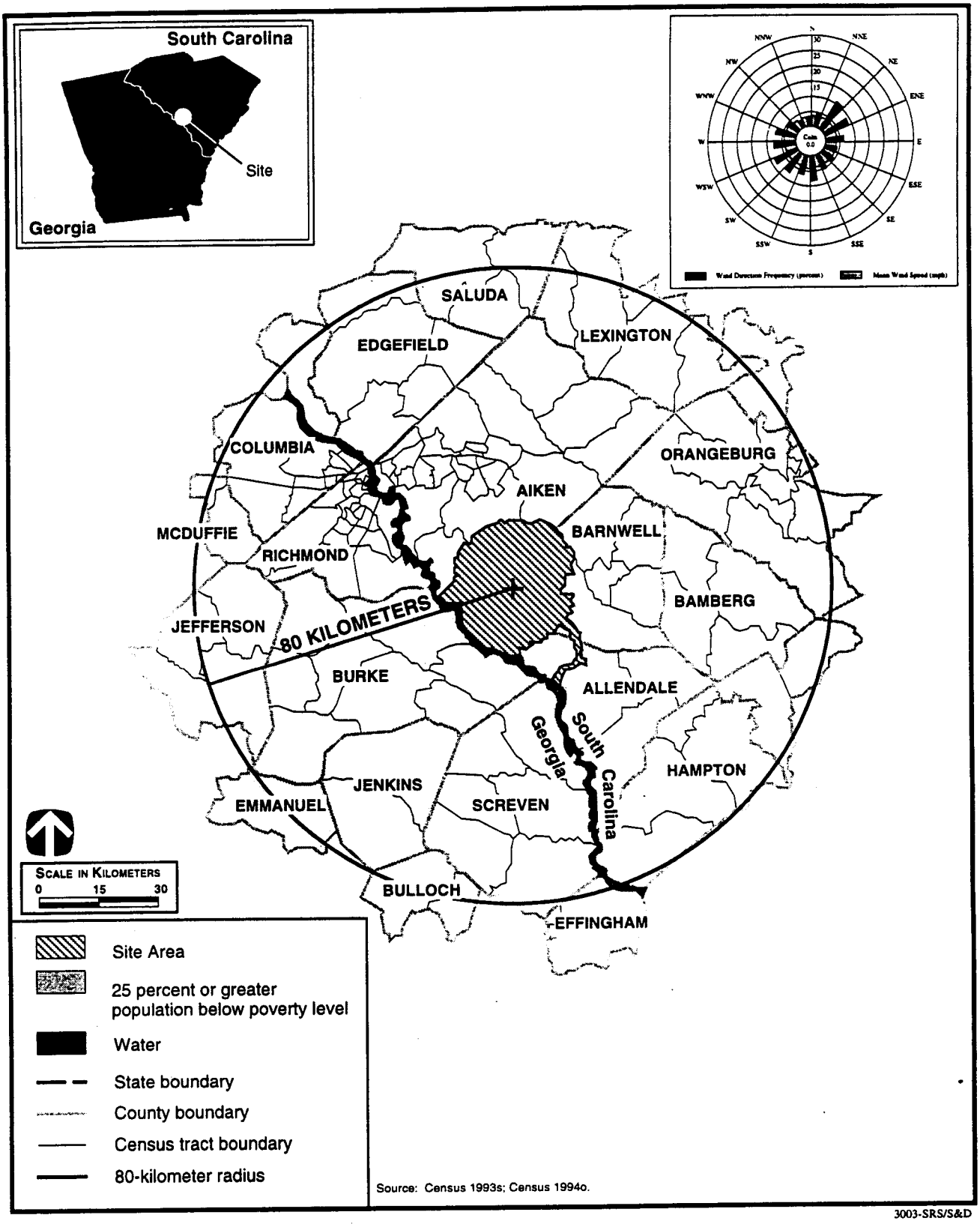

Figure 4.5.1–12. Low-Income Distribution by Poverty Status for Savannah River Site and Surrounding Area.

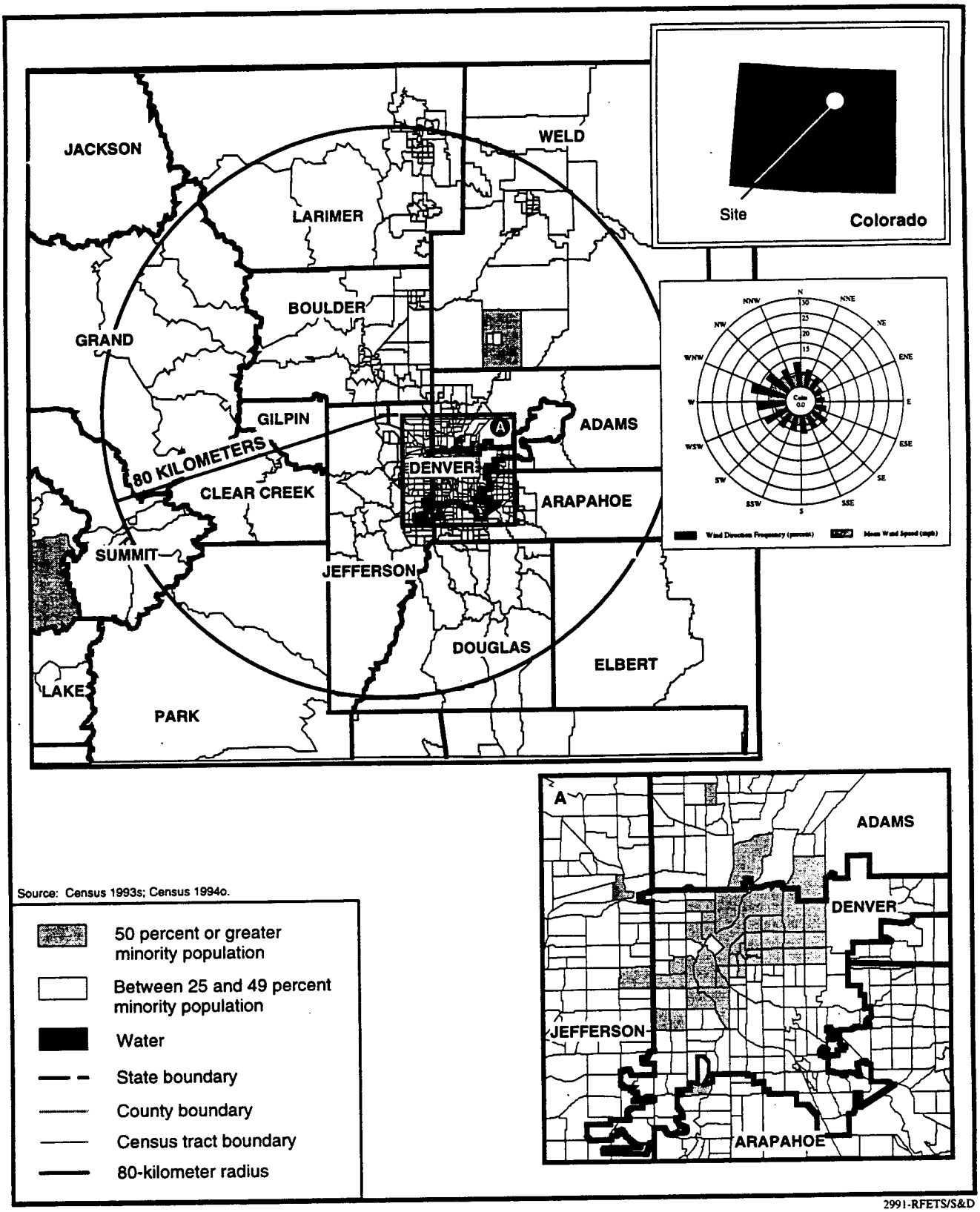

Figure 4.5.1–13. Minority Population Distribution for Rocky Flats Environmental Technology Site and Surrounding Area.

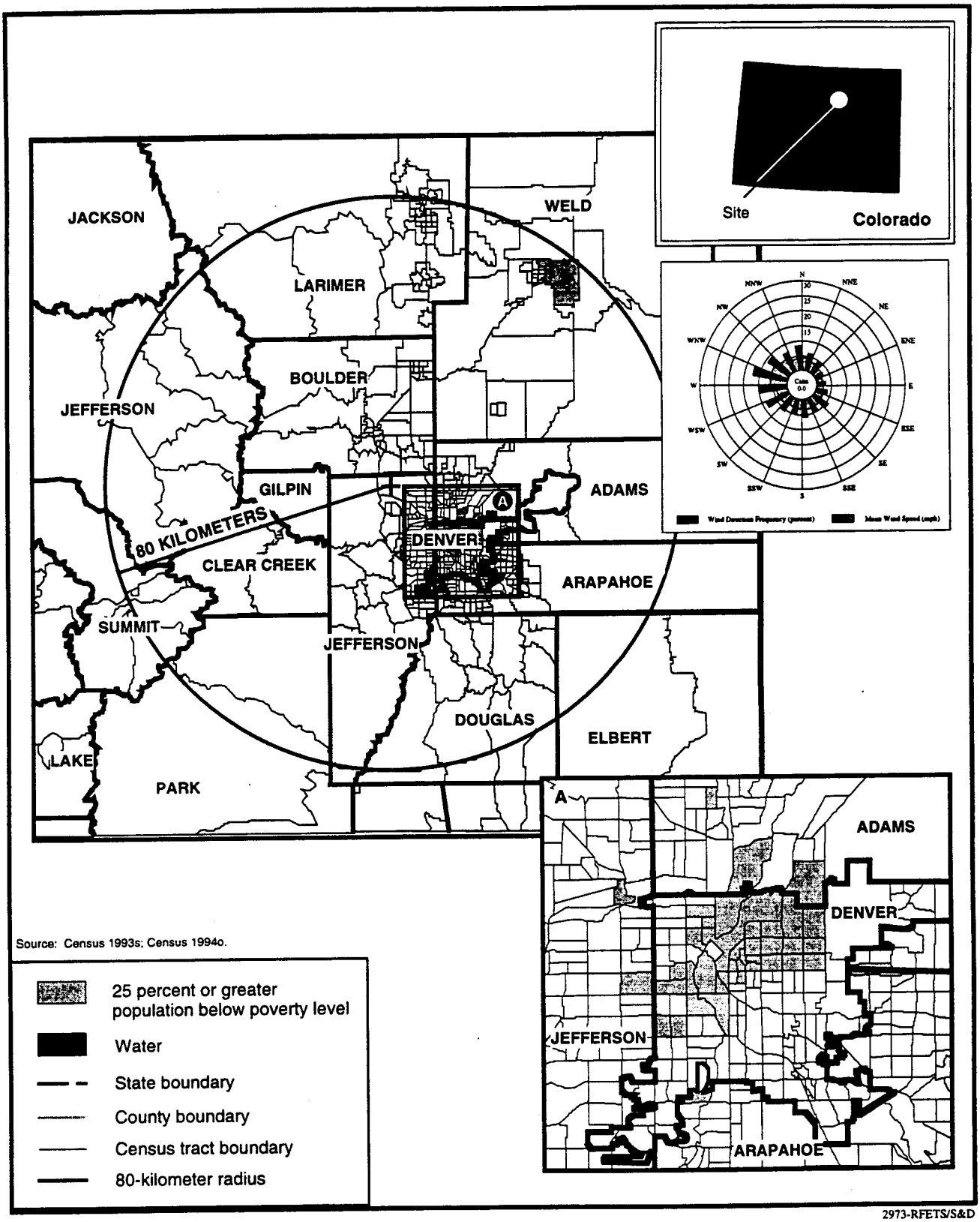

Figure 4.5.1–14. Low-Income Distribution by Poverty Status for Rocky Flats Environmental Technology Site and Surounding Area.

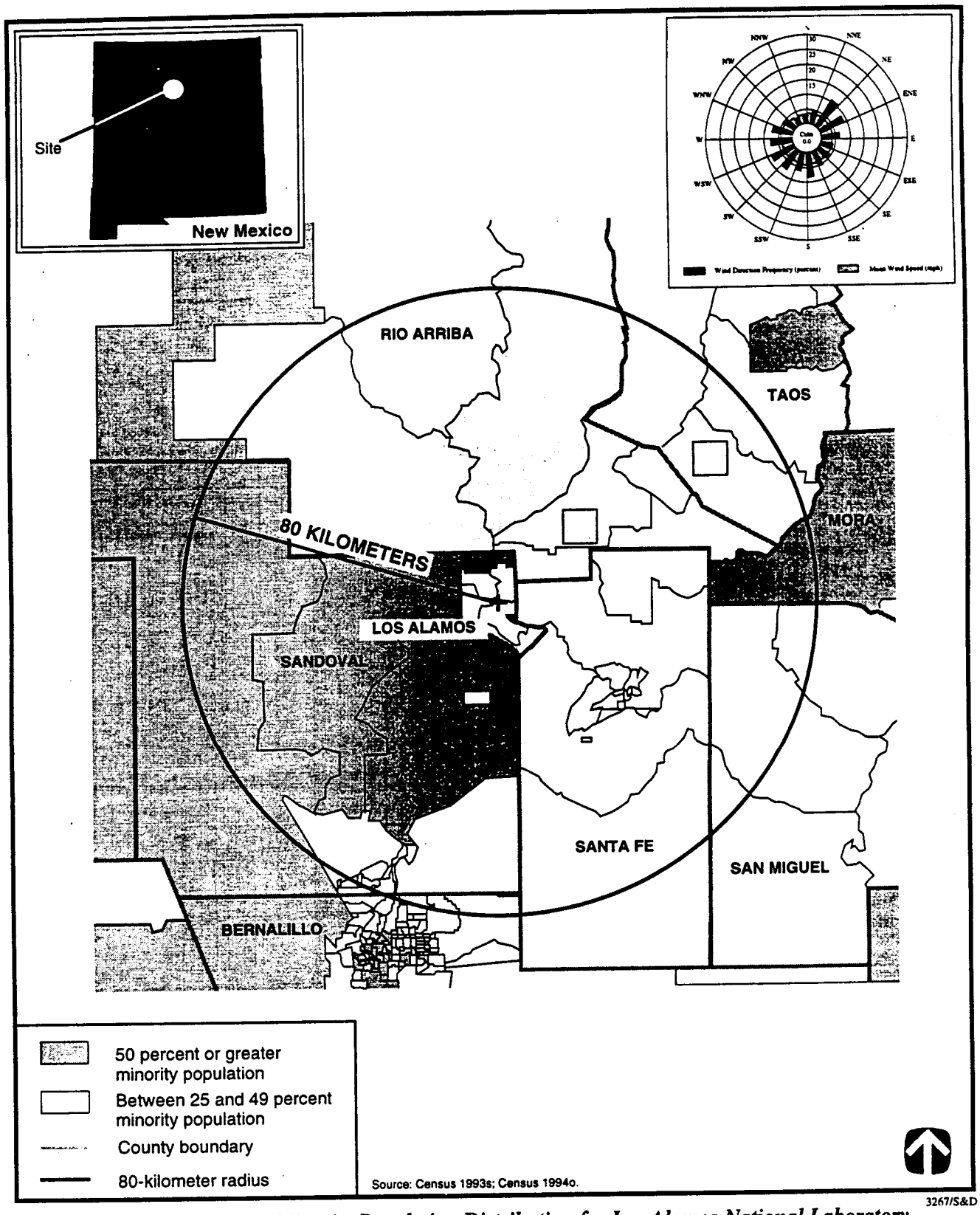

Figure 4.5.1–15. Minority Population Distribution for Los Alamos National Laboratory and Surrounding Area.

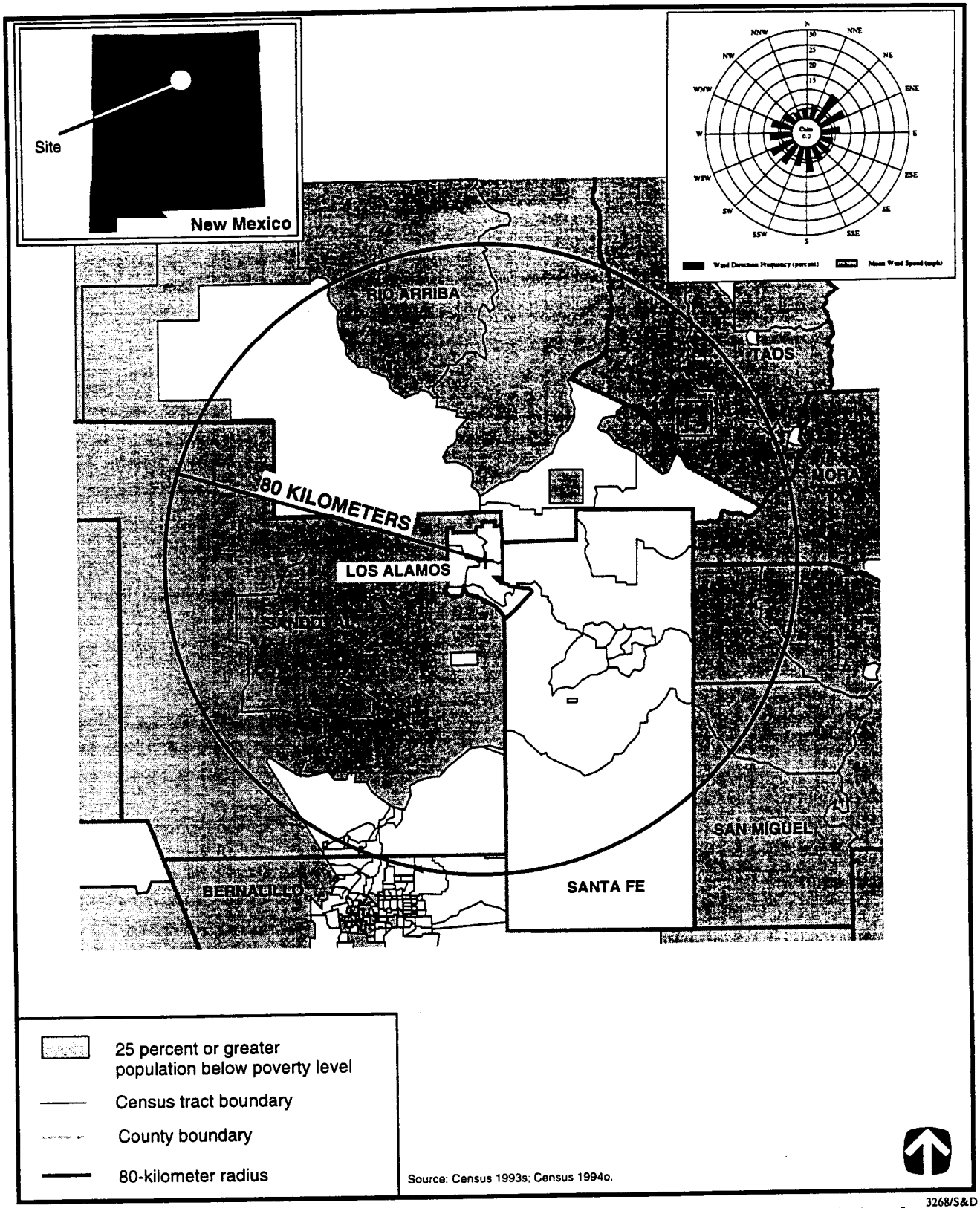

Figure 4.5.1–16. Low-Income Distribution by Poverty Status for Los Alamos National Laboratory and Surrounding Area.

4.5.2 ENVIRONMENTAL CONSEQUENCES

As seen in Figures 4.5.1–1 through 4.5.1–16, minority populations and low-income populations reside within 80 km (50 mi) of each of the DOE sites. The density and distribution of these populations vary from site to site with SRS and LANL having relatively large low-income populations and minority populations and NTS with relatively small low-income populations and minority populations within an 80-km (50-mi) radius of the site. Tables 4.5.1–1 through 4.5.1–8 provide demographic statistics for the ROIs used in the socioeconomic analysis.

For environmental justice impacts to occur, there must be high and adverse human health or environmental impacts that disproportionately affect minority populations or low-income populations. The public health and safety analysis shows that air emissions and hazardous chemical and radiological releases from normal operations for all storage and disposition alternatives would be within regulatory limits and that no latent cancer fatalities would result.

The public health and safety analyses also indicate that radiological releases from accidents would not result in significant adverse human health or environmental impacts. Therefore, such accidents would not have disproportionately high and adverse impacts on minority or low-income populations. For the Preferred Alternative, for accidents associated with existing reactors using MOX fuel, the maximum risk (which includes accident probability) of latent cancer fatalities to the public within 80 km (50 mi) would be 0.10 for the 11-year Pu disposition campaign. It is unlikely that there would be disproportionately high and adverse impacts to minority populations or low-income populations surrounding the existing reactors.

The Preferred Alternative would potentially combine different technologies and facilities at a number of sites. As discussed in Section 4.6, there would be no high or adverse impacts from routine operations or accidents, for such a combination of activities, that would disproportionately affect minority or low-income nonworker populations.

The environmental justice analysis also takes into account potential impacts to subsistence populations. However, DOE is unaware of any identified subsistence populations residing on or near any of the alternative sites.

The Department also notes that because none of the alternatives would lead to radiological releases to water that exceed Federal and State regulations, there would be no incremental impacts to fish or other edible aquatic life in the areas surrounding the alternative sites. All chemical releases would be regulated by NPDES permits and would be in compliance with Federal and State regulations. Furthermore, this PEIS evaluates doses to the surrounding population through air and liquid exposures for all alternatives, including No Action.

The analyses indicates that socioeconomic changes resulting from implementing any of the proposed alternatives would not lead to environmental justice impacts. Most alternatives would provide economic benefits through generating additional employment and income in the affected regions. At some sites there would be increased traffic congestion during facility construction or modification, however this impact would be temporary and would not disproportionately affect minority or low income communities. [Text deleted.] Regional income and employment would never decrease by more than one percent during phaseout, and at INEL, LANL, and Pantex, phaseout would have virtually no impact on either site or regional employment levels.

Transportation accidents are random occurrences that could potentially affect the population around the accident site. However, the random nature of these accidents precludes any disproportionate impact to minority or low income populations.

4.6 SUMMARY OF IMPACTS

The reasonable action alternatives analyzed in the PEIS are this Preferred Alternative, three long-term storage alternatives, and nine disposition alternatives (3 categories). The long-term storage alternatives, the disposition by immobilization alternative, and the Preferred Alternative all have suboptions or variants. In addition to these alternatives, the No Action Alternative has been analyzed for storage and disposition. The potential environmental impacts described in the following sections represent the impacts resulting from each alternative. Detailed explanations and the supporting data for the statements made and conclusions drawn are contained in Sections 4.1 through 4.5.

4.6.1 PREFERRED ALTERNATIVE IMPACTS

The Department's Preferred Alternative for storage and disposition is shown in Table 4.6.1–1. For long-term storage, DOE's Preferred Alternative is a combination of No Action, upgrade, and phaseout for the various DOE sites. For disposition of surplus Pu, the Preferred Alternative is a combination of reactor and immobilization alternatives.

Table 4.6.1–1. Storage and Disposition Actions at Department of Energy Sites Proposed by the Preferred Alternative

Action	Hanford	NTS	INEL	Pantex	ORR	SRS	RFETS	LANL
Storage								
No Action	X[a]	X[b]	X[a]					X[a]
Upgrade				X[c]	X[d]	X[e]		
Phaseout							X	
Disposition[f]								
Pit disassembly/conversion	X		X	X		X		
MOX fuel fabrication	X		X	X		X		
Pu conversion	X					X		
Immobilization	X					X		

[a] Pending subsequent tiered NEPA analysis for disposition of surplus Pu at these sites.
[b] NTS does not currently store either Pu or HEU.
[c] For storage of those pits currently at Pantex, pits from RFETS, and strategic reserve pits only.
[d] For storage of HEU only.
[e] For storage of only those Pu materials currently at SRS and non-pit Pu materials from RFETS.
[f] "X" denotes potential sites for locating the disposition facilities pending subsequent tiered NEPA decisions. Only one of each facility is needed for accomplishing the disposition mission.

Impacts from Storage Actions Under the Preferred Alternative

The Department's Preferred Alternative for the long-term storage of surplus Pu is a combination of No Action, upgrade, and phaseout for the various DOE sites. Table 4.6.1–2 shows the incremental operation requirements, public health risk, and waste generation that would result from the storage actions under the Preferred Alternative.

Land Resources. The implementation of the storage actions under the Preferred Alternative would have no additional impact to land resources and visual resources at all sites except Pantex. The upgrade actions at Pantex would require 0.1 ha (0.25 acre) of land. The amount of land required is a very small portion of the land available for development at the site. The proposed upgrade would be consistent with current and future land-use plans for the site.

Table 4.6.1–2. Incremental Impact Indicators Over No Action From the Annual Operation of the Storage Actions Under the Preferred Alternative

	Hanford No Action	NTS No Action	INEL No Action	Pantex Upgrade[a]	ORR Upgrade	SRS Upgrade[b]	RFETS Phaseout	LANL No Action
Land area used (ha)	0	0	0	0.1	0	0	0	0
Water usage (MLY)	0	0	0	27.5	3	7.1	0	0
Maximum direct employment	0	0	0	90	111	130	-2179	0
Risk of fatal cancer for MEI from lifetime operation	0	0	0	4.5×10^{-13}	5.5×10^{-13}	2.1×10^{-10}	0	0
Solid TRU waste (m^3/yr)	0	0	0	0.8	0	0	0	0
Solid low-level waste (m^3/yr)	0	0	0	138	3	0	0	0
Solid hazardous waste (m^3/yr)	0	0	0	1.5	0.8[c]	0.8	0	0

[a] With RFETS pits.
[b] With RFETS non-pit materials.
[c] Data includes mixed LLW.

Site Infrastructure. The infrastructure at Pantex, ORR, and SRS would be capable of supporting the storage actions under the Preferred Alternative without major modifications. Any minor infrastructure modifications would have negligible impacts at these sites because they would most likely follow existing infrastructure base and rights-of-way.

Air Quality and Noise. Implementing the Preferred Alternative storage action at Pantex, ORR, and SRS would result in short-term air quality impacts during construction and negligible air quality impacts during operation. Modeled air emissions concentrations within applicable Federal, State, and local air quality standards and guidelines. Noise impacts would be negligible at all sites during construction and operation.

Water Resources. At Pantex, all water requirements for the upgrade would be supplied from existing onsite groundwater production wells. The construction and operation of the Upgrade Alternative would contribute to the continued depletion of the Ogallala Aquifer. Surface and groundwater resources at ORR and SRS are adequate to meet the additional requirements of the Preferred Alternative. Water resource impacts at ORR and SRS would be negligible.

Geology and Soils. The construction and operation of the storage actions under the Preferred Alternative would involve some ground disturbing activities with potential for soil erosion at Pantex and SRS. Using standard construction and erosion control measures soil impacts would be negligible. No other apparent direct or indirect effects on geologic resources are anticipated at any of the other DOE sites.

Biological Resources. Construction and operation of the storage actions under the Preferred Alternative would cause minimal disturbance to biological resources at Pantex, ORR, and SRS. All construction and operation activities would take place within an area that was previously disturbed. Minimal impacts to biological resources are expected at any of the other DOE sites as a result of the Preferred Alternative.

Cultural and Paleontological Resources. At Pantex, determinations of NRHP-eligible Cold War Era structures have not yet been completed, but none of the structures that would be modified under the Upgrade Alternative are currently considered NRHP eligible. At ORR, four buildings that are part of the proposed Y–12 Plant

National Register Historic District would be modified under the Preferred Alternative. The Preferred Alternative would not be expected to impact cultural and Paleontological resources at the rest of the DOE sites.

Socioeconomics. At Pantex and SRS, the upgrade would require a small number of additional workers for construction and operation. The small increase in employment would have negligible impact to the regional economy. At RFETS, phaseout of Pu storage would result in the loss of 2,197 direct jobs. Compared to the total employment in the area, the loss of these jobs and the impacts to the regional economy would not be severe. Minimal socioeconomic impacts are expected at the other DOE sites as a result of the Preferred Alternative.

Public and Occupational Health and Safety. The Upgrade Alternative under the Preferred Alternative would increase the amount of Pu stored at Pantex and SRS; increased doses to the public would be negligible. At ORR, doses to the public from upgraded storage would be virtually the same as for storage under No Action. At RFETS, the phaseout of Pu storage would reduce the impacts from radiological and chemical releases and exposure to levels slightly below the No Action levels for normal operations. Stabilization and packaging activities at RFETS would have short-term minor increases in exposure to workers associated with the transport of the Pu. The potential worker exposures would not exceed applicable health and safety regulatory standards. No impacts are expected at the other DOE sites as a result of the Preferred Alternative.

Waste Management. The construction and operation of the storage actions under the Preferred Alternative at Pantex, ORR, and SRS would have an impact on existing waste management activities. Additional wastewater and nonhazardous and hazardous solid waste would be generated at these sites. Hazardous waste would be shipped offsite to a commercial RCRA-permitted treatment and disposal facility. Existing waste handling practices would be used for additional nonhazardous wastes from the new facilities. No waste management impacts are expected at the other DOE sites as a result of the storage action under the Preferred Alternative.

Environmental Justice. The air emissions and hazardous chemical and radiological emissions from normal operations of the storage actions under the Preferred Alternative would be within regulatory limits at all sites. Therefore, there would be no disproportionate impacts to any low income or minority populations at any of the site's due to normal operations. The public health and safety analyses show that air emissions and hazardous chemical and radiological releases from normal operations for the Preferred Alternative storage facilities would be within regulatory limits and that no latent cancer fatalities would result. Because no populations within 80 km (50 mi) of the proposed site would experience high or adverse health or environmental impacts, neither minority populations nor low-income populations would experience disproportionate high and adverse human health or environmental impacts.

The public health and safety analyses also indicate that radiological releases from accidents would not result in significant adverse human health or environmental impacts. Therefore, such accidents would not have disproportionately high and adverse impacts on minority or low-income populations. Potential transportation accidents would be random events along the transportation corridors, therefore, such accidents would not disproportionately impact minority or low income populations.

Intersite Transportation. Potential intersite transportation impacts could occur for transportation of RFETS material to Pantex and because of the small increased risk of traffic accident fatalities. Intersite transportation impacts would primarily be the result of nonradiological impacts such as fatalities from nonradiological highway accidents. The total potential fatalities from the transportation of material under the Preferred Alternative would be 0.006 for Pantex and 0.06 for SRS.

Impacts from Storage and Disposition Actions Under the Preferred Alternative

This section identifies the maximum site impacts that would result at Hanford, INEL, Pantex, and SRS from combining the Preferred Alternative for storage with the Preferred Alternative for disposition at each site. Total site impacts associated with No Action for NTS and LANL, and with phaseout at RFETS, are described in

Section 4.2. The impacts from operating most of the existing reactors would not affect DOE sites and are described in Section 4.3.5. To the extent practical, DOE would use existing buildings and facilities for portions of the disposition activities. The use of existing buildings would reduce the impacts identified in this section. DOE would analyze and compare existing and new buildings for the technologies chosen as part of the Preferred Alternative in subsequent, tiered NEPA reviews.

The preferred strategy for disposition is a combination of reactor and immobilization alternatives. For purposes of analysis, approximately 70 percent of the surplus Pu, which is high purity material, would be converted into MOX fuel for use in nuclear reactors. The Preferred Alternative identifies the use of existing reactors. The Department would retain using MOX fuel in Canadian CANDU reactors in the event of a multilateral agreement among Russia, Canada, and the United States. Low purity Pu would be immobilized in glass or ceramic forms (approximately 30 percent for analysis purposes only). Disposition by use in reactors would require the construction of a MOX fuel fabrication facility and a pit disassembly/conversion facility at a DOE site. Disposition by immobilization would require the construction of a Pu conversion facility and an immobilization facility (either ceramic immobilization or vitrification) at a DOE site. DOE has identified four DOE sites in Table 4.6.1–1 as potential locations for MOX fuel fabrication and pit disassembly/conversion facilities, and two sites for the Pu conversion and immobilization facilities.

The following sections describe the total impacts that would result from the implementation of the Storage and Disposition Program Preferred Alternative at the four DOE sites identified for potential placement of the disposition facilities. The analysis conservatively assumed a maximum impact scenario where two or four disposition facilities could be placed at the same DOE site as shown in Table 4.6.1–1. For immobilization, the analysis conservatively uses impacts from the ceramic immobilization facility since they are generally larger than the impacts from the vitrification facility.

Land Resources. The land-use requirements associated with construction and operation of the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS are shown in Table 4.6.1–3. The requirements shown in Table 4.6.1–3 are the maximum impacts if multiple disposition facilities were located at the same site. Collocating the disposition facilities at a site would likely reduce the amount of land-use impacts due to the sharing of land resources. In addition, optimal use of existing buildings and facilities would occur where possible. All four sites would have adequate land area to accommodate the facilities. Most disposition facilities would be sited in a 1.6-km (1-mi) buffer zone contained within the site boundary. This section describes the impacts to land resources from constructing and operating the Preferred Alternative storage and disposition facilities for each site.

For all four DOE sites, construction and operation would not affect other onsite or offsite land uses. No prime farmlands exist onsite. Construction and operation would be compatible with State and local land-use plans, policies, and controls. Hanford provides information to local jurisdictions for use in their efforts to comply with the GMA.

Hanford Site. Plutonium materials would continue to be stored at the PFP in the 200 West Area, pending decisions on their disposition. No impacts to land-use or visual resources are expected. The pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be located on vacant land in the 200 Area adjacent to 200 East. Construction and operation of the facilities would conform to existing and future land use as described in the *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land-use planning process. According to the *Hanford Site Development Plan*, 200 Area land use is identified as waste operations, which includes radioactive material management, processing, and storage.

Construction and operation would be consistent with the industrialized landscape character of the 200 Area and with the current VRM Class 5 designation. A potential source of visual impacts during operation of the ceramic immobilization facility or MOX facility would be the stack plumes that could be visible from public viewpoints

Table 4.6.1–3. Land-Use Requirements From the Preferred Alternative

Action	Area of Disturbance (ha)			
	Hanford	INEL	Pantex	SRS
Construction				
Storage	0.0	0.0	0.18	0.0
Pit disassembly/conversion	14	14	14	14
Pu conversion	36	NA	NA	36
MOX fuel fabrication	121	121	121	121
Ceramic immobilization	20	NA	NA	20
Total (Maximum Impact)	191	135	135.18	191
Operation				
Storage	0.0	0.0	0.1	0.0
Pit disassembly/conversion	12	12	12	12
Pu conversion	28	NA	NA	28
MOX fuel fabrication	81	81	81	81
Ceramic immobilization	12	NA	NA	12
Total (Maximum Impact)	133	93	93.1	133

Note: NA=not applicable.

Source: Section 4.2.1.1; Section 4.2.3.1; Section 4.3.4.1; Section 4.2.6.1; Section 4.3.1.1; Section 4.3.2.1; Section 4.3.4.2.1; Section 4.3.5.1.1.

with high sensitivity levels, including State Highways 24 and 240 and the city of Richland; however, the proposal would be compatible with the existing industrial character of the area.

Idaho National Engineering Laboratory. Pu materials would continue to be stored at the ICPP and at ANL-W in the ZPPR and FMF vaults, pending decisions on their disposition. No impacts to land-use or visual resources are expected. The pit disassembly/conversion and MOX facilities would be located on undeveloped land within or near the ICPP security area. Construction and operation would be consistent with the *Idaho National Engineering Laboratory Site Development Plan*, which designates the ICPP as situated within the central core area/Prime Development Zone at INEL.

Construction and operation would be consistent with the industrialized landscape character of the ICPP and with the current VRM Class 5 designation. A potential source of visual impact during operation of the MOX facility would be from the stack plumes that could be visible; however, the proposal would be compatible with the existing industrial character of the area.

Pantex Plant. Buildings 12-66 and 12-82 in Zone 12 South would be modified to accommodate the long-term storage of Pantex Pu material and RFETS pit Pu material for the storage Preferred Alternative. Construction and operation would conform with the *Pantex Site Development Plan*, which includes as part of its master plan the Fissile Material Storage Facility in Zone 12. Zone 12 is also the potential location for the pit disassembly/conversion facility. Construction and operation would conform with the *Pantex Site Development Plan*, which designates Zone 12 for weapon assembly/disassembly. The MOX fuel fabrication facility would be located on undeveloped land in Zone 11, which is designated for applied technology. However, Pantex could revise the site development plan. If this change were approved, the proposed MOX facility would be in compliance, resulting in no impact.

The proposed visual environment of Zone 12 would be compatible with the existing industrialized landscape character and the current VRM Class 5 designation would remain. A potential source of visual impacts during operation of the MOX facility in Zone 11 would be the stack plumes that could be visible; however, the proposal would be compatible with the existing industrial character of the area.

Savannah River Site. The APSF in F-Area would be modified to accommodate the long-term storage of SRS non-pit Pu material and RFETS non-pit Pu material for the Preferred Alternative. Vacant land in the F-Area would be used for the pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities. Construction and operation would conform with existing and future land use as designated by the *Savannah River Site Development Plan*. According to the Plan, current F-Area land use is designated industrial operations, while the future land-use category is primary industrial mission. The MOX fuel fabrication facility would be located on undeveloped land approximately 1.6 km (1 mi) north of the P-Reactor Area on the east side of SRS Route F. Construction and operation would conform with future land use as designated by the *Savannah River Site Development Plan*. According to the Plan, the future land-use category for the proposed development site is primary industrial mission. Although the proposal would convert undeveloped land, forested land, and a very small portion of NERP lands, due to conformance of the proposed MOX fuel fabrication facility would conform with site land-use plans.

Construction and operation of the upgrade storage, pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities would be consistent with the industrial landscape character and current VRM Class 5 designation of the F-Area. Construction and operation of the MOX facility would change the current VRM Class 4 designation of the site north of the P-Reactor Area to Class 5. Potential visual impacts could occur during operation of the ceramic immobilization and MOX facilities from additional stack plumes; however, because of hilly terrain, visual effects to public access roads with high sensitivity levels would not occur.

Site Infrastructure. The resource requirements for the construction of the proposed facilities are not expected to exceed site capabilities. Operational requirements from the Preferred Alternative at all sites analyzed are shown in Table 4.6.1–4. The planned facilities use natural gas as the primary utility fuel, and the total requirement for natural gas would be larger than currently available at Hanford, INEL, and SRS. Since INEL and SRS use fuel oil as the primary utility fuel, use of natural gas in lieu of fuel oil would require additional infrastructure. Final designs for facilities under the Preferred Alternative at INEL and SRS would be adapted to use fuel oil. Additional oil and natural gas requirements could be procured through normal contractual means at all sites. Locating the Preferred Alternative disposition actions at any of the analyzed sites would require the construction of additional roads and rail.

Air Quality and Noise. Construction and operation of the proposed facilities under the Preferred Alternative would generate criteria and toxic/hazardous air pollutants. To evaluate potential air quality impacts at Hanford, INEL, Pantex, and SRS, potential concentrations from the facilities have been compared to Federal and State guidelines in Table 4.6.1–5.

Concentrations of PM_{10} and TSP are expected to increase during construction of the facilities. Simultaneous construction of the facilities could result in elevated levels of these pollutants. However, appropriate control measures would be used to control fugitive emissions. It is expected that the sites would typically comply with applicable Federal and State ambient air quality standards during construction.

The PSD regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modification to existing sources. Based on emission rates presented in Appendix F, PSD permits may be required at all of the sites under consideration for the preferred alternative facilities. PSD permits may require inclusion of "offsets" (reductions of existing emissions) for any additional or new emission source.

During operation, concentrations of criteria and toxic/hazardous air pollutants are expected to be in compliance with Federal, State, and local air quality regulations and guidelines at all of the sites analyzed. The estimated pollutant concentrations for the preferred alternative facilities, plus the No Action concentrations, are presented in Table 4.6.1–5.

Noise sources associated with the preferred alternative facilities may include construction equipment, increased traffic, ventilation equipment, cooling systems, and emergency diesel generators. The contribution to offsite

Table 4.6.1–4. Site Infrastructure Requirements From the Preferred Alternative

Action	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Hanford Site					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage (No Action)	345,500	58	9,334,800	21,039,531	0
Projected usage (with Preferred Alternative maximum impact)	424,500	76	9,612,550	34,648,531	0
Storage—No Action[a]	0	0	0	0	0
Pit disassembly/conversion	20,000	5	28,000	3,398,000	0
Pu conversion	21,000	5	39,750	4,361,000	0
MOX fuel fabrication	13,000	5	20,000	2,350,000	0
Ceramic immobilization	25,000	3	190,000	3,500,000	0
Amount required in excess to site availability	0	0	0	13,609,000	0
Idaho National Engineering Laboratory					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage (No Action)	232,500	42	5,820,000	0	11,340
Projected usage (with Preferred Alternative maximum impact)	265,500	52	5,868,000	5,748,000	11,340
Storage—No Action[a]	0	0	0	0	0
Pit disassembly/conversion	20,000	5	28,000	3,398,000	0
MOX fuel fabrication	13,000	5	20,000	2,350,000	0
Amount required in excess to site availability	0	0	0	5,748,000	0
Pantex Plant					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage (No Action)	46,266	10	795,166	7,200,000	0
Projected usage (with Preferred Alternative maximum impact)	80,641	20.3	856,414	13,112,000	0
Storage—upgrade (pits from RFETS)[b]	1,375	0.3	13,248	164,000	0
Pit disassembly/conversion	20,000	5	28,000	3,398,000	0
MOX fuel fabrication	13,000	5	20,000	2,350,000	0
Amount required in excess to site availability	0	0	0	0	0
Savannah River Site					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage (No Action)	794,000	116	28,390,500	0	221,352
Projected usage (with Preferred Alternative maximum impact)	876,600	134	28,668,250	13,609,000	221,642
Storage—upgrade (non-pits from RFETS)[b]	3,600	0	0	0	290
Pit disassembly/conversion	20,000	5	28,000	3,398,000	0
Pu conversion	21,000	5	39,750	4,361,000	0
MOX fuel fabrication	13,000	5	20,000	2,350,000	0
Ceramic immobilization	25,000	3	190,000	3,500,000	0
Amount required in excess to site availability	0	0	277,750	13,609,000	0

[a] Zeros represent no change for values versus site availability.

[b] Assumes impacts for storage without RFETS and LANL material.

Source: Table C.2.1.1–2; Table C.2.1.2–1; Table C.2.1.2–2; Table C.2.1.2–3; Table C.2.1.3–5.

Table 4.6.1–5. Estimated Operational Concentrations of Pollutants From the Preferred Alternative, Including No Action

Pollutant	Averaging Time	No Action ($\mu g/m^3$)	Preferred Alternative Actions: Storage Alternative ($\mu g/m^3$)	Pit Disassembly/ Conversion[a] ($\mu g/m^3$)	Pu Conversion ($\mu g/m^3$)	MOX Fuel Fabrication[a] ($\mu g/m^3$)	Ceramic Immobilization ($\mu g/m^3$)	Most Stringent Regulation or Guideline[b] ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)
Hanford Site[c]									
Criteria Pollutants									
Carbon monoxide	8-hour	0.08	0.08	0.08	0.71	0.08	39.68	10,000	40.31
	1-hour	0.3	0.3	0.3	5.23	0.3	314.95	40,000	319.88
Lead	Calendar Quarter	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.5	<0.06
	24-hour	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.5	<0.06
Nitrogen dioxide	Annual	0.03	0.03	0.03	0.06	0.03	3.75	100	3.78
Particulate matter less than or equal to 10 microns in diameter	Annual	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	50	<0.06
	24-hour	0.02	0.02	0.02	0.02	0.02	0.06	150	0.06
Sulfur dioxide	Annual	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	52	<0.06
	24-hour	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	260	<0.06
	3-hour	0.01	0.01	0.01	0.01	0.01	0.04	1,300	0.04
	1-hour	0.02	0.02	0.02	0.02	0.02	0.11	1,018	0.11
	1-hour	0.02	0.02	0.02	0.02	0.02	0.11	655	0.11
Mandated by the State of Washington									
Gaseous fluoride (as HF)	30-day	[d]	[d]	[d]	<0.01[e]	[d]	[d]	0.8	<0.01[e]
	7-day	[d]	[d]	[d]	<0.01[e]	[d]	[d]	1.6	<0.01[e]
	24-hour	[d]	[d]	[d]	<0.01[e]	[d]	[d]	2.9	<0.01[e]
	12-hour	[d]	[d]	[d]	<0.01[e]	[d]	[d]	3.7	<0.01[e]
Total suspended particulates	Annual	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	60	<0.06
	24-hour	0.02	0.02	0.02	0.02	0.02	0.06	150	0.06

Table 4.6.1–5. Estimated Operational Concentrations of Pollutants From the Preferred Alternative, Including No Action—Continued

Pollutant	Averaging Time	No Action ($\mu g/m^3$)	Preferred Alternative Actions: Storage Alternative ($\mu g/m^3$)	Pit Disassembly/ Conversion[a] ($\mu g/m^3$)	Pu Conversion ($\mu g/m^3$)	MOX Fuel Fabrication[a] ($\mu g/m^3$)	Ceramic Immobilization ($\mu g/m^3$)	Most Stringent Regulation or Guideline[b] ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)
Idaho National Engineering Laboratory[f]									
Criteria Pollutants									
Carbon monoxide	8-hour	284	284	284	NA	284	NA	10,000	284
	1-hour	614	614	614	NA	614	NA	40,000	614
Lead	Calendar Quarter	0.001	0.001	0.001	NA	0.001	NA	1.5	0.001
Nitrogen dioxide	Annual	4	4	4	NA	4	NA	100	4
Particulate matter less than or equal to 10 microns in diameter	Annual	5	5	5	NA	5	NA	50	5
	24-hour	80	80	80	NA	80	NA	150	80
Sulfur dioxide	Annual	6	6	6	NA	6	NA	52	6
	24-hour	135	135	135	NA	135	NA	260	135
	3-hour	579	579	579	NA	579	NA	1,300	579
Mandated by the State of Idaho									
Total suspended particulates	Annual	5	5	5	NA	5	NA	60	5
	24-hour	80	80	80	NA	80	NA	150	80
Pantex Plant[g]									
Criteria Pollutants									
Carbon monoxide	8-hour	602	602	602	NA	602	NA	10,000	602
	1-hour	2,900	2,900	2,900	NA	2,900	NA	40,000	2,900
Lead	Calendar Quarter	0.09	0.09	0.09	NA	0.09	NA	1.5	0.09
Nitrogen dioxide	Annual	2.15	2.15	2.15	NA	2.15	NA	100	2.15
Particulate matter less than or equal to 10 microns in diameter	Annual	8.73	8.73	8.73	NA	8.73	NA	50	8.73
	24-hour	88.5	88.5	88.5	NA	88.5	NA	150	88.5

Table 4.6.1–5. Estimated Operational Concentrations of Pollutants From the Preferred Alternative, Including No Action—Continued

Pollutant	Averaging Time	No Action ($\mu g/m^3$)	Preferred Alternative Actions: Storage Alternative ($\mu g/m^3$)	Pit Disassembly/ Conversion[a] ($\mu g/m^3$)	Pu Conversion ($\mu g/m^3$)	MOX Fuel Fabrication[a] ($\mu g/m^3$)	Ceramic Immobilization ($\mu g/m^3$)	Most Stringent Regulation or Guideline[b] ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)
Pantex Plant (continued)									
Sulfur dioxide	Annual	<0.01	<0.01	<0.01	NA	<0.01	NA	52	<0.01
	24-hour	<0.01	<0.01	<0.01	NA	<0.01	NA	260	<0.01
	3-hour	<0.01	<0.01	<0.01	NA	<0.01	NA	1,300	<0.01
	30-minute	<0.01	<0.01	<0.01	NA	<0.01	NA	1,045	<0.01
Mandated by the State of Texas									
Gaseous fluoride (as HF)	30-day	<0.75	<0.75	<0.75	NA	<0.75	NA	0.8	<0.75
	7-day	<0.75	<0.75	<0.75	NA	<0.75	NA	1.6	<0.75
	24-hour	0.75	0.75	0.75	NA	0.75	NA	2.9	0.75
	12-hour	1.05	1.05	1.05	NA	1.05	NA	3.7	1.05
	3-hour	4.21	4.21	4.21	NA	4.21	NA	4.9	4.21
Total suspended particulates	3-hour	[d]	[d]	<0.01[e]	NA	<0.01[e]	NA	200	<0.02[e]
	1-hour	[d]	[d]	<0.01[e]	NA	<0.01[e]	NA	400	<0.02[e]
Savannah River Site[h]									
Criteria Pollutants									
Carbon monoxide	8-hour	22	22.17	22	27.42	22	360.7	10,000	366.29
	1-hour	171	171.78	171	196.51	171	1,765	40,000	1,791.29
Lead	Calendar Quarter	0.0004	0.0004	0.0004	<0.01	<0.01	<0.01	1.5	<0.03
Nitrogen dioxide	Annual	5.7	5.8	5.7	5.81	5.7	21.91	100	22.12
Particulate matter less than or equal to 10 microns in diameter	Annual	3	3.01	3	3	3	3.02	50	3.03
	24-hour	50.6	50.75	50.6	50.61	50.6	50.97	150	51.13
Sulfur dioxide	Annual	14.5	14.79	14.5	14.5	14.5	14.5	80	14.79

Table 4.6.1–5. Estimated Operational Concentrations of Pollutants From the Preferred Alternative, Including No Action—Continued

Pollutant	Averaging Time	No Action ($\mu g/m^3$)	Preferred Alternative Actions: Storage Alternative ($\mu g/m^3$)	Pit Disassembly/ Conversion[a] ($\mu g/m^3$)	Pu Conversion ($\mu g/m^3$)	MOX Fuel Fabrication[a] ($\mu g/m^3$)	Ceramic Immobilization ($\mu g/m^3$)	Most Stringent Regulation or Guideline[b] ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)
Savannah River Site (continued)	24-hour	196	201.65	196	196	196	196.03	365	201.68
	3-hour	823	859.65	823	823.03	823	823.21	1,300	859.89
Mandated by the State of South Carolina									
Gaseous fluoride (as HF)	30-day	0.09	0.09	0.09	0.09	0.09	0.09	0.8	0.09
	7-day	0.39	0.39	0.39	0.39	0.39	0.39	1.6	0.39
	24-hour	1.04	1.04	1.04	1.04	1.04	1.04	2.9	1.04
	12-hour	1.99	1.99	1.99	1.99	1.99	1.99	3.7	1.99
Total suspended particulates	Annual	12.6	12.61	12.6	12.6	12.6	12.62	75	12.63

[a] Emissions estimates for the facilities are based on data from similar processes at existing facilities. Because of the processing technology (which does not emit some of the criteria pollutants), the defense-in-depth for Pu processing systems and the extensive HEPA filtration (which removes the remaining criteria pollutants), emissions from criteria pollutants other than VOCs are expected to be below detection limits.

[b] The more stringent of the Federal and State standards is presented for the averaging time.

[c] No Action is the preferred alternative at Hanford for the storage of Pu.

[d] No sources of this pollutant have been identified.

[e] Data does not include No Action.

[f] No Action is the preferred alternative at INEL for the storage of Pu.

[g] Upgrade is the preferred alternative at Pantex for the long-term storage of Pu (pit material only).

[h] Upgrade is the preferred alternative at SRS for the long-term storage of Pu (non-pit material only).

Note: NA=not applicable.

Source: Table 4.2.1.3–1; Table 4.2.3.3–1; Table 4.2.4.3–1; Table 4.2.6.3–1; Table 4.3.1.3–1; Table 4.3.2.3–1; Table 4.3.4.2.3–1; Table 4.3.5.1.3–1.

noise levels would continue to be small at all of the sites because the facilities associated with the Preferred Alternative would be a sufficient distance away from the site boundary and sensitive receptors. Due to the size of the sites, noise emissions from construction and operation activities would not be expected to cause annoyance to the public. Some noise sources may result in the disturbance of wildlife.

Water Resources. The construction and operation of the proposed facilities under the Preferred Alternative would affect water resources. Table 4.6.1–6 shows the estimated water usage and wastewater generation from the Preferred Alternative at Hanford, INEL, Pantex, and SRS. All facilities would be constructed outside of the 100-year, 500-year, and probable maximum floodplain; although, where the 500-year floodplain is not completely mapped at SRS, the facility would likely be located outside of the 500-year floodplain. Flooding from dam failures and flooding from a landslide resulting in river blockage are not expected to occur where applicable. The wastewater discharges are expected to continue to meet NPDES limits and reporting requirements at all sites.

Hanford Site. Surface water obtained from the Columbia River would be used as the water source for operation of the proposed facilities. The total water requirement for the Preferred Alternative at Hanford would be less than 1 percent of the Columbia River's average annual flow (3,360 m^3/s [118,642 ft^3/s]). The withdrawals are minor in comparison with the average flow of the river and would not noticeably affect the local or regional water supply.

Table 4.6.1–6. Potential Changes to Water Resources Resulting From the Preferred Alternative

Affected Resource Indicator	Hanford	INEL	Pantex	SRS
Water Source	Surface	Ground	Ground	Ground
No Action water requirement (million l/yr)	13,511	7,570	249	13,247
No Action wastewater discharges (million l/yr)	246	540	141	700
Construction				
Water availability and use				
Total water requirement (million l/yr)	44.2	3.8	3.86	47.2
Storage alternative (million l/yr)	0[a]	0[a]	0.06[b]	3[c]
Pit disassembly/conversion facility (million l/yr)	1.9	1.9	1.9	1.9
Plutonium conversion facility (million l/yr)	2.4	NA	NA	2.4
MOX fuel fabrication facility (million l/yr)	1.9	1.9	1.9	1.9
Ceramic immobilization alternative (million l/yr)	38	NA	NA	38
Percent increase in projected water use[d]	0.33	0.05	1.55	0.36
Water quality				
Total wastewater discharge (million l/yr)	35	3.8	6.9	37.4
Storage alternative (million l/yr)	0[a]	0[a]	3.1[b]	2.4[c]
Pit disassembly/conversion facility (million l/yr)	1.9	1.9	1.9	1.9
Plutonium conversion facility (million l/yr)	2.4	NA	NA	2.4
MOX fuel fabrication facility (million l/yr)	1.9	1.9	1.9	1.9
Ceramic immobilization alternative (million l/yr)	28.8	NA	NA	28.8
Percent increase in wastewater discharge[e]	14.23	0.70	4.89	5.34
Percent increase in stream flow	neg	NA	NA	0.74[f]
Operation				
Water availability and use				
Total water requirement (million l/yr)	481.9	151.4	178.9	489
Storage alternative (million l/yr)	0[a]	0[a]	27.5[b]	7.1[c]
Pit disassembly/conversion facility (million l/yr)	94.6	94.6	94.6	94.6
Plutonium conversion facility (million l/yr)	80.5	NA	NA	80.5
MOX fuel fabrication facility (million l/yr)	56.8	56.8	56.8	56.8
Ceramic immobilization alternative (million l/yr)	250	NA	NA	250

Table 4.6.1–6. Potential Changes to Water Resources Resulting From the Preferred Alternative—Continued

Affected Resource Indicator	Hanford	INEL	Pantex	SRS
Percent increase in projected water use[g]	3.57	2.00	71.85	3.69
Water quality				
Total wastewater discharge (million l/yr)	241.7	128.7	141.6	243.5
Storage alternative (million l/yr)	0[a]	0[a]	12.9[b]	1.8[c]
Pit disassembly/conversion facility (million l/yr)	85.2	85.2	85.2	85.2
Plutonium conversion facility (million l/yr)	15	NA	NA	15
MOX fuel fabrication facility (million l/yr)	43.5	43.5	43.5	43.5
Ceramic immobilization alternative (million l/yr)	98	NA	NA	98
Percent increase in wastewater discharge[h]	98.25	23.83	100.4	34.79
Percent increase in stream flow	neg	NA	NA	4.83[f]
Floodplain				
Is action in 100-year floodplain?	No	No	No	No
Is critical action in 500-year floodplain?	No	No	No	Unlikely

[a] Zero values indicate No Action Alternative for storage at Hanford and INEL.
[b] Value represents upgrade without RFETS and LANL material.
[c] Value represents a conservative assumption for SRS to receive all RFETS and LANL Pu material as opposed to non-pit Pu material only.
[d] Percent increases in water requirements during construction of the proposed facilities are calculated by dividing water requirements for the facility by No Action water requirements at each analyzed site.
[e] Percent increases in wastewater discharged during construction of the proposed facilities are calculated by dividing wastewater discharges for the facility by No Action discharge at each analyzed site.
[f] Percent change in stream flow from wastewater discharges is calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).
[g] Percent increases in water requirements during operation of the proposed facilities are calculated by dividing water requirements for the facilities by No Action water requirements at each analyzed site.
[h] Percent increases in wastewater discharged during operation of the proposed facilities are calculated by dividing wastewater discharges for the facilities by No Action discharge at each analyzed site.

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: Table 4.2.4.4–1; Table 4.2.6.4–1; Table 4.3.1.4–1; Table 4.3.2.4–1; Table 4.3.4.2.4–1; Table 4.3.5.1.4–1.

The wastewater would be disposed to newly constructed sanitary, utility, and process wastewater treatment systems. The wastewater discharge would account for a 98-percent increase over the No Action Alternative projected discharge.

Idaho National Engineering Laboratory. Water requirements for the operation of the Preferred Alternative at INEL would be obtained from groundwater sources. The water requirements for the site over the projected No Action water usage would be a 2-percent increase for operations (approximately 9.6 percent of the groundwater allotment) and less than a 0.05-percent increase for construction (approximately 0.24 percent of the groundwater allotment).

The wastewater discharged during operations would be a 24-percent increase over the No Action projected discharge. Existing INEL treatment facilities could accommodate all the new Preferred Alternative processes and wastewater streams. However, if necessary, new sanitary, utility, and process wastewater treatment systems would be constructed.

Pantex Plant. Water requirements for the operation of the Preferred Alternative at Pantex would be obtained from groundwater resources or, if feasible, from the City of Amarillo Hollywood Road Wastewater Treatment Plant. Should only groundwater be used, the total annual site groundwater withdrawal, including the Preferred Alternative in the year 2005 (the No Action base year), would be 428 million l/yr (112 million gal/yr). This represents a 72-percent increase in the projected No Action usage. However, because the projected No Action

usage reflects reductions in water use due to planned downsizing over the next few years, this quantity (No Action plus the Preferred Alternative) is considerably less than what is currently being withdrawn at Pantex (836 million l/yr [221 million gal/yr]). Although Pantex's groundwater usage is expected to decline in the future, the site will still contribute to the declining water levels of the Ogallala Aquifer.

Total estimated wastewater discharge for the Preferred Alternative (283 million l/yr [74.7 million gal/yr]) at Pantex would result in a 100-percent increase in the No Action projected discharge. If necessary, new sanitary, utility, and process wastewater treatment systems would be constructed.

Savannah River Site. Water requirements during operation of the Preferred Alternative would be obtained from existing or new well fields at SRS. The Preferred Alternative water requirements for the site would be a 3.7-percent increase over projected No Action groundwater usage. Suitable groundwater from the deep aquifers at the site is abundant, and aquifer depletion is not a problem.

The Preferred Alternative wastewater discharge to the river would be less than 5 percent of the minimum flow of Fourmile Branch (0.16 m^3/s [5.7 ft^3/s]), and less than 0.003 percent of the Savannah River average flow (282 m^3/s [9,960 ft^3/s]). SRS treatment facilities could accommodate all the new processes and wastewater streams if a new facility is built for tritium supply and recycling operations as planned. However, if necessary, new sanitary, utility, and process wastewater treatment systems would be constructed.

Geology and Soils. The construction of the proposed facilities under the Preferred Alternative would involve some ground disturbing activities at Hanford, INEL, Pantex, and SRS. Ground disturbance increases the potential for soil erosion. The key factors affecting the erosion potential of a site are the amount of disturbed land and the amount of annual precipitation. The amount of land disturbed as a result of the Preferred Alternative facilities is shown in Table 4.6.1–3. The potential for soil erosion at Hanford, INEL, and Pantex is slight because of low precipitation. Since SRS receives more precipitation, the potential for erosion is considered moderate. The amount of soil loss would depend on the frequency and severity of precipitation events, wind velocities, and the size, location, and duration of soil disturbance.

During operation, improvements (buildings, roads, and landscaping) would considerably reduce the erosion potential. Erosion from stormwater runoff and wind could occasionally occur during operation of the facilities. Beyond increased erosion potential, no direct or indirect effects on geologic resources are anticipated. The construction and operation of the facilities and the site infrastructure improvements would not restrict access to potential geologic resources.

Biological Resources.

Hanford Site. Pu materials would continue to be stored at the PFP in the 200 West Area. There would be no impacts on biological resources anticipated. The pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be constructed on vacant land in the 200 Area adjacent to 200 East. Construction of the four disposition facilities would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Noise from construction and operation activities would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. If the area to which they moved were below its carrying capacity, these animals would be expected to survive. However, if the area were already supporting the maximum number of individuals, the additional animals would compete for limited resources, which could lead to habitat degradation and eventual loss of excess population. Nests and young animals living within the assumed sites may not survive. The sites would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Construction and operation of the four disposition facilities would not affect wetlands or aquatic resources since no wetlands or surface water bodies exist near the assumed facilities locations. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure, and wastewater would be discharged to evaporation/infiltration ponds. Wetlands or aquatic resources bordering the river would not be affected because the volume of water included represents a small percentage of the flow of the river.

It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the four disposition facilities, but sagebrush habitat would be disturbed. The sagebrush community is an important nesting/breeding and foraging habitat for several State-listed and candidate species, such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, and sage thrasher. Pre-activity surveys would be conducted as appropriate before construction to determine the occurrence of plant species or animal species and habitat in the area to be disturbed. DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes, as appropriate.

Idaho National Engineering Laboratory. Pu materials would continue to be stored at the ICPP and at ANL-W in the ZPPR and FMF vaults. There would be no impacts on biological resources anticipated. The pit disassembly/conversion and MOX facilities would be located on undeveloped land within or near the ICPP security area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Construction of the two disposition facilities would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Noise from construction and operation activities would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. If the area to which they moved were below its carrying capacity, these animals would be expected to survive. However, if the area were already supporting the maximum number of individuals, the additional animals would compete for limited resources, which could lead to habitat degradation and eventual loss of excess population. Nests and young animals living with the assumed sites may not survive. The sites would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Wetlands and aquatic resources associated with the nearest surface water body, the Big Lost River, are located 1.6 km (1 mi) from the facility location, so impacts are not expected there. Due to the lack of wetlands or aquatic resources at the assumed facility locations, these resources would not be affected by construction or operation of the two facilities.

It is unlikely that federally threatened or endangered species would be affected by construction of the two disposition facilities, but several State-listed species may be affected. Burrows and foraging habitat for the pygmy rabbit would be lost. Bat species such as the Townsend's western big-eared bat may roost in caves and forage through the assumed site. One State-listed sensitive plant species could potentially be affected by construction of the facility. The plant species, tree-like oxytheca, has been collected at eight sites on INEL and at only two other sites in Idaho. If present, individual plants of this species could be destroyed during land clearing activities. Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of these species in the area to be disturbed. DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes, as appropriate. No impacts to threatened and endangered species are expected due to facility operation.

Pantex Plant. Buildings 12-66 and 12-82 in Zone 12 South would be modified to accommodate the long-term storage of Pantex Pu material and RFETS pit Pu material. Upgrading the existing storage Pu storage facility at Pantex would cause minimal disturbance to biological resources because all activities, including some new construction, would take place within the developed area. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the developed area have already adapted to its presence. Impacts to wetlands and aquatic resources would not occur

since these resources are not found in the upgrade area. Since the upgrade would take place within a developed area, impacts to threatened and endangered species would not be expected.

Zone 12 is also the potential location for the pit disassembly/conversion facility. The MOX fuel fabrication facility would be located on undeveloped land in Zone 11, which lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed locations; however, small mammals and some birds and reptiles could be displaced by construction. Since the area around both locations does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the facility. During operation, wastewater would be discharged to site playas through NPDES-regulated outfalls. The additional wastewater could lead to minor increases in open water near the outfalls, as well as changes in plant species composition. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of the facilities. Although the assumed sites have been disturbed, it is possible that the State-listed Texas horned lizard could be present. Before construction, preactivity surveys would be conducted, as appropriate, to determine the presence of any special status species and habitat on the proposed site. DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes, as appropriate.

Savannah River Site. The APSF in F-Area would be modified to accommodate the storage of RFETS non-pit Pu material in addition to SRS non-pit Pu material. There would be minimal additional impacts on biological resources anticipated with modifying the APSF in F-Area.

Vacant land in the F-Area would be used for the pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities. Impacts to terrestrial resources would be minimal because the F-Area is one of the highly developed industrial areas of the SRS. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since there would be relatively small increases in treated wastewater and stormwater that would be discharged via NPDES permitted outflows. Impacts from construction and operation of the three disposition facilities would not be expected to affect threatened and endangered species due to the developed nature of the assumed facility locations. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the facilities so that this species would not be directly affected by these facilities. Before committing construction resources, DOE would consult with Federal and State agencies pursuant to the ESA and other statutes, as appropriate.

The MOX fuel fabrication facility would be located on undeveloped land approximately 1.6 km (1 mi) north of the P-Reactor Area on the east side of SRS Route F. Construction of the MOX facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Noise from construction and operation activities would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. If the area to which they moved were below its carrying capacity, these animals would be expected to survive. However, if the area were already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of excess population. Nests and young animals living with the assumed sites may not survive. The sites would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Since the majority of the assumed MOX fuel fabrication facility site is upland, the facility could be located to avoid direct impacts to wetlands. It would not be necessary to disturb wetlands along the site streams. Wastewater discharge from construction and operation would be minimal and would not be expected to affect wetlands associated with the receiving stream. Stormwater runoff during construction could cause temporary

water quality changes in local tributaries to Par Pond. During operation, nonhazardous wastewater would be discharged to local drainage channels. Flow increases are not expected to impact stream hydrology or aquatic resources. All discharges would be required to meet NPDES permit regulations.

It is unlikely that federally listed threatened or endangered species are expected to be affected by construction or operation of a MOX fuel fabrication facility. Although bald eagles have been sighted in the vicinity of the assumed facility location, it is highly unlikely that construction and operation of the MOX fuel fabrication facility would affect this species. Although suitable foraging habitat for the red cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the facilities so that this species would not be directly affected by the MOX facility, Before construction, preactivity surveys would be conducted as appropriate to determine the presence of any special status species and habitat on the proposed site. DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes, as appropriate.

Cultural and Paleontological Resources. The potential impacts to cultural and paleontological resources are closely related to the amount of land disturbed. The land-use requirements associated with construction and operation of the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS are shown in Table 4.6.1–3. Collocating the disposition facilities at a site would likely reduce the amount of land disturbed during construction and reduce the impacts to cultural and paleontological resources. In addition, optimal use of existing buildings and facilities would occur where possible. Because most of the locations proposed have been previously disturbed (except at SRS), it is unlikely that they would contain subsurface prehistoric or historic archaeological deposits. Some paleontological remains may be encountered during construction. Operations would not have additional impacts on historic, prehistoric, or paleontological resources, but there may be visual or auditory intrusions to Native American resources at some site. This section describes the impacts to cultural and paleontological resources of constructing and operating the storage and disposition facilities for each Preferred Alternative site.

Hanford Site. Pu materials would continue to be stored at the PFP in the 200 West Area. For the storage Preferred Alternative, there would be no anticipated impacts to cultural or paleontological resources. The pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be located on vacant land in the 200 Area adjacent to 200 East. Although no archeological resources have been identified during surveys conducted in the adjacent 200 Areas, some may exist in the facility locations. Any such sites would be identified through compliance with Sections 106 and 110 of the NHPA. Any identified sites may be affected by facility construction. Operation would not result in additional impacts.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Area. Resources may be identified through facility-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the facility locations, they may exist. These resources may be affected by ground disturbing construction. Operations would not have additional impacts on paleontological resources.

Idaho National Engineering Laboratory. Pu materials would continue to be stored at the ICPP and the ZPPR and FMF vaults in ANL-W. For the storage Preferred Alternative, there would be no anticipated impacts to cultural or paleontological resources. The pit disassembly/conversion and MOX facilities would be located on undeveloped land within or near the ICPP security area. The pit disassembly/conversion facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of this area identified no prehistoric or historic sites. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits, due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archeological remains be discovered during construction. Two historic sites occur adjacent to the ICPP—one historic can scatter across the Big Lost River to the northeast, and one

abandoned homestead to the east. The can scatter is not considered eligible for NRHP listing, and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed facilities. Facility construction and operation may have visual or auditory impacts on traditional use areas or sacred sites. Resources may be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain, which have produced fossilized remains. Operation would not have an effect on paleontological resources.

Pantex Plant. Buildings 12-66 and 12-82 in Zone 12 South would be modified to accommodate the long-term storage of Pantex Pu material and RFETS pit Pu material for the storage Preferred Alternative. These buildings are not considered NRHP eligible based on an evaluation of World War II Era structures at Pantex. However determinations of NRHP-eligible Cold War Era structures have not been completed, and some structures in Zone 12 may be determined eligible on that basis. Zone 12 is also the potential location for the pit disassembly/conversion facility. Because Zone 12 South is developed, disturbed, and removed from water sources, it is unlikely to contain subsurface prehistoric or historic archeological deposits, even on lands used for equipment laydown or construction parking. No impacts to prehistoric or historic resources are expected to result from the construction or operation of these facilities.

The MOX fuel fabrication facility would be located on undeveloped land in Zone 11. Areas that would be disturbed in Zone 11 have not been systemically surveyed for archaeological or paleontological resources. Before construction, additional survey work may be necessary under Section 106 of the NHPA. Because Zone 11 is disturbed, it is unlikely to contain subsurface prehistoric or historic archeological deposits. Should any subsurface remains be discovered during construction, appropriate mitigation, documentation, and/or preservation measures would be conducted as necessary. Operations would not have additional impacts to archeological resources as it does not result in additional ground disturbance. Facility construction may have an impact on historic structures at Pantex. The original buildings in Zone 11 were constructed between 1942 and 1945 to produce general purpose bombs. Zone 11 contains buildings, ramps, and landscape features that clearly illustrate the historic layout of a World War II bomb manufacturing line. Only two buildings within Zone 11 have been determined ineligible for listing on the NRHP. Construction may obscure the spatial relationship between these buildings, thereby compromising their historic significance. Operation of the facility is not expected to affect historic structures.

The Department has recently initiated consultation with Native American groups that have expressed interest in Pantex lands. To date, no Native American resources have been identified within Zones 11 and 12. Resources may be identified through additional consultation. Although no mortuary remains have been discovered at Pantex to date, it is possible that some exist within land to be disturbed by development. Burials are considered important Native American resources. Construction and operation could affect traditionally used plant and animal species.

The surficial geology of the Pantex area consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the High Plains, this formation has produced Late Pleistocene vertebrate remains including woolly mammoth, bison, and camel, sometimes in context with archaeological remains. The land to be disturbed during construction may contain some fossilized remains. Operation would not have an affect on paleontological resources.

Savannah River Site. The APSF in F-Area would be modified to accommodate the storage of SRS non-pit Pu material and RFETS non-pit Pu material for the storage Preferred Alternative. Vacant land in the F-Area would be used for the pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities. Portions of

the F-Area have been surveyed and contain sites potentially eligible for the NRHP. Additional surveys would be conducted in any unsurveyed areas to be disturbed by construction to comply with NHPA Sections 106 and 110. Site types known to occur at SRS include remains of prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by new facility construction, but not operation.

The MOX fuel fabrication facility would be located on undeveloped land approximately 1.6 km (1 mi) north of the P-Reactor Area on the east side of SRS Route F. To date, seven prehistoric sites have been located within 0.5 km (0.3 mi) of this area, so the potential for archaeological sites is moderate to high, and some NRHP-eligible resources may occur within the acreages that would be disturbed by construction. Prehistoric site types that may occur at SRS include villages, base camps, limited activity sites, quarries, and workshops. Historic site types that may occur at SRS include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farming dikes, cattle pens, dams, towns, churches, cemeteries, trash scatters, and roads.

Some Native American resources may be affected by construction and operation of the facilities. Resources such as prehistoric sites, cemeteries, isolated burials, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to the areas may also result from the proposed facilities. These resources would be identified through consultation with the potentially affected tribes.

Some paleontological remains may occur on this acreage, but impacts during construction would be considered negligible because fossil assemblages known to occur at SRS are of low research value. No additional impacts are expected to paleontological resources during operation since no additional ground disturbance is expected.

Socioeconomics. The socioeconomic impact indicators associated with construction and operation of the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS are shown in Table 4.6.1–7. The maximum impacts that could result from the operating of multiple storage and disposition facilities at one site are shown in the table. Although collocating multiple disposition facilities would likely lead to economies of scale, the ensuing analysis assumes that there would be no sharing of labor resources among the different operations. At all four sites the primary impact of the Preferred Alternative would be to increase regional employment and income. There would be some increase in demand for community services and housing at each of the sites as a result of in-migrating population. However, the available housing and existing community infrastructure would be able to accommodate these small population increases. Construction and operation of the proposed facilities would increase traffic flow and cause a potential decline in the level of service on some road segments at all sites except Hanford.

Table 4.6.1–7. Changes to Economic and Demographic Indicators for the Preferred Alternative (Full Operation)

Indicator	Hanford	INEL	Pantex	SRS
Change in ROI population	5,095	2,125	4,298	6,153
Percent change in ROI population	1.1	0.9	2.0	1.2
Change in REA employment	10,370	5,998	6,404	9,482
Percent change in REA employment	2.8	3.8	2.9	3.3
Change in REA per capita income	$464	$266	$94	$326
Percent change in REA per capita income	2.0	1.4	0.5	1.6

Source: Socio 1996a.

Hanford Site. Plutonium materials would continue to be stored at the PFP in the 200 West Area, and there would be no impact on the site workforce. However, under the Preferred Alternative, pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would also be located at Hanford. Construction of the various facilities would continue through the year 2013, and there would be sufficient available labor within the

region to fulfill construction workforce requirements. Economic impacts from construction would peak in 2010, during construction of the ceramic immobilization facility. Total REA employment would increase by 2,001 due to construction of the ceramic immobilization facility. However, during this same period, the other three disposition facilities would already be fully operational, generating an additional 7,467 jobs in the REA.

In 2003, the pit disassembly/conversion and MOX facilities would be the first disposition alternative facilities to become fully operational. Pu conversion would begin in 2006, and the ceramic immobilization operations would begin in 2013. The operational workforce would increase beginning in 2003 and peak in 2013 when all of the disposition facilities would become fully operational. Total direct employment would reach 3,073 in 2013. Total REA employment would increase by 10,370, and unemployment would decrease from 9.1 percent to 7.1 percent. The per capita income would increase by 2 percent. In-migration to fulfill specialized direct job requirements would lead to a population increase of about 1 percent in the ROI.

The additional population would increase the demand for community services by approximately 1 percent. A total of about 50 new teachers would be needed by 2013. Because the increase in demand would occur over a 10-year period and would be distributed over several school districts, there would be no significant impact on any single district. Thirteen additional police officers and seven firefighters would be needed to maintain No Action service levels. Six more doctors would be needed to maintain the projected No Action doctor-to-population ratio. In each case, the increase would be 1 percent or less over the No Action Alternative. Demand for housing would also increase, but the impact on the local markets would be minimal.

Construction and operation workers at Hanford would generate 1,920 and 5,900 additional vehicle trips per day on local roads, respectively. The level of service would not change due to the additional traffic generated during construction. Operations would cause a drop in level of service from B to C on Washington State Route 240 from Washington State Route 24 to Washington State Route 224.

Idaho National Engineering Laboratory. Plutonium material would continue to be stored at ICPP and ZPPR, and in FMF vaults at ANL-W. No additional workforce would be required for continuation of the storage mission at INEL. However, under the Preferred Alternatives, pit disassembly/conversion and MOX facilities would also be located at INEL. Construction of the two facilities would take place concurrently and continue through 2003. Some in-migration would take place both during construction and operation to fill specialized job requirements. Direct employment during peak construction would reach 660 in 1999 and total 1,330 during the first year of full operation in 2003. Total REA employment would increase by 1,192 during construction and by 5,998 during operations. Unemployment would decrease from 5.4 percent to 4.8 percent during peak construction and fall further to 2.4 percent during operation. The per capita income would increase by less than 0.4 percent during construction and by about 1.4 percent during operations.

In-migration to fulfill direct job requirements for both construction and operations would lead to a population increase of less than 1 percent in the ROI. The additional population would increase demand for community services by less than 1 percent during both construction and operations. A total of approximately 7 new teachers would be needed by 1999, and 29 by 2003. Because the increase in demand would occur over a multiyear period and would be distributed over several school districts, there would be no significant impact on any single district. One additional police officer and no firefighters would be needed during the construction phase to maintain the No Action service levels. During operations, five police officers and four firefighters would be needed. While one additional doctor would be required during construction, two doctors would be needed to maintain the No Action doctor-to-population ratio during full operation. In each case, the increase would be less than 1 percent over the No Action Alternative. Demand for housing would also increase, but, the impact on the local markets would be minimal.

Construction and operation workers at INEL would generate 1,267 and 2,554 additional vehicle trips per day on local roads, respectively. The level of service would not change due to the additional traffic generated during construction. Operations would cause a drop in level of service from D to E on US 20 from US 26/91 at Idaho

Falls to US 26 East. Operations would also cause a drop in level of service from B to C on US 20/26 from US 26 East to Idaho State Route 22/33.

Pantex Plant. Buildings 12-66 and 12-82 would be modified to accommodate the long-term storage of Pantex Pu material and RFETS pit Pu material for the storage Preferred Alternative. Additional workers would be required for construction and operation of the modified storage facilities. The Preferred Alternative would also involve locating pit disassembly/conversion and MOX fabrication facilities at Pantex. Construction of these two facilities would take place concurrently and continue through 2003, when full operations would commence. Because the construction of the disposition facilities would require a larger workforce than would modification of the storage facilities, peak construction impacts would occur in 1999. Peak operation impacts would occur in 2005, when all three facilities would be fully operational. Total direct construction employment during peak construction would reach 660 in 1999, and direct operation employment would reach 1,420 in 2005, when all three facilities would be fully operational. Total REA employment would increase by 1,192 during peak construction and by 6,404 during operations. Unemployment would decrease from 4.8 percent to 4.3 percent during peak construction and fall further to 3.0 percent during operations. The per capita income would increase about 0.3 percent during construction and by 0.5 percent during operations.

In-migration to fulfill direct job requirements for both construction and operations would lead to a population increase of 0.1 percent during construction and about 2 percent during operation. The increase in demand for community services during construction would be minimal. One additional teacher would be needed to maintain the No Action level of service. However, no additional police officers, firefighters, or doctors would be required during the construction phase. During operation, an additional 48 teachers would be required to maintain the No Action student-to-teacher ratio. Because the increased demand would occur over a multiyear period and would be distributed over several school districts, there would be no significant impact on any single district. Seven additional police officers and 10 firefighters would be needed to maintain No Action service levels. In addition, seven more doctors would be needed to maintain the No Action doctor-to-population ratio. These increases would average about 2 percent over the No Action Alternative. Demand for housing would also increase, but, the impact on the local markets would be minimal.

Construction and operation workers at Pantex would generate 1,267 and 2,726 additional vehicle trips per day on local roads, respectively. The level of service would not change due to the additional traffic generated during construction. Operations would cause a drop in level of service from A to B on Farm-to-Market 683 from U.S. 60 to Farm-to-Market 293 and on Farm-to-Market 2373 from I-40 to U.S. 60.

Savannah River Site. Under the Preferred Alternative, the Actinide Packaging and Storage Facility in the F-area would be modified to accommodate the long-term storage of the SRS non-pit Pu material and RFETS non-pit Pu material. The modification activities would employ workers from the current workforce, while operation of the expanded storage facility would require some additional workers. Under this alternative, pit disassembly/conversion, Pu conversion, MOX fuel fabrication, and the ceramic immobilization facilities would also be located at SRS. Construction of the various facilities would continue until 2013, when all of the facilities would become operational. There would be sufficient available labor in the region to fulfill the construction workforce requirements.

Economic impacts from construction would peak in 2010, during construction of the ceramic immobilization facility. Total REA employment would increase by 1,793 due to construction of the ceramic immobilization facility. However, during this same period, the other three disposition facilities would already be operating and generating an additional 6,936 jobs in the REA.

Peak economic impacts would occur in 2013, when all of the storage and disposition facilities would be fully operational. Total employment in the region would increase by 9,482, and unemployment would decrease to 4.5 percent. Regional per capita income would increase by about 1.6 percent.

Because of the demand for in-migrating workers to fill specialized employment requirements, the ROI population would increase by 0.9 percent. Demand for community services would also increase. To maintain the No Action student-to-teacher ratio, a total of 65 new teachers would have to be added to the ROI school districts, an increase of about 1 percent. Because the increase in demand for teachers would take place over a several years and affect several school districts, there would be minimal impact on any single school district.

The population increase would also result in the need for 18 police officers and 18 firefighters to maintain No Action service levels. In addition, 10 doctors would be required to maintain the No Action doctor-to-population ratio. In each case the increase would be about 1 percent or less. The increase in demand for housing would be too small to affect the market.

Construction and operation workers at SRS would generate 1,920 and 6,150 additional vehicle trips per day on local roads, respectively. Construction would cause a drop in level of service from E to F on South Carolina State Route 19 from U.S. 1/78 at Aiken to U.S. 278. Operations would not significantly impact local roads.

Public and Occupational Health and Safety. Tables 4.6.1–8 through 4.6.1–11 present the potential human health impacts from the radiological and hazardous chemical releases during facility normal operations and potential accidents associated with the combination of storage and disposition Preferred Alternative actions at each of the DOE sites.

Normal Operations. The human health impacts from the radiological and hazardous chemical releases during facility normal operations associated with the storage and disposition Preferred Alternative actions were analyzed at each of the DOE sites. The impact of the Preferred Alternative actions were then combined to obtain the "total impact." Total impact for each receptor/impact parameter is the summation of each facility, action, process, or technology for each of the operational campaigns (the number of years required to complete Pu disposition). Under normal radiological operations, the annual incremental dose to the MEI ranges from 2.7×10^{-4} mrem/yr at INEL to 4.1×10^{-3} mrem/yr at SRS. All doses, when added to No Action, are within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The annual incremental dose to the population within 80 km (50 mi) from the Preferred Alternative ranges from 4.2×10^{-3} person-rem/yr at INEL to 0.22 person-rem/yr at SRS. For DOE activities, proposed 10 CFR 834 (See 58 FR 1628) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA Program. When the contribution from the Preferred Alternative is combined with the No Action population dose for each of the sites, the total dose is well within the proposed 10 CFR 834. The dose assessments of the involved worker for storage and disposition facilities are within DOE radiological limits and administrative control levels. The incremental latent cancer fatalities to the involved workforce statistically estimated from these doses attributed to the Preferred Alternative range from 0.48 at INEL to 1.32 at SRS for the entire campaign (estimates based on the *1990 Recommendations of the International Commission of Radiological Protection*).

Facility Accidents. A set of potential accidents was postulated for each component of the Preferred Alternative. For each DOE site subject to multiple storage and disposition actions (Hanford, INEL, Pantex, and SRS), this includes a set of accidents for the storage option coupled with the combination of preferred disposition technologies assumed for the analysis. For the Existing LWR Alternative, a PRA approach was applied to determine the effects of operating an existing LWR with a MOX core. The incremental effects are described below.

One measure of impact calculated from modeled accident scenarios is expected risk, the summation of risk (the product of accident occurrence probability and consequence) for the accident spectrum modeled for each component of the Preferred Alternative. These expected risks were aggregated for the Preferred Alternative for the following impact receptors: a worker located 1,000 m (3,280 ft) from the accident release point; the maximum offsite individual located at the site boundary; and the population located within 80 km (50 mi) of the accident release point. Aggregated expected risk estimates of cancer fatality(s) for each assumed campaign under the Preferred Alternative range from: 1.3×10^{-6} at INEL to 1.5×10^{-5} at Pantex; 1.4×10^{-8} at INEL to

Table 4.6.1–8. Potential Human Health Impacts to the Public and Workers Under Normal Operation and Potential Accidents for the Preferred Alternative at Hanford Site

Receptor/Impact Parameter	Site No Action/ Reference Baseline (per 50 years of operation)[a,b]	Disposition Facility: Pit Disassembly/ Conversion (per 10-year campaign)[b]	Disposition Facility: Pu Conversion (per 10-year campaign)[b]	Disposition Facility: MOX Fuel Fabrication (per 11-year campaign)[b]	Disposition Facility: Immobilization (per 3.5-year campaign)[b]	Total Incremental Impact
Normal Operations						
Radiological Impacts						
MEI						
Annual dose (mrem/yr)	5.3×10^{-3}	2.9×10^{-4}	1.8×10^{-4}	1.4×10^{-4}	2.3×10^{-7}	6.1×10^{-4}
Health effects (LCF risk)	1.3×10^{-7}	1.4×10^{-9}	9.0×10^{-10}	7.8×10^{-10}	4.2×10^{-13}	3.1×10^{-9}
Public Within 80 km						
Annual dose (person-rem/yr)	1.6	0.016	8.4×10^{-3}	6.2×10^{-3}	3.9×10^{-5}	0.031
Health effects (LCFs)	0.039	8.0×10^{-5}	4.2×10^{-5}	5.3×10^{-5}	7.0×10^{-8}	1.6×10^{-4}
Total Involved Workforce						
Health effects (LCFs)	5.1	0.34	0.53	0.14	0.16	1.17
Hazardous Chemical Impacts						
MEI						
Hazard index	6.2×10^{-5}	2.7×10^{-5}	2.9×10^{-5}	3.3×10^{-5}	2.6×10^{-3}	0.003
Cancer risk	0	0	3.2×10^{-8}	0	0	3.2×10^{-8}
Worker Onsite						
Hazard index	4.0×10^{-3}	5.0×10^{-4}	1.6×10^{-3}	1.6×10^{-3}	1.6×10^{-1}	0.164
Cancer risk	0	0	1.4×10^{-5}	0	0	1.4×10^{-5}
Facility Accidents						
MEI (LCF risk)	[c]	2.6×10^{-8}	2.0×10^{-8}	2.9×10^{-8}	1.7×10^{-11}	7.5×10^{-8}
Public within 80 km (LCF risk)	[c]	4.7×10^{-5}	3.6×10^{-5}	5.2×10^{-4}	2.4×10^{-8}	6.0×10^{-4}
Worker at 1,000 m (LCF risk)	[c]	6.5×10^{-7}	4.9×10^{-7}	7.1×10^{-7}	2.0×10^{-9}	1.9×10^{-6}

[a] The contribution from existing Pu storage is included in the site No Action total. A more detailed description of No Action impacts can be found in Section 4.2.1.9.

[b] Applies to health effects calculations for normal operations and facility accident risks.

[c] The safety to workers and the public from accidents at existing facilities is controlled by Technical Safety Requirements specified in a SAR or a Basis for Interim Operations document.

Note: LCF=latent cancer fatality; MEI=maximally exposed individual member of the public.

Source: Section 4.2.1.9; Section 4.3.1.9; Section 4.3.2.9; Section 4.3.4.1.9; Section 4.3.5.1.9.

Table 4.6.1–9. Potential Human Health Impacts to the Public and Workers Under Normal Operation and Potential Accidents for the Preferred Alternative at Idaho National Engineering Laboratory

Receptor/Impact Parameter	Site No Action/ Reference Baseline (per 50 years of operation)[a,b]	Disposition Facility: Pit Disassembly/ Conversion (per 10-year campaign)[b]	Disposition Facility: MOX Fuel Fabrication (per 11-year campaign)[b]	Total Incremental Impact
Normal Operations				
Radiological Impacts				
MEI				
Annual dose (mrem/yr)	0.018	1.8×10^{-4}	8.8×10^{-5}	2.7×10^{-4}
Health effects (LCF risk)	4.4×10^{-7}	9.0×10^{-10}	4.9×10^{-10}	1.4×10^{-9}
Public Within 80 km				
Annual dose (person-rem/yr)	2.4	3.2×10^{-3}	9.7×10^{-4}	4.2×10^{-3}
Health effects (LCFs)	0.061	1.5×10^{-5}	5.4×10^{-6}	2.0×10^{-5}
Total Involved Workforce				
Health effects (LCFs)	4.4	0.34	0.14	0.48
Hazardous Chemical Impacts				
MEI				
Hazard index	1.5×10^{-2}	5.8×10^{-5}	7.1×10^{-5}	1.3×10^{-4}
Cancer risk	3.6×10^{-6}	0	0	0
Worker Onsite				
Hazard index	2.2×10^{-1}	5.1×10^{-4}	1.6×10^{-3}	2.1×10^{-3}
Cancer risk	7.7×10^{-4}	0	0	0
Facility Accidents				
MEI (LCF risk)	[c]	6.6×10^{-9}	7.1×10^{-9}	1.4×10^{-8}
Public within 80 km (LCF risk)	[c]	1.4×10^{-5}	1.6×10^{-5}	3.0×10^{-5}
Worker at 1,000 m (LCF risk)	[c]	6.1×10^{-7}	6.5×10^{-7}	1.3×10^{-6}

[a] The contribution from existing Pu storage is included in the site No Action total. A more detailed description of No Action impacts can be found in Section 4.2.3.9.

[b] Applies to health effects calculations for normal operations and facility accident risks.

[c] The safety to workers and the public from accidents at existing facilities is controlled by Technical Safety Requirements specified in a SAR or a Basis for Interim Operations document.

Note: LCF=latent cancer fatality; MEI=maximally exposed individual member of the public.

Source: Section 4.2.3.9; Section 4.3.1.9; Section 4.3.2.9; Section 4.3.4.1.9; Section 4.3.5.1.9.

6.0×10^{-6} at Pantex; and 3.0×10^{-5} at INEL to 9.1×10^{-4} at Pantex; respectively for these impact receptors. The Y–12 upgrade at ORR under the Preferred Alternative could reduce the expected risk of cancer fatalities for the design basis accidents analyzed in the Y–12 EA to 5.1×10^{-7}, 7.4×10^{-6}, and 5.7×10^{-8} per year for the 80-km (50-mi) offsite population, MEI, and noninvolved worker, respectively by meeting the performance goal for a moderate hazard facility of Performance Category 3 as prescribed in DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*.

The evaluated accident scenario with the highest risk to the public at the DOE sites under the Preferred Alternative (a fire on the loading dock of the MOX fuel fabrication facility) would result in an estimated risk of 5.2×10^{-5}, 1.6×10^{-5}, 1.8×10^{-5}, and 5.2×10^{-5} cancer fatalities over the assumed MOX fuel fabrication campaign at Hanford, INEL, Pantex, and SRS, respectively.

Table 4.6.1–10. Potential Human Health Impacts to the Public and Workers Under Normal Operation and Potential Accidents for the Preferred Alternative at Pantex Plant

Receptor/Impact Parameter	No Action/ Reference Baseline (per 50 years of operation)[a]	Pantex Pu Storage Upgrade (per 50 years of operation)[a,b]	Disposition Facility: Pit Disassembly/ Conversion (per 10-year campaign)[a]	Disposition Facility: MOX Fuel Fabrication (per 11-year campaign)[a]	Total Incremental Impact
Normal Operations					
Radiological Impacts					
MEI					
Annual dose (mrem/yr)	6.1×10^{-5}	1.8×10^{-8}	1.1×10^{-3}	5.2×10^{-4}	1.6×10^{-3}
Health effects (LCF risk)	1.5×10^{-9}	4.5×10^{-13}	5.5×10^{-9}	2.9×10^{-9}	8.4×10^{-9}
Public Within 80 km					
Annual dose (person-rem/yr)	2.8×10^{-4}	6.3×10^{-6}	6.4×10^{-3}	2.8×10^{-3}	9.2×10^{-3}
Health effects (LCFs)	7.0×10^{-6}	1.6×10^{-7}	3.3×10^{-5}	1.6×10^{-5}	5.0×10^{-5}
Total Involved Workforce					
Health effects (LCFs)	0.68	0.12	0.34	0.14	0.6
Hazardous Chemical Impacts					
MEI					
Hazard index	5.7×10^{-3}	0	1.5×10^{-4}	1.9×10^{-4}	3.4×10^{-4}
Cancer risk	1.1×10^{-8}	0	0	0	0
Worker Onsite					
Hazard index	6.1×10^{-3}	0	2.6×10^{-4}	8.0×10^{-4}	1.0×10^{-3}
Cancer risk	4.5×10^{-7}	0	0	0	0
Facility Accidents					
MEI (LCF risk)	[c]	5.8×10^{-6}	1.0×10^{-7}	1.2×10^{-7}	6.0×10^{-6}
Public within 80 km (LCF risk)	[c]	8.8×10^{-4}	1.6×10^{-5}	1.8×10^{-5}	9.1×10^{-4}
Worker at 1,000 m (LCF risk)	[c]	1.4×10^{-5}	2.6×10^{-7}	2.9×10^{-7}	1.5×10^{-5}

[a] Applies to health effects calculations for normal operations and facility accident risks.

[b] The committed effective dose equivalent for the storage facility is calculated based upon analysis of measured dose.

[c] The safety to workers and the public from accidents at existing facilities is controlled by Technical Safety Requirements specified in a SAR or a Basis for Interim Operations document.

Note: LCF=latent cancer fatality; MEI=maximally exposed individual member of the public.

Source: Section 4.2.4.9; Section 4.3.1.9; Section 4.3.2.9; Section 4.3.4.1.9; Section 4.3.5.1.9.

Under the Preferred Alternative, the use of LWRs is being pursued for the disposition of surplus plutonium through the use of MOX fuel in place of UO_2. An important question is whether the use of MOX fuel changes the safety envelope of UO_2 fueled reactors documented in SARs, PRAs, and NUREG-1150 (*Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*). Related reactor safety issues are addressed in a recent report by the NAS (*Management and Disposition of Excess Weapons Plutonium Reactor-Related Options*). The report indicates that the potential influences on safety of the use of MOX fuel in LWRs has been extensively studied in the United States in the 1970s (*Final Generic Environmental Impact Statement on the Use of Recycled Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors*, NUREG-0002). These influences have also been extensively studied in Europe, Japan and Russia. Regarding effects of MOX on accident probabilities, the National Academy of Sciences report states, "... no important overall adverse impact of MOX use on the accident probabilities of the LWRs involved will occur; if there are adequate reactivity and thermal margins in the fuel, as licensing review should ensure, the main remaining determinants of accident probabilities will involve factors not related to fuel composition and hence unaffected by the use of MOX rather

Table 4.6.1–11. Potential Human Health Impacts to the Public and Workers Under Normal Operation and Potential Accidents for the Preferred Alternative at Savannah River Site

Receptor/Impact Parameter	Site No Action/ Reference Baseline (per 50 years of operation)[a]	Upgrade of Actinide Packaging and Storage Facility (per 50 years of operation)[a,b]	Disposition Facility: Pit Disassembly/ Conversion (per 10-year campaign)[a]	Disposition Facility: Pu Conversion (per 10-year campaign)[a]	Disposition Facility: MOX Fuel Fabrication (per 11-year campaign)[a]	Disposition Facility: Immobilization (per 3.5-year campaign)[a]	Total Incremental Impact
Normal Operations							
Radiological Impacts							
MEI							
Annual dose (mrem/yr)	0.79	7.6×10^{-6}	1.6×10^{-3}	1.0×10^{-3}	1.5×10^{-3}	1.3×10^{-6}	4.1×10^{-3}
Health effects (LCF risk)	2.0×10^{-5}	2.1×10^{-10}	8.0×10^{-9}	5.0×10^{-9}	8.4×10^{-9}	2.3×10^{-12}	2.2×10^{-8}
Public Within 80 km							
Annual dose (person-rem/yr)	44	3.5×10^{-4}	0.11	0.066	0.044	6.7×10^{-5}	0.22
Health effects (LCFs)	1.1	8.8×10^{-6}	5.6×10^{-4}	3.3×10^{-4}	2.4×10^{-4}	1.2×10^{-7}	1.1×10^{-3}
Total Involved Workforce							
Health effects (LCFs)	5.2	0.13	0.34	0.53	0.14	0.16	1.32
Hazardous Chemical Impacts							
MEI							
Hazard index	5.2×10^{-3}	1.6×10^{-6}	7.3×10^{-6}	7.9×10^{-6}	9.0×10^{-6}	7.1×10^{-4}	7.4×10^{-4}
Cancer risk	1.3×10^{-7}	0	0	8.7×10^{-9}	0	0	8.7×10^{-9}
Worker Onsite							
Hazard index	1.2	2.2×10^{-4}	4.5×10^{-4}	1.4×10^{-3}	1.4×10^{-3}	0.14	1.3
Cancer risk	1.9×10^{-4}	0	0	1.3×10^{-5}	0	0	1.3×10^{-5}
Facility Accidents							
MEI (LCF risk)	[c]	7.2×10^{-8}	1.0×10^{-8}	7.9×10^{-9}	1.6×10^{-8}	2.9×10^{-11}	1.1×10^{-7}
Public within 80 km (LCF risk)	[c]	3.5×10^{-4}	5.1×10^{-5}	3.8×10^{-5}	5.8×10^{-5}	3.0×10^{-8}	5.0×10^{-4}
Worker at 1,000 m (LCF risk)	[c]	3.0×10^{-6}	4.3×10^{-7}	3.2×10^{-7}	4.7×10^{-7}	1.3×10^{-9}	4.2×10^{-6}

[a] Applies to health effects calculations for normal operations and facility accident risks.

[b] The dose results are taken from the APSF which is based on 5,000 storage positions. The SRS Upgrade With RFETS Pu and LANL Pu Subalternative contains 4,100 storage positions for the additional material at the upgraded APSF. A more detailed description of No Action and APSF upgrade impacts can be found in Section 4.2.6.9.

[c] The safety to workers and the public from accidents at existing facilities is controlled by Technical Safety Requirements specified in a SAR or a Basis for Interim Operations document.

Note: LCF=latent cancer fatality; MEI=maximally exposed individual member of the public.

Source: Section 4.2.6.9; Section 4.3.1.9; Section 4.3.2.9; Section 4.3.4.1.9; Section 4.3.5.1.9.

than LEU fuel." Regarding the effects of MOX on accident consequences, the report states, "... it seems unlikely that the switch from uranium-based fuel could worsen the consequences of a postulated (and very improbable) severe accident in a LWR by more than 10 to 20 percent. The influence on the consequences of less severe accidents, which probably dominate the spectrum value of population exposure per reactor-year of operation would be even smaller, because less severe accidents are unlikely to mobilize any significant quantity of plutonium at all."

The incremental effects of utilizing MOX fuel in a commercial reactor in place of UO_2 were derived from a quantitative analysis of several typical severe accident scenarios for MOX and UO_2 using the MACCS computer code and generic population and meteorology data. The analysis only considers highly unlikely severe accidents where sufficient damage would occur to cause the release of Pu or uranium. The risks of severe accidents were found to be in the range of plus 8 to minus 7 percent, compared to UO_2 fuel, depending on the accident release scenario. The incremental risk of cancer fatalities to a generic offsite population located within 80 km (50 mi) of the severe accident release point would range from -2.0×10^{-4} to 3.0×10^{-5} per year for the accident release scenarios analyzed. Accidents severe enough to cause a release of Pu or uranium include combinations of events that are highly unlikely. Estimates and analyses presented in chapter 4 and summarized in Table 2.5–3 indicate a range of latent cancer fatalities and risk per year from 5.9×10^{3}/0.15 to 7.3×10^{3}/0.16. These preliminary results would be reexamined for licensing purposes and subsequent NEPA review. More detailed safety analyses would be performed using both up-to-date calculations of radionuclide inventories for different fuel compositions and irradiation histories, and population-exposure models for sensitivity changes in those inventories resulting from the use of weapons-grade Pu in the fuel.

Natural Phenomena. Under the Preferred Alternative, HEU would continue to be stored at Y–12 at ORR in existing facilities that would be upgraded. The majority of the HEU would be housed in upgraded facilities currently used for HEU storage. The remaining HEU would be stored in facilities that were formerly used for material processing but are currently being modified and converted into storage areas. Modifications to existing buildings would make the facilities suitable for long-term storage and consist primarily of those upgrades required to meet natural phenomena requirements (including earthquakes and tornadoes) as documented in *Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities* (Y/EN-5080, 1994). The Y–12 storage buildings would be upgraded to meet the performance goal for a moderate hazard facility of Performance Category 3 in DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*. In a Performance Category 3 facility, radioactive or toxic materials are present in significant quantities. Design considerations for this category are to limit facility damage so that hazardous materials can be controlled and confined, occupants can be protected, and functions of the facility can continue without interruption. A performance goal for Performance Category 3 is a hazard exceedance frequency of 1.0×10^{-4} per year (DOE Order 5480.28). Meeting this performance goal would reduce the expected risk for the design basis accidents analyzed in the Y–12 EA (for example, Building 9212) by approximately 80 percent, resulting in a latent cancer fatality risk of 5.1×10^{-7} to the MEI and 5.7×10^{-8} to a noninvolved worker, and potential latent cancer fatalities of 7.4×10^{-6} for the 80-km (50-mi) offsite population.

At SRS, F-Canyon facilities could be used for the immobilization of surplus Pu using the can-in-canister variant under the Preferred Alternative. The earthquake accident analysis in the *Environmental Impact Statement, Interim Management of Nuclear Materials* (IMNM EIS) determined that the F-Canyon facilities are structurally sound. Since that time, DOE has prepared a *Supplemental Analysis of Seismic Activity on F-Canyon* (August 1996). Based on the evaluation, an earthquake that could occur about once every 8,000 years could cause a level of structural damage to F-Canyon similar to the level of damage attributed to the earthquake considered in the IMNM EIS. Thus, the capability of F-Canyon to survive an earthquake more severe than that evaluated in the EIS, in combination with the fact that the likelihood of this level of damage was less than assumed in the EIS (1 per 8,000 years compared to 1 per 5,000 years), indicates that F-Canyon is seismically safe, or safer, than indicated in the IMNM EIS.

Waste Management. There is no spent nuclear fuel or HLW associated with construction or operation of Preferred Alternative facilities, but the ceramic immobilization facility would generate as its product output a stabilized ceramic form spiked with Cs radionuclides. (For immobilization using vitrification a stable glass form of Pu and HLW would be generated.) Storage of this immobilized product would be provided until disposal in a geologic repository pursuant to the NWPA. Pursuant to the NWPA, DOE is currently characterizing the Yucca Mountain Site as a potential repository for spent nuclear fuel and HLW. Legislative clarification, or a determination by the NRC that the immobilized Pu should be isolated as HLW, may be required before the material could be placed in Yucca Mountain should DOE and the President recommend, and Congress approve its operation. No radionuclides, which are RCRA wastes, would be used for immobilization so the immobilized product would be consistent with the repository's WAC. Each of the facilities under the Preferred Alternative has as part of its conceptual design waste management facilities that would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with the regulatory requirements of RCRA, and other applicable statutes. Under the Preferred Alternative, the waste management infrastructure of the individual facilities would be integrated into a single waste management infrastructure to include maximum use of existing and planned site waste management facilities. Depending in part on decisions in the waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and (depending on the type of waste) disposed of onsite or at regionalized or centralized DOE sites. The treatment level and potential disposal of TRU and mixed-TRU waste at WIPP will depend on decisions in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*. For the purposes of analyses only, this PEIS assumes that TRU and mixed-TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that hazardous waste LLW and mixed LLW would be treated and disposed of in accordance with current site practice.

Construction and operation of the proposed facilities would affect existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes as shown in Table 4.6.1–12. Wastes generated during construction would consist of wastewater and hazardous and solid nonhazardous wastes. Wastewater and solid nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be treated onsite or shipped offsite, to a commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of offsite in a commercial RCRA-permitted disposal facility. No radioactive or hazardous soil contamination is expected to be generated during construction. However, if any were generated, it would be managed in accordance with site practice and all applicable Federal and State regulations.

Hanford Site. Under the Preferred Alternative approximately 78.2 m^3 (20,660 gal) of liquid and 750 m^3 (981 yd^3) of solid TRU waste would require treatment, and packaging to meet the current planning-basis WIPP WAC or an alternate treatment level. An estimated 200 m^3 (262 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the Hanford Tri-Party Agreement to meet the WIPP WAC or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase,* 109 additional truck shipments per year or, if applicable, 54 regular train shipments per year, or 18 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 70.4 m^3 (18,590 gal) of liquid and 2,010 m^3 (2,630 yd^3) of solid LLW would require treatment, processing, and packaging to meet the WAC of the 200-Area LLW Burial Grounds. After treatment and volume reduction, 2,010 m^3 (2,630 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 3,400 m^3/ha (1,800 yd^3/acre), this would require 0.6 ha/yr (1.5 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.2 m^3 (320 gal) of liquid and 231 m^3 (302 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the Hanford Tri-Party Agreement. The 46 m^3 (12,150 gal) of liquid and 184 m^3 (241 yd^3) of solid hazardous wastes would be collected, treated onsite or offsite, and shipped in Department of

Table 4.6.1–12. Estimated Annual Generated Waste Volumes for the Preferred Alternative

Category	No Action (m^3)	Storage Alternative (m^3)	Pit Disassembly/ Conversion (m^3)	Pu Conversion (m^3)	MOX Fuel Fabrication (m^3)	Ceramic Immobilization (m^3)	Total Impact (m^3)
Hanford Site[a]							
Transuranic							
Liquid	None	0	None	3.2[b]	None	75[b]	78.2
Solid	271	0	67	278	306	99	1,021
Mixed transuranic							
Liquid	None	0	None	0	None	None	0
Solid	98	0	4[b]	191	4	0.7	297.7
Low-level							
Liquid	None	0	4	56[b]	4[b]	7[b]	71
Solid	3,390	0	102	1,743	153	14	5,402
Mixed low-level							
Liquid	3,760	0	0.4	0.04	0.8	None	3,761.24
Solid	1,505	0	1.7	191	38	0.15	1,735.85
Hazardous							
Liquid	Included in solid	0	2	2	4	38	46
Solid	560	0	0.7	11	153	19	743.7
Nonhazardous (sanitary)							
Liquid	414,000	0	85,200	15,000	43,300	34,000	591,500
Solid	5,107	0	100	2,060	76	920	8,263
Nonhazardous (other)							
Liquid	Included in sanitary	0	Included in sanitary	56	227	170,000	170,283
Solid	Included in sanitary	0	3[c]	0	84[c]	15[c]	102
Idaho National Engineering Laboratory[d]							
Transuranic							
Liquid	None	0	None	NA	None	NA	0
Solid	3.5	0	67	NA	306	NA	376.5

Table 4.6.1–12. Estimated Annual Generated Waste Volumes for the Preferred Alternative—Continued

Category	No Action (m^3)	Storage Alternative (m^3)	Pit Disassembly/ Conversion (m^3)	Pu Conversion (m^3)	MOX Fuel Fabrication (m^3)	Ceramic Immobilization (m^3)	Total Impact (m^3)
Mixed transuranic							
Liquid	None	0	None	NA	None	NA	0
Solid	Included in TRU	0	4	NA	4	NA	8
Low-level							
Liquid	None	0	4[b]	NA	4[b]	NA	8
Solid	7,200	0	102	NA	153	NA	7,455
Mixed low-level							
Liquid	4	0	0.4	NA	0.8	NA	5.2
Solid	170	0	1.7	NA	38	NA	209.7
Hazardous							
Liquid	Included in solid	0	2	NA	4	NA	6
Solid	1,200	0	0.7	NA	153	NA	1,353.7
Nonhazardous (sanitary)							
Liquid	Included in solid	0	85,200	NA	43,300	NA	128,500
Solid	52,000	0	100	NA	76	NA	52,176
Nonhazardous (other)							
Liquid	None	0	Included in sanitary	NA	227	NA	227
Solid	Included in sanitary	0	3[c]	NA	84[c]	NA	87
Pantex Plant[e]							
Transuranic							
Liquid	None	0	None	NA	None	NA	0
Solid	None	0.8	67	NA	306	NA	373.8
Mixed transuranic							
Liquid	None	0	None	NA	None	NA	0
Solid	None	0	4	NA	4	NA	8
Low-level						NA	
Liquid	8	0.08[b]	4[b]	NA	4[b]	NA	16.08
Solid	32	138	102	NA	153	NA	425

Table 4.6.1–12. Estimated Annual Generated Waste Volumes for the Preferred Alternative—Continued

Category	No Action (m^3)	Storage Alternative (m^3)	Pit Disassembly/ Conversion (m^3)	Pu Conversion (m^3)	MOX Fuel Fabrication (m^3)	Ceramic Immobilization (m^3)	Total Impact (m^3)
Mixed low-level							
Liquid	4	0.2	0.4	NA	0.8	NA	5.4
Solid	46	8	1.7	NA	38.1	NA	93.7
Hazardous							
Liquid	2	1	2	NA	4	NA	9
Solid	31	1.5	0.7	NA	153	NA	186.2
Nonhazardous (sanitary)							
Liquid	141,000	12,900	85,200	NA	43,300	NA	282,400
Solid	339	275	100	NA	76	NA	790
Nonhazardous (other)							
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	NA	227	NA	227
Solid	Included in sanitary	344[c]	3[c]	NA	84[c]	NA	431
Savannah River Site[f]							
Transuranic							
Liquid	None	0	None	3.2[b]	None	75[b]	78.2
Solid	338	0	67	278	306	99	1,088
Mixed transuranic							
Liquid	None	0	None	0	None	None	0
Solid	Included in TRU	0	4	191	4	0.7	199.7
Low-level							
Liquid	74,000	0	4[b]	56[b]	4[b]	7[b]	74,071
Solid	16,400	0	102	1,743	153	14	18,412
Mixed low-level							
Liquid	1,330	0	0.4	0.04	0.8	None	1,331.24
Solid	7,700	0	1.7	191	38	0.15	7,930.85
Hazardous							
Liquid	1,260	0	2	2	4	38	1,306
Solid	15,100	0.8	0.7	11	153	19	15,284.5

Table 4.6.1–12. Estimated Annual Generated Waste Volumes for the Preferred Alternative—Continued

Category	No Action (m^3)	Storage Alternative (m^3)	Pit Disassembly/ Conversion (m^3)	Pu Conversion (m^3)	MOX Fuel Fabrication (m^3)	Ceramic Immobilization (m^3)	Total Impact (m^3)
Nonhazardous (sanitary)							
Liquid	703,000	1,806	85,200	15,000	43,300	34,000	882,306
Solid	61,200	18	100	2,060	76	920	64,374
Nonhazardous (other)							
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	56	227	170,000	170,283
Solid	Included in sanitary	18[c]	3[c]	0	84[c]	15[c]	120

[a] No Action is the Preferred Alternative for storage of surplus Pu at Hanford.

[b] Liquid TRU and low-level waste would be treated and solidified before disposal.

[c] Includes recyclable waste.

[d] No Action is the Preferred Alternative for storage of surplus Pu at INEL.

[e] Upgrade is the Preferred Alternative at Pantex for the long-term storage of surplus Pu pit material only.

[f] Upgrade is the Preferred Alternative at SRS for the long-term storage of surplus Pu non-pit material only.

Note: NA=not applicable.

Source: Table 4.2.1.10–1; Table 4.2.3.10–1; Table 4.2.4.10–1; Table 4.2.6.10–1; Table 4.3.1.10–1; Table 4.3.2.10–1; Table 4.3.4.2.10–1; Table 4.3.5.1.10–1.

Transportation (DOT)-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities.

Approximately 177,000 m^3 (46.8 million gal) of liquid nonhazardous sanitary and industrial wastewater and 170,000 m^3 (45.0 million gal) of steam plant and cooling blowdown and estimated stormwater runoff would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new sanitary, utility, and process wastewater treatment facilities may be required. The 3,240 m^3 (4,240 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the City of Richland landfill per current site practice.

Idaho National Engineering Laboratory. Under the Preferred Alternative approximately 373 m^3 (488 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC or an alternate treatment level. An estimated 8 m^3 (11 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the INEL Site Treatment Plan to meet the current planning-basis WIPP WAC or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase,* 44 additional truck shipments per year or, if applicable, 22 regular train shipments per year, or 7 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 8 m^3 (2,000 gal) of liquid and 255 m^3 (333 yd^3) of solid LLW would require treatment, processing, and packaging to meet the WAC of the RWMC. Assuming a land usage of factor of 6,200 m^3/ha (3,300 yd^3/acre), the disposal of LLW would require 0.04 ha/yr (0.1 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.1 m^3 (290 gal) of liquid and 40 m^3 (52 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the INEL Site Treatment Plan. The 6 m^3 (1,500 gal) of liquid and 154 m^3 (201 yd^3) of solid hazardous wastes would be collected, treated onsite or offsite, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities.

Approximately 129,000 m^3 (34.0 million gal) of liquid nonhazardous sanitary, industrial, and other process wastewater would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new sanitary, utility, and process wastewater treatment facilities may be required. The 253 m^3 (331 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the onsite landfill per current site practice.

Pantex Plant. Under the Preferred Alternative approximately 374 m^3 (489 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC or an alternate treatment level. An estimated 8 m^3 (11 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the *Pantex Plant Federal Facility Compliance Act Site Treatment Plan/Compliance Plan* to meet the WIPP WAC or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase,* 44 additional truck shipments per year or, if applicable, 22 regular train shipments per year, or 7 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 8 m^3 (2,100 gal) of liquid and 392 m^3 (513 yd^3) of solid LLW would require treatment, processing, and packaging to meet the WAC of the NTS Area 5 RWMS WAC. After treatment and volume reduction, 324 m^3 (424 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 6,000 m^3/ha (3,200 yd^3/acre), the disposal of LLW would require 0.05 ha/yr (0.13 acres/yr) of LLW disposal area at NTS. Assuming 16.6 m^3 (21.7 yd^3) of LLW per shipment, 20 additional LLW shipments per year from Pantex to NTS would be required. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.3 m^3 (350 gal) of liquid and 48 m^3 (63 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the *Pantex Plant Federal Facility Compliance Act Site Treatment Plan/Compliance Plan*. The 7 m^3 (1,760 gal) of liquid and 155 m^3 (203 yd^3) of solid hazardous wastes would be collected, treated onsite or offsite, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities.

Approximately 141,000 m^3 (37.2 million gal) of liquid nonhazardous sanitary, industrial, and other process wastewater would require treatment in accordance with site practice. Depending on site location, expansion of existing or construction of new utility and process wastewater treatment facilities may be required. The existing sanitary wastewater treatment system has adequate excess capacity to treat the additional quantity of sanitary wastewater. The 391 m^3 (511 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the City of Amarillo landfill under current site practice.

Savannah River Site. Under the Preferred Alternative approximately 78.2 m^3 (20,660 gal) of liquid and 750 m^3 (981 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC or an alternate treatment level. An estimated 200 m^3 (262 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the SRS Treatment Plan to meet the current planning-basis WIPP WAC or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase,* 109 additional truck shipments per year or, if applicable, 54 regular train shipments per year, or 18 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 70.4 m^3 (18,600 gal) of liquid and 2,010 m^3 (2,630 yd^3) of solid LLW would require treatment, processing, and packaging to meet the WAC of the SRS E-Area Low-Level Radioactive Disposal Facility. After treatment and volume reduction, 2,010 m^3 (2,630 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 8,600 m^3/ha (4,600 yd^3/acre), this would require 0.2 ha/yr (0.5 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.2 m^3 (311 gal) of liquid and 231 m^3 (302 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the SRS Site Treatment Plan. The 46 m^3 (12,070 gal) of liquid and 184 m^3 (241 yd^3) of solid hazardous wastes would be collected, treated onsite or offsite, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities.

Approximately 179,000 m^3 (47.3 million gal) of liquid nonhazardous sanitary and industrial wastewater and 170,000 m^3 (45 million gal) of steam plant and cooling blowdown and estimated stormwater runoff would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new utility and process wastewater treatment facilities may be required. The centralized sanitary wastewater treatment system is adequate to treat the sanitary portion. The 3,250 m^3 (4,250 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to an offsite landfill per current site practice.

Intersite Transportation. A summary of the estimated health effects from transportation of radiological materials for the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS if all the applicable Preferred Alternative disposition facilities were located at a single site is shown in Table 4.6.1–13. If the disposition facilities are at multiple sites then the health effects would be larger, as described below. For the storage Preferred Alternative, there would be no additional transportation of Pu to Hanford and INEL and therefore, no potential fatalities at those sites. Pits from RFETS would be transported to Pantex, and non-pit Pu material from RFETS would be transported to SRS. Pits to be transferred would be packaged in FL (Type B) containers at RFETS before shipment and, upon receipt at Pantex, would be repackaged into AL-R8 containers in Zone 12 South and placed into storage in Zone 4 West pending availability of AT-400A containers and relocation to

Table 4.6.1–13. Total Potential Fatalities[a] From the Transportation of Materials for the Preferred Alternative

Activity	Hanford	INEL	Pantex	SRS
Storage	0.0	0.0	0.006	0.060
Pit disassembly/conversion	0.209	0.161	0.0	0.184
Pu conversion	[b]	NA	NA	[b]
MOX fuel fabrication	0.193	0.193	0.193	0.193
Ceramic immobilization	0.98	NA	NA	1.43
Total if disposition activities are one site	1.382	0.354	0.199	1.867

[a] Resulting from both radiological and nonradiological risks for the life of the project.

[b] The analysis assumed that the Pu conversion facility would be located at the immobilization site.

Note: NA = not analyzed for the Preferred Alternative.

Source: Table 4.4.3.2-1; Table 4.4.3.3-1; Table 4.4.3.3-3; Table 4.4.3.3-4.

upgraded storage facilities in Zone 12 South. The transportation of pits between Zone 4 and Zone 12 and the repackaging of the pits from AL-R8 to AT-400A containers is analyzed in the Pantex EIS.

For the disposition alternative, the transportation analysis was based upon the assumption that the storage Preferred Alternative had been implemented prior to the start disposition transportation.

Further, the reactor portion of the disposition Preferred Alternative assumed that the pit disassembly/conversion facility and the MOX facility could be sited at one location or sited at different locations. The total potential fatalities could range from 0.193 (the pit disassembly/conversion and MOX facilities at Pantex) to 0.761 (the pit disassembly/conversion and MOX facilities at different sites). In addition to the DOE sites, there would be transportation of the MOX fuel from the DOE site to existing reactors. The destination of the MOX fuel could be either the eastern or western United States. Assuming 4,000 km (2,484 mi), there would be an additional 3.61 potential fatalities.

For the immobilization portion of the disposition Preferred Alternative, the analysis assumed that the Pu conversion and ceramic immobilization facility would be at the same location. The total potential fatalities could range from 0.98 (both facilities at Hanford) to 1.43 (both facilities at SRS). The analysis includes the effect of transporting Cs-137 to the immobilization site and the transportation of immobilized materials to a HLW repository site. The ceramic immobilization facility was selected for this analysis because the transportation impacts were slightly greater that the vitrification facility.

Environmental Justice. The public health and safety analyses show that air emissions and hazardous chemical and radiological releases from normal operations for all of the storage alternatives would be within regulatory limits and that no latent cancer fatalities would result. Because no populations within 80 km (58 mi) of the proposed site would experience high or adverse health or environmental impacts, neither minority populations nor low-income populations would experience disproportionate high and adverse human health or environmental impacts.

The public health and safety analyses also indicate that radiological releases from accidents would not result in significant adverse human health or environmental impacts. Therefore, such accidents would not have disproportionately high and adverse impacts on minority or low-income populations. Potential transportation accidents would be random events along the transportation corridors, therefore, such accidents would not disproportionately impact minority or low income populations.

4.6.2 LONG-TERM STORAGE ALTERNATIVES

Tables 4.6.2–1 through 4.6.2–6 present the maximum requirements for key environmental resources. The following paragraphs discuss the unique impacts related to each alternative evaluated.

Table 4.6.2–1. Maximum Incremental Direct Employment Over No Action Generated During Operation at Each Candidate Site

Site	Total Site Employment in 2005	Upgrade	Consolidation	Collocation
Hanford	14,586	252[a]	443	572
NTS	3,800	NA	527[b]	641[b]
INEL	6,911	116[a]	432	561
Pantex	3,559	90[c]	509[b]	601
ORR	18,010	111	[d]	566[e]
SRS	16,562	30[f]	485	614

[a] Upgrade with RFETS and LANL material.
[b] Construct new and modify existing facilities.
[c] Upgrade with RFETS and LANL materials. Actual number of employees during operation could be higher.
[d] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[e] Construct new Pu and HEU facilities.
[f] Workers would be supplied from existing workforce.
Note: NA=not applicable.

Table 4.6.2–2. Maximum Annual Net Incremental Water Usage Over No Action During Operation at Each Candidate Site

Site	Water Usage in 2005 (MLY)	Upgrade (MLY)	Consolidation (MLY)	Collocation (MLY)
Hanford	195	8.9[a]	110	150
NTS	2,400	NA	130[b]	190[b]
INEL	7,570	22[a]	66	87
Pantex	249	110[a]	110[c]	130
ORR	14,760	0.24	[d]	360[e]
SRS	13,247	7.1[a]	360	460

[a] Upgrade with RFETS and LANL material.
[b] Modify P-Tunnel.
[c] Construct new and modify existing facilities.
[d] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[e] Construct new Pu and HEU facilities.
Note: NA=not applicable.

Table 4.6.2–3. Maximum Annual Net Incremental Volume of Solid Low-Level Waste Generated Over No Action During Operation at Each Candidate Site

Site	Water Generation in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)
Hanford	3,390	89[a]	1,260	1,300
NTS	15,000	NA	1,260	1,300
INEL	7,200	500[a]	1,260	1,300
Pantex	32	1,260[a]	1,260	1,300
ORR	7,320	3	[b]	1,300[c]
SRS	16,400	0[a]	1,220[d]	1,260[d]

[a] Upgrade with RFETS and LANL material.
[b] Since HEU is currently at ORR, the Consolidation and Collocation Alternatives would be the same.
[c] Construct new Pu and HEU facilities.
[d] Net waste from new facility and from phaseout of existing facility.
Note: NA=not applicable.

Table 4.6.2–4. Maximum Annual Net Incremental Volume of Solid Transuranic Waste Generated Over No Action During Operation at Each Candidate Site

Site	Water Generation in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)
Hanford	271	21[a]	10	10
NTS	0	NA	10	10
INEL	3.5	2[a]	10	10
Pantex	0	10[a]	10	10
ORR	119	0	[b]	10
SRS	338	0	2[c]	2[c]

[a] Upgrade with RFETS and LANL material.
[b] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[c] Net waste from new facility and phaseout of existing facility.
Note: NA=not applicable.

Table 4.6.2–5. Maximum Annual Net Incremental Volume of Solid Hazardous Waste Generated Over No Action During Operation at Each Candidate Site

Site	Water Generation in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)
Hanford	560	4	2	2
NTS	212	NA	2	2
INEL	1,200	1	2	2
Pantex	31	2[a]	2	2
ORR	26	0.8[b]	[c]	2
SRS	15,100	0.8[a]	2	2

[a] Upgrade with RFETS and LANL material.
[b] Solid hazardous material includes mixed low-level waste at ORR.
[c] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
Note: NA=not applicable.

Table 4.6.2–6. Maximum Latent Cancer Fatalities Over No Action for Maximally Exposed Individual for 50 Years From Normal Operation

Site	Risk of Fatal Cancer in 2005	Upgrade	Consolidation	Collocation
Hanford	1.0×10^{-8}	4.5×10^{-11}	6.2×10^{-11}	6.2×10^{-11}
NTS	1.0×10^{-7}	NA	1.4×10^{-10}	1.4×10^{-10}
INEL	4.4×10^{-7}	1.3×10^{-11}	4.0×10^{-11}	4.0×10^{-11}
Pantex	1.5×10^{-9}	4.5×10^{-13}	2.4×10^{-10}	2.4×10^{-10}
ORR	3.5×10^{-8}	5.5×10^{-13}	[a]	1.1×10^{-9}
SRS	2.0×10^{-5}	2.1×10^{-10}	3.5×10^{-10}	3.5×10^{-10}

[a] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.

Note: NA=not applicable.

4.6.2.1 *No Action*

The No Action Alternative, which would continue existing storage practices, would have no or negligible impacts to land resources at all of the DOE sites under consideration. Land use would conform with existing land-use plans, policies, and controls, and the landscape character would remain compatible. The No Action Alternative would not affect site infrastructure and waste management facilities beyond the normal, scheduled maintenance, repair, and upgrades. Most of the DOE sites under consideration are operating at or below their respective site infrastructure and waste management capacities.

Air emissions from continuing operations would continue to affect local air quality, but the sites are expected to continue to comply with the ambient air quality standards and guidelines. Noise emissions from ongoing operations are consistent with the land-use categories and do not violate any existing local government noise standards. Geology and soils are not being affected by ongoing operations.

Biological resources and cultural and paleontological resources would experience no or negligible impacts from the No Action Alternative. Most industrial areas of the DOE sites have already been heavily disturbed, so existing storage practices are not causing any further disturbance of cultural and paleontological resources or terrestrial plant communities. Any wildlife still inhabiting the area, including any threatened and endangered or other special status species, have adjusted to the existing environment, and continuing operations are unlikely to have any additional impacts. Under the No Action Alternative, surplus fissile materials would stay in place, so there would be no impact from intersite transportation. Due to ongoing changes in workforce size, the No Action Alternative could continue to generate employment impacts to the local communities surrounding the DOE sites under consideration.

[Text deleted.]

Impacts to water resources at Pantex result from the continued local drawdown of the Ogallala Aquifer, one of the largest aquifers in the western United States. By 2005, changes in activities and improvements in operation that will reduce Pantex's contribution to this drawdown are expected to decrease drawdown by approximately 70 percent from current levels. Neither surface nor groundwater resources at the other DOE sites would be affected.

4.6.2.2 Upgrade

The Upgrade Alternative does not apply to NTS, RFETS or LANL. The implementation of the Upgrade Alternative would have no or negligible additional impacts to land resources, biological resources, and waste management at any of the remaining DOE sites under consideration. [Text deleted.]

The Upgrade Alternative would have the potential for additional impacts to air quality at Hanford (both options), INEL, Pantex, and SRS, because air pollutant concentrations would increase during construction and operations. Projected emissions would be lower at ORR. At all sites, projected emissions for both criteria and hazardous pollutants would not exceed, and would comply with ambient air quality standards and NESHAPS during both construction and operations. Cultural and paleontological resources at candidate DOE sites could be affected wherever there is ground disturbance due to construction activities, except at Hanford under the modification of existing facilities option, and at Pantex, where construction would be within an area that was previously disturbed. Operation of facilities may have some effect on Native American resources at Hanford, INEL, and SRS. Soil resources would be affected at DOE sites under consideration wherever ground disturbance due to construction activities occurs. Implementation of the Upgrade Alternative would have no or negligible impacts to geologic resources.

[Text deleted.]

Because of the continued depletion of the Ogallala Aquifer, water resources would be affected at Pantex. Either Upgrade Alternative (with or without RFETS and LANL material) would require additional water for construction and operation. However, this additional use, factored in with the projected decrease under No Action, would result in an overall decrease in water use at Pantex. Surface and groundwater resources at the other DOE sites would be adequate to meet the additional water requirements for this alternative.

4.6.2.3 Consolidation

Under this alternative, there could be a temporary decrease in level of service on one or more local roads at INEL during construction. [Text deleted.] Air quality could potentially be affected at all DOE sites by construction and operations activities that would increase emissions, especially PM_{10} and TSP. The sites are expected to comply with ambient air quality standards and guidelines. At all of the DOE sites under consideration, cultural and paleontological resources could be affected wherever there is ground disturbance due to construction activities. Additionally, some Native American resources may be affected by facility operations at Hanford, NTS, INEL, Pantex, and SRS.

[Text deleted.]

The Consolidation Alternative would generate potential impacts on the following: land use at NTS under the P-Tunnel modification option; soil resources at all DOE sites considered; water resources at Pantex (both options); biological resources at Hanford, NTS under the new facility construction option, INEL, Pantex (both options), and SRS; and waste management at all sites. Land resources at NTS under the P-Tunnel modification option could have impacts on weapons effects testing ability. [Text deleted.]

At all of the DOE sites under consideration, soil resources would be affected by ground disturbance associated with construction activities. Because of the continued depletion of the Ogallala Aquifer, water resources would be affected at Pantex. This alternative would require an additional 110 million l/yr (29.1 million gal/yr). However, this additional use, factored in with the projected decrease under No Action, would result in an overall decrease in water use of 57 percent by 2005. Surface and groundwater resources at the other DOE sites would not be affected by this alternative.

With the exception of NTS (under the P-Tunnel modification option) and Pantex, where no or negligible impacts would occur, biological resources would experience impacts under the Consolidation Alternative at all of the DOE sites. There would be habitat loss, and some reptiles and small mammals would not be expected to survive the ground disturbance associated with construction activities. In addition, the potential exists for impacts to either federally or State-listed threatened and endangered or special status species at Hanford, NTS (under the new facility construction option), INEL, and SRS. There could be impacts to playa wetlands at Pantex (both

options). Impacts to waste management would occur at NTS (both options) and INEL where construction of utility and process wastewater treatment systems for nonhazardous liquid wastes would be required. In addition, NTS would require new sanitary lagoons.

4.6.2.4 Collocation

Under the Collocation Alternative, the level of service on one or more local roads would increase during construction at INEL, Pantex, and ORR (all three options). [Text deleted.] The potential for impacts to air quality would occur at all of the DOE sites due to increased levels of PM_{10} and TSP emissions from construction and operation activities. The sites are expected to comply with ambient air quality standards and guidelines. Cultural and paleontological resources at all candidate sites could potentially be affected wherever there is ground disturbance due to construction activities at all of the DOE sites under consideration. Operation could potentially affect Native American resources at all sites.

[Text deleted.]

The Collocation Alternative would cause impacts to the following: land resources at NTS (under the P-Tunnel modification option) and ORR (all three options); soil resources at all DOE sites; water resources at Pantex; biological resources at all DOE sites except Pantex; and waste management at Hanford, NTS (both options), and INEL. Land use at NTS under the P-Tunnel modification option could have impacts on weapons effects testing ability. [Text deleted.] At ORR, construction and operation of the proposed sites for all three options could result in visual impacts to Bear Creek Road and Route 95 sensitive viewpoints and could cause the VRM classifications to change from Class 4 to Class 5.

At all of the DOE sites under consideration, soil resources would be affected by ground disturbance associated with construction activities. Because of the continued depletion of the Ogallala Aquifer, water resources would be affected at Pantex. This alternative would require an additional 130 million l/yr (34.3 million gal/yr). However, this additional use, factored in with the projected decrease under No Action, would result in an overall decrease in water use of 55 percent by 2005. Surface and groundwater resources at the other DOE sites would not be affected by this alternative.

With the exception of NTS (under the P-Tunnel modification option) and Pantex, where no or negligible impacts would occur, biological resources at all of the DOE sites would experience impacts under the Collocation Alternative. There would be habitat loss, and some reptiles and small mammals would not be expected to survive the ground disturbance associated with construction activities. In addition, the potential exists for impacts to either federally or State-listed threatened and endangered or special status species at, Hanford, NTS (under the new facility construction option), INEL, ORR, and SRS. There could be impacts to wetlands and aquatic resources at Pantex and ORR (all three options) from sediment runoff during construction.

Implementation of this alternative would require construction of sanitary, utility, and process wastewater treatment systems to treat nonhazardous liquid wastes at Hanford and at NTS under the new facility construction option. Under the P-Tunnel modification option at NTS, expansion of the Area 12 sanitary wastewater treatment facility would be required to treat liquid nonhazardous waste. Construction of utility and process wastewater treatment systems to treat nonhazardous liquid wastes would be required at INEL.

4.6.2.5 Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

If the strategic reserve and weapons R&D materials are not included, the incremental impacts would remain the same for some resources because the building would be approximately the same (for example, land, geology, cultural). For other resources the change would be minimal because there would be a slight decrease if the strategic reserve is not included (for example, radiological releases to the public). Other impacts are proportional to the amount of material being stored.

4.6.2.6 Phaseout

For both the Consolidation and Collocation Alternatives, storage of existing Pu and HEU materials at various sites would be phased out. In addition, storage of existing Pu and HEU materials would be phased out at LANL and RFETS as a result of some of the Upgrade Alternatives. Phaseout would have no or negligible impacts for all environmental resource and issue areas except cultural resources at all DOE sites other than Pantex, and public and occupational health and safety at all DOE sites. The impacts of intersite transportation are addressed under the Consolidation and Collocation Alternatives. For all DOE sites, with the exception of Pantex, phaseout could potentially affect cultural resources if any of the structures eligible for NRHP listing are modified or are not maintained. Currently, none of the affected structures in Zone 4 at Pantex are considered eligible for NRHP listing. All of the regional economic areas surrounding the affected DOE sites would experience a loss in employment with phaseout. However, compared to the total employment in these areas, the loss of jobs would be small and would have no or negligible impacts.

[Text deleted.] Phaseout of existing Pu storage facilities would reduce the impacts from radiological and chemical releases and exposures to levels slightly below the No Action levels for normal operations. All workers involved in the transfer of the Pu would be monitored to ensure that their doses remain within acceptable levels. However, the radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. However, there would be a potential for accidents during the phaseout process from Pu handling, packaging, and transportation that could affect workers and the public. These potential accidents and their consequences have been included in the intersite transportation analysis. As mentioned in the No Action Alternative, only under unusual wind conditions at SRS would low income and minority populations have the potential to be disproportionately affected by an accidental release. Potential intersite transportation impacts related to all DOE sites could occur because of the increased risk of traffic accident fatalities.

For air quality, there could be some short-term impacts resulting from handling and shipping operations, but overall, the elimination of storage alternatives is not expected to result in any long-term impacts.

[Text deleted.]

4.6.3 DISPOSITION ALTERNATIVES

[Text deleted.]

Table 4.6.3–1 represents the incremental impacts to key environmental resources for the activities common to disposition alternatives. Table 4.6.3–2 represents the incremental impacts to the same resources for each individual disposition alternative.

Table 4.6.3–1. Incremental Net Increase During Operation for Activities Common to Disposition Alternatives

Resource	Pit Disassembly/ Conversion Facility	Pu Conversion Facility	MOX Fuel Fabrication
Land area used (ha)	12	28	81
Water usage (MLY)	94.6	80.5	56.8
Maximum direct employment	830	883	500
Risk of fatal cancer for MEI from lifetime operations	7.6×10^{-10} to 7.0×10^{-8}	4.8×10^{-10} to 4.6×10^{-8}	1.8×10^{-7} to 7.8×10^{-10}
Solid TRU waste (m^3/yr)	67	278	306
Solid LLW (m^3/yr)	102	1,743	153
Solid hazardous waste (m^3/yr)	0.7	11	153
Spent nuclear fuel[a] (t/yr)	0	0	0

[a] Residual heavy metal content.

4.6.3.1 Activities Common to Disposition Alternatives

Implementation of any of the disposition alternatives would require construction and operation of the pit disassembly/conversion facility or the Pu conversion facility, either at the same site or at two different sites. In addition, selection of any of the reactor alternatives would require construction of the MOX fuel fabrication facility, either collocated with the reactor or located at another site.

Pit Disassembly/Conversion Facility

Construction and operation of the pit disassembly facility would have no or negligible impacts to noise and geology at all of the DOE sites analyzed. The associated employment would generate minor socioeconomic benefits at all of the DOE sites.

Impacts to biological resources at each site are possible because of habitat loss associated with land disturbance. There is the potential for impacts to special status species at Hanford, to the desert tortoise at NTS, and playa wetlands at Pantex. At all of the DOE sites except ORR, cultural and paleontological resources could be affected wherever there is ground disturbance, especially in areas that have not been extensively surveyed. Operation may affect Native American resources at all sites except ORR. Waste management impacts could occur at Hanford, INEL, and SRS due to the increase in TRU waste shipments and onsite LLW disposal. A radioactive waste facility would be required at ORR, so potential impacts to waste management at ORR are possible. Impacts to waste management would occur at NTS and Pantex, where the pit disassembly/conversion facility would require construction of a radioactive waste management facility. Potential impacts from the pit disassembly/conversion facility to public and occupational health and safety exist from the radiological and hazardous chemical releases during normal operation. However, the annual radiological dose to onsite workers and the public would be within radiological limits. Similarly, the health risk to the public and onsite workers would be within hazardous chemical regulatory levels. As mentioned in the No Action Alternative discussion, only under unusual wind conditions at SRS would low income and minority populations have the potential to be disproportionately affected by accidental releases. Intersite transportation impacts related to all DOE sites could occur because of the increased risk of traffic accident fatalities.

Soil resources would be affected at all of the DOE sites under consideration due to ground disturbance associated with construction activities from the pit disassembly/conversion facility. Because this alternative would require an additional 946 million l/yr (25 million gal/yr) of water during operation, water resources would be affected at Pantex. Surface water and groundwater resources at the other DOE sites would be affected minimally by this alternative.

Table 4.6.3–2 Incremental Net Increase During Operation by Disposition Alternative[a]

Resource	Direct Disposition	Immobilized Disposition	Vitrification	Ceramic Immobilization	Electrometallurgical Treatment	5 Existing LWRs[b,c]	2 Partially Completed[b] LWRs	4 Evolutionary LWRs[b] (small)	2 Evolutionary LWRs[b] (Large)
Land area used (ha)	57	75.2	12	12	0	81	81	237	138
Water usage (MLY)	165.4	485.4	250	250	0	56.8	138,225	813-109,065	739-121,777
Maximum direct employment	342	1,180	768	860	83	700	1,775	2,500	2,160
Risk of fatal cancer for MEI from lifetime operations	1.4×10^{-14} to 4.7×10^{-13}	9.7×10^{-14} to 3.6×10^{-12}	3.6×10^{-11} to 1.3×10^{-9}	6.0×10^{-13} to 2.1×10^{-11}	3.8×10^{-9}	1.3×10^{-7} to 2.3×10^{-7}[c]	1.3×10^{-5}	2.1×10^{-7} to 2.4×10^{-5}	2.9×10^{-7} to 4.1×10^{-5}
Solid TRU waste (m^3/yr)	0.2	151	99	99	6	306	306	306	306
Solid LLW (m^3/yr)	5	29	14	14	55	153	267-1,427	1,233	1,153
Solid hazardous waste (m^3/yr)	17	38	19	19	0.8	153	207	261	207
Spent nuclear fuel (t/yr)[d]	0	0	0	0	0	70	70	70.6	76.5

[a] Does not include activities common to all disposition alternatives (that is, the Pu conversion facility and the pit disassembly/conversion facility).

[b] Includes the MOX fuel fabrication facility and two to four reactors as indicated.

[c] For the existing LWR, the analysis assumes that two LEU reactor cores would be replaced with MOX cores. Between 3 and 5 reactors would be needed if the LEU core was only partially replaced with MOX fuel.

[d] Residual heavy metal content.

Plutonium Conversion Facility

The environmental impacts of constructing and operating the Pu conversion facility would be identical to those previously identified for the pit disassembly/conversion facility with the following exceptions. The employment associated with construction and operation would generate small socioeconomic benefits at all affected sites. At ORR, NTS, and Pantex, the Pu conversion facility would require construction of a radioactive waste management facility. At Pantex, water requirements for this alternative are slightly less than for the pit disassembly/conversion facility. Also, the annual radiological doses to the public would be slightly lower for the conversion facility than for the disassembly/conversion facility. The doses to onsite workers would be higher for the conversion facility, however, all doses to the public and to onsite workers would be within regulatory limits.

4.6.3.2 Deep Borehole Category

There are two deep borehole category alternatives: the Direct Disposition Alternative and the Immobilized Disposition Alternative. Both require drilling deep boreholes, 4 km (2.5 mi) or more in depth, into geologically stable rock below the water table. The borehole facility would be similar for both alternatives. No specific locations have been identified for the deep borehole facilities, therefore, environmental impacts are evaluated for a generic site. However, the public and occupational health and safety impacts include estimates using representative DOE sites for analysis purposes. The types and range of likely impacts have been identified, but site-specific impacts cannot be determined at this time. Requirements for both alternatives would be in addition to those presented for pit disassembly/conversion facility. The annual radiological doses to the public would be slightly lower for the conversion facility than for the disassembly/conversion facility. The doses to onsite workers would be higher for the conversion facility, however, all doses to the public and to onsite would be within regulatory limits.

4.6.3.2.1 *Direct Disposition*

Under the Direct Disposition Alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, packaged, and placed into a deep borehole. The environmental impacts of implementing this alternative would be the sum of impacts described previously for the pit disassembly/conversion facility and the Pu conversion facility, in addition to the impacts described below.

Infrastructure requirements could exceed current capacities. Air emissions, particularly PM_{10} and TSP concentrations, would be expected to increase during the peak construction period. The potential exists for noise impacts from heavy construction equipment and increased traffic. Water resource requirements would increase during construction and operation, possibly affecting existing supplies, and surface water quality could be affected by discharge of wastewater. Geologic resources could be affected by restricted access, and soil disturbance would occur during construction. There would be a potential for biological resource impacts because of the loss of habitat and potential impacts to wetlands, aquatic resources, and special status species. Cultural resources could be affected whenever there is ground disturbance, especially in areas that have not been extensively surveyed. Operations may affect Native American resources. The associated employment would have a socioeconomic impact, and the level of service on local roadways could decline during construction.

Potential impacts from the Direct Disposition Alternative to public and occupational health and safety exist from the radiological and hazardous chemical releases during normal operations. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. Environmental justice impacts are possible if health and safety or environmental impacts disproportionately affect minority and low-income populations. Potential intersite transportation impacts related to the movement of materials to the deep borehole complex could occur primarily from nonradiological impacts (air pollution and highway accidents) as opposed to impacts from radiological releases.

Impacts to waste management would occur. Construction and operation of a deep borehole disposal facility for direct disposition would require the construction of waste management facilities. These would include facilities to treat and store generated TRU, low-level, hazardous, and nonhazardous wastes.

4.6.3.2.2 *Immobilized Disposition*

Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility and the ceramic immobilization facility, packaged, and placed in a deep borehole. The environmental impacts of implementing this alternative are the sum of the impacts previously described for the pit disassembly/conversion facility and the Pu conversion facility, in addition to the impacts described below.

Ceramic Immobilization Facility. Construction of the ceramic immobilization facility would have potential impacts to land resources, site infrastructure, air quality and noise, and geology and soils. The usage of one or more local roadways would increase during construction at INEL, Pantex, and ORR, and could lead to a temporary decrease in the level of service.

Construction and operation of the ceramic immobilization facility would affect land resources at ORR and water resources at Pantex. For land use at ORR, construction and operation of the ceramic immobilization facility would lead to a reduction in visual quality at the Bear Creek Round and Route 95 sensitive viewpoints, resulting in a VRM classification change from Class 4 to Class 5. Because this alternative would require an additional drawdown of 320 million l/yr (84.5 million gal/yr) of water during operation, water resources would be affected at Pantex. Surface and groundwater resources at the other DOE sites would not be affected by this alternative. At NTS, Pantex, and ORR, construction of a radioactive waste management facility would be necessary.

The potential for impacts to biological resources at each site except SRS exists due to habitat loss associated with land disturbance during construction. At Hanford, Pantex, and ORR, there would also be potential impacts to special status species. At NTS, the desert tortoise and other threatened and endangered species could be affected by construction activities. Playa wetlands at Pantex may be affected. At ORR, the potential for wetlands displacement exists due to land disturbance during construction. Aquatic resources at Pantex and SRS could be affected. At any site where there is ground disturbance (all sites under consideration), cultural and paleontological resources could be affected. Operation may have some impact on Native American resources. There would be the potential for impacts to waste management because of an increase in TRU waste shipments for all sites, onsite LLW disposal at Hanford, INEL, ORR, NTS, and SRS, and an increase in the number of LLW shipments from Pantex to NTS. At all of the DOE sites under consideration, soil resources would be affected by ground disturbance associated with construction activities.

Public and occupational health and safety impacts could result from the radiological and hazardous chemical releases during normal operations. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. As mentioned in the No Action Alternative discussion, exposures to minority and low-income populations in an accident would be dependent upon the magnitude of release and wind direction at the time of the accident. Intersite transportation impacts related to all DOE sites could occur primarily from nonradiological impacts (air pollution and highway accidents) as opposed to impacts from radiological releases.

Deep Borehole Complex. The deep borehole facilities required for this alternative would be similar to those for the Direct Disposition Alternative, with minor exceptions in the receiving and storage facilities and an additional pellet-grout mixing facility and process waste management at the emplacing facilities. Thus, the environmental impacts would be similar to those described previously for the Direct Disposition Alternative.

4.6.3.3 Immobilization Category

Under this category, surplus Pu would be immobilized to create a chemically stable form for emplacement in a HLW repository. The radiation level of the immobilized form would meet the Spent Fuel Standard, which would serve as a proliferation deterrent. There are three Immobilization Alternatives: Vitrification, Ceramic Immobilization, and Electrometallurgical Treatment. Requirements for all three would be in addition to those described previously for pit disassembly/conversion and Pu conversion.

4.6.3.3.1 *Vitrification*

Under the Vitrification Alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, packaged, and transported to the vitrification facility. The environmental impacts of implementing this alternative would be the sum of the impacts described previously for the pit disassembly/conversion facility and the Pu conversion facility, in addition to the impacts described below.

Construction and operation of the vitrification facility would impact land resources at ORR and water resources at Pantex. For land resources at ORR, construction and operation of the vitrification facility would lead to a reduction in visual quality at the Bear Creek Road and Route 95 sensitive viewpoints, resulting in a VRM classification change from Class 4 to Class 5. Because this alternative would require an additional drawdown of 250 million l/yr (66 million gal/yr) of water during operation, water resources would be affected at Pantex. Surface water and groundwater resources at other DOE sites would be affected minimally by this alternative.

Air quality impacts could occur at Pantex and SRS because pollutant concentrations would increase. The potential for impacts to biological resources exists at each site, except SRS, due to habitat loss associated with land disturbance during construction. There is also potential for impacts to special status species at Hanford, Pantex, and ORR; the desert tortoise at NTS; playa wetlands at Pantex; and wetlands and aquatic resources at ORR. At any site where there is ground disturbance (all sites under consideration), cultural and paleontological resources may be affected. Operation has the potential to affect Native American resources at all sites. Soil resources would be affected at all of the DOE sites under consideration by ground disturbance associated with construction activities.

Public and occupational health and safety impacts could result from the radiological and hazardous chemical releases during normal operations. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. As mentioned in the No Action Alternative discussion, exposures to minority and low-income populations in an accident is dependent upon the magnitude of release and wind direction at the time of the accident. Potential intersite transportation impacts related to all DOE sites could occur primarily from nonradiological impacts (air pollution and highway accidents) as opposed to impacts from radiological releases.

Waste management impacts could occur at Hanford, INEL, and SRS, because these sites may require expansion of their existing TRU waste management facilities and construction of sanitary, utility, and process wastewater treatment systems. Impacts to waste management would occur at NTS, Pantex, and ORR, because each site would require the construction of a radioactive waste facility. These three sites may also require the construction of sanitary, utility, and process wastewater treatment systems.

4.6.3.3.2 *Ceramic Immobilization*

Under the Ceramic Immobilization Alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, packaged, and transported to the ceramic immobilization facility. The environmental impacts of implementing this alternative would be the sum of the

impacts described previously for the pit disassembly/conversion facility and the Pu conversion facility, in addition to the impacts described below.

The environmental impacts of constructing and operating the ceramic immobilization facility would be identical to those identified in the preceding section for the vitrification facility, with the exception of public health and safety at all sites and air quality at Hanford, NTS, and INEL. The annual radiological doses to the public would be smaller whereas the dose to workers would be somewhat higher for the ceramic immobilization facility. Locating the ceramic immobilization facility at these sites could lead to high pollutant concentrations which would affect air quality.

4.6.3.3.3 *Electrometallurgical Treatment*

Under the Electrometallurgical Treatment Alternative, existing facilities at ANL-W at INEL are used as a basis for analysis. Such facilities would be modified to accommodate this added mission. Surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, packaged, and transported to the electrometallurgical treatment facility. The environmental impacts of implementing this alternative would be the sum of the impacts identified previously for the pit disassembly/conversion facility and the Pu conversion facility, in addition to the impacts described below.

Public and occupational health and safety, waste management, and intersite transportation would be the resources affected. Public and occupational health and safety impacts could result from the radiological and hazardous chemical releases under the Electrometallurgical Treatment Alternative. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. Waste management impacts would result if additional sanitary, utility, and process wastewater treatment systems are required. Potential intersite transportation impacts could occur at all DOE sites primarily from nonradiological impacts (air pollution and highway accidents) as opposed to impacts from radiological releases.

4.6.3.4 Reactor Category

Four disposition alternatives using reactor technologies would convert Pu to spent nuclear fuel by burning it in a reactor in the form of MOX fuel leading to disposition at a U.S. repository or within the Canadian spent fuel program. The four alternatives are existing LWR, partially completed LWR, evolutionary LWR, and CANDU reactor. Under the Reactor Category Alternatives, surplus Pu would be used as MOX fuel in domestic or Canadian reactors. The United States currently does not have a MOX fuel fabrication facility and does not engage in the commercial MOX fuel market, so a facility would have to be developed at a U.S. site. Under the Existing LWR Alternative, limited quantities of MOX fuel could be produced on an interim basis in existing European facilities using U.S. surplus Pu until a domestic facility is constructed.

4.6.3.4.1 *Mixed Oxide Fuel Fabrication Facility*

Each of the reactor alternatives would require the construction of a MOX fuel fabrication facility that may be collocated with the reactor or located at a separate site. The impacts are described below for DOE sites and a generic site.

Construction and operation of the MOX fuel fabrication facility would have no or negligible impacts to noise and geology at any of the DOE sites. There would be no or negligible impacts to these same environmental resources/issue areas at a generic site.

Because of the continued depletion of the Ogallala Aquifer, water resources would be affected at Pantex, where this alternative would require an additional drawdown of 56.8 million l/yr (15 million gal/yr). Surface and groundwater resources at the other DOE sites would be minimally affected by this alternative.

At all DOE sites, except Pantex, terrestrial resource impacts could result from habitat disturbance. Potential impacts to special status species during construction activities may occur at each DOE site. Playa wetlands at Pantex may be affected. At any site where there is ground disturbance (all DOE sites under consideration except ORR), especially in areas that have not be extensively surveyed, cultural and paleontological resources could be affected. Soil resources would be affected at all of the DOE sites under consideration due to ground disturbance associated with construction.

Potential impacts from the MOX fuel fabrication facility to public and occupational health and safety exist from the radiological and hazardous chemical releases during normal operations. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. As mentioned in the No Action Alternative discussion, exposures to minority and low-income populations in an accident would be dependent upon the magnitude of release and wind direction at the time of the accident. Potential intersite transportation impacts related to all DOE sites could occur, primarily from nonradiological impacts (air pollution and highway accidents) as opposed to impacts from radiological releases.

Impacts to these same environmental resources/issue areas could occur at a generic site: land resources, water resources, soil resources, biological resources, cultural resources, public and occupational health and safety, intersite transportation, and environmental justice.

Construction and operation of the MOX fuel fabrication facility would affect waste management at all of the DOE sites and the generic site. A TRU waste management facility would be required as part of the MOX fuel fabrication facility at NTS, Pantex, ORR, and the generic site. TRU waste management facilities at Hanford, INEL, and SRS would require expansion. All sites would require additional storage facilities where TRU waste would be staged until it is shipped.

4.6.3.4.2 *Existing Light Water Reactor*

Under the Existing LWR Alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, and processed by the MOX fuel fabrication facility. The finished MOX fuel would be transported to three to five LWRs for use instead of conventional uranium reactor fuel. The environmental impacts of implementing this alternative would be the sum of the impacts previously described for the pit disassembly/conversion facility and the Pu conversion facility, the impacts of the MOX fuel fabrication facility, and the reactor impacts described below. The impacts described are for a single reactor. The Pu disposition action would require a minimum of three to five existing LWRs.

The use of an existing LWR would require the substitution of MOX fuel for LEU fuel. There would be no or negligible impacts for all environmental resources/issue areas except public and occupational radiological health and safety, waste management, and intersite transportation. Public and occupational health and safety impacts could result from the radiological releases during normal operations that would be due to the change in doses received when a uranium core is replaced with a MOX core. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The potential for impacts exist for waste management, because an expansion of spent nuclear fuel storage at the site may be required. Intersite transportation impacts related to the transportation of MOX fuel could occur, primarily from nonradiological impacts (air pollution and highway accidents) as opposed to radiological releases.

4.6.3.4.3 *Partially Completed Light Water Reactor*

Under the Partially Completed LWR Alternative, commercial LWRs on which construction has been halted would be completed to burn MOX fuel. The facility and operating characteristics of these units would be essentially the same as for the existing commercial LWRs discussed above. Because no specific site has been identified, impacts are analyzed for a representative site.

Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, followed by the MOX fuel fabrication facility, and the finished MOX fuel transported to the completed LWRs for use instead of conventional LEU reactor fuel. The environmental impacts of implementing this alternative would be the sum of the impacts described previously for the pit disassembly/conversion facility and the Pu conversion facility, the impacts of the MOX fuel fabrication facility, and the impacts described below. The impacts described are for a single reactor. Since the Pu disposition action would require two partially completed LWRs, the requirements would be two times those identified if they are all at one site, or repeated at a second site if two separate geographical locations are chosen.

There would be potential impacts to biological resources, cultural and paleontological resources, soil resources, public and occupational health and safety, waste management, and intersite transportation. Local roads may experience an increase in usage during construction, leading to potential impacts to local transportation.

If ground disturbance is necessary for the completion of construction, both biological and cultural and paleontological resources may be affected. Operation may affect some Native American resources. Impacts to wetlands, aquatic resources, and threatened and endangered species may occur due to facility operations. Soil resources would be affected if ground disturbance is necessary for the completion of construction. Public and occupational health and safety impacts could result from the radiological and hazardous chemical releases under the Partially Completed LWR Alternative. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. Intersite transportation impacts related to the transportation of MOX fuel could occur because of the increased risk of traffic accident fatalities. Impacts to waste management could occur because of the introduction of spent nuclear fuel, LLW, and mixed LLW.

4.6.3.4.4 *Evolutionary Light Water Reactor*

Under the Evolutionary LWR Alternative, the individual reactors would be improved versions of existing commercial nuclear power reactors using light water as a moderator and coolant. The fuel rods would consist of MOX fuel. There could be two design approaches: a large evolutionary LWR and a small evolutionary LWR.

Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, and processed through the MOX fuel fabrication facility. The finished MOX fuel would be transported to the evolutionary LWRs for use instead of conventional LEU reactor fuel. Therefore, the environmental impacts of implementing this alternative would be the sum of the impacts described previously for the pit disassembly/conversion facility and the Pu conversion facility, the impacts of the MOX fuel fabrication facility, and the impacts described below.

The summary of impacts presented below is based on the conclusions reached for the construction and operation of either a large or small evolutionary LWR. However, the proposed Pu disposition action would require a minimum of two large evolutionary LWRs or four small evolutionary LWRs. Thus, the requirements of implementing this alternative would nominally be two to four times those described if the reactors were built at one site, or would be repeated at more than one site if the reactors were built at multiple locations. Since the Storage and Disposition PEIS is not intended to support a siting decision for the disposition alternatives, the precise configuration is unknown at this time.

Construction and operation of the evolutionary LWR could have site impacts on infrastructure, noise, and geology. With respect to air quality, any increase in pollutant concentrations would not exceed applicable standards. Local roads may experience a decline in the level of service during construction at INEL, Pantex, and ORR.

The potential exists for impacts to biological resources, soil resources, cultural and paleontological resources, and public and occupational health and safety at all DOE sites; waste management at Hanford and INEL; and

intersite transportation. Habitat loss during construction could impact wildlife, including special status species, at all sites. At NTS, the desert tortoise could be affected during construction. At Hanford, ORR, and SRS, the potential exists for impacts to sensitive plants from the salt drift from wet cooling towers and to aquatic resources from blowdown waters from the cooling systems into local streams and rivers. Wetlands at Pantex, ORR, and SRS may also be affected. At sites where there is ground disturbance (all sites under consideration), cultural and paleontological resources could be affected. Native American resources may be affected by facility operation. At all of the DOE sites under consideration, soil resources would be affected by ground disturbance associated with construction activities. Hanford and INEL require either major upgrades to existing sanitary, utility, and process wastewater treatment systems or construction of new facilities.

Public and occupational health and safety impacts could result from the radiological and hazardous chemical releases during normal operations at all DOE sites. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. Intersite transportation impacts related to all DOE sites could occur, primarily from nonradiological impacts (air pollution and highway accidents) as opposed to radiological releases.

Construction and operation of the evolutionary LWR would have impacts on land resources at ORR; water resources at Pantex; public health and safety at SRS; and waste management at NTS, Pantex, ORR, and SRS. Land resources at ORR would be affected because the proposed use of vacant land would change the VRM classification from Class 3 to Class 5, resulting in visual impacts to the Watts Bar Lake and adjacent area's sensitive viewpoints; and the proposed facility location would not be within the ORR site boundary, but rather on the adjacent TVA land. Because of the continued depletion of the Ogallala Aquifer, water resources would be affected at Pantex, where this alternative would require an additional drawdown of 341 million l/yr (90 million gal/yr). However, this additional use, factored in with the projected decrease under No Action, would result in an overall decrease in water use of 30 percent by 2005. Surface and groundwater resources at the other DOE sites would be minimally affected by this alternative.

At SRS, the radiological dose to the population living within 80 km (50 mi) of the site under normal operations is estimated at 110 person-rem per year and represents 0.049 percent of natural background exposure. As mentioned in the No Action Alternative discussion, exposures to minority and low-income populations surrounding SRS in an accident is dependent upon the magnitude of release and wind direction at the time of the accident.

For waste management, all sites would require the construction of storage facilities for spent nuclear fuel, and both ORR and SRS would require the construction of sanitary, utility, and process wastewater treatment systems. In addition, Pantex would require LLW facilities or additional LLW shipments, and major upgrades or new construction of sanitary, utility, and process wastewater treatment systems.

4.6.3.4.5 *Canadian Deuterium Uranium Reactor*

Under the CANDU Reactor Alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or Pu conversion facility, and processed through the MOX fuel fabrication facility. The finished fuel would be transported to the Ontario Hydro Nuclear Bruce-A Generating Station in Ontario, Canada.

Other than intersite transportation impacts, the environmental impacts within the United States of implementing this alternative would be limited to the sum of the impacts described above for the pit disassembly/conversion, Pu conversion facility, and the MOX fuel fabrication facility. Potential intersite transportation impacts related to the transportation of MOX fuel could occur because of the increased risk of traffic accident fatalities. All other impacts would occur in Canada.

[Text deleted.]

4.7 CUMULATIVE IMPACTS

4.7.1 METHODOLOGY

This section identifies the potential for cumulative impacts over the life of the program which could result from incremental impacts of proposed actions and alternatives identified previously, when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such actions.

The reference condition for cumulative effects is the No Action Alternative, which addresses the impacts of past, present, and ongoing programs. In particular, for alternatives that are proposed for DOE sites, the analysis focuses primarily on the potential for cumulative impacts at each candidate site where other programs or environmental management programs are reasonably anticipated.

The reasonably foreseeable future actions that may be implemented at some of the DOE sites under consideration in this PEIS include the following:

- *Storage and Disposition of Weapons-Usable Fissile Materials PEIS* (Final)
- *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (ROD issued)
- *Disposition of Surplus Highly Enriched Uranium Final EIS* (ROD issued)
- *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Restoration and Waste Management Programs Final Environmental Impact Statement* (ROD issued)
- *Stockpile Stewardship and Management PEIS* (Final)
- *Tritium Supply and Recycling PEIS* (ROD issued)
- *Waste Management PEIS* (Draft)

The following documents and associated actions were considered in assessing cumulative impacts, but were eliminated from further study because they do not contribute to cumulative impacts, they had impacts that were already included in the No Action Alternative, or they would be completed by the 2005 start date:

- *Defense Waste Processing Facility at the Savannah River Site EIS* (ROD issued)
- *Dual Axis Radiographic Hydrodynamic Test Facility EIS* (ROD issued)
- *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y–12 Plant, Oak Ridge, Tennessee* (FONSI issued)
- *Interim Management of Nuclear Materials at the Savannah River Site EIS* (Final)
- *Plutonium Finishing Plant EIS* (ROD issued)
- *Proposed Medical Isotope Production EIS* (ROD issued)
- *Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (Final)

- *Savannah River Site Waste Management EIS* (ROD issued)
- *EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (Final)
- *Stabilization of Plutonium Solutions Stored in the F-Canyon Facility at the Savannah River Site EIS* (ROD issued)

No other Federal, State, local, or private reasonably foreseeable actions were found that would contribute to cumulative impacts. When possible, planned projects before the 2005 No Action baseline have been incorporated into the No Action Alternative. The No Action Alternative takes into account existing site operations and includes the impacts resulting from planned changes to operations until the year 2005. Projects planned for beyond the 2005 No Action baseline are in such a preliminary stage as to make analysis speculative. Future tiered-NEPA documents would further analyze the impacts from other Federal, State, local, and private actions.

For the Storage Alternatives, the seven DOE programs and the eight DOE sites potentially affected are identified in Table 4.7.1–1. The cumulative impacts for long-term storage are discussed in Section 4.7.2. For the Disposition Alternatives, a generic analysis that is applicable to all DOE sites was developed. Since there are multiple combinations of alternatives that could be selected for the disposition program, a representative scenario was selected for the cumulative impacts analysis. The cumulative impacts for the disposition program are discussed in Section 4.7.3.

Table 4.7.1–1. Reasonably Foreseeable Future Programs at Department of Energy Sites

Program	NEPA Document Status	Hanford	NTS	INEL	Pantex	ORR	SRS	RFETS	LANL
Storage and Disposition	Final PEIS	X	X	X	X	X	X	X	X
Foreign Research Reactor Spent Nuclear Fuel	ROD issued			X			X		
HEU Disposition	ROD issued					X	X		
[Text deleted.]									
Spent Nuclear Fuel	ROD issued	X		X			X		
Stockpile Stewardship and Management	Final PEIS		X		X	X	X		X
Tritium Supply/Recycling	ROD issued						X		
Waste Management	Draft PEIS	X	X	X	X	X	X	X	X

4.7.2 STORAGE ALTERNATIVE CUMULATIVE IMPACTS

4.7.2.1 Hanford Site

4.7.2.1.1 *Land Resources*

In addition to the storage alternatives, Hanford is being considered as a site for the two other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs during operation is 230 ha (570 acres), or less than 0.2 percent of the total land at Hanford. Site development would be performed in accordance with the land use plans in the *Hanford Site Development Plan*. Proposed development would also be compatible with the industrial use visual character of the developed areas of Hanford. Cumulatively, the actions would consume land, but would be consistent with the land-use plans and visual character of the site.

4.7.2.1.2 *Site Infrastructure*

Some cumulative impacts are possible at Hanford resulting from implementation of any of the storage actions when added to the other two DOE programs identified in Table 4.7.1–1. The site infrastructure cumulative impacts at Hanford that would result from operation of the proposed projects are shown in Table 4.7.2.1.2–1. Hanford has adequate site availability to meet the resource requirements for all of the site infrastructure resources.

Table 4.7.2.1.2–1. Site Infrastructure Cumulative Operation Impacts at Hanford Site

Requirement	Electrical		Fuel	
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)
No Action	345,500	58	9,334,800	21,039,531
Storage and Disposition[a]	92,000	18	38,000	0
Spent Nuclear Fuel	0	NA	0	0
Waste Management	NA	47	NA	NA
Cumulative Requirement	437,500	123	9,372,800	21,039,531
Site Availability	1,678,700	281	14,775,000	21,039,531

[a] Collocation Alternative.
Note: NA=data was not analyzed in the associated EIS.
Source: DOE 1995o; DOE 1995cc; Table 4.2.1.2–1.

4.7.2.1.3 *Air Quality and Noise*

Cumulative impacts to air quality at Hanford include impacts from the No Action Alternative, the two DOE programs identified in Table 4.7.1–1, and the proposed facilities for each storage alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

Hanford is currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the Storage Alternatives would increase concentrations of criteria pollutants. Potential cumulative impacts are presented in Table 4.7.2.1.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no

Table 4.7.2.1.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Hanford Site and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Other Onsite Activities[b] ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Criteria Pollutants							
Carbon monoxide	8-hour	10,000[c]	0.08	0	0.09	0.17	0.17
	1-hour	40,000[c]	0.3	0	0.37	1.04	1.04
Lead	Calendar Quarter	1.5[c]	<0.01	0	<0.01	<0.01	<0.01
	24-hour	0.5[d]	<0.01	0	<0.01	<0.01	<0.01
Nitrogen dioxide	Annual	100[c]	0.03	0.1	0.13	0.14	0.14
Ozone	1-hour	235[c]	[e]	[e]	[e]	[e]	[e]
Particulate matter less than or equal to 10 micron in diameter	Annual	50[c]	<0.01	0	<0.01	<0.01	<0.01
	24-hour	150[c]	0.02	0	0.02	0.02	0.02
Sulfur dioxide	Annual	52[c]	<0.01	1.6	1.61	1.61	1.61
	24-hour	260[c]	<0.01	7.3	7.31	7.31	7.31
	3-hour	1,300[c]	0.01	26	26.01	26.01	26.11
	1-hour	1,018[d]	0.02	[f]	0.02	0.22	0.22
	1-hour	655[d,g]	0.02	[f]	0.02	0.22	0.22
Mandated by Washington							
Total suspended particulates	Annual	60[d]	<0.01	0	<0.01	<0.01	<0.01
	24-hour	150[d]	0.02	0	0.02	0.02	0.02
Gaseous fluorides	30-day	0.8[d]	[h]	0	[h]	[h]	[h]
	7-day	1.7[d]	[h]	0	[h]	[h]	[h]
	24-hour	2.9[d]	[h]	0	[h]	[h]	[h]
	12-hour	3.7[d]	[h]	0	[h]	[h]	[h]

Table 4.7.2.1.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Hanford Site and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Other Onsite Activities[b] ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Hazardous and Other Toxic Compounds							
Ammonia	24-hour	100[d]	<0.01	0	<0.01	<0.01	<0.01
Chlorine	24-hour	5[d]	[h]	0	[h]	<0.01[i]	<0.01[i]
Hydrogen chloride	24-hour	7[d]	[h]	0	[h]	<0.01[i]	<0.01[i]
Hydrazine	Annual	0.0002[d]	[h]	0	[h]	<0.00001[i]	<0.00001[i]
Nitric acid	24-hour	17[d]	[h]	0	[h]	<0.01[i]	<0.01[i]
Phosphoric acid	24-hour	3.3[d]	[h]	0	[h]	<0.01[i]	<0.01[i]
Sulfuric acid	24-hour	3.3[d]	[h]	0	[h]	<0.01[i]	<0.01[i]

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.
[b] Other onsite activities include those associated with the Spent Nuclear Fuel and Waste Management Programs.
[c] Federal and State standard.
[d] State standard or guideline.
[e] Ozone as a criteria pollutant is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.
[f] Not reported.
[g] The standard is not to be exceeded more than twice in any 7 consecutive days.
[h] No sources of this pollutant have been identified.
[i] The concentration represents the alternative contribution and other onsite activities.
Source: 40 CFR 50; DOE 1995o; DOE 1995dd; HF 1995a:1; HF DOE 1996a; Table 4.2.1.3–1.

increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.1.4 *Water Resources*

Table 4.7.2.1.4–1 shows the estimated cumulative water usage from the storage alternatives and the two other DOE programs identified in Table 4.7.1–1. The total cumulative water requirements for the site would be less than 1 percent of the Columbia River's average annual flow (3,360 m^3/s [118,642 ft^3/s]). The proposed storage Collocation Alternative would account for approximately 1 percent of the cumulative water usage. The additional withdrawals are minor in comparison with the average flow of the river and would not noticeably affect the local or regional water supply.

Table 4.7.2.1.4–2 summarizes the estimated cumulative wastewater that would be generated from the storage alternatives and the other two DOE programs. The wastewater from the Storage and Disposition Program would be recycled at newly constructed wastewater treatment facilities. [Text deleted.]

Table 4.7.2.1.4–1. Cumulative Annual Water Usage at Hanford Site

Program	Water Requirements (million l/yr)
No Action	13,706[a]
Storage and Disposition	150[b,c]
[Text deleted.]	
Spent Nuclear Fuel	0[d]
Waste Management	503[a,d]
Total annual cumulative water usage	14,359

[a] Includes both surface and groundwater usage (13,511 million l/yr from surface water and 195 million l/yr from groundwater).
[b] Data represents the maximum value for the comparative alternative scenario.
[c] Data represents the Collocation Alternative.
[d] No additional water resources are required.
Source: DOE 1995o; DOE 1995cc; DOE 1995dd; HF 1995a:1; Table 4.2.1.4–1.

Table 4.7.2.1.4–2. Cumulative Annual Wastewater Discharge at Hanford Site

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	246
Storage and Disposition	0[a]
[Text deleted.]	
Spent Nuclear Fuel	0[b]
Waste Management	238[c,d]
Total annual cumulative wastewater	484

[a] Wastewater would be recycled.
[Text deleted.]
[b] Because the ROD resulted in the movement of material away from Hanford, no additional wastewater discharge would result.
[c] Data represents the maximum value for the comparative alternative scenario.
[d] Based on preliminary data.
Source: DOE 1995o; DOE 1995cc; DOE 1995dd; HF 1995a:1; Table 4.2.1.4–1.

4.7.2.1.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1-1. A total of 230 ha (570 acres) could be disturbed at the site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.1.6 *Biological Resources*

In addition to ongoing activities and the Storage Alternatives, Hanford is being considered for the two other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs is 230 ha (570 acres), or less than 0.2 percent of Hanford. Due to the lack of wetlands and aquatic resources on the site, cumulative impacts to these resources would not be expected. The cumulative loss of habitat could lead to additional impacts to special status species compared to those resulting from construction of a storage facility alone; however, the viability of site populations would not be expected to be jeopardized. Species that could be affected include several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher.

4.7.2.1.7 *Cultural and Paleontological Resources*

The two other DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access at Hanford. Construction at Hanford under these programs is primarily proposed for developed areas which have either been surveyed or are disturbed, and are therefore unlikely to contain cultural or paleontological resources. Prior to construction activity, specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act,* and the *Native American Graves Protection and Repatriation Act*. Each of the Storage Alternatives would be located either within existing buildings or in areas that have already been disturbed. Thus, the cumulative impacts resulting from the storage alternatives, if any, are expected to be minimal.

4.7.2.1.8 *Socioeconomics*

Cumulative impacts to Hanford's regional economy, population, housing, community services, and local transportation would be minor. Overall, adding the other DOE programs identified in Table 4.7.1–1 would confer economic benefits to the region through additional job creation and increased earnings. As shown in Table 4.7.2.1.8–1, the cumulative impact of the programs under consideration at Hanford is not expected to be significant because of the relatively small size of each program. The primary impact beyond providing some stimulus to the regional economy would be to increase traffic flow to and from the site. However, it is not expected that traffic congestion would be significantly increased if one or all of these programs were sited at Hanford.

Table 4.7.2.1.8–1. Socioeconomic Cumulative Impacts at Hanford Site

Program	Direct Employment[a]
Storage and Disposition[b]	572
Spent Nuclear Fuel	0
Waste Management	416
Total	988

[a] Operations.
[b] Collocation Alternative.
Source: DOE 1995o; DOE 1995cc; Section 4.2.1.8.

4.7.2.1.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the storage alternative, the No Action Alternative, and other actions planned at Hanford are presented in Table 4.7.2.1.9–1. The impacts of these actions have not been summed because the exact locations of the facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Table 4.7.2.1.9–1. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Hanford Site

	Maximally Exposed Individual Member of the Public		Offsite Population Within 80 km		Total Site Workforce	
Program	Total Dose (mrem)	Fatal Cancer Risk	Total Dose (person-rem)	Number of Fatal Cancers	Total Dose (person-rem)	Number of Fatal Cancers
No Action	5.3×10^{-3}	2.7×10^{-9}	1.6	7.7×10^{-4}	250	0.10
Storage and Disposition[a]	2.5×10^{-6}	1.3×10^{-12}	1.1×10^{-4}	5.5×10^{-8}	25	0.010
[Text deleted.]						
Spent Nuclear Fuel	0.028	1.4×10^{-8}	1.6	8.0×10^{-4}	142	0.057
Waste Management	0.45	2.2×10^{-7}	22	0.011	0.35	1.4×10^{-4}

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage.

Source: DOE 1995o; DOE 1995cc; DOE 1995dd; Tables 4.2.1.9–1 and 4.2.1.9–2.

Chemical Impacts. For Hanford, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at Hanford is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

4.7.2.1.10 *Waste Management*

Cumulative impacts to waste management at Hanford could arise from any of the reasonably foreseeable future actions as identified in Table 4.7.2.1.10–1. Waste management activities associated with the storage of Pu and HEU would have consistently smaller impacts than any future environmental restoration and waste management activities at Hanford. Thus, the overall impacts of Pu and HEU storage would not contribute significantly to cumulative impacts. The largest cumulative impacts at Hanford result from the Waste Management PEIS under alternatives where Hanford is selected as a centralized treatment, storage, and/or disposal site, such as the HLW Centralized Alternative, the LLW Centralized Alternative 5, and the Mixed LLW Centralized Alternative. As a result of the ROD from the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Program Final*

Table 4.7.2.1.10–1. Waste Management Cumulative Impacts at Hanford Site (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Spent Nuclear Fuel[c] (m^3)	Waste Management (m^3)	Total (m^3)
Spent Fuel	0	0	0	0	0
High Level					
Liquid	0	0	0	Included in solid	0
Solid	0	0	0	19,935[d]	19,935
Transuranic					
Liquid	0	0.02	Included in solid	Included in solid	0.02
Solid	271	10	53	675[e]	1,009
Mixed Transuranic					
Liquid	0	0	Included in TRU	Included in TRU	0
Solid	98	4	Included in TRU	Included in TRU	102
Low-Level					
Liquid	0	2.1	1,300	Included in solid	1,302
Solid	3,390	1,300	407	69,600[f]	74,700
Mixed Low-Level					
Liquid	3,760	0.2	Included in solid	Included in solid	3,760
Solid	1,505	66	0.46	9,655[g]	11,230
Hazardous					
Liquid	Included in solid	2	Included in solid	Included in solid	2
Solid	560	2	2	504[h]	1,068
Nonhazardous (Sanitary)					
Liquid	414,000	146,000	NA	NA	560,000
Solid	5,107	1,760	NA	NA	6,870

Table 4.7.2.1.10–1. Waste Management Cumulative Impacts at Hanford Site (2005)—Annual Volumes—Continued

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Spent Nuclear Fuel [c] (m^3)	Waste Management (m^3)	Total (m^3)
Nonhazardous (Other)					
Liquid	Included in sanitary	Included in sanitary	NA	153,380[i]	153,380
Solid	Included in sanitary	2,200[i]	NA	NA	2,200

[a] No Action volumes are from Table 4.2.1.10–1.

[b] Collocation Alternative annual volume generated from operations, Table E.3.1.3–1.

[Text deleted.]

[c] The Department has decided to implement the preferred alternative, Regionalization by Fuel Type (Alternative 4a) identified in Volume 1 of the DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final EIS. According to the amended ROD (61 FR 9441), existing Hanford production reactor spent nuclear fuel will remain at the Hanford Site. Data is from table 3–2, page 350, follow-on NEPA analysis, Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, of Richland, Washington using preferred alternative (dry storage/passivation).

[Text deleted.]

[d] Under the HLW Centralized Alternative, 11,400 m^3 (8,500 canisters) of HLW shipments from INEL, 126,900 m^3 (4,572 canisters) from SRS, and 1,600 m^3 (300 canisters) from West Valley Demonstration Project would be transported to Hanford for storage. Hanford would have 258,800 m^3 (15,000 canisters) of HLW in storage. Annual volume derived by dividing total volume by 20. Acceptance of DOE-managed HLW at the geologic repository is delayed past 2015 (Draft Waste Management PEIS, Vol. I of IV, Table 9.1–1 Page 9-3; Table 9-3-6; Page 9-22).

[e] Under the TRU Waste Centralized Alternative, Hanford would treat 10 percent of the estimated inventory plus 20 year generation of RH-TRU from INEL and LANL (Draft Waste Management PEIS, Vol. I of IV, Table 8.1–1, Page 8-4).

[f] Under the LLW Centralized Alternative 5, Hanford would receive LLW from all sites. The volume was obtained by taking the estimated inventory at Hanford plus the estimated inventory and 20-year generation projection for offsite receipts and dividing by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 7.1–1, Page 7-3; Table 7.3–14, Page 7-28).

[g] Under the Mixed LLW Centralized Alternative, Hanford would receive mixed LLW from all sites. The volume was obtained by taking the annual estimate the estimated inventory at Hanford plus the estimated inventory and 20-year generation projection for offsite receipts and dividing by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 6.3–7, Page 6-24; Table 6.1–1, Pages 6-3 and 6-4).

[h] Under the Regionalized Alternative 1, Hanford would treat two-thirds of 50 percent of the received hazardous wastes from LLNL and send the other one-third to a commercial facility. One metric ton of hazardous waste is approximately 1 cubic meter in volume (Draft Waste Management PEIS, Vol. I of IV, Table 10.3–7, Page 10-20).

[i] Represents the total annual incremental wastewater over No Action for all alternatives. Annual volume estimated by assuming 365 days per year (Draft Waste Management PEIS, Vol. II, Tables II-5.1–16 [mixed LLW], page 5–18; II-5.2–12 [LLW], page 5–32; II-5.3–11 [TRU], page 5–45; II-5.4–8 [HLW], page 5–55; and II-5.5–10 [hazardous], page 5–67).

Note: NA=data was not analyzed in the associated EIS.

Source: 61 FR 9441; DOE 1995o; DOE 1995cc; DOE 1995dd; DOE 1996b; Table 4.2.1.10–1.

Environmental Impact Statement, Hanford will not receive spent nuclear fuel from domestic offsite sources, and thus would not contribute significantly to spent nuclear fuel cumulative impacts. However, additional waste volumes would be generated from the storage of existing inventories.

4.7.2.2 Nevada Test Site

4.7.2.2.1 *Land Resources*

In addition to the storage alternatives, NTS is under consideration for the siting of the two other DOE programs identified in Table 4.7.1-1. The total area of undisturbed land that could be affected by these programs during operation is 111 ha (276 acres), or less than 0.04 percent of the total land at NTS. The site development plans for the P-Tunnel alternative in Area 12 and the storage facilities in Area 6 do not conform with land use plans outlined in the *Nevada Test Site Development Plan*. However, all new development projects are in accordance with the land use plans outlined in the Expanded Use Alternative of the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*. The proposed development would be compatible with the industrial use visual character of the developed areas of NTS. Cumulatively, the actions would consume land, but would be consistent with the land use plans and visual character of the site.

4.7.2.2.2 *Site Infrastructure*

Some cumulative impacts are possible at NTS resulting from implementation of any of the storage actions when added to the other two DOE programs identified in Table 4.7.1–1. Currently, the United States is under a self-imposed nuclear testing moratorium. Should a decision be made to reinstate the underground test program, NTS would again restore all of the dormant infrastructure. Operational procedures across the site would also be affected if underground testing resumes, creating cumulative impacts upon the other programs. Table 4.7.2.2.2–1 shows the site infrastructure cumulative impacts that would result at NTS from operation of the proposed programs were they to be sited at NTS. The cumulative requirement for energy, peak load, oil, and natural gas would exceed the site availability at NTS. High voltage transmission lines, electrical distribution equipment, and oil storage tanks would be constructed to meet the new resource requirements. Oil-based utilities would be substituted for the natural gas utilities if needed.

Table 4.7.2.2.2–1. Site Infrastructure Cumulative Operation Impacts at Nevada Test Site

	Electrical		Fuel	
Requirement	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)
No Action	124,940	25	5,716,000	0
Storage and Disposition[a]	89,000	13	38,000	3,600,000
Stockpile Stewardship and Management	83,000	27	4,332,000	0
Waste Management	NA	11	NA	NA
Cumulative Requirement	296,940	76	10,086,000	3,600,000
Site Availability	176,844	45	5,716,000	0

[a] Collocation Alternative.

Note: NA=data was not analyzed in the associated EIS.

Source: DOE 1995cc; DOE 1996b; Table 4.2.2.2–1.

4.7.2.2.3 *Air Quality and Noise*

Cumulative impacts to air quality at NTS include impacts from the No Action Alternative, the other two DOE programs identified in Table 4.7.1–1, and the proposed facilities for each alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

The NTS is currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the storage alternatives would increase concentrations of criteria pollutants. Potential cumulative

impacts are presented in Table 4.7.2.2.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.2.4 *Water Resources*

Table 4.7.2.2.4–1 summarizes the estimated cumulative water withdrawals for the storage alternatives and the two other DOE programs identified in Table 4.7.1–1. Water requirements during the operation of all the proposed projects would be obtained from groundwater resources. The cumulative water requirements for the site would be a 26-percent increase in the projected No Action usage and approximately 7.2 percent of the estimated minimum recharge rate. The proposed Collocation Alternative using the modify P-Tunnel option would account for approximately 6.4 percent of the cumulative water usage.

Because all wastewater generated during operations of the proposed facilities would be recycled, the amount of wastewater generated during construction was evaluated. Table 4.7.2.2.4–2 summarizes the estimated cumulative water discharges. The estimated cumulative wastewater discharge would be a 178-percent increase in the projected No Action discharge. The proposed collocation alternative using a new storage facility would account for approximately 5 percent of the total estimated cumulative wastewater. [Text deleted.]

Table 4.7.2.2.4–1. Cumulative Annual Water Usage at Nevada Test Site

Program	Water Requirements (million l/yr)
No Action	2,400[a]
Storage and Disposition	190[b]
Stockpile Stewardship and Management	250
Waste Management	147[c]
Total annual cumulative water usage	2,987

[a] Data represents groundwater usage.
[b] Data represents the Collocation Alternative using the modify P-Tunnel option.
[c] Based on preliminary data.
Source: DOE 1995cc; DOE 1996b; NTS 1995a:1; Table 4.2.2.4–1.

Table 4.7.2.2.4–2. Cumulative Annual Wastewater Discharge at Nevada Test Site

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	82.0
Storage and Disposition	11.8[a]
Stockpile Stewardship and Management	72
Waste Management	61[b]
Total annual cumulative wastewater	227

[a] Data represents the maximum value for the comparative scenario during construction of the Collocation Alternative using a new storage facility.
[b] Based on preliminary data.
Source: DOE 1995cc; DOE 1996b; NTS 1995a:1; Table 4.2.2.4–1.

Table 4.7.2.2.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Nevada Test Site and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Other Onsite Activities[b] ($\mu g/m^3$)	Consolidation: Modify P-Tunnel ($\mu g/m^3$)	Consolidation: New Facility ($\mu g/m^3$)	Collocation: Modify P-Tunnel ($\mu g/m^3$)	Collocation: New Facility ($\mu g/m^3$)
Criteria Pollutants								
Carbon monoxide	8-hour	10,000[c]	2,290	0.80	2,291	2,291	2,291	2,291
	1-hour	40,000[c]	2,748	6.03	2,758	2,756	2,758	2,756
Lead	Calendar Quarter	1.5[c]	[d]	<0.01	[d]	[d]	[d]	[d]
Nitrogen dioxide	Annual	100[c]	[d]	0.20	0.21[e]	0.2[e]	0.21[e]	0.2[e]
Ozone	1-hour	235[c]	[f]	[f]	[f]	[f]	[f]	[f]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[c]	9.4	0	9.4	9.4	9.4	9.4
	24-hour	150[c]	106	0	106	106	106	106
Sulfur dioxide	Annual	80[c]	8.4	0	8.4	8.4	8.4	8.4
	24-hour	365[c]	94.6	0.2	94.8	94.8	94.8	94.8
	3-hour	1,300[c]	725	1.6	727	727	727	727
Mandated by Nevada								
Hydrogen sulfide	1-hour	112[g]	[d]	0	[d]	[d]	[d]	[d]
Hazardous and Other Toxic Compounds								
Chlorine	8-hour	35.7[g]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]
Hydrogen chloride	8-hour	[h]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]
Hydrazine	8-hour	3.1[g]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]
Nitric acid	8-hour	123.8[g]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]
Phosphoric acid	8-hour	23.8[g]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]
Sulfuric acid	8-hour	23.8[g]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Other onsite activities include those associated with the Stockpile Stewardship and Management and Waste Management programs.

[c] Federal and State standard.

[d] No sources of this pollutant have been identified.

[e] The concentration represents the alternative contribution and other onsite activities.

[f] Ozone, as a criteria pollutant, is not directly emitted nor monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[g] State standard or guideline.

[h] No State standard for indicated averaging time.

Source: 40 CFR 50; DOE 1995dd; DOE 1996b; NT DOE 1996a; NV DCNR 1992a; NV DCNR 1995a; Table 4.2.2.3–1.

4.7.2.2.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1–1. A total of 111 ha (276 acres) could be disturbed at the site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.2.6 *Biological Resources*

In addition to ongoing activities and the Storage Alternatives, NTS is being considered for the two other programs identified in Table 4.7.1–1. A number of these facilities would be located to the south and west of Yucca Lake in Areas 5 and 6, although the collocated storage facility could alternatively be located at the P-Tunnel. The total area of undeveloped land used by new facilities would be 111 ha (276 acres), or less than 0.04 percent of NTS. Due to the lack of wetlands and aquatic resources at NTS, cumulative impacts to these resources would not be expected. To the extent that facilities were constructed within the southern portion of the site, cumulative impacts to the threatened desert tortoise could occur. Cumulative impacts to other special status species, such as the Beatley milkvetch, could also occur due to the additive effect of habitat loss.

4.7.2.2.7 *Cultural and Paleontological Resources*

The two other DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access and use at NTS. Much of the land potentially affected by construction has received some level of evaluation for cultural resources. Plant communities significant to Native Americans may be affected on Rainier Mesa and near the DAF. Prior to construction activity, specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act*, and the *Native American Graves Protection and Repatriation Act*. Cumulative impacts resulting from the storage alternatives, if any, are expected to be minimal.

4.7.2.2.8 *Socioeconomics*

Cumulative impacts on NTS's regional economy, population, housing, community services, and local transportation would be minor. Table 4.7.2.2.8–1 shows the socioeconomic cumulative impacts at NTS. The regional economy would improve without any burden on the housing market. The cumulative socioeconomic impact of the other two DOE programs is expected to be insignificant, due to the relatively small size of each program.

Table 4.7.2.2.8–1. Socioeconomic Cumulative Impacts at Nevada Test Site

Program	Direct Employment[a]
Storage and Disposition[b]	622
Stockpile Stewardship and Management	1,423
Waste Management	3,272
Total	5,317

[a] Operations.
[b] Collocation Alternative.
Source: DOE 1995cc; DOE 1996b; Section 4.2.2.8.

4.7.2.2.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the Storage Alternative, the No Action Alternative, and other actions planned at NTS are presented in Table 4.7.2.2.9–1. Although these impacts could be added, it should be noted that the exact locations of the

Table 4.7.2.2.9–1. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Nevada Test Site

	Maximally Exposed Individual Member of the Public		Offsite Population Within 80 km		Total Site Workforce	
Program	Total Dose (mrem)	Fatal Cancer Risk	Total Dose (person-rem)	Number of Fatal Cancers	Total Dose (person-rem)	Number of Fatal Cancers
No Action	4.2×10^{-3}	2.1×10^{-9}	3.7×10^{-3}	1.9×10^{-6}	3	1.2×10^{-3}
Storage and Disposition[a]	5.6×10^{-6}	2.8×10^{-12}	1.7×10^{-6}	8.5×10^{-10}	40	0.016
Stockpile Stewardship and Management	3.5×10^{-6}	1.8×10^{-12}	3.1×10^{-6}	1.6×10^{-9}	2.6	1.0×10^{-3}
Waste Management	7.8×10^{-9}	3.9×10^{-15}	3.0×10^{-8}	1.5×10^{-11}	8.4×10^{-8}	3.4×10^{-11}
[Text deleted.]						

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage at P-Tunnel.

[Text deleted.]

Source: DOE 1995cc; DOE 1995dd; DOE 1996b; NT DOE 1986b; Tables 4.2.2.9–1 and 4.2.2.9–2.

facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Chemical Impacts. For NTS, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at NTS is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

4.7.2.2.10 *Waste Management*

The actions and alternatives which could contribute to the cumulative impacts at NTS are listed in Table 4.7.2.2.10–1. The largest impact on radioactive waste management would result if NTS is selected as a regional treatment and disposal facility for mixed LLW and a central disposal facility for LLW as a result of the waste-type specific RODs developed from the Waste Management PEIS. The next smaller impact would result from the alternatives considered in this PEIS. NTS is also a candidate site for an Assembly/Disassembly facility and the National Ignition Facility from the Stockpile Stewardship and Management PEIS.

Table 4.7.2.2.10–1. Waste Management Cumulative Impacts at Nevada Test Site (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Stockpile Stewardship and Management[c] (m^3)	Waste Management (m^3)	Total (m^3)
Spent Fuel	0	0	0	0	0
High Level					
Liquid	0	0	0	0	0
Solid	0	0	0	0	0
Transuranic					
Liquid	0	0.02	0	Included in solid	0.02
Solid	0	10	0	30.5[d]	40.5
Mixed Transuranic					
Liquid	0	0	0	Included in TRU	0
Solid	0	4	0	Included in TRU	4
Low-Level					
Liquid	Dependent on restoration activities	2.1	0.66	Included in solid	2.8
Solid	15,000	1,300	33	74,000[e]	90,330
Mixed Low-Level					
Liquid	0	0.2	2	Included in solid	2.2
Solid	50	66	2	11,300[f]	11,420
Hazardous					
Liquid	Included in solid	2	8	0	10
Solid	212	2	8	0	222
Nonhazardous (Sanitary)					
Liquid	Included in solid	189,000	70,900	NA	260,000
Solid	2,120	1,960	6,100	NA	10,180

Table 4.7.2.2.10–1. Waste Management Cumulative Impacts at Nevada Test Site (2005)—Annual Volumes—Continued

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Stockpile Stewardship and Management[c] (m^3)	Waste Management (m^3)	Total (m^3)
Nonhazardous (Other)					
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	36,300[g]	36,300
Solid	76,500	2,500[h]	0	NA	79,000

[a] No Action volumes are from Table 4.2.2.10–2.

[b] Collocation Alternative using modification of P-Tunnel, Table E.3.1.3–2.

[c] Assembly/disassembly and National Ignition Facility alternatives.

[d] Represents the Decentralized Alternative in which NTS would treat and store its TRU waste onsite, and dispose of it at a Federal geologic repository. The number is the existing inventory divided by 20 from Table 8.1–1, page 8-4 of the Draft Waste Management PEIS (DOE/EIS-0200D).

[e] Represents the LLW Centralized Alternative 2 in which NTS would dispose of DOE LLW. The volume was obtained by taking the estimated inventory at NTS plus the estimated inventory and 20-year generation projection for offsite receipts and dividing by 20 to get annual estimate (Table 7.1–1, page 7-3 of the Draft Waste Management PEIS).

[f] Represents the mixed LLW Regionalized Alternative 3 in which NTS would ship its mixed LLW to INEL for treatment. NTS would then dispose of all DOE treated mixed LLW. The volume was obtained by taking the estimated inventory at NTS plus the estimated inventory and 20-year generation projection for offsite receipts and dividing by 20 to get annual estimate (Table 6.1–1, page 6-3 of the Draft Waste Management PEIS).

[g] Represents the total annual incremental wastewater for all alternatives (Draft Waste Management PEIS, Vol. II; Tables II-9.3-11 [TRU], page 9-42; II-9.2–11 [LLW], page 9-28; and II-9.1-14 [mixed LLW], page 9-15).

[h] Recyclable waste.

Note: NA=data was not analyzed in the associated EIS.

Source: DOE 1995cc; DOE 1995dd; DOE 1996b; Table 4.2.2.10–1.

4.7.2.3 Idaho National Engineering Laboratory

4.7.2.3.1 *Land Resources*

In addition to the storage alternatives, INEL is being considered as a site for the three other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs during operation is 328 ha (812 acres), or less than 0.2 percent of the total land at INEL. Site development would be performed in accordance with the land-use plans in the *INEL Site Development Plan*. Proposed development would also be compatible with the industrial use visual character of the developed areas of INEL. Cumulatively, the actions would consume land, but would be consistent with the land-use plans and visual character of the site.

4.7.2.3.2 *Site Infrastructure*

Some cumulative impacts are possible from siting the storage alternatives at INEL if facilities resulting from the three other DOE programs identified in Table 4.7.1–1 are also located at INEL. The site infrastructure cumulative impacts that would result at INEL from operation of all the proposed projects are shown in Table 4.7.2.3.2–1. INEL has adequate site availability for all of the site infrastructure resource requirements except for coal. Additional coal requirements would be satisfied using the current procurement practices at the site.

Table 4.7.2.3.2–1. Site Infrastructure Cumulative Impacts at Idaho National Engineering Laboratory

	Electrical		Fuel	
Requirement	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Coal (t/yr)
No Action	232,500	42	5,820,000	11,340
Storage and Disposition	58,000[a]	10[a]	140,000[b]	14,000[a]
Foreign Research Reactor Spent Nuclear Fuel	1,000	NA	NA	NA
Spent Nuclear Fuel	2,200	NA	330,000	NA
Waste Management	NA	15.8	NA	NA
Cumulative Requirement	293,700	67.8	6,290,000	25,340
Site Availability	394,200	124	16,000,000	11,340

[a] Collocation Alternative.
[b] Upgrade with All or Some RFETS and LANL Pu material alternative.
Note: NA=data was not analyzed in the associated EIS.
Source: DOE 1995j; DOE 1995cc; DOE 1996g; Table 4.2.3.2–1.

4.7.2.3.3 *Air Quality and Noise*

Cumulative impacts to air quality at INEL include impacts from the No Action Alternative emissions, three other DOE programs identified in Table 4.7.1–1, and the proposed facilities for each alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

The INEL is currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the storage alternatives would increase concentrations of criteria pollutants. Potential cumulative impacts are presented in Table 4.7.2.3.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as

Table 4.7.2.3.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Idaho National Engineering Laboratory and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Other Onsite Activities[b] ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Criteria Pollutants							
Carbon monoxide	8-hour	10,000[c]	284	18	302.4	303.4	303.6
	1-hour	40,000[c]	614	605	1220	1222	1223
Lead	Calendar Quarter	1.5[c]	0.001	0.004	0.005	0.005	0.005
Nitrogen dioxide	Annual	100[c]	4	7	11.02	11.73	11.91
Ozone	1-hour	235[c]	[d]	[d]	[d]	[d]	[d]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[c]	5	0	5.01	5.05	5.06
Sulfur dioxide	24-hour	150[c]	80	6	86.14	86.98	87.17
	Annual	80[c]	6	0	6.01	7.25	7.53
	24-hour	365[c]	135	2	137.3	160.5	165.7
	3-hour	1,300[c]	579	12	592.2	693.3	716.2
Mandated by Idaho							
Total suspended particulate	Annual	60[e]	5	0	5.1	5.05	5.06
	24-hour	150[e]	80	6	86.4	86.98	87.17
Hazardous and Other Toxic Compounds							
Ammonia	Annual	180[f]	6.0	0.0007	6.0	6.0	6.0
Chlorine	Annual	30[f]	[g]	0	[g]	<0.01[h]	<0.01[h]
Hydrogen chloride	Annual	7.5[f]	0.98	0.092	1.07	1.07	1.07
Hydrazine	Annual	0.00034[f]	0.000001	0	0.000001	0.000004	<0.000004
Mercury	Annual	1[f]	0.042	0.0014	0.0434	0.0434	0.0434
Nitric acid	Annual	50[f]	0.64	0.0013	0.6413	0.6413	0.6413

Table 4.7.2.3.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Idaho National Engineering Laboratory and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Other Onsite Activities[b] ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (continued)							
Phosphoric acid	Annual	10[f]	[g]	0	[g]	<0.01[h]	<0.01[h]
Sulfuric acid	Annual	10[f]	[g]	0.00085	[g]	<0.01[h]	<0.01[h]
Trivalent chromium	Annual	5[f]	0.036	0.0004	0.03604	0.03604	0.03604

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Other onsite activities include those associated with the Foreign Research Reactor Spent Nuclear Fuel, Spent Nuclear Fuel Management and Waste Management programs.

[c] Federal and State standard.

[d] Ozone, as a criteria pollutant, is not directly emitted nor monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[e] State standard or guideline

[f] Acceptable air concentrations listed in Rules for the Control of Air Pollution in Idaho apply only to new (not existing) sources and are used here only as reference levels.

[g] No sources of this pollutant have been identified.

[h] The concentration represents the alternative contribution and other onsite activities.

Source: 40 CFR 50; DOE 1995j; DOE 1995dd; DOE 1996b; DOE 1996g; FDI 1996a:1; ID DHW 1995a; ID DHW 1995c; IN DOE 1996a; Table 4.2.3.3–1.

traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.3.4 *Water Resources*

Table 4.7.2.3.4–1 summarizes the estimated cumulative water usage for the storage alternatives and the three other DOE programs identified in Table 4.7.1–1. Water requirements during the operation of all the proposed projects would be obtained from groundwater resources. The cumulative water requirements for the site would be a 6-percent increase over the projected No Action water usage, or approximately 18.3 percent of the groundwater allotment. The operation of the Collocation Alternative would account for approximately 1.1 percent of the total annual cumulative water usage.

Because all wastewater could be recycled during operation, wastewater generated during construction would have the most impact. Table 4.7.2.3.4–2 summarizes the estimated volumes of cumulative wastewater discharged to ponds or recycled. The cumulative wastewater discharged would be a 27-percent increase in the projected discharge. Existing INEL treatment facilities could accommodate all the new cumulative process and wastewater streams.

Table 4.7.2.3.4–1. Cumulative Annual Water Usage at Idaho National Engineering Laboratory

Program	Water Requirements (million l/yr)
No Action	7,570[a]
Storage and Disposition	87[b,c]
Foreign Research Reactor Spent Nuclear Fuel	2.1[b]
Spent Nuclear Fuel	49
Waste Management	353[b,d]
Total annual cumulative water usage	8061.1

[a] Data represents groundwater usage.
[b] Data represents maximum value for the comparative scenario.
[c] Date represent the Collocation Alternative.
[d] Based on preliminary data.
Source: DOE 1995j; DOE 1995dd; DOE 1996g; INEL 1995a:1; Table 4.2.3.4–1.

Table 4.7.2.3.4–2. Cumulative Annual Wastewater Discharge at Idaho National Engineering Laboratory

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	540
Storage and Disposition	12.8[a,b]
Foreign Research Reactor Spent Nuclear Fuel	1.6[a]
Spent Nuclear Fuel	49
Waste Management	85[a,c]
Total annual cumulative wastewater	688.4

[a] Data represents the Collocation Alternative during construction.
[b] Data represents maximum value for the comparative scenario.
[c] Based on preliminary data.
Source: DOE 1995j; DOE 1995dd; DOE 1996g; INEL 1995a:1; Table 4.2.3.4–1.

4.7.2.3.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1–1. A total of 328 ha (812 acres) could be disturbed at the site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.3.6 *Biological Resources*

In addition to ongoing activities and the storage alternatives, INEL is being considered for the three other DOE programs identified in Table 4.7.1–1. Although many of these facilities would be located within developed areas of the site, certain environmental restoration and waste management facilities and consolidated or collocated storage facilities would be constructed on undeveloped land. The total area of undeveloped land required would be 328 ha (812 acres), or less than 0.2 percent of INEL. Due to the general lack of wetlands and aquatic resources at INEL, and the fact that facilities would be constructed away from the Big Lost River, cumulative impacts to these resources would not be expected. The cumulative loss of habitat could lead to additional impacts to special status species compared to those resulting from construction of a storage facility alone; however, their status on INEL would not be expected to be jeopardized. Species that could be affected include several State-status species such as the pygmy rabbit, a number of bat species, and oxytheca.

4.7.2.3.7 *Cultural and Paleontological Resources*

The three other DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access and use at INEL. Construction at INEL under these programs is primarily proposed for developed areas which have either been surveyed or are disturbed and are therefore unlikely to contain cultural or paleontological resources. Prior to construction activity, specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act*, and the *Native American Graves Protection and Repatriation Act*. Cumulative impacts resulting from the storage alternatives, if any, are expected to be minimal.

4.7.2.3.8 *Socioeconomics*

Cumulative impacts on INEL's regional economy, population, housing, community services, and local transportation would be minor. Generally, the regional economy would improve without burdening the housing market, but new traffic could lead to congestion on local roads. Table 4.7.2.3.8–1 shows the other DOE programs that are being considered at INEL. Because each of these programs is relatively small, their cumulative socioeconomic impact would be minor. The primary impact will be to stimulate regional economic growth. If all of these programs were located at INEL, transportation congestion could result as well as the demand for new housing and other public services. However, housing construction trends indicate that this additional population could be accommodated without significant impacts to the housing market.

Table 4.7.2.3.8–1. Socioeconomic Cumulative Impacts at Idaho National Engineering Laboratory

Program	Direct Employment[a]
Storage and Disposition[b]	561
Foreign Research Reactor Spent Nuclear Fuel	30
Spent Nuclear Fuel	0
Waste Management	4,925
Total	5,516

[a] Operations.

[b] Collocation Alternative.

Source: DOE 1996g; DOE 1995j; DOE 1995cc; Section 4.2.3.8.

4.7.2.3.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the storage alternative, the No Action Alternative and other actions planned at INEL, are presented Table 4.7.2.3.9–1. Although these impacts could be added, it should be noted that the exact locations of the facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Chemical Impacts. For INEL, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at INEL is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

Table 4.7.2.3.9–1. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Idaho National Engineering Laboratory

	Maximally Exposed Individual Member of the Public		Offsite Population Within 80 km		Total Site Workforce	
Program	Total Dose (mrem)	Fatal Cancer Risk	Total Dose (person-rem)	Number of Fatal Cancers	Total Dose (person-rem)	Number Fatal Cancers
No Action	0.018	9.0×10^{-9}	2.4	1.2×10^{-3}	220	0.088
Storage and Disposition[a]	1.6×10^{-6}	8.0×10^{-13}	1.8×10^{-5}	9.0×10^{-9}	25	0.010
Foreign Research Reactor Spent Nuclear Fuel	5.6×10^{-4}	2.8×10^{-10}	4.5×10^{-3}	2.3×10^{-6}	33	0.013
Spent Nuclear Fuel	8.0×10^{-3}	4.0×10^{-9}	0.19	9.5×10^{-5}	5.4	2.2×10^{-3}
Waste Management	1.0	5.2×10^{-7}	8.4	4.2×10^{-3}	2.5	1.0×10^{-3}

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage.

Source: DOE 1995j; DOE 1995dd; DOE 1996g; Tables 4.2.3.9–1 and 4.2.3.9–2.

4.7.2.3.10 *Waste Management*

The actions and alternatives which could contribute to the cumulative impacts at INEL are listed in Table 4.7.2.3.10–1. The largest impact on radioactive waste management would result if INEL is selected as a regional treatment and disposal facility for LLW and mixed LLW or as a regional treatment facility for TRU waste as a result of the waste-type-specific RODs developed from the Waste Management PEIS. The next largest impact would result from the alternative considered in this PEIS for the Collocation Alternative for long-term storage analyzed for INEL. The *Department of Energy Programmatic Spent Nuclear Fuel and Idaho National Engineering Laboratory Environmental Restoration Waste Management Programs EIS* and the *Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel EIS* would have smaller impacts at INEL.

Table 4.7.2.3.10–1. Waste Management Cumulative Impacts at Idaho National Engineering Laboratory (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Foreign Research Reactor Spent Nuclear Fuel[c] (m^3)	Spent Nuclear Fuel Management[d] (m^3)	Waste Management (m^3)	Total (m^3)
Spent Fuel	0	0	1.0 t	165 t	0	166 t
High Level						
Liquid	538	0	0	27	0	565
Solid	192	0	0	Included in liquid	0[e]	192
Transuranic						
Liquid	0	0.02	0	32	Included in solid	32
Solid	3.5	10	0	Included in liquid	2,790[f]	2,804
Mixed Transuranic						
Liquid	Included in TRU	0	0	Included in TRU	Included in TRU	0
Solid	Included in TRU	4	0	Included in TRU	Included in TRU	4
Low-Level						
Liquid	0	2.1	0	0	Included in solid	2.1
Solid	7,200	1,300	23	197	11,870[g]	20,600
Mixed Low-Level						
Liquid	4	0.2	0	0	Included in solid	4.4
Solid	170	66	0	0	2,725[h]	2,960
Hazardous						
Liquid	Included in solid	2	0	0	Included in solid	2
Solid	1,200	2	0	0	1,854[i]	3,056
Nonhazardous (Sanitary)						
Liquid	Included in solid	86,800	1,990	0	NA	88,740
Solid	52,000	1,720	NA	0	NA	53,720

Table 4.7.2.3.10–1. Waste Management Cumulative Impacts at Idaho National Engineering Laboratory (2005)—Annual Volumes—Continued

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Foreign Research Reactor Spent Nuclear Fuel[c] (m^3)	Spent Nuclear Fuel Management[d] (m^3)	Waste Management (m^3)	Total (m^3)
Nonhazardous (Other)						
Liquid	0	Included in sanitary	Included in sanitary	601	68,170[j]	68,800
Solid	Included in sanitary	2,100[k]	NA	NA	NA	2,100

[a] No Action volumes from Table 4.2.3.10–1.

[b] Collocation Alternative.

[c] Alternative announced in Federal Register on May 17, 1996 (61 FR 25092).

[d] Also includes the site-specific environmental restoration and waste management analysis from Volume 2.

[e] Approximately 327 canisters (493 m^3) per year starting 2014.

[f] Represents the estimated TRU waste to be treated to LDR standards at INEL as a result of the TRU Waste Regionalized Alternative 3. The volume was obtained by taking the estimated inventory at INEL and the estimated inventory and 20-year projected generation for the offsite receipts, and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 8.1–1, page 8–4).

[g] Represents the estimated LLW to be treated and disposed of at INEL as a result of the LLW Regionalized Alternative 5. The volume was obtained by taking the estimated inventory at INEL and the estimated inventory and 20-year projected generation for the offsite receipts, and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table
7.1–1, page 7–3).

[h] Represents the estimated mixed LLW to be treated and disposed of at INEL as a result of the Mixed LLW Regionalized Alternative 4. The volume was obtained by taking the estimated inventory at INEL and the estimated inventory and 20-year projected generation for the offsite receipts, and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 6.1–1, page 6–3).

[i] Represents the estimated hazardous wastes to be treated at INEL as a result of the hazardous waste Regionalized Alternative 2 (Draft Waste Management PEIS, Vol. I of IV, Table 10.3–7, page 10–20).

[j] Represents the incremental increase of wastewater over No Action all alternatives. Annual volume estimated by assuming 365 days per year (Draft Waste Management PEIS, Vol. II, Tables
II-6.4–8 [HLW], page 6–55; II-6.3–11 [TRU], page 6–45; II-6.1–16 [mixed LLW], page 6–19; II-6.2–2 [LLW], page 6–32; and II-6.5–10 [hazardous], page 6–67).

[k] Recyclable wastes.

Note: NA=data was not analyzed in the associated EIS.

Source: 60 FR 28680; 61 FR 9441; 61 FR 25092; DOE 1995cc; DOE 1995dd; DOE 1996g; DOE 1996n; Table 4.2.3.10–1.

4.7.2.4 Pantex Plant

4.7.2.4.1 *Land Resources*

In addition to the storage alternatives, Pantex is being considered as a site for the two other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs during operation 97 ha (241 acres), or 6.5 percent of the government-owned land at Pantex. Site development would be performed in accordance with the land use plans in the *Pantex Site Development Plan*. Long-term storage alternatives which utilize recycled wastewater could require land disturbance and land acquisition for construction of a pipeline. Proposed development would be compatible with the industrial use visual character of the developed areas of Pantex. Cumulatively, the actions would consume land, but would be consistent with the land use plans and visual character of the site.

4.7.2.4.2 *Site Infrastructure*

Some cumulative impacts are possible at Pantex resulting from siting the disposition and storage facilities, and facilities resulting from the other two DOE programs identified in Table 4.7.1–1. The site infrastructure cumulative impacts at Pantex that would result from operation of the proposed projects are shown in Table 4.7.2.4.2–1. Pantex has adequate site availability to meet the requirements for all of the site infrastructure resources except for peak load. Power transmission lines and electrical distribution equipment would be needed to meet the increased power demand.

Table 4.7.2.4.2–1. Site Infrastructure Cumulative Operation Impacts at Pantex Plant

	Electrical		Fuel	
Requirement	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m3/yr)
No Action	46,266	10	795,166	7,200,000
Storage and Disposition[a]	58,000	10	38,000	5,200,000
Stockpile Stewardship and Management	0[b]	1[c]	0[b]	0[b]
Waste Management	NA	3.8	NA	NA
Cumulative Requirement	104,266	24.8	833,166	12,400,000
Site Availability	201,480	23	1,775,720	289,000,000

[a] Collocation Alternative.
[b] No Action Alternative.
[c] Downsize Weapons Assembly/Disassembly and High Explosive Fabrication Alternative.
Note: NA=data was not analyzed in the associated EIS.
Source: DOE 1995cc; DOE 1996b; Table 4.2.4.2–1.

4.7.2.4.3 *Air Quality and Noise*

Cumulative impacts to air quality at Pantex include impacts from the No Action Alternative, the two other DOE programs identified in Table 4.7.1–1, and the proposed facilities for each storage alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

Pantex is currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the storage alternatives would increase concentrations of criteria pollutants. Potential cumulative impacts are presented in Table 4.7.2.4.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Table 4.7.2.4.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Pantex Plant and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Other Onsite Activities[b] ($\mu g/m^3$)	Upgrade Without RFETS or LANL Material ($\mu g/m^3$)	Consolidation: Construct New and Modify Existing Zone 12 South Facilities ($\mu g/m^3$)	Consolidation: New Facility ($\mu g/m^3$)	Consolidation: Collocation ($\mu g/m^3$)
Criteria Pollutants								
Carbon monoxide	8-hour	10,000[c]	602	17.5	619.5	625.4	625.75	625.4
	1-hour	40,000[c]	2,900	92.8	2,993	3,014	3,015	3,014
Lead	Calendar Quarter	1.5[c]	0.09	[d]	0.09	0.09	0.09	0.09
Nitrogen dioxide	Annual	100[c]	2.15	1.4	3.55	3.69	3.68	3.69
Ozone	1-hour	235[c]	[d]	[e]	[e]	[e]	[e]	[e]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[c]	8.73	0.06	8.79	8.83	8.82	8.83
	24-hour	150[c]	88.5	0.93	89.4	90.1	90.0	90.1
Sulfur dioxide	Annual	80[c]	<0.01	0	<0.01	<0.01	<0.01	<0.01
	24-hour	365[c]	<0.01	0	<0.01	0.05	0.04	0.05
	3-hour	1,300[c]	<0.01	0	<0.01	0.26	0.24	0.26
	30-minute	1,045[e]	<0.01	0	<0.01	0.69	0.65	0.69
Mandated by Texas								
Gaseous fluorides (as HF)	30-day	0.8[f]	<0.75	0	<0.75	<0.75	<0.75	<0.75
	7-day	1.6[f]	<0.75	0	<0.75	<0.75	<0.75	<0.75
	24-hour	2.9[f]	0.75	0	0.75	0.75	0.75	0.75
	12-hour	3.7[f]	1.05	0	1.05	1.05	1.05	1.05
	3-hour	4.9[f]	4.21	0	4.21	4.21	4.21	4.21
Hydrogen sulfide	30-minute	111[f]	[d]	0	[d]	[d]	[d]	[d]
Total suspended particulates	3-hour	200[f]	[g]	0	[d]	3.62[h]	3.23[h]	3.77[h]
	1-hour	400[f]	[g]	0	[d]	9.75[h]	8.71[h]	10.15[h]

Table 4.7.2.4.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Pantex Plant and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Other Onsite Activities[b] ($\mu g/m^3$)	Upgrade Without RFETS or LANL Material ($\mu g/m^3$)	Consolidation: Construct New and Modify Existing Zone 12 South Facilities ($\mu g/m^3$)	Consolidation: New Facility ($\mu g/m^3$)	Consolidation: Collocation ($\mu g/m^3$)
Hazardous and Other Toxic Compounds								
Chlorine	Annual	1.5[f]	[d]	0	[d]	<0.01[h]	<0.01[h]	<0.01[h]
	30-minute	15[f]	[d]	0	[d]	0.03[h]	0.03[h]	0.04[h]
Hydrogen chloride	Annual	0.1[f]	0.07	0	0.07	0.07	0.07	0.07
	30-minute	75[f]	6.17	0	6.17	6.18	6.18	6.17
Hydrazine	Annual	0.013[f]	[d]	0	[d]	<0.0001[h]	<0.0001[h]	<0.0001[h]
	30-minute	0.13[f]	[d]	0	[d]	0.01[h]	<0.01[h]	0.01[h]
Nitric acid	Annual	5.2[f]	[d]	0	[d]	<0.01[h]	<0.01[h]	<0.01[h]
	30-minute	52[f]	[d]	0	[d]	0.04[h]	<0.04[h]	0.76[h]
Phosphoric acid	Annual	1[f]	[d]	0	[d]	<0.01[h]	<0.01[h]	<0.01[h]
	30-minute	10[f]	[d]	0	[d]	0.01[h]	0.01[h]	0.01[h]
Sulfuric acid	24-hour	15[f]	[d]	0	[d]	<0.01[h]	<0.01[h]	<0.01[h]
	1-hour	50[f]	[d]	0	[d]	0.01[h]	0.01[h]	0.01[h]

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Other onsite activities include those associated with the Stockpile Stewardship and Management and Waste Management programs.

[c] Federal and State standards.

[d] No sources of this pollutant have been identified.

[e] Ozone, as a criteria pollutant, is not directly emitted nor monitored by the site. See Section 4.1.3 for a discussion of ozone-related activities.

[f] State standard or guideline.

[g] Data not available from source document.

[h] The concentration represents the alternative contribution and other onsite activities.

Note: 1-hour predicted concentrations were used for 30-minute standard. Concentrations are based on site contribution and do not include the contribution from non-facility sources.

Source: 40 CFR 50; DOE 1995dd; DOE 1996b; PX DOE 1995a:1; PX DOE 1996a; TX NRCC 1992a; Table 4.2.4.3–1.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.4.4 *Water Resources*

Table 4.7.2.4.4–1 summarizes the estimated cumulative water requirements for the storage alternatives and the two other DOE programs identified in Table 4.7.1–1. Water requirements during the operation of all the proposed projects would be obtained from groundwater resources or if feasible, from the city of Amarillo Hollywood Road Wastewater Treatment Plant. The cumulative water requirements for the site would be a 66-percent increase in the projected No Action usage or approximately 22 percent of the capacity of the groundwater wells at Pantex (1,900 million l/yr [502 million gal/yr]). The total annual site cumulative withdrawal would be approximately 50 percent less than what is currently being withdrawn from the aquifer for use at Pantex (836 million l/yr [221 million gal/yr]). Withdrawing 414 million l/yr (109 million gal/yr) at Pantex would result in drawdowns of approximately 3.9 cm/yr (1.5 in/yr). These additional groundwater withdrawals would add to the existing decline in water levels of the Ogallala Aquifer. To alleviate some of the affects from pumping groundwater from the Ogallala Aquifer, the City of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details have not been determined.

Table 4.7.2.4.4–2 summarizes the estimated cumulative wastewater discharge to ponds or available for recycling. Total estimated cumulative wastewater discharge (169.2 million l/yr [44.7 million gal/yr]) would be a 20-percent increase in the projected discharge. Existing Pantex treatment facilities could accommodate all the new cumulative process and wastewater streams.

4.7.2.4.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1–1. A total of 97 ha (241 acres) of the available land at Pantex could be disturbed at the site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.4.6 *Biological Resources*

In addition to ongoing activities and the Storage Alternatives, the Pantex site is being considered for the two other DOE programs identified in Table 4.7.1–1. Some facilities associated with these two programs would largely be within developed areas of the site. Cumulative impacts to terrestrial resources or threatened and endangered species would be minimal. The total area of land used by new facilities would represent about 97 ha (241 acres). Wastewater discharge from the various alternatives could lead to cumulative impacts to site playas. These could include increases in the area of permanent water and possible changes in vegetative composition.

4.7.2.4.7 *Cultural and Paleontological Resources*

The other two DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access and use at Pantex. To date, no known archaeological, Native American, or paleontological resources exist within the areas selected for construction at Pantex, but some of the areas have not been systematically surveyed. Prior to construction activity, specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act*, and the *Native American Graves Protection and Repatriation Act*. Cumulative impacts resulting from the storage alternatives, if any, are expected to be minimal.

Table 4.7.2.4.4–1. Cumulative Annual Water Usage at Pantex Plant

Program	Water Requirements (million l/yr)
No Action	249
Storage and Disposition	130[a,b]
Stockpile Stewardship and Management	0[c]
Waste Management	35[a]
Total annual cumulative water usage	414

[a] Data represents the maximum value for the comparative scenario.
[b] Data represents the Collocation Alternative.
[c] No additional water usage would result from this program.
Source: DOE 1995dd; DOE 1996b; PX 1995a:1; Table 4.2.4.4–1.

Table 4.7.2.4.4–2. Cumulative Annual Wastewater Discharge at Pantex Plant

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	141
Storage and Disposition	12.2[a,b]
Stockpile Stewardship and Management	0[c]
Waste Management	16[a]
Total annual cumulative water usage	169.2

[a] Data represents the maximum value for the comparative scenario.
[b] Data represents the Collocation Alternative.
[c] No additional wastewater discharge would result from this program.
Source: DOE 1995dd; DOE 1996b; PX 1995a:1; PX MH 1994a; Table 4.2.4.4–1.

[Text deleted.]

4.7.2.4.8 *Socioeconomics*

Cumulative impacts on Pantex's regional economy, population, housing, community services and local transportation would be minor. As shown in Table 4.7.2.4.8–1, the regional economy would improve without any burden on the housing market. The cumulative impact shown in Table 4.7.2.4.8–1 would be minor because of the relatively small size of the programs.

Table 4.7.2.4.8–1. Socioeconomic Cumulative Impacts at Pantex Plant

Program	Direct Employment[a]
Storage and Disposition[b]	1,176
Stockpile Stewardship and Management	280
Waste Management	654
Total	2,110

[a] Operations.
[b] Collocation Alternative.
Source: DOE 1995cc; DOE 1996b; Section 4.2.4.8.

4.7.2.4.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the storage alternative, the No Action Alternative, and other actions planned at Pantex, are presented in Table 4.7.2.4.9–1. Although these impacts could be added, it should be noted that the exact locations of the facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Chemical Impacts. For Pantex, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at Pantex is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

Table 4.7.2.4.9–1. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Pantex Plant

	Maximally Exposed Individual Member of the Public		Offsite Population Within 80 km		Total Site Workforce	
Program	Total Dose (mrem)	Fatal Cancer Risk	Total Dose (person-rem)	Number of Fatal Cancers	Total Dose (person-rem)	Number of Fatal Cancers
No Action	6.1×10^{-5}	3.1×10^{-11}	2.8×10^{-4}	1.4×10^{-7}	14	5.6×10^{-3}
Storage and Disposition[a]	9.6×10^{-6}	4.8×10^{-12}	5.3×10^{-5}	2.9×10^{-8}	25	0.010
Stockpile Stewardship and Management	4.0×10^{-5}	2.0×10^{-11}	4.0×10^{-4}	2.0×10^{-7}	-7.7	-3.1×10^{-3}
Waste Management	5.9×10^{-4}	2.9×10^{-10}	6.9×10^{-3}	3.5×10^{-6}	6.9×10^{-4}	2.8×10^{-7}

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage.
Source: DOE 1995cc; DOE 1995dd; DOE 1996b; Tables 4.2.4.9–1 and 4.2.4.9–2.

4.7.2.4.10 *Waste Management*

In addition to the storage alternatives, the other DOE programs listed in Table 4.7.1–1 would contribute to cumulative impacts at Pantex as shown in Table 4.7.2.4.10–1. The largest impact on waste management would result if the LLW Regionalized Alternative 2 and the mixed LLW Regionalized Alternative 1 were selected as the preferred alternative in the Waste Management PEIS. The Collocation Storage Alternative from this PEIS would contribute the next largest impact on waste management at Pantex.

Table 4.7.2.4.10–1. Waste Management Cumulative Impacts at Pantex Plant (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition PEIS[b] (m^3)	Stockpile Stewardship and Management PEIS (m^3)	Waste Management PEIS (m^3)	Total (m^3)
Transuranic					
Liquid	None	0.02	0[c]	0	0.02
Solid	None	10	0[c]	0	10
Mixed Transuranic					
Liquid	None	0	0[c]	0	0
Solid	None	4	0[c]	0	4
Low-Level					
Liquid	8	2.1	0[c]	Included in solid	10
Solid	32	1,300	0[c]	1,700[d]	3,032
Mixed Low-Level					
Liquid	4	0.2	0[c]	Included in solid	4
Solid	46	66	0[c]	7[e]	119
Hazardous					
Liquid	2	2	0[c]	0	4
Solid	31	2	0[c]	0[f]	33
Nonhazardous (Sanitary)					
Liquid	141,000	129,500	7,060[g]	NA	277,600
Solid	339	1,840	18[g]	NA	2,197

Table 4.7.2.4.10–1. Waste Management Cumulative Impacts at Pantex Plant (2005)—Annual Volumes—Continued

Category	No Action[a] (m^3)	Storage and Disposition PEIS[b] (m^3)	Stockpile Stewardship and Management PEIS (m^3)	Waste Management PEIS (m^3)	Total (m^3)
Nonhazardous (Other)					
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	12,700[h]	12,700
Solid	Included in sanitary	2,300[i]	Included in sanitary	Included in sanitary	2,300

[a] No Action volumes are from Table 4.2.4.10–1.

[b] Collocation Storage Alternative (New Pu and HEU Storage Facility).

[c] No Action Alternative.

[d] Represents LLW Regionalized Alternative 2 in which Pantex would treat and dispose of its own LLW onsite. The volume was obtained by taking the estimated inventory and dividing by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 7.1–1, page 7–3).

[e] Represents mixed LLW Decentralized Alternative or Regionalized Alternative 1. Pantex would treat and dispose of its own mixed LLW onsite. The volume was obtained by taking the estimated inventory and dividing by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 6.1–1, page 6–3).

[f] No Action or Decentralized Alternative.

[g] Downsize Assembly/Disassembly and HE fabrication alternative.

[h] Represents the total annual incremental wastewater over No Action for all alternatives. Annual volume estimated by assuming 365 days per year (Draft Waste Management PEIS, Vol. II. Tables II-12.1–14 [mixed LLW], page 12–15; and II-12.2–12 [LLW], page 12–29).

[i] Recyclable wastes.

Source: DOE 1995cc; DOE 1995dd; DOE 1996b; PX 1995a:2, PX DOE 1995e; Table 4.2.4.10–1.

4.7.2.5 Oak Ridge Reservation

4.7.2.5.1 *Land Resources*

ORR is a potential site for the storage alternatives and for the three other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs during operation is 154 ha (382 acres), or less than 1 percent of the total land at ORR. Cumulative impacts are possible to NERP lands at ORR due to encroachment of the new development projects. A portion of the consolidated storage facility could be constructed on land designated for waste management in the *ORR Site Development and Facilities Utilization Plan*. Proposed development could affect visual resources near Route 95 and Bear Creek Road by changing the current VRM class 4 to a class 5.

4.7.2.5.2 *Site Infrastructure*

Some cumulative impacts are possible at ORR resulting from implementation of the storage alternatives, ongoing activities, and the three other DOE programs identified in Table 4.7.1–1. In addition, environmental restoration activities at ORR are expected to continue for 30 years and therefore will coincide with the construction and operation of the proposed disposition facilities as well as many of the other DOE programs. Table 4.7.2.5.2–1 shows the site infrastructure cumulative impacts that would result from operation of the proposed programs were they to be sited at ORR. The cumulative requirements for oil and coal exceed the ORR site availability. Oil storage tanks and coal handling facilities would need to be constructed to meet the new resource requirements.

Table 4.7.2.5.2–1. Site Infrastructure Cumulative Operation Impacts at Oak Ridge Reservation

	Electrical		Fuel		
Requirement	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
No Action	726,000	110	379,000	95,000,000	16,300
Storage and Disposition	60,260[a]	10[a]	50,000[b]	949[a]	5,973[b]
HEU Disposition	5,000	2	56,800	0	363
Stockpile Stewardship and Management[c]	0	0	0	0	0
Waste Management	NA	88.6	NA	NA	NA
Cumulative Requirement	791,260	210.6	485,800	95,000,949	22,636
Site Availability	13,880,000	2,100	416,000	250,760,000	16,300

[a] Collocation Alternative (New Pu Storage Facility and Modify Y–12).

[b] Collocation Alternative (New Pu and HEU Storage Facilities).

[c] No Action data is used because the rest of the alternatives in the Stockpile Stewardship and Management PEIS would result in downsizing.

Note: NA=data was not analyzed in the associated EIS.

Source: DOE 1995cc; DOE 1996b; DOE 1996m; Table 4.2.5.2–1.

4.7.2.5.3 *Air Quality and Noise*

Cumulative impacts to air quality at ORR include impacts from No Action Alternative, the three other DOE programs identified in Table 4.7.1–1, and the proposed facilities for each storage alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

The ORR is currently in compliance with the NAAQS as well as state regulations and guidelines. Air emissions attributable to the storage alternatives would increase concentrations of criteria pollutants. Potential cumulative impacts are presented in Table 4.7.2.5.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.5.4 *Water Resources*

Table 4.7.2.5.4–1 summarizes the estimated cumulative water requirements for the storage alternatives and the three other DOE programs identified in Table 4.7.1–1. Water requirements during the operation of all the proposed projects would be obtained from the Clinch River. The cumulative water requirements for the site would be 0.3 percent of the Clinch River's average flow (135 m^3/s [4,763 ft^3/s]). The Collocation Alternative would account for approximately 2.4 percent of the cumulative usage. The additional withdrawals are minor in comparison to the average flow of the river and would not noticeably affect the local or regional water supply.

Table 4.7.2.5.4–1. Cumulative Annual Water Usage at Oak Ridge Reservation

Program	Water Requirements (million l/yr)
No Action	14,760[a]
Storage and Disposition	360[b]
HEU Disposition	19[c,d]
Stockpile Stewardship and Management	0[e]
Waste Management	814.5[c]
Total annual cumulative water usage	15,954

[a] Data include both groundwater and surface water.
[b] Number is based on the Collocation Alternative.
[c] Data represents the maximum value for the comparative alternative scenario.
[d] Based on preliminary data.
[e] The Stockpile Stewardship and Management alternatives would require no additional water.
Source: DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996m; Table 4.2.5.4–1.

Table 4.7.2.5.4–2 summarizes the estimated cumulative water discharge to the Clinch River via Bear Creek, McCoy Branch, Rogers Quarry, and East Fork Poplar Creek. The cumulative wastewater discharge would be a 75-percent increase in the average Bear Creek flow near Y–12 (0.11 m^3/s [3.9 ft^3/s]), 5.5 percent of the average flow at East Fork Poplar Creek (1.5 m^3/s [53 ft^3/s]) and 0.06 percent of the average flow of the Clinch River (132 m^3/s [4,647 ft^3/s]). The Collocation Alternative would account for 7 percent of the total annual cumulative wastewater discharge. The expected total cumulative wastewater discharge to the tributaries would continue to meet limits and reporting requirements. Existing ORR treatment facilities could accommodate all the new cumulative process and wastewater streams.

[Text deleted.]

4.7.2.5.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1–1. A total of 154 ha (382 acres) could be disturbed at the

Table 4.7.2.5.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Oak Ridge Reservation and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Other Onsite Activities[b] ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Collocation		
						New Pu Storage Facility Only ($\mu g/m^3$)	New Pu Storage Facility and Modify Y–12 ($\mu g/m^3$)	New Pu and HEU Storage Facilities ($\mu g/m^3$)
Criteria Pollutants								
Carbon monoxide	8-hour	10,000[c]	5	11.5	16.5	16.58	16.57	16.59
	1-hour	40,000[c]	11	62.4	73.4	73.56	73.55	73.58
Lead	Calendar Quarter	1.5[c]	0.05	<0.01	<0.06	<0.06	<0.06	<0.06
Nitrogen dioxide	Annual	100[c]	3	1.93	4.93	4.93	4.99	5.0
Ozone	1-hour	235[c]	[d]	[d]	[d]	[d]	[d]	[d]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[c]	1	10.03	11.03	11.03	11.03	11.04
	24-hour	150[c]	2	30.37	32.37	32.42	32.42	32.42
Sulfur dioxide	Annual	80[c]	2	48.11	50.11	50.21	50.21	50.23
	24-hour	365[c]	32	237.5	269.5	270.6	270.5	270.8
	3-hour	1,300[c]	80	902	982	986.2	986.0	986.9
Mandated by Tennessee								
Total suspended particulates	24-hour	150[e]	2	80.16	82.16	82.21	82.20	82.21
Gaseous fluorides (as HF)	30-day	1.2[e]	0.2	0	0.2	0.2	0.2	0.2
	7-day	1.6[e]	0.3	0	0.3	0.3	0.3	0.3
	24-hour	2.9[e]	0.6[f]	0	0.6[f]	0.6[f]	0.6[f]	0.6[f]
	12-hour	3.7[e]	0.6[f]	0	0.6[f]	0.6[f]	0.6[f]	0.6[f]
	8-hour	250[e]	0.6	0	0.6	0.6	0.6	0.6

Table 4.7.2.5.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Oak Ridge Reservation and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Other Onsite Activities[b] ($\mu g/m^3$)	Upgrade ($\mu g/m^3$)	Collocation		
						New Pu Storage Facility Only ($\mu g/m^3$)	New Pu Storage Facility and Modify Y–12 ($\mu g/m^3$)	New Pu and HEU Storage Facilities ($\mu g/m^3$)
Hazardous and Other Toxic Compounds								
Chlorine	8-hour	150[e]	4.1	0	4.1	4.1	4.1	4.1
Hydrogen chloride	8-hour	750[e]	57	0	57	57	57	57
Hydrazine	8-hour	1.3[e]	[g]	0	[g]	[g]	[g]	<0.01[h]
Mercury	8-hour	5[e]	0.06[i]	0	0.06[i]	0.06[i]	0.06[i]	0.06[i]
Nitric acid	8-hour	[j]	78	0	78	78	78	78
Phosphoric acid	8-hour	[j]	[g]	0	[g]	[g]	[g]	<0.01[h]
Sulfuric acid	8-hour	[j]	20	0	20	20	20	20

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Other onsite activities include those associated with HEU Disposition, Stockpile Stewardship and Management, and Waste Management programs.

[c] Federal and State standard.

[d] Ozone, as a criteria pollutant, is not directly emitted nor monitored by the site. See section 4.1.3 for a discussion of ozone-related issues.

[e] State standard or guideline.

[f] 8-hour concentration was used.

[g] No sources of this pollutant have been identified.

[h] The concentration represents the alternative contribution and other onsite activities.

[i] Annual average (monitored value).

[j] No State standard for indicated averaging time.

Note: Concentrations are based on site contribution and do not include the contribution from non-facility sources.

Source: 40 CFR 50; DOE 1995w; DOE 1995dd; DOE 1996b; DOE 1996m; OR DOE 1993a; OR LMES 1996i; OR MMES 1996a; TN DEC 1994a; TN DHE 1991a; Table 4.2.5.3–1.

Table 4.7.2.5.4–2. Cumulative Annual Wastewater Discharge at Oak Ridge Reservation

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	2,277[a]
Storage and Disposition	172[b,c]
HEU Disposition	18.7[b]
Stockpile Stewardship and Management	0[d]
Waste Management	101.9[b]
Total annual cumulative wastewater	2,569.6

[a] These data include nonhazardous sanitary and nonhazardous wastewater discharges.

[b] Data are based on the highest treated volumes from the alternatives scenario.

[Text deleted.]

[c] Number is based on the Collocation Alternative.

[d] The Stockpile Stewardship and Management alternatives at ORR include the downsizing or the phaseout of the secondary and fabrication mission. No additional wastewater discharge is to be expected.

Source: DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996m; Table 4.2.5.4–1..

site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.5.6 *Biological Resources*

In addition to ongoing activities and the Storage Alternatives, ORR is being considered for the three other DOE programs identified in Table 4.7.1–1. While some of these programs would be located within existing structures or developed areas of ORR, others would be constructed at undisturbed sites. The total area of undeveloped land would be 154 ha (382 acres), or about 1 percent of the total ORR area. Discharges from the proposed facilities would be directed to Bear Creek, East Fork Popular Creek, and the Clinch River, thus increasing the possibility of cumulative impacts to wetlands and aquatic resources associated with these water bodies. Cumulative impacts to Bear Creek could also increase the potential to affect the Tennessee dace (State-deemed in need of management). The cumulative loss of habitat could lead to additional impacts to special status species compared to those resulting from construction of a storage facility along; however, their status on ORR would not be expected to be jeopardized. Species that could be affected include a number of State-protected plant species such as the pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily, and golden seal.

4.7.2.5.7 *Cultural and Paleontological Resources*

The three other DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access and use at ORR. New construction is proposed for currently undeveloped land within ORR. Some of the undeveloped land has been surveyed. Archaeological sites have been identified on this land and they could be affected by proposed disposition alternatives. [Text deleted.] Prior to construction activity, specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act*, and the *Native American Graves Protection and Repatriation Act*.

New construction and building modification would also occur within Y–12 under several DOE programs. This area is unlikely to contain archaeological, Native American, and paleontological resources because it is developed and disturbed. Y–12 does, however, contain a proposed historic district and many of the facilities are potentially NRHP-eligible. Extensive building modification and new facility construction could compromise the historic integrity of the area. Work would be done in consultation with the Tennessee SHPO and the Advisory Council on Historic Preservation. Cumulative impacts to cultural resources are possible at ORR

because it contains known NRHP-eligible facilities that may be impacted by the storage alternatives as well as other reasonably foreseeable future actions.

4.7.2.5.8 *Socioeconomics*

Cumulative impacts on ORR's regional economy, population, housing, community services, and local transportation would be minor. Generally, the regional economy would improve without burdening the housing market, but new traffic could cause congestion on local roads. Because each of the other three DOE programs identified in Table 4.7.2.5.8–1 is relatively small, their cumulative socioeconomic impact is expected to be minor. The primary impact will be to stimulate regional economic growth. If all of these programs were located at ORR, transportation congestion and the demand for new housing and other public services could increase. However, housing construction trends indicate that this additional population could be accommodated without significant impacts to the housing industry.

Table 4.7.2.5.8–1. Socioeconomic Cumulative Impacts at Oak Ridge Reservation

Program	Direct Employment[a]
Storage and Disposition[b]	566
HEU Disposition	125
Stockpile Stewardship and Management	-805
Waste Management	3,581
Total	3,467

[a] Operations.
[b] Collocation Alternative.
Source: DOE 1995cc; DOE 1996b; DOE 1996m; Section 4.2.5.8.

4.7.2.5.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the storage alternative, the No Action Alternative, and other actions planned at ORR, are presented in Table 4.7.2.5.9–1. Although these impacts could be added, it should be noted that the exact locations of the facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Chemical Impacts. For ORR, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at ORR is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

Table 4.7.2.5.9–1. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Oak Ridge Reservation

	Maximally Exposed Individual Member of the Public		Offsite Population Within 80 km		Workers	
Program	Total Dose (mrem)	Fatal Cancer Risk	Total Dose (person-rem)	Number of Fatal Cancers	Total Dose (person-rem)	Number of Fatal Cancers
No Action	3.2	1.6×10^{-6}	34	0.017	44	0.018
Storage and Disposition[a]	4.5×10^{-5}	2.3×10^{-11}	8.7×10^{-4}	4.4×10^{-7}	25	0.010
HEU Disposition	3.9×10^{-2}	2.0×10^{-8}	0.16	8.0×10^{-5}	11.3	4.5×10^{-3}
Stockpile Stewardship and Management	0.20	1.0×10^{-7}	0.60	3.0×10^{-4}	-1.8	-7.2×10^{-4}
[Text deleted.]						
Waste Management	0.58	2.9×10^{-7}	19	9.4×10^{-3}	0.45	1.8×10^{-4}

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage.

Source: DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996m; Tables 4.2.5.9–1 and 4.2.5.9–2.

4.7.2.5.10 *Waste Management*

Cumulative impacts to waste management at ORR could arise from the activities associated with ongoing activities, the storage alternatives, and the other three DOE programs identified in Table 4.7.1–1. Table 4.7.2.5.10–1 summarizes the estimated cumulative waste amounts. The largest cumulative impacts at ORR resulting from DOE's Waste Management Program would be if ORR were selected as a regional treatment and disposal site for LLW and a regional treatment and disposal site for mixed LLW. It is expected that waste management activities associated with the storage of Pu and HEU would have consistently smaller impacts than any future environmental restoration and waste management activities at ORR, and that the overall impact of Pu and HEU storage would not contribute significantly to cumulative impacts, except for TRU waste.

As part of the Stockpile Stewardship and Management PEIS, a downsize and consolidation alternative for the secondary fabrication mission is being considered. This alternative would decrease the generation of all categories of waste at ORR; therefore, the No Action Alternative would have the greatest negative impact on waste management at ORR.

Table 4.7.2.5.10–1. Waste Management Cumulative Impacts at Oak Ridge Reservation (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition (m^3)	HEU Disposition (m^3)	Stockpile Stewardship and Management[b] (m^3)	Waste Management (m^3)	Total (m^3)
Spent Fuel	0	0	0	0	0	0
High Level						
Liquid	0	0	0	0	0	0
Solid	0	0	0	0	0	0
Transuranic						
Liquid	0	0.02[c]	0	0	Included in solid	0.02
Solid	119	10[c]	0	0	99[d]	227
Mixed Transuranic						
Liquid	0	0[c]	0	0	Included in TRU	0
Solid	0	4[c]	0	0	Included in TRU	4
Low-Level						
Liquid	2,970	2[e]	280[f]	0	Included in solid	3,250
Solid	7,320	1,300[c]	545[f]	0	16,200[g]	25,400
Mixed Low-Level						
Liquid	87,600	0.2[e]	46[h]	0	Included in solid	87,700
Solid	432	66[e]	0	0	3,540[i]	4,040
Hazardous						
Liquid	6,460	2[c]	88[h]	0	Included in solid	6,550
Solid	26	2[c]	0	0	1,120[j]	1,150
Nonhazardous (Sanitary)						
Liquid	550,000	171,840[c]	18,000[h]	0	NA	739,000
Solid	53,100	1,720[c]	410[h]	0	NA	55,200

Table 4.7.2.5.10–1. Waste Management Cumulative Impacts at Oak Ridge Reservation (2005)—Annual Volumes—Continued

Category	No Action[a] (m^3)	Storage and Disposition (m^3)	HEU Disposition (m^3)	Stockpile Stewardship and Management[b] (m^3)	Waste Management (m^3)	Total (m^3)
Nonhazardous (Other)						
Liquid	650,000	0.8[g]	773[h]	0	64,800[k]	716,000
Solid	321	2,200[c]	410[g,h]	0	NA	2,930

[a] No Action volumes are from Table 4.2.5.10–1.

[b] No Action Alternative.

[c] Collocation Alternative (New Pu and HEU Storage Facility).

[d] Represents TRU Waste Decentralized Alternative in which ORR would treat its own newly generated and existing inventory of TRU waste. The volume was obtained by taking the current inventory divided by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 8.1–1, page 8–4).

[e] Collocation Alternative (New Pu Storage Facility and Upgrade Y-12).

[f] Represents blending HEU to LEU as metal.

[g] Represents LLW Regionalized Alternative 5 in which ORR would treat and dispose of onsite and offsite LLW. The volume was obtained by taking the estimated inventory at ORR plus the inventory and 20-year generation projection for offsite receipts and dividing by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 7.1–1, page 7–3).

[h] Represents blending HEU to 4 percent LEU as UNH.

[i] Represents mixed LLW Regionalized Alternative 4 in which ORR would treat and dispose of onsite and offsite mixed LLW. The volume was obtained by taking the estimated inventory at ORR plus the estimated inventory and 20-year generation for offsite receipts and dividing by 20 to get annual estimate (Draft Waste Management PEI Vol. I of IV, Table 6.1–1, page 6–3).

[j] Represents the estimated hazardous waste to be treated at ORR as a result of hazardous waste Regionalized Alternative 2 (Draft Waste Management PEIS, Vol. I of IV, Table 10.3–7, page 10–20).

[k] Represents the total incremental annual wastewater over No Action for all alternatives. Annual volume was obtained by assuming 365 days per year (Draft Waste Management PEIS, Vol. II, Tables II-10.3–11 [TRU], page 10–45; II-10.1–15 [mixed LLW], page 10–17; II-10.2–12 [LLW]. page 10–33; and II-10.5–10 [hazardous], page 10–58).

Note: NA=data was not analyzed in the associated PEIS.

Source: DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996m; Table 4.2.5.10–1.

4.7.2.6 Savannah River Site

4.7.2.6.1 *Land Resources*

In addition to the storage alternatives, SRS is being considered as a site for the six other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs during operation is 223 ha (550 acres), or less than 0.3 percent of the total land at SRS. Site development would be performed in accordance with the land-use plans in the SRS Site Development Plan. Proposed development would also be compatible with the industrial use visual character of the developed areas of SRS. Cumulatively, the actions would consume land but would be consistent with the land use plans and visual character of the site.

4.7.2.6.2 *Site Infrastructure*

Some cumulative impacts are possible at SRS resulting from implementation of the storage alternatives and the other six DOE programs identified in Table 4.7.1–1. The site infrastructure cumulative impacts that would result at SRS from operation of all of the proposed alternatives are shown in Table 4.7.2.6.2–1. The cumulative requirements for energy, peak load, oil, and coal would exceed the site availability at SRS. Transmission lines, electrical distribution equipment, and oil storage tanks would need to be constructed to satisfy the new resource requirements. Additional coal requirements would be satisfied using existing procurement practices.

Table 4.7.2.6.2–1. Site Infrastructure Cumulative Operation Impacts at Savannah River Site

	Electrical		Fuel	
Requirement	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Coal (t)
No Action	794,000	116	28,390,500	221,352
Storage and Disposition[a]	76,000	13	47,000	4,800
Foreign Research Reactor Spent Nuclear Fuel	1,500	NA	NA	NA
HEU Disposition	5,000	NA	56,800	360
Spent Nuclear Fuel	24,400	NA	0	0
Stockpile Stewardship and Management	9,700	1.6	28,400	1,090
Tritium Supply/Recycling	3,740,000	550	13,200	0
Waste Management	NA	13.7	NA	NA
Cumulative Requirement	4,790,600	694.3	32,135,900	227,602
Site Availability	1,672,000	330	28,390,500	221,352

[a] Collocation Alternative.

Note: NA=data was not analyzed in the associated EIS.

Source: DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1996b; DOE 1996g; DOE 1996m; Table 4.2.6.2–1.

4.7.2.6.3 *Air Quality and Noise*

Cumulative impacts to air quality at SRS include impacts from the No Action Alternative, the other seven DOE programs identified in Table 4.7.1–1, and the proposed facilities for each alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

The SRS is currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the storage alternatives would increase concentrations of criteria pollutants. Potential cumulative impacts are presented in Table 4.7.2.6.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Table 4.7.2.6.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Savannah River Site and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Other Onsite Activities[b] ($\mu g/m^3$)	Upgrade[c] ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Criteria Pollutants							
Carbon monoxide	8-hour	10,000[d]	22	41.88	64.05	66.03	66.28
	1-hour	40,000[d]	171	107.1	278.9	288.2	289.4
Lead	Calendar Quarter	1.5[d]	0.0004	0.00003	0.00043	0.00043	0.00043
Nitrogen dioxide	Annual	100[d]	5.7	3.53	9.33	10.15	10.31
Ozone	1-hour	235[d]	e	e	e	e	e
Particulate matter less than or equal to 10 microns in diameter	Annual	50[d]	3	1.125	4.135	4.185	4.195
	24-hour	150[d]	50.6	5.68	56.43	57.51	57.72
Sulfur dioxide	Annual	80[d]	14.5	0.386	15.18	16.34	16.67
	24-hour	365[d]	196	19.09	220.7	243.1	249.6
	3-hour	1,300[d]	823	112.2	971.9	1116	1158
Mandated by South Carolina							
Total suspended particulates (TSP)	Annual	75[f]	12.6	2.065	14.68	14.73	14.74
Gaseous fluorides (as HF)	30-day	0.8[f]	0.09	0.019	0.109	0.109	0.109
	7-day	1.6[f]	0.39	0.067	0.457	0.457	0.457
	24-hour	2.9[f]	1.04	0.175	1.215	1.215	1.215
	12-hour	3.7[f]	1.99	0.327	2.317	2.317	2.317

Table 4.7.2.6.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Savannah River Site and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] ($\mu g/m^3$)	No Action ($\mu g/m^3$)	Other Onsite Activities[b] ($\mu g/m^3$)	Upgrade[c] ($\mu g/m^3$)	Consolidation ($\mu g/m^3$)	Collocation ($\mu g/m^3$)
Hazardous and Other Toxic Compounds							
Benzene	24-hour	150[d]	31.71	0.001	31.71	31.71	31.71
Chlorine	24-hour	75[f]	7.63	0	7.63	7.63[g]	7.63
Hydrogen chloride	24-hour	175[f]	[h]	0	[h]	<0.01[g]	<0.01[g]
Hydrazine	24-hour	0.5[f]	[h]	0	[h]	<0.01[g]	<0.01[g]
Nitric acid	24-hour	125[f]	50.96	4.76	55.72	55.72	55.77
Phosphoric acid	24-hour	25[f]	0.462	0	0.462	0.462	0.462
Sulfuric acid	24-hour	10[f]	[h]	0	[h]	<0.01[g]	<0.01[g]

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging period.

[b] Other onsite activities include those associated with the Foreign Research Reactor Spent Nuclear Fuel, HEU Disposition, Interim Management of Nuclear Materials, Spent Nuclear Fuel Management, Stockpile Stewardship and Management, Tritium Supply/Recycling, and Waste Management Programs.

[c] Applies to the New F-Area Facility option.

[d] Federal and State standards.

[e] Ozone, as a criteria pollutant, is not directly emitted nor monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[f] State standard or guideline.

[g] The concentration represents the alternative contribution and other onsite activities.

[h] No sources of this pollutant have been identified.

Note: Concentrations are based on site contribution and do not include the contribution from non-facility sources.

Source: 40 CFR 50; DOE 1995p; DOE 1996b; DOE 1996g; SC DHEC 1991a; SC DHEC 1992b; SR DOE 1994a; SR DOE 1994e; SR DOE 1995b; SR DOE 1995e; WSRC 1994e; Table 4.2.6.3–1.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources, such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.6.4 *Water Resources*

Table 4.7.2.6.4–1 summarizes the estimated cumulative annual water requirements for the storage alternatives and the six other DOE programs identified in Table 4.7.1–1. Water requirements during operation of all the proposed projects would be obtained from existing or new well fields at SRS and from the Savannah River. The cumulative water requirements for the site would be a 4-percent increase over projected No Action water usage. Suitable groundwater from the deep aquifers at the site is abundant and aquifer depletion is not a problem. The proposed Collocation Alternative would account for 0.3 percent of the total cumulative water usage.

Table 4.7.2.6.4–2 summarizes the estimated treated wastewater discharge to the Savannah River. The cumulative wastewater discharge to the river would be 0.02 percent of the average Savannah River flow (283 m^3/s [9,994 ft^3/s]), and 0.04 percent of the Savannah River minimum flow (152 m^3/s [5,368 ft^3/s]). The proposed Collocation Alternative would account for approximately 17 percent of the total annual cumulative wastewater discharge. The expected total cumulative wastewater discharge to the tributaries would continue to meet NPDES limits and reporting requirements. Existing SRS treatment facilities could accommodate all the new cumulative processes and wastewater streams if a new facility is built for tritium supply and recycling operations as planned.

[Text deleted.]

Table 4.7.2.6.4–1. Cumulative Annual Water Usage at Savannah River Site

Program	Water Requirement (million l/yr)
No Action	140,247[a]
Storage and Disposition	460[b]
Foreign Research Reactor Spent Nuclear Fuel	1.9
HEU Disposition	2.1
[Text deleted.]	
Spent Nuclear Fuel	49
Stockpile Stewardship and Management	46
Tritium Supply and Recycling	4,735
Waste Management	325[c]
Total annual cumulative water usage	145,883.1

[a] Includes both groundwater and surface water usage (13,247 million l/yr from groundwater and 127,000 million l/yr from surface water).

[b] Collocation Alternative.

[Text deleted.]

[c] Based on preliminary data.

[Text deleted.]

Source: DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996g; DOE 1996m; SR DOE 1994b; SR DOE 1995b; SRS 1995a:1; Table 4.2.6.4–1.

Table 4.7.2.6.4–2. Cumulative Annual Wastewater Discharge at Savannah River Site

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	700
Storage and Disposition	215
Foreign Research Reactor Spent Nuclear Fuel	1.6
HEU Disposition	18.7
[Text deleted.]	
Spent Nuclear Fuel	49
Stockpile Stewardship and Management	46
Tritium Supply and Recycling	143
Waste Management	83[a]
Total annual cumulative wastewater	1,256.3

[a] Based on the highest treated volumes from the alternative scenarios.

[Text deleted.]

Source: DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996g; DOE 1996m; SR DOE 1994b; SR DOE 1995b; SRS 1995a:1; Table 4.2.6.4–1.

4.7.2.6.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1–1. A total of 223 ha (550 acres) could be disturbed at the site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.6.6 *Biological Resources*

In addition to ongoing activities and the Storage Alternatives, SRS is being considered for the other DOE programs identified in Table 4.7.1–1. While a number of these would be located within existing structures or developed areas of SRS, others would be constructed at undisturbed sites. The total area of undeveloped land used by new facilities would be 223 ha (550 acres), or about 0.3 percent of the total SRS area. Discharges from the proposed facilities would be directed to a number of site waterbodies, thus increasing the possibility of cumulative impacts to wetlands and aquatic resources in these waterbodies. The cumulative loss of habitat could lead to additional impacts to special status species compared to those resulting from construction of a storage facility alone; however, their status on SRS would not be expected to be jeopardized. Species that could be affected include green-fringed orchid, nailwort, beak-rush, [text deleted], Florida false loosestrife, Cooper's hawk, and eastern tiger salamander. Red-cockaded woodpeckers colonies are located far enough from the sites that they would not be affected by the facilities.

4.7.2.6.7 *Cultural and Paleontological Resources*

The six other DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access and use at SRS. New construction is proposed for some currently undeveloped land within SRS under both the Tritium Supply and Recycling and Storage and Disposition programs. Portions of this undeveloped land have been surveyed and contain NRHP-eligible resources which may be affected by construction. Building modification is also proposed under several programs. Facilities at SRS have not been reviewed for NRHP-eligibility, but many may be eligible based on their association with the Cold War. Specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act*, and the *Native American Graves Protection and*

Repatriation Act. There is potential for moderate cumulative impacts to cultural resources at SRS based on the presence of sites and facilities that have been or are likely to be determined eligible for listing on the NRHP.

4.7.2.6.8 *Socioeconomics*

Cumulative impacts on SRS's regional economy, population, housing, community services, and local transportation would be minor. Generally, the regional economy would improve without burdening the housing market, but new traffic could cause congestion on local roads. Because each of the other six DOE programs identified in Table 4.7.2.6.8–1 is relatively small, their cumulative socioeconomic impact is expected to be minor. The primary impact will be to stimulate regional economic growth. If all of these programs were located at SRS, transportation congestion and the demand for new housing and other public services could increase. However, housing construction trends indicate that this additional population could be accommodated without significant impacts to the housing market.

Table 4.7.2.6.8–1. Socioeconomic Cumulative Impacts at Savannah River Site

Program	Direct Employment[a]
Storage and Disposition[b]	614
Foreign Research Reactor Spent Nuclear Fuel	30
HEU Disposition	125
Spent Nuclear Fuel	0
Stockpile Stewardship and Management	810
Tritium Supply/Recycling	600
Waste Management	5,670
Total	7,849

[a] Operations.
[b] Collocation Alternative.
Source: DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1996b; DOE 1996g; DOE 1996m; Section 4.2.6.8.

4.7.2.6.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the storage alternative, the No Action Alternative and other actions planned at SRS, are presented in Table 4.7.2.6.9–1. Although these impacts could be added, it should be noted that the exact locations of the facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Chemical Impacts. For SRS, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at SRS is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

Table 4.7.2.6.9–1. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Savannah River Site

	Maximally Exposed Member of the Public		Offsite Population Within 80 km		Total Site Workforce	
Program	Total Dose (mrem)	Fatal Cancer Risk	Total Dose (person-rem)	Number of Fatal Cancers	Total Dose (person-rem)	Number of Fatal Cancers
No Action	0.79	4.0×10^{-7}	44	0.022	259	0.090
Storage and Disposition[a]	1.4×10^{-5}	7.0×10^{-12}	8.8×10^{-4}	4.4×10^{-7}	25	0.010
Foreign Research Reactor Spent Nuclear Fuel	1.8×10^{-4}	9.0×10^{-11}	0.010	5.3×10^{-6}	32	0.013
HEU Disposition	2.5×10^{-3}	1.3×10^{-9}	0.16	8.0×10^{-5}	11.3	4.5×10^{-3}
[Text deleted.]						
Spent Nuclear Fuel	0.50	2.5×10^{-7}	18.4	9.2×10^{-3}	76	0.034
Stockpile Stewardship and Management	1.0×10^{-5}	5.0×10^{-12}	5.9×10^{-4}	3.0×10^{-7}	156	0.062
Tritium Supply and Recycling[b]	2.5	1.2×10^{-6}	210	0.11	42	0.017
Waste Management	0.033	1.7×10^{-8}	1.5	7.5×10^{-4}	81	0.032
[Text deleted.]						

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage.

[b] Accelerator Production of Tritium Alternative.

Source: DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996g; DOE 1996m; Tables 4.2.6.9–1 and 4.2.6.9–2.

4.7.2.6.10 *Waste Management*

Cumulative impacts to waste management at SRS could arise from any of the reasonably foreseeable future actions as identified in Table 4.7.2.6.10–1. The largest potential contribution to cumulative impacts would result from the Waste Management PEIS if SRS were selected as a regional site for HLW storage, TRU waste treatment and storage, and mixed LLW and LLW treatment and disposal site. The Collocation Alternative for the Storage and Disposition PEIS would contribute to the cumulative impacts for LLW.

Table 4.7.2.6.10–1. Waste Management Cumulative Impacts at Savannah River Site (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Foreign Research Reactor Spent Nuclear Fuel (m^3)	HEU EIS[c] (m^3)	Spent Nuclear Fuel Management (m^3)	Stockpile Stewardship and Management[d] (m^3)	Tritium Supply and Recycling (m^3)	Waste Management (m^3)	Total (m^3)
Spent Fuel	0	0	1.4 t	0	0.4 t	0	0	0	2 t
High Level									
Liquid	126	0	0	0	0	0	0	0	126
Solid	3,525	0	0	0	0	0	0	533[e]	4,060
Transuranic									
Liquid	0	0.02	0	0	0	28	0	Included in solid	28
Solid	338	2	0	0	20	129	0	445[f]	934
Mixed Transuranic									
Liquid	0	0	0	0	0	0	0	Included in TRU	0
Solid	Included in TRU	4	0	0	0	11	0	Included in TRU	15
Low-Level									
Liquid	74,000	2.1	0	22	0	80	0	Included in solid	74,100
Solid	16,400	1,260	673	76	400	88	416	26,835[g]	46,150
Mixed Low-Level									
Liquid	1,330	0.2	NA	46	0	0	0	0	1,380
Solid	7,970	66	NA	0	0	0	5	340[h]	8,110
Hazardous									
Liquid	1,260	2	NA	88	NA	0.5	0	Included in solid	1,350
Solid	15,100	2	NA	0	NA	0	2	151[i]	15,300
Nonhazardous (Sanitary)									
Liquid	703,000	195,780	NA	18,800	NA	46,200	925,076	NA	1,870,000
Solid	61,200	18[j]	NA	410	NA	1,450	917	NA	64,000

Table 4.7.2.6.10–1. Waste Management Cumulative Impacts at Savannah River Site (2005)—Annual Volumes—Continued

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Foreign Research Reactor Spent Nuclear Fuel (m^3)	HEU EIS[c] (m^3)	Spent Nuclear Fuel Management (m^3)	Stockpile Stewardship and Management[d] (m^3)	Tritium Supply and Recycling (m^3)	Waste Management (m^3)	Total (m^3)
Nonhazardous (Other)									
Liquid	Included in sanitary	Included in sanitary	38,450	Included in sanitary	NA	Included in sanitary	Included in sanitary	35,417[k]	74,600
Solid	Included in sanitary	2,300[l]	NA	410[l]	NA	1,450[l]	0	NA	4,160

[a] No Action volumes from Table 4.6.2.10–1.

[b] Colloçation Alternative (New Pu and HEU Storage Facility).

[c] Blending HEU to 4 percent LEU as UNH.

[d] Pit Fabrication Alternative.

[e] Represents HLW Regionalized Alternative 1, in which SRS would receive a total of 300 canisters from West Valley Demonstration Project for storage awaiting availability of geologic repository. Receipt of 100 canisters per year was assumed (Draft Waste Management PEIS, Vol I of IV, Table 9.1–1, page 9–3).

[f] Represents TRU waste Regionalized Alternatives 2 and 3, in which SRS would treat its TRU waste and contact-handled TRU waste from several other facilities. The volume was obtained by taking the estimated inventory at SRS plus the estimated inventory and 20-year generation projection for offsite facilities and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 8.1–1, page 8–4).

[g] Represents LLW Regionalized Alternatives 6 and 7, in which SRS disposes of wastes, its LLW, and LLW from several other facilities. The volume was obtained by taking the estimated inventory at SRS plus the estimated inventory and 20-year generation projection for offsite facilities and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 7.1–1, page 7–3).

[h] Represents mixed LLW Regionalized Alternative 2, in which SRS treats and disposes of its mixed LLW and mixed LLW from several other facilities. The volume was obtained by taking the estimated inventory at SRS plus the estimated inventory and 20-year generation projection for offsite facilities and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 6.1–1, page 6–3).

[i] Represents hazardous waste Regionalized Alternative 1, in which SRS would treat onsite approximately 55 percent of its hazardous waste with the remainder going to commercial facilities. One metric ton of hazardous waste is approximately 1 cubic meter in volume (Draft Waste Management PEIS, Vol. I of IV, Table 10.3–7, page 10–20).

[j] Upgrade with RFETS and LANL material Alternative.

[k] Represents the total incremental wastewater over No Action for all alternatives. Annual volume estimated by assuming 365 days per year (Draft Waste Management PEIS, Vol II, Tables II-16.4–8 [HLW], page 16–55; II-16.3–11 [TRU], page 16–45; II-16.2–12 [LLW], page 16–32; II-16.1–16 [mixed LLW], page 16–18; and II-16.5–10 [hazardous], page 16–67).

[l] Recyclable wastes.

Note: NA=data was not analyzed in the associated PEIS.

Source: 60 FR 28680; 60 FR 63878; 60 FR 65300; 61 FR 9441; 61 FR 25092; DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996g; DOE 1996m; SR DOE 1995b; SR DOE 1995c; SR DOE 1995e; Table 4.2.6.10–1.

4.7.2.7 Rocky Flats Environmental Technology Site

4.7.2.7.1 *Land Resources*

Since no new construction would be needed for any of the storage alternatives, there would be no cumulative impacts to land resources. In the case of phaseout, future use of the facility would be consistent with the land use plans outlined in site development plans.

4.7.2.7.2 *Site Infrastructure*

Since no storage alternatives would be implemented at RFETS, no major site infrastructure enhancements are anticipated, and there would not be any obvious cumulative impacts. Table 4.2.7.2–1 shows that all site infrastructure categories reported still have sufficient reserve capacity to support ongoing missions.

4.7.2.7.3 *Air Quality and Noise*

Operations at the RFETS are currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the interim storage and phaseout of Pu would not increase concentrations of criteria pollutants. The cumulative impacts are the same as No Action concentrations except for increases in SO_2 concentrations resulting from waste management activities and are in compliance with Federal and State regulations (DOE 1995dd:14-9,14-24,14-38).

Cumulative noise impacts include contributions from existing and planned facilities including the storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. No increase in cumulative noise impacts to offsite individuals is expected to occur.

4.7.2.7.4 *Water Resources*

Since no additional water would be needed for any of the storage alternatives, the storage program would not contribute to cumulative impacts for water resources at RFETS. There may be a decrease in water usage and wastewater generation as a result of the phaseout alternative. The benefits as a result of the phaseout alternative are expected to be negligible.

[Text deleted.]

4.7.2.7.5 *Geology and Soils*

Since no ground disturbing activities would be needed for any of the storage alternatives, there would not be cumulative impacts to geology and soils.

4.7.2.7.6 *Biological Resources*

Since no facility construction would be needed to accommodate any of the storage options, there would be no cumulative impacts to biological resources at the site.

4.7.2.7.7 *Cultural and Paleontological Resources*

Some cumulative impacts are possible at RFETS as a result of alternatives in the Waste Management PEIS. In the case of the phaseout alternative for the storage program, additional impacts could result if potentially NRHP-eligible structures were modified for other uses.

4.7.2.7.8 *Socioeconomics*

The cumulative impacts resulting from the Storage Alternatives at RFETS on the regional economy, population, housing, community services, and local transportation would be minor. In addition to the proposed phaseout of the storage mission, the only other DOE action being considered for RFETS is the Waste Management program. As shown in Table 4.7.2.7.8–1, employment generated by the Waste Management program would offset some of the job losses resulting from phaseout of the storage mission. However, the combined impact of these two actions would be to reduce the workforce from the No Action level. The cumulative impact on the regional economy and ROI housing market and community services would be minor. Any transportation congestion that may exist on roads leading to the site would be reduced slightly due to fewer site workers.

Table 4.7.2.7.8–1. Socioeconomic Cumulative Impacts at Rocky Flats Environmental Technology Site

Program	Direct Employment[a]
Storage and Disposition[b]	-2,129
Waste Management	1,344
Total	-785

[a] Operations.
[b] Phaseout Alternative.
Source: DOE 1995cc; Section 4.2.7.8.

4.7.2.7.9 *Public and Occupational Health and Safety*

No additional radiological or chemical impacts are expected as a result of the storage alternatives at RFETS. Therefore, the contribution to cumulative impacts from the storage alternatives are the same as the No Action impacts shown in Section 4.2.7.9.

4.7.2.7.10 *Waste Management*

No additional waste would be generated as a result of the No Action or phaseout alternatives at RFETS. Therefore, the storage alternatives would not contribute to cumulative impacts.

4.7.2.8 Los Alamos National Laboratory

4.7.2.8.1 *Land Resources*

Since none of the alternatives would require additional ground disturbance, the storage alternatives would not contribute to cumulative impacts that may result from the two other DOE programs identified in Table 4.7.1–1. In the case of phaseout, any future use of the facility would be consistent with the land uses outlined in site development plans.

4.7.2.8.2 *Site Infrastructure*

Some cumulative impacts are possible at LANL from the implementation of the two other DOE programs identified in Table 4.7.1–1. However, since none of the storage alternatives would require facility construction or modification, the cumulative impacts would not be affected by this program.

4.7.2.8.3 *Air Quality and Noise*

Operations at LANL are currently in compliance with NAAQS and State regulations and guidelines. Air emissions attributable to the No Action and phaseout alternatives would not increase concentrations of criteria pollutants. The contribution to cumulative impacts from the storage alternatives are the same as the No Action concentrations shown in Section 4.2.8.3.

Cumulative noise impacts include contributions from existing and planned facilities including the storage facilities at the site. Noise impacts may result both from onsite noise sources and offsite sources such as traffic. Noise impacts on individuals from the storage alternatives are expected to be small, resulting in little or no increase in noise levels at offsite areas. No increase in cumulative noise impacts is expected to occur as a result of the storage alternatives.

4.7.2.8.4 *Water Resources*

Since no additional water would be needed for any of the storage alternatives, the storage program would not contribute to cumulative impacts for water resources at LANL. There may be a decrease in water usage and wastewater generation as a result of the phaseout alternative. The benefits to water resources as a result of the phaseout alternative are expected to be negligible.

4.7.2.8.5 *Geology and Soils*

Since no ground disturbing activities would be needed for any of the storage alternatives, there would be no contribution to cumulative impacts for geology and soils at LANL.

4.7.2.8.6 *Biological Resources*

Since no ground disturbing activities would be needed for any of the storage alternatives, there would be no contribution to cumulative impacts for biological resources at LANL.

4.7.2.8.7 *Cultural and Paleontological Resources*

Some cumulative impacts are possible at LANL as a result of the two DOE programs identified in Table 4.7.1–1. In the case of the phaseout alternative for the storage program, additional impacts could result if potentially NRHP-eligible structures were modified for other uses.

4.7.2.8.8 *Socioeconomics*

The storage alternatives would result in no loss of jobs at LANL. In the case of phaseout, workers currently employed in the P-storage area would be relocated to other areas. Therefore, the storage alternatives would not contribute to cumulative impacts that may result from other DOE programs.

4.7.2.8.9 *Public and Occupational Health and Safety*

No additional radiological or chemical impacts are expected as a result of the storage alternatives at LANL. Therefore, the contribution to cumulative impacts from the storage alternatives are the same as the No Action impacts shown in Section 4.2.8.9.

4.7.2.8.10 *Waste Management*

No additional waste would be generated as a result of the No Action or phaseout alternatives at LANL. Therefore, the storage alternatives would not contribute to cumulative impacts that may result from the two other DOE programs identified in Table 4.7.1–1.

4.7.3 DISPOSITION ALTERNATIVES CUMULATIVE IMPACTS

Implementation of the various proposed disposition alternatives may result in incremental cumulative impacts in addition to the long-term storage cumulative impacts identified in Section 4.7.2. The impacts identified in this section are additive to the cumulative impacts identified in the long-term storage cumulative impact analysis.

A site-specific cumulative impact analysis was not performed for the disposition alternatives, because only representative or generic sites were considered. Instead, a generic cumulative impact analysis that is applicable to all DOE sites was developed for the disposition alternatives. Future tiered NEPA documents will provide detailed site-specific cumulative impact analyses.

Since there are multiple combinations of disposition operations and facilities that could be selected, a representative scenario was used for the disposition cumulative impact analysis. This scenario includes all of the common activities that would be needed for all of the disposition alternatives (pit disassembly/conversion and Pu conversion facilities), the common activity that would be required for the reactor alternatives (MOX fuel fabrication facility), and the immobilization alternative that would generally have the largest impacts (ceramic immobilization facility). For consistency, all analyses assume use of the ceramic immobilization technology. The scenario conservatively assumes that all four of the facilities would be constructed and operated concurrently at the same DOE site. The following sections describe the impacts from the disposition scenario for each resource area.

4.7.3.1 Land Resources

The contribution to land-use cumulative impacts from the disposition scenario is shown in Table 4.7.3.1–1. The construction of all four of the disposition scenario facilities at the same site would disturb up to 191 ha (474 acres) of land during construction, of which up to 133 ha (330 acres) would be used during operations. If all four of the facilities were located at the same site, there would likely be a reduced area of disturbed land due to the sharing of land resources. In addition, optimal use of existing buildings and facilities would occur where possible. The site chosen for the disposition scenario would likely have adequate land area to accommodate the facilities. If the site development is not in conformance with existing land-use plans, it may be possible for land-use plans, policies, and controls to be revised. The use of special status lands and prime farmland could be affected. It is anticipated that the new facilities would be relatively visually unobtrusive to adjacent lands.

Table 4.7.3.1–1. Contribution to Land-Use Cumulative Impacts From the Disposition Scenario

Area of Disturbance (ha)	Pit Disassembly/ Conversion	Pu Conversion	MOX Fuel Fabrication	Ceramic Immobilization	Total Impact
Construction	14	36	121	20	191
Operation	12	28	81	12	133

Source: Section 4.3.1.1; Section 4.3.2.1; Section 4.3.4.2.1; Section 4.3.5.1.1.

4.7.3.2 Site Infrastructure

The contribution to site infrastructure cumulative impacts from the disposition scenario is shown in Table 4.7.3.2–1. The additional resource requirements could require new transmission lines, oil storage tanks, and gas transfer pipelines. Additional fuel oil and natural gas requirements would probably be available using the current procurement practices at the site. If the natural gas requirement is not available, oil-based utilities could substitute. Construction and operation of these facilities would require the construction of transportation links to existing road and rail networks.

Table 4.7.3.2–1. Contribution to Site Infrastructure Cumulative Impacts From the Disposition Scenario[a]

Utility	Pit Disassembly/ Conversion	Pu Conversion	MOX Fuel Fabrication	Ceramic Immobilization	Total Impact
Electrical Energy (MWh/yr)	20,000	21,000	13,000	25,000	79,000
Peak Load (MWe)	5	5	5	3	18
Oil (l/yr)	28,000	39,750	20,000	190,000	277,750
Natural gas (m^3/yr)	3,398,000	4,361,000	2,350,000	3,500,000	13,609,000

[a] Operations only.
Source: Section 4.3.1.2; Section 4.3.2.2; Section 4.3.4.2.2; Section 4.3.5.1.2.

4.7.3.3 Air Quality and Noise

The construction and operation of the disposition scenario facilities would result in the emission of some air pollutants at each of the sites. The modeling needed to determine the concentrations of the pollutants is highly site-specific. The concentrations would vary depending on the ambient conditions of each of the sites. Air pollutant emission sources include exhaust from vehicles, emissions from facility processes, boiler and generator emissions, and fugitive dusts from land clearing and site preparation. Concentrations of criteria and toxic/hazardous pollutants during construction and operation of the facilities may not be in compliance with Federal, State, and local regulations and guidelines.

4.7.3.4 Water Resources

The contribution to water resource cumulative impacts from the disposition scenario is shown in Table 4.7.3.4–1. The disposition scenario facilities would obtain raw water from surface or groundwater sources that currently support the site. Most of the DOE sites analyzed would have adequate water supply to support the proposed projects. Wastewater would be treated using existing treatment, monitoring, and discharge systems. New wastewater treatment systems would be constructed if the current systems do not have adequate capacity.

Table 4.7.3.4–1. Contribution to Water Resource Cumulative Impacts From the Disposition Scenario[a]

Water Resource Requirement (million l/yr)	Pit Disassembly/ Conversion	Pu Conversion	MOX Fuel Fabrication	Ceramic Immobilization	Total Impact
Total water requirement	94.6	80.5	56.8	250	481.9
Total wastewater discharge	85.2	15	43.5	98	241.7

[a] Operations only.
Source: Section 4.3.1.4; Section 4.3.2.4; Section 4.3.4.2.4; Section 4.3.5.1.4.

4.7.3.5 Geology and Soils

Construction of the disposition scenario facilities would involve disturbing up to 191 ha (474 acres) of land. The ground disturbing activities would lead to a temporary increase in the erosion potential of the exposed soils. The disposition scenario facilities are not expected to restrict access to potential geologic resources.

4.7.3.6 Biological Resources

Construction and operation of the disposition scenario facilities could result in the direct disturbance of terrestrial resources, wetlands, and threatened and endangered species. Construction of the disposition scenario facilities would involve disturbing up to 191 ha (474 acres) of land. Less mobile animals within the project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and

noise would cause larger mammals and birds to move to similar habitat nearby. Nests and young animals living within the project area would not be expected to survive. Surrounding areas could be indirectly affected by erosion and sedimentation. The use of existing buildings and previously disturbed areas would reduce impacts.

4.7.3.7 Cultural and Paleontological Resources

The construction and operation of the disposition scenario facilities could affect cultural and paleontological resources. Construction of the facilities could disturb up to 191 ha (474 acres) of land. Cultural and paleontological resources could be affected by ground disturbance, building modification, visual intrusion, audio intrusion, disruption of historic and/or environmental setting, reduced access to traditional use areas, unauthorized artifact collecting, and vandalism. Construction and operation of the facilities could affect Native American and buried paleontological materials.

4.7.3.8 Socioeconomics

The contribution to socioeconomic cumulative impacts from the disposition scenario is shown in Table 4.7.3.8–1. Constructing and operating the disposition scenario facilities would generate employment and income increases in the region. In-migrating workers may be needed to fill specialized positions during construction and operation. Housing units, in excess of existing vacancies, may be required during construction and operation of the facilities. Operation of the facilities would result in an increased demand for community services at the selected site. There may be an increase in congestion on local roads as a result of new traffic from construction and operation workers. Generally, the impacts from the new facilities would be minor relative to the size of the regional population and economy.

Table 4.7.3.8–1. Contribution to Socioeconomic Cumulative Impacts From the Disposition Scenario

Labor Category	Pit Disassembly/ Conversion	Pu Conversion	MOX Fuel Fabrication	Ceramic Immobilization	Total Impact
Direct construction workers	125	358	475	1,000	1,958
Direct operational workers	830	883	500	860	3,073

Source: Section 4.3.1.8; Section 4.3.2.8; Section 4.3.4.2.8; Section 4.3.5.1.8.

4.7.3.9 Public and Occupational Health and Safety

The contribution to public and occupational health and safety cumulative impacts are shown in Table 4.7.3.9–1. During normal operations of the disposition scenario facilities, there would be both radiological and chemical releases to the environment and direct in-plant exposures. However, concentrations are expected to be within regulated exposure limits.

4.7.3.10 Waste Management

The contribution to waste management cumulative impacts from the disposition cumulative impacts is shown in Table 4.7.3.10–1. Existing treatment systems would be used for the wastestreams from the disposition scenario facilities. If capacity or appropriate treatment technology is not available, new treatment facilities would be built to handle the waste from the new facilities.

Table 4.7.3.9–1. Contribution to Public and Occupational Health and Safety Cumulative Impacts From the Disposition Scenario[a]

Receptor	Pit Disassembly/ Conversion	Pu Conversion	MOX Fuel Fabrication	Ceramic Immobilization
Maximally Exposed Individual Member of the Public				
Annual dose (mrem/yr)	1.5×10^{-3} to 1.4×10^{-2}	9.5×10^{-5} to 9.2×10^{-3}	8.8×10^{-5} to 0.015	1.2×10^{-7} to 4.2×10^{-6}
Fatal cancer risk[b]	7.6×10^{-10} to 7.0×10^{-8}	4.8×10^{-10} to 4.6×10^{-8}	7.8×10^{-10} to 1.8×10^{-7}	6.0×10^{-13} to 2.1×10^{-11}
Public Within 80 km				
Annual dose (person-rem/yr)	2.9×10^{-4} to 0.12	1.9×10^{-4} to 0.074	1.4×10^{-4} to 0.14	1.7×10^{-7} to 6.7×10^{-5}
Fatal cancers[b]	1.5×10^{-6} to 6.0×10^{-4}	9.5×10^{-7} to 3.7×10^{-4}	1.2×10^{-6} to 1.2×10^{-3}	8.5×10^{-10} to 3.4×10^{-7}
Involved Worker				
Annual dose (mrem/yr)	200	233	250	279
Fatal cancer risk[b]	8.0×10^{-4}	9.3×10^{-4}	2.3×10^{-3}	1.1×10^{-3}
Total Involved Workforce				
Annual dose (mrem/yr)	83	133	31	120
Fatal cancers[b]	0.34	0.53	0.29	0.46
Hazardous Chemical Impacts				
Maximally Exposed Individual of the Public				
Hazard index	4.0×10^{-6} to 1.5×10^{-4}	7.9×10^{-6} to 1.7×10^{-4}	4.9×10^{-6} to 1.9×10^{-4}	3.9×10^{-4} to 1.5×10^{-2}
Cancer risk[b]	0	4.7×10^{-9} to 1.9×10^{-7}	0	0
Site Worker				
Hazard index	2.6×10^{-4} to 5.3×10^{-4}	8.0×10^{-4} to 1.7×10^{-3}	8.2×10^{-4} to 1.7×10^{-3}	8.3×10^{-2} to 0.17
Cancer risk[b]	0	7.2×10^{-6} to 1.5×10^{-5}	0	0

[a] During normal operations.

[b] Over the operational life.

Note: The impacts projected in this table are for 50t for either immobilization or reactor burning. The pit dissassembly/conversion, Pu conversion, and ceramic immobilization impacts are for 10 years and the MOX fuel fabrication impacts are for 17 years.

Source: Section 4.3.1.9; Section 4.3.2.9; Section 4.3.4.2.9; Section 4.3.5.1.9.

Table 4.7.3.10–1. Contribution to Waste Management Cumulative Impacts From the Disposition Scenario[a]

Waste Category	Pit Disassembly/ Conversion (m^3/yr)	Pu Conversion (m^3/yr)	MOX Fuel Fabrication (m^3/yr)	Ceramic Immobilization (m^3/yr)	Total Impact (m^3/yr)
Transuranic					
Liquid	0	3.2	0	75	78.2
Solid	67	278	306	99	750
Mixed Transuranic					
Liquid	0	0	0	0	0
Solid	4	191	4	0.7	200
Low-Level					
Liquid	4	56	4	7	70
Solid	102	1,743	153	14	2,012
Mixed Low-Level					
Liquid	0.4	0.04	0.8	0	1
Solid	1.7	191	38	0.15	231
Hazardous					
Liquid	2	2	4	38	46
Solid	0.7	11	153	19	184
Nonhazardous (Sanitary)					
Liquid	85,200	15,000	43,300	34,000	177,500
Solid	100	2,060	76	920	3,160
Nonhazardous (Other)					
Liquid	Included in sanitary	56	227	170,000	170,300
Solid	3	0	84[b]	15	102

[a] Operations only.

[b] Includes recyclable waste.

Source: Section 4.3.1.10; Section 4.3.2.10; Section 4.3.4.2.10; Section 4.3.5.1.10.

4.8 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Siting, construction, and operation of facilities for both the long-term storage and disposition of weapons-usable fissile materials at Hanford, NTS, INEL, Pantex, ORR, and SRS, and for disposition facilities evaluated at generic sites would result in some unavoidable environmental impacts. The impact assessment conducted in this PEIS has identified potential impacts, along with mitigation measures that could be implemented to minimize them. The impacts that would remain following mitigation actions are unavoidable; the potential impacts of all alternatives at all sites are discussed below.

Land

At each of the long-term storage analysis sites, up to 87 ha (215 acres) of land would be required during operation of the collocated storage facilities, including necessary supporting infrastructure and access roads. This requirement would represent a maximum of about 2 percent of the total land of any site. Construction and operation of some long-term storage facility alternatives at ORR and SRS would change the VRM classification from Class 4 to Class 5. This change would affect some key viewpoints with high sensitivity levels at ORR.

Under the disposition alternatives, up to 57 ha (141 acres) of land would be required during operation of the deep borehole disposition complex, with necessary supporting infrastructure and access roads. If sited at a generic location, additional land area for a 1.6-km (1-mi) buffer zone could be required. At least 142 ha (350 acres) of land area would be required to operate the evolutionary LWR facilities (for one reactor unit only), including necessary supporting infrastructure and access roads. The potential facility location for the evolutionary LWR at ORR is not within the site boundary. The evolutionary LWR would change the VRM classification of several analyses sites from Class 3 or 4 to Class 5. Other potential actions would change the VRM classification of several analyses sites from Class 4 to Class 5. Cooling towers and other large stacks associated with the disposition facilities would impact visual resources through their physical structure and vapor plumes, which would be visible during certain atmospheric conditions. Construction and operation of some disposition alternatives at ORR would affect key viewpoints with high sensitivity levels.

Site Infrastructure

There would be minor unavoidable impacts anticipated for site infrastructure for long-term storage or disposition activities.

Air Quality and Noise

Air pollutant concentrations would increase slightly or remain the same during construction and operation for long-term storage and disposition activities; however, during construction and operation the sites are expected to be in compliance with Federal, State, and local ambient air quality regulations or standards.

Water

Under the storage alternatives, the maximum amount of groundwater withdrawn would be approximately 190 million l/yr (50.2 million gal/yr) at NTS for the modify P-Tunnel option of the Collocation Alternative. This would represent a 7.9-percent increase over the projected No Action water use, representing 0.5 percent of the minimum estimated recharge.

Under the disposition alternatives, the maximum amount of groundwater withdrawn would be approximately 341 million l/yr (90 million gal/yr) at NTS, INEL, Pantex, and SRS for the evolutionary LWR. At Pantex, the amount of water withdrawal would result in minor drawdowns of the Ogallala Aquifer in the area. Total site groundwater withdrawal would be less than what is currently being withdrawn from the Ogallala Aquifer for industrial use at Pantex.

Geology and Soils

For long-term storage and disposition alternatives, soil erosion resulting from wind and stormwater runoff in disturbed areas would occur.

Biological

For long-term storage and disposition alternatives, federally listed threatened or endangered species, such as the desert tortoise and bald eagle, could be affected directly or by disruptions to foraging, breeding, and nesting habits during construction and operation of facilities. Several candidate or State-listed animal species and special status plant species could also be affected at different sites. While such disruptions may be unavoidable, appropriate measures could be implemented and monitored to ensure that any impacts would not be irreversible. Construction of new facilities would have some unavoidable impacts on animal populations. Larger animals and birds would move to similar habitats nearby if the habitats could sustain them, while less mobile animals within the disturbed areas, such as amphibians, reptiles, and small mammals, would not be expected to survive.

Clearing and grading operations could result in the direct loss of wetlands, although proper placement of the facility within the overall site would eliminate or reduce the potential for such loss. Where direct loss is unavoidable, mitigation measures would be developed.

Cultural Resources

Some NRHP-eligible prehistoric and historic resources may exist within the area to be disturbed at any potential long-term storage or disposition site. The appropriate SHPO and the Advisory Council on Historic Preservation would be consulted to minimize unavoidable impacts. Native American resources could be unavoidably affected by land disturbance, audio or visual intrusions on Native American sacred sites, or by reduced access to traditional use areas, or theft or vandalism. DOE would consult with the affected tribes to minimize any impacts. Paleontological resources could exist within acreage disturbed during construction of facilities. Construction activities would be monitored by a paleontologist to minimize any impacts to scientifically important paleontological materials.

Socioeconomics

Construction and operation of the long-term storage and disposition facilities at some sites could lead to increases in regional population, which would have an impact on the surrounding jurisdictions. For some alternatives, the additional population would increase the demand for community services including education, public safety, and health care. However, at none of the sites analyzed would the increase in demand exceed the capacity of the affected communities to provide these services. Implementing these proposed alternatives would increase traffic on the roads leading into some of the sites analyzed. The resulting increases in traffic congestion and accidents would be unavoidable and could require upgrading the affected roads to accommodate increase traffic and minimize accidents.

Public Safety and Health

During the normal operation of any of the storage facilities, there would be radiological releases to the environment and to workers. The largest increase in radiation dose to the MEI from annual storage operations would result from the collocated storage facilities at ORR. The dose to the MEI would be 4.5×10^{-5} mrem/yr and the associated risk of fatal cancer from the 50 year period of storage operations would be 1.1×10^{-9}. This same new facility operating at ORR would also result in the largest increase in dose to the population within 80 km (50 mi) of any site from annual storage operations. The dose to the ORR populations would be 8.7×10^{-4} person-rem/yr; in 50 years of storage operations, 2.2×10^{-5} excess fatal cancers could occur in this population. The largest increase in dose to the involved workforce from annual new storage operations would

result from operation of the modified FMEF Pu storage facility at Hanford. The dose to this workforce would be 52 person-rem/yr; in 50 years of storage operations, one fatal cancer could occur in the workforce.

Hazardous and toxic chemicals would be present during construction and operation of the long-term storage facilities. Worker exposure to these chemicals would be unavoidable. The HI from the facility to the MEI for collocation at Pantex would be 2.0×10^{-4} and for collocation at ORR the cancer risk would be 1.6×10^{-7}. The HI from the facility to the onsite worker for collocation at INEL would be 1.9×10^{-3} and for modifying the P-Tunnel for consolidation or collocation at NTS the cancer risk would be 6.4×10^{-6}.

During the normal operation of any of the disposition facilities, there could also be radiological releases to the environment and to workers. The largest increase in radiation dose to the MEI from annual disposition operations would result from the operation of the evolutionary LWR at ORR. The dose to the MEI from a single evolutionary LWR would be 4.9 mrem/yr, and the associated risk of fatal cancer from the projected 17-year period of reactor operation would be 4.1×10^{-5}. The largest increase in dose to the population within 80 km (50 mi) of any site from annual disposition operations would be 32 person-rem from operation of a large evolutionary LWR at SRS; in the 17-year operational period, 0.27 excess fatal cancers could occur in this population from total site operations. The largest increase in annual dose to the workers from disposition operations would result from operation of the partially completed LWR. The dose to the involved workforce would be 380 person-rem/yr; in the projected 17-year period of operation of this reactor, 2.5 excess fatal cancers could result in the workforce.

Hazardous and toxic chemicals would be present during construction and operation of the disposition facilities. Worker exposure to these chemicals would be unavoidable. The HI from the ceramic immobilization facility to the MEI for the Ceramic Immobilization Alternative at Pantex and ORR would be 1.5×10^{-2} and the cancer risk for the Pu conversion facility at ORR would be 1.9×10^{-7}. The HI from the deep borehole complex to the onsite worker for the Direct Disposition Alternative would be 0.29 and the cancer risk for the Pu conversion facility at ORR would be 1.5×10^{-5}.

Waste Management

Construction and operation of long-term storage facilities would affect existing waste management activities by increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Increased hazardous wastes would require additional shipments to RCRA-permitted treatment and disposal facilities. Increased TRU waste would require new or expanded above-grade storage facilities and additional shipments to WIPP (depending on decisions made in the ROD associated with the supplemental EIS being prepared for the continued phased development of WIPP for disposal of TRU waste). The increased LLW for the Consolidation or Collocation Alternatives could require additional engineered trenches or vaults at some candidate sites. Generation of additional nonhazardous wastes could require the expansion of existing or construction of new liquid and solid waste treatment facilities, or could reduce the lifetimes of existing solid waste landfills.

Construction and operation of disposition facilities would affect existing waste management activities by increasing or initiating the generation of spent nuclear fuel for the reactor alternatives, and increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes for all disposition facilities with the exception of the existing LWR site. The deep borehole complex would require the construction of waste treatment and storage facilities. Construction of new or expansion of existing spent fuel storage facilities would be required at all sites for the reactor alternatives. Increased TRU waste would require new or expanded radwaste treatment facilities and above-grade storage facilities at some sites. Additional shipments to WIPP (depending on decisions made in the ROD associated with the supplemental EIS being prepared for the continued phased development of WIPP for disposal of TRU waste) would be required at all sites. Increased LLW would require additional LLW shipments from Pantex to NTS (assuming Pantex would continue the current practice of shipping LLW to NTS) and could require additional engineered trenches or vaults at some candidate sites. Increased mixed waste could require expansion of treatment capability developed at each of the

sites as reflected in the individual site treatment plans which were developed to comply with the *Federal Facility Compliance Act*. Additional or expanded RCRA-permitted staging or storage areas would be required at the generic MOX facility and some of the representative sites. Construction of new or expansion of existing sanitary, utility, and process wastewater treatment systems would be required for alternatives where the increase waste stream volumes exceed the capacity. For those sites that would discharge to a publicly-owned treatment works, such as the partially completed LWR, expansion of pretreatment systems may be required. Generation of additional solid nonhazardous wastes could reduce the expected lifetimes of current solid waste landfills.

Transportation

Existing facilities would be used for continued storage, which is the baseline case to which the transportation impacts for other alternatives is compared. Under No Action for storage and disposition, there would be no transportation of materials, and thus no transportation risks incurred. For storage, the maximum total potential fatalities from the transportation of Pu and HEU would be 1.070 for the Collocation Alternative at Hanford. For disposition, the maximum total potential fatalities from the transportation of surplus Pu would be 5.65 for the Existing LWR, Partially Completed LWR, and Evolutionary LWR Alternatives.

4.9 AVOIDED ENVIRONMENTAL IMPACTS AND IMPACTS ON URANIUM INDUSTRIES

This section discusses the potential avoided environmental impacts from the reactor alternatives for disposition, which have not been addressed in previous sections. Avoided environmental impacts of using MOX fuel instead of traditional uranium fuel in LWR power plants are discussed in Section 4.9.1. The potential impacts from the reactor alternatives on the uranium mining and nuclear fuel cycle industries are analyzed in Section 4.9.1.4. Section 4.9.2 discusses the avoided environmental impacts of using MOX fuel in LWR power plants instead of fossil fuel power plants in the generation of electricity.

The analysis presented in this section is based on the assumption that all of surplus Pu would be used as MOX fuel. For the Preferred Alternative, as a result of implementing a multiple technology disposition strategy, for analysis purposes, approximately 70 percent of the surplus Pu would be fabricated into MOX fuel and used in existing reactors. Subsequently, the avoided environmental impacts from the Preferred Alternative would be 70 percent of the respective avoided impacts presented in this section.

Potential avoided health impacts due to the use of MOX fuel in the CANDU reactors are not presented. Avoided health impacts beyond the U.S. borders are not required to be analyzed. If the CANDU reactors were selected as part of a multilateral agreement among Russia, Canada, and the United States, subsequent tiered NEPA review would be conducted.

4.9.1 USE OF MIXED OXIDE FUEL INSTEAD OF TRADITIONAL LOW-ENRICHED URANIUM FUEL IN NUCLEAR POWER PLANTS

For the Preferred Alternative, surplus Pu would be converted to MOX fuel for use in existing commercial nuclear power plants. In this alternative, part of the current nuclear fuel cycle in the existing commercial nuclear power plants would be replaced. In the United States, the uranium nuclear fuel cycle for commercial nuclear power plants is normally considered to begin with mining uranium ore and end with the disposal of the final radioactive wastes. The typical uranium fuel cycle for LWRs without spent fuel reprocessing in the United States is illustrated in Table 4.9.1–1. The MOX fuel cycle steps for proposed reactor alternatives are also listed in Table 4.9.1–1 for comparison. The pit disassembly/conversion process would replace the current uranium fuel cycle steps from uranium ore mining through uranium enrichment (steps 1 through 4 in Table 4.9.1–1). The nuclear fuel fabrication and burning in reactors would also be slightly different.

Table 4.9.1–1. Comparison of Uranium Fuel and Mixed Oxide Fuel Cycles

Step	Uranium Fuel Cycle	MOX Fuel Cycle
1	Uranium mining	Pit disassembly/conversion
2	Uranium milling	NA
3	Uranium conversion	NA
4	Uranium enrichment	NA
5	Uranium preparation and uranium fuel element fabrication	Uranium preparation and MOX fuel element fabrication
6	Nuclear power plants fueling–burning in the reactor	Nuclear power plants fueling–burning in the reactor
7	Spent fuel storage	Spent fuel storage

Note: NA=not applicable.

This section discusses the avoided environmental impacts of using the MOX fuel in existing LWRs. For the Existing LWR Alternative, the avoided environmental impacts would be due to the substitution of the MOX fuel for LEU (UO_2) fuel in LWRs. The existing LWRs are already in operation, and substitution of MOX fuel for uranium fuel may avoid some human health and environmental impacts.

4.9.1.1 Avoided Radiological Human Health Impacts

In the LWR uranium fuel cycle, contributors to the potential impacts on human health and the environment include uranium mining, uranium milling, and uranium conversion (from triuranic octaoxide [U_3O_8] to uranium hexafluoride [UF_6]). The other nuclear fuel cycle processes (enrichment plants, fuel fabrication plants) have considerably lower radioactive emissions than previous steps of the fuel cycle (mining, milling, and conversion). A summary of the atmospheric emissions of radioactive materials from the uranium fuel cycle and the MOX fuel cycle is shown in Table 4.9.1.1–1. Radioactive materials released into any liquid effluent are considerably less than the atmospheric emission and are not addressed.

By replacing the current uranium fuel cycle with MOX fuel, the uranium mining, milling, conversion, and enrichment are eliminated. As a result, the potential impacts to human health and the environment in the uranium fuel cycle process are reduced. Although the pit disassembly/conversion and MOX fuel fabrication processes create other impacts to the workers and public, the magnitude of these impacts are smaller than those of the uranium mining, milling, and conversion processes. Tables 4.9.1.1–2 and 4.9.1.1–3 compare the potential radiological impacts to the public and involved workers respectively, between the current fuel cycle process and the proposed MOX fuel cycle in existing LWRs.

For the general public within 80 km (50 mi), the expected latent cancer fatalities (LCFs) per year of operation would be 2.1×10^{-2} to 3.4×10^{-2} for the current uranium fuel cycle process and 2.7×10^{-5} to 1.4×10^{-2} for the proposed MOX fuel cycle burning in the two full MOX core existing LWRs. The avoided LCFs to the public then are 0.020 per year due to the substitution of MOX fuel for uranium fuel in LWRs. The total avoided LCFs for the public over the lifetime of the project (17 years) then would be 0.34, which represents the lower bounds of avoided health impact. For the Existing LWR Alternative, it would need three to five reactors that operate with the partial MOX core over their operating lifetime, which is equivalent to the two full core LWRs. Also the Preferred Alternative would dispose of the 70 percent of the surplus Pu in the existing reactors. Therefore, for the Preferred Alternative, the avoided impacts would be 0.24 LCFs for the general public.

For the involved workers, the expected LCFs per year of operation are 0.92 to 1.3 for the current uranium fuel cycle and 0.21 to 0.55 for the proposed MOX fuel cycle in existing LWRs. The avoided LCFs for the involved workers then are 0.75 per year due to the substitution of MOX fuel for uranium fuel in LWRs. The total avoided LCFs to the involved workers over the lifetime of the project (17 years) then are about 13. The Existing LWR Alternative would need three to five reactors that operate with the partial MOX core over their operating lifetime, which is equivalent to the two full core LWRs. For the Existing LWR Alternative, for analysis purposes, 70 percent of the surplus Pu was assumed to be used in existing LWRs. Therefore, for the Existing LWR Alternative, the avoided impacts would be 9.1 latent cancer fatalities for the involved workers.

[Text deleted.]

4.9.1.2 Avoided Air Quality Impacts

Ambient air quality can be affected by emissions of pollutants from the current fuel cycle process and the proposed Pu disposition facilities. The pollutants from the current fuel cycle come from the uranium mining, milling, conversion, and enrichment processes. The pollutant emissions are also from the fossil-fuel power plant that supply the electric power for the current uranium fuel cycle, mainly the uranium enrichment process. By replacing the current fuel cycle with MOX fuel, the uranium fuel enrichment process is eliminated. Thus, the fossil-fuel power that supplies the electric power to the uranium enrichment facility would not be needed. Table 4.9.1.2–1 compares the pollutant air emissions between proposed processes from Pit disassembly/conversion through MOX fuel fabrication and the fossil fuel power plant that supplies the electric power for the current uranium fuel cycle. The comparison shows that pollutant emissions from the current fuel cycle are higher than the potential emissions from the proposed MOX fuel fabrication process.

Table 4.9.1.1–1. Comparison of Radionuclide Atmosphere Emissions

Source	Principal Radionuclide	Emission Rate[a] (Ci/yr)	
		Current Fuel Cycle[b]	MOX Fuel Cycle
Uranium mines	Rn-222	1,200	NA
Uranium mills and mill tailing	Pb-210	1.3×10^{-2}	NA
	Po-210	1.3×10^{-2}	NA
	Rn-222	752	NA
	Ra-226	1.3×10^{-2}	NA
	Th-230	1.4×10^{-2}	NA
	U-234	2.6×10^{-2}	NA
	U-238	2.6×10^{-2}	NA
Uranium conversion	Ra-226	1.7×10^{-6}	NA
	Rn-222	0.23	NA
	Th-234	2.1x10-3	NA
	Pa-234m	2.1×10^{-3}	NA
	Th-230	2.4×10^{-5}	NA
	U-234	2.1×10^{-3}	NA
	U-235	5.1×10^{-5}	NA
	U-238	2.1×10^{-3}	NA
Uranium enrichment	Tc-99	1.7×10^{-3}	NA
	U-234	5.0×10^{-3}	NA
	U-235	2.2×10^{-4}	NA
	U-236	9.2×10^{-6}	NA
	U-238	5.0×10^{-3}	NA
Pit disassembly/conversion	Pu-238	NA	4.2×10^{-7}
	Pu-239	NA	4.3×10^{-5}
	Pu-240	NA	1.0×10^{-5}
	Pu-241	NA	3.2×10^{-5}
	Pu-242	NA	2.9×10^{-10}
	Am-241	NA	1.7×10^{-5}
Fuel fabrication	U-232	NA	1.3×10^{-7}
	U-234	2.1×10^{-4}	3.2×10^{-8}
	U-235	7.1×10^{-6}	6.2×10^{-10}
	U-236	1.1×10^{-5}	NA
	U-238	2.7×10^{-5}	4.8×10^{-8}
	Pu-238	NA	7.9×10^{-7}
	Pu-239	NA	2.9×10^{-5}
	Pu-240	NA	7.6×10^{-6}
	Pu-241	NA	2.7×10^{-5}
	Pu-242	NA	1.1×10^{-9}
	Am-241	NA	1.4×10^{-7}

Table 4.9.1.1–1. Comparison of Radionuclide Atmosphere Emissions—Continued

Source	Principal Radionuclide	Emission Rate[a] (Ci/yr)	
		Current Fuel Cycle[b]	MOX Fuel Cycle
Fuel fabrication (continued)	Th-231	7.1×10^{-6}	NA
	Th-234	2.7×10^{-5}	NA
	Pa-234	2.7×10^{-5}	NA

[a] The emissions are based on the assumption that two full MOX core equivalent large LWRs (about 2.0 GWe) are needed for Pu disposition. For the Existing LWR Alternative, it would need three to five existing LWRs. These three to five LWRs would operate with the partial or full MOX core over their operating lifetime, which is equivalent to the two full MOX core LWRs. For the Existing LWR Alternative, for analysis purposes, 70 percent of the surplus Pu was assumed to be used in existing LWRs. As a result, the campaign length would be reduced. However, since the comparison in this table is based on the annual emissions, it is independent of the number of years of operation for the Pu disposition.

[b] The radionuclide emissions given are for the model facilities. The emissions are adjusted according to the 2.0-GWe power output for two large LWRs (EPA 1979a; TTI 1996c).

Note: NA=not applicable.

Source: EPA 1979a; Table M.2.3.1–2.

Table 4.9.1.1–2. Comparison of Potential Radiological Human Health Impacts to the General Public

Fuel Cycle Process	Current Fuel Cycle[a]	MOX Fuel Cycle[a]
Uranium mining (LCF/yr)	1.2×10^{-2}	NA
Uranium milling (LCF/yr)	8.0×10^{-3}	NA
Uranium conversion (LCF/yr)	4.6×10^{-4}	NA
Pit disassembly/conversion[b] (LCF/yr)	NA	1.5×10^{-7}-6.0×10^{-5}
Fuel fabrication[c] (LCF/yr)	2.0×10^{-5}	7.1×10^{-8}-2.4×10^{-5}
Fuel burning in LWRs[d] (LCF/yr)	2.0×10^{-5}-2.4×10^{-3}	2.2×10^{-5}-2.0×10^{-3}
Total (LCF/yr)	2.1×10^{-2}-2.3×10^{-2}	2.7×10^{-5}-2.1×10^{-3}
Total (LCF/campaign[e])	0.36-0.39	0.00037-0.036

[a] Ranges of human health impacts in represent the health effects from different sites analyzed in the PEIS. No data for uranium enrichment are presented because of its minimal contribution to health impacts compared to other fuel cycle steps.

[b] See Table 4.3.1.9–1.

[c] See Table 4.3.5.1.9–1 for MOX Fuel Cycle. The LCFs for the current fuel cycle are adjusted for 2 large LWRs for consistency with risk estimators used in this PEIS (EPA 1979a; TTI 1996c).

[d] See Table 4.3.5.2.9–1.

[e] The impacts in this table are based on the assumption that two full core-equivalent large LWRs (about 2.0 GWE) are needed for Pu disposition in 17 years for all surplus Pu. For the Existing LWR Alternative, it would need three to five existing LWRs. These three to five LWRs would operate with the partial MOX core over their operating lifetime, which is equivalent to the two full-core LWRs. For the Existing LWR Alternative, for analysis purposes, 70 percent of the surplus Pu was assumed to be used in existing LWRs. As a result, the campaign length would be reduced.

Note: NA=not applicable.

Table 4.9.1.1–3. Comparison of Potential Radiological Human Health Impacts to Workers

Fuel Cycle Process	Current Fuel Cycle[a]	MOX Fuel Cycle[a]
Uranium mining (LCF/yr)	0.38	NA
Uranium milling (LCF/yr)	0.30	NA
Uranium conversion (LCF/yr)	0.0018	NA
Pit disassembly/conversion[b] (LCF/yr)	NA	0.034
Fuel fabrication[c] (LCF/yr)	0.10	0.012
Fuel burning in LWRs[d] (LCF/yr)	0.14-0.48	0.14-0.48
Total (LCF/yr)	0.92-1.3	0.19-0.53
Total (LCF/campaign)[e]	16-22	3.2-8.9

[a] Ranges of human health impacts represent the health effects from different sites analyzed in the PEIS. No data for uranium enrichment are presented because of its minimal contribution to health impacts compared to other fuel cycle stops.

[b] See Table 4.3.1.9–2.

[c] See Table 4.3.5.1.9–2 for MOX Fuel Cycle. The LCFs for the current fuel cycle are adjusted for 2 large LWRs for consistency with risk estimators used in this PEIS (NRC 1987d; TTI 1996c).

[d] See Table 4.3.5.2.9–2.

[e] The impacts in this table are based on the assumption that two full core-equivalent large LWRs (about 2.0 GWE) are needed for Pu disposition in 17 years for all surplus Pu. For the Existing LWR Alternative, it would need three to five existing LWRs. These three to five LWRs would operate with the partial MOX core over their operating lifetime, which is equivalent to the two full-core LWRs. For the Existing LWR Alternative, for analysis purposes, 70 percent of the surplus Pu was assumed to be used in existing LWRs. As a result, the campaign length would be reduced.

Note: NA=not applicable.

Table 4.9.1.2–1. Comparison of Potential Emission Rates of Criteria Pollutants

Pollutant	Current Fuel Cycle[a] (kg/yr)	MOX Fuel Cycle[b] (kg/yr)
Carbon monoxide (CO)	59,000	NA
Nitrogen dioxide (NO_2)	2,400,000	NA
Ozone (O_3)	NA	NA
Particulate matter (PM_{10})	2,300,000	NA
Sulfur dioxide (SO_2)	8,800,000	NA
Total suspended particulate (TSP)	NA	NA
Volatile organic compounds (VOC)	NA	2,500

[a] The emissions from a supporting coal power plant are derived from the NRC regulations (10 CFR 51 Table S-3). The original numbers in the NRC document are for 1-GWe LWRs. The numbers shown in the table are adjusted for 2-GWe LWRs.

[b] Emissions from the MOX fuel cycle are the sum of the emissions from pit disassembly/conversion and MOX fuel fabrication. See Tables F.1.3–4 and F.1.3–6. The MOX fuel burning in existing LWRs would not cause incremental pollutant air emissions over the current uranium fuel cycle. See Table F.1.3–12.

Note: NA=not available.

4.9.1.3 Other Avoided Environmental Impacts

In addition to reducing potential radiological human health and air quality impacts, fabricating the surplus weapons-usable Pu into MOX fuel for use in existing LWRs would cause other positive environmental impacts. The following positive impacts can be qualitatively stated:

- *Land Resources.* Reduced land disturbance from mining operations.
- *Water Resources.* Reduced impacts to water quality are expected since no mining and mill tailing would be produced, which allows surface runoff or leaching (mine drainage) to occur.

- *Waste Generation.* The total wastes generated by the MOX fueling process (including the pit disassembly/conversion, MOX fuel fabrication, and MOX fuel burning in existing LWRs) would be less than the total wastes generated by the uranium mining, milling, conversion, enrichment, fuel fabrication, and UO_2 fuel burning in existing LWRs.

4.9.1.4 Impacts on Uranium Mining and Nuclear Fuel Cycle Industries

Among the disposition alternatives evaluated in the PEIS, only the reactor alternatives (which would use MOX fuel instead of uranium fuel) could potentially affect the domestic nuclear fuel cycle industry. However, of the four reactor options evaluated in the PEIS (that is, using CANDU reactors, completing a partially built LWR, constructing a new evolutionary LWR, and use of existing LWRs), only using MOX fuel in the existing domestic LWR alternative would likely have any impact on the domestic nuclear fuel cycle industry. By using MOX fuel instead of fuel derived solely from LEU, this reactor alternative could potentially displace some demand for uranium feed products and services.

The CANDU Alternative would have no impact on U.S. uranium and nuclear fuel industries, because Canadian firms currently supply all of the nuclear fuel services and products required by that country's nuclear reactors. Canadian nuclear fuel is derived from Canadian uranium and is converted and fabricated by Canadian companies (CANDU reactors do not require enrichment services). Therefore, the only potential economic impacts would be to Canadian firms rather than U.S. producers. Producing MOX fuel would require significant quantities of depleted uranium, which comprises 97 to 98 percent of MOX feed material. However, the large DOE surplus inventory of depleted uranium would assure that this demand could be easily accommodated.[3]

The construction of an evolutionary LWR or the partially completed LWR could have some impact on the nuclear fuel cycle industries, although the magnitude of the impact would be highly uncertain. The impact from adding a new nuclear reactor as a source of electricity to the national power grid would depend on several factors, including whether:

- The new evolutionary LWR would be supplying power to meet new demand for electricity or supplanting supply from an existing reactor.

- The MOX-fueled plant would otherwise have been a uranium-fueled plant.

If the new power plant were to supplant existing commercial electricity supply from LWRs conventional uranium fuel, then it is possible that uranium demand could decrease. However, this scenario would be unlikely, because during the life cycle of any plant that would be brought on line, many of the currently operating nuclear power plants are expected to be retired. In fact, the EIA projects that between 1994 and 2015, nuclear power generation capacity will decline by 32 percent due to plant retirement. Furthermore, no new reactors are expected to come online before 2015. Electricity demand growth during this period is expected to be met through the construction of new fossil fuel plants, cogeneration, increased energy efficiency, and demand management. Therefore, it is unlikely that the construction of an evolutionary LWR or the completion of a partially built LWR would alter future demand for uranium, uranium enrichment services, or fuel fabrication from the No Action alternative.

The use of MOX fuel in existing domestic nuclear power plants would likely affect the demand for nuclear fuel services. Under this alternative, MOX fuel would be substituted for uranium fuel. If 2 to 3 t (2.2 to 3.3 tons) of Pu (93-percent enriched) per year were converted to MOX fuel and employed in nuclear reactors, approximately 730 to 1,100 t (805 to 1,213 tons) of U_3O_8 would be displaced per year. Because projections indicate that U.S. production of uranium fuel would only supply about 20 percent of domestic needs during the plant's life cycle (2004-2029), much of the impact projected on uranium fuel production would be borne by foreign producers.

[3] DOE is currently developing an EIS for the management of depleted UF_6

Based on current market shares, the MOX fuel could displace from 145 to 218 t/yr (160 to 240 tons/yr) of U.S. uranium oxide production. This compares to EIA projections that domestic uranium oxide production will reach approximately 4,000 t (4,409 tons) in 2005. Although the actual impacts would depend on the state of the uranium market during the nuclear power plant's lifetime, the use of MOX fuel should not have a significant impact on domestic production.

The impacts on uranium conversion, enrichment, and fabrication services would be similar to the impacts on the uranium mining and milling industries. The MOX fuel could displace a small percentage of these services, but the actual impacts are likely to be small. For example, the uranium conversion sector has recently experienced a much stronger market with large price increases over the past few years. This sector is projected to operate at almost full capacity into the foreseeable future. The impacts on the fabrication industry would likewise by small. The throughput rate of 51 to 73 t (56 to 80 tons) of heavy metal per year (depending on the type of reactor used), would represent less than one percent of current U.S. capacity.

It should be noted that the potential impacts described above would occur over the same timeframe as other DOE actions projected to affect the domestic uranium mining and nuclear fuel cycle industries. As, discussed in the HEU Final EIS, the disposition of U.S. surplus HEU and the purchase of Russian surplus HEU are projected to create only small and temporary economic impacts on the domestic uranium mining nuclear fuel cycle industries. Similarly, the sale of surplus natural and LEU currently stored at DOE's gaseous diffusion plants in Piketon, OH and Paducah, KY is expected to have minimal impact on these industries because of the small quantities and the protections provided by the *United States Enrichment Corporation Privatization Act* (DOE 1996s:4-33–4-36). The incremental impacts of using MOX fuel would be small, as would the cumulative impacts of these actions.

4.9.2 USE OF NUCLEAR POWER PLANTS INSTEAD OF FOSSIL FUEL POWER PLANTS

For the proposed Partially Completed and Evolutionary LWR Alternatives, the surplus Pu would be converted to MOX fuel for use in these power plants. Completing or building such nuclear power plants would create net environmental impact over existing conditions. The incremental environmental impacts from the Partially Completed LWR Alternative and the Evolutionary LWR Alternative have been analyzed and presented in Sections 4.3.5.3 and 4.3.5.4, respectively. This section discusses the potential avoided environmental impacts from these two alternatives.

According to the energy consumption projection for the next two decades, 252 gigawatts of new generating capacity will be needed between 1994 and 2015 to satisfy electricity demand and to replace retiring units (EIA 1996a:28). According to the same projection, new power plant constructions will be dominated by coal-fired and natural gas-fired power plants. Although the goal of all alternatives in the Pu disposition program is to dispose of the surplus weapon-usable Pu, the Partially Completed and Evolutionary LWR alternatives do generate electricity. If these alternatives are selected, the required new capacity for the coal-fired or natural gas-fired power plants could be reduced by the same capacity as the partially completed or evolutionary LWR using MOX fuel.

Comparing the coal-fired or natural gas-fired power plants, partially completed or evolutionary LWRs may have positive and negative impacts to the environment. Complete comparisons of the environmental impacts between the proposed partially completed or evolutionary LWRs and the coal-fired or natural gas-fired power plants are beyond the scope of this PEIS. The primary potential avoided impact for these alternatives is the impacts to ambient air quality in the area surrounding the facilities.

Ambient air quality can be affected by emissions of criteria pollutants from the coal-fired and natural gas-fired power plants, and the proposed Pu disposition facilities. More pollutant emissions from a facility poses more environmental impact. Table 4.9.2–1 compares the pollutant air emissions between the MOX fueling process using the partially completed LWR and the fossil fuel power plant that supplies the same amount of the electric power. The MOX fueling process using the Partially Completed LWR Alternative includes pit disassembly/conversion, MOX fuel fabrication, and MOX fuel burning. The comparison shows that almost all criteria pollutant emissions from the coal-fired power plants are much higher than the potential emissions from the proposed partially completed LWR with MOX fuel. Comparing the gas fired power plants, some of pollutants are emitted more from the proposed partially completed LWR using MOX fuel and some pollutants are emitted less. This comparison shows that the impact to the ambient air quality would be reduced if the surplus weapons-usable Pu is utilized as MOX fuel in the partially completed LWR to replace new construction of coal-fired power plants. However, it cannot be concluded that using MOX fuel in partially completed LWRs results in a positive environmental impact over the natural gas-fired power plants.[4]

Table 4.9.2–2 compares the pollutant air emissions between the proposed MOX fueling process using evolutionary LWRs and the fossil fuel power plant that supplies the same amount of the electric power. The MOX fueling process using the evolutionary LWR alternative includes pit disassembly/conversion, MOX fuel fabrication, and MOX fuel burning. The comparison shows that almost all criteria pollutant emissions from the coal-fired power plants are much higher than the potential emissions from evolutionary LWRs using MOX fuel. Comparing the gas-fired power plants, some pollutants are emitted more from evolutionary LWRs with MOX fuel and some pollutants are emitted less. This comparison shows that the impact to the ambient air quality would be reduced if the surplus weapons-usable Pu is utilized as fuel in the evolutionary LWRs to replace new construction of the coal and natural gas power plants.

[4] Use of the partially completed LWR or evolutionary LWR would create additional spent nuclear fuel.

Table 4.9.2–1. Comparison of Potential Emission Rates of Criteria Pollutants Between the Mixed Oxide Fuel Cycle Using Partially Completed Light Water Reactors and Conventional Power Plants

Pollutant	Coal Fired Plant[a] (kg/yr)	Natural Gas Fired Plant[b] (kg/yr)	MOX Fueled Nuclear Plant[c] (kg/yr)
Carbon monoxide	2,800,000	NA	81.6
Nitrogen dioxide	42,000,000	2,000,000	228,000
Ozone	NA	NA	NA
Particulate matter less than or equal to 10 microns in diameter	2,200,000	NA	17,500
Sulfur dioxide	42,000,000	24,000	171,000
Total suspended particulate	2,200,000	NA	17,500
Volatile organic compounds	NA	12,000[d]	2,500

[a] The original numbers in the NRC document are for a 1-GWe LWR (NRC 1987d: Table 17). The numbers shown in the table are adjusted for 2-GWe LWRs.

[b] The natural gas boiler is assumed to be the "controlled-flue gas recirculation" utility type, which has lowest air emissions listed in the EPA report (EPA 1995a).

[c] Emissions from the MOX fuel cycle are the sum of the emissions from the pit disassembly/conversion, MOX fuel fabrication, and the MOX fuel burning in the partially completed LWRs. See Tables F.1.3–4, F.1.3–6, and F.1.3–13.

[d] Organic compounds from the natural gas-fired power plant include methane that comprises 17 percent of organic compounds (EPA 1995a). The VOC value presented here assumes that methane is the only VOC among the organic compounds from the gas fire emissions.

Note: NA=not available.

Table 4.9.2–2. Comparison of Potential Emission Rates of Criteria Pollutants Between the Mixed Oxide Fuel Cycle Using Evolutionary Light Water Reactors and Conventional Power Plants

Pollutant	Coal Fired Plant[a] (kg/yr)	Natural Gas Fired Plant[b] (kg/yr)	MOX Fueled Nuclear Plant[c] (kg/yr)
Carbon monoxide	2,800,000	NA	90
Nitrogen dioxide	42,000,000	2,000,000	5,260
Ozone	NA	NA	NA
Particulate matter less than or equal to 10 microns in diameter	2,200,000	NA	NA
Sulfur dioxide	42,000,000	24,000	900
Total suspended particulate	2,200,000	NA	NA
Volatile organic compounds	NA	12,000[d]	2,500

[a] The original numbers in the NRC document are for a 1-GWe LWR (NRC 1987d, Table 17). The numbers shown in the table are adjusted for 2-GWe LWRs.

[b] The natural gas boiler is assumed to be the "controlled-flue gas recirculation" utility type, which has lowest air emissions listed in the EPA report (EPA 1995a).

[c] Emissions from the MOX fuel cycle are the sum of the emissions from the pit disassembly/conversion, MOX fuel fabrication, and the MOX fuel burning in the evolutionary LWRs. See Tables F.1.3–4, F.1.3–6, and F.1.3–14.

[d] Organic compounds from the natural gas-fired power plant include methane that comprises 17 percent of organic compounds (EPA 1995a). The VOC value presented here assumes that methane is the only VOC among the organic compounds from the gas fire emissions.

Note: NA=not available.

4.10 RELATIONSHIP BETWEEN SHORT-TERM USES OF ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The use of land on any of the six candidate DOE sites being considered for storage and disposition facilities (Hanford, NTS, INEL, Pantex, ORR, and SRS) would enhance the long-term productivity on each site. In light of current reductions in the nuclear weapons stockpile, the lack of new weapons development or production, the moratorium on nuclear testing, and concerns about safety and reliability in the aging stockpile, DOE's Preferred Alternative is to, over time, phase out the RFETS existing storage facility, upgrade the Pantex, ORR, and SRS storage facilities for Pu and HEU storage, and to continue to use existing facilities at Hanford, INEL, and LANL. The reduction of Pu stockpile meets the U.S. nonproliferation policy. In addition, DOE proposes to modify existing or build new disposition facilities that will enhance the long-term use of the selected sites. The Preferred Alternative for disposition is a combination of using pit disassembly/conversion, Pu conversion, MOX fuel fabrication, and immobilization facilities.

Most storage and disposition alternatives would require the use of additional land. Such usage would remove this land from other beneficial uses. Disposal of solid nonhazardous waste generated from facilities construction and operations would require additional land at onsite sanitary landfills. Solid nonhazardous waste generated from these facilities would continuously require additional land at a sanitary landfill site that would be unavailable for other uses in the long term. LLW would require additional space for onsite storage and waste processing and would involve the commitment of associated land, transportation, processing facilities, and other disposal resources. Creation of land disposal facilities allows the site to be productive for the long-term by protecting the overall environment and complying with Federal and State environmental requirements.

Losses of terrestrial and aquatic species and habitats from natural productivity to accommodate new facilities and temporary disturbances required during construction are possible. Land clearing and construction activities resulting in large numbers of personnel and equipment moving about an area would disperse wildlife and temporarily eliminate habitats. Although some destruction would be inevitable during and after construction, these losses would be minimized by careful site selection, including environmental reviews at the site-specific level. In addition, short-term disturbances of previously undisturbed biological habitats from the construction of new facilities could cause long-term reductions in the biological productivity of an area. These long-term effects could occur, for example, at facilities located in arid areas of the western United States such as Hanford, NTS, and INEL, where biological communities recover very slowly from disturbances. Threatened and endangered species would have minimal impacts from the Preferred Alternative.[5]

[5] The range of the threatened desert tortoise lies in the southern third of NTS. Construction and operation of new facilities associated with the storage and disposition facilities have the potential to impact the federally listed threatened desert tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented with mitigation measures developed in consultation with USFWS.

4.11 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section describes the major irreversible and irretrievable commitments of resources that can be identified at this programmatic level of analysis. A commitment of resources is irreversible when its primary or secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of resources that would be neither renewable nor recoverable for later use by future generations.

The programmatic decisions resulting from this PEIS will commit the resources required for the new construction and renovation of storage and disposition facilities at various locations. This section discusses three major resource categories that would be committed irreversibly or irretrievably to the proposed actions: land, materials, and energy.

Land. Land that is currently occupied by or designated for storage or reactor-related disposition facilities could ultimately be returned to open space if buildings, roads, and other structures were removed, areas were cleaned up, and the land revegetated. Alternatively, some of the facilities could be modified for use in other DOE programs. Therefore, commitment of this land is not necessarily irreversible. However, land rendered unfit for other purposes, such as that set aside for radiological, hazardous and chemical waste disposal facilities or deep borehole emplacement, represents an irreversible commitment because wastes in below-ground disposal areas could not be completely removed nor could the site be feasibly used for any other purposes following closure of disposal or storage facilities. This land would be perpetually unusable because the substrata would not be suitable for potentially intrusive activities such as mining, utilities, or building foundations. However, the surface area appearance and biological habitat lost during construction and operation of the facilities could be restored to a large extent.

Materials. The irreversible and irretrievable commitment of material resources during the entire life-cycle of storage and disposition includes construction materials that could not be recovered or recycled, materials rendered radioactive that could not be decontaminated, and materials consumed or reduced to unrecoverable forms of waste. Where construction is necessary, materials required could include wood, concrete, sand, gravel, plastics, steel, aluminum, and other metals. Construction resources that could not be recovered and recycled with present technology would be irretrievably lost. However, none of these identified construction resources is in short supply, and all would be readily available in the vicinity of the candidate and representative sites.

Materials committed to the manufacture of new equipment that could not be recycled at the end of the project's useful lifetime would be irretrievable. Operating supplies, miscellaneous chemicals, and gases consumed during the operation of long-term storage and disposition facilities, while irretrievable, would not constitute a permanent drain on local resources or involve any material in critically short supply in the United States. Materials consumed or reduced to unrecoverable forms of waste, such as uranium, would also be irretrievably lost. Resources could be recycled. Plans to recover and recycle as much of these valuable, depletable resources as would be practical would depend on the need. Each resource would be individually considered at the time a recovery decision was required. The spent fuel generated by the reactor alternative would not be processed so as to recycle the LEU or Pu.

Energy. The irretrievable commitment of energy resources during construction and operations of the long-term storage and disposition facilities would include the consumption of fossil fuels used to generate heat and electricity for the sites. Energy would also be expended in the form of diesel fuel, gasoline, and oil for construction equipment and transportation vehicles. The energy required to operate the long-term storage and disposition facilities, quantified in the site infrastructure sections previously presented in this chapter, would be irretrievable.

Any decision to dispose of Pu represents an irretrievable commitment of a potential energy source. To protect against proliferation, all disposition alternatives are irreversible and the Pu is lost forever as a fuel resource.

4.12 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL OF THE VARIOUS ALTERNATIVES AND MITIGATION MEASURES

The proposed long-term storage and disposition alternatives would result in increased energy demands at the affected site or sites during the construction and operation phases. The anticipated energy requirements of all the alternatives would be within the supply capacities of the power grid that would serve its candidate or representative site. Fuel requirements would exceed the current site availability during operation at NTS, Pantex, ORR, and SRS for several of the alternatives, but can be accommodated through normal contractual means. For the Preferred Alternative, additional oil needed at SRS would be required and could be obtained through normal contractual means. Since Hanford, NTS, INEL, and SRS do not use natural gas, the facilities would have to be redesigned to burn fuel oil. Energy requirements would be subject to established conservation practices at the affected site.

Chapter 5
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Chapter 7
Glossary of Terms

Absorbed Dose: The energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest in that material. Expressed in units of radiation absorbed dose (rad) or grays, where 1 rad equals 0.01 gray. Also, see "Radiation Absorbed Dose."

Accident Sequence: An initiating event followed by system failures or operator errors, which can result in significant core damage, confinement system failure, and/or radionuclide releases.

Actinides: Radioactive elements with atomic number larger than 88 (that is, 89 or higher)

Action Description Memorandum: A document used in the DOE's NEPA process to facilitate a determination of the appropriate level of NEPA documentation for a proposed action.

Acute: Extremely severe or intense for a limited amount of time.

Acute Exposure: The exposure incurred during and shortly after a radiological release. Generally, the period of acute exposure ends when long-term interdiction is established, as necessary. For convenience, the period of acute exposure is normally assumed to end 1 week after the inception of a radiological accident.

Acute Standard: A numerical limit on the amount of a particular chemical contaminant that an organism may be exposed to over a short period of time.

Air Pollutant: Any substance in air which could, if in high enough concentration, harm man, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of matter capable of being airborne.

Air Quality Control Region (AQCR): An interstate area designated by the EPA for the attainment and maintenance of NAAQS.

Air Quality Standards: The level of pollutants in the air prescribed by regulations that may not be exceeded during a specified time in a defined area.

Alloy: A homogeneous mixture of two or more metals.

Alluvial Deposits: Deposits of earth, sand, gravel, and other materials carried by moving surface water and deposited at points of weak water flow.

Alluvium: A general term for all sedimentary accumulations that are deposited by surface water flow. Alluvium includes sediment laid down in riverbeds, flood plains, and alluvial fans.

Alpha Activity: The emission of alpha particles by fissionable materials (uranium or Pu).

Alpha Particle: A positively charged particle, consisting of two protons and two neutrons, that is emitted during radioactive decay from the nucleus of certain nuclides. It is the least penetrating of the three common types of radiation (alpha, beta, and gamma).

Alpha Wastes: Wastes containing radioactive isotopes which decay by producing alpha particles.

Alternative Option: A group of alternative pathways through a different specific set of facilities than that of the baseline or another option.

Ambient Air: The surrounding atmosphere as it exists around people, plants, and structures.

***American Indian Religious Freedom Act* of 1978:** This Act establishes national policy to protect and preserve for Native Americans their inherent right of freedom to believe, express, and exercise their traditional religions, including the rights of access to religious sites, use and possession of sacred objects, and the freedom to worship through traditional ceremonies and rites.

Anadromous: Fish that migrate from salt to fresh water to spawn.

***Anadromous Fish Conservation Act*:** This act seeks to enhance the conservation and development of the anadromous fishery resources of the United States that are subject to depletion from water resources development.

Anhydrous: Without water.

Anisotropic: Conditions where a physical phenomenon is oriented preferentially in a particular direction or on a particular axis. When the groundwater in a region moves north/south faster than it moves east/west, the groundwater movement is anisotropic.

Aquatic Biota: The sum total of living organisms within any designated aquatic area.

Aqueous Process: An operation involving chemicals dissolved in water.

Aquifer: A saturated geologic unit through which significant quantities of water can migrate under natural hydraulic gradients.

Aquitard: A less-permeable geologic unit in a stratigraphic sequence. The unit is not permeable enough to transmit significant quantities of water. Aquitards separate aquifers.

***Archaeological and Historic Preservation Act* of 1974:** This Act is designed to preserve historic and archaeological data that could be destroyed or compromised as the result of Federal construction or other Federally licensed or assisted activities.

***Archaeological Resources Protection Act* of 1979:** This Act serves to protect cultural resources on Federally owned lands. It requires a permit for archaeological excavations or removal of any archaeological resources located on public lands or Native American lands. It prohibits interstate or foreign trafficking of cultural resources taken in violation of state or local laws, and requires Federal agencies to develop plans for surveying lands under their control.

Archaeological Sites: Any location where humans have altered the terrain or discarded artifacts during either prehistoric or historic times.

Artifact: An object produced or shaped by human workmanship of archaeological or historical interest.

As Low as Reasonably Achievable (ALARA): A concept applied to the quantity of radioactivity released in routine operation of a nuclear system or facility, including "anticipated operational occurrences." It takes into account the state of technology, economics of improvements in relation to benefits to public health and safety, and other societal and economic considerations in relation to the use of nuclear energy in the public interest.

Atmospheric Dispersion: The process of air pollutants being dispersed in the atmosphere. This process occurs through wind movement that carries the pollutants away from their source. It is also due to turbulent air motion that results from solar heating of the Earth's surface and air movement over rough terrain and surfaces.

***Atomic Energy Act* (AEA) of 1954:** This Act was originally enacted in 1946 and amended in 1954. For the purpose of this PEIS "...a program for Government control of the possession, use, and production of atomic energy and special nuclear material whether owned by the Government or others, so directed as to make the maximum contribution to the common defense and security and the national welfare, and to provide continued assurance of the Government's ability to enter into and enforce agreements with nations or groups of nations for the control of special nuclear materials and atomic weapons..." (Section 3(c)).

Atomic Energy Commission: A five-member commission, established by the AEA of 1946, to supervise nuclear weapons design, development, manufacturing, maintenance, modification, and dismantlement. In 1974, the AEC was abolished and all functions were transferred to the NRC and the Administrator of the Energy Research and Development Administration. The Energy Research and Development Administration was later terminated and its functions vested by law in the Administrator were transferred to the Secretary of Energy.

Attainment Area: An area considered to have air quality as good as or better than the national ambient air quality standards as defined in the CAA. An area may be an attainment area for one pollutant and a non-attainment area for others.

Attribute: A measurable relevant characteristic of an option, such as public acceptability or technical risk.

Background Radiation: Ionizing radiation present in the environment from cosmic rays and natural sources in the Earth; background radiation varies considerably with location. Also, see "Natural Radiation."

Badged Worker: A worker equipped with an individual dosimeter who has the potential to be exposed to radiation.

***Bald and Golden Eagle Protection Act*:** This act states that it is unlawful to take, pursue, molest, or disturb the American bald and golden eagle, their nests, or their eggs, anywhere in the United States.

Basalt: The most common volcanic rock. Basalt is dark-gray to black in color, high in iron and magnesium, and low in silica. It is typically found in lava flows.

Base Requirement: The nuclear material quantity needed to support the nuclear weapons stockpile (new weapons builds, research and development, and tests) and other needs (nonweapons research and development, isotopic power devices, and commercial sales).

Baseline: A quantitative expression of conditions, costs, schedule, or technical progress to serve as a base or standard for measurement during the performance of an effort; the established plan against which the status of resources and the progress of a project can be measured. For this PEIS, the environmental baseline is the site environmental conditions as they are projected to occur in 2005.

Basin: For geology it is a circular or elliptical downwarp with younger beds in the center after erosion exposes the structure. For topography it is a depression into which the surrounding area drains.

BEIR V: Biological Effects of Ionizing Radiation; referring to the fifth in a series of committee reports from the National Research Council.

Benthic: Plants and animals dwelling at the bottom of oceans, lakes, rivers, and other surface waters.

Best Available Control Technology: A term used in the CAA that means the most stringent level of air pollutant control considering economics for a specific type of source based on demonstrated technology.

Beta Activity: The emission of beta particles by radioisotopes.

Beta Particle: An elementary particle emitted from a nucleus during radioactive decay; it is negatively or positively charged, identical in mass to an electron, and in most cases easily stopped, as by a thin sheet of metal.

Beyond Design Basis Accident: An accident, generally with more severe impacts to onsite personnel and the public than a DBA, initiated by operational or external causes with an estimated probability of occurrence less than 10^{-6} per year and used for estimating the impacts of a facility and/or process.

Biofouling: Aquatic organisms such as bacteria, fungi, algae, and mollusks, that colonize in waterflow structures (for example, cooling water systems of power plants/reactors), often causing restricted water flow.

Biological Dose: The radiation dose absorbed in biological material measured in rem or millirem (one-thousandth of a rem).

Biota (Biotic): The plant and animal life of a region.

Biotic Resources: Biotic resources include terrestrial resources, wetlands, and aquatic resources, and threatened and endangered species.

Boiling Water Reactor (BWR): A type of nuclear reactor that uses fission heat to generate steam in the reactor to drive turbines and generate electricity.

Borehole: A deep hole drilled below the water table and at least 2 km (1.2 mi) deep into ancient, geologically stable rock formations.

Bryozoa: A phylum consisting of various small aquatic animals that reproduce by budding and form colonies attached to stones or seaweed.

Burn: To consume in a reactor through fission.

Burnable Poison Rod: A nuclear reactor rod used to absorb excess neutrons in the core during the early core life. As the core life proceeds, the absorbing material is depleted ("burned"), reducing the absorptive power concurrent with the reduction in excess neutron production.

Calcareous: Containing calcium carbonate (for example, calcite or limestone).

Calcination: The process of converting high-level waste to unconsolidated granules or powder. Calcined solid wastes are primarily salts and oxides of metals (heavy metals) and components of high level waste (also called calcining).

Calcine: Drying of liquids or other material at high temperature (approximately 800° C) to drive off water and other volatile substances.

Caldera: A large crater formed by the collapse of the central part of a volcano.

Cancer: The name given to a group of diseases characterized by uncontrolled cellular growth with cells having invasive characteristics such that the disease can transfer from one organ to another.

Canadian Deuterium Uranium (CANDU) Reactor: A nuclear reactor in which circulating heavy water is used to cool the reactor core and to moderate (reduce the energy of) the neutrons created in the core by the fission reactions.

Canyon: A remotely operated, heavily shielded Pu or uranium processing facility.

Capable Fault: As defined in 10 CFR 100, Appendix A, III (g), a fault that has exhibited one or more of the following characteristics: (1) Movement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature within the past 500,000 years; (2) Macro-seismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault; (3) A structural relationship to a capable fault according to characteristics (1) or (2) such that movement on one could be reasonably expected to be accompanied by movement on the other. Notwithstanding the above, structural association of a fault with geologic structural features that are at least pre-Quarternary in use, in the absence of conflicting evidence, demonstrates that the fault is not a capable fault within this definition.

Capacity Factor: The ratio of the annual power production of a power plant to its rated capacity.

Carbon Adsorption: A physiochemical process in which organic and certain inorganic compounds in a liquid stream are absorbed on a bed of activated carbon; used in water or waste purification and chemical processing.

Carbon Dioxide (CO_2): A colorless, odorless, nonpoisonous gas that is a normal component of the ambient air; it is an expiration product of normal animal life.

Carbon Monoxide (CO): A colorless, odorless gas that is toxic if breathed in high concentration over a period of time.

Carolina Bay: Ovate, intermittently flooded depression of a type occurring on the Coastal Plain from New Jersey to Florida.

Cask (Radioactive Materials): A container that meets all applicable regulatory requirements for shipping spent nuclear fuel or HLW.

Cenozoic Era: A geologic era characterized by the dominance of advanced mollusks and mammals. The Cenozoic Era dates from 65 million years ago to the present.

Ceramic: For this PEIS, surplus Pu and other materials mixed to form a porcelain end product which has mineral phases similar to Synroc-C.

Cesium (Cs): A silver-white alkali metal. A radioactive isotope of cesium, Cs-137, is a common fission product.

Chemical Oxygen Demand: A measure of the quantity of chemically oxidizable components present in water.

Chronic: Lasting for a long period of time or marked by frequent recurrence.

Chronic Exposure: Low-level radiation exposure incurred over a long time period due to residual contamination.

Chronic Standard: A numerical limit on the amount of a particular chemical contaminant that an organism may be exposed to over an extended period of time. The allowable exposure concentration for the chronic standard is less than that of the acute standard.

Cladding: An external layer of material applied directly to nuclear fuel or other material to provide protection from a chemically reactive environment, to provide containment of radioactive products produced during the irradiation of the composite, or to provide structural support.

***Clean Air Act* (CAA):** This Act mandates and enforces air pollutant emissions standards for stationary sources and motor vehicles.

***Clean Air Act Amendments* of 1990:** Expands the EPA's enforcement powers and adds restrictions on air toxics, ozone depleting chemicals, stationary and mobile emissions sources, and emissions implicated in acid rain and global warming.

***Clean Water Act* (CWA) of 1972, 1987:** This Act regulates the discharge of pollutants from a point source into navigable waters of the United States in compliance with a NPDES permit as well as regulates discharges of dredge or fill material to waters of the United States including wetlands.

Climatology: The science that deals with climates and investigates their phenomena and causes.

Code of Federal Regulations (CFR): All Federal regulations in force are published in codified form in the CFR.

Cold Standby: Maintenance of a protected reactor condition in which the fuel is removed, the moderator is stored in tanks, and equipment and system layup is performed to prevent deterioration, such that future refueling and restart are possible.

Coliform: Normally harmless types of bacteria that reside in the intestinal tract of humans and other animals whose presence in water is an indicator that the water may be contaminated with other disease-causing organisms found in untreated human and animal waste.

Collapse Depression: A depression formed when underground lava or gases move or escape (for example, in an eruption) and the ground above collapses.

Collected Dose Equivalent: The sum of per capita dose equivalents for a given organ over the number of exposed individuals.

Collective Committed Effective Dose Equivalent: The committed effective dose equivalent of radiation for a population.

Committed Effective Dose Equivalent: The predicted total dose equivalent to a tissue or organ over a 50-year period after an intake of radionuclide into the body. It does not include external dose contributions. Committed dose equivalent is expressed in units of rem or Sievert. The committed effective dose equivalent is the sum of the committed dose equivalents to the various tissues of the body, each multiplied by the appropriate weighting factor.

Community (Biotic): All plants and animals occupying a specific area under relatively similar conditions.

Complex: The Nuclear Weapons Complex, which is a set of Federal sites and government-owned/ contractor-operated facilities administered by DOE.

Compound (Other Than Oxides): Fluorides, carbides, chlorides, and other materials containing less than 50 percent impurities of Pu that may require chemical processing for some disposition options.

***Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) of 1980 (Superfund):** This Act provides a regulatory framework for remediation of past contamination from hazardous waste. If a site meets the Act's requirements for designation, it is ranked along with other "Superfund" sites and is listed on the NPL. This ranking is the EPA's way of determining which sites have the highest priority for cleanup.

Conceptual Design: Efforts to develop a project scope that will satisfy program needs; ensure project feasibility and attainable performance levels for congressional consideration; develop project criteria and design parameters for all engineering disciplines; and identify applicable codes and standards, quality assurance requirements, environmental studies, construction materials, space allowances, energy conservation features, health, safety, safeguards, security requirements, and any other features or requirements necessary to describe the project.

Confined Aquifer: A permeable geological unit containing water that is at a pressure higher than atmospheric pressure. It is bounded above and below by aquitards.

Consumptive Water Use: The difference in the volume of water withdrawn from a body of water and the amount released back into the body of water.

Container: The metal envelope in the waste package that provides the primary containment function of the waste package and is designed to meet the containment requirements of 10 CFR 60.

Control Rods: The elements of a nuclear reactor that absorb slow neutrons and are used to increase, decrease, or maintain the neutron density in the reactor.

Conversion: An operation for changing material from one form, use, or purpose to another.

Coolant: A substance, either gas or liquid, circulated through a nuclear reactor or processing plant to remove heat.

Cosmic Radiation: Streams of highly penetrating, charged particles, composed of protons, alpha particles, and a few heavier nuclei, that bombard the earth from outer space.

Counter-proliferation: The activities of the DoD across the full range of U.S. efforts to combat proliferation, including diplomacy, arms control, export controls, and intelligence collection and analysis, with particular responsibility for assuring that U.S. forces and interests can be protected should they confront an adversary armed with weapons of mass destruction or missiles.

Credible Accident: An accident that has a probability of occurrence greater than or equal to one in a million years.

Cretaceous: The geologic period making up the end of the Mesozoic Era, dating from approximately 144 million to 66 million years ago.

Criteria Pollutants: Six air pollutants for which national ambient air quality standards are established by EPA: sulfur dioxide, nitric oxides, carbon monoxide, ozone, particulate matter less than or equal to 10 microns in diameter, and lead.

Critical Action: Any activity for which even a slight chance of flooding would be too great; such actions may include the storage of highly volatile, toxic, or water reactor materials (10 CFR 1022).

Critical Habitat: Defined in the *Endangered Species Act* of 1973 as "specific areas within the geographical area occupied by [an endangered or threatened] species..., essential to the conservation of the species and which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species... that are essential for the conservation of the species."

Critical Mass: The smallest mass of fissionable material that will support a self-sustaining nuclear chain reaction under specified conditions.

Criticality: A state in which a self-sustaining nuclear chain reaction is achieved.

Crystalline Rock: Rock consisting of minerals in a crystalline state.

Cultural Resources: Archaeological sites, architectural features, traditional use areas, and Native American sacred sites.

Cumulative Impacts: The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal), private industry, or individual undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7.)

Curie: A unit of radioactivity equal to 37 billion disintegrations per second; also a quantity of any nuclide or mixture of nuclides having 1 curie of radioactivity.

Decay (Radioactive): The decrease in the amount of any radioactive material with the passage of time, due to the spontaneous transformation of an unstable nuclide into a different nuclide or into a different energy state of the same nuclide; the emission of nuclear radiation (alpha, beta, or gamma radiation) is part of the process.

Decay Heat (Radioactivity): The heat produced by the decay of certain radionuclides.

Decibel (dB): A unit of sound measurement. In general, a sound increases in loudness by a factor of 10 for every increase of 10 decibels.

Decibel, A-weighted (dBA): A unit of weighted sound pressure level, measured by the use of a metering characteristic and the "A" weighting specified by the ANSI S1.4-1971(R176), that refers to the effect on humans.

Decontamination: The removal of radioactive or chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

Demilitarization: An irreversible modification or destruction of a weapons component or part of a component to the extent required to prevent use in its original weapon purpose.

Demography: The statistical study of human populations, including size, density, distribution, and such vital statistics as age, sex, and ethnicity.

Depleted Uranium: Uranium whose content of the isotope U-235 is less than 0.7 percent, which is the U-235 content of naturally occurring uranium.

Deposition: In geology, the laying down of potential rock-forming materials; sedimentation. In atmospheric transport, the settling out on ground and building surfaces of atmospheric aerosols and particles ("dry deposition") or their removal from the air to the ground by precipitation ("wet deposition" or "rainout").

Derived Concentration Guide (DCG): The concentration of a radionuclide in air or water which, under conditions of continuous exposure by one exposure mode (that is, ingestion of water or submersion or inhalation of air) for one year, a "reference man" would receive the most restrictive of (1) an effective dose equivalent of 100 mrem or (2) a dose equivalent of 5 rem to any tissues, including skin and lens of the eye.

Design Basis: For nuclear facilities, information that identifies the specific functions to be performed by a structure, system, or component and the specific values (or ranges of values) chosen for controlling parameters for reference bounds for design. These values may be: (1) restraints derived from generally accepted state-of-the-art practices for achieving functional goals; (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals; or (3) requirements derived from Federal safety objectives, principles, goals, or requirements.

Design-Basis Accident (DBA): For nuclear facilities, a postulated abnormal event that is used to establish the performance requirements of structures, systems, and components that are necessary to (1) maintain them in a safe shutdown condition indefinitely or (2) prevent or mitigate the consequences of the design-basis accident so that the general public and operating staff are not exposed to radiation in excess of appropriate guideline values.

Design-Basis Events: Postulated disturbances in process variables that can potentially lead to design-basis accidents.

Design Laboratory: A DOE facility involved in the design of nuclear weapons.

Detritus: Dead organic material and organisms.

Deuterium: A nonradioactive isotope of the element hydrogen with one neutron and one proton in the atomic nucleus.

Deuterium Oxide: See "Heavy Water."

[Text deleted.]

Dip: The acute angle that a structural surface (for example, a bedding or fault plane) in a geologic material makes with the horizontal, measured perpendicular to the strike of the surface. Updip is at a higher elevation on the surface.

Direct Economic Effects: The initial increases in output from different sectors of the economy resulting from some new activity within a predefined geographic region.

Direct Jobs: The number of workers required at a site to implement an alternative.

Discard: To dispose of material as waste.

Dismantlement: The process of taking apart a nuclear warhead and removing the subassemblies, components, and individual parts.

Disposal: The process of placing waste in a final repository.

Disposition: A process of use or disposal of materials that results in the remaining material being converted to a form that is substantially and inherently more proliferation-resistant than the original form.

Dissolution: The chemical dispersal of a solid throughout a liquid medium.

Dolomite: A mineral composed of calcium magnesium carbonate ($CaMg(CO_3)_2$) and the chief constituent in the rock also commonly called dolomite and of some kinds of marble.

Dome: For geology it is a circular or elliptical uplift with older beds in the center whose beds dip away in all directions from a central area. For topography it is any dome-shaped rock mass.

Dose: The energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad or gray.

Dose Commitment: The dose an organ or tissue would receive during a specified period of time (for example, 50 to 100 years) as a result of intake (by ingestion or inhalation) of one or more radionuclides from a defined release, frequently over a year's time.

Dose Equivalent: The product of absorbed dose in rad or gray and the effect of this type of radiation in tissue and a quality factor. Dose equivalent is expressed in units of rem or Sievert, where 1 rem equals 0.01 Sievert. The dose equivalent to an organ, tissue, or the whole body will be that received from the direct exposure plus the 50-year committed dose equivalent received from the radionuclides taken into the body during the year.

Dosimeter: A small device or instrument (for example, film badge or ionization chamber) carried by a radiation worker that measures cumulative radiation dose.

Drainage Basin: An above ground area that supplies the water to a particular stream.

Drawdown: The height difference between the natural water level in an aquifer and the reduced water level in the formation caused by the withdrawal of groundwater.

Drift: Effluent mist or spray carried into the atmosphere from cooling towers.

Drinking-Water Standards: The prescribed level of constituents or characteristics in a drinking water supply that cannot be exceeded legally.

Dry Site: For the purpose of this PEIS any site where adequate surface water is not abundantly available for storage and disposition needs. At such sites, groundwater is used for water supply.

Effective Dose Equivalent: The summation of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighting factor. This sum is a risk-equivalent value and can be used to estimate the health effects risk of the exposed individual. The tissue-specific weighting factor represents the fraction of the total health risk resulting from uniform whole-body irradiation that would be contributed by that particular tissue. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides, and the effective dose equivalent due to penetrating radiation from sources external to the body. Effective dose equivalent is expressed in units of rem or Sievert.

[Text deleted.]

Effluent: A gas or fluid discharged into the environment.

Emergency Condition: For a nuclear facility, occurrences or accidents that might occur infrequently during start-up testing or operation of the facility. Equipment, components, and structures might be deformed by these conditions to the extent that repair is required prior to reuse.

Emission Standards: Legally enforceable limits on the quantities and/or kinds of air contaminants that can be emitted into the atmosphere.

Empirical: Something that is based on actual measurement, observation, or experience rather than on theory.

Endangered Species: Defined in the ESA of 1973 as "any species which is in danger of extinction throughout all or a significant part of its ranges."

***Endangered Species Act* (ESA) of 1973:** This Act requires Federal agencies, with the consultation and assistance of the Secretaries of the Interior and Commerce, to ensure that their actions will not likely jeopardize the continued existence of any endangered or threatened species or adversely affect the habitat of such species.

Engineered Safety Features: For a nuclear facility, features that prevent, limit, or mitigate the release of radioactive material from its primary containment.

Entrainment: The involuntary capture and inclusion of organisms in streams of flowing water, a term often applied to the cooling water systems of power plants/reactors. The organisms involved may include phyto- and zooplankton, fish eggs and larvae (ichthyoplankton), shellfish larvae, and other forms of aquatic life.

Environment, Safety, and Health (ES&H) Program: In the context of DOE, encompasses those DOE requirements, activities, and functions in the conduct of all DOE and DOE-controlled operations that are concerned with: impacts to the biosphere; compliance with environmental laws, regulations, and standards controlling air, water, and soil pollution; limiting the risks to the well-being of both operating personnel and the general public to acceptably low levels; and protecting property adequately against accidental loss and damage. Typical activities and functions related to this program include, but are not limited to, environmental protection, occupational safety, fire protection, industrial hygiene, health physics, occupational medicine, and process and facilities safety, nuclear safety, emergency preparedness, quality assurance, and radioactive and hazardous waste management.

Environmental Assessment (EA): A written environmental analysis that is prepared pursuant to NEPA to determine whether a Federal action would significantly affect the environment and thus require preparation of a more detailed EIS. If the action does not significantly affect the environment, then a FONSI is prepared.

Environmental Audit: A documented assessment of a facility to monitor the progress of necessary corrective actions, to ensure compliance with environmental laws and regulations, and to evaluate field organization practices and procedures.

Environmental Documentation: Documents describing information and results from studies and evaluations required by NEPA. This documentation includes both an EA and an EIS.

Environmental Impact Statement (EIS): A document required of Federal agencies by NEPA for major proposals or legislation significantly affecting the environment. A tool for decisionmaking, it describes the positive and negative effects of the undertaking and alternative actions.

Environmental Justice: The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no population of people should be forced to shoulder a disproportionate share of the negative environmental impacts of pollution or environmental hazards due to a lack of political or economic strength.

Environmental Survey: A documented, multidisciplined assessment (with sampling and analysis) of a facility to determine environmental conditions and to identify environmental problems requiring corrective action.

Eocene: A geologic epoch early in the Cenozoic Era, dating from approximately 54 to 38 million years ago.

Ephemeral Stream: A stream that flows intermittently, typically only after periods of heavy precipitation.

Epicenter: The point on the Earth's surface directly above the focus of an earthquake.

Epidemiology: The science concerned with the study of events that determine and influence the frequency and distribution of disease, injury, and other health-related events and their causes in a defined human population.

Equivalent Sound (Pressure) Level: The equivalent steady sound level that, if continuous during a specified time period, would contain the same total energy as the actual time-varying sound. For example, L_{eq} (1-h) and L_{eq} (24-h) are the 1-hour and 24-hour equivalent sound levels, respectively.

Estuary: A thin zone along a coastline where fresh water from rivers mixes with salty ocean waters that provides aquatic habitats with a lower average salinity (salt concentration) than ocean waters. Three-fourths of the commercially important aquatic animal species in the United States spend all or part of their life in estuaries and coastal wetlands.

Evaluation Basis Accident: An accident generally with small impacts to the public, initiated by operational or external causes with an estimated probability of occurrence greater than 10^{-6} per year and used for estimating the impacts of a planned new or modified facility, and/or process when a Safety Analysis Report, that would define a DBA, has not been prepared. A DBA is used to establish the performance requirements of structures, systems, and components that are necessary to maintain them in a safe shutdown condition indefinitely or to prevent or mitigate the consequences of the DBA so that the public and onsite personnel are not exposed to radiation in excess of appropriate guidelines values.

Executive Order 12372, Intergovernmental Review of Federal Programs: The Order directs Federal agencies to consult with and solicit input from state and local governments whose jurisdictions would be affected by Federal actions.

Exposure Limit: The level of exposure to a hazardous chemical (set by law or a standard) at which or below which adverse human health effects are not expected to occur:

- Reference dose is the chronic exposure dose (mg/kg/day) for a given hazardous chemical at which or below which adverse human non-cancer health effects are not expected to occur.

- Reference concentration is the chronic exposure concentration (mg/m^3) for a given hazardous chemical at which or below which adverse human non-cancer health effects are not expected to occur.

***Farmland Protection Policy Act*:** The purpose of the Act is to reduce the conversion of farmland to nonagricultural uses by Federal projects and programs. The Act requires that Federal agencies comply to the fullest extent possible with state and local government policies to preserve farmland. Specifically, the Act advises that evaluations and analyses of prospective farmland conversion impacts be made early in the planning process before a site or design is selected and that, where possible, agencies make such evaluations and analyses part of the NEPA process.

Fast Reactor: A fast reactor does not contain a moderator to slow down neutrons after they are generated. It is distinguished from a fast breeder reactor by not necessarily producing more fuel than it consumes.

Fault: A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred. A normal fault occurs when the hanging wall has been depressed in relation to the footwall. A reverse fault occurs when the hanging wall has been raised in relation to the footwall. A thrust fault is a low-angle (dip less than about 30 degrees) reverse fault.

Fault-plane: A fault surface that is more or less flat or level.

Fauna: Animals, especially those of a specific region, considered as a group.

***Federal Land Policy and Management Act*:** This act states that all public lands would be retained in Federal ownership unless it is determined that another use would better serve the interests of the nation. Specifically, the Act addresses land retained in public-domain status, land withdrawn from the public domain for use by a Federal agency, land to be returned to the public domain, or public land identified for disposal. Additionally, the Act requires that public lands be managed in a manner that would protect the quality of its scientific, scenic, historical, ecological, and environmental aspects; and that public lands and their resources be inventoried periodically and systematically.

Finding of No Significant Impact (FONSI): A document by a Federal agency briefly presenting the reasons why an action, not otherwise excluded, will not have a significant effect on the human environment and will not require an EIS.

Fissile: The term "fissile" refers to nuclear materials that are fissionable by slow (thermal) neutrons. Fissile materials include U-235, U-233, Pu-239, and Pu-241. Materials such as U-238 and Th-232, which can be converted into fissile materials, are called fertile materials. It should be noted that Th-232, U-238 and all Pu isotopes are fissionable by fast neutrons but not by thermal (slow) neutrons. They are not called fissile materials but may be called fissionable materials.

Fissile Material: Pu-239, Pu-241, U-233, U-235, or any material containing any of the foregoing.

Fission: The splitting of a heavy atomic nucleus into at least two nuclei of lighter elements, accompanied by the release of energy and generally one or more neutrons. Fission can occur spontaneously or be induced by neutron bombardment.

Fission Products: Nuclei formed by the fission of heavy elements (primary fission products); also, the nuclei formed by the decay of the primary fission products, many of which are radioactive.

Fissionable Material: Material whose nuclei fission when bombarded by neutrons.

Fissure: A long and narrow crack in the earth.

Floodplain: The lowlands adjoining inland and coastal waters and relatively flat areas including at a minimum that area inundated by a 1-percent or greater chance flood in any given year. The base floodplain is defined as the 100-year (1.0 percent) floodplain. The critical action floodplain is defined as the 500-year (0.2 percent) floodplain.

Flora: Plants, especially those of a specific region, considered as a group.

Footwall: The mass of rock beneath a fault plane.

Formation: In geology, the primary unit of formal stratigraphic mapping or description. Most formations possess certain distinctive features.

Fossil: Impression or trace of an animal or plant of past geological ages that has been preserved in the earth's crust.

Fossiliferous: Containing a relatively large number of fossils.

Frit: Finely ground glass used as feedstock input for vitrification.

Fuel-Grade Material: Pu and HEU, in various forms (for example, metals and oxides), that can be used in experimental and research reactors. Fuel grade Pu contains between 7 to 19 percent Pu-240.

Fugitive Emissions: Emissions to the atmosphere from pumps, valves, flanges, seals, and other process points not vented through a stack. Also includes emissions from area sources such as ponds, lagoons, landfills, and piles of stored material.

Gamma Radiation: Short-wavelength electromagnetic radiation of nuclear origin, similar to, but with higher energy than, x rays.

Gamma Rays: High-energy, short-wavelength, electromagnetic radiation accompanying fission and emitted from the nucleus of an atom. Gamma rays are very penetrating and can be stopped only by dense materials (such as lead) or a thick layer of shielding materials.

Gaussian Plume: The distribution of material (a plume) in the atmosphere resulting from the release of pollutants from a stack or other source. The distribution of concentrations about the centerline of the plume, which is assumed to decrease as a function of its distance from the source and centerline (Gaussian distribution), depends on the mean wind speed and atmospheric stability.

Genetic Effects: The outcome resulting from exposure to mutagenic chemicals or radiation which results in genetic changes in germ line or somatic cells.

- Effects on genetic material in germ line (sex cells) cause trait modifications that can be passed from parents to offspring.

- Effects on genetic material in somatic cells result in tissue or organ modifications (for example, liver tumors) that do not pass from parents to offspring.

Geologic Repository (Mined Geologic Repository): A HLW repository pursuant to the NWPA as amended, for the disposal of nuclear waste; the waste is isolated by placement in a continuous, stable geologic formation at depths greater than 300 m (984 ft).

Geology: The science that deals with the study of the Earth: the materials, processes, environments, and history of the planet, including the rocks and their formation and structure.

Gigawatt Electric: A gigawatt electric is equal to one thousand MWe or one billion watts of electric power.

Glass: Borosilicate material in an amorphous mixture formed by melting silica and boric oxide together with the oxides of elements such as sodium.

Global Commons: Resources not yet allocated to national states. Resources primarily include oceans and outer space. The inclusion of Antarctica as a "Global Commons" area is controversial, and no professional consensus has been determined.

Glove Box: An airtight box used to work with hazardous material, vented to a closed filtering system, having gloves attached inside of the box to protect the worker.

Ground Shine: An area on the ground where radioactivity has been deposited by a radioactive plume or cloud.

Groundwater: The supply of water found beneath the Earth's surface, usually in aquifers, which may supply wells and springs.

Guideline Level: A suggested, desired level of concentration. It is not a regulatory value, but is a value offered as desirable by an agency to protect human health or the environment.

Half-life (Radiological): The time in which half the atoms of a radioactive substance decays to another nuclear form; this varies for specific radioisotopes from millionths of a second to billions of years.

Hazard Index (HI): A summation of the HQ for all chemicals now being used at a site and those proposed to be added to yield cumulative levels for a site. A HI value of 1.0 or less means that no adverse human health effects (non-cancer) are expected to occur.

Hazard Quotient (HQ): The value used as an assessment of non-cancer associated toxic effects of chemicals, (for example, kidney or liver dysfunction). It is independent of a cancer risk, which is calculated only for those chemicals identified as carcinogens.

Hazardous Material: A material, including a hazardous substance, as defined by 49 CFR 171.8 which poses a risk to health, safety, and property when transported or handled.

Hazardous/Toxic Waste: Any solid waste (can also be semisolid or liquid, or contain gaseous material) having the characteristics of ignitability, corrosivity, toxicity, or reactivity, defined by RCRA and identified or listed in 40 CFR 261 or by TSCA.

Heat Exchanger: A device that transfers heat from one fluid (liquid or gas) to another.

Heavy Metals: Metallic or semimetallic elements of high molecular weight, such as mercury, chromium, cadmium, lead, and arsenic, that are toxic to plants and animals at known concentrations.

Heavy Water: A form of water (a molecule with two hydrogen atoms and one oxygen atom) in which the hydrogen atoms consist largely or completely of the deuterium isotope. Heavy water has almost identical chemical properties, but quite different nuclear properties, as light water (common water).

Hemi-shells: Product that results when a pit is divided into two half pieces.

High Efficiency Particulate Air (HEPA) Filter: A filter used to remove particulates from dry gaseous effluent streams.

High-Level Waste (HLW): The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid. HLW contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation.

Highly Enriched Uranium (HEU): Uranium enriched in isotope U-235 to 20 percent or above, which becomes suitable for weapons use.

Historic Resources: In the United States, (that is, archaeological sites), architectural structures, and objects produced from 1492 on, after the arrival of the first Europeans to the Americas.

Holocene: The current epoch of geologic time, which began approximately 10,000 years ago.

Hydraulic Conductivity: The constant of proportionality in Darcy's Law of fluid flow that describes the ease with which a porous medium permits fluids to flow and the ease with which the fluid flows given its physical properties.

[Text deleted.]

Hygroscopic: Capable of absorbing and retaining moisture.

Igneous Rock: Rock originally formed by the cooling and consolidation of magma (molten silicate minerals) including volcanic rocks and plutonic rocks.

Immersion Dose: Dose resulting from being surrounded by a medium (air or water) that contains radionuclides.

Immobilization: A process that converts Pu to a chemically stable form for disposal.

Impingement: The process by which aquatic organisms too large to pass through the screens of a water intake structure become caught on the screens and are unable to escape.

Impoundment: A collection area for water, usually for irrigation purposes.

Incident-Free Risk: The radiological or chemical impacts resulting from packages aboard vehicles in normal transport. This includes the radiation or hazardous chemical exposure of specific population groups such as crew, passengers, and bystanders.

Indirect Economic Effects: Indirect effects result from the need to supply industries experiencing direct economic effects with additional outputs to allow them to increase their production. The additional output from each directly affected industry requires inputs from other industries within a region (that is, purchases of goods and services). This results in a multiplier effect to show the change in total economic activity resulting from a new activity in a region.

Indirect Jobs: Within an REA, jobs generated or lost in related industries as a result of a change in direct employment.

Infrastructure: The basic facilities, services, and installations needed for the functioning of a plant or other site, such as transportation and communication systems.

Injection Well: A well that transfers water from the surface into the ground, either through gravity or by mechanical means.

Interbedded: Occurring between beds or lying in a bed parallel to other beds of a different material.

Interfluvial: Falling in the area between two streams.

Interim (Permit) Status: Period during which treatment, storage, and disposal facilities coming under RCRA are temporarily permitted to operate while awaiting denial or issuance of a permanent permit.

Interim Storage: Providing safe and secure capacity in the near term to support continuing operations in the interim period until long-term storage or disposition actions are implemented.

Ion Exchange: A physiochemical process that removes anions and cations, including radionuclides, from liquid streams (usually water) for the purpose of purification or decontamination.

Ionizing Radiation: Radiation that can displace electrons from atoms or molecules, thereby producing ions.

Isotope: An atom of an element with a specific atomic number and atomic mass. Isotopes of the same element have the same number of protons (atomic number) but different numbers of neutrons and different atomic masses.

Joule: A metric unit of energy, work, or heat, equivalent to 1 watt-second, 0.737 foot-pound, or 0.239 calories.

Jurassic: The middle period of the Mesozoic Era, dating from 208 million to 144 million years ago.

Karst Terrain: A type of land surface that is found in regions underlain by soluble rocks, such as limestone and dolomite, which is peculiar to and dependent upon underground solution of the bedrock and the diversion of surface waters to underground waters (that is, streams that disappear underground). Karst terrain is characterized by sinkholes, underground streams, and caves.

Lacustrine Wetland: Lakes, ponds, and other enclosed open waters at least 8 ha (20 acres) in extent and not dominated by trees, shrubs, and emergent vegetation.

Lag Storage: Temporary storage at a disposition facility.

Land Resources: Land resources are comprised of all of the terrestrial areas available for economic production, residential or recreational use, Government activities (such as military bases), or natural resources consumption. The patterns and densities of land use and the quality of visual resources are evaluated under land resources.

Land Use: The characterization of land in terms of the use potential of the land's surface for the location of various activities.

Landscape Character: The arrangement of a particular landscape as formed by the variety and intensity of the landscape features (land, water, vegetation, and structures) and the four basic elements (form, line, color, and texture). These factors give an area a distinctive quality that distinguishes it from its immediate surroundings.

Large Release: A release of radioactive material that would result in doses greater than 25 rem to the whole body or 300 rem to the thyroid at 1.6 km (1 mi) from the control perimeter (security fence) of a reactor facility.

Latent Fatalities: Fatalities associated with acute and chronic environmental exposures to chemical or radiation that occur within 30 years of exposure.

Lava Tube: A hollow space beneath the surface of a solidified lava flow, formed by the withdrawal of molten lava after the formation of the surficial crust.

Light Water: The common form of water (a molecule with two hydrogen atoms and one oxygen atom) in which the hydrogen atom consists largely or completely of the normal hydrogen isotope (one proton).

Light Water Reactor: There are two types of light water reactors. One is a pressurized water reactor and the other is a boiling water reactor. Both are thermal reactors in which circulating light water is used to cool the reactor core and to moderate (reduce the energy of) the neutrons created in the core by the fission reactions. All commercially operating reactors in the United States and most commercial reactors worldwide are LWRs.

Light Water Reactor (MOX Fuel): An LWR with full MOX fuel is fueled with fuel rods each containing a mixture or blend of uranium oxide and plutonium oxide. Traditional programs of using Pu in LWRs start with a partial core, not full core of MOX fuel.

Limited-lifetime Component: A weapon component that decays with age and must be replaced periodically.

Lithic: Pertaining to stone or a stone tool.

Lithic Scatter: An archaeological site consisting of stone artifacts and by-products of their manufacture and maintenance.

Lithologic: Pertaining to the structure and composition of a rock.

Long-Lived Radionuclides: Radioactive isotopes with half-lives greater than about 30 years.

Low-Enriched Uranium (LEU): Naturally occurring uranium contains only about 0.7 percent U-235 and almost all of the rest is U-238. Low-enriched uranium is enriched in the isotopic content of U-235, greater than 0.7 percent but less than 20 percent of the total mass, for use as LWR fuel.

Low-Level Waste (LLW): Waste that contains radioactivity but is not classified as HLW, TRU waste, spent nuclear fuel, or "11e(2) by-product material" as defined by DOE Order 5820.2A, *Radioactive Waste Management.* Test specimens of fissionable material irradiated for research and development only, and not for the production of power or Pu, may be classified as LLW, provided the concentration is less than 100 nanocuries per gram, which would then be TRU waste. Some LLW is considered classified because of the nature of the generating process and/or constituents, because the waste would tell too much about the process.

Mandatory Standards: Standards adopted by the DOE that define the minimum requirements that the DOE and its contractors must comply with. Standards may be classified as mandatory because of applicable Federal or state statutes or implementing requirements, or as a matter of DOE policy.

Marsh: An area of low-lying wetland, dominated by grasslike plants.

Mastodon: Any of numerous extinct mammals that differ from the related mammoths and existing elephants chiefly in the form of molar teeth.

Maximum Contaminant Level: The maximum permissible level of a contaminant in drinking water delivered to any user of a public water system. Maximum contaminant levels are enforceable standards.

Maximally Exposed Individual (MEI): A hypothetical person who could potentially receive the maximum dose of radiation or hazardous chemicals.

Megajoule: A unit of power equal to 1 million joules. See "Joule."

Megawatt (MW): A unit of power equal to 1 million watts. Megawatt thermal is commonly used to define heat produced, while megawatt electric defines electricity produced.

Mesozoic: The geologic era dating from 245 million to 66 million years ago. The Mesozoic Era is the era of the dinosaurs.

Metal: Essentially pure Pu metal that meets weapons specifications. The Pu can be weapons grade, fuels grade, or reactor grade. The metal may have oxidation or casting residues on the surface.

Metal Reduction: The conversion of a compound such as plutonium dioxide or plutonium tetrafluoride into metal.

Metamorphic Rock: Rock formed by the transformation of preexisting rocks in response to changes in temperature and/or pressure, and the chemical action of fluids.

Meteorology: The science dealing with the atmosphere and its phenomena, especially as relating to weather.

Migration: The natural movement of a material through the air, soil, or groundwater; also, seasonal movement of animals from one area to another.

***Migratory Bird Treaty Act*:** This act states that it is unlawful to pursue, take, attempt to take, capture, possess, or kill any migratory bird, or any part, nest, or egg of any such bird other than permitted activities.

Minor Actinides: Radioactive element with an atomic number larger than 95 (that is, 96 or higher).

Miocene: A geologic epoch in the Cenozoic Era dating from 26 to 7 million years ago.

Mississippian Period (Geologic): A portion of the Paleozoic Era in North America dating from 360 to 330 million years ago (following the Devonian Period and preceding the Pennsylvanian Period).

Mixed Oxide (MOX): A physical blend of uranium oxide and plutonium oxide.

Mixed Waste: Waste that contains both "hazardous waste" and "radioactive waste" as defined in this glossary.

Modified Mercalli Intensity (MMI): A level on the modified Mercalli scale. A measure of the perceived intensity of earthquake ground shaking with 12 divisions, from I (not felt by people) to XII (damage nearly total). It is a unitless expression of observed effects.

Mutation: Inheritable changes in the DNA molecules found in genes as a result of exposure to various environmental factors such as radiation or certain chemicals.

National Ambient Air Quality Standards (NAAQS): Air quality standards established by the CAA, as amended. The primary NAAQS are intended to protect the public health with an adequate margin of safety, and the secondary NAAQS are intended to protect the public welfare from any known or anticipated adverse effects of a pollutant.

National Asset Reserve: The quantity of U.S. Pu above that amount in the stockpile, the production process, R&D inventories, and the strategic reserve.

National Emission Standards for Hazardous Air Pollutants (NESHAP): A set of national emission standards for listed hazardous pollutants emitted from specific classes or categories of new and existing sources. These were implemented in the CAA Amendments of 1977.

***National Environmental Policy Act* (NEPA) of 1969:** This Act is the basic national charter for the protection of the environment. It requires the preparation of an EIS for every major Federal action that may significantly affect the quality of the human or natural environment. Its main purpose is to provide environmental information to decision makers so that their actions are based on an understanding of the potential environmental consequences of a proposed action and its reasonable alternatives.

National Environmental Research Park (NERP): An outdoor laboratory set aside for ecological research to study the environmental impacts of energy developments. NERPs were established by DOE to provide protected land areas for research and education in the environmental sciences and to demonstrate the environmental compatibility of energy technology development and use.

***National Historic Preservation Act* (NRHP) of 1966, as amended:** This Act provides that property resources with significant national historic value be placed on the NRHP. It does not require any permits but, pursuant to Federal code, if a proposed action might impact an historic property resource, it mandates consultation with the proper agencies.

National Pollutant Discharge Elimination System (NPDES): Federal permitting system required for discharge of effluents to surface waters of the United States, regulated through the CWA, as amended.

National Register of Historic Places (NRHP): A list maintained by the Secretary of the Interior of districts, sites, buildings, structures, and objects of prehistoric or historic local, state, or national significance. The list is expanded as authorized by Section 2(b) of the *Historic Sites Act* of 1935 (16 U.S.C. 462) and Section 101(a)(1)(A) of the NHPA of 1966, as amended.

***Native American Graves and Repatriation Act* (NAGPRA) of 1990**: Established to protect Native American graves and associated funerary objects. This act requires Federal agencies and museums to inventory human remains and associated funerary objects and to provide culturally affiliated tribes with the inventory of collections. Requires repatriation, on request, to the culturally affiliated tribes.

Natural Uranium: Uranium with a U-235 concentration of approximately 0.7 percent, the average concentration of U-235 in uranium in the natural, pre-enriched state.

Neutron Poison: A chemical solution (for example, boron or rare earth solution) injected into a nuclear reactor to absorb neutrons and end criticality.

Nitrogen Oxides: Refers to the oxides of nitrogen, primarily NO and NO_2. These are produced in the combustion of fossil fuels and can constitute an air pollution problem. When NO_2 combines with VOCs such as ammonia or CO, ozone is produced.

***Noise Control Act* of 1972:** This Act directs all Federal agencies to carry out programs in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health or welfare.

Nonattainment Area: An air quality control region (or portion thereof) in which EPA has determined that ambient air concentrations exceed national ambient air quality standards for one or more criteria pollutants.

Nonproliferation: Preventing the spread of nuclear weapons, nuclear weapons materials, and nuclear weapon technology.

Nonproliferation Treaty: A treaty with the aim of controlling the spread of nuclear weapons technologies, limiting the number of nuclear weapons states and pursuing, in good faith, effective measures relating to the cessation of the nuclear arms race. The treaty does not invoke stockpile reductions by nuclear states, and it does not address actions of nuclear states in maintaining their stockpiles.

Notification Level: A term used only in NPDES permitting. Discharges are permitted under NPDES for particular parameters; however, when parameters that have not been permitted appear in excess of a predetermined concentration (that is, 100 milligrams per liter), the discharger is required by the NPDES permit to notify the permitter (the EPA) that a new parameter has appeared. Violations of NPDES concentration limits are usually called "noncompliances."

Nuclear Assembly: Collective term for the primary, secondary, and case of a nuclear explosive device.

Nuclear Component: A part of a nuclear weapon that contains fissionable or fusionable material.

Nuclear Criticality: See "Criticality."

Nuclear Facility: A facility whose operations involve radioactive materials in such form and quantity that a nuclear hazard potentially exists to the employees or the general public. Included are facilities that: produce, process, or store radioactive liquid or solid waste, fissionable materials, or tritium; conduct separations operations; conduct irradiated materials inspection, fuel fabrication, decontamination, or recovery operations; or conduct fuel enrichment operations. Incidental use of radioactive materials in a facility operation (for example, check sources, radioactive sources, and x-ray machines) does not necessarily require a facility to be included in this definition.

Nuclear Grade: Material of a quality adequate for use in a nuclear application.

Nuclear Material: Composite term applied to (1) special nuclear material; (2) source material such as uranium or thorium or ores containing uranium or thorium; and (3) by-product material, which is any radioactive material that is made radioactive by exposure to the radiation incident to the process of producing or using special nuclear material.

Nuclear Power Plant: A facility that converts nuclear energy into electrical power. Heat produced in a nuclear reactor is used to make steam which drives a turbine connected to an electric generator.

Nuclear Reactor: A device in which a fission chain reaction is maintained, and which is used for irradiation of materials or to produce heat for the generation of electricity.

Nuclear Weapon: The general name given to any weapon in which the explosion results from the energy released by reactions involving atomic nuclei, either fission, fusion, or both.

Nuclear Weapons Complex: See "Complex."

Nuclide: A species of atom characterized by the constitution of its nucleus and hence by the number of protons, the number of neutrons, and the energy content.

Obsidian: A black volcanic glass.

Occupational Safety and Health Administration (OSHA): Oversees and regulates workplace health and safety, created by *Occupational Safety and Health Act* of 1970.

Off-specification: Material not meeting the requirements for use.

Onsite Population: DOE and contractor employees who are on duty, and onsite visitors.

Operable Unit: A discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration or eliminates or mitigates a release, threat of release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units.

Option: A group of related alternative pathways through a specific set of facilities that takes surplus fissile material to complete disposition. See alternative options.

Outfall: The discharge point of a drain, sewer, or pipe as it empties into a body of water.

Oxidation: The combination of an atom with another atom (normally oxygen). During this reaction, the atom combines with oxygen and loses electrons.

Oxide: A compound in which an element (such as Pu) is bonded to oxygen.

Ozone: The triatomic form of oxygen; in the stratosphere, ozone protects the Earth from the sun's ultraviolet rays, but in lower levels of the atmosphere ozone is considered an air pollutant.

Package: For radioactive materials, the packaging together with its radioactive contents as presented for transport (the packaging plus the radioactive contents is the package).

Packaging: For radioactive materials, it may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shock to ensure compliance with DOT regulations.

Paleoindian: Term applied to both (1) the period to which the earliest presence of humans can be traced, dating in North America to the late Pleistocene (circa 10,000-12,000 before the present), and (2) the earliest human groups identified in North America (for example, Clovis and Folsom points are considered to have been manufactured by Paleoindian peoples).

Paleontology: The study of extinct plant and animal life that existed in former geologic times, especially fossils.

Paleozoic: The longest era of geologic time, dating from 570 million to 245 million years ago. Seed-bearing plants, amphibians, and reptiles first appeared in the Paleozoic Era.

Palustrine: Lakes, ponds and other enclosed open waters at least 8 ha (20 acres) in extent and dominated by trees, shrubs and emergent vegetation.

Pascal: A metric unit of pressure equal to one Newton per square meter; 101,000 pascals is equal to 14.7 lb/in^2.

Passivation: To make inactive or less reactive by coating or surface treatment.

Perched Groundwater: A body of groundwater of small lateral dimensions lying above a more extensive aquifer.

Perennial Creek: A stream or reach of a stream that flows continuously throughout the year and whose upper surface generally stands lower than the water table in the region adjoining the stream.

Permeability: The ability of rock or soil to transmit a fluid. It is the measure of the relative ease of fluid flow under unequal pressure.

Person-rem: The unit of collective radiation dose commitment to a given population; the sum of the individual doses received by a population segment.

Petroglyph: Art carved or inscribed on a rock by a historic or prehistoric people.

pH: A numeric value that indicates the relative acidity or alkalinity of a substance on a scale of 0 to 14, with the neutral point at 7.0. Acid solutions have pH values lower than 7.0 and basic (alkaline) solutions have pH values higher than 7.0.

Physical Setting: The land and water form, vegetation, and structures that compose the landscape.

Physiography: Description of earth surface features.

Piedmont Province: Area of rolling topography between the Appalachian mountain range and the coastal plain, extending from New Jersey to Alabama. The Piedmont is underlain chiefly by Precambrian and Paleozoic metamorphic and igneous rocks, but it also has relatively large areas underlain by Triassic sedimentary rocks and sporadic basaltic sills and dikes.

Pit: The core element of a nuclear weapon's "primary" or fission component.

Pit Cladding: The material that encapsulates a pit to form a hermetic seal around the pit.

Playa: A dry lake bed in a desert basin or a closed depression that contains water on a seasonal basis.

Pleistocene: The geological time of the earliest epoch of the Quaternary Period, occurring approximately 11,000 to 2 million years ago, characterized by a succession of northern glaciations and the appearance of human beings.

Pliocene: The geological time of the latest epoch of the Tertiary Period, occurring approximately 2 million to 7 million years ago, characterized by the appearance of distinctly modern animals.

Plume: The elongated pattern of contaminated air or water originating at a point source, such as a smokestack or a hazardous waste disposal site.

Plume Immersion: Occurs when an individual is enveloped by a cloud of radioactive gaseous effluent and receives an external radiation dose.

Plutonium: A heavy, radioactive, metallic element with the atomic number 94. It is produced artificially in a reactor by bombardment of uranium with neutrons and is used in the production of nuclear weapons. Plutonium has 15 isotopes with mass numbers ranging from 232 to 246. The weapons-usable plutonium consists mainly of Pu-239, which has a radioactive decay half-life of 24,110 years.

Polychlorinated Biphenyl (PCB): Any of family of chlorinated chemicals that are noted as dangerous environmental pollutants that can accumulate in animal tissues with resultant pathogenic or teraogenic (causing birth defects) effects.

Position: See "Storage Position."

Post Closure Period: An indefinitely long period (hundreds of millions of years) extending from closure of the facility to a time when the emplaced waste is no longer a security or safety hazard. It is expected that, at least during the early years, the facility will be safeguarded and monitored.

Potable (Water): Fit to drink.

[Text deleted.]

Potential Fatalities: A conservative estimate of those fatalities that would result from both radiological and nonradiological risks from normal operations and accident conditions for a proposed action.

Pounds per Square Inch: A measure of pressure; atmospheric pressure is about 14.7 lb/in^2.

Power Reactor-Grade Material: Pu and HEU in various forms (for example, metals and oxides) that can be used in commercial nuclear power reactors. Power reactor-grade Pu contains greater than 19 percent Pu-240.

Precambrian: Dating from before the Cambrian geologic period more than 570 million years ago.

Precipitate: To cause a solid substance to become separate from a solution.

Prehistoric: Predating written history. In North America, also predating contact with Europeans.

Pressurized Water Reactor (PWR): A nuclear power reactor that uses water under pressure as a coolant. The water boiled to generate steam is in a separate system.

Prevention of Significant Deterioration (PSD): Regulations established by the CAA to limit increases in criteria air pollutant concentrations above baseline.

Primary System: The system that circulates a coolant (for example, water) through the reactor core to remove the heat of reaction.

Prime Farmland: Land with the best combination of physical and chemical characteristics (soil quality, growing season, and moisture supply) for economically producing high yields of food, feed, forage, fiber, and oilseed crops, with minimum inputs of fuel, fertilizer, pesticides, and labor without intolerable soil erosion (*Farmland Protection Policy Act* of 1981, 7 CFR 7, paragraph 658). Land classified as prime farmland includes cropland, pastureland, rangeland, or forest land; but not urban or built-up land or land covered with water. Prime farmlands are identified by the NRCS (also known as Soil Conservation Service).

Prime Farmland Soils: Soil map units that meet the soil requirements for prime farmland.

Probabilistic Risk Assessment (PRA): A comprehensive, logical, and structured methodology to identify and quantitatively evaluate significant accident sequences and their consequences.

Probable Maximum Flood: Flood levels predicted for a scenario having hydrological conditions that maximize the flow of surface waters.

Process: To extract, separate, or purify a substance by physical or chemical means (for example, to remove actinides).

Programmatic Environmental Impact Statement (PEIS): A document prepared in accordance with the requirements of 102(2)(C) of NEPA which evaluates the environmental impacts of proposed Federal Actions that involve multiple decisions potentially affecting one or more sites.

Project: Any undertaking with a defined starting point and defined objectives by which completion is identified.

Project-Specific EIS: A legal document prepared in accordance with the requirements of 102(2)(C) of NEPA which evaluates the environmental impacts of a single action at a single site.

Proliferation: The spread of nuclear, biological, and chemical capabilities and the missiles to deliver them.

Protected Area (PA): An area encompassed by physical barriers, subject to access controls, surrounding material access areas, and meeting the standards of DOE Order 5632.1C, *Protection and Control of Safeguards and Security Interests*.

Quality Factor: The principal modifying factor that is employed to derive dose equivalent from absorbed dose.

Quaternary: The second geologic period of the Cenozoic Era, occurring from 2 million years ago to the present, characterized by the appearance of human beings.

Rad: See "Radiation Absorbed Dose."

Radiation: The emitted particles or photons from the nuclei of radioactive atoms. Some elements are naturally radioactive; others are induced to become radioactive by bombardment in a reactor. Naturally occurring radiation is indistinguishable from induced radiation.

Radiation Absorbed Dose: The basic unit of absorbed dose equal to the absorption of 0.01 joule per kilogram of absorbing material.

Radioactive Accident Risk: As described in the *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes* (NUREG-0170), it is the probability of an accident in which the release of radioactive material is likely to occur, and its consequences. The consequences are expressed in terms of the potential effects of the release of a specified quantity of dispersible radioactive material to the environment or the exposure resulting from a damaged package shielding. The risk calculations incorporate accident rates and package release fraction estimates, both of which are functions of accident severity. Radiological accident risks are expressed in terms of annual expected latent cancer fatalities and early fatality probabilities.

Radioactive Vehicle Accident: A vehicle accident involving one or more packages of radioactive material that could result in a loss of shielding efficiency of the package, or a loss of containment and subsequent dispersal of the radioactive material, or an accidental assembly of a critical mass (in fissile material shipments).

Radioactive Waste: Materials from nuclear operations that are radioactive or are contaminated with radioactive materials, and for which use, reuse, or recovery are impractical.

Radioactivity: The spontaneous decay or disintegration of unstable atomic nuclei, accompanied by the emission of radiation.

Radioisotopes: Radioactive nuclides of the same element (same number of protons in their nuclei) that differ in the number of neutrons.

Radiolysis: Chemical decomposition induced by radiation.

Radionuclide: A radioactive element characterized according to its atomic mass and atomic number which can be man-made or naturally occurring. Radionuclides can have a long life as soil or water pollutants, and are believed to have potentially mutagenic or carcinogenic effects on the human body.

Radon: Gaseous, radioactive element with the atomic number 86 resulting from the radioactive decay of radium. Radon occurs naturally in the environment, and can collect in unventilated enclosed areas, such as basements. Large concentrations of radon can cause lung cancer in humans.

Raptor: A bird of prey, such as an eagle, hawk, or falcon.

Reactor Accident: See "Design-Basis Accident" *and* "Severe Accident."

Reactor Core: In a heavy water reactor: the fuel assemblies, including the fuel and target tubes, control assemblies, blanket assemblies, safety rods, and coolant/moderator. In a LWR: the fuel assemblies, including the fuel and target rods, control rods, and coolant/moderator.

Reactor Facility: Unless it is modified by words such as containment, vessel, or core, the term reactor facility includes the housing, equipment, and associated areas devoted to the operation and maintenance of one or more reactor cores. Any apparatus that is designed or used to sustain nuclear chain reactions in a controlled manner, including critical and pulsed assemblies and research, test, and power reactors, is defined as a reactor. All assemblies designed to perform subcritical experiments that could potentially reach criticality are also to be considered reactors.

[Text deleted.]

Recharge: Replenishment of water to an aquifer. Can occur as a result of surface infiltration of rainwater (or other sources) and through leakage between aquifers.

Record of Decision (ROD): A document prepared in accordance with the requirements of 40 CFR 1505.2 that provides a concise public record of DOE's decision on a proposed action for which an EIS was prepared. A ROD identifies the alternatives considered in reaching the decision, the environmentally preferable alternative(s), factors balanced by DOE in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not.

Recycling: The recovery, purification, and reuse of tritium contained in reservoirs within the nuclear weapons stockpile.

Reference Standards: Guides or standards that the DOE and its contractors should consider for guidance, as applicable, in addition to mandatory standards.

Region of Influence (ROI): A site-specific geographic area that includes the counties where approximately 90 percent of the current DOE and/or contractor employees reside.

Regional Economic Area (REA): A geographic area consisting of an economic node and the surrounding counties that are economically related and include the places of work and residences of the labor force. Each REA is defined by the BEA.

Rem: See "Roentgen Equivalent Man."

Remediate: Render radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

Remediation: The process, or a phase in the process, of rendering radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

Reprocessing: The chemical separation of spent reactor fuel into uranium, transuranic elements, and fission products.

Residue: Pu materials in process or left over from processes of making weapons.

***Resource Conservation and Recovery Act* (RCRA) as Amended:** The Act that provides a "cradle to grave" regulatory program for hazardous waste that establishes, among other things, a system for managing hazardous waste from its generation until its ultimate disposal.

Retirement: As applied to nuclear weapons, the removal of a weapon from the stockpile.

Rhyolite: A volcanic rock rich in silica; the volcanic equivalent of granite.

Richter Scale: A logarithmic scale used to express the total amount of energy released by an earthquake; it has 10 divisions, from 1 (not felt by humans) to 10 (nearly total damage).

Riffle: A rocky shoal or sand bar lying just below the surface of a waterway.

Riparian: On or around rivers or streams.

Riparian Wetlands: Wetlands on or around rivers and streams.

Rip rap: A loose assemblage of stones used in water or soft ground to prevent erosion.

Risk: A quantitative or qualitative expression of possible loss that considers both the probability that a hazard will cause harm and the consequences of that event.

Risk Assessment (Chemical Or Radiological): The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or radiological pollutants.

Roentgen: A unit of exposure to ionizing x- or gamma radiation equal to or producing 1 electrostatic unit of charge per cubic centimeter of air. It is approximately equal to 1 rad.

Roentgen Equivalent Man (rem): The unit of radiation dose for biological absorption: equal to the product of the absorbed dose, in rads, a quality factor which accounts for the variation in biological effectiveness of different types of radiation.

Runoff: The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually enters streams.

Ruthenium: A brittle gray metal. A radioactive form of ruthenium is a common fission product.

***Safe Drinking Water Act* (SDWA), as Amended:** This Act protects the quality of public water supplies, water supply and distribution systems, and all sources of drinking water.

Safe Secure Trailer (SST): A specially designed semi-trailer, pulled by a specially designed tractor, which is used for the safe, secure transportation of cargo containing nuclear weapons or special nuclear material.

Safety: Minimizing the possibility that a nuclear weapon will be exposed to accidents and preventing the possibility of nuclear yield or Pu dispersal should there be an accident involving a nuclear weapon.

Safety Analysis Report (SAR): A safety document providing a concise but complete description and safety evaluation of a site, design, normal and emergency operation, potential accidents, predicted consequences of such accidents, and the means proposed to prevent such accidents or mitigate their consequences. A safety analysis report is designated as final when it is based on final design information. Otherwise, it is designated as preliminary.

Safety Document: A document prepared specifically to ensure that the safety aspects of part or all of the activities conducted at a reactor are formally and thoroughly analyzed, evaluated, and recorded (for example, technical specifications, safety analysis reports and addenda, and documented reports of special safety reviews and studies).

Salt Drift: Deposition of salts from the drifting of mist from cooling tower operation and the associated deposition of entrained chemicals.

Saltcrete: A solidified mixture of salt residue from the evaporation process at a liquid waste treatment facility and Portland cement.

Saltstone: Low radioactivity fraction of high-level waste from the in-tank precipitation process mixed with cement, flash, and slag to form a concrete block.

Sandstone: A sedimentary rock composed mostly of sand-size particles cemented usually by calcite, silica, or iron oxide.

Sanitary Wastes: Wastes generated by normal housekeeping activities, liquid or solid (includes sludge), which are not hazardous or radioactive.

Sanitization: An irreversible modification or destruction of a component or part of a component to the extent required to prevent revealing classified or otherwise controlled information.

Schist: Crystalline metamorphic rock formed by dynamic metamorphism that can be split easily into thin slabs or flakes.

Scintillation: Minute flash of light caused when alpha, beta, or gamma rays strike certain phosphors.

Scope: In a document prepared pursuant to NEPA, the range of actions, alternatives, and impacts to be considered.

Scoping: Involves the solicitation of comments from interested persons, groups, and agencies at public meetings, public workshops, in writing, electronically, or via fax to assist DOE in defining the proposed action, identifying alternatives, and developing preliminary issues to be addressed in an EIS.

Scrap: Pu materials in process or left over from process of making weapons.

Scrubber: An air pollution control device that uses a spray of water or reactant or a dry process to trap pollutants in emissions.

Secondary: Component of a nuclear weapon that contains elements needed to initiate the fusion reaction in thermonuclear explosion.

Secondary System: The system that circulates a coolant (water) through a heat exchanger to remove heat from the primary system.

Security: Minimizing the likelihood of unauthorized access to or loss of custody of a nuclear weapon or weapon system, and ensuring that the weapon can be recovered should unauthorized access or loss of custody occur.

Sedimentary Rock: Rock formed from the accumulation and consolidation of sediments.

Sedimentation: The settling out of soil and mineral solids from suspension in water.

Seepage Basin: An unlined excavation in the ground that receives aqueous effluent.

Seismic: Pertaining to any earth vibration, especially an earthquake.

Seismic Zone: An area defined by the Uniform Building Code (1991), designating the amount of damage to be expected as the result of earthquakes. The United States is divided into six zones: (1) Zone 0—no damage; (2) Zone 1—minor damage; corresponds to intensities V and VI of the MMI scale; (3) Zone 2A—moderate damage; corresponds to intensity VII of the MMI scale (eastern U.S.); (4) Zone 2B—slightly more damage than 2A (western U.S.); (5) Zone 3—major damage; corresponds to intensity VII and higher of the MMI scale; (6) Zone 4—areas within Zone 3 determined by proximity to certain major fault systems.

Seismicity: The tendency for the occurrence of earthquakes.

Sensitivity Level: The relative degree of viewer numbers, visibility of the subject landscape and the degree of potential viewer interest, concern, and attitude for existing or proposed changes in landscape character.

Severe Accident: An accident with a frequency rate of less than 10^{-6} per year that would have more severe consequences than a design-basis accident, in terms of damage to the facility, offsite consequences, or both.

Sewage: The total of organic waste and wastewater generated by an industrial establishment or a community.

Shale: A type of easily split rock composed of layers of claylike, fine-grained sediments.

Shielding: Any material of obstruction (bulkheads, walls, or other constructions) that absorbs radiation in order to protect personnel or equipment.

Short-Lived Nuclides: Radioactive isotopes with half-lives no greater than about 30 years (for example, Cs-137 and Sr-90).

Shrink-Swell Potential: Refers to the potential for soils to contract while drying and expand after wetting.

Shutdown: For a DOE reactor, that condition in which the reactor has ceased operation and DOE has declared officially that it does not intend to operate it further.

Silica: Silicon dioxide, a common mineral that occurs naturally as quartz.

Silt: A sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

Siltstone: A fine-grained, elastic (fragmented) sedimentary rock in which particles range from 1/6 to 1/256 millimeters in diameter.

Sinkhole: A depression in the earth's surface formed by the collapse of a cavern roof. Typically associated with Karnst terrain.

Sitewide EIS: A legal document prepared in accordance with the requirements of 102(2)(C) of NEPA which evaluates the environmental impacts of many actions at one large, multiple-facility site. Sitewide EISs are used to support specific decisions.

Slope Factor: A upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The slope factor is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen.

Socioeconomic Baseline Characterization: A description and discussion of the social and economic characteristics of a study area, including a profile of local population, economy, housing supply, and public and private services.

Solution: Liquid mixtures containing Pu.

Source Term: The estimated quantities of radionuclides or chemical pollutants released to the environment.

Spec Metal (Specification Metal): Pu metal whose impurities do not exceed an established concentration.

Special Nuclear Materials: As defined in Section 11 of the AEA, special nuclear material means (1) Pu, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the NRC determines to be special nuclear material or (2) any material artificially enriched by any of the foregoing.

Spent Fuel Standard: A term coined by the NAS and modified by DOE, means that alternatives for the disposition of surplus weapons-usable Pu should seek to make this Pu roughly as inaccessible and unattractive for weapons use as the much larger and growing stock of Pu in civilian spent nuclear fuel.

Spent Nuclear Fuel: Irradiated reactor fuel that is no longer useful as fuel.

Stabilize: To convert a compound, mixture, or solution to a non-reactive form.

Stage Right: A horizontal palletized multiple stacking configuration of pits in containers at Pantex. The operation utilizes an electric forklift with shielding for radiation protection for storage, retrieval, and inventory operations. The shielded fork lift has a passive guidance system (for example, rail guides, wire guides) for the palletized stacking configuration that prevents the forklift from veering from the aisle.

Staging: An interim storage or gathering of items awaiting use, transportation, consumption, or other disposition.

Standardization (Epidemiology): Techniques used to control the effects of differences (for example, age) between populations when comparing disease experience. The two main methods are the following:

- Direct method, in which specific disease rates in the study population are averaged, using as weights the distribution of the comparison population.
- Indirect method, in which the specific disease rates in the comparison population are averaged, using as weights the distribution of the study population.

Standby: That condition in which a reactor facility is neither operable nor declared excess and in which documentary authorization exists to maintain the reactor for possible future operation.

State Historic Preservation Officer (SHPO): State officer established to carry out the duties associated with the NHPA, for identification and protection of prehistoric and historic resources.

Steppe: A semi-arid, grass-covered, and generally treeless plain.

Steppe Climate (Semiarid Climate): The type of climate in which precipitation is very slight but sufficient for the growth of short, sparse grass.

Storage: Any method of keeping items while awaiting use, transportation, consumption, or other disposition.

Storage Position: A cubicle with dimensions of 46 cm (18 in) wide by 46 m (18 in) deep by 57 cm (24 in) tall. It is sized to accommodate one pit or nonpit primary containment vessel per storage position for Pu or a single drum or can per position for HEU. This configuration is necessary for criticality and heat load considerations of the Pu and HEU material stored within each position.

[Text deleted.]

Stored Weapons Standard: This invokes the high standards of security and accounting applied to the storage of intact nuclear weapons. Therefore, applying the Stored Weapons Standard means those high standards should be maintained to the extent practical for weapons-usable fissile materials throughout dismantlement, storage, and disposition.

Straight-Line: A site-independent pilot Pu management system.

Strategic Reserve Material: The quantity of Pu and HEU material reserved for future weapons use.

Stratigraphy: Division of geology dealing with the definition and description of rocks and soils, especially sedimentary rocks.

Sulfur Oxides: Common air pollutants, primarily SO_2, a heavy, pungent, colorless gas (formed in the combustion of coal), which is considered a major air pollutant, and sulfur trioxide.

***Superfund Amendments and Reauthorization Act* (SARA) of 1986:** In addition to certain freestanding provisions of law, it includes amendments to CERCLA and the SDWA.

Surface Water: Water on the Earth's surface, as distinguished from water in the ground (groundwater).

Surplus Facility: Any facility or site (including installed equipment) that has no identified programmatic use or that may or may not be radioactively contaminated to levels that require controlled access.

Surplus Fissile Materials: Weapons-usable fissile materials that have no identified programmatic use or do not fall into one of the categories of national security reserves.

System International: For the purpose of this PEIS, synonymous with the metric system.

Technology: A specific technical component that is subset of a facility; for example, glass melter and feed preparation technology might fall under vitrification of Pu in borosilicate glass.

Tectonic Plate: One of the massive rigid plates that together form the Earth's lithosphere, or outermost layer (crust).

Tertiary: The first geologic period of the Cenozoic Era, dating from 66 million to about 3 million years ago. During the Tertiary, mammals became the dominant life form.

Threatened Species: Defined in the ESA of 1973 as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

Threshold Limit Values: The recommended concentrations of contaminants workers may be exposed to according to the ACGIH.

***Toxic Substances Control Act* (TSCA) of 1976:** This Act authorizes the EPA to secure information on all new and existing chemical substances and to control any of these substances determined to cause an unreasonable risk to public health or the environment. This law requires that the health and environmental effects of all new chemicals be reviewed by the EPA before they are manufactured for commercial purposes.

Transmissivity: A measure of a water-bearing unit's capacity to transmit fluid: the product of the thickness and the average hydraulic conductivity of a unit. Also, the rate at which water is transmitted through a strip of an aquifer of a unit width under a unit hydraulic gradient at a prevailing temperature and pressure.

Transparency: Exchange of information, access to facilities, and cooperative arrangements undertaken to provide ready observation and verification of defense or other activities.

Transportation and Emergency Management Program: The transportation program is responsible for the safe movement of wastes among facilities for the purposes of treatment, storage, and disposal. The emergency management program is responsible for coordinating the response to adverse occurrences in environmental restoration and waste management operations.

Transuranic: Any element whose atomic number is higher than that of uranium (that is, atomic number 92). All transuranic elements are produced artificially and are radioactive.

Transuranic Waste: Waste contaminated with alpha-emitting radionuclides with half-lives greater than 20 years and concentrations greater than 100 nanocuries/gram at time of assay. It is not a mixed waste.

Treatment: An operation necessary to prepare material for disposal.

Triassic: First period of the Mesozoic Era, dating from between 245 to 208 million years ago.

Tritium: A radioactive isotope of the element hydrogen with two neutrons and one proton. Common symbols for the isotope are H-3 and T.

Tritium Recycling: The recovery, purification, and reuse of tritium contained in tritium reservoirs within the nuclear weapons stockpile.

Tuff: A fine-grained rock composed of volcanic ash.

Tunnel Drift: A small cross cut in a mine connecting two larger tunnels.

Unconfined Aquifer: A permeable geological unit having the following properties: a water-filled pore space (saturated), the capability to transmit significant quantities of water under ordinary differences in pressure, and an upper water boundary that is at atmospheric pressure.

Unsaturated Zone (Vadose): A region in a porous medium in which the pore space is not filled with water.

Uranium: A heavy, silvery-white metallic element (that is, atomic number 92) with many radioactive isotopes. U-235 is most commonly used as a fuel for nuclear fission. Another isotope, U-238, is transformed into fissionable Pu-239 following its capture of a neutron in a nuclear reactor.

Viewshed: The extent of the area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

Visual Resource Management (VRM): A methodology devised by the BLM to analytically assess the aesthetic quality of a landscape. The objective of this process is to lessen the visual impact of proposed activities while these actions are still in the design stage. The process consists of a rating of site visual quality (see VRM Class) followed by a measurement of the degree of contrast between proposed development activities and the existing landscape.

Visual Resource Management Class: As part of the BLM Visual Resource Management process, an inventory and evaluation of visual resources is conducted and lands are assigned a relative visual rating or management classification. There are five classes which define the different degrees of modification to landscape elements: Class 1 would apply to pristine areas including designated wilderness and wild and scenic rivers; Class 2 would apply to areas with very limited land development activity resulting in contrasts that are seen but do not attract attention; Class 3 would apply to areas where contrasts caused by development activity are evident, but the natural landscape still dominates; Class 4 would apply to areas where contrasts caused by human activities attract attention and are dominant features of the landscape in terms of scale, but repeat the contrast of the characteristic landscape; Class 5 would apply to areas where contrasts caused by cultural activities are the dominant feature of the landscape to the point that the natural landscape character no longer exists.

Visual Resources: Natural and cultural features that define the appearance of a particular landscape.

[Text deleted.]

Vitrification: A waste treatment process that uses glass (for example, borosilicate glass) to encapsulate or immobilize radioactive wastes.

Volatile Organic Compounds: A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures, such as benzene, chloroform, and methyl alcohol.

Waste: A discardable residue from a manufacturing or purification process.

Waste Isolation Pilot Plant (WIPP): A facility in southeastern New Mexico being developed as the disposal site for transuranic and transuranic mixed waste, not yet in operation.

Waste Minimization and Pollution Prevention: An action that economically avoids or reduces the generation of waste and pollution by source reduction, reducing the toxicity of hazardous waste and pollution, improving energy use, or recycling. These actions will be consistent with the general goal of minimizing present and future threats to human health, safety, and the environment.

Waste Package: The waste, waste container, and any absorbent that is intended for disposal as a unit. In the case of surface contaminated, damaged, leaking, or breached waste packages, any overpack shall be considered the waste container, and the original container shall be considered part of the waste.

Wastewater: Spent water originating from all aspects of human sanitary water use (domestic wastewater) and from a myriad of industrial processes that use water for a variety of purposes (industrial wastewater).

Water Quality Standard and Criteria: Concentration limit of constituents or characteristics allowed in water; often based on water use classifications (for example, drinking water, recreation use, propagation of fish and aquatic life, and agricultural and industrial use). Water quality standards are legally enforceable: water quality criteria are non-enforceable recommendations based on biotic impacts.

Water Table: The first water encountered below the surface of the ground occurs in two zones, an upper unsaturated zone and a deeper saturated zone. The boundary between the two zones is the water table.

Weapon Secondary: See "Secondary."

Weapon System: Collective term for the nuclear assembly and weapons usable nonnuclear components, subsystems, and systems that comprise a nuclear weapon.

Weapons Assembly/Disassembly: Assembly operations assembles piece parts into subassemblies using joining techniques such as welding, adhesive bonding, and mechanical joining. Disassembly takes retired weapons apart and recycles all materials of value.

Weapons-Grade Material: Pu or HEU, in metallic form, that has been removed from weapons as a result of stockpile downsizing, and Pu and HEU parts that were manufactured for weapons application. Weapons-grade Pu contains less than 7 percent Pu-240.

Weapons Laboratories: Colloquial term for the three DOE national laboratories—Los Alamos, Lawrence Livermore, and Sandia—that are responsible for the design, development, and stewardship of U.S. nuclear weapons.

Weapons Retirement: The process by which nuclear weapons are determined to be obsolete or unnecessary for national defense. A retired weapons or weapon system is no longer in an active status or deliverable, but may still be a fully functioning nuclear device.

Weapons-Usable Material: Pu and HEU in various forms (for example, metals and oxides) that can be readily converted for use in nuclear weapons, including weapons-grade, fuel-grade, and power reactor-grade Pu.

Weighting Factor: Represents the fraction of the total health risk resulting from uniform whole-body irradiation that could be contributed to that particular tissue.

Wet Site: For the purposes of this PEIS, any site where adequate surface water is available for the various storage and disposition needs.

Wetland: Land or areas exhibiting hydric soil conditions, saturated or inundated soil during some portion of the year, and plant species tolerant of such conditions.

Whole-Body Dose: Dose resulting from the uniform exposure of all organs and tissues in a human body. Also, see "Effective Dose Equivalent."

***Wild and Scenic Rivers Act*:** This Act establishes a National Wild and Scenic Rivers System to preserve and protect the free-flowing condition of selected rivers with outstanding natural, cultural, or recreational features. For Federally-owned land within the boundaries of rivers in the System, certain activities that would have a direct and adverse effect on river values may be controlled.

Wind Rose: A depiction of wind speed and direction frequency for a given period of time.

χ/Q (Chi/Q): The relative calculated air concentration due to a specific air release; units are (sec/m^3). For example, (Ci/m^3)/(Ci/sec)=(sec/m^3) or (gm/m^3)/(gm/sec)=(sec/m^3).

[Text deleted.]

2R Container: An inner containment vessel for radioactive materials built to approved specifications of the DOT pursuant to 49 CFR 178.360-1. Each 2R vessel must be made of stainless steel, malleable iron, or brass, or other material having equivalent physical strength and fire resistance. The inside diameter of the vessel may not exceed 30 cm (12 in) with a wall thickness no less than for schedule 40 pipe. Each 2R vessel must have welded, brazed, screw-type or flanged closure devices which meet DOT specifications.

6M: A container which resembles a 55-gallon stainless steel drum which DOE uses as an outer container with impact absorber material (Type B packaging) placed inside the container to protect the inner container (usually a Type 2R) which is typically used to ship radioactive material.

Chapter 8
List of Preparers

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B.A., Mathematics, 1969, Hartwick College, Oneonta, NY
Years of Experience: 26

Biegel, Herb, Data Coordinator, Lamb Associates, Inc.
B.S., Electrical Engineering, 1965, Naval Post Graduate School, Monterey, CA
B.S., Naval Science, 1955, U.S. Naval Academy, Annapolis, MD
Years of Experience: 21

Bienenfeld, Paula, Cultural and Paleontological Specialist, Tetra Tech, Inc.
Ph.D., Anthropology, 1986, State University of New York at Binghamton, Binghamton, NY
M.A., Anthropology, 1979, State University of New York at Binghamton, Binghamton, NY
B.A., Anthropology, 1973, University of Michigan, Ann Arbor, MI
Years of Experience: 18

Bingaman, Trip, Technical Coordinator, Halliburton NUS Corp.
B.A., Economics, 1991, West Virginia University, Morgantown, WV
Years of Experience: 6

Blauer, H. Mark, Deputy Program Manager, Tetra Tech, Inc.
Ph.D., Nuclear Chemistry, 1977, University of Glasgow, Scotland
M.S., Earth and Space Science, 1971, State University of New York at Stony Brook, Stony Brook, NY
B.S., Chemistry, 1968, State University of New York at Stony Brook, Stony Brook, NY
Years of Experience: 28

Boucher, Marc, Fissile Materials Storage Specialist, SRA Technologies, Inc.
B.S., Nuclear Engineering, 1991, University of Florida, Gainesville, FL
Years of Experience: 5

Bruner, Daniel L., General Engineer, Office of NEPA Compliance and Outreach, Office of Fissile Materials Disposition, MD-4, DOE
B.S., Civil Engineering, 1971, Auburn University, Auburn, AL
Years of Experience: 25

Cambria, Michael J., Infrastructure and Immobilization Specialist, SRA Technologies, Inc.
M.S., Nuclear Engineering, 1964, Pennsylvania State University, State College, PA
B.S., Physics, 1962, Villanova University, Villanova, PA
Years of Experience: 32

Chambers, Matthew J., Waste Management Specialist, Lamb Associates, Inc.
M.S., Environmental Engineering, 1995, Johns Hopkins University, Baltimore, MD
B.S., Chemical Engineering, 1989, University of Maryland, College Park, MD
Years of Experience: 7

Choephel, Ann Marie, Comment Analysis and Response Coordinator, Halliburton NUS Corp.
M.S., Public Administration, 1981, George Washington University, Washington, DC
B.S., Education, 1973, Virginia Commonwealth University, Richmond, VA
Years of Experience: 22

Collier, Crystal D., Publications Manager, Tetra Tech, Inc.
M.A., English, 1992, Virginia Polytechnic Institute and State University, Blacksburg, VA
B.A., English, 1990, Virginia Polytechnic Institute and State University, Blacksburg, VA
Years of Experience: 6

Dabak, Turgay, Implementation Plan Task Manager, Tetra Tech, Inc.
Ph.D., Civil Engineering, 1986, Virginia Polytechnic and State University, Blacksburg, VA
M.S., Civil Engineering, 1979, Orta Dogu Technical University, Ankara, Turkey
B.S., Civil Engineering, 1976, Orta Dogu Technical University, Ankara, Turkey
Years of Experience: 15

Davis, Larry J., Nuclear Weapons Design and Engineering Technical Coordinator, Lamb Associates, Inc.
M.S., Physics, 1971, Naval Postgraduate School, Monterey, CA
B.S., Mathematics, 1964, Jacksonville State University, Jacksonville, AL
Years of Experience: 32

Felkner, Ira Cecil, Chemical Hazards Specialist, SRA Technologies, Inc.
Ph.D., Microbiology/Biochemistry, 1966, University of Texas, Austin, TX
M.A., Bacteriology/Genetics, 1960, University of Texas, Austin, TX
B.A., Zoology/Chemistry, 1958, University of Texas, Austin, TX
Years of Experience: 35

Fleming, William R., Technical Coordinator, SRA Technologies, Inc.
Ph.D., Public Policy, 1987, Florida State University, Tallahassee, FL
M.P.A., Urban Administration and Planning, 1979, Florida Atlantic University, Boca Raton, FL
B.A., Political Science, 1976, Saint Leo College, Saint Leo, FL
Years of Experience: 15

Fluck, Paul V., Geology and Soils Specialist, Tetra Tech, Inc.
B.S., Geology, 1985, Stockton State College, Pomona, NJ
B.S., Environmental Science, 1985, Stockton State College, Pomona, NJ
Years of Experience: 10

Flynn, David T., Nuclear Safety Specialist, Tetra Tech, Inc.
B.S., Geology, 1979, Southern Illinois University, Carbondale, IL
Years of Experience: 17

Gandee, Kitty R., PEIS Manager, Office of NEPA Compliance and Outreach, Office of Fissile Materials Disposition, MD-4, DOE
M.S., Nuclear Engineering, 1978, Oregon State University, Corvallis, OR
M.L.S., Library Science, 1975, University of Pittsburgh, Pittsburgh, PA
M.S., Materials Engineering, 1974, University of Maryland, College Park, MD
B.S., Metallurgical Engineering, 1972, Chen Kung University, Taiwan
Years of Experience: 19

Garrison, Roy F., Packaging & Transportation Program Specialist, Lamb Associates, Inc.
Ph.D., Transportation Management, 1987, Kensington University, Glendale, CA
M.A., Business Administration/Management, 1986, University of Washington Joint Center for Graduate Studies, Richland, WA
B.A., 1970, College of Advance Traffic, Chicago, IL
Years of Experience: 36

Gerard, Thomas A., Immobilization Technology Specialist, SRA Technologies, Inc.
M.B.A., 1989, Golden Gate University, San Francisco, CA
M.S., Civil Engineering, 1976, California Institute of Technology, Pasadena, CA
B.S., Engineering, 1970, U.S. Military Academy, West Point, NY
Years of Experience: 26

Grant, Johnnie W., Waste Management Task Leader, Lamb Associates, Inc.
M.S., Physics, 1978, Arizona State University, Tempe, AZ
B.S., Military Science, 1969, U.S. Military Academy, West Point, NY
Years of Experience: 26

Hamilton, Michael A., Facility Security Manager, SRA Technologies, Inc.
B.A., Liberal Arts, 1981, University of Central Florida, Orlando, FL
Years of Experience: 14

Heppner, Marie, Land Resources Specialist, Tetra Tech, Inc.
M.P., Environmental Planning, 1995, University of Virginia, Falls Church, VA
B.A., Urban Studies, 1983, University of Maryland, College Park, MD
Years of Experience: 11

Howard, Robert D., E.I.T., PEIS Document Integrator, Tetra Tech, Inc.
B.S., Civil Engineering, 1992, Virginia Polytechnic Institute and State University, Blacksburg, VA
Years of Experience: 4

Humes, Donald C., Waste Management and Socioeconomics Specialist, SRA Technologies, Inc.
M.S., Environmental Engineering, 1994, Colorado State University, Fort Collins, CO
B.S., Electrical Engineering, 1989, Villanova University, Villanova, PA
Years of Experience: 5

Hussey, Michael K., NEPA Compliance Specialist, Tetra Tech, Inc.
Registered Professional Landscape Architect, 1967
Years of Experience: 29

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M.A., Engineering Administration, 1987, George Washington University, Washington, DC
B.S., Civil Engineering, 1985, George Washington University, Washington, DC
Years of Experience: 9

Jacobs, Maryce M., Toxicology Specialist, SRA Technologies, Inc.
Ph.D., Biological Chemistry, 1970, University of California, Los Angeles, CA
Postdoctoral Study, Electron Microscopy, 1971, University of Colorado Medical Center, Denver, CO
M.S., Business Administration, 1991, Strayer College, Washington, DC
B.S., Chemistry, 1966, New Mexico State University, Las Cruces, NM
Years of Experience: 25

Jones, Rebecca, Comment Analysis and Response Coordinator, Tetra Tech, Inc.
B.A., Broadcast Journalism, 1992, West Texas A & M, Canyon, TX
Years of Experience: 4

Joyce, William E., Health Physics Specialist, Halliburton NUS Corp.
B.S., Chemical Engineering, 1968, University of Connecticut, Storrs, CT
Years of Experience: 27

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M.Eng., Environmental Engineering, 1995, The Johns Hopkins University, Baltimore, MD
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Years of Experience: 4

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M.P.P., Public Policy, 1981, Wharton School, University of Pennsylvania, Philadelphia, PA
B.S., Biology of Natural Resources, 1979, University of California, Berkeley, CA
Years of Experience: 13

Kriz, Joseph B., NEPA Compliance Manager, Tetra Tech, Inc.
B.S., Biology, 1979, Shippensburg University, Shippensburg, PA
B.A., Geoenvironmental Studies, 1979, Shippensburg University, Shippensburg, PA
Years of Experience: 14

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M.A., Meteorology, 1974, South Dakota School of Mines and Technology, Rapid City, SD
B.S., Meteorology and Oceanography, 1972, New York University, New York, NY
Years of Experience: 19

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B.A., History, 1990, Pennsylvania State University, University Park, PA
B.A., Anthropology, 1990, Pennsylvania State University, University Park, PA
Years of Experience: 6

MacConnell, James M., Biological Resources Specialist, Halliburton NUS
B.S., Zoology, 1974, University of Maryland, College Park, MD
Years of Experience: 22

Magette, Thomas E., P.E., Program Manager, Tetra Tech, Inc.
M.S., Nuclear Engineering, 1979, University of Tennessee, Knoxville, TN
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Years of Experience: 19

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M.S., Operations Research, 1970, George Washington University, Washington, DC
B.S., Mathematics, 1961, Fairleigh Dickinson University, Rutherford, NJ
Years of Experience: 34

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B.A., Economics, 1995, Wittenberg University, Springfield, OH
Years of Experience: 1

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Years of Experience: 20

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M.S., Nuclear Engineering, 1972, University of New Mexico, Albuquerque, NM
Years of Experience: 25

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M.B.A., 1972, University of Utah, Salt Lake City, UT
B.S., Air Science, 1960, Oklahoma State University, Stillwater, OK
Years of Experience: 33

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Years of Experience: 3

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Years of Experience: 1

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M.S., Mechanical Engineering, 1970, Stanford University, Stanford, CA
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Years of Experience: 28

Petraglia, Jeffrey P., Deputy Project Task Manager, Tetra Tech, Inc.
M.Eng., Nuclear Engineering, 1986, Pennsylvania State University, University Park, PA
B.S., Nuclear Engineering, 1981, Pennsylvania State University, University Park, PA
Years of Experience: 15

Schinner, James R., Biotic Resources Specialist, Halliburton NUS Corp.
Ph.D., Wildlife Management, 1974, Michigan State University, East Lansing, MI
B.S., Zoology, 1967, University of Cincinnati, Cincinnati, OH
Years of Experience: 23

Schlegel, Robert, Health Physics Specialist, Halliburton NUS Corp.
M.S., Nuclear Engineering, 1961, Columbia University, New York, NY
B.S., Chemical Engineering, 1959, Massachusetts Institute of Technology, Cambridge, MA
Years of Experience: 31

Sclichter, Edward F., Commercial MOX Fuel Fabrication Specialist and ADC Reviewer, Lamb Associates, Inc.
Ph.D., Business/Financial Management, 1980, University of Nebraska, Lincoln, NE
M.S., Management, 1967, Naval Postgraduate School, Monterey, CA
B.S., U.S. Naval Academy, 1961, Annapolis, MD
Years of Experience: 31

Shukla, Nilesh, Environmental Analyst, Tetra Tech, Inc.
B.S., Biochemistry, 1992, University of California Riverside, Riverside, CA
Years of Experience: 4

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M.P.H., Health Physics, 1961, University of Michigan, Ann Arbor, MI
M.S., Sanitary Engineering, 1957, University of Wisconsin, Madison, WI
B.S., Civil Engineering, 1956, Case Western Reserve, Cleveland, OH
Years of Experience: 39

Steibel, John, Waste Management Specialist, SRA Technologies, Inc.
B.S., Industrial Engineering/Management Systems, 1958, General Motors Institute, Flint, MI
Years of Experience: 37

Stevenson, G. Bert, Deputy Director, Office of NEPA Compliance and Outreach, Office of Fissile Materials Disposition, MD-4, DOE
B.S., Physics, 1963, Marshall University, Huntington, WV
Years of Experience: 33

Stewart, Jeffrey D., C.P.G., Geology and Soils Specialist, Tetra Tech, Inc.
B.S., Geophysics, 1985, Virginia Polytechnic Institute and State University, Blacksburg, VA
Years of Experience: 11

Sullivan, Barry D., Facility Accidents Specialist, Halliburton NUS Corp.
M.B.A., Management, 1964, Hofstra University, Hempstead, NY
B.S., Electrical Engineering, 1960, Rutgers University, New Brunswick, NJ
Years of Experience: 35

Tammara, Rao, Transportation Specialist, Halliburton NUS Corp.
M.S., Environmental Engineering, 1976, University of Maryland
M.S., Chemical/ Nuclear Engineering, 1970, University of Maryland
M. Tech (M.S.), Chemical Engineering, Plant Design, 1968, Osmania University, India
M. Tech (B.S.), Chemical Engineering, 1966, Osmania University, India
B. Sci. (B.S.), Mathematics, Physics and Chemistry, 1961, Osmania University, India
Years of Experience: 25

Tan, Roy, Health Physics Specialist, Tetra Tech, Inc.
Ph.D., Radiological Environmental Engineering, 1996, University of Cincinnati, Cincinnati, OH
M.S., Nuclear Engineering, 1994, University of Cincinnati, Cincinnati, OH
B.S., Power Engineering, 1982, Harbin Engineering Institute, Harbin, China
Years of Experience: 14

Thayer, Patrick M., Fissile Materials Conversion Technology Specialist, SRA Technologies, Inc.
M.B.A., 1979, University of Colorado, Boulder, CO
B.G.S., Business, 1973, University of Nebraska, Omaha, NE
Years of Experience: 31

Trautman, Samantha, Production Coordinator, Tetra Tech, Inc.
B.A., English, 1991, Vassar College, Poughkeepsie, NY
Years of Experience: 5

Tray, Michaela, Reference Coordinator, Tetra Tech, Inc.
Currently enrolled, University of Virginia, Falls Church, VA
Years of Experience: 26

Truesdale, F. Scott, Water Resources Specialist, Tetra Tech Inc.
B.A., Environmental Science/Geology, 1984, University of Virginia, Charlottesville, VA
Years of Experience: 11

Tsou, James, Air Quality Specialist, Halliburton NUS Corp.
M.S., Environmental Science, 1991, University of Cincinnati, Cincinnati, OH
B.S., Atmospheric Science, 1985, National Taiwan University, Taiwan
Years of Experience: 11

Werth, Robert, Air Quality and Acoustics Specialist, Halliburton NUS Corp.
B.A., Physics, 1973, Gordon College, Wenham, MA
Years of Experience: 23

Westbrook, Chris R., Technical Coordinator, Lamb Associates, Inc.
M.S., Nuclear Engineering, 1980, Air Force Institute of Technology, Fairborn, OH
M.B.A., 1976, Webster University, St. Louis, MO
B. S., Nuclear Engineering, 1973, University of Tennessee, Knoxville, TN
Years of Experience: 23

Wilkins, Lawrence, Socioeconomics Specialist, SRA Technologies, Inc.
M.A., Management, 1981, Central Michigan University, Mount Pleasant, MI
B.S., Engineering, 1970, U.S. Military Academy, West Point, NY
Years of Experience: 26

Chapter 9
Federal, State, and Local Agencies and Organizations Contacted

This chapter identifies the various agencies and organizations contacted during the preparation of this Storage and Disposition PEIS. The entities were contacted to actively solicit site-specific data; regulatory compliance requirements; Federal, State, and local laws; or Executive Orders that may be applicable to the proposed alternatives considered.

Aberdeen, Idaho
Aberdeen Fire Department

Adams County, Colorado
Adams County Fire Department

Adams County, Colorado
Adams County Police Department

Adams County, Colorado
Adams County Schools

Adams County, Colorado
Bennett Schools

Adams County, Colorado
Brighton Schools

Adams County, Colorado
Mapleton Schools

Adams County, Colorado
Northglenn-Thornton Schools

Adams County, Colorado
Strasburg Schools

Adams County, Colorado
Westminster Schools

Advisory Council on Historic Preservation
Washington, DC

Aiken, South Carolina
Aiken Fire Department

Aiken County, South Carolina
Aiken County Fire Department

Aiken County, South Carolina
Aiken County School District

Allendale County, South Carolina
Allendale County School District

Allendale Town, South Carolina
Allendale Town Fire Department

Allenspark, Colorado
Allenspark Fire Department

Almer, South Carolina
Almer Fire Department

Amarillo, Texas
Amarillo Fire Department

Amarillo, Texas
Amarillo Planning Department

Amarillo, Texas
Amarillo School District

Ammon, Idaho
Ammon Fire Department

Anderson County, Tennessee
Anderson County Fire Department

Anderson County, Tennessee
Anderson County Police Department

Anderson County, Tennessee
Anderson County School District

Arapahoe County, Colorado
Adams-Arapahoe Schools

Arapahoe County, Colorado
Byers Schools

Arapahoe County, Colorado
Cherry Creek Schools

Arapahoe County, Colorado
Deer Trails Schools

Arapahoe County, Colorado
Englewood Schools

Arapahoe County, Colorado
Littleton Schools

Arapahoe County, Colorado
Sheridan Schools

Armstrong County, Texas
Claude School District

Arvada, Colorado
Arvada Fire Department

Ash Meadows National Wildlife Refuge, Nevada

Augusta, Georgia
Augusta Fire Department

Aurora, Colorado
Aurora Fire Department

Bamberg County, South Carolina
Bamberg District #1

Bamberg County, South Carolina
Bamberg District #2

Bamberg County, South Carolina
County Administrator's Office
Emergency Preparedness-Fire

Bannock County, Idaho
Bannock County Fire Department

Bannock County, Idaho
Marsh Valley School District

Bannock County, Idaho
Pocatello School District

Barnwell County, South Carolina
Barnwell School District #19

Barnwell County, South Carolina
Barnwell School District #29

Barnwell County, South Carolina
Barnwell School District #45

Basin City, Washington
Basin City Fire Department

Bennett, Colorado
Bennett Fire Department

Benton City, Washington
Benton City Fire Department

Benton County, Washington
Finley School District

Benton County, Washington
Horse Haven Fire Department

Benton County, Washington
Kiona-Benton School District

Benton County, Washington
Patterson School District

Bingham County, Idaho
Aberdeen School District

Bingham County, Idaho
Blackfoot School District

Bingham County, Idaho
Firth School District

Bingham County, Idaho
Shelley School District

Bingham County, Idaho
Snake River School District

Blackfoot, Idaho
Blackfoot Fire Department

Bonneville County, Idaho
Bonneville School District

Bonneville County, Idaho
Idaho Falls School District

Bonneville County, Idaho
Swan Valley School District

Boulder County, Colorado
Boulder County Police Department

Boulder County, Colorado
Boulder Valley Schools

Boulder County, Colorado
Office of Emergency Management-Fire

Boulder County, Colorado
St. Vrain Valley Schools

Boulder, Colorado
Boulder Fire Department

Brighton, Colorado
Brighton Fire Department

Buffalo Creek, Colorado
Buffalo Creek Fire Department

Butte County, Idaho
Arco School District

Butte County, Idaho
Butte County Fire Department

Byers, Colorado
Byers Fire Department

Canyon, Texas
Canyon Fire Department

Canyon, Texas
Canyon School District

Carson County, Texas
Claude School District

Clark County, Nevada
Clark County Fire Department

Clark County, Nevada
Clark County School District

Clinton, Tennessee
Clinton City Fire Department

Clinton, Tennessee
Clinton City Police Department

Clinton, Tennessee
Clinton City School District

Columbia Basin
U.S. Fish and Wildlife Service
Columbia National Wildlife Refuge Project Leader

Columbia County, Georgia
Columbia County Fire Department

Columbia County, Georgia
Columbia County School District

Commerce City, Colorado
Commerce City Fire Department

Conifer, Colorado
Conifer Fire Department

Connell, Washington
Connell Fire Department

Cowiche, Washington
Cowiche Fire Department

Deer Trail, Colorado
Deer Trail Fire Department

Denver County, Colorado
Denver County Fire Department

Denver County, Colorado
Denver County Schools

Denver County, Colorado
Department of Local Affairs-Population

Edgewater, Colorado
Edgewater Fire Department

Eldorado Springs, Colorado
Eldorado Springs Fire Department

Englewood, Colorado
Englewood Fire Department

Evergreen, Colorado
Evergreen Fire Department

Fairfax, South Carolina
Fairfax Fire Department

Federal Heights, Colorado
Federal Heights Fire Department

Firth, Idaho
Firth Fire Department

Franklin County, Washington
North Franklin School District

Franklin County, Washington
Star School District

Georgia Center for Disease Control and Prevention

Gleed, Washington
Gleed Fire Department

Glendale, Colorado
Glendale Fire Department

Glendale, Tennessee
Glendale Fire Department

Golden, Colorado
Golden Fire Department

Grandview, Washington
Grandview Fire Department

Grandview, Washington
Grandview School District

Granger, Washington
Granger Fire Department

Granger, Washington
Granger School District

Greenback, Tennessee
Greenback Fire Department

Greenwood Village, Colorado
Greenwood Village Fire Department

Groom, Texas
Groom Fire Department

Groom, Texas
Groom School District

Hamer, Idaho
Hamer Fire Department

Harriman, Tennessee
Harriman Fire Department

Harriman, Tennessee
Harriman Police Department

Harriman, Tennessee
Harriman School District

Henderson, Nevada
Henderson Fire Department

Hephzibah, Georgia
Hephzibah Fire Department

Hygiene, Colorado
Hygiene Fire Department

Idaho Falls, Idaho
Idaho Falls Fire Department

Idaho Falls, Idaho
Idaho Falls Planning Department

Idledale, Colorado
Idledale Fire Department

Indian Hills, Colorado
Indian Hill Fire Department

Jameston, Colorado
Jameston Fire Department

Jefferson County, Colorado
Department of Emergency Preparedness-Fire

Jefferson County, Colorado
Jefferson County Schools

Jefferson County, Idaho
Jefferson County Fire Department

Jefferson County, Idaho
Jefferson School District

Jefferson County, Idaho
Ririe School District

Jefferson County, Idaho
West Jefferson School District

Kahlotus, Washington
Kahlotus Fire Department

Kahlotus, Washington
Kahlotus School District

Kennewick, Washington
Kennewick Fire Department

Kennewick, Washington
Kennewick School District

Kingston, Tennessee
Kingston Fire Department

Kingston, Tennessee
Kingston Police Department

Knox County, Tennessee
Knox County Fire Department

Knox County, Tennessee
Knox County Police Department

Knox County, Tennessee
Knox County School District

Knoxville, Tennessee
Knoxville Fire Department

Knoxville, Tennessee
Knoxville Police Department

Lafayette, Colorado
Lafayette Fire Department

Lake City, Tennessee
Lake City Fire Department

Lake City, Tennessee
Lake City Police Department

Lakewood, Colorado
Lakewood Fire Department

Las Vegas, Nevada
Las Vegas Fire Department

Lenoir City, Tennessee
Lenoir City Fire Department

Lenoir City, Tennessee
Lenoir City Police Department

Lenoir City, Tennessee
Lenoir City School District

Littleton, Colorado
Littleton Fire Department

Longmont, Colorado
Longmont Fire Department

Los Alamos County, New Mexico
Community Development Director

Loudon County, Tennessee
Loudon County Fire Department

Loudon County, Tennessee
Loudon County Police Department

Loudon County, Tennessee
Loudon County School District

Loudon, Tennessee
Loudon Fire Department

Loudon, Tennessee
Loudon Police Department

Louisville, Colorado
Louisville Fire Department

Lyons, Colorado
Lyon Fire Department

Mabton, Washington
Mabton Fire Department

Mabton, Washington
Mabton School District

Martin, South Carolina
Martin Fire Department

Martinez, Georgia
Martinez Fire Department

Menan, Idaho
Menan Fire Department

Mesa, Washington
Mesa Fire Department

Morrison, Colorado
Morrison Fire Department

Naches, Washington
Naches Fire Department

National Institute for Occupational Safety and Health
Division of Surveillance
Hanford Evaluation and Field Studies

Nederland, Colorado
Nederland Fire Department

Nile, Washington
Nile Fire Department

Norris, Tennessee
Norris Fire Department

Norris, Tennessee
Norris Police Department

North Augusta, South Carolina
North Augusta Fire Department

North Las Vegas, Nevada
North Las Vegas Fire Department

Northglenn, Colorado
Northglenn Fire Department

Nye County, Nevada
Nye County Fire Department

Nye County, Nevada
Nye County Planning Department

Nye County, Nevada
Nye County School District

Oak Ridge, Tennessee
Oak Ridge Fire Department

Oak Ridge, Tennessee
Oak Ridge Planning Department

Oak Ridge, Tennessee
Oak Ridge Police Department

Oak Ridge, Tennessee
Oak Ridge School District

Oliver Springs, Tennessee
Oliver Springs Fire Department

Oliver Springs, Tennessee
Oliver Springs Police Department

Osage, Texas
Osage Fire Department

Panhandle Groundwater Conservation District 3

Panhandle, Texas
Panhandle Fire Department

Panhandle, Texas
Panhandle School District

Parker, Colorado
Parker Fire Department

Pasco, Washington
Pasco Fire Department

Pasco, Washington
Pasco School District

Philadelphia, Tennessee
Philadelphia Fire Department

Plymouth, Washington
Plymouth Fire Department

Pocatello, Idaho
Pocatello Fire Department

Potter County, Texas
Bushland School District

Potter County, Texas
Highland Park School District

Potter County, Texas
Potter County Fire Department

Potter County, Texas
River Road School District

Prosser, Washington
Prosser Fire Department

Prosser, Washington
Prosser School District

Richland, Washington
Richland Fire Department

Richland, Washington
Richland School District

Richmond County, Georgia
Richmond County Fire Department

Richmond County, Georgia
Richmond County School District

Rigby, Idaho
Rigby Fire Department

Roane County, Tennessee
Roane County Fire Department

Roane County, Tennessee
Roane County Police Department

Roane County, Tennessee
Roane County School District

Roane County, Tennessee
Roane County Zoning Officer

Roberts, Idaho
Roberts Fire Department

Rockwood, Tennessee
Rockwood Fire Department

Rockwood, Tennessee
Rockwood Police Department

Rollinsville, Colorado
Rollinsville Fire Department

Santa Fe County, New Mexico
Planning Department

Sedalia, Colorado
Sedalia Fire Department

Selah, Washington
Selah Fire Department

Selah, Washington
Selah School District

Shelley, Idaho
Shelley Fire Department

Sheridan, Colorado
Sheridan Fire Department

Skellytown, Texas
Skellytown Fire Department

Skyline, Colorado
Skyline Fire Department

State of Colorado
Education Department

State of Colorado
Public Health and Environment Department
Water Quality Division
Drinking Water Section

State of Idaho
Education Department

State of Idaho
Health and Welfare Department

State of Nevada
Conservation and Natural Resources Department
Environmental Protection Division
Water Quality Section

State of Nevada
Conservation and Natural Resources Department
State Engineer

State of Nevada
Conservation and Natural Resources Department
Water Planning Division

State of New Mexico
Education Department

State of New Mexico
Energy, Minerals, and Natural Resources Department
Forest Resources and Conservation Division
Fire Management Bureau

State of New Mexico
Environment Department
Drinking Water Program Division

State of New Mexico
Environment Department
Ground Water Quality Bureau

State of New Mexico
Public Safety Department

State of New Mexico
State Engineer's Office

State of South Carolina
Education Department

State of South Carolina
Health and Environmental Control Department
Environmental Quality Control Division
Drinking Water Bureau

State of South Carolina
Health and Environmental Control Department
Environmental Control Division
Water Pollution Control Bureau

State of South Carolina
Natural Resources Department
Water Resources Division
Water Use Section

State of South Carolina
Transportation Department

State of Tennessee
Department of Health

State of Tennessee
Education Department

State of Tennessee
Environmental Conservation Department
Environment Bureau
Division of Water Pollution Control

State of Tennessee
Health and Environment Department
Office of Water Management

State of Tennessee
Transportation Department

State of Texas
Department of Health
Division of Water Hygiene

State of Texas
Health Department
Bureau of Chronic Disease Prevention and Control
Cancer Registry Division

State of Texas
Natural Resources Conservation Commission

State of Texas
Water Commission

Strasburg, Colorado
Strasburg Fire Department

Sunnyside, Washington
Sunnyside Fire Department

Sunnyside, Washington
Sunnyside School District

Swan Valley, Idaho
Swan Valley Fire Department

Teleco, Tennessee
Teleco Fire Department

Thorton, Colorado
Thorton Fire Department

Tieton, Washington
Tieton Fire Department

Toppenish, Washington
Toppenish Fire Department

Toppenish, Washington
Toppenish School District

U.S. Department of Agriculture
Natural Resources Conservation Service
Benton County, Washington

U.S. Department of Agriculture
Natural Resources Conservation Service
Franklin County, Washington

U.S. Department of Agriculture
Soil Conservation Service
Aiken County, South Carolina

U.S. Department of Agriculture
Soil Conservation Service
Albuquerque, New Mexico

U.S. Department of Agriculture
Soil Conservation Service
Silver City, New Mexico

U.S. Department of Commerce
Bureau of Economic Analysis

U.S. Department of the Interior
Bureau of Land Management
Big Butte Resource Area

U.S. Department of the Interior
Bureau of Land Management
Idaho Falls District

U.S. Department of the Interior
National Park Service
Seattle, Washington

U.S. Department of the Interior
National Park Service
Washington, DC

U.S. Department of the Interior
National Register of Historic Places
Washington, DC

U.S. Department of the Interior
National Rivers Program Manager

U.S. Department of the Interior
U.S. Fish and Wildlife Service
Desert National Wildlife Refuge Complex

U.S. Department of the Interior
U.S. Geological Survey
Arco, Idaho

U.S. Department of the Interior
U.S. Geological Survey
Water Resources Division
Boise, Idaho

U.S. Department of the Interior
U.S. Geological Survey
Oak Ridge, Tennessee

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Region IV
Atlanta, Georgia

U.S. Environmental Protection Agency
Region VI
Dallas, Texas

U.S. Environmental Protection Agency
Region VIII
Denver, Colorado

U.S. Environmental Protection Agency
Region IX
San Francisco, California

U.S. Environmental Protection Agency
Region X
Seattle, Washington

Ucon, Idaho
Ucon Fire Department

Umbarger, Texas
Umbarger Fire Department

Union Gap, Washington
Union Gap Fire Department

Union Gap, Washington
Union Gap School District

Wapato, Washington
Wapato Fire Department

Wapato, Washington
Wapato School District

Ward, Colorado
Ward Fire Department

Water Resource Center
Desert Research Institute
University and Community College System of Nevada
Las Vegas/Reno

West Richland, Washington
West Richland Fire Department

Westminster, Colorado
Westminster Fire Department

Wheat Ridge, Colorado
Wheat Ridge Fire Department

White Deer, Texas
White Deer Fire Department

White Deer, Texas
White Deer School District

Yakima County, Washington
Broadway Fire Department

Yakima County, Washington
East Valley School District

Yakima County, Washington
Glade Fire Department

Yakima County, Washington
Highland School District

Yakima County, Washington
Mount Adams School District

Yakima County, Washington
Naches Heights Fire Department

Yakima County, Washington
Naches Valley School District

Yakima County, Washington
Terrace Heights Fire Department

Yakima County, Washington
West Valley Fire Department

Yakima County, Washington
West Valley School District

Yakima, Washington
Yakima Fire Department

Yakima, Washington
Yakima School District

Zillah, Washington
Zillah Fire Department

Zillah, Washington
Zillah School District

Chapter 10
Distribution List

The Department is providing copies of this Final PEIS to Federal, State, and local elected and appointed government officials and agencies; Native American groups; and other organizations and individuals listed below. DOE will distribute bulk quantities of this Final PEIS to some individuals and organizations for further distribution to the organizations listed below (for example, State points of contact). Copies will be provided to other interested parties upon request.

Federal-Elected Officials Representing Affected Areas
States: Colorado
Georgia
Idaho
Nevada
New Mexico
Oregon
South Carolina
Tennessee
Texas
Washington

Congressional Committees
Committee on Appropriations, U.S. Senate
Committee on Appropriations, U.S. House of Representatives
Committee on Armed Services, U.S. Senate
[Text deleted.]
Committee on National Security, U.S. House of Representatives
[Text deleted.]

Governors Representing Affected Areas
States: Colorado
Georgia
Idaho
Nevada
New Mexico
Oregon
South Carolina
Tennessee
Texas
Washington

State-Elected Officials Representing Affected Areas
States: Colorado
Georgia
Idaho
Nevada
New Mexico
Oregon
South Carolina
Tennessee
Texas
Washington

Federal-Recognized Indian Tribes
Alabama-Coushatta Tribe of Texas, TX
All Indian Pueblo Council, NM
Battle Mountain Band Council, NV
Burns-Paiute General Council, OR
Carson Colony Community Council, NV
Chehalis Business Council, WA
Cochiti Pueblo, NM
Coeur D'Alene Tribal Council, ID
Colville Business Council, WA
Colville Tribe, WA
Confederated Tribes of the Umatilla Reservation, OR
Coquille Indian Tribe, OR
Council of Energy Resource Tribes, CO
Dresslerville Community Council, NV
Duckwater Shoshone Indian Tribe, NV
Elko Band Council, NV
Ely Shoshone Indian Tribe, NV
Fort Hall Business Council; Sho Ban Tribes, ID
Hoh Tribal Business Council, WA
Isleta Pueblo, NM
Jemez Pueblo, NM
Jicarilla Apache Tribe, NM
Kickapoo Traditional Tribe of Texas, TX
Las Vegas Indian Center, NV
Las Vegas Indian Colony, NV
Lummi Business Council, WA
Makah Tribal Council, WA
Mescalero Apache Tribe, NM
Moapa Paiute Indian Tribe, NV
Muckleshoot Tribal Council, WA
Nambe Pueblo, NM
Native Indian Association, TN
Nez Perce Tribal Executive Committee, ID
Nisqually Indian Community Council, WA
Pahrump Paiute Indian Tribe, NV
Pojoaque Pueblo, NM

Port Gamble S'Klallam Tribe, WA
Puyallup Tribal Council, WA
Pyramid Lake Paiute Tribal Council, NV
Quileute Tribal Council, WA
Ramah Navajo Chapter, NM
San Felipe Pueblo, NM
San Ildefonso Pueblo, NM
San Juan Pueblo, NM
Santa Ana Pueblo, NM
Santa Clara Pueblo, NM
Santa Domingo Pueblo, NM
Sauk-Suiattle Tribal Council, WA
Shoalwater Bay Tribal Council, WA
Shoshone Paiute Business Council, NV
Skokomish Tribal Council, WA
South Fork Band Council, NV
Southern Ute Tribe, CO
Squaxin Island Tribal Council, WA
Stewart Community Council, NV
Stillaquamish Board of Directors, WA
Summit Lake Paiute Council, NV
Suquamish Tribal Council, WA
Swinomish Indian Tribal Community, WA
Tennessee Commission of Indian Affairs, TN
Tesuque Pueblo, NM
Tribal Council of the Te-Moak Western, NV
Tulalip Board of Directors, WA
Umatilla Board of Trustees, OR
Upper Skagit Tribal Council, WA
Ute Mountain Ute Tribe, CO
Walker River Paiute Tribal Council, NV
Wells Indian Colony Band Council, NV
Western Shoshone Elders Council, NV
Western Shoshone Government, NV
Western Shoshone National Council, NV
Winnemucca Indian Colony, NV
Yakama Indian Nation, WA
Yakama Tribal Council, WA
Yerington Paiute Tribal Council, NV
Yomba Shoshone Indian Tribe, NV
Zia Pueblo, NM
Zuni Pueblo, NM

NEPA Points of Contact by State

States: Colorado
Georgia
Idaho
Nevada
New Mexico
Oregon
South Carolina
Tennessee
Texas
Washington

Federal Agencies

Defense Nuclear Facilities Safety Board
Federal Energy Regulatory Commission
General Accounting Office
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National Academy of Sciences
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
National Parks and Conservation
National Science Foundation
Office of Technology Assessment
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U.S. Arms Control and Disarmament Agency
[Text deleted]
U.S. Bureau of Indian Affairs
U.S. Environmental Protection Agency
U.S. Environmental Protection Agency, Region IV
U.S. Environmental Protection Agency, Region VI
U.S. Environmental Protection Agency, Region VII
U.S. Environmental Protection Agency, Region IX
U.S. Environmental Protection Agency, Region X
U.S. National Park Service

State Agencies

BSHWM, Nuclear Emergency Planning, SC
Colorado Department of Health
East Tennessee Economic Council
Georgia Emergency Management Agency
South Carolina Nuclear Waste Program
Southern States Energy Board, GA
State of Idaho, INEL Oversight Program
State of Tennessee DRA
State of Tennessee, DOE Oversight Division
State of Texas, Division of Emergency Management,
State of Texas, Office of the Attorney General
TDEC/DOE Oversight Division, TN
Tennessee Department of Energy and Conservation
Tennessee Department of Health
Tennessee Emergency Management Agency
Texas Natural Resources Conservation Commission
Texas Department of Health
Washington State Department of Ecology
Washington State Energy Office
Western Governors' Association, CO

DOE Reading Rooms

Aiken, SC
Amarillo, TX
[Text deleted]

Idaho Falls, ID
Kirtland AFB, NM
Las Vegas, NV
[Text deleted]
Los Alamos, NM
Oak Ridge, TN
Panhandle, TX
Richland, WA
Westminister, CO

Table 10–1. Representatives From Affected Areas by State (Colorado, Georgia, Idaho, Nevada, New Mexico, South Carolina)

Colorado	Georgia	Idaho	Nevada	New Mexico	South Carolina
City	**City**	**City**	**City**	**City**	**City**
Arvada	Atlanta	Aberdeen	Alamo	Albuquerque	Aiken
Boulder	Augusta	American Falls	Amargosa Valley	Espanola	Almer
Brighton	Bath	Ammon	Ash Springs	Santa Fe	Augusta
Broomfield	Blyth	Arco	Beatty		Batesburg
Denver	Evans	Atomic	Blue Diamond		Blackville
Golden	Girard	Basalt	Boulder City		Beech Island
Lakewood	Harlem	Bellevue	Henderson		Columbia
Longmont	Hephzibah	Blackfoot	Hiko		Denmark
Louisville	Keysville	Carey	Indian Springs		Edgefield
Northglenn	Martinez	Dubois	Las Vegas		Estill
Superior	Millen	Firth	North Las Vegas		Fairfax
Thornton	Sardis	Fort Hall	Pahrump		Gaston
Westminster	Savannah	Hailey	Tonopah		Gloverville
Wheat Ridge	Statesboro	Hamer	Warm Springs		Graniteville
	Thomson	Idaho Falls			Hampton
County	Waynesboro	Iona	**County**		Hilton Head Island
Adams	Wrens	Ketchum	Clark		Jackson
Arapahoe		Lewisville	Nye		Johnston
Boulder	**County**	Menan			Leesville
Denver	Columbia	Mud Lake			Martin
Jefferson	Richmond	Pocatello			Monmorenci
		Richfield			New Ellenton
		Rigby			North
		Ririe			Norway
		Roberts			Orangeburg
		Rupert			Owdoms
		Shelley			Pelion
		Sun Valley			Perry
		Swan Valley			Salley
		Ucon			Saluda
					Springfield
		County			Sycamore
		Bannock			Trenton
		Bingham			Vanville
		Bonneville			Wagener
		Butte			Warrenville
		Jefferson			Williston
					Windsor
					County
					Aiken
					Allendale
					Bamberg
					Barnwell

Table 10–2. Representatives From Affected Areas by State (Tennessee, Texas, Washington)

Tennessee	Tennessee	Texas	Washington
City	**City (Continued)**	**City**	**City**
Alcoa	Maryville	Amarillo	Basin City
Allardt	Mascot	Ashtola	Benton City
Andersonville	Maynardville	Borger	Connell
Athens	Midtown	Bushland	Cowiche
Bethel	New Market	Canyon	Gleed
Blaine	New Tazwell	Channing	Grandview
Briceville	Niota	Clarendon	Granger
Caryville	Norris	Claude	Kahlotus
Clarkrange	Oakdale	Cliffside	Kennewick
Clinton	Oak Ridge	Conway	Mabton
Coalfield	Old Washington	Dawn	Mesa
Corrytown	Oliver Springs	Dial	Naches
Crossville	Oneida	Dumas	Nile
Dandridge	Petros	Electric City	Pasco
Decatur	Philadelphia	Fritch	Plymouth
Deer Lodge	Pigeon Forge	Goodnight	Prosser
Elgin	Pomona	Groom	Richland
Erwin	Powell	Happy	Selah
Etowah	Rockford	Hereford	Sunnyside
Fairfield Glade	Rockwood	Lake Tanglewood	Tieton
Fairview	Rutledge	Osage	Toppenish
Farragut	Sevierville	Paloduro	Union Gap
Friendsville	Sharps Chapel	Pampa	Wapato
Gatlinburg	Solway	Panhandle	West Richland
Glendale	Speedwell	Phillips	Yakima
Grandview	Spring City	Pullman	Zillah
Greenback	Strawberry Plains	Sanford	
Halls Crossroads	Sunbright	Silverton	**County**
Harriman	Sweetwater	Skelleytown	Benton
Huntsville	Talbot	Spearman	Franklin
Jacksonboro	Teleco Village	Stinnett	Yakima
Jamestown	Tellico Plains	Tulia	
Jefferson City	Ten Mile	Umbarger	
Jellico	Townsend	Vega	
Karns	Vonore	Washburn	
Kingston	Walland	Whitedeer	
Knoxville	Wartburg	Wildorado	
Kodak	Washington		
La Follette	Wildwood		

Table 10–2. Representatives From Affected Areas by State (Tennessee, Texas, Washington)—Continued

Tennessee	Tennessee	Texas	Washington
Lake City	**County**	**County**	
Lancing	Anderson	Carson	
Lenoir City	Knox	Potter	
Louisville	Loudon	Randall	
Luttrell	Roane		
Madisonville			

Table 10–3. Individuals Who Provided Comments on the Draft Programmatic Environmental Impact Statement or Have Requested Copies

Alabama
Jim Chardos
Nicholas C. Kazanas
Ricky C. Miles

Arizona
Patricia T. Birnie

California
Masayo Baillet
Joseph E. Blackburn
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Charles Boardman
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Wes Brinsfield
John Burroughs
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Christine Cockey
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Susako DeAmgelis
Joanne Dean-Freemire
Madeline T. Duckles
H. A. Dutton
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Don Eichelberger
Stephanie D. Ericson
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Michael Franks
Stephanie Fraser
Michael Freemire
Jo Ann Frisch
Elsworth Gerrells
Ernest Goitein
Frank Harris
John Harvey
Dan Hirsch
John Holdren
Helen Hubbard
Diane Hughes
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Donald F. King
Shigeyuki Kiyooka
Sidney Langer
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Eric William Martens
Dale D. Nesbitt
A. J. (Tony) Neylan
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Virginia M. Oversby
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Colorado
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Heaton Butterfield
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Tom W. Marshall
Toni McCammon
Al Meiklejohn
LeRoy Moore
David M. Navarro
Karen Norris
Karen North
Douglas A. Parker
Lyman Parkhurst
Vivienne E. Perkins
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Phil Rogas
Kay Ryan
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Frank W. Smith
Katie L. Smith
Dennis Smits
Jill Smits
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James S. Stone, P. E.
Mervyn Tano
Stephen Tarlton
Gary H. Thompson
Alan Trenary
Kenneth Werth
Fred Wilson

Connecticut
Katharine D. Knowles

District of Columbia
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David Albright
Sakae Aoyagi
Amelia F. Barton
Anthony R. Barton
Jennifer Blomstrom
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Audrey Cardwell
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Andy Chakrabarti
Joseph Circincione
Tom Clements
Thomas Cochran
Kathryn A. Crandall
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Jonathan Dean
Blythe C. Delgado
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Steven Dolley
Ralph Earle
Maureen E. Eldredge
Dan L. Fenstermacher
Marvin S. Fertel

Table 10–3. Individuals Who Provided Comments on the Draft Programmatic Environmental Impact Statement or Have Requested Copies—Continued

District of Columbia (Continued)
Roger Gale
Martin Hamberger
Mark Holt
Daniel Horner
John Isaacs
Andrea Jennetta
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Richard T. Kennedy
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Alan Kuperman
Paul Leventhal
Dunbar Lockwood
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Rachel McMillan
Marilyn F. Meigs
Jack Mendelsohn
Patricia Metz
Gail Miller
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Sophie M. Ras
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Warren Stern
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Morris A. Ward
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Karina Wood
Tom Zamora-Collina
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Florida
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Mustafah Abdallah
Grady Abrams
Valentis F. Ali
Ed Arnold
Bill Beazley
Sam W. Booher
Lance Brown
Diana Coney
Ken Davis
Dana L. Edwards
Edward E. Floyd
James Lee Frazier, Jr.
Beth Fulmer
Richard Garniewicz
Joseph M. Gilkison
Kathleen Gore
Jim Hardeman
Krista Harris
Warren Hills, Sr.
Altsert Hodge
Chuck Irwin
J. A. Favortie
Richard Johnson
Albert Jones
Thelonious Jones
W. H. Keisimeyer
Joan King
Asiya DeBorah Konte
Clayton M. Lanier
William Lawless
Tony Liutkus
William P. Mayson, Jr.
Mildred McClain
Anne McClure
Trisha McCracken
Mustafa Mohammed
Stephen C. Newman
Christopher Noah
J. Christopher Noah, Sr.
R. A. Pedde
Harold Reheis
Carolin E. Rivard
Lawrence Russell
Karin Schill
Mark Schmitz
Michael F. Sujka
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W. M. Stacey
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Carolyn White
Robert H. Wilcox

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Lori Bergfeld
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Casey Burns
Elisha Calvin
Marlene Christianson
Wayne Clarton
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Jana K. Hinckley
Elaine Hoggan
Martin Huebner
Christopher Jarrell
Lowell A. Jobe
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David Kahn
Steve Kahn
Mike Keesler
Richard Kenney
Jennifer Kidwell
R. G. Larsen
Gail Lewis-Kido
Brandon Loomis
William G. Lussie
Larry Lyon
Robert McEnaney
Kay C. Merriam
Cathy Middleton
Joy H. Myers
William J. Quapp
Andrew Richardson
David L. Rose
Peggy Scherbinske
Don Smith
Michael Smith
John Tanner
Anita Thomas
A. N. Tschaeche
Bob Tyler

Table 10–3. Individuals Who Provided Comments on the Draft Programmtic Environmental Impact Statement or Have Requested Copies—Continued

Idaho (Continued)
Gordon Venable
Marshal A. Wade
Sonne G. Ward
Marie Warnick
Theodore Watanabe
Charlie White, Jr.
Stormie Winterbottom

Illinois
Robert A. Cleveland
Mary H. Lanaghan
William F. Naughton
A. David Rossin
Charles Schroeder
Thomas V. Thanton
Thomas V. Thornton

Indiana
John E. O'Neill

Iowa
Janie Stein

Kansas
J. Marc Cottrell
Mark Frey
Nick and Nancy Mohr

Kentucky
Terry Devine

Louisana
Toney Johnson

Maryland
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Maurice Bryson
William Carroll
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Richard L. Humphrey, M.D.
D. K. Magnus
Arjun Makhijani
Loring E. Mills
Alexander P. Murray
Eric Reeves
Vijay K. Sazawal
William Seddon
Herman Sturm
Elaine Tholen and Nikita Wells
Viktor Yevsikov

Massachusetts
Katheryn E. Adams
Lee Cranberg
Paul M. Doty
Deborah Katz
Mary Lampert
Taya M. Portnova
Robert A. Schaeffer
Maria Valenti
Mary Jane Williams
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Michigan
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Lewis C. Green
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Paul Marengo
Nancy Torner

Nevada
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Carmen Battaglia
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Felicia Bradfield
Les Bradshaw
Brian Bresee
Chris Brown
Markus Brown
Thomas Burton
Robert Chrisman
Joy Cotter
Sally Devlin
Michael Dillaplain
A. C. Douglas
Russell duBartolo
Thomas O. Edwards
Hugh W. Ferree
William G. Flangas
Will Foster
Steve Frishman
Patty Goin
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Jody S. Hart
Johanna C. Hawley
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James Henderson
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Grant Hudlow
Sherri Johnson
Rachael Juipe
Reinard Knutson
Christy Leskover
Ruth Lindahl
Bob Loux
Mary Manning
W. Curt McGee
Thomas J. McGowan
Rick Nielson
Cheryl Oar
Gretchen Prins
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Joseph Ruggieri
Dale Schutte
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Robert Smith
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Margaret Springgate
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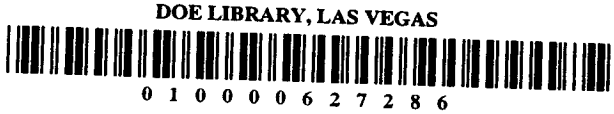

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Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Volume III

December 1996

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Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Volume III

United States Department of Energy
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ABSTRACT: This document analyzes the potential environmental consequences of alternatives for the long-term storage (up to 50 years), including storage until disposition, and disposition of weapons-usable fissile materials from U.S. nuclear weapon dismantlements under the responsibility of the DOE. Long-term storage of nonsurplus inventories of weapons-usable plutonium (Pu) and highly enriched uranium (HEU) are required for national defense purposes, while the disposition of surplus weapons-usable Pu is necessary in order to implement our national nonproliferation policy. In addition to the No Action Alternative, this PEIS assesses three storage alternatives (that is, upgrade at multiple sites, consolidation of Pu, and collocation of Pu and HEU) at six DOE candidate sites located across the country. These sites are Hanford Site, Nevada Test Site, Idaho National Engineering Laboratory, Pantex Plant, Oak Ridge Reservation, and Savannah River Site. Although they are not candidate sites for storage, Rocky Flats Environmental Technology Site (RFETS) and Los Alamos National Laboratory are assessed for the No Action Alternative. For the disposition of surplus Pu, three alternative categories (that is, deep borehole, immobilization, and reactor) with nine primary alternatives are assessed at several DOE and representative sites for analysis purposes. Evaluations of impacts on site infrastructure, water resources, air quality and noise, socioeconomics, waste management, public and occupational health and safety, and environmental justice are included in the assessment. The intersite transportation of nuclear and hazardous materials is also assessed. DOE's Preferred Alternative is identified in this Final PEIS. The Preferred Alternative for storage is a combination of No Action and Upgrade Alternatives for the various DOE sites, and phaseout of Pu storage at RFETS. The Preferred Alternative for disposition of surplus Pu is to pursue a disposition strategy involving a combination of immobilization and reactor alternatives, including vitrification, ceramic immobilization, and existing reactors.

PUBLIC INVOLVEMENT: The DOE issued a Draft PEIS on March 8, 1996, and held a formal public comment period on the Draft through June 7, 1996. In preparing the Final PEIS, DOE considered comments received via mail, fax, electronic bulletin board (Internet), and transcripts of messages recorded by telephone. In addition, comments and concerns were recorded by notetakers during interactive public meetings held during March and April 1996 in Denver, CO, Las Vegas, NV, Oak Ridge, TN, Richland, WA, Idaho Falls, ID, Washington, DC, Amarillo, TX, and North Augusta, SC. Comments received and DOE's responses to those comments are found in Volume IV of the Final PEIS.

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LIST OF ACRONYMS AND ABBREVIATIONS

AADT	Average Annual Daily Traffic
ACEC	Area of Critical Environmental Concern
ACGIH	American Conference of Governmental Industrial Hygienists
AEA	*Atomic Energy Act*
AEC	Atomic Energy Commission
AGV	automated guided vehicle
ALARA	as low as reasonably achievable
ALE	Arid Lands Ecology Reserve
ANL-W	Argonne National Laboratory-West
APSF	Actinide Packaging and Storage Facility
AQCR	Air Quality Control Region
ARA	Auxiliary Reactor Area
ARIES	Advanced Recovery and Integrated Extraction System
BEA	Bureau of Economic Analysis
BEIR	biological effects of ionizing radiation
BLM	Bureau of Land Management
BOP	balance-of-plant
BPA	Bonneville Power Administration
BWR	boiling water reactor
CAA	*Clean Air Act*
CANDU	Canadian deuterium uranium
CAS	Chemical Abstracts Service
CCDF	complimentary cumulative distribution function
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
CI	confidence interval
CIC	can-in-canister
CLUP	Comprehensive Land-Use Plan
CMR	Chemistry and Metallurgy Research

COE	Corps of Engineers
Complex	Nuclear Weapons Complex
CRD	Comment Response Document
CRT	Cargo Restraint Transporters
CWA	*Clean Water Act*
D&D	decontamination and decommissioning
DAF	Device Assembly Facility
DCG	derived concentration guide
DHLW	defense high-level waste
DNB	departure of nucleate boiling
DNFSB	Defense Nuclear Facilities Safety Board
DNL	day and night average sound levels
DNWR	Desert National Wildlife Range
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DP	Office of Defense Programs
DRCOG	Denver Regional Council of Governments
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EBR	Experimental Breeder Reactor
EDNA	Environmental Design for Noise Abatement
EIA	Energy Information Administration
EIS	environmental impact statement
EM	Office of Environmental Management
EPA	Environmental Protection Agency
ERR	excess relative risk
ES&H	Office of Environment, Safety, and Health
ESA	*Endangered Species Act*
ETF	effluent treatment facility
FAIR	Forest, Agriculture, Industry, and Research
FCF	Fuel Cycle Facility
FEMA	Federal Emergency Management Agency
FFCA	Federal Facility Compliance Agreement
FFTF	Fast Flux Test Facility

FLPMA	*Federal Land Planning Management Act*
FMEF	Fuels and Materials Examination Facility
FMF	Fuel Manufacturing Facility
FONSI	Finding of No Significant Impact
FR	Federal Register
FSAR	Final Safety Analysis Report
GBZ	Glass-bonded zeolite
GESMO	Generic Environmental Statement on Mixed Oxide
GIS	Geographical Information System
GMA	*Growth Management Act*
GMODS	Glass Material Oxidation Dissolution System
HAD	hazard analysis document
Hanford	Hanford Site
HE	high explosives
HEAST	Health Effects Summary Table
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HEU EIS	*Disposition of Surplus Highly Enriched Uranium Environmental Impact Statement*
HFEF	Hot Fuel Examination Facility
HI	Hazard Index
HLW	high-level waste
HQ	Hazard Quotient
HRA EIS	*Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan*
HVAC	Heating Ventilation and Air Conditioning
HWR	Heavy Water Reactor
IAEA	International Atomic Energy Agency
ICPP	Idaho Chemical Processing Plant
ICRP	International Commission of Radiological Protection
INEL	Idaho National Engineering Laboratory
IRIS	Integrated Risk Information System
ISCST2	Industrial Source Complex Short-Term Model Version 2
ISO	International Standards Organization
IWG	Interagency Working Group
K-25	K-25 Site

L/ER	Energy Research Program Office
LA	Limited Area
LAA	Limited Access Area
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Scattering Center
LCF	latent cancer fatalities
LDR	Land Disposal Restriction
LEU	low-enriched uranium
LIGO	Laser Interferometer Gravitational-Wave Observatory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LOB	Laboratory Office Building
LWR	Light Water Reactor
MAA	Material Access Area
MACCS	Melcor Accident Consequence Code System
MC&A	Material Control and Accountability
MD	Office of Fissile Materials Disposition
MEI	maximally exposed individual
MHR	Modular Helium Reactor
MMI	Modified Mercalli Intensity
MOX	mixed oxide
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAGPRA	*Native American Graves Protection and Repatriation Act*
NAS	National Academy of Sciences
NCDC	National Climatic Data Center
NCRP	National Commission of Radiological Protection
NEIC	National Earthquake Information Center
NEPA	*National Environmental Policy Act*
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFS	Nuclear Fuel Services Fuel Fabrication Plant
NHPA	*National Historic Preservation Act*
NIOSH	National Institute of Occupational Safety and Health
NMSF	Nuclear Material Storage Facility

NMSM	Nuclear Materials and Stockpile Management
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NRHP	National Register of Historic Places
NTS	Nevada Test Site
NTS EIS	*Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*
NWI	National Wetlands Inventory
NWPA	*Nuclear Waste Policy Act*
NWS	National Weather Service
OCRWM	Office of Civilian Radioactive Waste Management
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PA	Protected Area
Pantex	Pantex Plant
Pantex EIS	*Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*
PBF	Power Burst Facility
PCV	Primary Containment Vessel
PEIS	programmatic environmental impact statement
PEL	Permissible Exposure Level
PFP	Plutonium Finishing Plant
PFP EIS	*Plutonium Finishing Plant Stabilization Environmental Impact Statement*
PIDAS	Perimeter Intrusion Detection and Alarm System
PNNL	Pacific Northwest National Laboratory
PPA	Property Protection Area
PRA	probabilistic risk assessment
PSAR	Preliminary Safety Analysis Report
PSD	Prevention of Significant Deterioration

PUREX	Plutonium-Uranium Extraction Plant
PWR	pressurized water reactor
R&D	Research and Development
RCRA	*Resource Conservation and Recovery Act*
REA	regional economic area
RIA	reactivity insertion accident
RFETS	Rocky Flats Environmental Technology Site
RIMS II	Regional Input-Output Modeling System
RL	Richland Operations Office
ROD	Record of Decision
ROI	region of influence
RSWF	Radioactive Scrap and Waste Facility
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SAR	Safety Analysis Report
SARA	*Superfund Amendments and Reauthorization Act*
sd	standard deviation
SDWA	*Safe Drinking Water Act*
SEB	Security Equipment Building
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SISMP	Site Integrated Stabilization and Management Plan
SMR	Standardized Mortality Ratio
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SRR	standardize rate ratio
SRS	Savannah River Site
Stockpile Stewardship and Management PEIS	*Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*
Storage and Disposition PEIS	*Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement*
SST	safe secure trailer
START	Strategic Arms Reduction Talks

TA	Technical Area
TAN	Test Area North
TCLP	toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environmental Conservation
TDS	total dissolved solids
TI	transport index
TLV	Threshold Limit Values
TNRCC	Texas Natural Resources Conservation Commission
TRA	Test Reactor Area
TRU	transuranic
TSCA	*Toxic Substance Control Act*
TSD	Transportation Safeguards Division
TSP	total suspended particulates
TSR PEIS	*Tritium Supply and Recycling Programmatic Environmental Impact Statement*
TVA	Tennessee Valley Authority
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Survey
VOC	volatile organic compound
VRM	Visual Resource Management
WAC	Waste Acceptance Criteria
Waste Management PEIS	*Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*
WIPP	Waste Isolation Pilot Plant
WMIS	Waste Management Information System
WNP	Washington Nuclear Power
WPPSS	Washington Public Power Supply System
WSA	Weapons Storage Area
WSCC	Western Systems Coordinating Council
WSCF	Waste Sampling and Characterization Facility
Y–12	Y–12 Plant
Y–12 EA	*Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Level at the Y–12 Plant, Oak Ridge, Tennessee*
YMSCO	Yucca Mountain Site Characterization Office
ZPPR	Zero Power Physics Reactor

CHEMICALS AND UNITS OF MEASURE

°C	degrees Celsius
Ci	curie
cm	centimeter
CO	carbon monoxide
CO_2	carbon dioxide
Co-60	cobalt-60
Cs	cesium
Cs-137	cesium-137
CsCl	cesium chloride
Cu	copper
dB	decibel
dBA	decibel A-weighted
°F	degrees Fahrenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
g	gram
G	gravitational acceleration
gal	gallon
Gd	gadolinium
GWd	gigawatt-days
ha	hectare
H_2	hydrogen
HF	hydrogen fluoride
HNO_3	nitric acid
hr	hour
I-129	iodine-129
in	inch
k_{eff}	effective neutron multiplication factor
kg	kilogram
km	kilometer
km^2	square kilometer

Kr	krypton
kV	kilovolt
l	liter
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
mCi	millicurie
mg	milligram
mi	mile
mi^2	square miles
min	minute
mph	miles per hour
mrem	millirem (one thousandth of a rem)
MW	megawatt
MWe	megawatt electric
N_2	nitrogen
nCi	nanocurie (one-billionth of a Curie)
Ni	nickel
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
oz	ounce
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocurie (one-trillionth of a Curie)
PM_{10}	particulate matter less than or equal to 10 microns
ppm	parts per million
Pu	plutonium
PuCl	plutonium chloride
PuO_2	plutonium dioxide
rad	radiation absorbed dose
rem	roentgen equivalent man
RfC	Reference Concentration
RfD	Reference Dose

s	second
SO_2	sulfur dioxide
Sr-90	strontium-90
t	metric ton
Tc-99	technetium-99
ton	short ton
U	uranium
U-233	uranium-233
U-234	uranium-234
U-235	uranium-235
U-236	uranium-236
U-238	uranium-238
UF_6	uranium hexafluoride
UNH	uranyl nitrate hexahydrate
UO_2	uranium dioxide
U_3O_8	triuranium octaoxide
VOC	volatile organic compound
yd	yard
yr	year
µg	microgram (one-millionth of a gram)

METRIC CONVERSION CHART

To Convert Into Metric			To Convert Out of Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor
exa-	E	$1\,000\,000\,000\,000\,000\,000 = 10^{18}$
peta-	P	$1\,000\,000\,000\,000\,000 = 10^{15}$
tera-	T	$1\,000\,000\,000\,000 = 10^{12}$
giga-	G	$1\,000\,000\,000 = 10^{9}$
mega-	M	$1\,000\,000 = 10^{6}$
kilo-	k	$1\,000 = 10^{3}$
hecto-	h	$100 = 10^{2}$
deka-	da	$10 = 10^{1}$
deci-	d	$0.1 = 10^{-1}$
centi-	c	$0.01 = 10^{-2}$
milli-	m	$0.001 = 10^{-3}$
micro-	μ	$0.000\,001 = 10^{-6}$
nano-	n	$0.000\,000\,001 = 10^{-9}$
pico-	p	$0.000\,000\,000\,001 = 10^{-12}$
femto-	f	$0.000\,000\,000\,000\,001 = 10^{-15}$
atto-	a	$0.000\,000\,000\,000\,000\,001 = 10^{-18}$

Appendix A
Nonproliferation Policy and Joint Statement

This appendix contains a copy of the fact sheet on the President's *Nonproliferation and Export Control Policy* released by the White House on September 27, 1993. The fact sheet describes the major principles that guide the policy and the key elements of the policy. This appendix also contains a copy of the *Joint Statement by the President of the Russian Federation and the President of the United States of America on Non-Proliferation of Weapons of Mass Destruction and the Means of Their Delivery* agreed to during their meeting on January 14, 1994.

A.1 NONPROLIFERATION AND EXPORT CONTROL POLICY FACT SHEET

[Text deleted.]

THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release September 27, 1993

FACT SHEET

NONPROLIFERATION AND EXPORT CONTROL POLICY

The President today established a framework for U.S. efforts to prevent the proliferation of weapons of mass destruction and the missiles that deliver them. He outlined three major principles to guide our nonproliferation and export control policy:

- Our national security requires us to accord higher priority to nonproliferation, and to make it an integral element of our relations with other countries.

- To strengthen U.S. economic growth, democratization abroad and international stability, we actively seek expanded trade and technology exchange with nations, including former adversaries, that abide by global nonproliferation norms.

- We need to build a new consensus -- embracing the Executive and Legislative branches, industry and public, and friends abroad -- to promote effective nonproliferation efforts and integrate our nonproliferation and economic goals.

The President reaffirmed U.S. support for a strong, effective nonproliferation regime that enjoys broad multilateral support and employs all of the means at our disposal to advance our objectives.

Key elements of the policy follow.

Fissile Material

The U.S. will undertake a comprehensive approach to the growing accumulation of fissile material from dismantled nuclear weapons and within civil nuclear programs. Under this approach, the U.S. will:

- Seek to eliminate where possible the accumulation of stockpiles of highly-enriched uranium or plutonium to ensure that where these materials already exist they are subject to the highest standards of safety, security, and international accountability.

- Propose a multilateral convention prohibiting the production of highly-enriched uranium or plutonium for nuclear explosives purposes or outside of international safeguards.

- Encourage more restrictive regional arrangements to constrain fissile material production in regions of instability and high proliferation risk.

- Submit U.S. fissile material no longer needed for our deterrent to inspection by the International Atomic Energy Act.

- Pursue the purchase of highly-enriched uranium from the former Soviet Union and other countries and its conversion to peaceful use as reactor fuel.

- Explore means to limit the stockpiling of plutonium from civil nuclear programs, and seek to minimize the civil use of highly-enriched uranium.

- Initiate a comprehensive review of long-term options for plutonium disposition, taking into account technical, nonproliferation, environmental, budgetary and economic considerations. Russia and other nations with relevant interests and experience will be invited to participate in this study.

The United States does not encourage the civil use of plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes. The United States, however, will maintain its existing commitments regarding the use of plutonium in civil nuclear programs in Western Europe and Japan.

Export Controls

To be truly effective, export controls should be applied uniformly by all suppliers. The United States will harmonize domestic and multilateral controls to the greatest extent possible. At the same time, the need to lead the international community or overriding national security or foreign policy interests may justify unilateral export controls in specific cases. We will review our unilateral dual-use export controls and policies, and eliminate them unless such controls are essential to national security and foreign policy interests.

We will streamline the implementation of U.S. nonproliferation export controls. Our system must be more responsible and efficient, and not inhibit legitimate exports that play a key role in American economic strength while preventing exports that would make a material contribution to the proliferation of weapons of mass destruction and the missile that deliver them.

Nuclear Proliferation

The U.S. will make every effort to secure the indefinite extension of the Non-Proliferation Treaty in 1995. We will seek to ensure that the International Atomic Energy Agency has the resources needed to implement its vital safeguards responsibilities, and will work to strengthen the IAEA's ability to detect clandestine nuclear activities.

Missile Proliferation

We will maintain our strong support for the Missile Technology Control Regime. We will promote the principles of the MTCR Guidelines as a global missile nonproliferation norm and seek to use the MTCR as a mechanism for taking joint action to combat missile proliferation. We will support prudent expansion of the MTCR's membership to include additional countries that subscribe to international nonproliferation standards, enforce effective export controls and abandon offensive ballistic missile programs. The United States will also promote regional efforts to reduce the demand for missile capabilities.

The United States will continue to oppose missile programs of proliferation concern, and will exercise particular restraint in missile-related cooperation. We will continue to retain a strong presumption of denial against exports to any country of complete space launch vehicles or major components.

The United States will not support the development or acquisition of space-launch vehicles in countries outside the MTCR.

For MTCR member countries, we will not encourage new space launch vehicle programs, which raise questions on both nonproliferation and economic viability grounds. The United States will, however, consider exports of MTCR-controlled items to MTCR member countries for peaceful space launch programs on a case-by-case basis. We will review whether additional constraints or safeguards could reduce the risk of misuse of space launch technology. We will seek adoption by all MTCR partners of policies as vigilant as our own.

Chemical and Biological Weapons

To help deter violations of the Biological Weapons Convention, we will promote new measures to provide increased transparency of activities and facilities that could have biological weapons applications. We call on all nations -- including our own -- to ratify the Chemical Weapons Convention quickly so that it may enter into force by January 13, 1995. We will work with others to support the international Organization for the Prohibition of Chemical Weapons created by the Convention.

Regional Nonproliferation Initiatives

Nonproliferation will receive greater priority in our diplomacy, and will be taken into account in our relations with countries around the world. We will make special efforts to address the proliferation threat in regions of tension such as the Korean peninsula, the Middle East and South Asia, including efforts to address the underlying motivations for weapons acquisition and to promote regional confidence-building steps.

In Korea, our goal remains a non-nuclear peninsula. We will make every effort to secure North Korea's full compliance with its nonproliferation commitments and effective implementation of the North-South denuclearization agreement.

In parallel with our efforts to obtain a secure, just, and lasting peace in the Middle East, we will promote dialogue and confidence-building steps to create the basis for a Middle East free of weapons of mass destruction. In the Persian Gulf, we will work with other suppliers to contain Iran's nuclear, missile, and Biological Weapons Convention ambitions, while preventing reconstruction of Iraq's activities in these areas. In South Asia, we will encourage India and Pakistan to proceed with multilateral discussions of nonproliferation and security issues, with the goal of capping and eventually rolling back their nuclear and missile capabilities.

In developing our overall approach to Latin America and South Africa, we will take account of the significant nonproliferation progress made in these regions in recent years. We will intensify efforts to ensure that the former Soviet Union, Eastern Europe and China do not contribute to the spread of weapons of mass destruction and missiles.

Military Planning and Doctrine

We will give proliferation a higher profile in our intelligence collection and analysis and defense planning, and ensure that our own force structure and military planning address the potential threat from weapons of mass destruction and missile around the world.

Conventional Arms Transfers

We will actively seek greater transparency in the area of conventional arms transfers and promote regional confidence-building measures to encourage restraint on such transfers to regions of instability. The U.S. will undertake a

comprehensive review of conventional arms transfer policy, taking into account national security, arms control, trade, budgetary and economic competitiveness consideration.

A.2 NONPROLIFERATION OF WEAPONS OF MASS DESTRUCTION AND THE MEANS OF THEIR DELIVERY

THE WHITE HOUSE

Office of the Press Secretary

JOINT STATEMENT
BY THE PRESIDENT OF THE RUSSIAN FEDERATION
AND
THE PRESIDENT OF THE UNITED STATES OF AMERICA
ON NON-PROLIFERATION OF WEAPONS OF MASS DESTRUCTION
AND THE MEANS OF THEIR DELIVERY

President Clinton and President Yeltsin, during their meeting in Moscow on January 14, 1994, agreed that the proliferation of weapons of mass destruction and their missile delivery systems represents an acute threat to international security in the period following the end of the Cold War. They declared the resolve of their countries to cooperate actively and closely with each other, and also with other interested states, for the purpose of preventing and reducing this threat.

The Presidents noted that the proliferation of nuclear weapons creates a serious threat to the security of all states, and expressed their intention to take energetic measures aimed at prevention of such proliferation.

- Considering the Treaty on the Non-proliferation of Nuclear Weapons as the basis for efforts to ensure the nonproliferation of nuclear weapons, they called for its indefinite and unconditional extension at conference of its participants in 1995, and they urged that all states that have not yet done so accede to this treaty.

- They expressed their resolve to implement effective measures to limit and reduce nuclear weapons. In this connection, they advocated the most rapid possible entry into force of the START I and START II treaties.

- They agreed to review jointly appropriate ways to strengthen security assurances for the states which have renounced the possession of the nuclear weapons and that comply strictly with their nonproliferation obligations.

- They expressed their support for the International Atomic Energy Agency in its efforts to carry out its safeguards responsibilities. They also expressed their intention to provide assistance to the Agency in the safeguards field, including through joint efforts of their relevant laboratories to improve safeguards.

- They supported the Nuclear Suppliers Group, and agreed with the need for effective implementation of the principle of full-scope IAEA safeguard as a condition for nuclear exports with the need for export controls on dual-use materials and technology in the nuclear field.

- They reaffirmed their countries' commitment to the conclusion as soon as possible of an international treaty to achieve a comprehensive ban on nuclear test explosions and welcomed the decision to begin negotiations at the conference on disarmament. They declared their firm intentions to provide political support for the negotiating process, and appealed to other states to refrain from carrying out nuclear explosions while these talks are being held.

- They noted that an important contribution to the goal of nonproliferation of nuclear weapons would be made by a verifiable ban on the production of fissile materials for nuclear weapons and by the most rapid conclusion of an international convention to this effect with the widest possible participation of states and on a non-discriminatory basis.

- They agreed to cooperate with each other and also with other states to elaborate measures designed to prevent the accumulation of excessive stocks of fissile materials and over time to reduce such stocks.

- They agreed to establish a joint working group to consider:

  - including in their voluntary IAEA safeguards offers all source and special fissionable materials, excluding only those facilities associated with activities having direct national security significance;

  - steps to ensure the transparency and irreversibility of the process of reduction of nuclear weapons, including the possibility of putting a portion of fissionable material under IAEA safeguards. Particular attention would be given to materials released in the process of nuclear disarmament and steps to ensure that these materials would not be used again for nuclear weapons.

- The Presidents also tasked their experts to study options for the long-term disposition of fissile materials, particularly of plutonium, taking into account the issues of nonproliferation, environmental protection, safety, and technical and economic factors.

- They reaffirmed the intention of interested organizations of the two countries to complete within a short time a joint study of the possibilities of terminating the production of weapon-grade plutonium.

- The Presidents agreed that reduction of the risk of theft or diversion of nuclear materials is a high priority, and in this context they noted the usefulness of the September 1993 Agreement to cooperate in improving the system of controls, accounting, and physical protection for nuclear materials. They attached great significance to further joint work on the separate but mutually connected problems of accounting for nuclear materials used in the civilian and military fields.

Both Presidents favored a further increase in the efforts to prevent the proliferation of chemical and biological weapons.

- As the heads of the countries that have the world's largest stockpiles of chemical weapons, they acknowledged particular responsibility for eliminating the threat posed by these weapons. In this context, they declare their resolute support for the Convention of the Prohibition of Chemical Weapons, and their intention to promote ratification as rapidly as possible and entry into force of the Convention no later than 1995.

- To promote implementation of a comprehensive ban on chemical weapons, they welcomed the conclusion of the implementing documents for the Wyoming Memorandum of Understanding and agreed to conclude work in as short a time as possible on the implementing documents for the Bilateral Agreement on the Destruction of Chemical Weapons.

- The Presidents reaffirmed their desire to facilitate the safe, secure, timely, and ecologically sound destruction of chemical weapons in the Russian Federation and the United States. They applauded the joint Chemical Weapons Destruction Work Plan recently concluded between the two countries which leads the way for the United States to provide an additional $30 million in assistance to support an analytical chemical laboratory in Russia to facilitate chemical weapons destruction. The United States also agreed to consider appropriate additional measures to support Russia's chemical weapons destruction program.

- They reiterated the importance of strict compliance with the Convention on the Prohibition of Biological and Toxin Weapons and of continued implementation of measures in accordance with the Russia-America-

British Statement of September 1992, which provided inter alia for the reciprocal visits of facilities and meetings between experts in order to ensure confidence in the compliance with the Convention.

- They supported convening a special conference of the states' parties to the Convention on the Prohibition of Biological and Toxin Weapons in order to consider measures that would contribute to transparency and thereby confidence in compliance with the Convention and its effectiveness.

The Presidents expressed the determination of their countries to cooperate with each other in preventing the proliferation of missiles capable of carrying weapons of mass destruction.

- They welcomed the conclusion of the Bilateral Memorandum of Understanding between the Government of the Russian Federation and the Government of the United States of America Concerning the Export of Missile Equipment and Technologies, signed in September 1993, noted the importance of the Agreement for ensuring mutually beneficial cooperation between the U.S. and Russia in the field of space exploration, and agreed to collaborate closely in order to ensure its full and timely implementation.

- The U.S. welcomed Russia's intention to join the Missile Technology Control Regime and undertook to cooperate with Russia in facilitation its membership at an early date. The Russian Federation and the United Sates of America are certain that further improving the MTCR, including the prudent expansion of membership, will help reduce the threat of proliferation of missiles and missile technologies in the regional context as well.

The Presidents of the two countries agreed that, in addition to strengthening global norms of nonproliferation and working out agreements to this effect, close cooperation is essential in order to develop policies on nonproliferation applicable to specific regions posing the greatest risk of proliferation of weapons of mass destruction and their means of delivery.

- They agreed that nuclear weapons on the Korean Peninsula would represent a grave threat to regional and international security, and decided that their countries would consult with each other on ways to eliminate this danger. They called upon the DPRK to honor fully its obligation under the Treaty on the Non-proliferation of Nuclear Weapons and its safeguards agreement with the IAEA in connection with the Treaty, and to resolve the problems of safeguards implementation, inter alia, through dialogue between IAEA and DPRK. They also urged full and speedy implementation of the Joint Declaration of the ROK and the DPRK on Denuclearization of the Korean Peninsula.

- They support efforts to reach agreement on the establishment of a multilateral forum to consider measures in the field of arms control in nonproliferation that could strengthen security in South Asia. They call on India and Pakistan to join in the negotiation of and become original signatories to the Treaty Banning Nuclear Weapons Test Explosions and the proposed Convention to Ban Production of Fissile Materials for Nuclear Explosives and to refrain from deploying ballistic missiles capable of delivering weapons of mass destruction to each other's territories.

- They agreed that the U.S. and Russia, as co-chairs in the Middle East peace process, would actively promote progress in the activity of the working group for Arms Control and Regional Security in the Middle East, striving for speedy implementation of confidence-building measures and working towards turning the Middle East into a region free of weapons of mass destruction, where conventional forces would not exceed reasonable defense needs.

- They firmly supported the efforts of the UN Special Commission and the IAEA to put into operation a long-term monitoring system of the military potential of Iraq, and called upon Iraq to comply with all UN Security Council resolutions.

Appendix B
Building and Facility Specifications

This appendix provides predesign information on the gross size and type of construction required for key buildings and other structures within each facility complex analyzed in this programmatic environmental impact statement (PEIS). Key buildings and structures are those that perform the unique storage or processing functions required by this program.

B.1 STORAGE FACILITIES

The key building/structure requirements for long-term storage alternatives for the candidate sites are grouped as follows: storage upgrade (modification of existing and/or construction of new storage facilities), consolidated plutonium (Pu) storage facilities, and collocated Pu and highly enriched uranium storage facilities. These requirements are listed in Tables B.1–1 through B.1–20. Within each grouping, the tables are ordered by site as follows: Hanford Site (Hanford), Nevada Test Site (NTS), Idaho National Engineering Laboratory (INEL), Pantex Plant (Pantex), Oak Ridge Reservation (ORR), and Savannah River Site (SRS). The Preferred Alternative for the long-term storage of surplus Pu involves a combination of upgrade (Pantex, ORR, and SRS), No Action (Hanford, NTS, INEL, and Los Alamos National Laboratory [LANL]), and phaseout (Rocky Flats Environmental Technology Site).

Table B.1–1. Facility Requirements for the Upgrade Alternative at Hanford Site

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
New Hanford Pu Storage Facility (without RFETS Pu or LANL Pu)	4,459	2	Special nuclear materials	Reinforced concrete/metal
New Hanford Pu Storage Facility (with RFETS Pu and LANL Pu)	4,999	2	Special nuclear materials	Reinforced concrete/metal

[a] Indicates required construction for Pu Storage Facility option; option to modify Existing Fuels and Materials Examination Facility does not require new facility construction.

Note: m^2=square meters; LANL= Los Alamos National Laboratory; RFETS=Rocky Flats Environmental Technology Site.

Source: HF DOE 1995e:1.

Table B.1–2. Facility Requirements for the Upgrade Alternative at Idaho National Engineering Laboratory, Argonne National Laboratory-West

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Material handling building (without RFETS Pu or LANL Pu)	1,770	2	Special nuclear materials	Concrete
[Text deleted.]				
Material handling building (with RFETS Pu and LANL Pu)	2,550	2	Special nuclear materials	Concrete
Security portals	1,430	1	NA	Concrete
Secure vehicle staging	90	1	NA	Concrete
Secure vehicle staging area	930	NA	NA	Concrete
Tower cooling water facility	200	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable; LANL= Los Alamos National Laboratory; RFETS=Rocky Flats Environmental Technology Site.

Source: IN DOE 1996a.

Table B.1–3. Facility Requirements for the Upgrade Alternative at Pantex Plant

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Vault	3,490	1	Special nuclear materials	Concrete
AGV service/IAEA inspection, UPS	630	1	Special nuclear materials	Concrete
Unpackaging/packaging	370	2	Special nuclear materials	Concrete
Loading area/dock	580	1	NA	Steel
Ramps	310	1	NA	Concrete/steel

[a] Values shown apply to all Pantex upgrade subalternatives for pit material only. In the event non-pit materials were sent to Pantex for storage under the Upgrade with All or Some RFETS Pu and LANL Pu Subalternative, processing equipment and additional space would have to be provided to add the capability to either remediate or overpack any failed metal and oxide containers.

Note: IAEA=International Atomic Energy Agency.

Source: PX MH 1994a.

Table B.1–4. Facility Requirements for the Upgrade Alternative at Oak Ridge Reservation, Y–12 Plant

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
9212 E-Wing vault	490	1	Special nuclear materials	Reinforced concrete/steel
9204-2 first floor	1,680	1	Special nuclear materials	Metal structure
9204-2E first floor	1,510	1	Special nuclear materials	Metal structure
9215	1,620	1	Special nuclear materials	Metal structure
9998	520	1	Special nuclear materials	Steel structure

[a] All buildings currently exist. No new facility construction is required.

Note: m^2=square meters.

Source: OR MMES 1996a.

Table B.1–5. Facility Requirements for the Upgrade Alternative at Savannah River Site

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Hardened staging building (with all or some RFETS and LANL Pu)	1,100	1.5	Special nuclear materials	Concrete
Hardened staging building (with RFETS non-pit Pu)	840	1.5	Special nuclear materials	Concrete
[Text deleted.]				

[a] Values are for required new construction.

Note: m^2=square meters; LANL=Los Alamos National Laboratory; RFETS=Rocky Flats Environmental Technology Site.

Source: SRS 1996a:4; WSRC 1995e.

Table B.1–6. Facility Requirements for the Consolidation Alternative at Hanford Site

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
Security portals	1,530	1	NA	Hardened concrete
Utility building	1,840	1	NA	Steel frame/metal siding
Sanitary wastewater treatment building	370	1	NA	Steel frame/metal siding
Source calibration facility	550	1	Special nuclear materials	Concrete
Standby generator	290	1	NA	Hardened concrete
Secure vehicle staging	90	1	Special nuclear materials	Concrete
Unit substation (2)	280	1	NA	Concrete
Parking	32,140	NA	NA	NA
Tower cooling water facility	920	NA	NA	NA
Diesel fuel storage	920	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Sanitary/wastewater treatment facility	1,390	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: DOE 1996e.

Table B.1–7. Facility Requirements for the Consolidation Alternative Option to Construct a New Facility at Nevada Test Site

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
Security/training center	2,110	1	NA	Hardened concrete and steel frame/metal siding
Security portals	1,580	1	NA	Hardened concrete
Environmental, safety, and health	1,380	1	NA	Steel frame/metal siding
Waste storage	920	1	NA	Steel frame/metal siding
Utility building	1,840	1	NA	Steel frame/metal siding
Sanitary wastewater treatment building	370	1	NA	Steel frame/metal siding
Standby generator	290	1	NA	Hardened concrete
Secure vehicle staging	90	1	Special nuclear materials	Concrete
Unit substation (2)	280	1	NA	Concrete
Parking	32,140	NA	NA	NA
Bus loading & unloading	870	NA	NA	NA
Storage yard	4,590	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Switchyard	1,840	NA	NA	NA
Secure vehicle staging area	920	1	NA	NA
Tower cooling water facility	920	NA	NA	NA
Diesel fuel storage	920	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Sanitary/wastewater treatment facility	1,390	NA	NA	NA
Construction laydown area	18,370	NA	NA	NA
Stormwater ponds (4)	6,980	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: DOE 1996e.

Table B.1–8. Facility Requirements for the Consolidation Alternative Option to Modify P-Tunnel at Nevada Test Site

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Material handling building	17,650	3	Special nuclear materials	Hardened concrete
Administration and training	2,840	2	NA	Steel frame/metal siding
Fire station	1,490	1	NA	Steel frame/metal siding
Security/training center	2,110	1	NA	Hardened concrete and steel frame/metal siding
Security portals	1,630	1	NA	Hardened concrete
Environmental, safety, and health	1,380	1	NA	Steel frame/metal siding
Central warehouse (at Area 12 Camp)	2,760	1	NA	Steel frame/metal siding
Support warehouse (at P-Tunnel)	1,200	1	NA	Steel frame/metal siding
Facility maintenance shops	1,970	1	NA	Steel frame/metal siding
Utility building	1,840	1	NA	Steel frame/metal siding
Sanitary wastewater treatment facility	370	1	NA	Steel frame/metal siding
Standby generator	290	1	NA	Hardened concrete
Secure vehicle staging building	90	1	Special nuclear materials	Concrete
Unit substation (2)	280	1	NA	Concrete
Bus loading & unloading (2)	870	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Water storage tanks	1,840	NA	NA	NA
Secure vehicle staging area	920	1	NA	NA
Fire water storage tank/pumphouse (2)	920	NA	NA	NA
Tower cooling water facility	1,150	NA	NA	NA
Diesel fuel storage	920	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Sanitary/wastewater treatment facility	1,390	NA	NA	NA
Stormwater ponds (entry pad)	3,490	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: NT DOE 1996a.

Table B.1–9. Facility Requirements for the Consolidation Alternative at Idaho National Engineering Laboratory

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
Administration and training	3,210	2	NA	Steel frame/metal siding
Environmental, safety, and health	1,380	1	NA	Steel frame/metal siding
Waste storage	920	1	NA	Steel frame/metal siding
Utility building	1,840	1	NA	Steel frame/metal siding
Source calibration facility	550	1	Special nuclear materials	Concrete
Standby generator	290	1	NA	Hardened concrete
Secure vehicle staging	90	1	Special nuclear materials	Concrete
Unit substation (2)	280	1	NA	Concrete
Parking	32,140	NA	NA	NA
Storage yard	4,590	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Switchyard	1,840	NA	NA	NA
Secure vehicle staging area	920	1	NA	NA
Tower cooling water facility	920	NA	NA	NA
Diesel fuel storage	920	NA	NA	NA
Construction laydown area	18,370	NA	NA	NA
Stormwater ponds (4)	6,980	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: DOE 1996e.

Table B.1–10. Facility Requirements for the Consolidation Alternative Option to Construct a New Facility at Pantex Plant

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
Administration and training	3,210	2	NA	Steel frame/metal siding
Security/training center	2,110	1	NA	Hardened concrete and steel frame/metal siding
Security portals	1,530	1	NA	Hardened concrete
Environmental, safety, and health	1,380	1	NA	Steel frame/metal siding
Waste storage	920	1	NA	Steel frame/metal siding
Utility building	1,840	1	NA	Steel frame/metal siding
Source calibration facility	550	1	Special nuclear materials	Concrete
Standby generator	290	1	NA	Hardened concrete
Unit substation (2)	280	1	NA	Concrete
Parking	32,140	NA	NA	NA
[Text deleted.]				
Storage yard	4,590	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Switchyard	1,840	NA	NA	NA
Fire water storage tank/pumphouse (2)	920	NA	NA	NA
Helicopter pad	8,270	NA	NA	NA
Tower cooling water facility	920	NA	NA	NA
Diesel fuel storage	920	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Construction laydown area	18,370	NA	NA	NA
[Text deleted.]				
Stormwater ponds (2)	3,490	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: DOE 1996e.

Table B.1–11. Facility Requirements for the Consolidation Alternative Option to Modify Existing and Construct New Facilities in Zone 12 South at Pantex Plant

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Surplus storage building	27,370	3	Special nuclear materials	Hardened concrete
Strategic reserve storage building	2,940	2	Special nuclear materials	Hardened concrete
Administration and training	3,210	2	NA	Steel frame/metal siding
[Text deleted.]				
Security/training center	2,110	1	NA	Hardened concrete and steel frame/metal siding
Security portals	1,530	1	NA	Hardened concrete
Environmental, safety, and health	1,380	1	NA	Steel frame/metal siding
[Text deleted.]				
Waste storage	920	1	NA	Steel frame/metal siding
Utility building	1,840	1	NA	Steel frame/metal siding
[Text deleted.]				
Source calibration facility	550	1	Special nuclear materials	Concrete
Standby generator	290	1	NA	Hardened concrete
[Text deleted.]				
Secure vehicle staging building	90	1	Special nuclear materials	Concrete
Unit substation (2)	280	1	NA	Concrete
Parking	32,140	NA	NA	NA
Bus loading and unloading	870	NA	NA	NA
Storage yard	4,590	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Switchyard	1,840	NA	NA	NA
[Text deleted.]				
Secure vehicle staging area	920	NA	NA	NA
[Text deleted.]				
Tower cooling water facility	920	NA	NA	NA
Diesel fuel storage	920	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
[Text deleted.]				
Construction laydown area	18,370	NA	NA	NA
[Text deleted.]				
Stormwater ponds (2)	3,490	NA	NA	NA
[Text deleted.]				

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: PX DOE 1996a.

Table B.1–12. Facility Requirements for the Consolidation Alternative at Savannah River Site

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
Administration and training	3,210	2	NA	Steel frame/metal siding
Security/training center	2,110	1	NA	Hardened concrete and steel frame/metal siding
Security portals	1,580	1	NA	Hardened concrete
Environmental, safety, and health	1,380	1	NA	Steel frame/metal siding
Utility building	1,840	1	NA	Steel frame/ metal siding
Source calibration facility	550	1	Special nuclear materials	Concrete
Standby generator	290	1	NA	Hardened concrete
Personnel processing–employees/visitors	280	1	NA	Steel frame/metal siding
Secure vehicle staging	90	1	Special nuclear materials	Concrete
Unit substation (2)	280	1	NA	Concrete
Parking	32,140	NA	NA	NA
Bus loading and unloading	870	NA	NA	NA
Storage yard	4,590	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Switchyard	1,840	NA	NA	NA
Water storage tanks	1,840	NA	NA	NA
Secure vehicle staging area	920	1	NA	NA
Fire water storage tank/ pumphouse (2)	920	NA	NA	NA
Helicopter pad	8,270	NA	NA	NA
Tower cooling water facility	920	NA	NA	NA
Diesel fuel storage	920	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Construction laydown area	18,370	NA	NA	NA
Stormwater ponds (4)	6,980	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: DOE 1996e.

Table B.1–13. Facility Requirements for the Collocation Alternative at Hanford Site

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
National security storage facility	13,960	2	HEU	Hardened concrete
Security portals	1,530	1	NA	Hardened concrete
Utility building	3,040	1	NA	Steel frame/metal siding
Sanitary wastewater treatment building	520	1	NA	Steel frame/metal siding
Source calibration facility	550	1	Special nuclear materials	Concrete
Standby generator (2)	440	1	NA	Hardened concrete
[Text deleted.]				
Unit substitution (4)	560	1	NA	Concrete
Secure vehicle staging building (2)	180	1	HEU	Concrete
Parking	47,140	NA	NA	NA
Tower cooling water facility	1,150	NA	NA	NA
Diesel fuel storage (2)	1,840	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Sanitary wastewater treatment facility	1,950	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: DOE 1996f.

Table B.1–14. Facility Requirements for the Collocation Alternative Option to Construct a New Facility at Nevada Test Site

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
National security storage facility	13,960	2	HEU	Hardened concrete
Security/training center	3,150	1	NA	Hardened concrete and steel frame/metal siding
Security portals	1,580	1	NA	Hardened concrete
Environmental, safety, and health	1,600	1	NA	Steel frame/metal siding
Waste storage	1,140	1	NA	Steel frame/metal siding
Utility building	3,040	1	NA	Steel frame/metal siding
Sanitary wastewater treatment building	520	1	NA	Steel frame/metal siding
Standby generator (2)	440	1	NA	Hardened concrete
Unit substation (4)	560	1	NA	Concrete
Secure vehicle staging building (2)	180	1	HEU	Concrete
Parking	47,140	NA	NA	NA
Bus loading and unloading	1,250	NA	NA	NA
Storage yard	6,600	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Switchyard	2,760	NA	NA	NA
Secure vehicle staging area (2)	90	1	NA	NA
Tower cooling water facility	1,150	NA	NA	NA
Diesel fuel storage (2)	1,840	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Sanitary/wastewater treatment facility	1,950	NA	NA	NA
Construction laydown area	18,360	NA	NA	NA
Stormwater ponds (4)	10,600	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: DOE 1996f.

Table B.1–15. Facility Requirements for the Collocation Alternative Option to Modify P-Tunnel at Nevada Test Site

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Material handling building	23,980	3	Special nuclear materials	Hardened concrete
Administration and training	2,840	2	NA	Steel frame/metal siding
Fire station	1,490	1	NA	Steel frame/metal siding
Security/training center	2,110	1	NA	Hardened concrete and steel frame/metal siding
Security portals	1,630	1	NA	Hardened concrete
Environmental, safety, and health	1,380	1	NA	Steel frame/metal siding
Central warehouse	2,760	1	NA	Steel frame/metal siding
Support warehouse	1,200	1	NA	Steel frame/metal siding
Facility maintenance shops	1,970	1	NA	Steel frame/metal siding
Utility building	3,040	1	NA	Steel frame/metal siding
Sanitary wastewater treatment building	520	1	NA	Steel frame/metal siding
[Text deleted.]				
Standby generator	290	1	NA	Hardened concrete
Secure vehicle staging building	180	1	Special nuclear materials	Concrete
Unit substation (2)	280	1	NA	Concrete
Bus loading and unloading	870	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Water storage tanks	1,840	NA	NA	NA
Secure vehicle staging area	920	1	NA	NA
Fire water storage tank/pumphouse (2)	920	NA	NA	NA
Tower cooling water facility	1,150	NA	NA	NA
Diesel fuel storage	920	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Sanitary/wastewater treatment facility	1,390	NA	NA	NA
Stormwater ponds (entry pad)	3,490	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: NT DOE 1996a.

Table B.1–16. Facility Requirements for the Collocation Alternative at Idaho National Engineering Laboratory

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
National security storage facility	13,960	2	HEU	Hardened concrete
Administration and training	4,850	2	NA	Steel frame/metal siding
Environmental, safety, and health	1,600	1	NA	Steel frame/metal siding
Waste storage	1,140	1	NA	Steel frame/metal siding
Utility building	3,040	1	NA	Steel frame/metal siding
Source calibration facility	550	1	Special nuclear materials	Concrete
Standby generator (2)	440	1	NA	Hardened concrete
Unit substation (4)	560	1	NA	Concrete
Secure vehicle staging building (2)	180	1	HEU	Concrete
Parking	47,140	NA	NA	NA
Storage yard	6,600	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Switchyard	2,760	NA	NA	NA
Secure vehicle staging area (2)	90	1	NA	NA
Tower cooling water facility	1,150	NA	NA	NA
Diesel fuel storage (2)	1,840	NA	NA	NA
Construction laydown area	18,360	NA	NA	NA
Stormwater ponds (4)	10,600	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: DOE 1996f.

Table B.1–17. Facility Requirements for the Collocation Alternative at Pantex Plant

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
National security storage facility	13,960	2	HEU	Hardened concrete
Administration and training	4,850	2	NA	Steel frame/metal siding
Security/training center	3,150	1	NA	Hardened concrete and steel frame/ metal siding
Security portals	1,530	1	NA	Hardened concrete
Environmental, safety, and health	1,600	1	NA	Steel frame/metal siding
Waste storage	1,140	1	NA	Steel frame/metal siding
Utility building	3,040	1	NA	Steel frame/metal siding
Source calibration facility	550	1	Special nuclear materials	Concrete
Standby generator (2)	440	1	NA	Hardened concrete
Unit substation (4)	560	1	NA	Concrete
Parking	47,140	NA	NA	NA
[Text deleted.]				
Storage yard	6,600	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Switchyard	2,760	NA	NA	NA
Fire water storage tank/pumphouse (2)	920	NA	NA	NA
Helicopter pad	8,270	NA	NA	NA
Tower cooling water facility	1,150	NA	NA	NA
Diesel fuel storage (2)	1,840	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Construction laydown area	18,360	NA	NA	NA
[Text deleted.]				
Stormwater ponds (2)	5,100	NA	NA	NA

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: DOE 1996f.

Table B.1–18. Facility Requirements for the Collocation Alternative Option to Construct a New Facility at Oak Ridge Reservation

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
National security storage facility	13,960	2	HEU	Hardened concrete
[Text deleted.]				
Security portals	1,530	1	NA	Hardened concrete
Environmental, safety, and health	1,600	1	NA	Steel frame/metal siding
[Text deleted.]				
Waste storage	1,140	1	NA	Steel frame/metal siding
Utility building	3,040	1	NA	Steel frame/metal siding
Source calibration facility	550	1	Special nuclear materials	Concrete
Standby generator (2)	440	1	NA	Hardened concrete
Unit substation (4)	560	1	NA	Concrete
[Text deleted.]				
Parking	47,140	NA	NA	NA
Bus loading and unloading	1,250	NA	NA	NA
Storage yard	6,600	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Switchyard	2,760	NA	NA	NA
[Text deleted.]				
Secure vehicle staging area (2)	90	1	NA	NA
[Text deleted.]				
Helicopter pad	8,270	NA	NA	NA
Tower cooling water facility	1,150	NA	NA	NA
Diesel fuel storage (2)	1,840	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Construction laydown area	18,360	NA	NA	NA
[Text deleted.]				
Stormwater ponds (4)	10,600	NA	NA	NA

[a] Indicates required new construction.
Note: m^2=square meters; NA=not applicable.
Source: DOE 1996f.

Table B.1–19. Facility Requirements for the Collocation Alternative Option to Construct a New Plutonium Storage Facility at Oak Ridge Reservation; Modify or Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
[Text deleted.]				
Security portals	1,530	1	NA	Hardened concrete
Environmental, safety, and health	1,380	1	NA	Steel frame/metal siding
[Text deleted.]				
Waste storage	920	1	NA	Steel frame/metal siding
Utility building	1,840	1	NA	Steel frame/metal siding
Source calibration facility	550	1	Special nuclear materials	Concrete
Standby generator	290	1	NA	Hardened concrete
[Text deleted.]				
Unit substation (2)	280	1	NA	Concrete
Parking	32,140	NA	NA	NA
Bus loading and unloading	870	NA	NA	NA
Storage yard	4,590	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Switchyard	1,840	NA	NA	NA
[Text deleted.]				
Secure vehicle staging area	920	1	NA	NA
[Text deleted.]				
Helicopter pad	8,270	NA	NA	NA
Tower cooling water facility	920	NA	NA	NA
Diesel fuel storage	920	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Construction laydown area	18,370	NA	NA	NA
[Text deleted.]				
Stormwater ponds (4)	6,980	NA	NA	NA

[a] Indicates required new construction.
Note: m^2=square meters; NA=not applicable.
Source: DOE 1996e.

Table B.1–20. Facility Requirements for the Collocation Alternative at Savannah River Site

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Special nuclear materials storage building	29,200	3	Special nuclear materials	Hardened concrete
National security storage facility	13,960	2	HEU	Hardened concrete
Administration and training	4,850	2	NA	Steel frame/metal siding
Security/training center	3,150	1	NA	Hardened concrete and steel frame/ metal siding
Security portals	1,580	1	NA	Hardened concrete
Environmental, safety, and health	1,600	1	NA	Steel frame/metal siding
Utility building	3,040	1	NA	Steel frame/metal siding
Source calibration facility	550	1	Special nuclear materials	Concrete
Standby generator (2)	440	1	NA	Hardened concrete
Unit substation (4)	560	1	NA	Concrete
Secure vehicle staging building (2)	180	1	HEU	Concrete
Personnel processing–employees/visitors	280	1	NA	Steel frame/metal siding
Parking	47,140	NA	NA	NA
Bus loading and unloading	1,250	NA	NA	NA
Storage yard	6,600	NA	NA	NA
Effluent monitoring system/meteorological tower (4)	180	NA	NA	NA
Switchyard	2,760	NA	NA	NA
Water storage tanks	2,190	NA	NA	NA
Secure vehicle staging area (2)	90	1	NA	NA
Fire water storage tank/ pumphouse (2)	920	NA	NA	NA
Helicopter pad	8,270	NA	NA	NA
Tower cooling water facility	1,150	NA	NA	NA
Diesel fuel storage (2)	1,840	NA	NA	NA
Compressed gas supply	280	NA	NA	NA
Liquefied gas supply	460	NA	NA	NA
Construction laydown area	18,360	NA	NA	NA
Stormwater ponds (4)	10,600	NA	NA	NA

[a] Indicates required new construction.
Note: m^2=square meters; NA=not applicable.
Source: DOE 1996f.

B.2 FACILITIES COMMON TO MULTIPLE PLUTONIUM DISPOSITION ALTERNATIVES

Tables B.2–1, B.2–2, and B.2–3 list the key building/structure requirements for the pit disassembly/conversion facility, Pu conversion facility, and mixed oxide fuel fabrication facility, respectively. Under the Preferred Alternative for surplus Pu disposition, the pit disassembly/conversion facility and the mixed oxide fuel fabrication facility could each be located at either Hanford, INEL, Pantex, or SRS, and the Pu conversion facility could be located at Hanford or SRS. The facility requirements for these alternatives could be reduced by using existing facilities for portions of the operations. The next tier of *National Environmental Policy Act* (NEPA) review will examine locations for the selected alternatives including the use of existing facilities.

Table B.2–1. Facility Requirements for the Pit Disassembly/Conversion Facility

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Pu processing	4,600	2	Special nuclear materials	Concrete
Administration	2,300	2	NA	Steel frame/metal skin
Pu operations support	1,500	1	NA	Steel frame/metal skin
Warehouse	465	1	NA	Steel frame/metal skin
Utilities	215	1	NA	Steel frame/metal skin
Generator	190	1	NA	Steel frame/metal skin
Guard/vehicle monitoring station	325	1	NA	Steel frame/metal skin
Covered parking garage	2,800	2	NA	Concrete

[a] Indicates required new construction.
Note: m^2=square meters; NA=not applicable.
Source: LANL 1996d.

Table B.2–2. Facility Requirements for the Plutonium Conversion Facility

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Process building	9,300	2	Special nuclear materials	Concrete
Cold support building	7,900	2	NA	Steel frame/metal skin
Waste treatment facility	6,500	1	Special nuclear materials	Concrete
Staging/storage facility (feeds)	2,800	1	Special nuclear materials	Concrete
Source calibration building	195	1	Special nuclear materials	Heavy concrete
Standby generator building	195	1	NA	Concrete
Administration building	2,300	3	NA	Concrete
Long-term waste storage building	2,800	1	NA	Concrete
Utility support building	1,900	1	NA	Steel frame/metal skin
Central warehouse/shipping/receiving	2,800	1	NA	Concrete
Maintenance shops	2,200	1	NA	Steel frame/metal skin

[a] Indicates required new construction.
Note: m^2=square meters; NA=not applicable.
Source: LANL 1996c.

Table B.2–3. Facility Requirements for the Mixed Oxide Fuel Fabrication Facility

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Receiving and storage	1,900	1	Special nuclear materials	Type-1, FR, SC-1[b]
Fuel fabrication	9,300	2	Special nuclear materials	Type-1 FR, SC-1[a]
Waste management	2,800	1	Special nuclear materials	Type-1 FR, SC-1[a]
Cold support and utilities	1,400	1	NA	Metal frame
General administration and security	2,800	1	NA	Type-1 FR
Fire station	470	1	NA	Type-1 FR

[a] Indicates required new construction.

[b] Type-1 Fire Resistive, reinforced concrete Safety Class-1 according to the Uniform Building Code.

Note: m^2=square meters; NA=not applicable.

Source: LANL 1996b.

B.3 PLUTONIUM DISPOSITION FACILITIES

Tables B.3–1 through B.3–7 list the key building/structure requirements for facilities required to support the various Pu disposition alternatives. The tables are in the same order as the technology alternatives appear in Chapter 2 of this PEIS. Under the Preferred Alternative for surplus Pu disposition, the ceramic immobilization facility, or the vitrification facility could be located at Hanford or SRS. The facility requirements for these alternatives could be reduced by using existing facilities for portions of the operations. The next tier of NEPA review will examine locations for the selected alternatives including the use of existing facilities.

Table B.3–1. Facility Requirements for the Deep Borehole Complex—Direct Disposition Alternative

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Main Area Facilities				
Administration	1,394	1	NA	Light steel frame
Personnel services	1,394	1	NA	Light steel frame
Medical center	929	1	NA	Light steel
Environmental, safety, and health	929	1	NA	Light steel
Security center	1,858	1	NA	Light steel
Security and fire training area	929	1	NA	Light steel
Fire station	929	1	NA	Light steel
Warehouse and maintenance	2,323	1	NA	Light steel frame
Receiving and storage	4,181	2	Special nuclear materials	Concrete
Plant utilities	929	1	NA	Masonry
Plant waste management	650	1	Special nuclear materials, special nuclear material wastes	Light steel frame
Drilling and emplacing operations center	929	1	NA	Light steel frame
Electrical substation	650	1	NA	Steel, concrete
Cooling tower	743	NA	NA	Steel
Drilling Facilities				
Drill rig	1,858	NA	NA	Steel frame
Drilling shift office trailers	1,858	1	NA	Light steel frame
Treated water storage	3,716	1	NA	Steel, concrete
Drilling mud pits	7,432	1	NA	Earth
Emplacing Facilities				
Emplacing crane	1,858	NA	NA	Steel frame
Process waste management	1,742	1	Special nuclear materials waste	Concrete
Emplacing shift office trailers	1,858	1	NA	Light steel frame

[a] Indicates required new construction.
Note: m^2=square meters; NA=not applicable.
Source: LLNL 1996a.

Table B.3–2. Facility Requirements for the Deep Borehole Complex—Immobilized Disposition Alternative

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Main Area Facilities				
Administration	1,394	1	NA	Light steel frame
Personnel services	1,394	1	NA	Light steel frame
Medical center	929	1	NA	Light steel
Environmental, safety, and health	929	1	NA	Light steel
Security center	1,858	1	NA	Light steel
Security and fire training area	929	1	NA	Light steel
Fire station	929	1	NA	Light steel
Warehouse and maintenance	2,323	1	NA	Light steel frame
Receiving and storage	4,181	2	Special nuclear materials	Concrete
Plant utilities	929	1	NA	Masonry
Plant waste management	650	1	Special nuclear materials, special nuclear material wastes	Light steel frame
Drilling and emplacing operations center	929	1	NA	Light steel frame
Electrical substation	650	1	NA	Steel, concrete
Cooling tower	743	NA	NA	Steel
Drilling Facilities				
Drill rig	1,858	NA	NA	Steel frame
Drilling shift office trailers	1,858	1	NA	Light steel frame
Treated water storage	3,716	1	NA	Steel, concrete
Drilling mud pits	7,432	1	NA	Earth
Emplacing Facilities				
Emplacing crane	1,858	NA	NA	Steel frame
Pellet-grout mixing facility	743	1	Special nuclear materials	Concrete
Process waste management	1,742	1	Special nuclear materials waste	Concrete
Emplacing shift office trailers	1,858	1	NA	Light steel frame

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: LLNL 1996h.

Table B.3–3. Facility Requirements for the Ceramic Immobilization Facility—Immobilized Disposition Alternative

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Pu processing building	4,500	2	Special nuclear materials	Reinforced concrete[b]
Radwaste management building	2,300	1	Special nuclear materials	Reinforced concrete
Radiologically controlled maintenance building	1,400	1	Special nuclear materials	Reinforced concrete
Product storage building	460	1	Special nuclear materials	Reinforced concrete
Support utilities building	1,400	1	NA	Metal frame
Administration building	1,700	1	NA	Metal frame
Warehouse	2,300	1	NA	Metal frame
Shops building	2,300	1	NA	Metal frame
Industrial waste treatment building	930	1	NA	Metal frame
Sanitary waste treatment building	150	1	NA	Metal frame
Security portals	150	2	NA	Reinforced concrete
Cold chemical storage building	460	1	NA	Metal frame
Cooling tower	930	NA	NA	Reinforced concrete

[a] Indicates required new construction.

[b] Type-1 Fire Resistive, reinforced concrete Safety Class-1 according to the Uniform Building Code.

Note: m^2=square meters; NA=not applicable.

Source: LLNL 1996e.

Table B.3–4. Facility Requirements for the Vitrification Alternative

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Vitrification building	2,675	3	Special nuclear materials	Reinforced concrete
Service building	1,858	2	NA	Metal frame
Maintenance building	929	2	NA	Metal frame
Fan house	56	1	Special nuclear materials[b]	Reinforced concrete
Exhaust stack	6	1	NA	Metal
Radwaste building	595	2	Special nuclear materials[b]	Reinforced concrete
Chemical storage tank	10	1	NA	Metal
Cooling tower	558	NA	NA	Reinforced concrete
Substation	28	1	NA	Metal
Water treatment	372	1	NA	Metal frame
Security portals	140	1	NA	Reinforced concrete
Waste treatment	140	1	NA	Metal frame
Boiler house	446	1	NA	Metal frame

[Text deleted.]

[a] Indicates required new construction.

[b] Radiological constituents in offgas or liquid.

Note: m^2=square meters; NA=not applicable.

Source: LLNL 1996c.

Table B.3–5. Facility Requirements for the Ceramic Immobilization Alternative

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Pu processing building	2,700	2	Special nuclear materials	Reinforced concrete
Radwaste management building	1,700	1	Special nuclear materials	Reinforced concrete
Hot maintenance building	930	1	Special nuclear materials	Reinforced concrete
Canister storage building	93	2 (one below grade)	Special nuclear materials	Reinforced concrete
Support utilities building	930	1	NA	Metal frame
Administration building	1,400	1	NA	Metal frame
Warehouse	1,900	1	NA	Metal frame
Shops and equipment mock-up	1,900	1	NA	Metal frame
Industrial waste treatment building	740	1	NA	Metal frame
Sanitary waste treatment building	150	1	NA	Metal frame
Security portals	150	2	NA	Reinforced concrete
Cold chemical storage building	190	1	NA	Metal frame
Cooling tower	560	NA	NA	Reinforced concrete

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable.

Source: LLNL 1996d.

Table B.3–6. Facility Requirements for the Electrometallurgical Treatment Alternative (Glass-Bonded Zeolite)

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Fuel Conditioning Facility (FCF)	2,100	4	Special nuclear materials	Reinforced concrete and steel frame, PC-3
Safety Equipment Building (SEB)	230	1	NA	Reinforced concrete, PC-3
Hot Fuel Exam. Facility (HFEF)	1,700	4	Special nuclear materials	Reinforced concrete and steel frame, PC-3
Zero Power Physics Reactor (ZPPR)	400	1	Special nuclear materials	Reinforced concrete, PC-2
ZPPR Vault/Workroom/Equip. Room	470	1	Special nuclear materials	Reinforced concrete, PC-2
Laboratory and Office Building	7,800	1	Lab samples only	Reinforced concrete and masonry, PC-2
Fuel Manufacturing Facility (FMF)	440	1	Special nuclear materials	Reinforced concrete, PC-2

[a] Indicates required new construction.

Note: m^2=square meters; NA=not applicable; FCF has four levels: subbasement (logout room), a basement service floor, the main operating level, and a "roof" level (which is slated for decommissioning). The HFEF has four levels: service area basement, operating floor, office/data collection level, and the high-bay area with a "hot repair" area and an area for Waste Isolation Pilot Plant (WIPP) characterization. PC-2/PC-3=seismically qualified to standard PC-2/PC-3, respectively.

Source: LLNL 1996b.

Table B.3–7. Facility Requirements for the Evolutionary Light Water Reactor Alternative

Building/Structure	Footprint[a] (m^2)	Number of Levels	Special Materials	Construction Type
Reactor building	3,900	5	Special nuclear materials	Reinforced concrete
Turbine building	8,640	4	NA	Reinforced concrete
Control building	1,400	4	NA	Reinforced concrete
Radwaste building	6,600	1	Special nuclear materials	Reinforced concrete
Service building (hot)	3,510	1	Special nuclear materials	Reinforced concrete
Spent fuel storage	3,160	1	Special nuclear materials	Reinforced concrete
Fresh fuel storage	3,200	1	Special nuclear materials	Reinforced concrete
Access building	1,000	1	NA	Reinforced concrete
Pump house	1,250	1	NA	Reinforced concrete
Warehouse	4,300	1	NA	Steel frame or concrete
Switch yard	7,100	NA	NA	Outside equipment
Cooling towers	800	NA	NA	Reinforced concrete
Heat sink pool	10,000	1	NA	Reinforced concrete

[a] Indicates required new construction.
Note: m^2=square meters; NA=not applicable.
Source: LLNL 1996g.

Appendix C
Materials, Resources, and Employment Requirements for Construction and Operations

This appendix provides predesign data on the construction and operations requirements for the various facilities required to accomplish the storage and disposition activities essential to the alternatives described in this programmatic environmental impact statement (PEIS). The data assume separate facilities as listed. While it may be possible to combine several activities into a single facility, design information was not available for all the various possible combinations, so a one-activity-per facility concept was used for this analysis. This appendix presents data on material and resources required for construction, construction worker requirements, utilities required on an annual basis for operations, chemicals required on an annual basis for operations, and annual personnel requirements to operate the listed facilities.

C.1 CONSTRUCTION REQUIREMENTS

C.1.1 MATERIALS/RESOURCES REQUIRED

C.1.1.1 Long-Term Storage Alternatives

The materials and resources required to construct new or modify interim storage facilities to meet long-term storage standards are listed in the tables that follow. Tables C.1.1.1–1 and C.1.1.1–2 list the materials and/or resources required during construction of the Upgrade Alternative. Tables C.1.1.1–3 and C.1.1.1–4 list materials and resources required during construction of the Consolidation Alternative and Collocation Alternative, respectively. The Preferred Alternative for the long-term storage of surplus Pu involves a combination of upgrade (Pantex Plant [Pantex], Oak Ridge Reservation [ORR], and Savannah River Site [SRS]), No Action (Hanford Site [Hanford], Nevada Test Site [NTS], Idaho National Engineering Laboratory [INEL], and Los Alamos National Laboratory [LANL]), and phaseout (Rocky Flats Environmental Technology Site [RFETS]).

Table C.1.1.1–1. Materials/Resources Required During Construction of the Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative[a]

Materials/Resources	Total Consumption			
	Hanford [b]	INEL	Pantex	ORR
Utilities				
Electricity				
Total consumption (MWh)	5,000	7,000	170	20
Peak demand[c] (MWe)	1.0	1.0	1.0	0.1
Water				
Total consumption (l)	20,000,000	29,000,000	193,000	3,000,000
[Text deleted.]				
Solids				
Concrete (m^3)	4,300	5,100	230	27
Steel (t)	700	1,300	4.5	48
Liquids				
Fuel (l)	150,000	280,000	8,000	16,000
Gases				
Industrial gases (m^3)	3,000	5,600	170	1,200

[a] This subalternative does not apply to SRS.

[b] Of the two Hanford storage upgrade options, the New Hanford Pu Storage Facility option represents the upper bound in terms of construction impacts and is presented here for comparison. The other storage option, Modify Fuels and Materials Examination Facility, has smaller construction impacts associated with its implementation. It is not shown for simplicity.

[c] Peak demand is the maximum rate expected during any hour for electricity.

Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; t=metric tons.

Source: HF DOE 1995e:1; IN DOE 1996a; OR MMES 1996a; PX MH 1994a.

Table C.1.1.1–2. Materials/Resources Required During Construction of the Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative[a]

	Total Consumption			SRS[b]	
Materials/Resources	**Hanford[c]**	**INEL**	**Pantex[d]**	**(With All or Some RFETS and LANL Pu)**	**(With RFETS Non-Pit Pu)**
Utilities					
Electricity					
Total consumption (MWh)	6,200	8,300	22,000	1,000	800
Peak demand[e] (MWe)	1.0	1.0	3.0	0.2	0.1
Water					
Total consumption (l)	25,400,000	34,400,000	480,000,000	3,000,000	2,220,000
[Text deleted.]					
Solids					
Concrete (m^3)	7,300	8,100	84,000	2,600	1,930
Steel (t)	1,090	1,690	17,000	280	195
Liquids					
Fuel (l)	203,000	334,000	4,600,000	17,600	13,000
Gases					
Industrial gases (m^3)	4,100	6,700	95,000	1,180	860

[a] ORR is not eligible to receive RFETS or LANL Pu material under this upgrade subalternative.

[b] SRS is only eligible to receive RFETS Pu and LANL Pu material under the Upgrade Alternative.

[c] Of the two Hanford storage upgrade options, the New Hanford Pu Storage Facility option represents the upper bound in terms of construction impacts and is presented here for comparison. The other storage option, Modify Fuels and Materials Examination Facility, has smaller construction impacts associated with its implementation. It is not shown for simplicity.

[d] Values shown are based on an upgrade designed to accommodate the Consolidation Alternative.

[e] Peak demand is the maximum rate expected during any hour for electricity.

Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; t=metric tons.

Source: HF DOE 1995e:1; IN DOE 1996a; PX DOE 1996a; SRS 1996a:4; WSRC 1995e.

Table C.1.1.1–3. Materials/Resources Required During Construction of the Consolidation Alternative

Materials/ Resources	Total Consumption						
	Hanford	NTS		INEL	Pantex		SRS
		New Pu Storage Facility	Modify P-Tunnel		New Pu Storage Facility	New and Modified Zone 12 South Facilities	
Utilities							
Electricity							
Total consumption (MWh)	14,000	14,000	14,000	14,000	22,000	22,000	22,000
Peak demand[a] (MWe)	2	2	2	2	3	3	3
Water							
Total consumption (l)	510,000,000	510,000,000	210,000,000	510,000,000	510,000,000	480,000,000	510,000,000
[Text deleted.]							
Solids							
Concrete (m^3)	78,000	83,000	80,000	82,000	89,000	84,000	88,000
Steel (t)	13,000	14,000	14,000	14,000	16,000	17,000	15,000
Liquids							
Fuel (l)	4,300,000	4,500,000	4,500,000	4,500,000	4,700,000	4,600,000	4,600,000
Gases							
Industrial gases (m^3)	88,000	91,000	91,000	91,000	95,000	95,000	94,000

[a] Peak demand is the maximum rate expected during any hour for electricity.

Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; t=metric tons.

Source: DOE 1996e; NT DOE 1996a; PX DOE 1996a.

Table C.1.1.1–4. Materials/Resources Required During Construction of the Collocation Alternative

Materials/ Resources	Total Consumption							
	Hanford	NTS		INEL	Pantex	ORR		SRS
		New Pu and HEU Storage Facility	Modify P-Tunnel			New Pu and HEU Storage Facility	New Pu Storage Facility Only[a]	
Utilities								
Electricity								
Total consumption (MWh)	25,000	29,000	22,000	29,000	29,000	29,000	22,000	29,000
Peak demand[b] (MWe)	3.5	4	3	4	4	4	3	4
Water								
Total consumption (l)	628,000,000	628,000,000	210,000,000	628,000,000	628,000,000	628,000,000	510,000,000	628,000,000
[Text deleted.]								
Solids								
Concrete (m^3)	102,000	110,000	100,000	116,000	115,000	116,000	88,000	115,000
Steel (t)	16,600	18,600	20,000	19,600	20,600	18,800	15,000	19,600
Liquids								
Fuel (l)	5,700,000	5,900,000	5,300,000	6,000,000	6,100,000	5,900,000	4,500,000	6,100,000
Gases								
Industrial gases (m^3)	115,000	119,000	110,000	122,000	123,000	120,000	92,000	123,000

[a] The materials/resources required during construction of the Upgrade Alternative at ORR (Table C.1.1.1–1) are added to obtain the total materials/resources required during construction of the Collocation Alternative Option to Construct a New Plutonium Storage Facility at ORR and Modify Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant.

[b] Peak demand is the maximum rate expected during any hour for electricity.

Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; t=metric tons.

Source: DOE 1996e; DOE 1996f; NT DOE 1996a.

C.1.1.2 Activities Common to Multiple Plutonium Disposition Alternatives

The materials and resources required to construct the facilities that perform precursor activities on Plutonium (Pu) materials prior to certain Pu disposition alternatives are shown in Tables C.1.1.2–1, C.1.1.2–2, and C.1.1.2–3. Under the Preferred Alternative for surplus Pu disposition, the pit disassembly/conversion facility and the mixed oxide (MOX) fuel fabrication facility could each be located at either Hanford, INEL, Pantex, or SRS, and the Pu conversion facility could be located at Hanford or SRS. The facility construction requirements for these alternatives could be reduced by using existing facilities for portions of the operations. The next tier of *National Environmental Policy Act* (NEPA) review will examine locations for the selected alternatives including the use of existing facilities.

Table C.1.1.2–1. Materials/Resources Required During Construction of the Pit Disassembly/Conversion Facility

Materials/Resources	Total Consumption	Peak Demand
Utilities		
Electricity[a]	15,000 MWh	5 MWe
Water (l)	11,356,000	NA
Solids		
Concrete (m^3)	30,500	NA
Steel (t)	3,100	NA
Liquids		
Fuel (l)	757,000	NA
Gases		
Industrial gases[b] (m^3)	21,200	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; t=metric tons.
Source: LANL 1996d.

Table C.1.1.2–2. Materials/Resources Required During Construction of the Plutonium Conversion Facility

Materials/Resources	Total Consumption	Peak Demand
Utilities		
Electricity[a]	6,550 MWh	<1 MWe
Water (l)	14,142,300	NA
Solids		
Concrete (m^3)	36,700	NA
Steel (t)	4,100	NA
Liquids		
Fuel (l)	947,100	NA
Gases		
Industrial gases[b] (m^3)	19,800	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; t=metric tons.
Source: LANL 1996c.

Table C.1.1.2–3. Materials/Resources Required During Construction of the Mixed Oxide Fuel Fabrication Facility

Materials/Resources	Total Consumption	Peak Demand
Utilities		
Electricity[a]	<5,000 MWh	1 MWe
Water (l)	<11,400,000	NA
Solids		
Concrete (m^3)	<30,600	NA
Steel (t)	<3,630	NA
Liquids		
Fuel (l)	<757,080	NA
Gases		
Industrial gases[b] (m^3)	<15,600	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.

[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.

Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; t=metric tons.

Source: LANL 1996b.

C.1.1.3 Plutonium Disposition Alternatives

Tables C.1.1.3–1 through C.1.1.3–8 show the materials and resources required to construct the various disposition facilities. Under the Preferred Alternative for surplus Pu disposition, the ceramic immobilization facility, or the vitrification facility could be located at Hanford or SRS. The facility construction requirements for these alternatives could be reduced by using existing facilities for portions of the operations. The next tier of NEPA review will examine locations for the selected alternatives including the use of existing facilities.

Table C.1.1.3–1. Materials/Resources Required During Construction of the Deep Borehole Complex—Direct Disposition Alternative

Materials/Resources	Total Consumption	Peak Demand
Utilities		
Electricity[a]	1,800 MWh	0.8 MWe
Water (l)	45,400,000	NA
Solids		
Concrete (m^3)	27,000	NA
Steel (t)	6,400	NA
Liquids		
Fuel (gas & diesel) (l)	5,990,000	NA
Propane (l)	360,000	NA
Gases		
Industrial gases[b] (m^3)	NA	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; t=metric tons.
Source: LLNL 1996a.

Table C.1.1.3–2. Materials/Resources Required During Construction of the Deep Borehole Complex—Immobilized Disposition Alternative

Materials/Resources	Total Consumption	Peak Demand
Utilities		
Electricity[a]	1,700 MWh	0.8 MWe
Water (l)	41,630,000	NA
Solids		
Concrete (m^3)	25,000	NA
Steel (t)	5,800	NA
Liquids		
Fuel (gas & diesel) (l)	5,678,000	NA
Propane (l)	341,000	NA
Gases		
Industrial gases[b] (m^3)	NA	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; t=metric tons.
Source: LLNL 1996h.

Table C.1.1.3–3. Materials/Resources Required During Construction of the Ceramic Immobilization Facility—Immobilized Disposition Alternative

Materials/Resources	Total Consumption	Peak Demand
Utilities		
Electricity [a]	51,000 MWh	2.1 MWe
Water (l)	190,000,000	NA
Solids		
Concrete (m^3)	28,000	NA
Steel (t)	11,000	NA
Liquids		
Fuel (gas & diesel) (l)	15,000,000	NA
Propane (l)	18,000	NA
Gases		
Industrial gases[b] (m^3)	NA	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; t=metric tons.
Source: LLNL 1996e.

Table C.1.1.3–4. Materials/Resources Required During Construction of the Vitrification Alternative

Materials/Resources	Total Consumption	Peak Demand
Utilities		
Electricity [a]	10,000 MWh	5 MWe
Water (l)	53,000,000	NA
Solids		
Concrete (m^3)	34,000	NA
Steel (t)	13,600	NA
Liquids		
Fuel (gas & diesel) (l)	470,000	NA
Gases		
Industrial gases[b] (m^3)	14,000	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; t=metric tons.
Source: LLNL 1996c.

Table C.1.1.3–5. Materials/Resources Required During Construction of the Ceramic Immobilization Alternative

Materials/Resources	Total Consumption	Peak Demand
Utilities		
Electricity[a]	40,000 MWh	1.5 MWe
Water (l)	190,000,000	NA
Solids		
Concrete (m^3)	27,000	NA
Steel (t)	9,100	NA
Liquids		
Fuel (gas & diesel) (l)	11,000,000	NA
Gases		
Industrial gases[b] (m^3)	76	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.

[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.

Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; t=metric tons.

Source: LLNL 1996d.

Table C.1.1.3–6. Materials/Resources Required During Construction of the Electrometallurgical Treatment Alternative (Glass-Bonded Zeolite)

Materials/Resources	Total Consumption	Peak Demand
Utilities		
Electricity[a]	5,300 MWh	3 MWe
Water (l)	15,000,000	NA
Solids	NA	NA
Liquids		
Fuel (oil) (l)	570,000	NA
Gases	NA	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.

Note: l=liter; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; no construction is required for this alternative. The additional process equipment required by the Pu disposition project would be shipped in from offsite and installed in existing spaces. For this evaluation, 2 months operation of the site and facilities are allocated to this effort in lieu of any actual construction.

Source: LLNL 1996b.

Table C.1.1.3–7. Materials/Resources Required During Construction of the Partially Completed Light Water Reactor Alternative

Materials/Resource	Total Consumption	Peak Demand
Utilities		
Electricity[a]	1,075,000 MWh	160 MWe
Water (l)	440,000,000	NA
Solids		
Concrete (m^3)	3,980	NA
Steel (t)	450	NA
Liquids		
Fuel (l)	13,438,000	NA
Gases	NA	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; t=metric tons.
Source: TVA 1995b:1.

Table C.1.1.3–8. Materials/Resources Required During Construction of the Evolutionary Light Water Reactor Alternative

	Total Consumption	
Materials/Resources	Single Large Evolutionary LWR	Single Small Evolutionary LWR
Utilities		
Electricity (MWh)	120,000	120,000
Water (l)	757,000,000	454,000,000
Solids		
Concrete (m^3)	290,500	153,000
Steel (t)	61,700	45,400
Liquids		
Fuel (l)	5,677,000	5,677,000
Gases	NA	NA

Note: l=liter; LWR=light water reactor; m^3=cubic meters; MWh=megawatt hours; t=metric tons.
Source: LLNL 1996g.

C.1.2 CONSTRUCTION WORKER REQUIREMENTS

C.1.2.1 Long-Term Storage Alternatives

Tables C.1.2.1–1 through C.1.2.1–20 show the construction worker requirements for the Upgrade, Consolidation, and Collocation Alternatives. The Preferred Alternative for the long-term storage of surplus Pu involves a combination of upgrade (Pantex, ORR, and SRS), No Action (Hanford, NTS, INEL, and LANL), and phaseout (RFETS).

Table C.1.2.1–1. Employment Required During Construction of the Upgrade Alternative at Hanford Site

Employees	Year 1	Year 2	Year 3	Year 4
Total craft workers	22	39	32	21
Construction management and support staff	9	15	12	8
Total Employment Without RFETS Pu or LANL Pu Material	31	54	44	29
Total Employment With All or Some RFETS Pu and LANL Pu Material	54	78	55	29

Source: HF DOE 1995e:1.

Table C.1.2.1–2. Employment Required During Construction of the Upgrade Alternative at Idaho National Engineering Laboratory, Argonne National Laboratory-West

Employees	Year 1	Year 2	Year 3
Total craft workers	60	89	55
Construction management and support staff	25	33	21
Total Employment Without RFETS Pu or LANL Pu Material	85	122	76
Total Employment With All or Some RFETS Pu and LANL Pu Material	108	144	90

Source: IN DOE 1996a.

Table C.1.2.1–3. Employment Required During Construction of the Upgrade Alternative at Pantex Plant

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	1	17	5	0	0	0
Construction management and support staff	0	2	1	0	0	0
Total Employment Without RFETS Pu or LANL Pu Material	1	19	6	0	0	0
Total Employment With All or Some RFETS Pu and LANL Pu Material[a]	455	936	1,142	947	803	470
Total Employment With RFETS Pit Material	1	19	6	0	0	0

[a] Values shown are based on an Upgrade designed to accommodate the Consolidation Alternative Option to Modify Existing and Construct New Facilities in Zone 12 South.

Source: PX DOE 1996a; PX MH 1994c.

Table C.1.2.1–4. Employment Required During Construction of the Upgrade Alternative at Oak Ridge Reservation[a]

Employees	Year 1	Year 2	Year 3
Total craft workers	32	48	29
Construction management and support staff	12	18	11
Total Employment	44	66	40

[a] ORR is not eligible to receive RFETS Pu or LANL Pu material under the Upgrade Alternative.
Source: OR MMES 1996a.

Table C.1.2.1–5. Employment Required During Construction of the Upgrade Alternative at Savannah River Site[a]

Employees	Year 1
Total craft workers	140
Construction management and support staff	53
Total Employment With All or Some RFETS Pu and LANL Pu Material	193[b]
Total Employment With RFETS Non-Pit Pu Material	193[c]

[a] SRS is only eligible to receive RFETS and LANL Pu material under the Upgrade Alternative.
[b] The construction duration of this subalternative is 5 months.
[c] The construction duration of this subalternative is 4 months.
Source: SRS 1996a:4.

Table C.1.2.1–6. Employment Required During Construction of the Consolidation Alternative at Hanford Site

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	307	632	771	639	542	318
Construction management and support staff	116	240	293	243	206	121
Total Employment	423	872	1,064	882	748	439

Source: DOE 1996e.

Table C.1.2.1–7. Employment Required During Construction of the Consolidation Alternative Option to Construct a New Facility at Nevada Test Site

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	315	649	793	657	557	327
Construction management and support staff	121	246	301	250	212	124
Total Employment	436	895	1,094	907	769	451

Source: DOE 1996e.

Table C.1.2.1–8. Employment Required During Construction of the Consolidation Alternative Option to Modify P-Tunnel at Nevada Test Site

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	316	654	799	662	561	330
Construction management and support staff	102	248	304	251	213	144
Total Employment	418	902	1,103	913	774	474

Source: NT DOE 1996a.

Table C.1.2.1–9. Employment Required During Construction of the Consolidation Alternative at Idaho National Engineering Laboratory

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	317	654	798	661	561	329
Construction management and support staff	121	248	304	251	213	125
Total Employment	438	902	1,102	912	774	454

Source: DOE 1996e.

Table C.1.2.1–10. Employment Required During Construction of the Consolidation Alternative Option to Construct a New Facility at Pantex Plant

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	330	679	829	687	583	342
Construction management and support staff	127	258	315	261	221	130
Total Employment	457	937	1,144	948	804	472

Source: DOE 1996e.

Table C.1.2.1–11. Employment Required During Construction of the Consolidation Alternative Option to Modify Existing and Construct New Facilities in Zone 12 South at Pantex Plant

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	329	678	828	686	582	341
Construction management and support staff	126	258	314	261	221	129
Total Employment	455	936	1,142	947	803	470

Source: PX DOE 1996a.

Table C.1.2.1–12. Employment Required During Construction of the Consolidation Alternative at Savannah River Site

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	329	676	826	685	581	340
Construction management and support staff	126	256	314	261	221	129
Total Employment	455	932	1,140	946	802	469

Source: DOE 1996e.

Table C.1.2.1–13. Employment Required During Construction of the Collocation Alternative at Hanford Site

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	399	932	984	817	718	321
Construction management and support staff	152	355	374	311	273	122
Total Employment	551	1,287	1,358	1,128	991	443

Source: DOE 1996f.

Table C.1.2.1–14. Employment Required During Construction of the Collocation Alternative Option to Construct a New Facility at Nevada Test Site

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	414	964	1,021	847	744	335
Construction management and support staff	157	367	388	322	284	127
Total Employment	571	1,331	1,409	1,169	1,028	462

Source: DOE 1996f.

Table C.1.2.1–15. Employment Required During Construction of the Collocation Alternative Option to Modify P-Tunnel at Nevada Test Site

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	373	770	940	779	661	388
Construction management and support staff	138	293	357	296	251	152
Total Employment	511	1,063	1,297	1,075	912	540

Source: NT DOE 1996a.

Table C.1.2.1–16. Employment Required During Construction of the Collocation Alternative at Idaho National Engineering Laboratory

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	424	986	1,046	868	763	345
Construction management and support staff	163	375	398	330	289	131
Total Employment	587	1,361	1,444	1,198	1,052	476

Source: DOE 1996f.

Table C.1.2.1–17. Employment Required During Construction of the Collocation Alternative at Pantex Plant

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	428	991	1,056	877	769	351
Construction management and support staff	161	377	402	333	293	134
Total Employment	589	1,368	1,458	1,210	1,062	485

Source: DOE 1996f.

Table C.1.2.1–18. Employment Required During Construction of the Collocation Alternative Option to Construct a New Plutonium Storage Facility at Oak Ridge Reservation; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant[a]

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	321	661	808	669	568	333
Construction management and support staff	122	251	307	254	216	127
Total Employment	443	912	1,115	923	784	460

[a] To obtain the total construction employment required for the Collocation Alternative Option to Construct a New Plutonium Storage Facility at ORR and Modify Existing HEU Storage Facilities at Y–12 Plant, add the numbers from this table to the construction employment required for the Upgrade Alternative at ORR (Table C.1.2.1–4).

Source: DOE 1996e.

Table C.1.2.1–19. Employment Required During Construction of the Collocation Alternative Option to Construct a New Facility at Oak Ridge Reservation

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	450	1,042	1,112	924	810	372
Construction management and support staff	175	395	422	350	307	142
Total Employment	625	1,437	1,534	1,274	1,117	514

Source: DOE 1996f.

Table C.1.2.1–20. Employment Required During Construction of the Collocation Alternative at Savannah River Site

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	429	996	1,060	880	772	351
Construction management and support staff	163	379	403	334	294	134
Total Employment	592	1,375	1,463	1,214	1,066	485

Source: DOE 1996f.

C.1.2.2 Activities Common to Multiple Plutonium Disposition Alternatives

Tables C.1.2.2–1, C.1.2.2–2, and C.1.2.2–3 show the construction worker requirements to construct facilities that perform precursor activities on Pu materials prior to certain Pu disposition alternatives. Under the Preferred Alternative for surplus Pu disposition, the pit disassembly/conversion facility and the MOX fuel fabrication facility could each be located at either Hanford, INEL, Pantex, or SRS, and the Pu conversion facility at Hanford or SRS. The facility construction requirement for these alternatives could be reduced by using existing facilities for portions of the operations. The next tier of NEPA review will examine locations for the selected alternatives including the use of existing facilities.

Table C.1.2.2–1. Employment Required During Construction of the Pit Disassembly/Conversion Facility

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	60	120	135	90	90	60
Construction management and support staff	20	40	50	35	35	20
Total Employment	80	165	185	125	125	80

Source: LANL 1996d.

Table C.1.2.2–2. Employment Required During Construction of the Plutonium Conversion Facility

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	115	232	260	202	168	104
Construction management and support staff	42	87	98	78	64	36
Total Employment	157	319	358	280	232	140

Source: LANL 1996c.

Table C.1.2.2–3. Employment Required During Construction of the Mixed Oxide Fuel Fabrication Facility

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Total craft workers	125	265	300	230	195	115
Construction management and support staff	75	155	175	135	115	65
Total Employment	200	420	475	365	310	180

Source: LANL 1996b.

C.1.2.3 Plutonium Disposition Alternatives

Tables C.1.2.3–1 through C.1.2.3–8 list the construction worker requirements to construct facilities for the various Pu disposition alternatives. Under the Preferred Alternative for surplus Pu disposition, the ceramic immobilization facility, or the vitrification facility could be located at Hanford or SRS. The facility construction requirements for these alternatives could be reduced by using existing facilities for portions of the operations. The next tier of NEPA review will examine locations for the selected alternatives including the use of existing facilities.

Table C.1.2.3–1. Employment Required During Construction of the Deep Borehole Complex—Direct Disposition Alternative

Employees	Year 1	Year 2	Year 3
Total craft workers	280	785	425
Construction management and support staff	30	85	45
Total Employment	310	870	470

Source: LLNL 1996a.

Table C.1.2.3–2. Employment Required During Construction of the Deep Borehole Complex—Immobilized Disposition Alternative

Employees	Year 1	Year 2	Year 3
Total craft workers	260	725	405
Construction management and support staff	30	85	45
Total Employment	290	810	450

Source: LLNL 1996h.

Table C.1.2.3–3. Employment Required During Construction of the Ceramic Immobilization Facility—Immobilized Disposition Alternative

Employees	Year 1	Year 2	Year 3	Year 4	Year 5
Total craft workers	270	540	900	720	450
Construction management and support staff	30	60	100	80	50
Total Employment	300	600	1,000	800	500

Source: LLNL 1996e.

Table C.1.2.3–4. Employment Required During Construction of the Vitrification Alternative

Employees	Year 1	Year 2	Year 3	Year 4	Year 5
Total craft workers	200	320	320	300	200
Construction management and support staff	53	62	62	44	40
Total Employment	253	382	382	344	240

Source: LLNL 1996c.

Table C.1.2.3–5. Employment Required During Construction of the Ceramic Immobilization Alternative

Employees	Year 1	Year 2	Year 3	Year 4	Year 5
Total craft workers	270	540	900	720	450
Construction management and support staff	30	60	100	80	50
Total Employment	300	600	1,000	800	500

Source: LLNL 1996d.

Table C.1.2.3–6. Employment Required During Construction of the Electrometallurgical Treatment Alternative (Glass-Bonded Zeolite)

Employees	Period[a]
Officials and managers	30
Professionals	90
Technicians	79
Office and clerical	30
Operators/line supervisors	222
Safeguards and security	42
Total Employment	493

[a] Construction employment needs based upon labor associated with a 6-month equipment installation and checkout period.
Source: LLNL 1996b.

Table C.1.2.3–7. Employment Required During Construction of the Partially Completed Light Water Reactor Alternative

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Total craft workers	0	375	1,075	1,490	1,525	770	30
Construction management and support staff	40	325	580	815	615	310	25
Total Employment	40	700	1,655	2,305	2,140	1,080	55

Source: TVA 1995b:1.

Table C.1.2.3–8. Employment Required During Construction of the Evolutionary Light Water Reactor Alternative

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Single large reactor	300	3,000	3,500	3,500	2,000	300
Single small reactor	180	1,000	2,200	2,200	1,060	460

Source: LLNL 1996g.

C.2 REQUIREMENTS DURING OPERATIONS

C.2.1 UTILITIES REQUIRED

C.2.1.1 Long-Term Storage Alternatives

Tables C.2.1.1–1 through C.2.1.1–4 show utility requirements for all long-term storage alternatives.

Table C.2.1.1–1. Utilities Required During Operation of the Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative[a]

Utility	Annual Average Consumption			
	Hanford	INEL	Pantex	ORR
Electricity				
Annual average consumption (MWh)	20,000	3,800	1,375	7,260
Peak demand[b] (MWe)	5	0.7	0.25	1.1
Liquid fuel (l)	3,940	640,000	13,248	0
Natural gas (m^3)	0	0	164,000	949
Coal (t)	0	0	0	160
Water (l)	8,440,000	17,000,000	27,500,000	240,000

[a] This subalternative does not apply to SRS.
[b] Peak demand is the maximum rate expected during any hour for electricity.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; t=metric tons.
Source: HF DOE 1995e:1; IN DOE 1996a; OR MMES 1996a; PX MH 1994a.

Table C.2.1.1–2. Utilities Required During Operation of the Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative[a]

Utility	Annual Average Consumption					
			Pantex		SRS	
	Hanford	INEL	(With RFETS Pits)	(With All or Some RFETS and LANL Pu)[b]	(With All or Some RFETS and LANL Pu)	(With RFETS Non-Pit Pu)
Electricity						3,600
Annual average consumption (MWh)	21,150	4,500	1,375	48,000	4,900	
Peak demand[c] (MWe)	515	0.8	0.25	9	0.1	0.1
Liquid fuel (l)	3,940	720,000	13,248	38,000	0	0
Natural gas (m^3)	0	0	164,000	5,100,000	0	0
Coal (t)	0	0	0	0	400	290
Water (l)	8,892,000	22,000,000	27,500,000	110,000,000	7,100,000	5,678,000

[a] ORR is not eligible to receive RFETS or LANL Pu material under this upgrade subalternative.
[b] Values shown are based on an upgrade designed to accommodate the Consolidation Alternative Option to Modify Existing and Construct New Facilities in Zone 12 South.
[c] Peak demand is the maximum rate expected during any hour for electricity.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; t=metric tons.
Source: HF DOE 1995e:1; IN DOE 1996a; PX DOE 1996a; SRS 1996a:4; WSRC 1995e.

Table C.2.1.1–3. Utilities Required During Operation of the Consolidation Alternative

Utility	Average Annual Consumption						
	Hanford	NTS		INEL	Pantex		SRS
		New Pu Storage Facility	Modify P-Tunnel		New Pu Storage Facility	New and Modified Zone 12 South Facilities	
Electricity							
Annual average consumption (MWh)	71,000	49,000	72,000	45,000	43,000	48,000	57,000
Peak demand[a] (MWe)	9	8	10	8	8	9	10
Liquid fuel (l)	38,000	38,000	38,000	120,000	38,000	38,000	46,000
Natural gas (m^3)	NA	2,800,000	3,200,000	NA	4,500,000	5,100,000	NA
Coal (t)	NA	NA	NA	11,000	NA	NA	4,200
Raw water (l)	110,000,000	110,000,000	130,000,000	66,000,000	98,000,000	110,000,000	360,000,000

[a] Peak demand is the maximum rate expected during any hour for electricity.

Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; t=metric tons.

Source: DOE 1996e; NT DOE 1996a; PX DOE 1996a.

Table C.2.1.1–4. Utilities Required During Operation of the Collocation Alternative

Utility	Average Annual Consumption							
	Hanford	NTS		INEL	Pantex	ORR		SRS
		New Pu and HEU Storage Facility	Modify P-Tunnel			New Pu and HEU Storage Facility	New Pu Storage Facility Only[a]	
Electricity								
Annual average consumption (MWh)	92,000	65,000	89,000	58,000	58,000	68,000	53,000	76,000
Peak demand (MWe)[b]	18	11	13	10	10	11	9	13
Liquid fuel (l)	38,000	38,000	38,000	140,000	38,000	50,000	48,000	47,000
Natural gas (m^3)	NA	3,200,000	3,600,000	NA	5,200,000	NA	NA	NA
Coal (t)	NA	NA	NA	14,000	NA	6,300	5,500	4,800
Raw water (l)	150,000,000	150,000,000	190,000,000	87,000,000	130,000,000	360,000,000	280,000,000	460,000,000

[a] For modification of the Y–12 HEU Storage Facility, see Table C.2.1.1–1.

[b] Peak Demand is the maximum rate expected during any hour for electricity.

Note: HEU=highly enriched uranium; l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable; t=metric tons.

Source: DOE 1996e; DOE 1996f; NT DOE 1996a.

C.2.1.2 Activities Common to Multiple Plutonium Disposition Alternatives

Tables C.2.1.2–1, C.2.1.2–2, and C.2.1.2–3 show utility requirements for facilities that perform precursor activities on Pu prior to certain Pu disposition alternatives.

Table C.2.1.2–1. Utilities Required During Operation of the Pit Disassembly/Conversion Facility

Utility	Average Annual Consumption	Peak Demand
Electricity[a]	20,000 MWh	5 MWe
Liquid fuel (l)	28,000	NA
Natural gas[b] (m^3)	3,398,000	NA
[Text deleted.]		
Raw water (l)	94,635,000	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable.
Source: LANL 1996d.

Table C.2.1.2–2. Utilities Required During Operation of the Plutonium Conversion Facility

Utility	Average Annual Consumption	Peak Demand
Electricity[a]	21,000 MWh	5 MWe
Liquid fuel (l)	39,750	NA
Natural gas[b] (m^3)	4,361,000	NA
Raw water (l)	80,500,000	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable.
Source: LANL 1996c.

Table C.2.1.2–3. Utilities Required During Operation of the Mixed Oxide Fuel Fabrication Facility

Utility	Average Annual Consumption	Peak Demand
Electricity [a]	13,000 MWh	5 MWe
Liquid fuel (l)	20,000	NA
Natural gas[b] (m^3)	2,350,000	NA
Raw water (l)	56,781,000	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable.
Source: LANL 1996b.

C.2.1.3 Plutonium Disposition Alternatives

Tables C.2.1.3–1 through C.2.1.3–7 show the utilities and fuel expected to be required during a typical year of operation for each of the facilities required for Pu disposition.

Table C.2.1.3–1. Utilities Required During Operation of the Deep Borehole Complex—Direct Disposition Alternative

Utility	Average Annual Consumption	Peak Demand
Electricity[a]	6,500 MWh	2.3 MWe
Liquid fuel (l)	774,000	NA
Natural gas[b] (m^3)	5,100,000	NA
Raw water (l)	165,400,000	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable.
Source: LLNL 1996a.

Table C.2.1.3–2. Utilities Required During Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Utility	Average Annual Consumption	Peak Demand
Electricity[a]	6,100 MWh	2.3 MWe
Liquid fuel (l)	773,300	NA
Natural gas[b] (m^3)	4,810,000	NA
Raw water (l)	138,000,000	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable.
Source: LLNL 1996h.

Table C.2.1.3–3. Utilities Required During Operation of the Ceramic Immobilization Facility—Immobilized Disposition Alternative

Utility	Average Annual Consumption	Peak Demand
Electricity[a]	35,000 MWh	5 MWe
Liquid fuel (l)	210,000	NA
Natural gas[b] (m^3)	3,800,000	NA
Raw water (l)	320,000,000	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.
[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.
Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable.
Source: LLNL 1996e.

Table C.2.1.3–4. Utilities Required During Operation of the Vitrification Alternative

Utility	Average Annual Consumption	Peak Demand
Electricity[a]	12,000 MWh	3 MWe
Liquid fuel (l)	378,500	NA
Natural gas (m^3)	0	NA
Raw water (l)	250,000,000	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.

[Text deleted.]

Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable.

Source: LLNL 1996c.

Table C.2.1.3–5. Utilities Required During Operation of the Ceramic Immobilization Alternative

Utility	Average Annual Consumption	Peak Demand
Electricity [a]	25,000 MWh	3 MWe
Liquid fuel (l)	190,000	NA
Natural gas[b] (m^3)	3,500,000	NA
Raw water (l)	250,000,000	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.

[b] Standard cubic meters measured at 1 atmosphere and 15.6 °C.

Note: l=liter; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours; NA=not applicable.

Source: LLNL 1996d.

Table C.2.1.3–6. Utilities Required During Operation of the Electrometallurgical Treatment Alternative (Glass-Bonded Zeolite)

Utility	Average Annual Consumption	Peak Demand
Electricity[a]	2,400 MWh	8 kWe
Liquid fuel (l)	0	NA
Natural gas (m^3)	0	NA
Raw water (l)	17,413,000	NA

[a] Peak demand is the maximum rate expected during any hour for electricity.

Note: kWe=kilowatts electric; l=liter; m^3=cubic meters; MWh=megawatt hours; NA=not applicable.

Source: LLNL 1996b.

Table C.2.1.3–7. Utilities Required During Operation of the Evolutionary Light Water Reactor Alternative

Utility	Average Annual Consumption	
	Single Large Evolutionary LWR	Single Small Evolutionary LWR
Electricity		
Average Annual Consumption (MWh)		
Wet site	700,000	380,000
Dry site	1,100,000	580,000
Peak Demand[a] (MWe)		
Wet site	96	52
Dry site	140	75
Natural gas (m^3)	0	0
Liquid fuel (l)	757,000	416,000
Raw Water (l)		
Wet site	60,560,000,000	27,252,000,000
Dry site	340,600,000	189,300,000

[a] Peak demand is the maximum rate expected during any hour for electricity.
Note: l=liter; LWR=light water reactor; m^3=cubic meters; MWe=megawatts electric; MWh=megawatt hours.
Source: LLNL 1996g.

C.2.2 CHEMICALS UTILIZED

The tables in this section show annual chemical requirements during operation of facilities proposed for the various storage and disposition alternatives.

C.2.2.1 Long-Term Storage Alternatives

Annual chemical use during operation of long-term storage facilities for the upgrade, consolidation, and collocation alternatives is listed in Tables C.2.2.1–1 through C.2.2.1–4.

Table C.2.2.1–1. Chemicals Required During Operation of the Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative[a]

Chemical	Annual Quantity (kg)			
	Hanford	INEL	Pantex	ORR
Solid				
Adsorbent material	NA	2	NA	NA
Aluminum sulfate	NA	230[b]	NA	NA
Bentonite	NA	80[b]	NA	NA
[Text deleted.]				
Calcium hydroxide	NA	18[b]	NA	NA
Ethylene diaminetetra	NA	NA	NA	0.5
Ferrous ammonium sulfate	NA	NA	NA	0.5
Graphite	NA	NA	NA	0.5
Lithium tetraborate	NA	NA	NA	2
Magnesium oxide (crucible)	NA	7	NA	NA
Potassium dichromate	NA	NA	NA	0.5
Resin beads	NA	NA	NA	5
Sodium hydroxide	NA	NA	NA	0.5
[Text deleted.]				
Sodium sulfate	NA	18[b]	NA	NA
Sodium sulfite	NA	7[b]	54	NA
Titanium chloride	NA	NA	NA	5
Uranium oxide	NA	NA	NA	0.5
Liquid				
Ammonium hydroxide	NA	NA	NA	57
Cleaning solvents	50	140[c]	NA	NA
Diethylaminoethanol	NA	1[b]	NA	NA
Hydrazine	NA	1[b]	NA	NA
Hydrochloric acid	NA	NA	NA	57
Hydrogen peroxide	NA	NA	NA	80
Inorganic phosphate	NA	35[b]	NA	NA
Isopropyl alcohol	NA	NA	NA	8
Liquid nitrogen	34,000	860	118	NA
Nitric acid	NA	NA	NA	250
Oils and lubricants	NA	820	3	NA
Organic phosphate	NA	29[b]	NA	NA
Organic solvents	NA	NA	NA	80

Table C.2.2.1–1. Chemicals Required During Operation of the Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative[a]—Continued

Chemical	Annual Quantity (kg)			
	Hanford	INEL	Pantex	ORR
Liquid (continued)				
Perchloric acid	NA	NA	NA	8
Phosphoric acid	NA	40[b]	NA	20
Polyelectrolyte	NA	58[b]	NA	NA
Polyphosphate	NA	78[b]	82	NA
Sulfuric acid	NA	510[b]	277	20
Gas				
Argon	NA	1,000	2,500	NA
[Text deleted.]				
Chlorine	NA	38[b]	168	NA
Helium	NA	200	50	NA
Nitrogen	NA	2,600	NA	NA
Oxygen	NA	1	NA	NA
P-10 (calibration gas)	NA	1	NA	NA

[a] This subalternative does not apply to SRS.

[b] Chemicals used for water treatment.

[c] Cleaning solvents will be selected from the following list of non-halogenated liquids: 1-Hexanol, Dodecane, De-solve-it without surfactant, 1-Octanol, Spartan TH-9-33A, Diglyme, 3-Methylcyclohexanol, Methylacetoacetate, Actrel 1960 L, Tetradecane, 2-Butoxyethanol, Actrel 3360 L, Ashland 140-Solvent-66, Butyl Lactate, Pensolv L 1060, and Diacetone.

[Text deleted.]

Note: NA=not applicable.

Source: HF DOE 1995e:1; IN DOE 1996a; OR MMES 1996a; PX MH 1994a.

Table C.2.2.1–2. Chemicals Required During Operation of the Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Chemical	Annual Quality (kg)					
			Pantex		SRS	
	Hanford	INEL	(With RFETS Pits)	(With All or Some RFETS and LANL Pu)[a]	(With All or Some RFETS and LANL Pu)	(With RFETS Non-Pit Pu)
Solid						
Absorbent material	NA	2	NA	2	NA	NA
Alumina	NA	NA	NA	440	NA	NA
Aluminum nitrate	NA	NA	NA	750	NA	NA
Aluminum sulfate	NA	303[b]	NA	910	NA	NA
Bentonite	NA	107[b]	NA	450	NA	NA
Betz slimicide (CE-77 PE)	NA	NA	NA	NA	3[c]	2[c]
Betz 25k series corrosion inhibitors	NA	NA	NA	NA	15[c]	12[c]
Calcium fluoride	NA	NA	NA	1	NA	NA
Calcium hydroxide	NA	23[b]	NA	NA	NA	NA
Magnesium oxide (crucible)	NA	7	NA	7	NA	NA
Oxalic acid	NA	NA	NA	8	NA	NA
Resin (zeolites)	NA	NA	NA	3	NA	NA
Sodium hydroxide	NA	NA	NA	NA	5[b]	3[b]
Sodium hypochlorite	NA	NA	NA	NA	7[b]	5[b]
Sodium nitrite	NA	NA	NA	210	NA	NA
Sodium sulfate	NA	23[b]	NA	NA	NA	NA
Sodium sulfite	NA	8[b]	54	62	NA	NA
Ta-W-Mo (crucible)	NA	NA	NA	1	NA	NA
Urea	NA	NA	NA	140	NA	NA
Liquid			NA			
Cleaning solvents	50	140[d]	NA	140	0	0
Diethylaminoethanol	NA	1	NA	9	NA	NA
Hydrazine	NA	19	NA	3	NA	NA
Hydrofluoric acid	NA	NA	NA	1	NA	NA
Hydrogen peroxide	NA	NA	NA	1	NA	NA
Hydroxylamine nitrate	NA	NA	NA	230	NA	NA
Inorganic phosphate	NA	45[b]	NA	220	NA	NA
Liquid nitrogen	34,000	860	118	860	NA	NA
Nitric acid	NA	NA	NA	4,300	NA	NA
Oils and lubricants	NA	820	3	1,600	NA	NA
Organic phosphate	NA	37[b]	NA	170	NA	NA
Phosphoric acid	NA	53[b]	NA	230	NA	NA
Polyelectrolyte	NA	76[b]	NA	230	NA	NA
Polyphosphate	NA	98[b]	82	490	14[b]	10[b]
Sulfuric acid	NA	650[b]	277	3,100	NA	NA

Table C.2.2.1–2. Chemicals Required During Operation of the Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative—Continued

Chemical	Annual Quality (kg)					
			Pantex		SRS	
	Hanford	INEL	(With RFETS Pits)	(With All or Some RFETS and LANL Pu)[a]	(With All or Some RFETS and LANL Pu)	(With RFETS Non-Pit Pu)
Gas						
Argon	NA	1,000	2,500	7,300	0	0
Chlorine	NA	51[b]	168	220	NA	NA
Helium	NA	200	50	230	0	0
Hydrogen	NA	NA	NA	1	NA	NA
Nitrogen	NA	2,600	NA	2,600	10	10
Oxygen	NA	1	NA	1	NA	NA
P-10 (Calibration gas)	NA	1	NA	1	NA	NA

[Text deleted.]

[a] Values shown are based on an upgrade designed to accommodate the consolidation alternative Option to Modify Existing and Construct New Facilities in Zone 12 South.

[b] Chemicals used for water treatment.

[c] Chemicals used for cooling tower water treatment.

[d] Cleaning solvents will be selected from the following list of non-halogenated liquids: 1-Hexanol, Dodecane, De-solve-it without surfactant, 1-Octanol, Spartan TH-9-33A, Diglyme, 3-Methylcyclohexanol, Methylacetoacetate, Actrel 1960 L, Tetradecane, 2-Butoxyethanol, Actrel 3360 L, Ashland 140-Solvent-66, Butyl Lactate, Pensolv L 1060, and Diacetone.

Note: NA=not applicable.

Source: HF DOE 1995e:1; IN DOE 1996a; PX DOE 1996a; SRS 1996a:4; WSRC 1995e.

Table C.2.2.1–3. Chemicals Required During Operation of the Consolidation Alternative

Chemical	Annual Quantity (kg)						
	Hanford	NTS		INEL	Pantex		SRS
		New Pu Storage Facility	Modify P-Tunnel		New Pu Storage Facility	New and Modified Zone 12 South Facilities	
Solid							
Adsorbent material	2	2	2	2	2	2	2
Alumina	440	440	440	440	440	440	440
Aluminum nitrate	750	750	750	750	750	750	750
Aluminum sulfate[a]	780	850	950	770	810	910	3,400
Bentonite[a]	390	420	480	380	410	450	420
Calcium fluoride	1	1	1	1	1	1	1
Calcium hydroxide[a]	NA	NA	NA	NA	NA	NA	630
Glass frit	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Magnesium oxide (crucible)	7	7	7	7	7	7	7
Oxalic acid	8	8	8	8	8	8	8
Resin (zeolites)	3	3	3	3	3	3	3
Sodium chloride[a]	NA	NA	NA	NA	NA	NA	58
Sodium nitrite	210	210	210	210	210	210	210
Sodium sulfate[a]	NA	NA	38	NA	NA	NA	630
Sodium sulfite[a]	NA	34	NA	97	55	62	36
Ta-W-Mo (crucible)	1	1	1	1	1	1	1
Urea	140	140	140	140	140	140	140
[Text deleted.]							
Liquid							
Cleaning solvent[b]	140	140	140	140	140	140	140
Diethylaminoethanol[a]	NA	5	6	15	8	9	5
Hydrazine[a]	NA	2	2	5	3	3	2
Hydrofluoric acid	1	1	1	1	1	1	1
Hydrogen peroxide	1	1	1	1	1	1	1
Hydroxylamine nitrate	230	230	230	230	230	230	230
Inorganic phosphate[a]	220	230	270	130	190	220	1,300

Table C.2.2.1–3. Chemicals Required During Operation of the Consolidation Alternative—Continued

Chemical	Annual Quantity (kg)						
	Hanford	NTS		INEL	Pantex		SRS
		New Pu Storage Facility	Modify P-Tunnel		New Pu Storage Facility	New and Modified Zone 12 South Facilities	
Liquid (continued)							
Liquid nitrogen	860	860	860	860	860	860	860
Nitric acid	4,300	4,300	4,300	4,300	4,300	4,300	4,300
Oils and lubricants	1,600	1,600	1,600	1,600	1,600	1,600	1,600
Organic phosphate[a]	170	180	210	100	150	170	1,000
Phosphoric acid[a]	200	210	240	190	200	230	210
Polyelectrolyte[a]	200	210	240	190	200	230	840
Polyphosphate[a]	430	480	570	360	440	490	2,600
Sulfuric acid[a]	3,100	3,200	3,800	1,900	2,800	3,100	18,000
Gas							
Argon	7,300	7,300	7,300	7,300	7,300	7,300	7,300
Chlorine[a]	200	210	240	170	200	220	420
Helium	230	230	230	230	230	230	230
Hydrogen	1	1	1	1	1	1	1
Nitrogen	2,600	2,600	2,600	2,600	2,600	2,600	2,600
Oxygen	1	1	1	1	1	1	1
P-10 (calibration gas)	1	1	1	1	1	1	1

[a] Chemicals used for water treatment.

[b] Cleaning solvents will be selected from the following list of non-halogenated liquids: 1-Hexanol, Ashland 140-Solvent-66, 3-Methylcyclohexanol, De-solve-it without surfactant, 1-Octanol, Pensolv L1060, 2-Butoxyethanol, Methylacetoacetate, Diglyme, Dodecane, Butyl Lactate, Actrel 1960 L, Tetradecane, Spartan TH-9-33A, Diacetone, and Actrel 3360 L.

Note: kg=kilograms; NA=not applicable.

Source: DOE 1996e; NT DOE 1996a; PX DOE 1996a.

Table C.2.2.1–4. Chemicals Required During Operation of the Collocation Alternative

Chemicals	Annual Quantity (kg)							
	Hanford	NTS		INEL	Pantex	ORR		SRS
		New Pu and HEU Storage Facility	Modify P-Tunnel			New Pu and HEU Storage Facility	New Pu Storage Facility Only[a]	
Solid								
Absorbent material	2	2	2	2	2	2	2	2
Alumina	440	440	440	440	440	440	440	440
Aluminum nitrate	750	750	750	750	750	750	750	750
Aluminum sulfate[b]	990	1,100	1,200	980	1,000	3,400	2,700	4,300
Bentonite[b]	500	530	580	490	510	490	390	520
Calcium fluoride	1	1	1	1	1	1	1	1
Calcium hydroxide[b]	NA	NA	NA	NA	NA	610	490	810
Ethylene diamine tetra (acetic acid)	1	1	NA	1	1	1	NA	1
Ferrous ammonium sulfate	1	1	NA	1	1	1	NA	1
Glass frit	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Graphite	1	1	NA	1	1	1	NA	1
Lithium	2	2	NA	2	2	2	NA	2
Magnesium oxide (crucible)	7	7	7	7	7	7	7	7
Oxalic acid	8	8	8	8	8	8	8	8
Potassium dichromate	1	1	NA	1	1	1	NA	1
Resin (zeolites)	8	8	3	8	8	8	3	8
Sodium chloride[b]	NA	NA	NA	NA	NA	79	71	64
Sodium hydroxide	1	1	NA	1	1	1	NA	1
Sodium nitrite	210	210	210	210	210	210	210	210
Sodium sulfate[b]	NA	NA	NA	NA	NA	610	490	810
Sodium sulfite[b]	NA	38	43	120	63	54	47	41
Ta-W-Mo (crucible)	1	1	1	1	1	1	1	1
Titanium chloride	5	5	NA	5	5	5	NA	5
Uranium dioxide	1	1	NA	1	1	1	NA	1
Urea	140	140	140	140	140	140	140	140
Liquid								
Ammonium hydroxide	50	50	NA	50	50	50	NA	50
Cleaning solvent[c]	200	200	140	200	200	200	140	200
Diethylaminoethanol[b]	NA	5	6	17	10	8	7	6

Table C.2.2.1–4. Chemicals Required During Operation of the Collocation Alternative—Continued

Chemicals	Annual Quantity (kg)							
	Hanford	NTS		INEL	Pantex	ORR		SRS
		New Pu and HEU Storage Facility	Modify P-Tunnel			New Pu and HEU Storage Facility	New Pu Storage Facility Only[a]	
Liquid (continued)								
Hydrazine[b]	NA	2	2	6	3	3	2	2
Hydrochloric acid	84	84	NA	84	84	84	NA	84
Hydrofluoric acid	1	1	1	1	1	1	1	1
Hydrogen peroxide	110	110	1	110	110	110	1	110
Hydroxylamine nitrate	230	230	230	230	230	230	230	230
Inorganic phosphate[b]	290	300	370	170	260	1,200	980	1,600
Isoprophy alcohol	6	6	NA	6	6	6	NA	6
Liquid nitrogen	860	860	860	860	860	860	860	860
Nitric acid	4,700	4,700	4,300	4,700	4,700	4,700	4,300	4,700
Oils & lubricants	2,300	2,300	1,600	2,300	2,300	2,300	1,600	2,300
Organic phosphate[b]	230	240	300	140	200	980	780	1,300
Perchloric acid	13	13	NA	13	13	13	NA	13
Phosphoric acid[b]	280	300	290	280	290	280	190	290
Polyelectrolyte[b]	250	260	290	240	260	860	680	1,100
Polyphosphate[b]	580	640	790	460	570	2,500	2,000	3,300
Sulfuric acid[b]	4,200	4,400	5,300	2,500	3,700	17,000	14,000	23,000
Gas								
Argon	7,300	7,300	7,300	7,300	7,300	7,300	7,300	7,300
Chlorine[b]	250	260	300	220	250	430	350	530
Helium	230	230	230	230	230	230	230	230
Hydrogen	1	1	1	1	1	1	1	1
Nitrogen	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600
Oxygen	1	1	1	1	1	1	1	1
P-10 (calibration gas)	1	1	1	1	1	1	1	1

[a] The chemicals required for the Upgrade Alternative at ORR (Table C.2.2.1–1) are added to obtain the total chemicals required for the Collocation Alternative Option to construct a New Pu Storage Facility at ORR and Modify Existing HEU Storage Facilities at Y–12 Plant.

[b] Chemicals used for water treatment.

[c] Cleaning solvents will be selected from the following list of non-halogenated liquids: 1-Hexanol, Ashland 140-Solvent-66, 3-Methylcyclohexanol, De-solve-it without surfactant, 1-Octanol, Pensolv L 1060, 2-Butoxyethanol, Methylacetoacetate, Diglyme, Dodecane, Butyl Lactate, Actrel 1960L, Tetradecane, Spartan TH-9-33A, Diacetone, and Actrel 3360 L.

Note: kg=kilograms; NA=not applicable.

Source: DOE 1996e; DOE 1996f; NT DOE 1996a.

C.2.2.2 Activities Common to Multiple Plutonium Disposition Alternatives

Annual chemical use during operation of the Pit Disassembly/Conversion Facility and the Plutonium Conversion Facility is listed in the classified appendix to this PEIS. Annual chemical use during operation of the Mixed Oxide Fuel Fabrication Facility is listed in Table C.2.2.2–1.

Table C.2.2.2–1. Chemicals Required During Operation of the Mixed Oxide Fuel Fabrication Facility

Chemicals	Annual Quantity
Solid (kg)	
Aluminum nitrate	<3
Burnable neutron absorbers (rare earth oxides)	2,000
Calcium fluoride	<90
Calcium metal	<3
Cobalt nitrate	<3
Iron, magnesium, calcium	<3
Magnesium oxide	<3
Magnesium oxide (sand)	<3
Oxalic acid	<910
Portland cement	<45,400
Resin (reillex)	<180
Sodium hydroxide	<91,000
Sodium nitrate	<180
Sucrose	<3
Urea	<90
Zinc stearate	<450
Liquid (kg)	
Ammonia	<23,000
Cleaning solvent	<23,000
Hydrofluoric acid	<230
Hydroxylamine nitrate	<2,300
Liquid nitrogen	<182,000
Nitric acid	<953,100
Gas (m^3)	
Argon	<283,000
Helium	<28,000
Hydrogen	<28,000

Note: kg=kilograms; m^3=cubic meters.
Source: LANL 1996b.

C.2.2.3 Plutonium Disposition Alternatives

Tables C.2.2.3–1 through C.2.2.3–7 list the annual chemical use during operation of facilities proposed for each of the Pu disposition alternatives under consideration.

Table C.2.2.3–1. Chemicals Required During Operation of the Deep Borehole Complex—Direct Disposition Alternative

Chemical	Annual Quantity
Solid (kg)	
Bentonite	90,700
Cements	3,630,000
Decontamination detergent	1,360
Kaolinite (sealant)	1,200,000
Nonionic polymers for cooling water	136
Phosphates and phosphonates for cooling water	907
Polymers	36,300
[Text deleted.]	
Silica flour	36,300
Sodium citrate	36,300
Liquid	NA
Gas	
Nitrogen	120 cylinders

Note: kg=kilograms; NA=not applicable.
Source: LLNL 1996a.

Table C.2.2.3–2. Chemicals Required During Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Chemical	Annual Quantity
Solid (kg)	
Bentonite	90,700
Cements	3,610,000
Cement additives	10,000
Decontamination detergent	5,440
Filler ceramic pellets	500,000
Nonionic polymers for cooling water	136
Phosphates and phosphonates for cooling water	907
Polymers	34,000
Silica flour	34,000
Sodium citrate	34,000
[Text deleted.]	
Liquid (kg)	
Decon detergent	703
Gas	
Nitrogen	500 cylinders

Note: kg=kilograms.
Source: LLNL 1996h.

Table C.2.2.3–3. Chemicals Required During Operation of the Ceramic Immobilization Facility—Immobilized Disposition Alternative

Chemical	Annual Quantity (kg)
Solid	
Cements	1,100
Ceramic precursors (as oxides)	500,000
Decontamination detergent	3,000
Gadolinium–as $Gd(NO_3)_3 6H_2O$	9,500
Nonionic polymers for cooling water	150
Pellet coating oxide	5,000
Phosphates for cooling water	750
Phosphonates for cooling water	150
Resins	140
Silver nitrate	430
Liquid	
Nitric acid	3,500
Pellet binder	11,000
Potassium hydroxide	110
Sodium hydroxide	1,800
Urea	8,600
Gas	
Helium	900
Nitrogen	9,000

Note: kg=kilograms.
Source: LLNL 1996e.

Table C.2.2.3–4. Chemicals Required During Operation of the Vitrification Alternative

Chemical	Annual Quantity (kg)
Solid	
Borosilicate glass frit	95,500
Neutron absorber	3,400
Sodium hydroxide	4,545
Liquid	
Nitric acid	28,550
Gas	
Nitrogen	530
Welding gases	4,550[a]

[a] Assumes 200 cylinders (50 pounds each).
Note: kg=kilograms.
Source: LLNL 1996c.

Table C.2.2.3–5. Chemicals Required During Operation of the Ceramic Immobilization Alternative

Chemical	Annual Quantity (kg)
Solid	
Cements	730
Ceramic precursors	32,000
Decontamination detergent	2,000
Gadolinium	7,300
Nonionic polymers for cooling water	100
Phosphates for cooling water	500
Phosphonates for cooling water	100
Resins	120
Silver nitrate	250
Titanium oxide	26,000
Titanium metal	830
Liquid	
Nitric acid	3,500
Potassium hydroxide	110
Sodium hydroxide	1,800
Urea	8,600
Gas	
Welding gases	4,550[a]

[a] Assumes 200 cylinders (50 pounds each).

Note: kg=kilograms.

Source: LLNL 1996d.

Table C.2.2.3–6. Chemicals Required During Operation of the Electrometallurgical Treatment Alternative (Glass-Bonded Zeolite)

Chemical	Annual Quantity (kg)
Solid	
Cesium Chloride Salt in Steel Capsules	64
Potassium/Lithium/ Gadolinium Chloride Salts	34,000
Zeolite, Glass	77,000
Liquid	NA
Gas	NA

Note: kg=kilograms; NA=not applicable.

Source: LLNL 1996b.

Table C.2.2.3–7. Chemicals Required During Operation of the Evolutionary Light Water Reactor Alternative

Chemical	Annual Quantity (t)	
	Single Large Evolutionary LWR	Single Small Evolutionary LWR
Solid		
Aluminum oxide	2	1
Inconel	1	1
Lithium carbonate	1	1
Stainless steel	8	4
Zircalloy	21	11
Liquid		
Nitric acid	953	545
Water treatment chemicals[a]	907	499
Gas		
Ammonia	23	12
Argon	33	18
Hydrogen	1	1
Nitrogen	331	182

[a] Includes aluminum sulfate, bentonite, chlorine, diethylaminoethanol, hydrazine, inorganic phosphate, phosphoric acid, polyelectrolyte, polyphosphate, sodium sulphite, and sulfuric acid. May be solid, liquid, or gas.

Note: LWR=light water reactor; t=metric tons.

Source: LLNL 1996g.

C.2.3 PERSONNEL REQUIREMENTS

The tables in this section show annual employment requirements during operation of facilities proposed for the various storage and disposition alternatives.

C.2.3.1 Long-Term Storage Alternatives

Annual personnel requirements to operate long-term storage facilities under the upgrade, consolidation, and collocation alternatives are listed in Tables C.2.3.1–1, C.2.3.1–2, and C.2.3.1–3.

Table C.2.3.1–1. Employment Required During Operation of the Upgrade Alternative

	Number of Employees				
Labor Category	**Hanford**	**INEL**	**Pantex**	**ORR**	**SRS**
Officials and managers	31	10	2	14	NA
Professionals	28	17	17	25	NA
Technicians	84	33	25	16	NA
Office and clerical	15	7	5	12	NA
Craft workers	0	1	10	36	NA
Operators	30	3	27	8	NA
Laborers	0	1	0	0	NA
Service workers	37	9	4	0	NA
Total Employment Without RFETS Pu or LANL Pu Material	225	81	90	111	NA[a]
Total Employment With All or Some RFETS Pu and LANL Pu Material	252	116	509[b]	NA[c]	30
Total Employment With RFETS Non-Pit Pu Material	NA	NA	NA	NA	30
Total Employment With RFETS Pits	NA	NA	90	NA	NA

[a] This subalternative does not apply to SRS.

[b] Values shown are based on an upgrade alternative designed to accommodate the Consolidation Alternative Option to Modify Existing and Construct New Facilities in Zone 12 South.

[c] ORR is not eligible to receive RFETS or LANL Pu Material under this upgrade subalternative.

Note: NA=not applicable.

Source: HF DOE 1995e:1; IN DOE 1996a; OR MMES 1996a; PX DOE 1996a; PX MH 1994a; SRS 1996a:4; WSRC 1995e.

Table C.2.3.1–2. Employment Required During Operation of the Consolidation Alternative

	Number of Employees						
	Hanford	NTS		INEL	Pantex		SRS
Labor Category		New Pu Storage Facility	Modify P-Tunnel		New Pu Storage Facility	New and Modified Zone 12 South Facilities	
Officials and managers	45	50	52	45	51	53	50
Professionals	84	84	89	84	84	90	84
Technicians[a]	124.5	129.5	128.5	124.5	129.5	149	129.5
Office and clerical	34	43	42	34	43	48	46
Craft workers	40	40	42	40	40	41	40
Operators[a]	33.5	43.5	38.5	33.5	33.5	31	33.5
Laborers	8	8	8	8	8	9	8
Service workers	74	94	127	63	84	88	94
Total Employment	443	492	527	432	471	509	485

[a] Values reflected in this table are for full-time equivalent person-year.

Source: DOE 1996e; NT DOE 1996a; PX DOE 1996a.

Table C.2.3.1–3. Employment Required During Operation of the Collocation Alternative

	Number of Employees							
	Hanford	NTS		INEL	Pantex	ORR		SRS
Labor Category		New Pu and HEU Storage Facility	Modify P-Tunnel			New Pu and HEU Storage Facility	New Pu Storage Facility Only[a]	
Officials and managers	60	66	64	60	65	60	51	65
Professionals	106	106	102	106	106	107	85	106
Technicians[b]	148.5	153.5	154	148.5	153.5	146.5	122.5	153.5
Office and clerical	36	45	46	36	45	36	34	48
Craft workers	54	54	59	54	54	54	40	54
Operators[b]	52.5	62.5	55	52.5	52.5	58.5	39.5	52.5
Laborers	17	17	11	17	17	17	8	17
Service workers	98	118	150	87	108	87	63	118
Total Employment	572	622	641	561	601	566	443	614

[a] The operation employment required for the Upgrade Alternative at ORR (Table C.2.3.1–1) is added to obtain the total operation employment required for the Collocation Alternative Option to construct a New Pu Storage Facility at ORR and modify existing HEU Storage Facilities at Y–12 Plant.

[b] Values reflected in this table are for full-time equivalent person-year.

Source: DOE 1996e; DOE 1996f; NT DOE 1996a.

C.2.3.2 Activities Common to Multiple Plutonium Disposition Alternatives

Annual personnel requirements to operate facilities that perform precursor activities on Pu prior to certain disposition alternatives are provided in Tables C.2.3.2–1, C.2.3.2–2, and C.2.3.2–3.

Table C.2.3.2–1. Employment Required During Operation of the Pit Disassembly/Conversion Facility

Labor Category	Number of Employees
Officials and managers	80
Professionals	240
Technicians	65
Office and clerical	30
Craft workers	80
Operators	290
Laborers	15
Service workers	30
Total Employment	830

Note: Change from Draft PEIS reflects increase in throughput to 3.25 MT/yr.
Source: LANL 1996d.

Table C.2.3.2–2. Employment Required During Operation of the Plutonium Conversion Facility

Labor Category	Number of Employees
Officials and managers	114
Professionals	88
Technicians	63
Office and clerical	117
Craft workers	129
Operators	186
Laborers	93
Service workers	93
Total Employment	883

Source: LANL 1996c.

Table C.2.3.2–3. Employment Required During Operation of the Mixed Oxide Fuel Fabrication Facility

Labor Category	Number of Employees
Officials and managers	80
Professionals	40
Technicians	40
Office and clerical	50
Craft workers	140
Operators	100
Laborers	20
Service workers	30
Total Employment	500

Note: Change from Draft PEIS reflects increased capability to process increased throughput from Pit Disassembly/ Conversion Facility.

Source: LANL 1996b.

C.2.3.3 Plutonium Disposition Alternatives

Annual personnel requirements to operate facilities proposed for each of the Pu disposition alternatives under consideration are provided in Tables C.2.3.3–1 through C.2.3.3–7.

Table C.2.3.3–1. Employment Required During Operation of the Deep Borehole Complex—Direct Disposition Alternative

Labor Category	Number of Employees
Officials and managers	23
Professionals	45
Technicians	40
Office and clerical	8
Craft workers	82
Operators	98
Laborers	6
Service workers	40
Total Employment	342

Source: LLNL 1996a.

Table C.2.3.3–2. Employment Required During Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Labor Category	Number of Employees
Officials and managers	21
Professionals	31
Technicians	55
Office and clerical	4
Craft workers	42
Operators/line supervisors	85
Laborers	2
[Text deleted.]	
Service workers	40
Total Employment	280

Source: LLNL 1996h.

Table C.2.3.3–3. Employment Required During Operation of the Ceramic Immobilization Facility—Immobilized Disposition Alternative

Labor Category	Number of Employees
Officials and managers	40
Professionals	40
Technicians	100
Office and clerical	20
Craft workers	180
Operators/line supervisors	300
[Text deleted.]	
Safeguards and security	220
[Text deleted.]	
Total Employment	900

Source: LLNL 1996e.

Table C.2.3.3–4. Employment Required During Operation of the Vitrification Alternative

Labor Category	Number of Employees
Officials and managers	10
Professionals	65
Technicians	60
Office and clerical	50
Craft workers	125
Operators	250
Laborers	50
Safeguards and security	158
Total Employment	768

Source: LLNL 1996c.

Table C.2.3.3–5. Employment Required During Operation of the Ceramic Immobilization Alternative

Labor Category	Number of Employees
Officials and managers	40
Professionals	40
Technicians	90
Office and clerical	20
Craft workers	170
Operators/line supervision	280
Safeguards and security	220
Total Employment	860

Source: LLNL 1996d.

Table C.2.3.3–6. Employment Required During Operation of the Electrometallurgical Treatment Alternative (Glass-Bonded Zeolite)

Labor Category	Number of Employees
Officials and managers	5
Professionals	15
Technicians	14
Office and clerical	5
Operators/line supervisors	37
Safeguards and security	7
Total Employment	83

Source: LLNL 1996b.

Table C.2.3.3–7. Employment Required During Operation of the Evolutionary Light Water Reactor Alternative

	Number of Employees	
Labor Category	Single Large Evolutionary LWR	Single Small Evolutionary LWR
Officials and managers	130	70
Professionals	300	180
Technicians	200	120
Office and clerical	20	10
Craft workers	40	30
Operators	80	50
Laborers	10	10
Service workers	50	30
Total Employment	830	500

Source: LLNL 1996g.

Appendix D
Water Usage

This appendix provides information on overall water usage for the storage and disposition facilities covered by this programmatic environmental impact statement. This information is portrayed in a single water balance diagram for each facility. Gross quantities for intakes to the facility, and effluents from it, are provided. No quantities are estimated internal to the facility, but pathways are shown. Intakes are assumed to be from groundwater, surface water, and rainwater (stormwater).

D.1 STORAGE ALTERNATIVES

The water balance diagrams with flow rates in liter/year (l/yr) in Figure D.1–1 to D.1–20 for the plutonium (Pu) and highly enriched uranium (HEU) storage alternatives are organized into three groups: modification of existing and/or construction of new storage facilities, consolidated Pu storage facilities, and collocated Pu and HEU storage facilities. Figures within each group are arranged in the following order: Hanford Site (Hanford), Nevada Test Site (NTS), Idaho National Engineering Laboratory (INEL), the Pantex Plant (Pantex), Oak Ridge Reservation (ORR), and Savannah River Site (SRS). The Preferred Alternative for the long-term storage of surplus Pu involves a combination of upgrade (Pantex, ORR, and SRS), No Action (Hanford, NTS, INEL, and Los Alamos National Laboratory), and phaseout (Rocky Flats Environmental Technology Site).

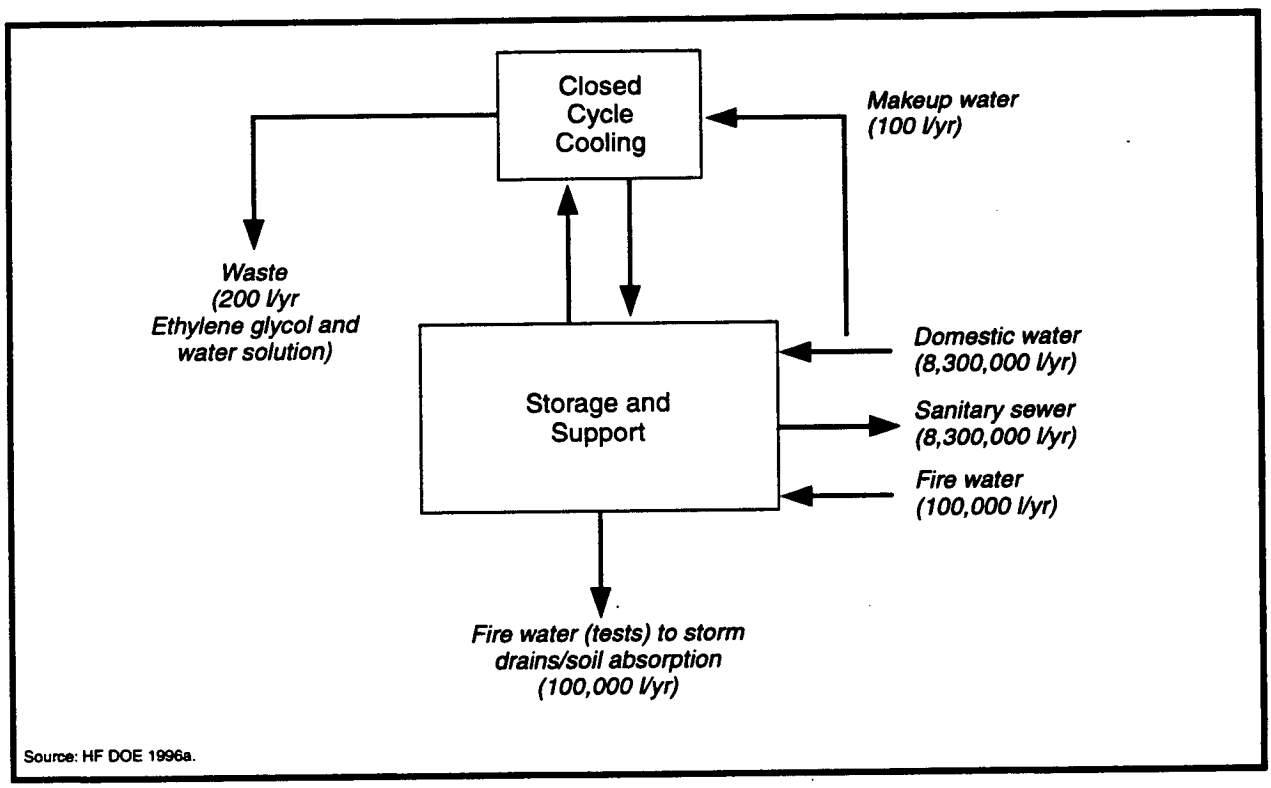
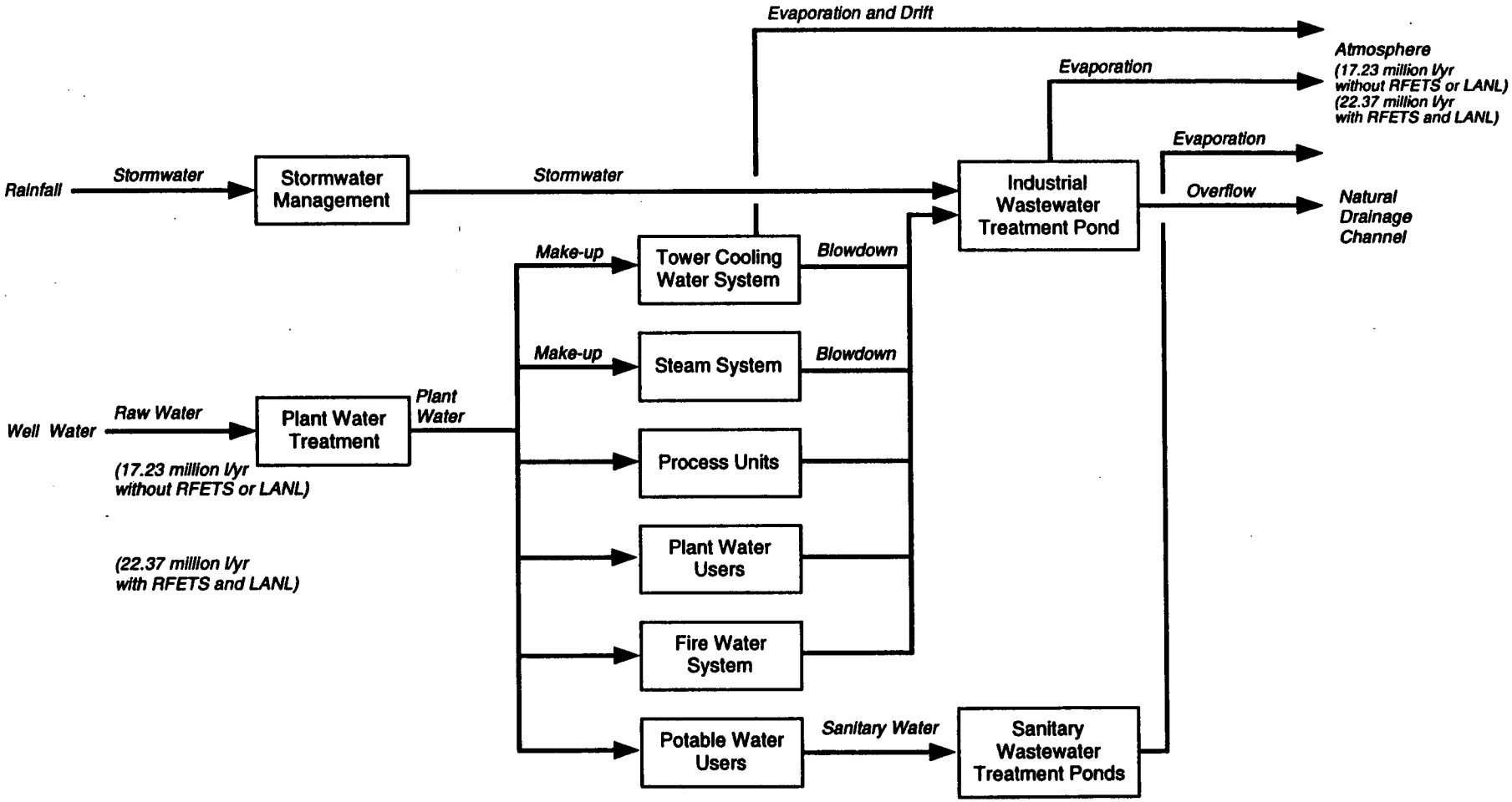


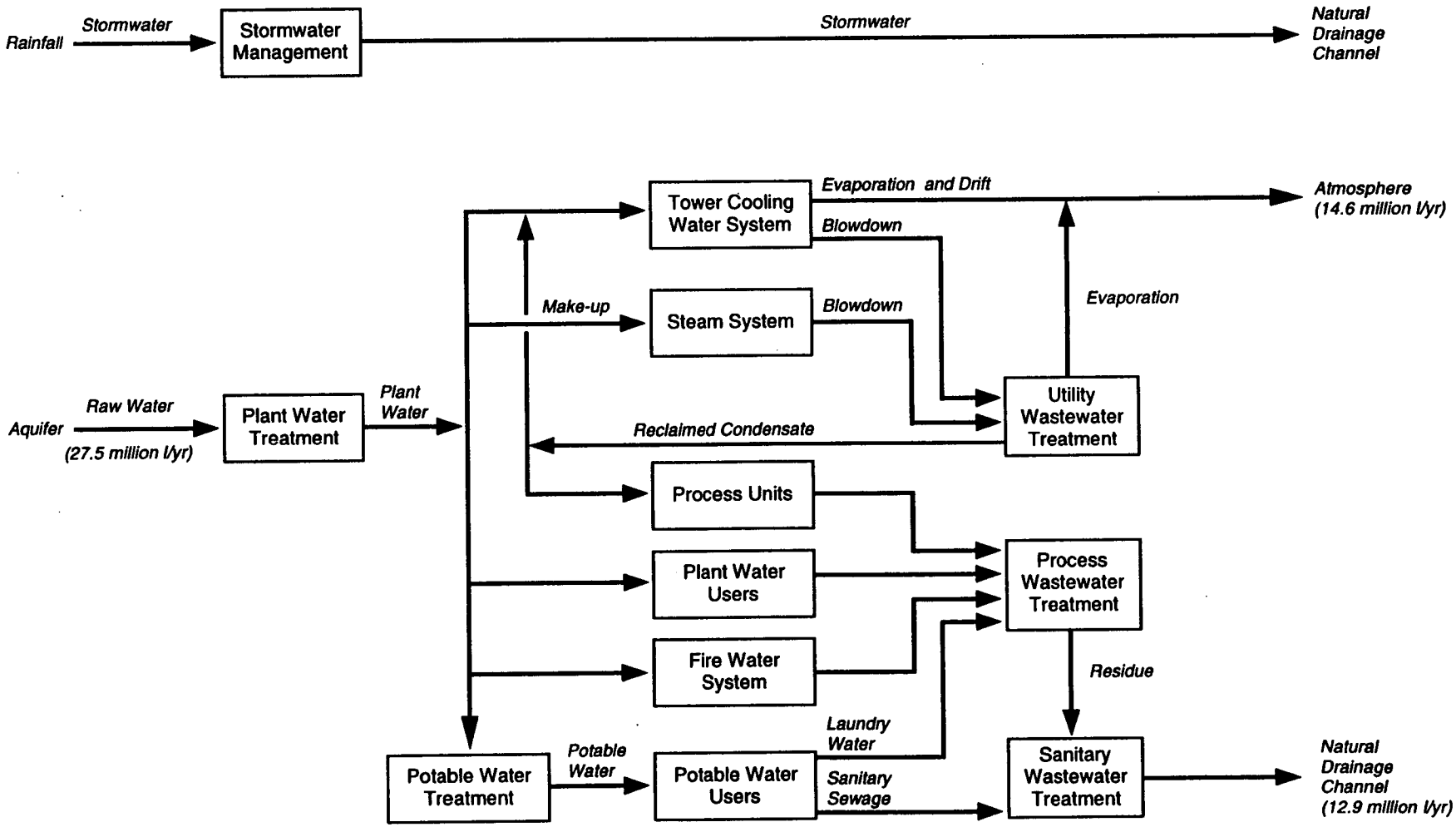
Figure D.1–1. Annual Water Balance for the Upgrade Alternative at Hanford Site.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding.
Values in this figure have more significant digits to match the source document's water balance diagram.
Source: IN DOE 1996a.

2523/S&D

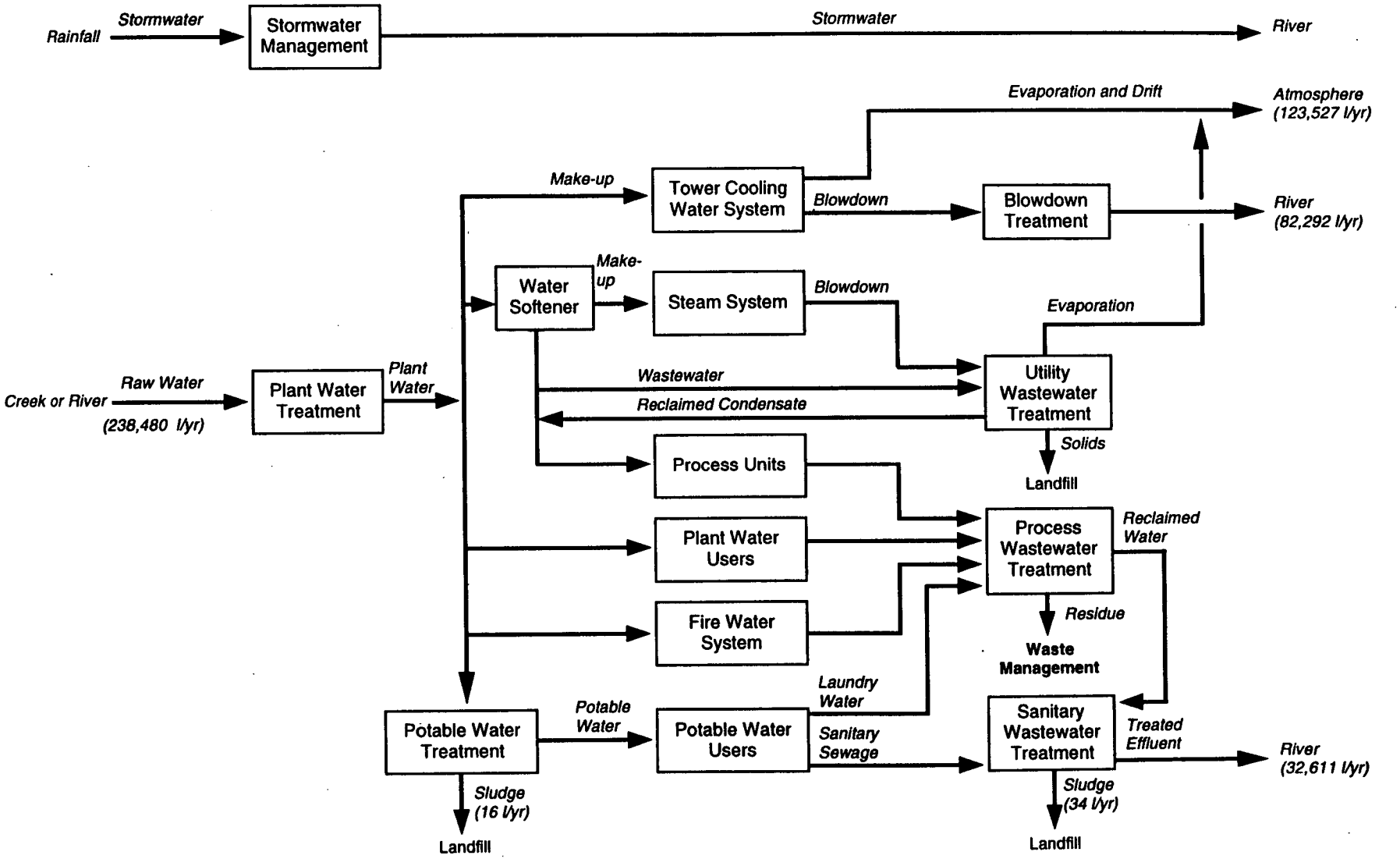
Figure D.1–2. Annual Water Balance for the Upgrade Alternative at Idaho National Engineering Laboratory, Argonne National Laboratory–West.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding.
Values in this figure have more significant digits to match the source document's water balance diagram.
Source: PX MH 1994a.

2965/S&D

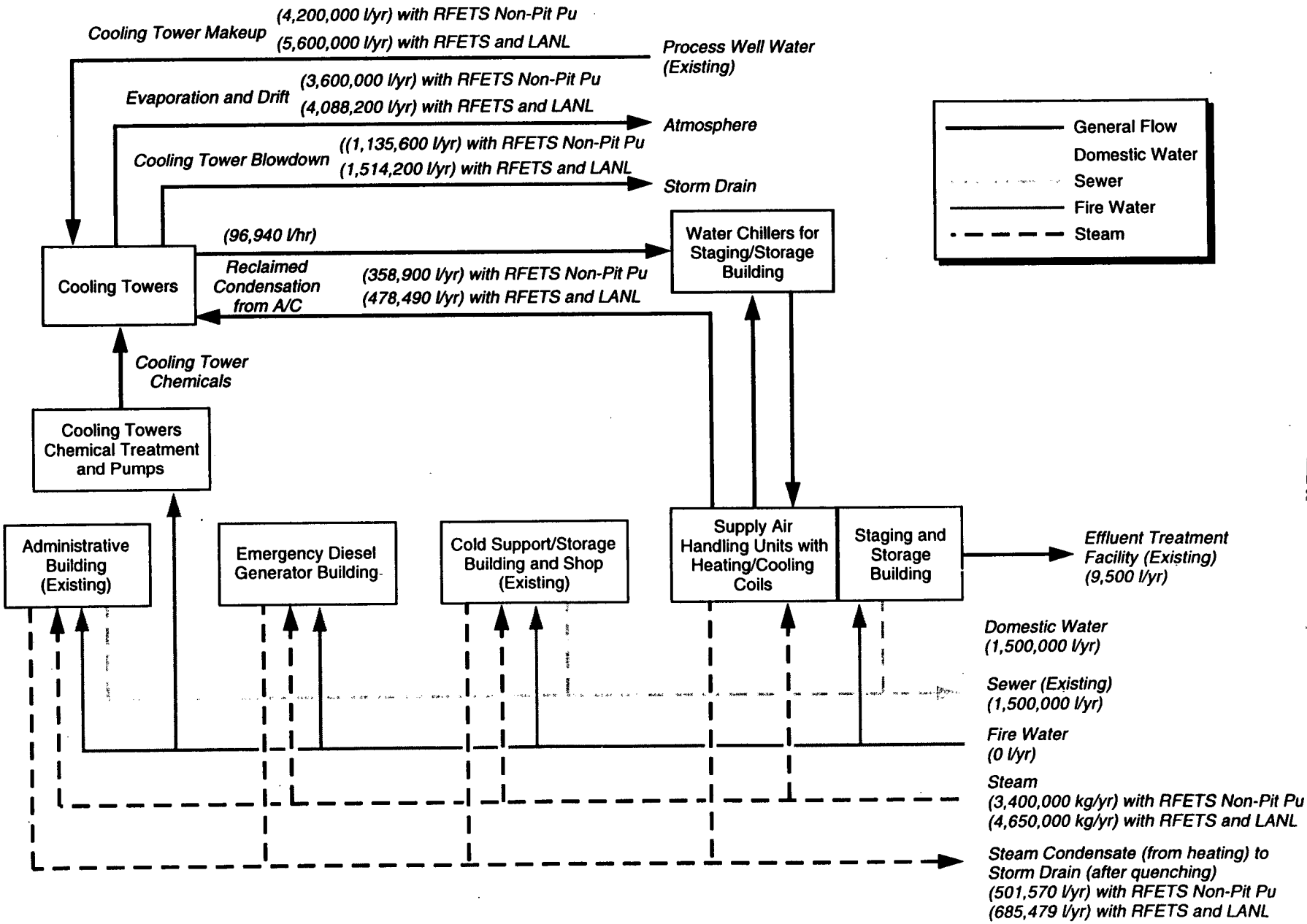
Figure D.1–3. Annual Water Balance for the Upgrade Alternative at Pantex Plant.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding.
Values in this figure have more significant digits to match the source document's water balance diagram.
Source: DOE 1996e.

2966WS&D

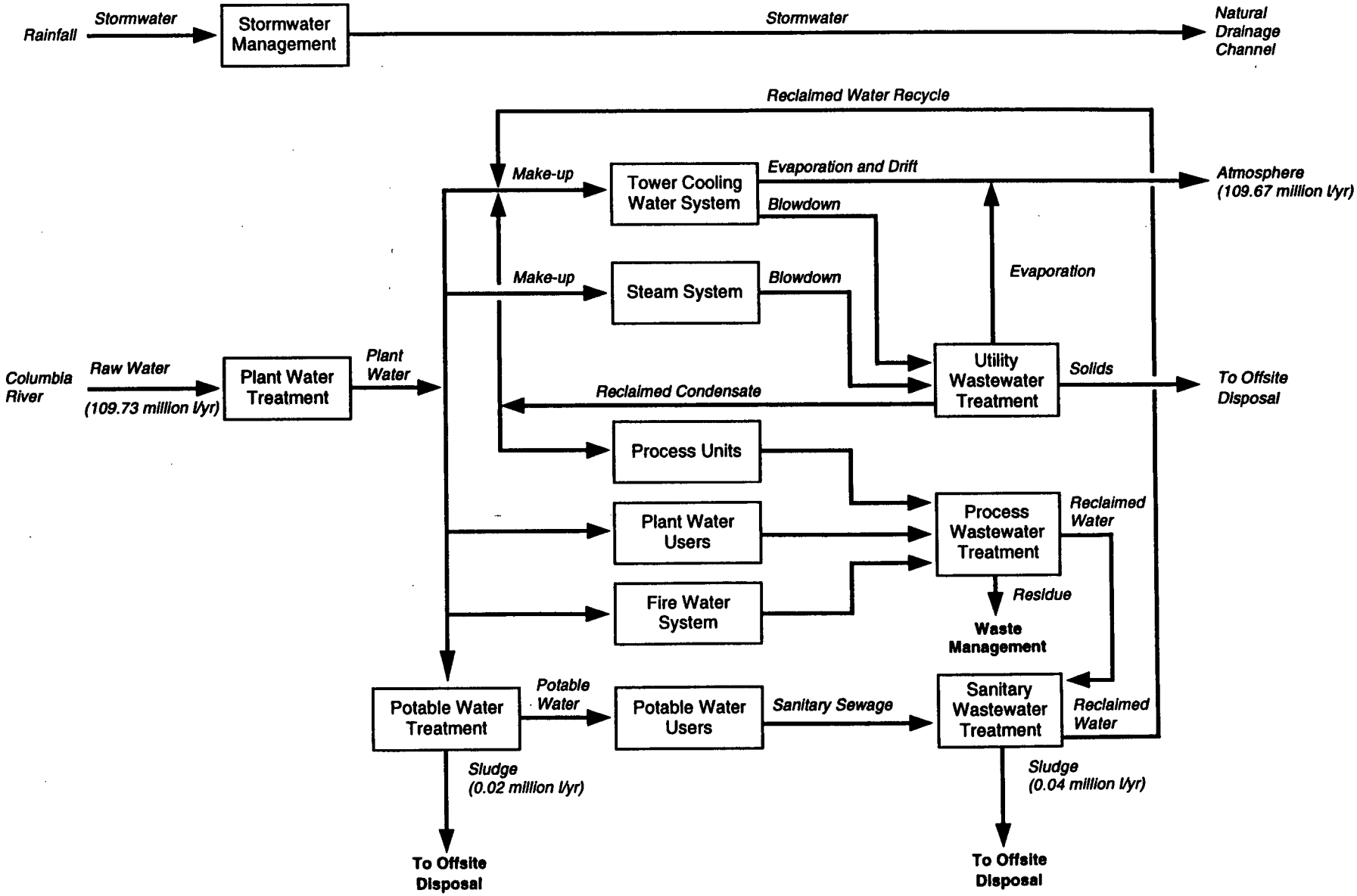
Figure D.1–4. Annual Water Balance for the Upgrade Alternative at Oak Ridge Reservation, Y–12 Plant.



Note: All values are with RFETS Pu and LANL Pu; values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding. Values in this figure have more significant digits to match the source document's water balance diagram.
Source: SR DOE 1994e; SRS 1996a:4; WSRC 1995e.

2471/S&D

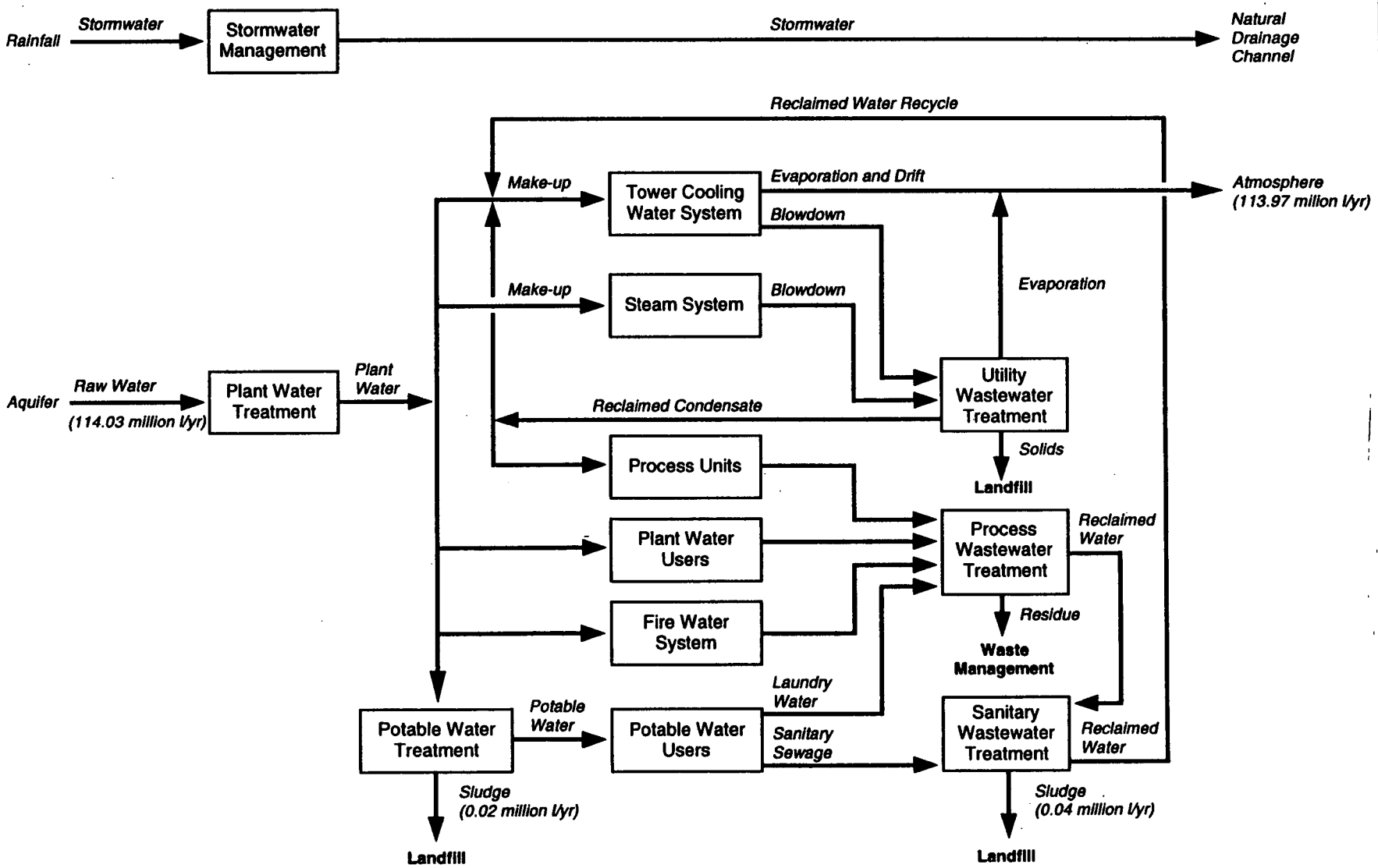
Figure D.1–5. Annual Water Balance for the Upgrade Alternatives at Savannah River Site.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding. Values in this figure have more significant digits to match the source document's water balance diagram.
Source: DOE 1996e.

3264/S&D

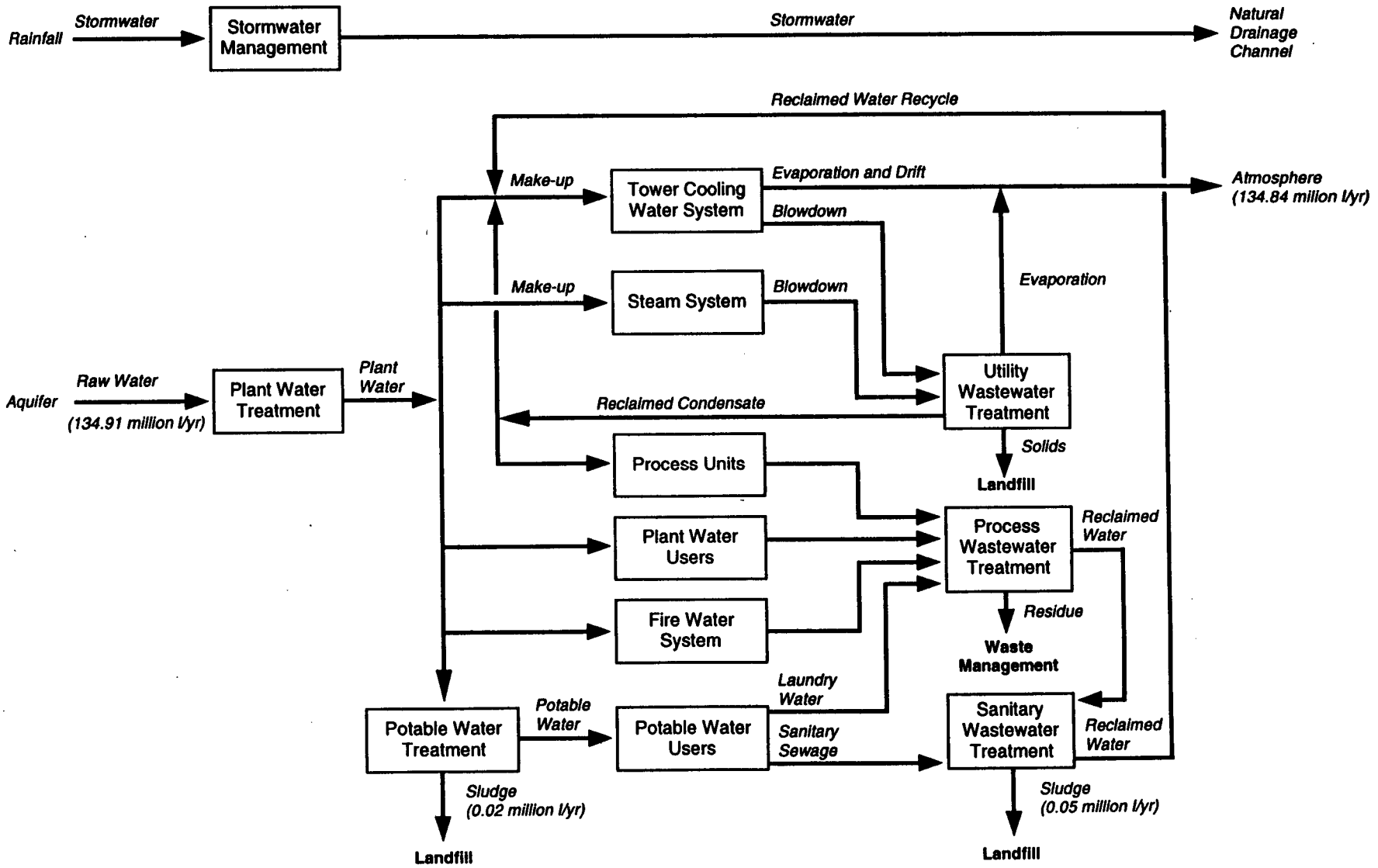
Figure D.1–6. Annual Water Balance for the Consolidation Alternative at Hanford Site.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding.
Values in this figure have more significant digits to match the source document's water balance diagram.
Source: DOE 1996e.

2496/S&D

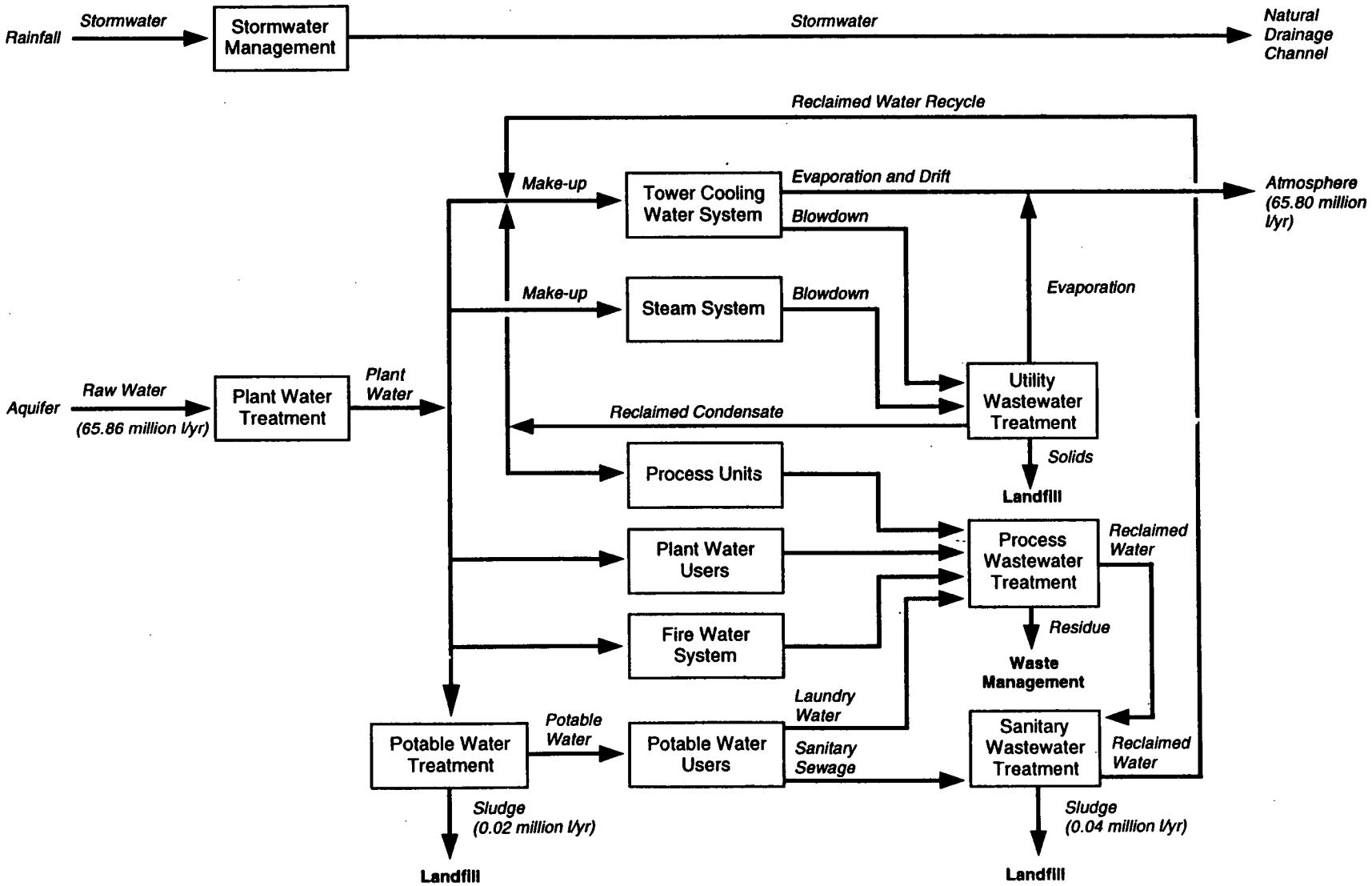
Figure D.1–7. Annual Water Balance for the Consolidation Alternative Constructing a New Facility at Nevada Test Site.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding. Values in this figure have more significant digits to match the source document's water balance diagram.
Source: NT DOE 1996a.

3089/S&D

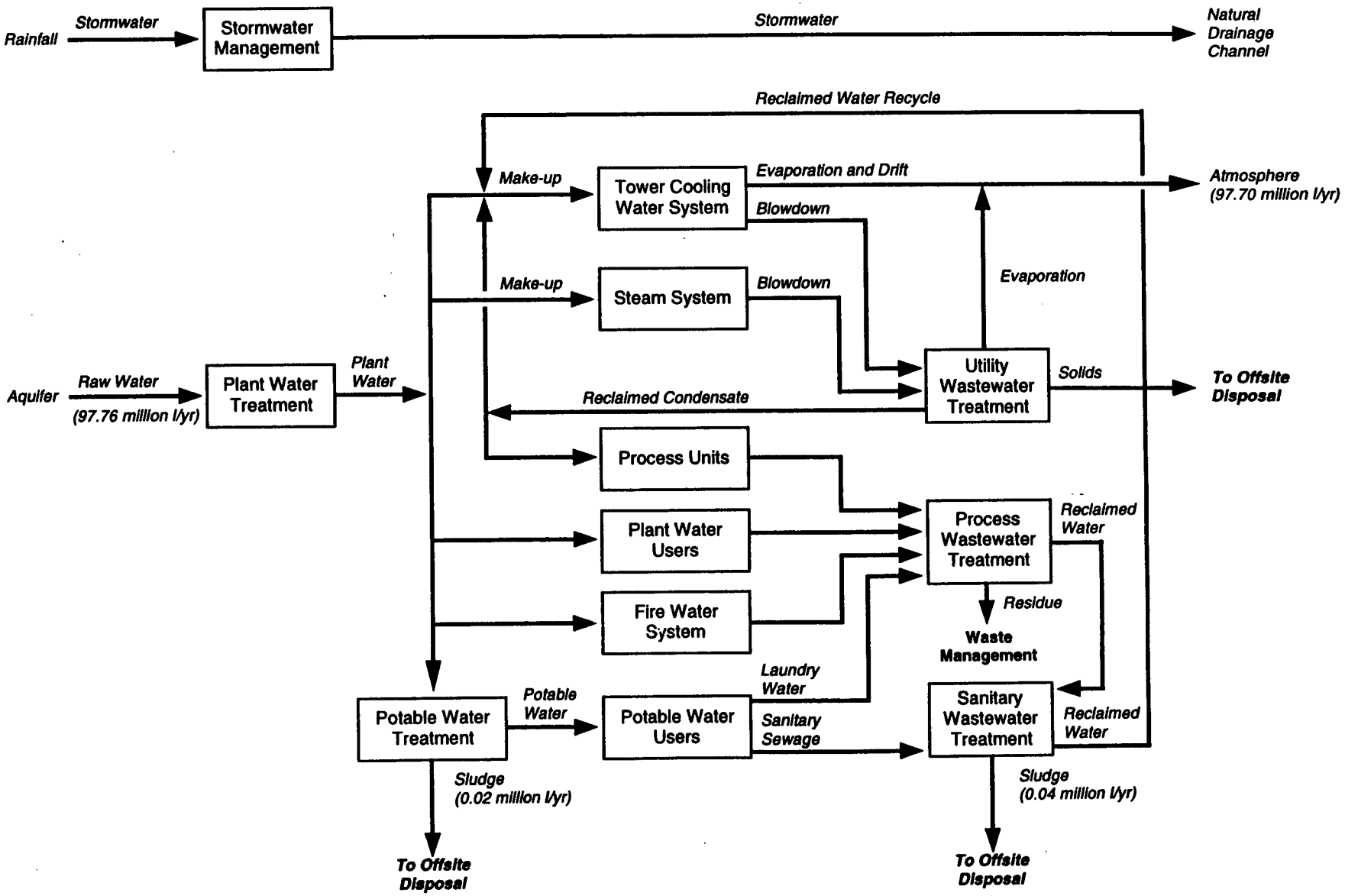
Figure D.1–8. Annual Water Balance for the Consolidation Alternative Modifying P-Tunnel at Nevada Test Site.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding.
Values in this figure have more significant digits to match the source document's water balance diagram.
Source: DOE 1996e.

2495/S&D

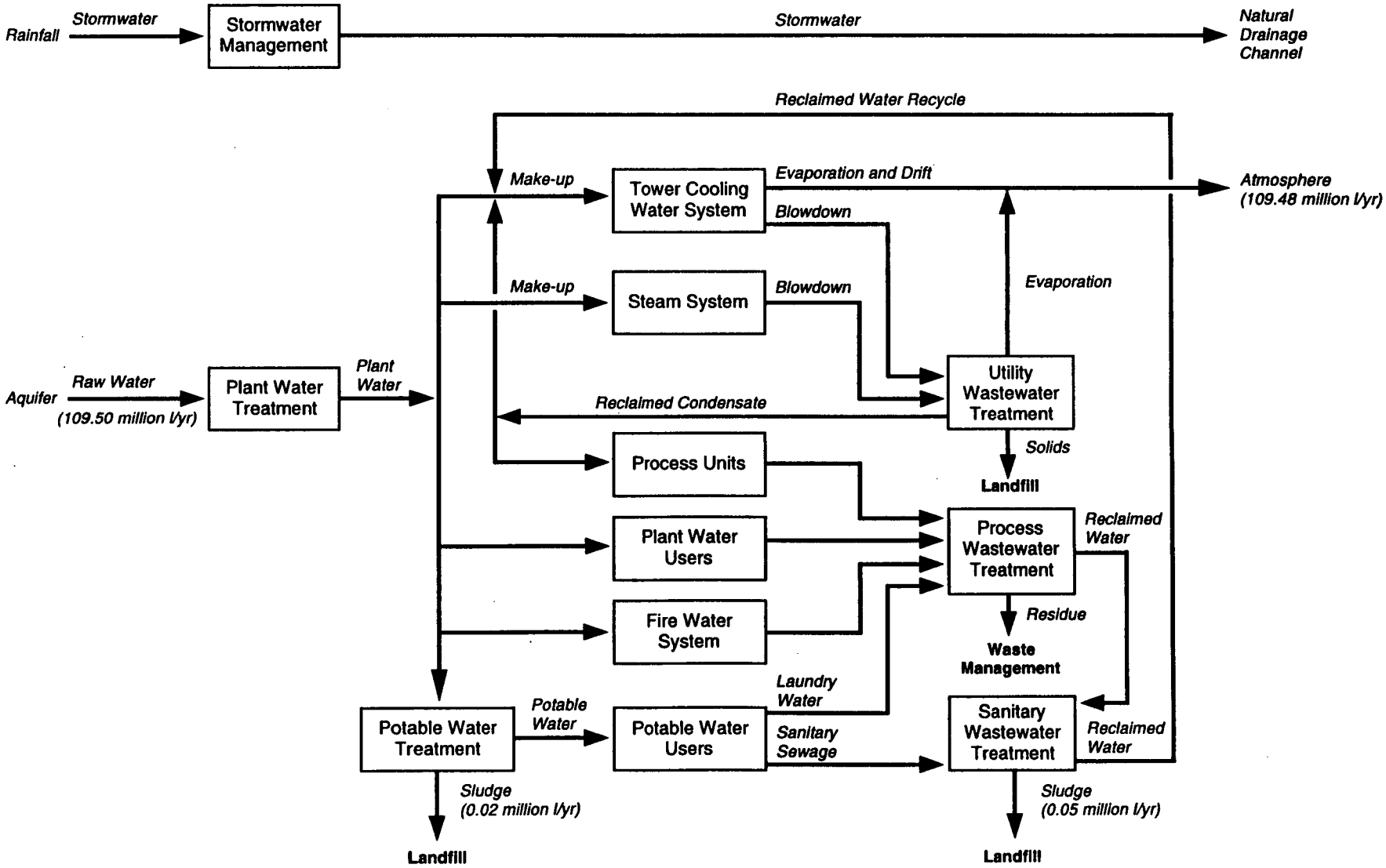
Figure D.1–9. Annual Water Balance for the Consolidation Alternative at Idaho National Engineering Laboratory.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding.
Values in this figure have more significant digits to match the source document's water balance diagram.
Source: DOE 1996e.

249R/S&D

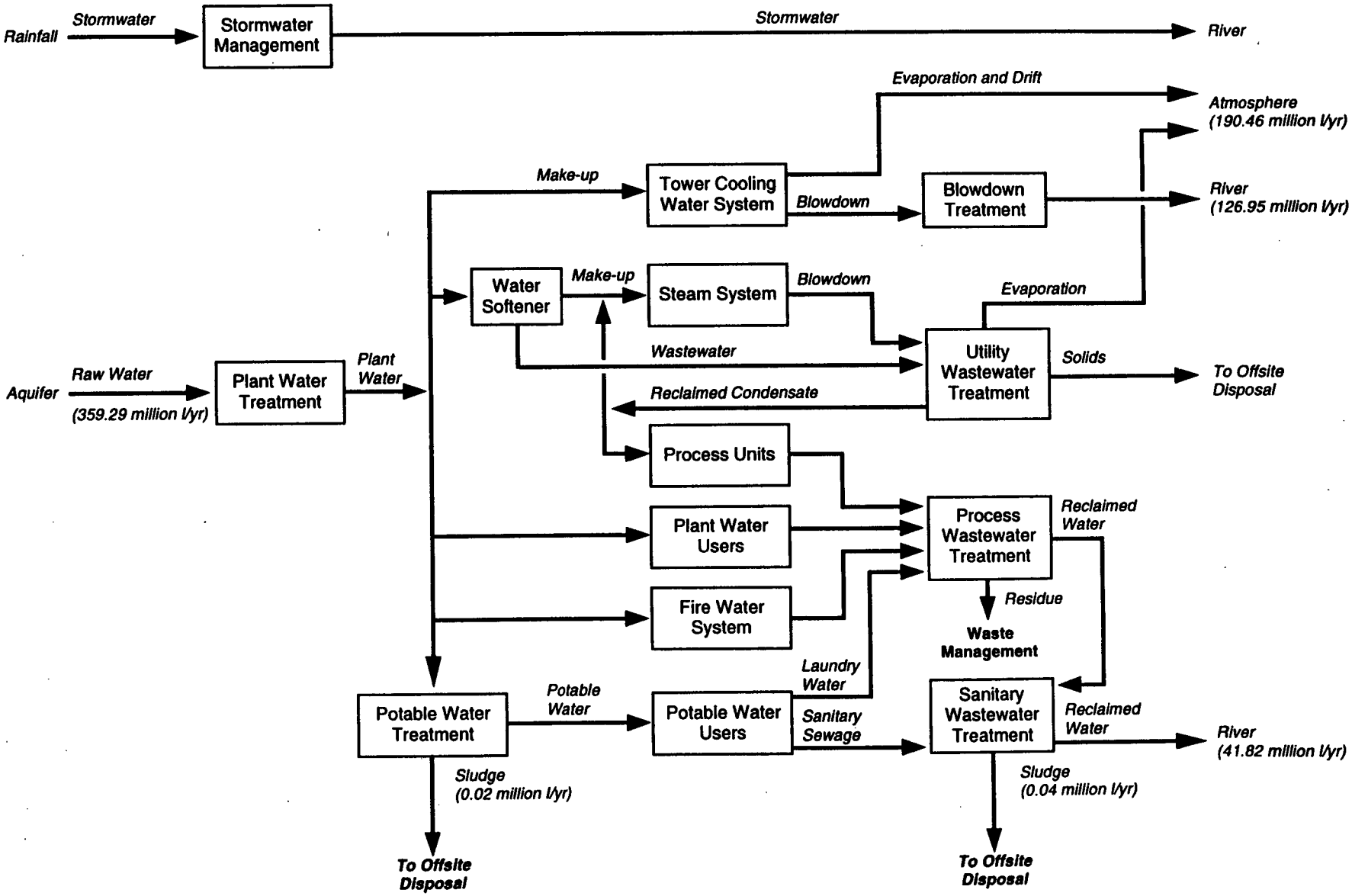
Figure D.1–10. Annual Water Balance for the Consolidation Alternative Constructing a New Facility at Pantex Plant.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding.
Values in this figure have more significant digits to match the source document's water balance diagram.
Source: PX DOE 1996a.

2519/S&D

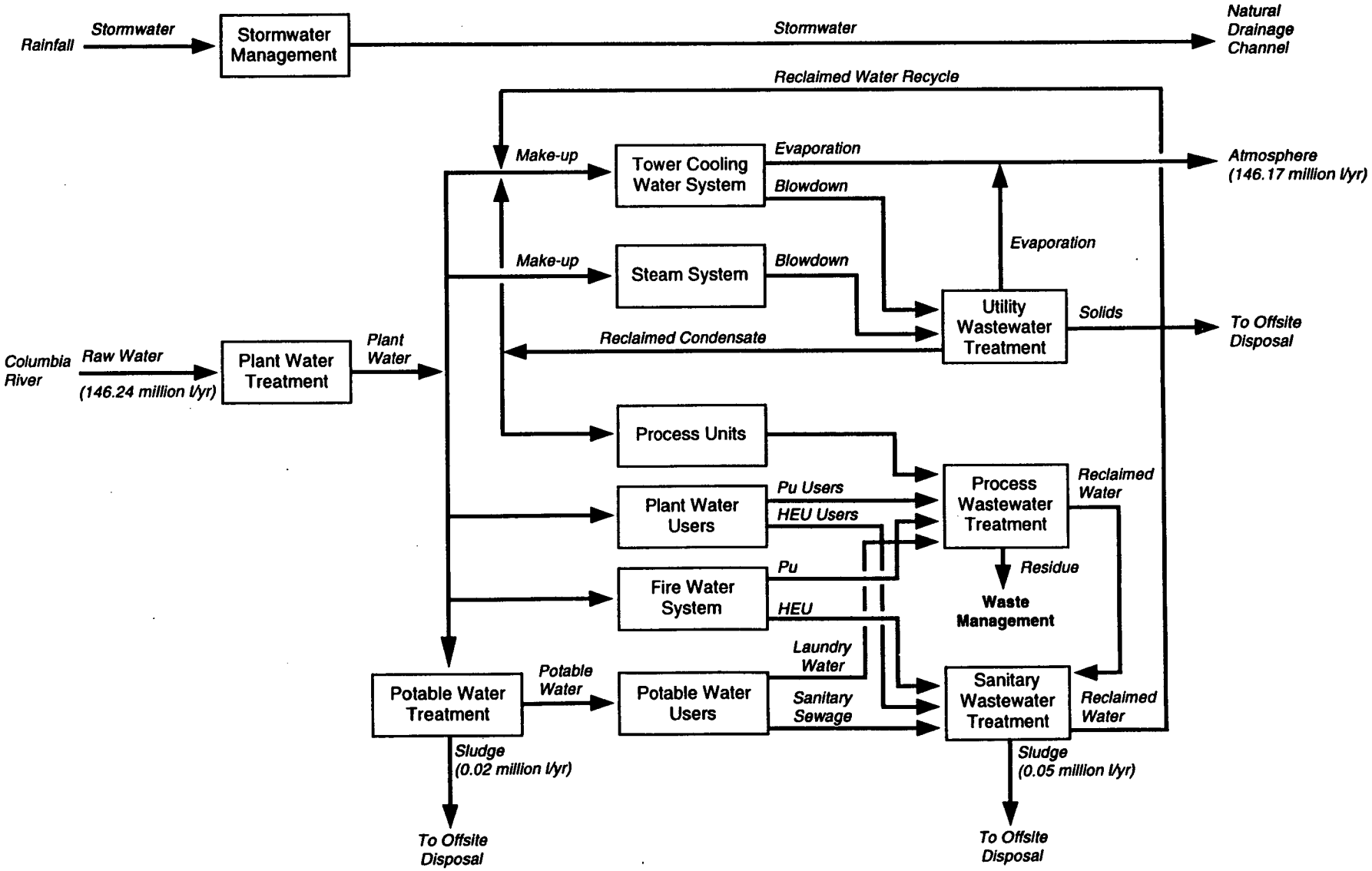
Figure D.1–11. Annual Water Balance for the Consolidation Alternative Modifying Zone 12 South at Pantex Plant.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding. Values in this figure have more significant digits to match the source document's water balance diagram.
Source: DOE 1996e.

2499/S&D

Figure D.1–12. Annual Water Balance for the Consolidation Alternative at Savannah River Site.

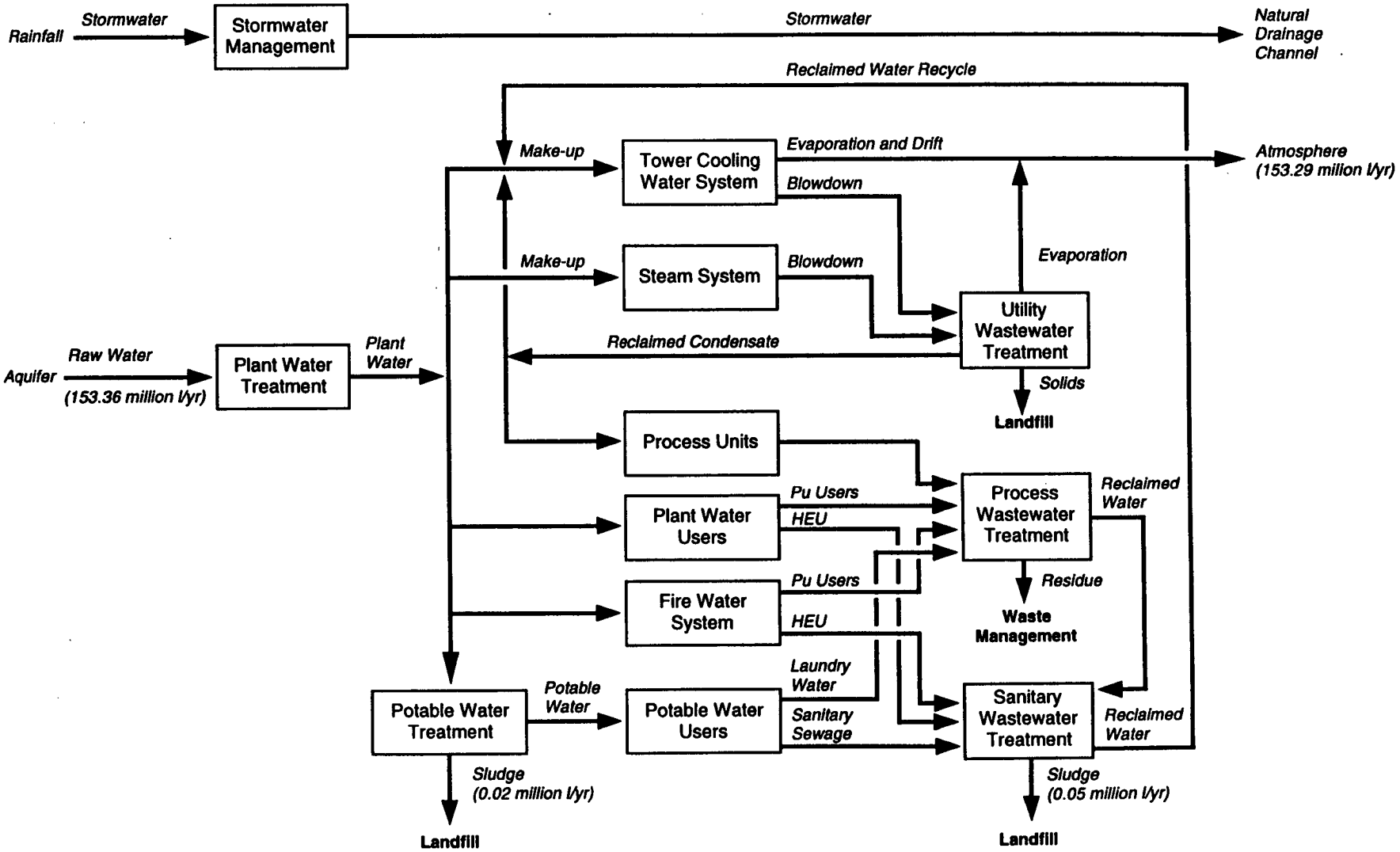


Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding. Values in this figure have more significant digits to match the source document's water balance diagram.

Source: DOE 1996f.

2724/S&D

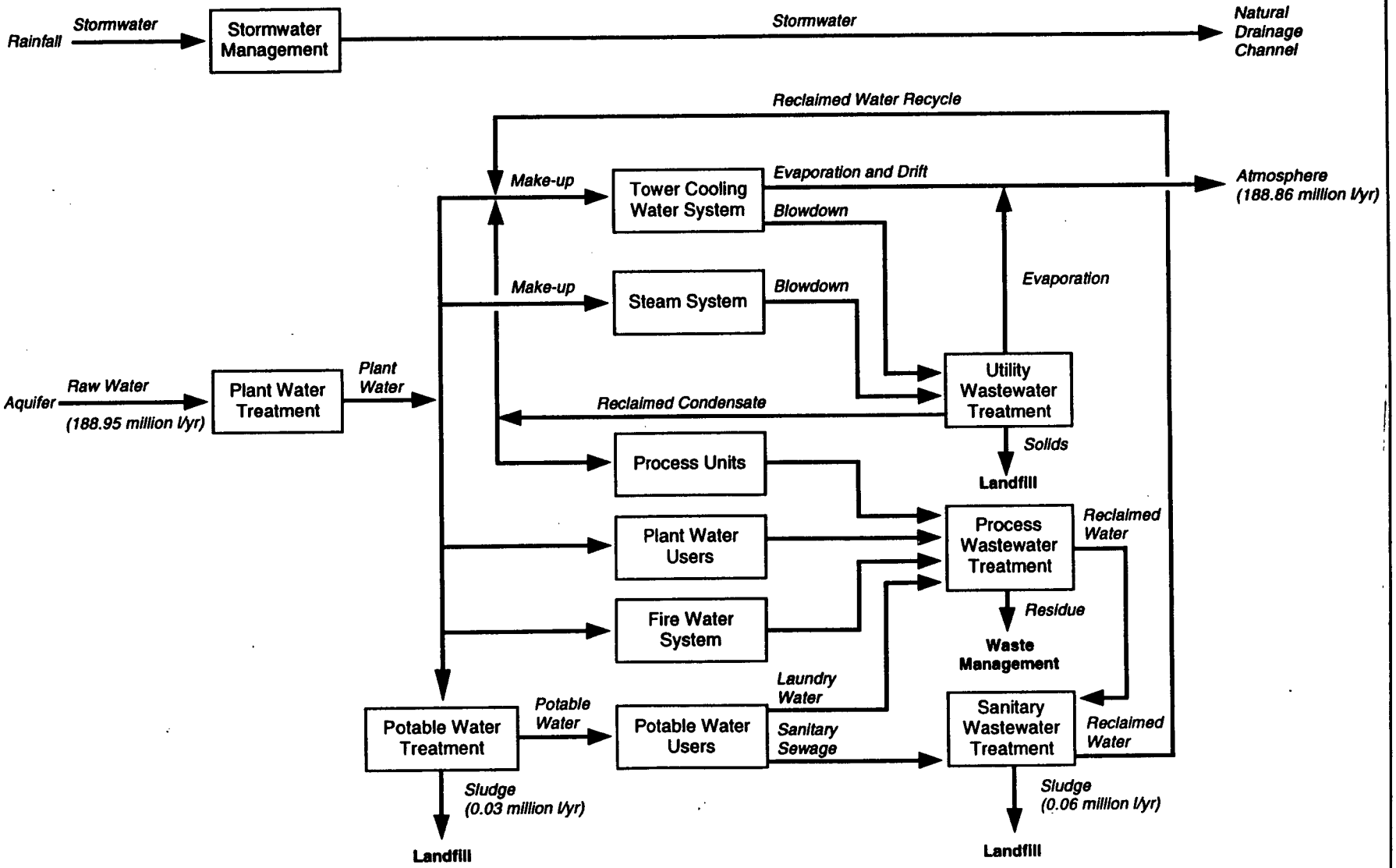
Figure D.1–13. Annual Water Balance for the Collocation Alternative at Hanford Site.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding.
Values in this figure have more significant digits to match the source document's water balance diagram.
Source: DOE 1996f.

2482/S&D

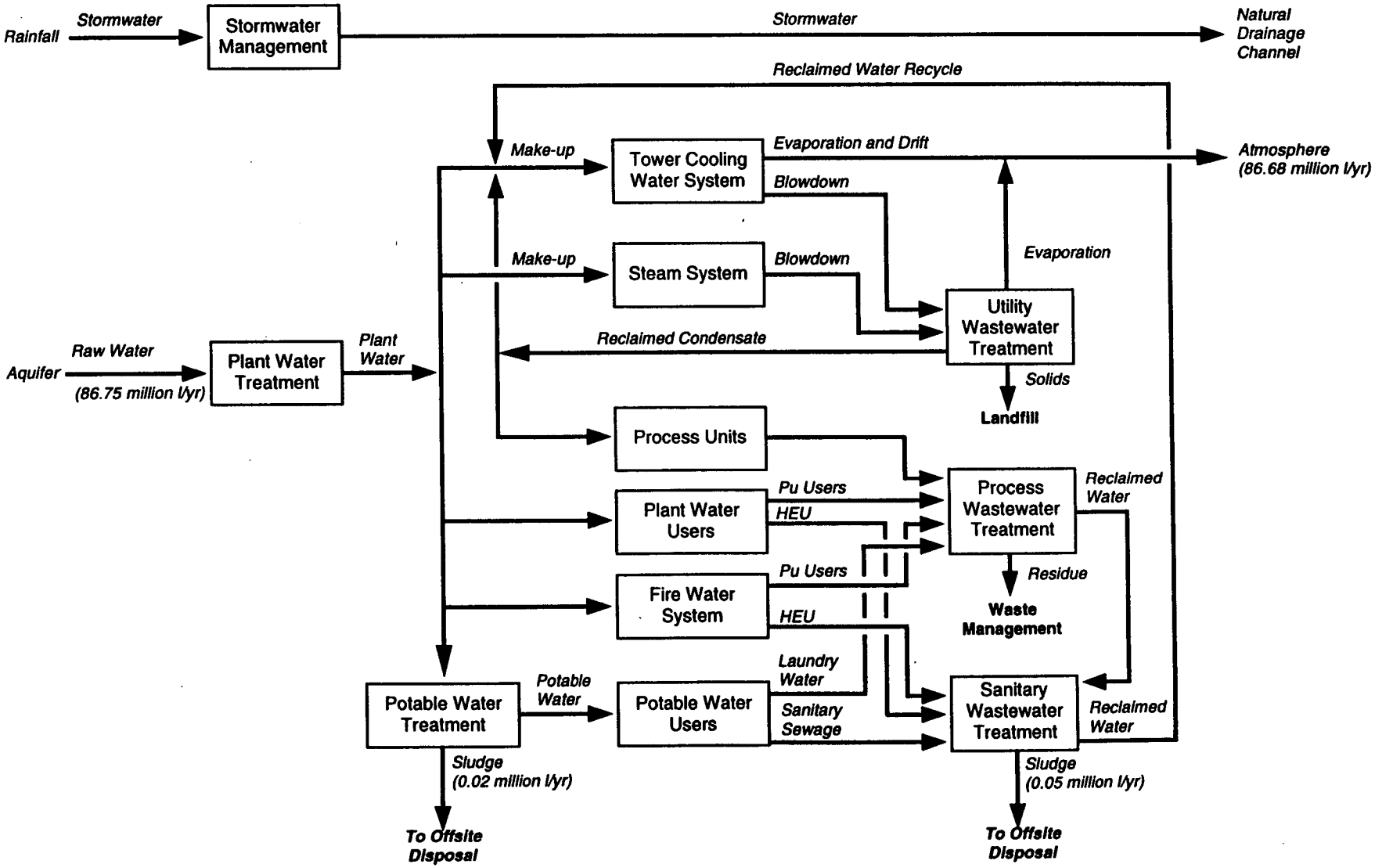
Figure D.1–14. Annual Water Balance for the Collocation Alternative Constructing a New Facility at Nevada Test Site.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding. Values in this figure have more significant digits to match the source document's water balance diagram.
Source: NT DOE 1996a.

24R6/S&D

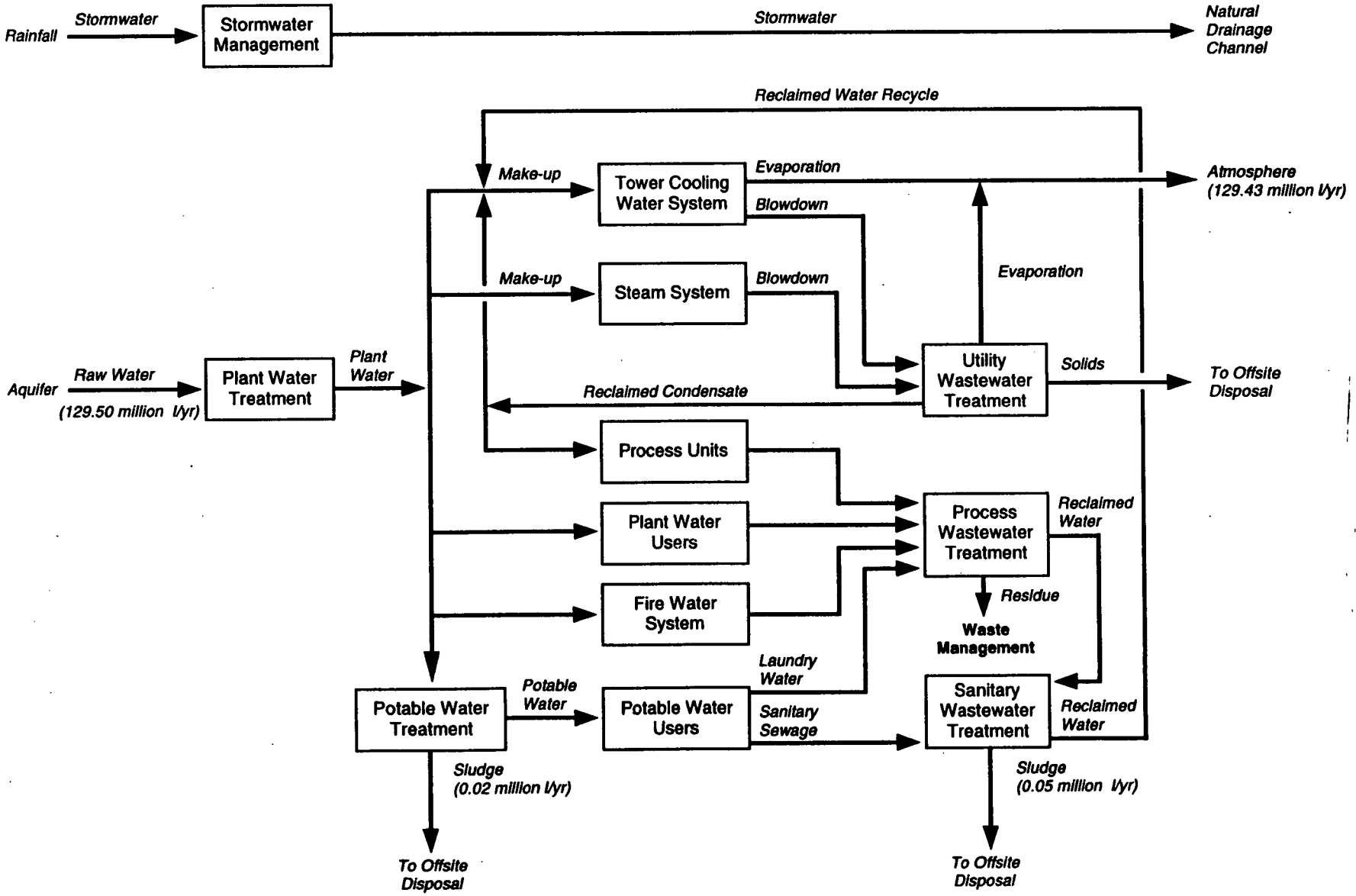
Figure D.1–15. Annual Water Balance for the Collocation Alternative Modifying P-Tunnel at Nevada Test Site.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding. Values in this figure have more significant digits to match the source document's water balance diagram.
Source: DOE 1996f.

2481/S&D

Figure D.1–16. Annual Water Balance for the Collocation Alternative at Idaho National Engineering Laboratory.

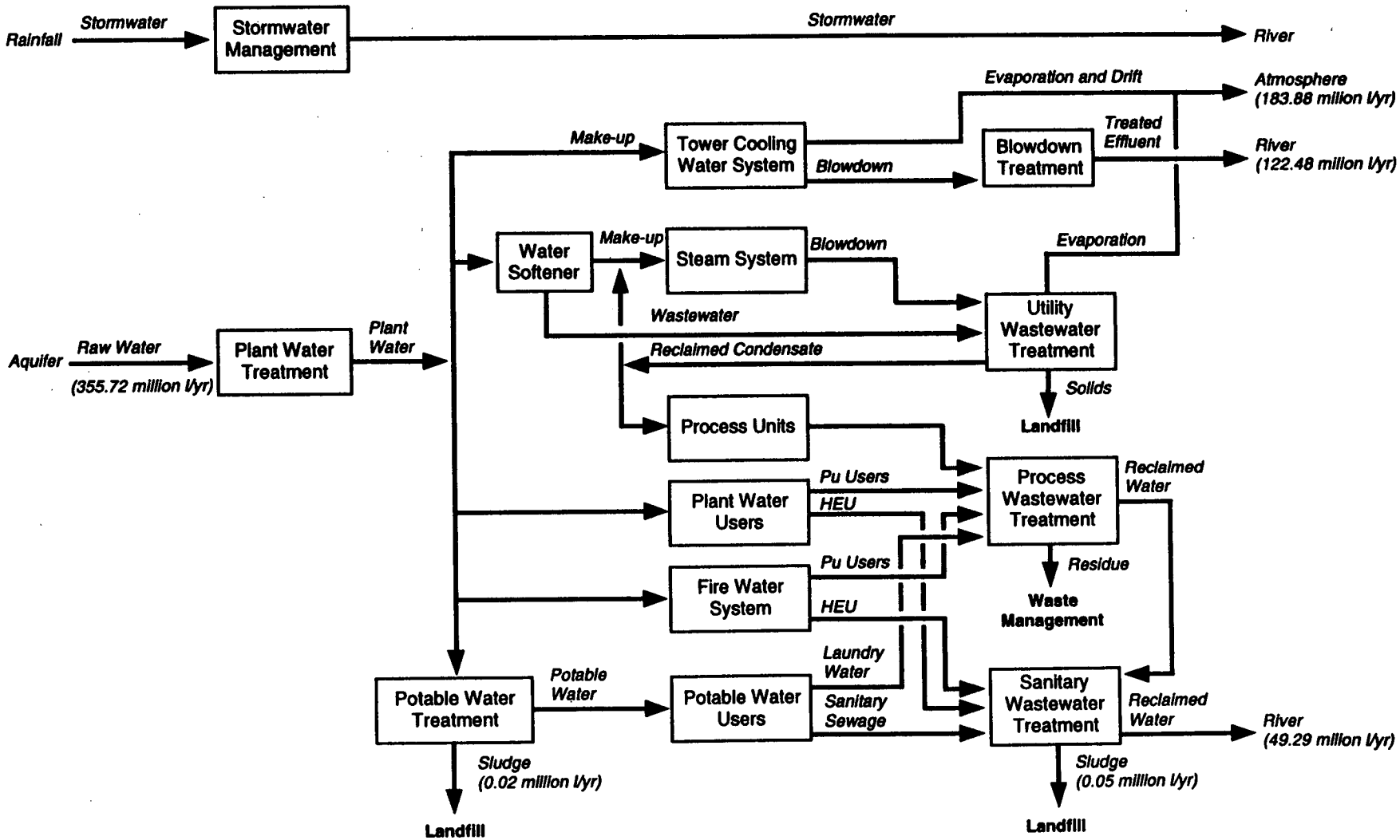


Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding. Values in this figure have more significant digits to match the source document's water balance diagram.

Source: DOE 1996f.

2968/S&D

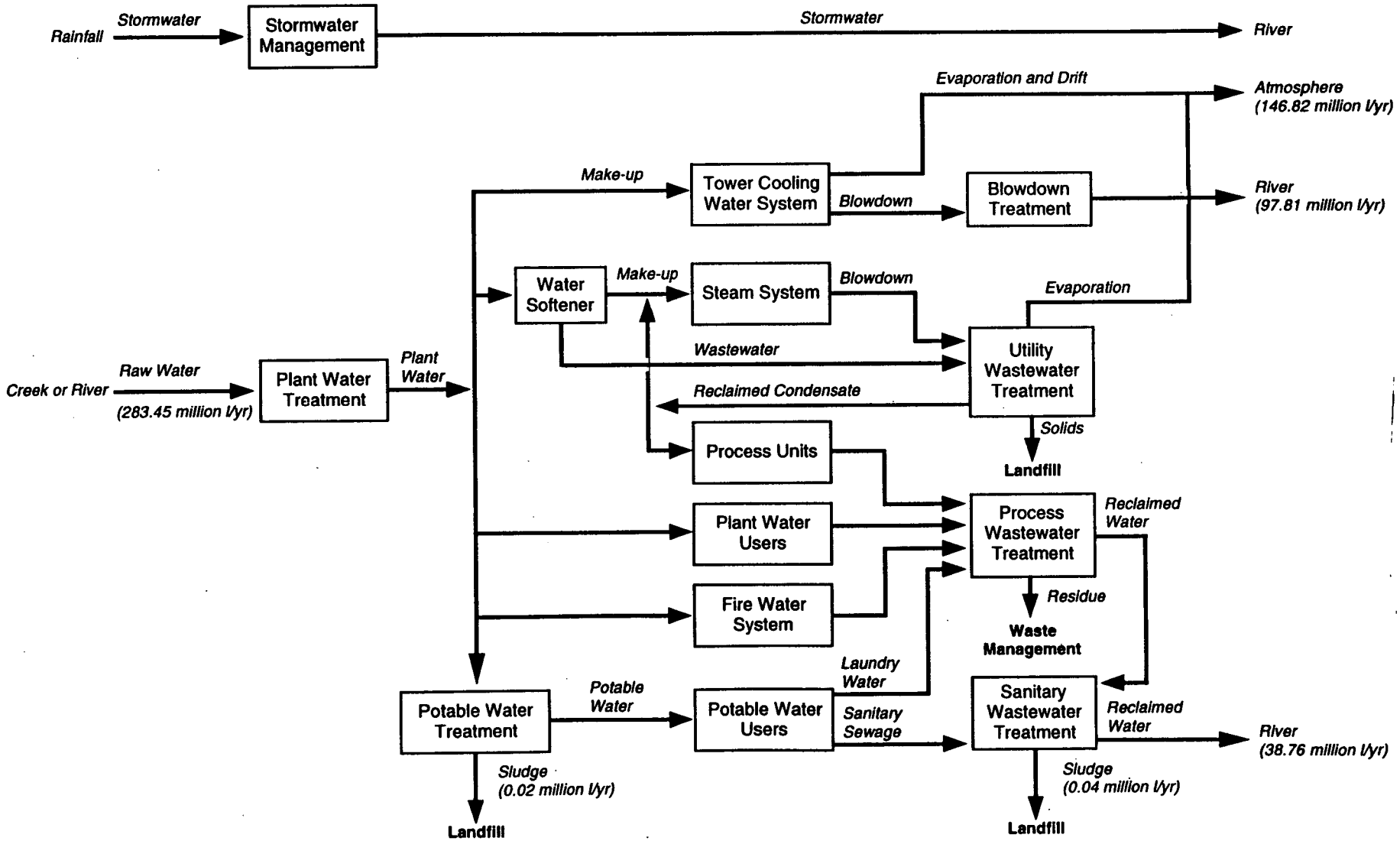
Figure D.1–17. Annual Water Balance for the Collocation Alternative at Pantex Plant.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding.
Values in this figure have more significant digits to match the source document's water balance diagram.
Source: DOE 1996f.

24R3/S&D

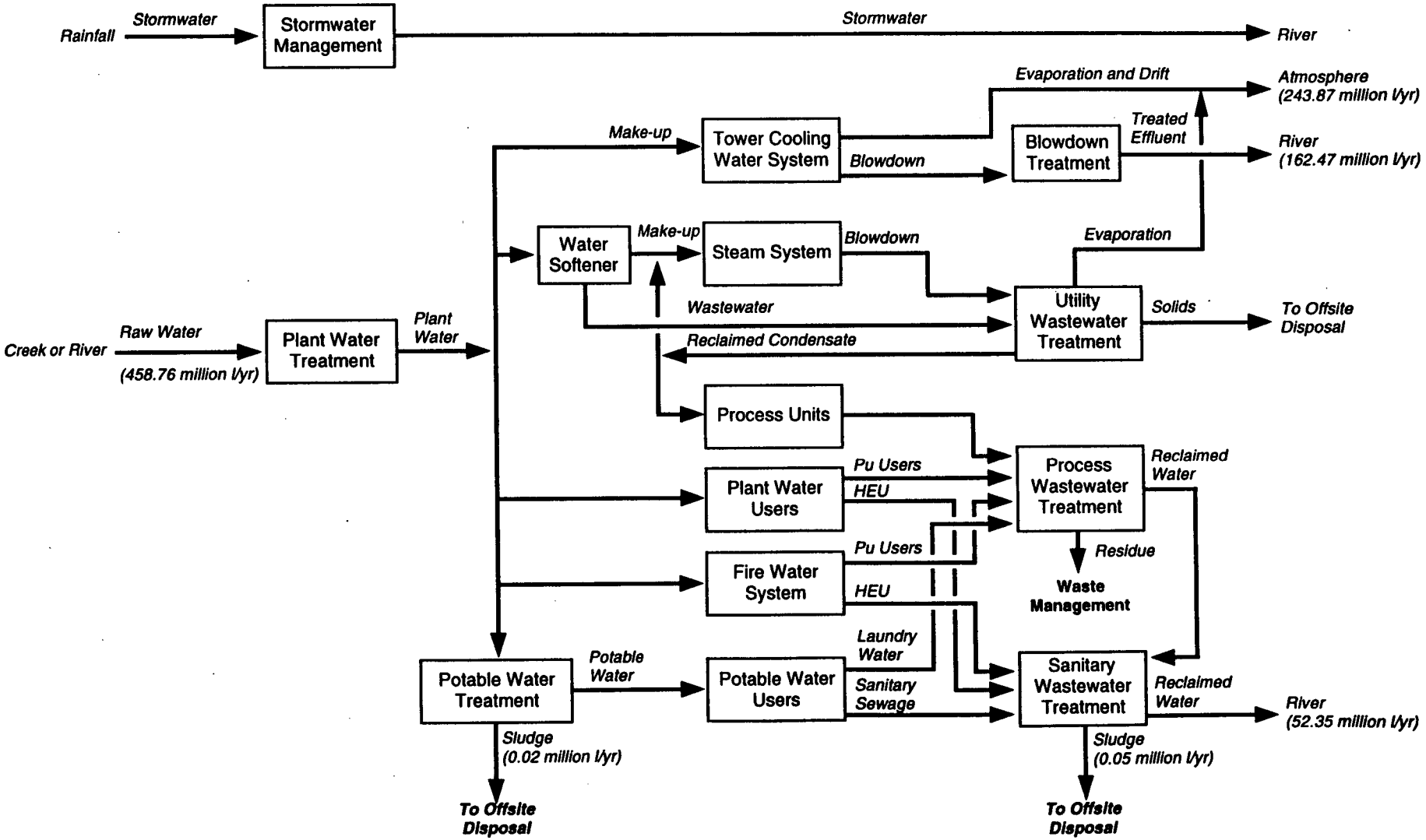
Figure D.1–18. Annual Water Balance for the Collocation Alternative Constructing a New Facility at Oak Ridge Reservation.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding.
Values in this figure have more significant digits to match the source document's water balance diagram.
Source: DOE 1996e.

2967/S&D

Figure D.1–19. Annual Water Balance for the Collocation Alternative Constructing a New Plutonium Storage Facility at Oak Ridge Reservation; Maintain Existing Highly Enriched Uranium Storage Facilities at Y–12 Plant.



Note: Values on this figure may not exactly match raw water requirements and wastewater values in other parts of this PEIS due to rounding.
Values in this figure have more significant digits to match the source document's water balance diagram.
Source: DOE 1996f.

2485/S&D

Figure D.1–20. Annual Water Balance for the Collocation Alternative at Savannah River Site.

D.2 FACILITIES COMMON TO MULTIPLE PLUTONIUM DISPOSITION ALTERNATIVES

The typical water balance diagrams for facilities that perform precursor activities on Pu materials before certain Pu disposition alternatives are provided in Figures D.2–1, D.2–2, and D.2–3. Under the Preferred Alternative for surplus Pu disposition, the pit disassembly/conversion facility and the mixed oxide fuel fabrication facility could each be located at either Hanford, INEL, Pantex, or SRS, and the Pu conversion facility could be located at Hanford or SRS. The facility water usage for these alternatives could be reduced by using existing facilities for portions of the operations. The next tier of *National Environmental Policy Act* (NEPA) review will examine locations for the selected alternatives including the use of existing facilities.

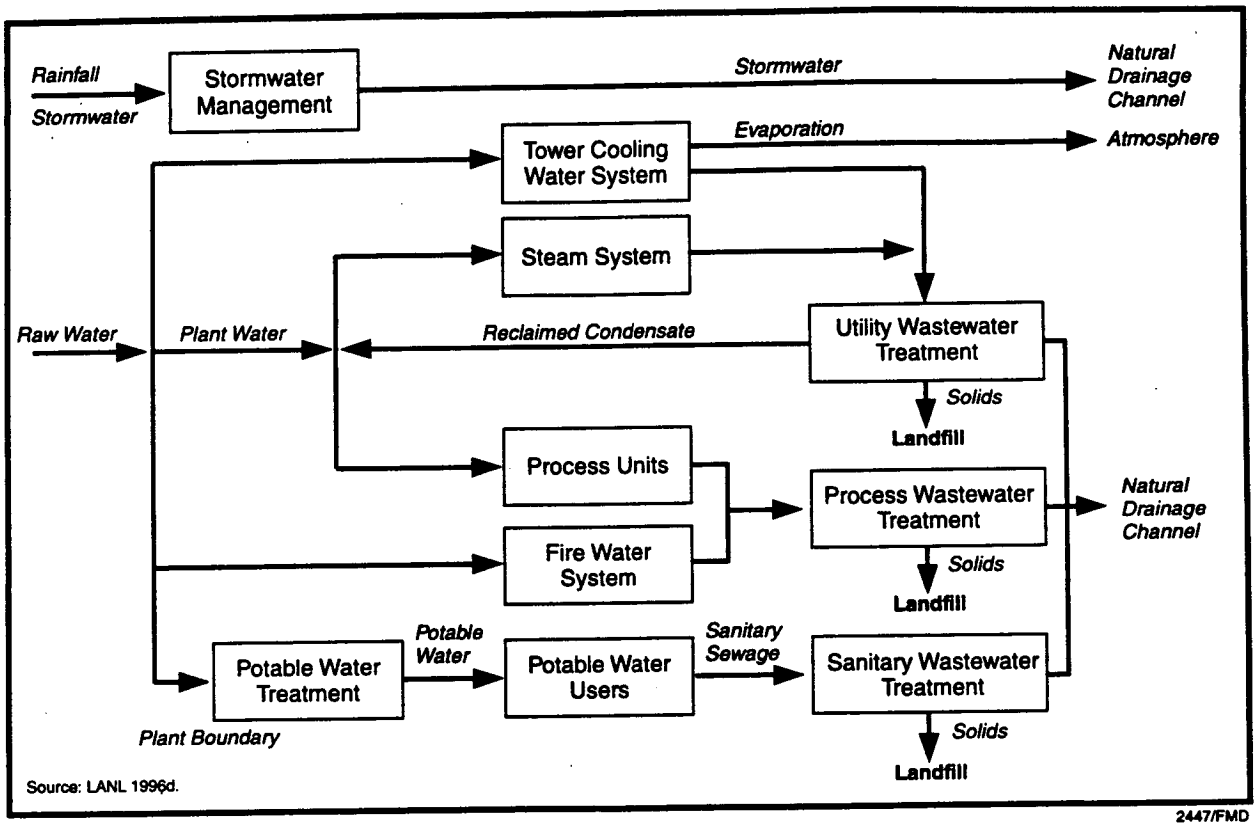


Figure D.2–1. Typical Water Balance for the Pit Disassembly/Conversion Facility.

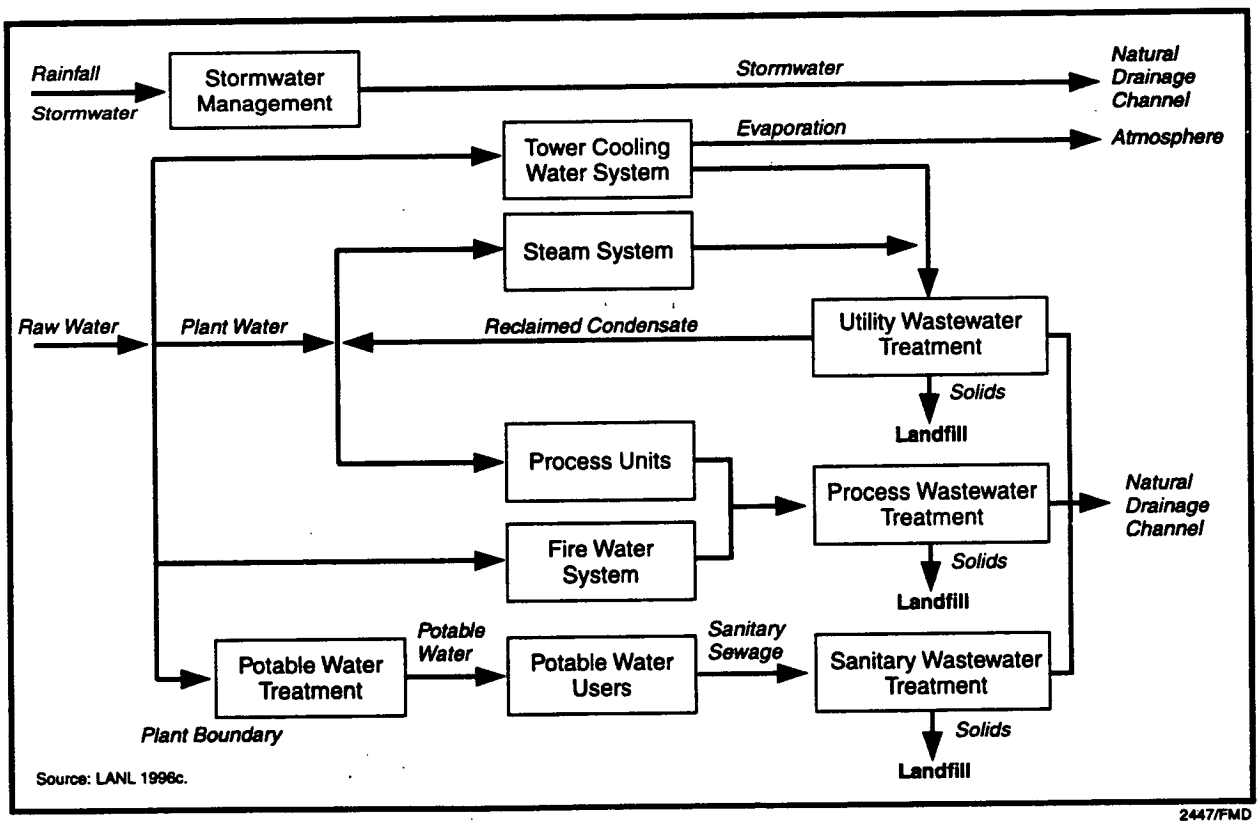
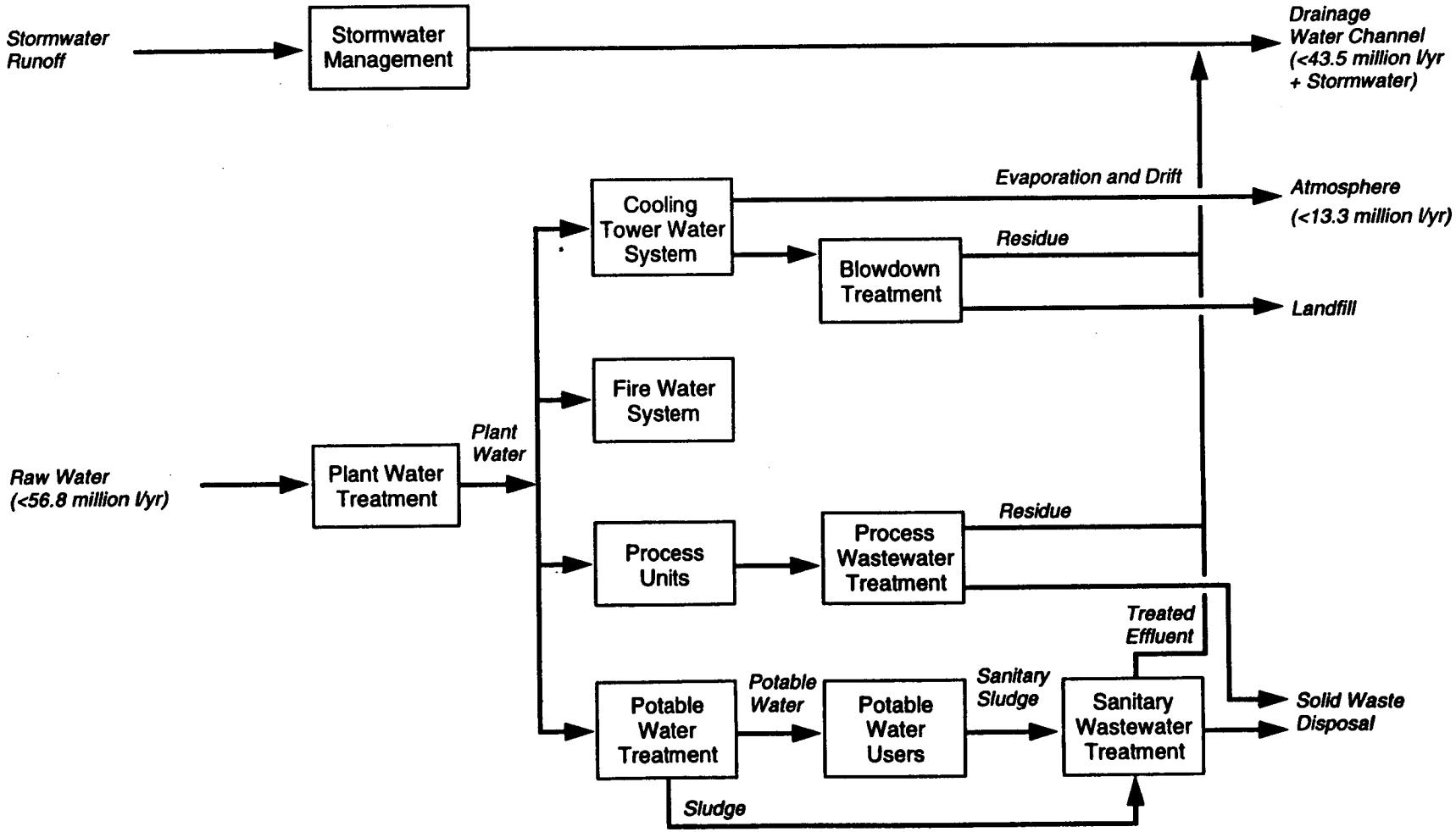


Figure D.2–2. Typical Water Balance for the Plutonium Conversion Facility.



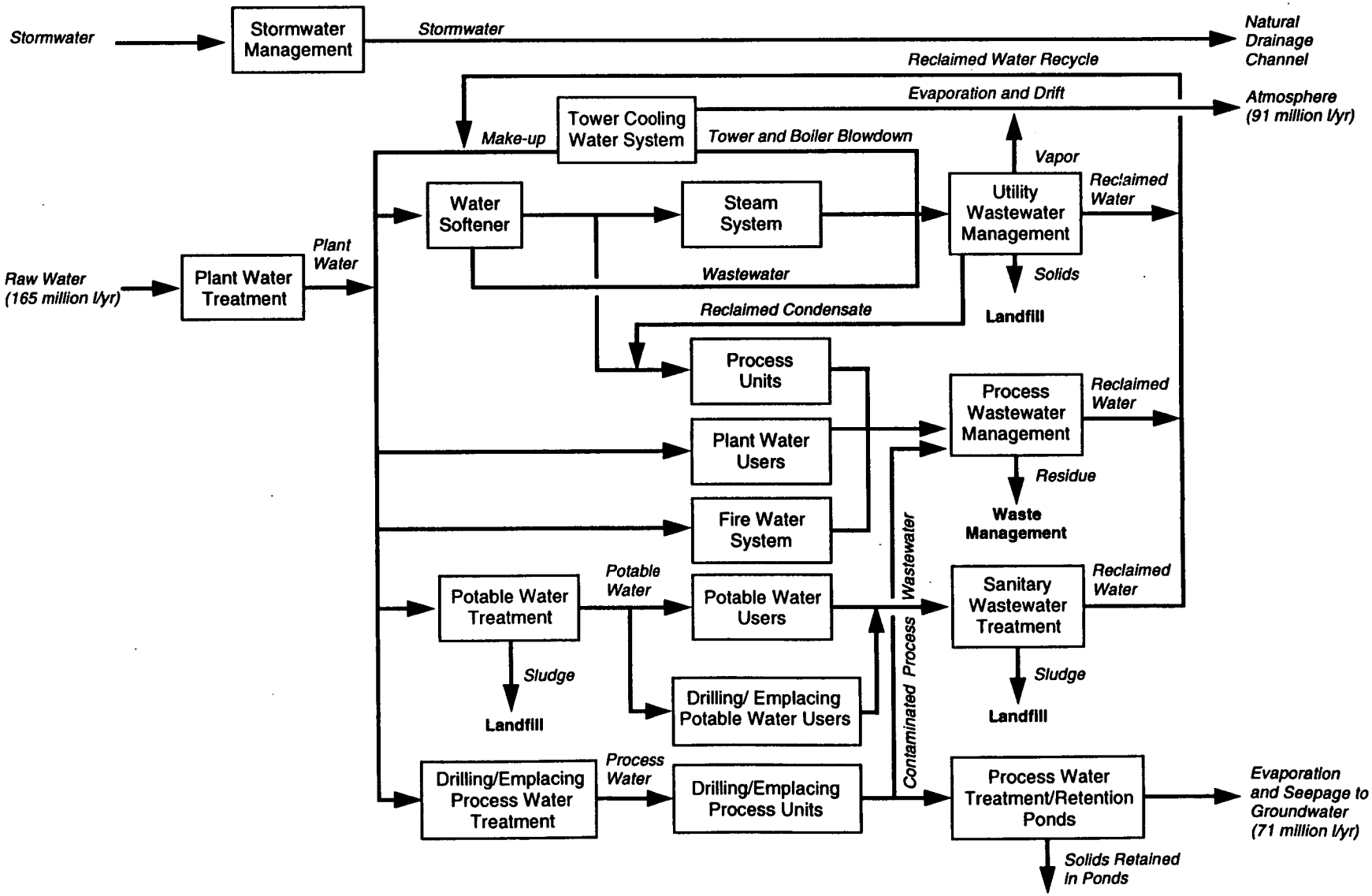
Source: LANL 1996b.

2437/FMD

Figure D.2–3. Typical Water Balance for the Mixed Oxide Fuel Fabrication Facility.

D.3 DISPOSITION ALTERNATIVES

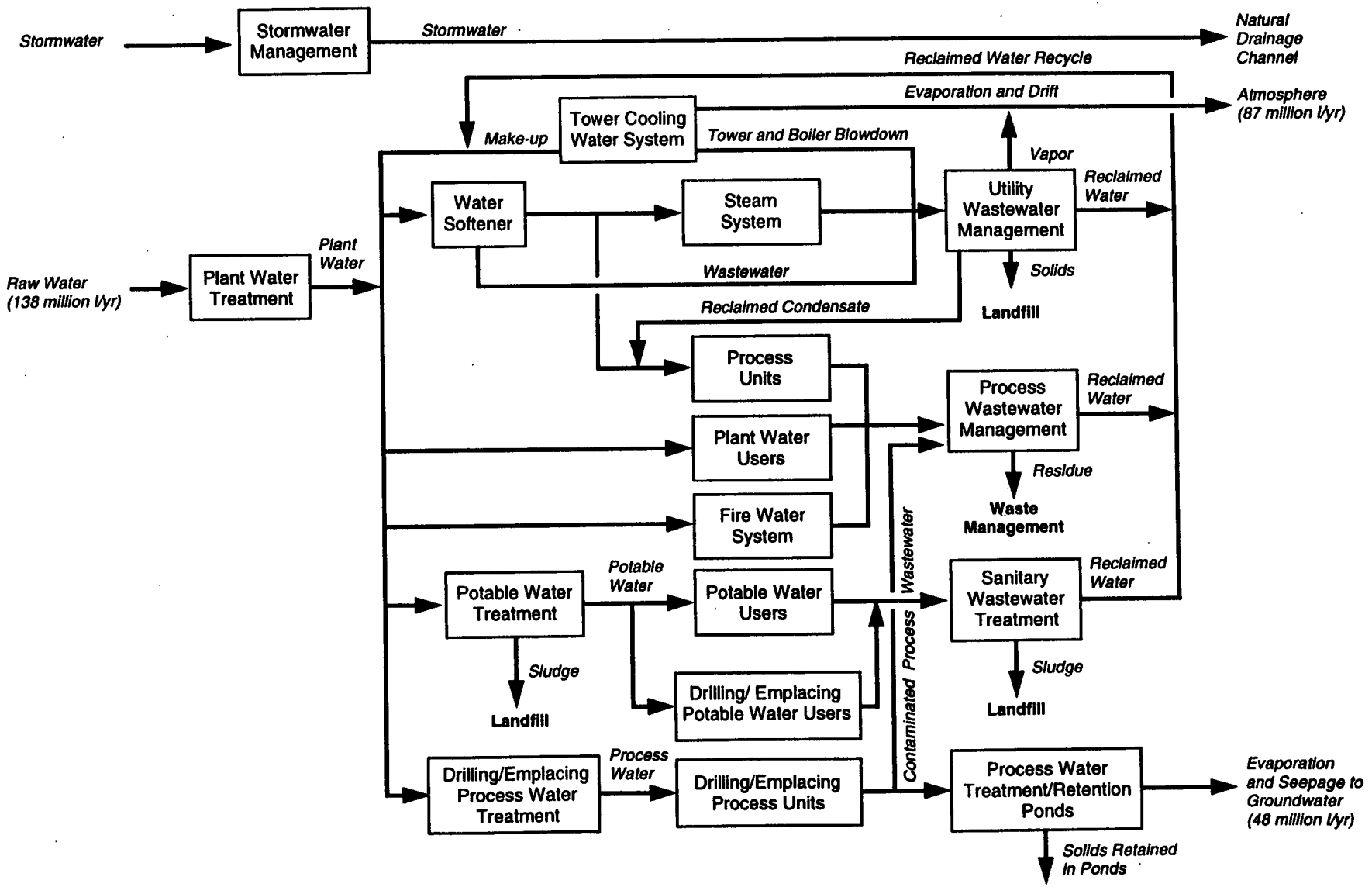
The typical water balance diagrams for each of the various Pu disposition alternatives are provided in Figures D.3–1 through D.3–7. The figures are in the same order as their description appears in Chapter 2. Under the Preferred Alternative for surplus Pu disposition, the ceramic immobilization facility or the vitrification facility could be located at Hanford or SRS. The facility water usage for these alternatives could be reduced by using existing facilities for portions of the operations. The next tier of NEPA review will examine locations for the selected alternatives including the use of existing facilities.



Source: LLNL 1996a.

2456/FMD

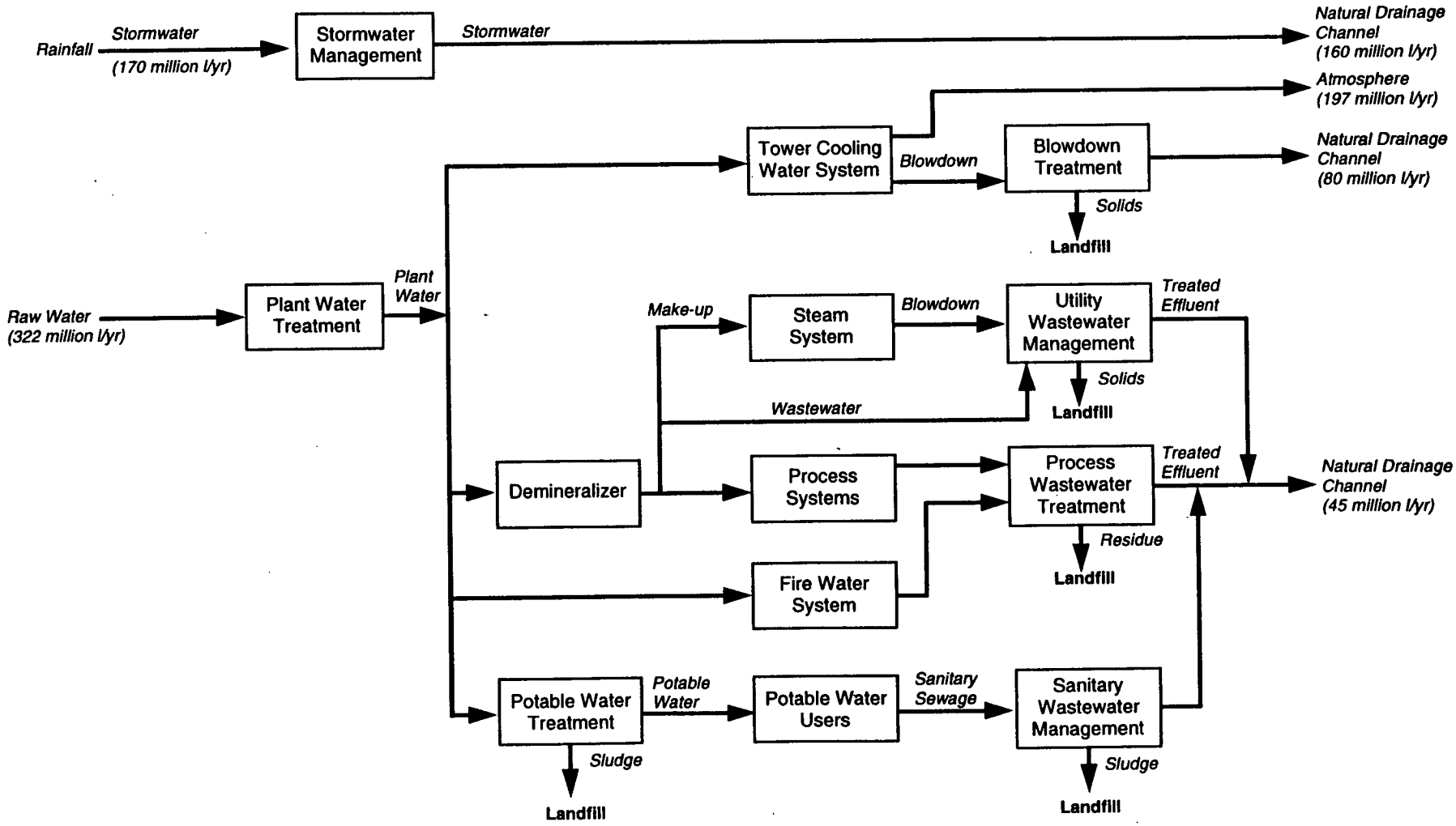
Figure D.3–1. Typical Water Balance for the Deep Borehole Complex—Direct Disposition Alternative.



Source: LLNL 1996h.

2697/FMD

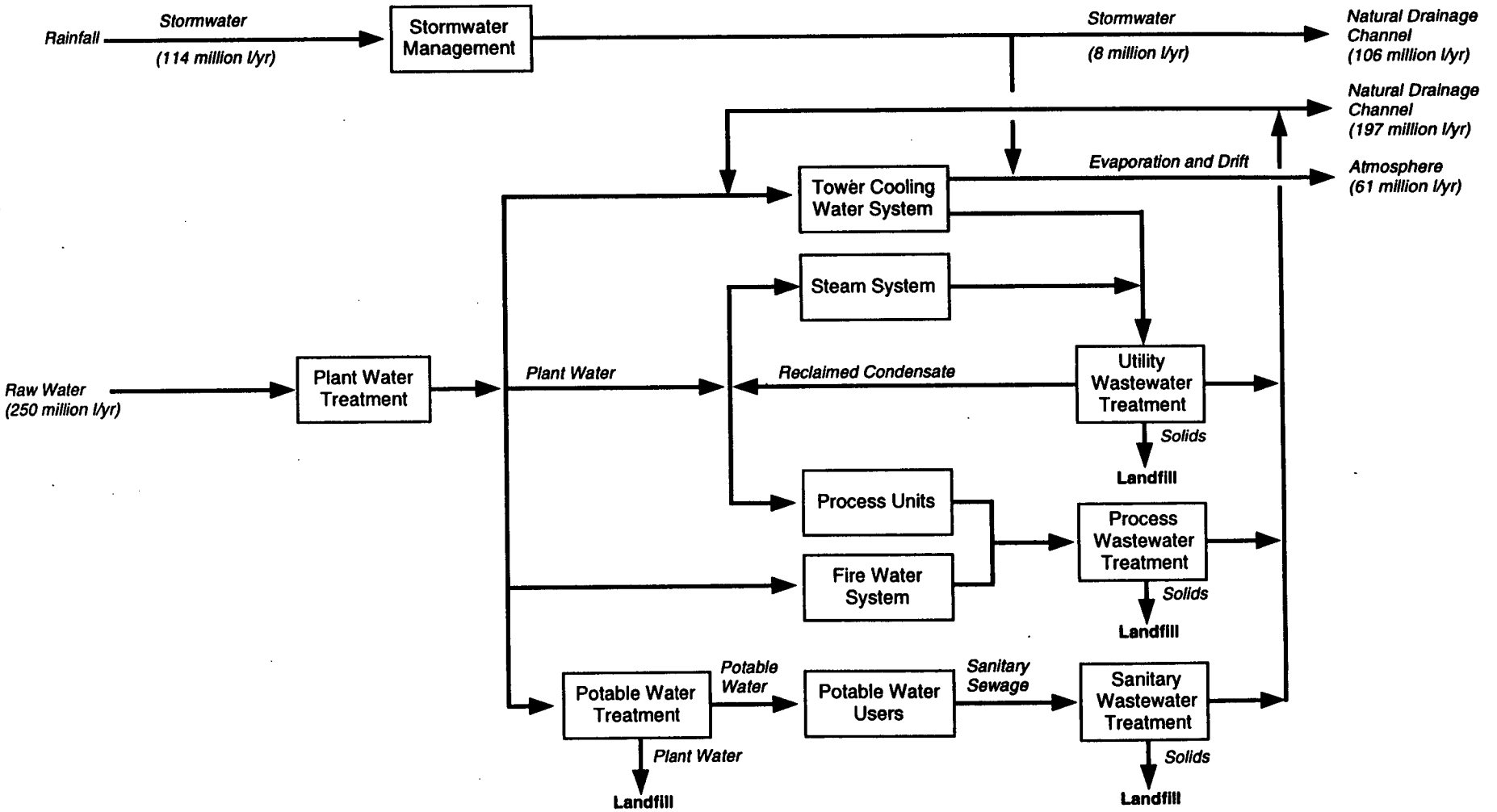
Figure D.3–2. Typical Water Balance for the Deep Borehole Complex—Immobilized Disposition Alternative.



Source: LLNL 1996e.

2596/FMD

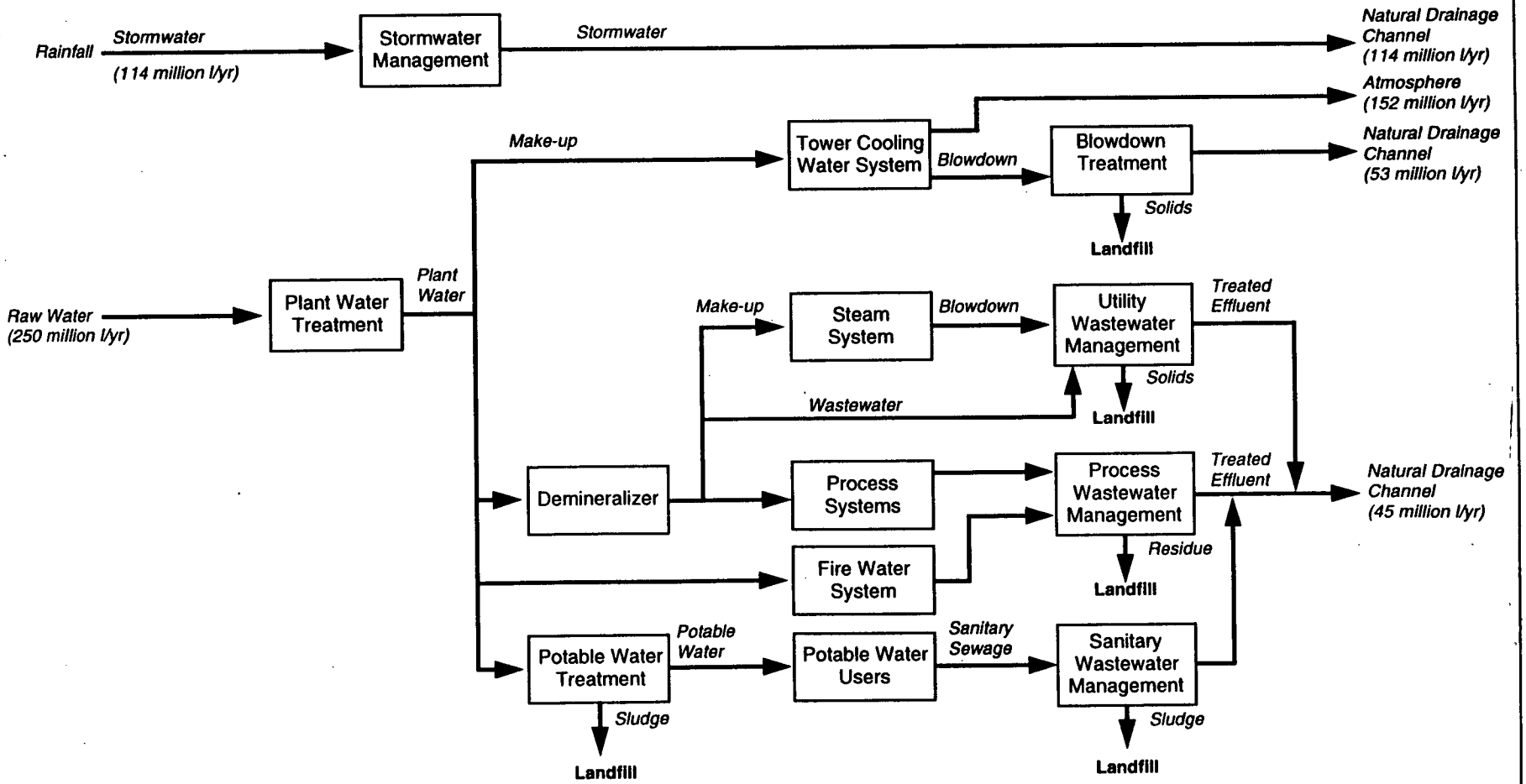
Figure D.3–3. Typical Water Balance for the Ceramic Immobilization Facility—Immobilized Disposition Alternative.



Source: LLNL 1996c.

2452/FMD

Figure D.3–4. Typical Water Balance for the Vitrification Alternative.



Source: LLNL 1996d.

2431/FMD

Figure D.3–5. Typical Water Balance for the Ceramic Immobilization Alternative.

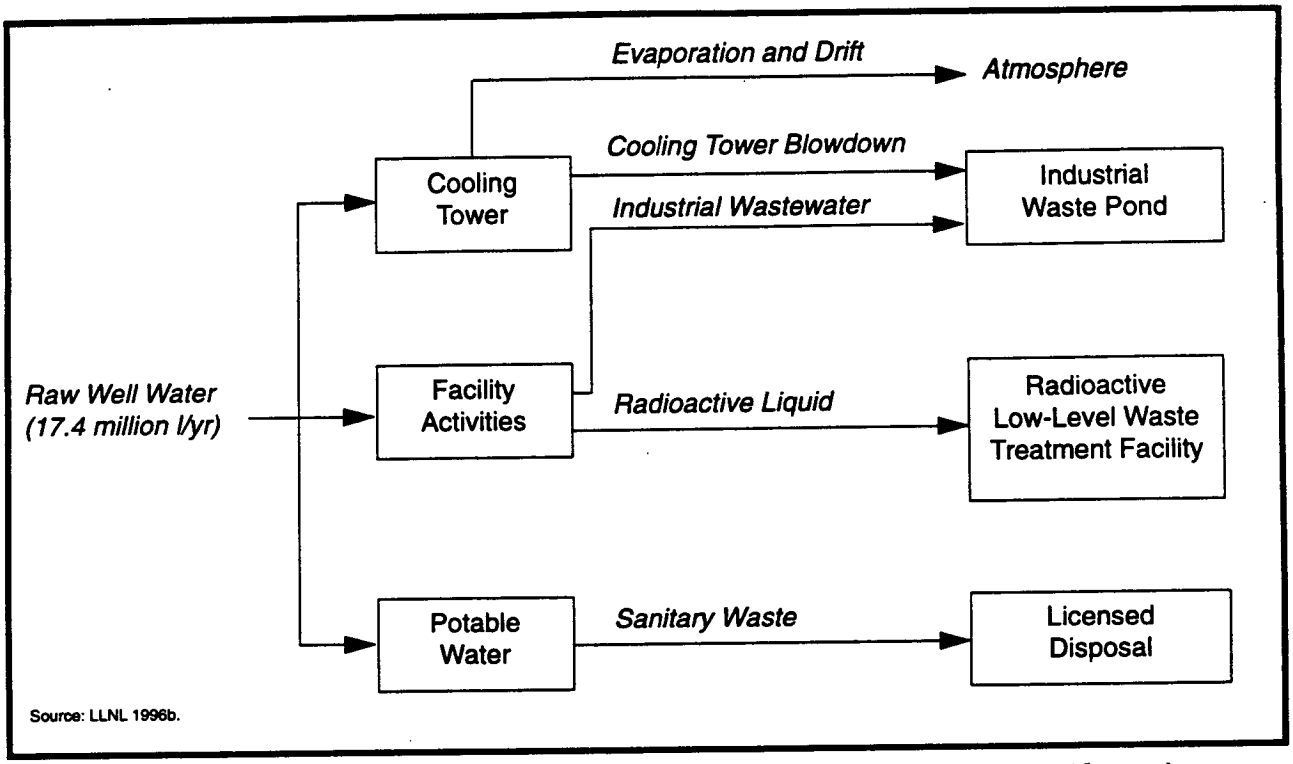
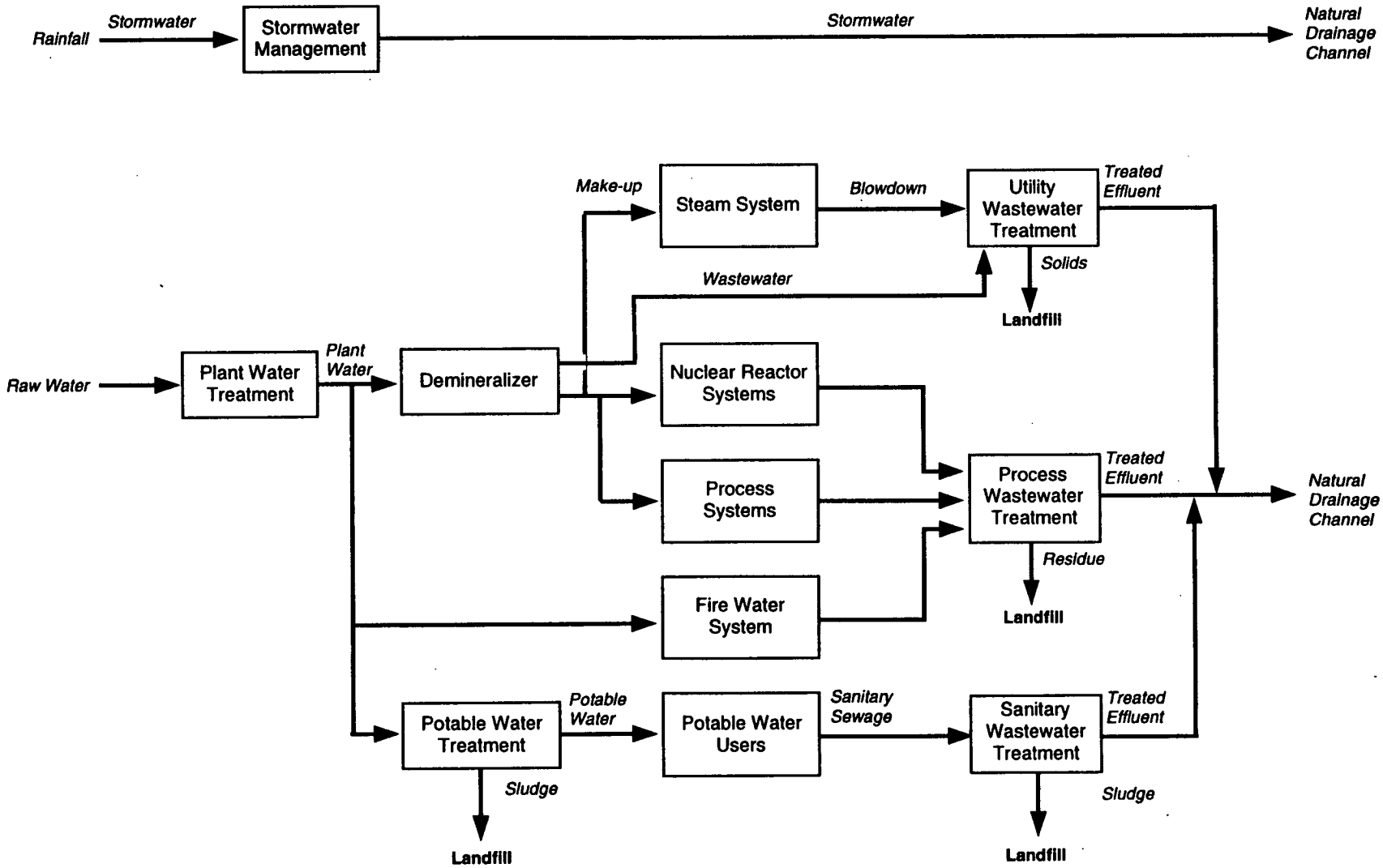


Figure D.3–6. Typical Water Balance for the Electrometallurgical Treatment Alternative (Glass-Bonded Zeolite).



Source: LLNL 1996g.

3038/S&D

Figure D.3–7. Typical Water Balance for the Evolutionary Light Water Reactor Alternative.

Appendix E
Waste Management

E.1 OVERVIEW

This appendix provides a general overview of the Department of Energy (DOE) environmental restoration and waste management program including the categories of waste streams managed by the Department; the applicable Federal statutes and DOE Orders; waste minimization and pollution prevention; waste treatment, storage, and disposal; transportation of wastes; and facility transition management. Current site-specific waste management activities will follow in Section E.2. Project-specific waste management activities are addressed in Section E.3.

E.1.1 WASTE CATEGORIES

Wastes are generated in gaseous, liquid, and solid form and are categorized by their health hazard and handling requirements. The categories are listed in Table E.1.1–1.

Table E.1.1–1. Waste Categories

Category	Characterization
Spent nuclear fuel	Nuclear reactor fuel that has been irradiated to the extent that it has undergone significant isotopic change to the point that fission-product poisons have reached an uneconomic threshold. DOE is no longer reprocessing spent nuclear fuel solely to recover fissile and fertile material. Although spent nuclear fuel is not categorized as a nuclear waste, the definition is provided here since it is radioactive material that must be stored, managed, and handled.
High-level (HLW)	Highly radioactive material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid that contains fission products in sufficient concentrations; and other highly radioactive material that the Nuclear Regulatory Commission (NRC), consistent with existing law, determines by rule to require permanent isolation.
Transuranic (TRU)	Radioactive waste that is contaminated with alpha-emitting elements with an atomic number greater than uranium, half-lifes greater than 20 years, and in concentrations greater than 100 nanocuries per gram (nCi/g). Such wastes result primarily from fuel reprocessing, and from the fabrication of Pu weapons components and Pu-bearing reactor fuel. Generally, little or no shielding is required ("contact-handled" TRU waste), but energetic gamma and neutron emissions from certain transuranic nuclides and fission-product contaminants may require shielding or remote handling ("remote-handled" TRU waste).
Low-level (LLW)	Radioactive waste that is not spent nuclear fuel, HLW, TRU waste, or byproduct material as defined by DOE Order 5820.2A, *Radioactive Waste Management.* Includes research and development fissionable test specimens with TRU waste less than 100 nCi/g. The radiation level from this waste may sometimes be high enough to require shielding for handling and transport. In 10 CFR 61, NRC defines four disposal categories of LLW that require differing degrees of confinement and/or monitoring: classes A, B, C, and Greater-Than-Class C.

Table E.1.1–1. Waste Categories—Continued

Category	Characterization
Hazardous	Nonradioactive waste that has characteristics identified by either or both of the following Federal statutes: *Resource Conservation Recovery Act* (RCRA) (40 CFR 261), as amended, or the *Toxic Substance Control Act*. These toxic, corrosive, reactive, or ignitable substances, or RCRA-listed wastes have been identified as posing health or environmental risks. Hazardous waste includes chemicals (such as chlorinated and nonchlorinated hydrocarbons), explosives, leaded oil, paint solvents, sludges, acids, organic solvents, heavy metals, and pesticides.
Mixed	Waste that contains both hazardous and radioactive constituents.
Nonhazardous (sanitary)	Solid sanitary waste that includes garbage, is routinely generated by normal housekeeping activities, and does not have a defined health risk (neither radioactive nor hazardous). Liquid sanitary waste includes sewage and industrial waste, and is treated in a wastewater process before discharge to a publicly owned treatment works or to surface waters. The management of liquid sanitary waste is regulated by the *Clean Water Act* and the National Pollutant Discharge Elimination System.
Nonhazardous (other)	Other wastes that do not have a defined health risk, such as process wastewater.

E.1.2 APPLICABLE FEDERAL STATUTES AND DEPARTMENT OF ENERGY ORDERS

Most of the regulations that govern the storage, treatment, and disposal of wastes were promulgated since the original Nuclear Weapons Complex (Complex) was established. In many cases, the technology available at the time the Complex was constructed does not meet current requirements for full compliance and, as a result, interim agreements have been made with the regulatory agencies. Through continuous upgrade programs, processes have been improved or added to meet the new regulations. Operations continue on the basis of using "best available technology" for facilities that were in operation before the regulation came into effect. In the siting and construction of new facilities, the intent is to meet current regulations and to reach the goal of maximum recycle, minimal waste generation, no liquid discharges to the surface, and treatment and stabilization of unavoidable wastes sufficient for long-term storage or permanent disposal either onsite or offsite.

In order to operate at most of its facilities, DOE has entered into numerous agreements with States and the Environmental Protection Agency (EPA) to address compliance issues concerning certain aspects of environmental regulatory requirements that have arisen due either to the age of DOE facilities or the uniqueness of DOE operations. For the most part, DOE facilities are in compliance with the major portion of all environmental regulatory requirements, and these compliance agreements address specific situations. At the same time, most of these compliance agreements include a commitment from DOE to achieve compliance with the specific requirement by a specified date and according to a schedule and milestones for achieving that compliance. These schedules and milestones are renegotiated on an ongoing basis as a result of changing budgets, additional environmental findings, and other factors. These agreements guide DOE activities at the sites under applicable environmental laws, regulations, and other standards. Compliance with the terms of these negotiated agreements is one of the highest DOE priorities. Site operations would be conducted consistent with commitments DOE has made and would make in these agreements. DOE would work with the regulators to amend existing agreements and to develop new agreements to ensure continued compliance. Under no circumstances would DOE's performance pursuant to any existing compliance agreement be compromised or diminished as a result of the proposed action.

The following summarizes the applicable Federal statutes and DOE Orders:

Atomic Energy Act. The *Atomic Energy Act* gives (AEA) DOE the authority to manage and regulate nuclear materials handled and generated at its facilities; however, DOE seeks to make its internal guidelines consistent with standards applied to commercial nuclear facilities regulated by the Nuclear Regulatory Commission (NRC). Pursuant to the AEA, DOE is committed to the practice of "as low as reasonably achievable" exposure to radiation from its operations whereby exposures and resultant doses are maintained as low as social, economic, technical, and practical considerations permit.

Resource Conservation and Recovery Act. The *Resource Conservation and Recovery Act* (RCRA) was passed in 1976 as an amendment to the *Solid Waste Disposal Act* of 1965. RCRA regulates the "cradle to grave" management (that is, generation, accumulation, storage, treatment, recycle, transport, and disposal) of hazardous waste, nonhazardous waste, underground storage tanks containing petroleum products and hazardous substances, and medical waste. Subtitle C of RCRA mandates that hazardous wastes be treated, stored, and disposed of in a matter that will minimize the threat to human health and the environment. To carry out this mandate, RCRA requires that owners and operators of hazardous waste treatment, storage, and disposal facilities obtain operating or post-closure care permits for certain waste management activities. RCRA defines the requirements for treatment, storage, and disposal facilities. Subtitle D of the law addresses the management of nonhazardous solid waste. Title 40 of the *Code of Federal Regulations* (CFR) implements the statutory provisions of RCRA. RCRA is a program that may be delegated to the States; such delegation has occurred for most States where DOE facilities are located.

Land Disposal Restrictions. The Hazardous and Solid Waste Amendments to RCRA enacted in 1984 required EPA to evaluate all listed and characteristic hazardous wastes according to a strict schedule and to develop requirements by which disposal of these wastes would be protective of human health and the environment. The implementing regulations for accomplishing this statutory requirement are established with the Land Disposal Restrictions (LDR) program. The LDR of RCRA (40 CFR 268) impose significant requirements on waste management operations and environmental restoration activities. For hazardous wastes restricted by statute from land disposal, EPA is required to set levels or methods of treatment that substantially reduce the waste's toxicity or the likelihood that the waste's hazardous constituents will migrate. After the LDR effective date, restricted wastes that do not meet treatment standards are prohibited from land disposal unless they qualify for certain variances or exemptions. EPA has promulgated standards for each of the five statutorily designated categories (40 CFR 268.31–35).

In addition to prohibiting disposal before appropriate treatment, land disposal restrictions prohibit any storage of land disposal restricted hazardous wastes (including mixed waste) except "for the purpose of the accumulation of such quantities of hazardous waste as are necessary to facilitate proper recovery, treatment, or disposal" (40 CFR 268.50). EPA has determined that storage of a hazardous waste pending development of treatment capacity does not constitute storage to accumulate sufficient quantities to facilitate proper recovery, treatment, or disposal.

Underground Storage Tank Provisions. The requirements for the facilities that use tank systems for storing or treating hazardous waste are outlined in 40 CFR 264, Subpart J. These requirements include the assessment of the existing tank system's integrity, the design and installation of new tank systems or components, and secondary containment. Hazardous wastes or treatment reagents are not placed in a tank system if they could cause the tank, its ancillary equipment, or the containment system to rupture, leak, corrode, or otherwise fail. Controls and practices to prevent spills and overflows from tank or containment systems are also required. Inspection requirements, procedures for response to leaks or spills, the disposition of leaking or unfit-for-use tanks, and closure and post-closure care requirements are also outlined in 40 CFR 264, Subpart J. Ignitable or reactive and incompatible hazardous wastes have special requirements.

Resource Conservation and Recovery Act Corrective Action Program. Hazardous waste permits require sites to institute corrective action programs for investigating and remediating Solid Waste Management Units. This program applies to all operating, closed, or closing RCRA facilities.

Federal Facility Compliance Act. The *Federal Facility Compliance Act* was passed in 1992. It waived sovereign immunity for Federal facilities and included provisions concerning DOE compliance with RCRA hazardous waste treatment for mixed waste. The *Federal Facility Compliance Act* requires DOE to have approved site-specific mixed waste treatment plans and related consent orders in place 3 years (October 1995) from the date of enactment in order to avoid the imposition of fines and penalties (except for sites already subject to a permit, agreement, or order addressing compliance with the RCRA LDR storage prohibition).

In an April 6, 1993, *Federal Register* (FR) notice (58 FR 17875), DOE published its schedule for submitting plans for treating mixed wastes for each facility at which DOE generates or stores mixed waste. Two interim versions of the plans were used to facilitate discussions among states and other interested parties. A subsequent consent order signed by the regulatory agency requires implementation of the final site treatment plan. For mixed waste for which identified treatment technologies exist, the plans provide a schedule for submitting permit applications, entering into contracts, initiating construction, conducting systems testing, starting operations, and processing mixed wastes. For mixed waste without an identified treatment technology, the plans include a schedule for identifying and developing technologies, identifying the funding requirements for research and development (R&D), submitting treatability study exemptions, and submitting R&D permit applications. In cases where DOE proposes radionuclide separation, the plans also provide an estimate of the volume of waste that would exist without such separation, and cost estimates and underlying assumptions. DOE will also prepare summary documents of the final plans to provide a national picture of DOE's technology needs and possible options for treatment of its mixed waste. The summaries will be provided to all states and made available to other interested parties.

Comprehensive Environmental Response, Compensation, and Liability Act. The *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), as amended by the *Superfund Amendments and Reauthorization Act* (SARA) of 1986, provides liability, compensation, cleanup, and emergency response for hazardous substances (including radionuclides) released to the environment. The cleanup of inactive waste disposal sites is one of the major requirements of CERCLA. It provides for prioritization of cleanup actions (National Priorities List [NPL] or Superfund List). Federal Facility Compliance Agreements are negotiated with EPA and the State to coordinate CERCLA and RCRA compliance activities in comprehensive strategies. CERCLA also requires public participation in the selection of remediation alternatives. Title III of CERCLA further requires that the National Response Center (operated by the U.S. Coast Guard) be notified in the event that a non-permitted release of a reportable quantity of hazardous substance or radionuclide occurs. In the case of such a release, the National Response Center alerts the appropriate Federal emergency personnel who assess the event, formulate response, and notify cognizant local emergency agencies. SARA requires industries to report the hazardous substances used at their facilities to include reporting inventories of these substances.

National Contingency Plan. The National Contingency Plan is an implementation regulation that sets forth requirements necessary to comply with CERCLA and SARA. For every site that is targeted for remedial response action under Section 104 of CERCLA, the National Contingency Plan requires that a detailed remedial investigation/feasibility study be conducted. The remedial investigation emphasizes data collection and site characterization. Its purpose is to define the nature, extent, and significance of contamination at a site in order to evaluate, select, and design a cost-effective remedial action. The feasibility study emphasizes analysis of data and decisionmaking; it uses results from the remedial investigation to develop response objectives and alternative remedial responses. These alternatives are then evaluated in terms of their engineering feasibility, public health protection, environmental impacts, and costs. The remedial investigation/feasibility study leads to a decision that sets forth the method selected for remedial action to clean up the NPL site. Under the provisions of CERCLA, Federal facilities have the lead for CERCLA actions.

Toxic Substances Control Act. The *Toxic Substances Control Act* (TSCA) was enacted in 1976 to ensure that the manufacture, sale, storage, and disposal of toxic chemical substances do not present an unreasonable risk of injury to health or the environment. Its applicability to DOE sites deals principally with the management and disposal of polychlorinated biphenyls (PCBs), asbestos, and dioxin. The problem created by radioactively-contaminated PCBs, asbestos, and dioxin is that currently there is a limited capability to treat these materials. Although the concentrations of radionuclides are relatively low, approximately 2 million pounds of radioactively-contaminated PCBs and PCB-contaminated material are destroyed annually by the K–1435 TSCA incinerator at the K–25 site (K–25) at the Oak Ridge Reservation (ORR).

Clean Air Act. The original *Clean Air Act* (CAA) was passed in 1955 and was wholly replaced by the *Air Quality Act* of 1967, although the name *Clean Air Act* is still used. It was reauthorized in 1990. The CAA establishes air quality requirements and pollutant emission limits. The National Emissions Standards of Hazardous Air Pollutants (NESHAP) is a section of the CAA that sets air quality standards for air emissions such as radionuclides, benzene, beryllium, and asbestos. NESHAP regulations require the use of EPA-approved monitoring instrumentation, sampling methodology, calculations, and modeling for each Federal facility.

Clean Water Act. The *Federal Water Pollution Control Act*, as amended by the *Clean Water Act* (CWA) of 1977, establishes a Federal/State scheme for controlling the introduction of pollutants into the Nation's waters. The CWA created the National Pollutant Discharge Elimination System (NPDES) program. This program regulates nonradiological effluent discharges to ensure that surface water bodies meet applicable water quality standards. Each discharge point (outfall) is permitted through the NPDES program. The CWA also requires permits for stormwater discharges.

Safe Drinking Water Act. The *Safe Drinking Water Act* (SDWA) was enacted in 1975 and is designed to protect drinking water resources. Primary drinking water standards set by SDWA apply to drinking water "at the tap" as delivered by public water systems. Of equal significance is that drinking water standards are used to determine groundwater protection regulations under a number of other statutes. The SDWA requires DOE to meet drinking water standards and complete sample analyses for DOE supplied drinking water at its sites. It also imposes requirements on installation and maintenance of drinking water wells.

Department of Energy Orders. The primary DOE Orders governing waste management are the following:

- DOE O 231.1, *Environment, Safety, and Health Reporting.* Establishes environmental protection program requirements, authorities, and responsibilities for DOE operations for assuring compliance with applicable Federal, State, and local environmental protection laws and regulations, Executive Orders, and internal department policies. Requires the preparation of waste minimization plans that describe how waste minimization activities will be promoted and implemented.

  [Text deleted.]

- DOE O 460.1, *Packaging and Transportation Safety.* Establishes the requirements for the packaging and transportation of hazardous materials, hazardous substances, and hazardous wastes.

  [Text deleted.]

- DOE Order 5820.A, *Radioactive Waste Management.* Establishes policies and guidelines by which DOE manages its radioactive waste, waste byproducts, and radioactively-contaminated surplus facilities.

E.1.3 WASTE MINIMIZATION AND POLLUTION PREVENTION

Waste minimization is the reduction, to the extent feasible, of radioactive and hazardous waste that is generated before treatment, storage, or disposal of the waste. Pollution prevention fully utilizes source reduction techniques in order to reduce risk to public health, safety, welfare, and the environment, and environmentally sound recycling to achieve these same goals. Each DOE site is required to have a Waste Minimization and Pollution Prevention Awareness Plan. To report progress towards their goals in the plan, each site prepares an Annual Report on Waste Generation and Waste Minimization Progress. When planning for facilities to be constructed by 2010, it will be necessary to consider currently available technology while providing modular, flexible designs that can incorporate process improvements as they become available. In accordance with Executive Orders 12856 and 12873, and DOE policy, the facilities that would support the long-term storage or disposition of weapons-usable fissile materials would be designed for waste minimization with an overall operating philosophy of pollution prevention. This waste minimization program would contribute to decreases in waste treatment, storage, and disposal costs and lower health risks to workers and the public. Technical approaches are being sought to optimize the number of production operations required, increase the use of nonhazardous chemicals and environmentally benign waste-producing chemicals, increase the use of recyclable chemicals and materials, and implement the new design or redesign of existing processes and products. Some criteria useful in determining successful technology include improved processing yield, reduced quantities of scrap, reduced waste and processing of byproducts, reduced use of hazardous chemicals, positive return on investment, and continued product quality.

E.1.4 WASTE TREATMENT, STORAGE, AND DISPOSAL

For the purpose of analyses, waste management activities that would support the Material Disposition Program are assumed to be per current site practice, although future management of the waste would be contigent in part upon decisions to be made in the Record of Decision (ROD) for the *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (Waste Management PEIS [DOE/EIS-0200-D]). Any future waste management facilities that may be required to support the Material Disposition Program would be coordinated with any decisions resulting from the Waste Management PEIS and any respective site-specific *National Environmental Policy Act* (NEPA) documentation.

Treated waste is waste that, following generation, has been altered chemically or physically to reduce its toxicity or prepare it for storage or disposal. Waste treatment can include volume reduction activities, such as incineration or compaction, that may be performed on a waste prior to storage or disposal, or both. Stored waste is waste that, following generation (and usually some treatment), is being temporarily retained in a retrievable manner and monitored pending disposal. Disposed waste is waste that has been emplaced to ensure its isolation from the environment, with no intention of retrieval. Deliberate action is required to regain access to the waste. Disposed wastes include materials placed in a geologic repository and buried in landfills.

Waste that is staged for processing would be stored according to its characterization and form. The disposal of waste from fissile material storage and disposition facilities would be managed by the DOE Office of the Assistant Secretary for Environmental Management (EM). A facility for disposal of retrievable and newly generated transuranic (TRU) waste near Carlsbad, New Mexico, is planned. All surface facilities at the Waste Isolation Pilot Plant (WIPP) have been completed. To date, only portions of the underground excavations have been completed. The remaining excavation would be completed once the facility is operational. Once operational, WIPP would become a permanent disposal site. The total projected capacity of WIPP is 175,543 cubic meters (m^3) (229,602 cubic yards [yd^3]), of which 7,080 m^3 (9,260 yd^3) can be remote-handled. A supplemental environmental impact statement (EIS) is being prepared for the proposed continued phased development of WIPP for disposal of TRU waste. This supplemental EIS will analyze the impacts of waste storage, characterization, certification, processing or treatment, and loading at the generator sites. It will also discuss the impacts of transportation of TRU waste between the generator sites and WIPP. The impacts of waste

disposal operations at WIPP will also be analyzed, including the impacts of waste receipt, waste package inspection, monitoring, emplacement, and subsequent activities associated with eventual closure, decommissioning, and institutional control of WIPP once disposal operations have been completed. Options for the interim storage of TRU waste are evaluated in the Waste Management PEIS. Yucca Mountain is a site being studied to determine its suitability for the disposal of commercial spent nuclear fuel and defense high-level waste (HLW). To date, no decisions to utilize either Yucca Mountain repository or WIPP have been made. The remainder of this section discusses some of the treatment, storage, and disposal options that may be utilized with the various waste streams from fissile material storage and disposition facilities.

Gaseous Waste. Gaseous wastes can be nonhazardous (for example, inert gases and air), hazardous (chlorinated hydrocarbon vapor and polyaromatic hydrocarbon vapor), or radioactive (for example, tritium and xenon). Hazardous gaseous wastes that are combustible may be incinerated to destroy the hazardous constituents, converting the combustibles into carbon dioxide and water vapor, while capturing any particulates that may result. When a particulate (ash) is contaminated with heavy metals, the end-product must be stabilized into an approved solid form suitable for disposal.

Gaseous radioactive wastes are held for interim storage in tanks; adsorbed on surfaces in filters, molecular sieves, or active beds; refrigerated and liquefied or solidified; or reacted to an aqueous solution. A minimal quantity of radioactive gas below the permitted limits will escape to the atmosphere because it is not possible to retain every atom of gas within the process with today's technology. The expected release of radioactive gases from the project alternatives is listed in Appendix M. Gaseous waste may be oxidized, mixed with other liquid wastes, or solidified in a stable form for long-term disposal. Reactive gases such as tritium are captured on reactive beds, in molecular sieves, or in cryogenic traps for recycling back to the process. Inert radioactive gases such as xenon and argon can be separated by cryogenic capture and held in storage tanks until they decay sufficiently to permit release. Gases that decay to metals can be captured on activated charcoal beds and held until they can be stabilized, packaged, and disposed of as solid waste. When sufficiently decayed, gases may be released to the atmosphere.

Liquid Waste. Liquid waste includes both wastewaters and nonwastewaters. Wastewaters are a mixture containing water together with organic, inorganic, or radioactive contaminants. Liquid radioactive wastes are processed according to their chemical nature and radiological sources and activities. Liquid wastes that meet release criteria in applicable regulations can be released at permitted discharge points. Where conditions permit, liquids can be processed and recycled to replace virgin feedstocks. Waste processing removes the hazardous or radioactive contaminants from the releasable or recyclable liquids. The largest volume of liquid radioactive waste is low-level waste (LLW), typically in aqueous solution from process operations. Some of this waste is contaminated with hazardous compounds such as solvents or resins, and the result is a liquid mixed waste. Liquid HLW would not be generated in fissile material storage and disposition facilities, but is part of the reference conditions at candidate sites where spent fuel or target processing was conducted. The desired final waste form for liquid wastes is a stable solid that is resistant to stresses from heat generation and from internal and external physical loads. The form must remain stable while stored and not allow the radioactive constituents to migrate to the surroundings.

Mixed waste often has combustible constituents. These are most readily decomposed in thermal treatment (incineration) or chemical reaction resulting in the creation of an ash. The resulting material would be granular and suitable for stabilization in a cemented form in which the hazardous constituents (radionuclides and heavy metal compounds) are bound in compounds that have an affinity for heavy metals and radionuclides. These processes have been utilized in various forms, and their retention properties have been credibly demonstrated.

Liquid LLW is normally processed to reclaim or remove the excess water, leaving a saturated salt solution. This can be accomplished by clarification processes normal to water treatment, or by evaporation. This usually results in the greatest volume reduction for liquid waste. The subsequent stabilization and solidification of the

concentrated solution results in a waste form that does not leach its active constituents for a time sufficient to allow the radioactive constituents to decay.

A method for stabilizing HLW for disposal is to process it into borosilicate glass casts within stainless steel cylinders. These are shock-resistant, elastic forms suitable for permanent disposal in an engineered repository. They also provide excellent retention during interim storage. In the preferred practice, the liquid waste stored in large tanks is pumped directly into the vitrification process where the liquid would be evaporated and the remaining salt would be fused with borosilicate into the glass waste form. In some processes (that is, at Idaho National Engineering Laboratory's [INEL] Idaho Chemical Processing Plant [ICPP]), the waste would be evaporated to calcine which is stored in a granular form for later processing. The disadvantage of this process is that airborne particulate matter is generated when the product is handled. The advantage is that the calcine can be stored safely in a stable form until it can be vitrified.

Liquid radioactive and hazardous wastes are usually stored in tanks where they are staged for further processing. Processes are employed to concentrate the hazardous constituents. These processes result in very significant volume reductions, with the reclaimed water processed to a purity sufficient for permitted discharge or recycle.

Liquid hazardous waste concentrates may contain combustive hydrocarbons and heavy metal contaminants. These can be treated by incineration to produce a dry waste. If this waste is still hazardous after treatment, it then can be processed into a stabilized solid that would not leach its hazardous constituents while in storage or in a disposal facility. Liquid low-level and noncombustible hazardous waste can also be processed into a stabilized solid form for storage and disposal.

Solid Waste. Solid radioactive wastes typically consist of contaminated materials (for example, filters, clothing, storage vessels, cleaning materials, and tools) that have been used in, or contaminated by, nuclear materials processing. The term is also applied to those stabilized forms resulting from gaseous or liquid waste processing. In solid waste handling, forms and materials would be segregated, combustibles could be incinerated, and the resultant materials would be reduced in volume, stabilized if necessary, and packaged in specified containers for storage or disposal.

HLW is stored at three of the sites considered for fissile material storage and disposition. It is stored as calcine granules at INEL in underground vaults, as liquids in tanks at Savannah River Site (SRS) and Hanford Site (Hanford). It would be processed to a glass/ceramic (at INEL) and borosilicate glass (at SRS), stored in an engineered facility onsite, and eventually shipped to a Federal repository.

Dry LLW that consists of protective clothing, containers, process materials, and equipment is stored in specified containers designed to retain the waste constituents for a time sufficient to permit decay of the radioactive constituents.

Solid hazardous wastes may contain combustible hydrocarbon compounds or mixtures with heavy metal contamination. These wastes are usually shipped to RCRA-permitted commercial facilities where they are treated, if required, and disposed of. Wastes that retain their hazardous constituents after processing must be packaged into forms that would retain the hazardous constituents safely within the waste form. For LLW or hazardous waste that results from liquid waste processing or incineration, the accepted form is solidification with a cement-like bonding agent.

Some mixed waste can be processed to remove its hazardous constituents and be disposed of as LLW. Otherwise, it can be processed into stabilized forms and packaged for storage in an engineered facility until a licensed facility is available for permanent disposal. Solid nonhazardous wastes from process wastewater evaporation ponds or from sanitary waste treatment plants are usually deposited as sludge in a landfill.

All DOE sites under consideration for fissile material storage and disposition facilities, except Pantex, either have or have planned an onsite LLW disposal facility. For the purposes of this programmatic environmental impact statement (PEIS), it was assumed that all LLW generated at the Pantex Plant (Pantex) would be shipped to the Nevada Test Site (NTS) per current practice. As shown in Table E.1.4–1, data from the DOE Integrated Data Base was used to calculate LLW disposal land usage factors from 1990 to 1993 for Hanford, INEL, SRS, and NTS. To determine a usage factor to use in the waste management impact analysis, an average value was calculated and then rounded down to the nearest hundred cubic meters. For the proposed Class II LLW disposal facility at ORR, a 3,300 m^3/hectares (ha) (1,700 yd^3/acres) usage factor was assumed (OR DOE 1995e:1).

Spent Nuclear Fuel. Spent nuclear fuel from the reactor-based fissile material disposition alternative would be stored within the fissile material disposition facility. The fuel would be kept in water-cooled storage until its decay heat had decreased sufficiently to permit dry storage. Several commercially available options for dry storage have been licensed by NRC, and the facilities required would be relatively small, utilizing a small percentage of the land area required for the fissile material storage and disposition facility. Spent nuclear fuel would not be reprocessed but would eventually be placed in a Federal repository. Spent nuclear fuel is not categorized with nuclear waste, and thus is not included in waste inventories. Since it is radioactive material that must be stored, managed, and handled, it is included here for each site to provide baseline information on its impact on land and facility use.

Table E.1.4–1. Low-Level Waste Disposal Land Usage Factors for Department of Energy Sites

Site	Total Cumulative Volume (m^3)	Estimated Area Utilized (ha)	Land Usage Factor (m^3/ha)
1993			
Hanford	601,610	171.8	3,502
NTS	458,435	174.2	2,632
INEL	147,084	32.3	4,554
SRS	665,239	67.9	9,797
1992			
Hanford	589,506	169.8	3,472
NTS	439,700	55.0	7,995
INEL	145,300	21.2	6,854
SRS	649,700	78.2	8,308
1991			
Hanford	582,800	167.8	3,473
NTS	419,600	55.0	7,629
INEL	145,300	21.2	6,854
SRS	636,700	78.2	8,142
1990			
Hanford	578,900	166.8	3,471
NTS	408,400	No Data	No Data
INEL	144,000	21.2	6,792
SRS	612,800	72.1	8,499
Average			
Hanford	NA	NA	3,480
NTS	NA	NA	6,085
INEL	NA	NA	6,264
SRS	NA	NA	8,687

Note: NA=not applicable.
Source: DOE 1991h; DOE 1992f; DOE 1994c; DOE 1994d.

E.1.5 TRANSPORTATION

The DOE complies with applicable Department of Transportation (DOT) regulations (10 CFR 71 and 49 CFR) when shipping hazardous materials over public roads. Transportation, especially for radioactive material, is highly regulated by Federal, State, and local laws. The stringent packaging requirements, combined with strict regulations and procedures governing the shipment of hazardous and radioactive material, ensure that transport is a safe activity. Federal DOT regulations require the use of appropriate warning placards on vehicles and labels on packages to alert workers, officials, and the public to the hazardous nature of the shipped material. The use of placards on vehicles and warning labels on packages is a joint responsibility of the carrier and the shipper. The labels and placards are familiar to emergency response personnel and are valuable in determining content and hazard information.

Shipments of hazardous materials, including radioactive materials, must be accompanied by properly completed shipping papers such as bills of lading and cargo manifests, which contain detailed information on the material being transported. These papers must be kept in the vehicle transporting the material and must be available for inspection by responsible officials at any time. The shipper must certify on the shipping papers that the hazardous material offered for transportation is properly classified, packaged, marked, labeled, and made ready for transportation according to all DOT regulations.

Radioactive material is shipped in secure packages. Type A packages are designed to contain small amounts of radioactive material and to withstand normal conditions of transport. Type A packages are subjected to rigorous water spray, free-fall compression, and penetration tests carried out in sequence to ensure that radioactive materials are contained. Type B packaging is designed to contain more hazardous, and larger amounts of, radioactive waste. It can withstand severe accident conditions and contain radioactive materials under any credible circumstance. Type B package rigorous testing conditions are discussed in Appendix G.

If WIPP is determined to be a suitable disposal facility for TRU and mixed TRU wastes pursuant to the requirements of 40 CFR 191 and 40 CFR 268, TRU wastes would be shipped in TRUPACT-II (contact-handled) and RH-72B (remote-handled) containers. No remote-handled waste is expected to be generated in any of the fissile material storage and disposition facilities. To determine the number of TRU waste shipments required, 8.7 m^3 (11.4 yd^3) per truck shipment, or if applicable, 17.5 m^3 (22.9 yd^3) per regular train shipment and 52.4 m^3 (68.6 yd^3) per dedicated train shipment was assumed (DOE 1994v:B-4). Transportation by rail may not be applicable at all sites.

As noted earlier, all sites being considered, except Pantex, either have or have planned an onsite LLW disposal facility. The additional shipments of LLW from Pantex as a result of locating fissile material storage and/or disposition functions at Pantex were estimated. All LLW would be transported in a solid form. A typical shipment consists of eighty 208-liter (l) (55-gallon [gal]) drums loaded into an enclosed semi-trailer type truck. Each drum is assumed to be fully loaded, resulting in a total shipment volume of 16.6 m^3 (21.7 yd^3). The truck is assumed to operate as an "exclusive-use" vehicle.

E.1.6 FACILITY TRANSITION MANAGEMENT

Any transition activities of facilities from a production mode to a cleanup mode that are part of the baseline for this PEIS are discussed in the facility impacts section of Chapter 4 and in Section E.2. Decontamination and decommissioning (D&D) considerations of fissile material disposition facilities have been planned for in the design.

The DOE Program Secretarial Officer is responsible for the safe operation, shutdown, and ultimate disposition of facilities used to support his or her program. EM is responsible for final facility disposition, which may include D&D of inactive facilities or refurbishing them for further economic development. Transition activities would require appropriate NEPA evaluation and would proceed consistent with the PEISs within the DOE

Offices of Environmental Management (EM), Defense Programs, and Materials Disposition. Depending on the site, facility transition activities are in different stages of planning. The dominant time-intensive activities are characterizations of the environmental hazards related to the building and the deactivation of the facility.

At the end of their useful lives, all potential facilities would require decommissioning. The transition process begins when DOE management decides to stop operating the facility and ends when responsibility for the facility is formally turned over to EM. Transition plans would be required for all facility transfers to EM. These plans define the actions necessary to bring the identified facilities into a condition acceptable for transfer to EM. Some facility transition issues raised in EM's scoping process for its PEIS, and which would be considered in the facilities design process, are the following:

- Land-use criteria defined for the period after cleanup
- Interim storage of mixed waste and spent nuclear fuel
- Disposal facilities for hazardous and LLW

The cleanup of fissile material storage and disposition facilities would be significantly less difficult because consideration for waste minimization and ease of decontamination would be included in the facility design. The surfaces that come in contact with potential contaminants would be easier to decontaminate. In-process decontamination (to reduce operational exposures) would significantly reduce the cleanup required at the end of life.

In spite of the best design and process practices, many of the fissile material storage and disposition facilities would require decontamination efforts at the end of life. Because of the necessity of working inside contaminated areas during the cleanup phase, the potential for exposure to cleanup workers is higher than during the operations phase. Workers would wear protective clothing and would be supplied breathing air to minimize their exposure.

Technologies for cleanup are established and are improving as experience in working with nuclear facilities increases. The use of robotics, improved task planning, and new materials to prevent the spread of contamination have already improved current cleanup activities. By the time the fissile material storage and disposition facilities are decommissioned, DOE would have gained considerable cleanup experience; thus, further improvements should be expected.

E.2 WASTE MANAGEMENT ACTIVITIES

E.2.1 HANFORD SITE

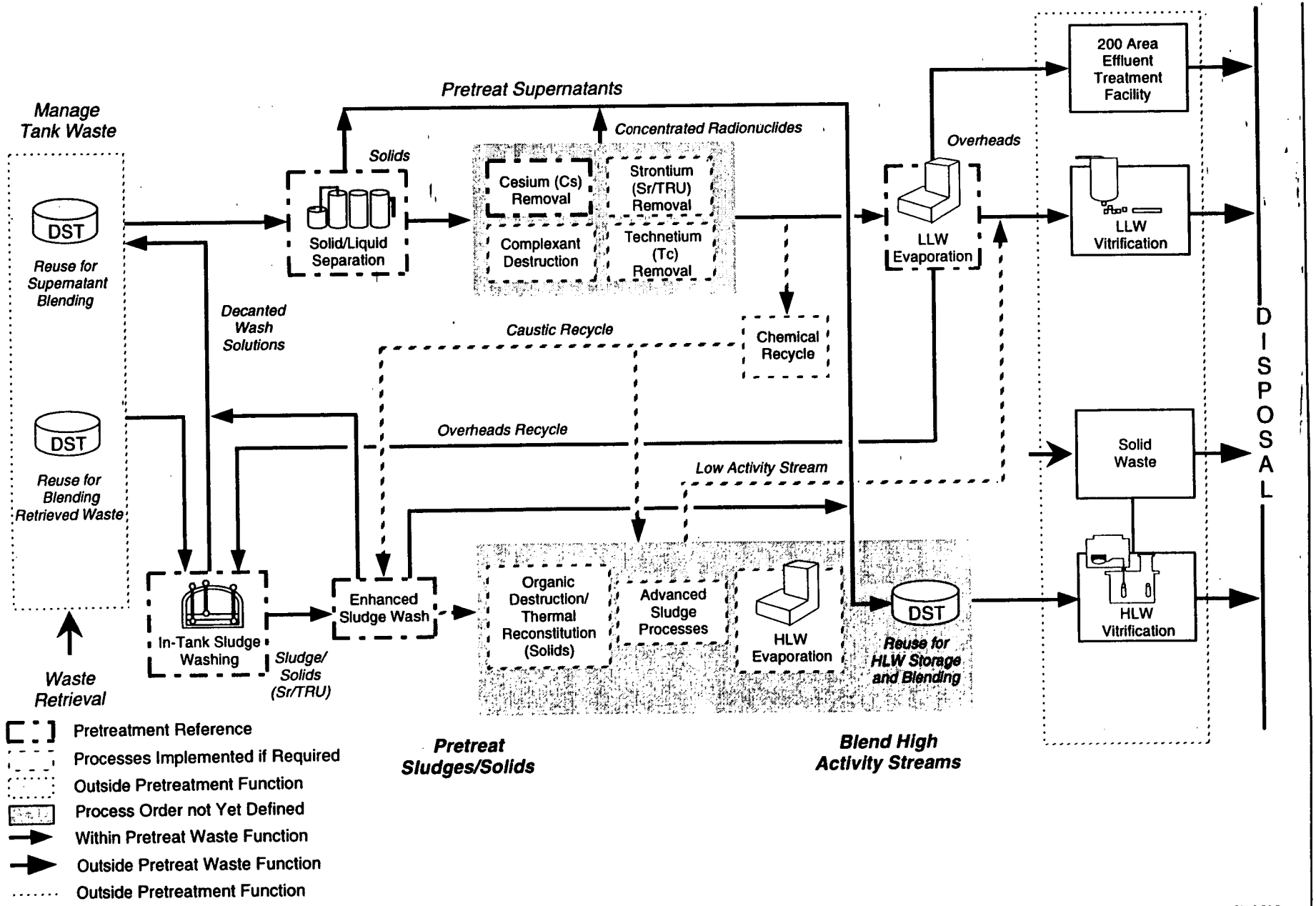
Established in 1943, Hanford facilities were primarily dedicated to the production of weapons-grade plutonium (Pu) and management of the wastes generated by defense activities. In later years, these missions were expanded to include increasingly diverse programs involving R&D for advanced reactors, renewable energy technologies, waste disposal technologies, and the cleanup of contamination from past activities.

Today, production of enriched fuel at Hanford reactors and recovery of Pu no longer occur. Hanford's primary mission is the cleanup of the site. On May 15, 1989, DOE, the Washington State Department of Ecology, and the EPA signed the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), an agreement to clean up radioactive and chemical waste at the site over the next 30 years. It contains a blueprint for the cleanup and uses enforceable milestones to keep the program on schedule. The Tri-Party Agreement negotiations—completed in 1993 and approved in January 1994—changed and added many new milestones. Most of the changes were related to the tank waste remediation system.

The waste management program accounts for the majority of lifecycle costs at Hanford. Much of the emphasis is placed on tank waste, which, when processed, will yield vitrified HLW and LLW fractions. Waste management programs at Hanford are divided into five key areas: (1) the tank waste remediation system program managing HLW, (2) spent nuclear fuel storage at the K-Basins and other locations, (3) cesium (Cs) and strontium capsule management at the waste encapsulation and storage facility at B-Plant, (4) liquid waste management, and (5) solid waste management. Each waste management program is described in the discussions that follow with regard to treatment, storage and handling, and disposal activities associated with spent nuclear fuel and the following waste categories: high-level, TRU, low-level, mixed, hazardous, and nonhazardous. Figure E.2.1–1 depicts tank waste management at Hanford.

Pollution Prevention. Radioactive, hazardous, and mixed wastes are treated, stored, or disposed of at Hanford. The total amount of waste generated and disposed of at Hanford has been, and is being, reduced through the efforts of the pollution prevention and waste minimization programs at the site. The Hanford Site Pollution Prevention Program is an ambitious program aimed at source reduction, product substitution, recycling, surplus chemical exchange, and waste treatment. The program is tailored to meet Executive Order 12780, DOE Orders, RCRA, and EPA guidelines. All wastes at Hanford, including radioactive, mixed, hazardous, and nonhazardous regulated wastes, are included in the Hanford Pollution Prevention Program. Reductions in the volumes of radioactive wastes generated have been achieved through methods such as intensive surveying, waste segregation, recycling, and the use of administration and engineering controls.

Spent Nuclear Fuel. [Text deleted.] Two spent nuclear fuel EISs were prepared that will eventually define the management of spent nuclear fuel at Hanford. The first is the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Program Final Environmental Impact Statement* (DOE/EIS-0203-F) referred to in Section 4.2.1, which led to a ROD published in June 1995 (60 FR 28680) and amended in March 1996 (61 FR 9441). That ROD specifies what spent nuclear fuel will be managed at Hanford, INEL, and SRS. Hanford production reactor fuel will remain at Hanford. As of 1995, Hanford has 2,133 metric tons (t) (2,351 short tons [tons]) or 81 percent of the total DOE existing spent fuel inventory. The published ROD projects 12 shipments (either truck or rail) of non-Hanford production reactor spent fuel will be sent to INEL. Each shipment, either by truck or by rail, was assumed to consist of one shipping container. Hanford would not receive any additional fuel. As a result of this action, and assuming no final disposition, by the year 2035 Hanford would have 2,132 t (2,350 tons), or 78 percent, of the total existing DOE redistributed and newly generated inventory in the form of production reactor spent nuclear fuel (61 FR 9441).



Note: DST=Dual Storage Tanks
Source: HF DOE 1995d.

2805/S&D

Figure E.2.1–1. Tank Waste Management at Hanford Site.

A follow-on tiered, site-specific NEPA analysis for the management of the spent nuclear fuel from the K-Basins was published in the January 1996, *Final Environmental Impact Statement on the Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, Richland, Washington* (DOE/EIS-0245). Based on the analysis a ROD was published in March 1996 (61 FR 10736). The decision consists of removing the spent nuclear fuel from the basins, vacuum drying, conditioning and sealing the spent nuclear fuel in inert-gas filled canisters for dry vault storage in a new facility, to be built at Hanford, for up to 40 years pending decisions on ultimate disposition. The K-Basins will continue to be operated during the period over which the decision is implemented. If possible, the basin sludge will be transferred to the double-shell tanks for management. If not possible, the basin sludge will continue to be managed as spent nuclear fuel, or disposed of as solid TRU waste. Non-spent nuclear fuel debris will be disposed of in the low-level burial ground at Hanford. The spent nuclear fuel will be loaded in multicanister overpacks that are already in transportation casks, then the multicanister overpacks will be drained and vacuum dried.

Spent nuclear fuel is presently located in 11 facilities at Hanford: 105-KE and 105-KW basins in the 100 Area at the north end of Hanford; T-Plant, LLW burial grounds, and Plutonium Finishing Plant (PFP) in the 200 West Area; Plutonium and Uranium Recovery through Extraction (PUREX) Plant in the 200 East Area; Fast Flux Test Facility (FFTF) in the 400 Area; and Buildings 308, 324, 325, and 327 in the 300 Area at the southeast corner of the site (DOE 1995o:3-3). A summary of the inventory of spent nuclear fuel is shown in Table E.2.1–1.

As of December 1994, the following spent nuclear fuel and associated facilities are at Hanford:

- **N-Reactor Spent Nuclear Fuel.** Zirconium-alloy-clad metallic uranium fuel stored in water in the 105-KW and 105-KE basins and exposed to air in the PUREX Plant dissolver cells A, B, and C.

- **Single-Pass Reactor Spent Nuclear Fuel.** Aluminum-clad metallic uranium fuel stored in water in the 105-KE and 105-KW basins and stored in water in the PUREX Plant basin.

- **Shippingport Core II Spent Nuclear Fuel.** Zirconium-alloy-clad uranium dioxide fuel stored in water in T-Plant canyon pool cell 4.

- **Fast Flux Test Facility Spent Nuclear Fuel.** Stainless steel-clad fuel stored in liquid sodium at the FFTF, consisting mostly of Pu and uranium oxide fuel, but also uranium and Pu metals, and carbide and nitride fuel.

- **Miscellaneous Commercial and Experimental Spent Nuclear Fuel.** Consisting mainly of zirconium-alloy-clad uranium dioxide fuel stored in air in Buildings 324, 325, and 327; training, research, and isotope reactors (built by General Atomics [TRIGA]) fuel stored in water in Building 308; miscellaneous fuel stored in air-filled shielded containers at the 200 West Area burial grounds; and aluminum-clad, uranium-aluminum alloy fuel stored in air in the PFP.

Hanford has developed a *Site Integrated Stabilization Management Plan* (WHC-EP-0853, August 1995) identifying the plans for placing spent nuclear fuel and other Pu-bearing materials in safe interim storage.

High-Level Waste. HLW at Hanford was generated from the reprocessing of production reactor fuel for the recovery of Pu and uranium for defense and other national programs of spent reactor fuel and irradiated targets. HLW has been accumulating at Hanford since 1944. Most of this HLW has undergone one or more treatment steps (for example, neutralization, precipitation, decantation, or evaporation) and will eventually require incorporation into a stable, solid medium (for example, glass) for final disposal. The HLW came from many different processes and sources and has been processed and transferred among tanks so that chemical and physical characteristics of the wastes vary greatly among tanks and even within individual tanks.

Hanford HLW is stored in underground carbon-steel tanks and consists of alkaline liquid, sludge, and salt cake in single-shell tanks; slurry in double-shell tanks; and Cs and strontium (Sr) salts in double-metal alloy capsules. HLW, TRU waste, and liquid mixed LLW were stored in single-shell tanks. These tanks eventually developed leaks and double-shell tanks were built to replace them. Liquids were drawn from the single-shell tanks, concentrated, and pumped to the double-shell tanks to be held for further processing. Sludge, salt cake, and interstitial liquid remains in the single-shell tanks, as they are not readily retrievable. Plans to remove and process this waste are being made. Some of these tanks presented special hazardous conditions because of the generation of explosive gases or the generation of excessive heat that required the addition of water for active cooling, while the tank continues to leak. These "watch list tanks" are being continuously monitored, and remedies are provided until such time as the waste can be removed and processed. There is not sufficient volume in the double-shell tanks to handle the process storage requirements for cleanup of the single-shell tank waste. Additional double-shell tanks and other liquid storage facilities are being designed, and processes are being developed to treat these wastes for disposal. The management and disposition of Hanford's tank waste, and encapsulated strontium and cesium will be in accordance with decisions resulting from the *Final Environmental Impact Statement for the Tank Waste Remediation System* (DOE/EIS-0189).

Between 1956 and 1990, the PUREX Plant processed irradiated reactor fuel to extract Pu and uranium. The PUREX process was a solvent extraction process that used a tributyl phosphate in a kerosene-like solvent for recovering uranium and Pu from nitric acid solutions of irradiated uranium. The waste from the PUREX process was placed in double-shell tanks after 1970. In December 1992, DOE decided to deactivate the PUREX Plant.

All wastes contained in double-shell tanks consist of mixtures of HLW, TRU waste, and LLW, and are managed as if they contain HLW. The aging waste storage unit comprises four double-shell tanks in the 241-AY (Tanks 241-AY-101 and -102) and 241-AZ (Tanks 241-AZ-101 and -102) tank farms in the 200 East Area of Hanford.

There are currently 261,700 m^3 (342,291 yd^3) of HLW stored as alkaline liquid (24,900 m^3 [6.5 million gal]), sludge (46,000 m^3 [60,166 yd^3]), and salt cake (93,000 m^3 [121,639 yd^3]) in single-shell tanks; slurry (97,800 m^3 [127,918 yd^3]) in double-shell tanks; and as Cs and Sr salts in double-metal alloy capsules (DOE 1994c:48). The single-shell tank wastes make up 95 percent of the Hanford mixed HLW. The single-shell tanks consist of 149 tanks containing approximately 136,600 m^3 [178,666 yd^3] of waste (HF DOE 1995d:3-14). The wastes in the single-shell tanks are multi-phased: most is sludge with interstitial liquids; some is in the form of crystalline solids, along with some supernatant liquids.

Eighty-three of the single-shell tanks are located in the 200 West Area and 66 are in the 200 East Area. One hundred thirty-three of the tanks are 22.9 meters (m) (25 yards [yd]) in diameter with nominal capacities between 2,000 and 3,800 m^3 (2,616 and 4,970 yd^3). Sixteen tanks are 6.1 m (7 yd) in diameter with capacities of 210 m^3 (275 yd^3). The single-shell tanks wastes are scheduled under the Tri-Party agreement to be retrieved and vitrified in the same manner as the double-shell tanks wastes. The single-shell tanks will be closed in accordance with schedules negotiated in the Tri-Party Agreement.

Twenty-eight double-shell tanks, each with a 4,300 m^3 (5,624 yd^3) capacity, stored 78,706 m^3 (102,944 yd^3) of waste as of December 31, 1994. The double-shell tanks do not simply accumulate and store waste; the tanks are a waste-handling system. The inflows to the double-shell tank system include supernate and interstitial liquids pumped from single-shell tanks, laboratory wastes, dilute wastes from across Hanford, and waste from inactive facilities. Outflows include waste destined for evaporation and future pretreatment and vitrification processes. Evaporation decreases the double-shell tank waste volume; pretreatment and vitrification remove double-shell tank waste and prepare it for disposal. The wastes in double-shell tanks consist of solids and liquids. Typically, the solids fraction has settled out as a sludge layer. LLW, TRU waste, and HLW are further designated as ignitable, corrosive, toxic, persistent, and carcinogenic extremely hazardous waste. Many RCRA-listed waste codes are also present. Because of heavy metals contamination, double-shell tank waste also is designated as toxic by the toxicity characteristic leaching procedure. Treatment plans are to recover the contents of the tanks, separate the waste into high- and low-level fractions, and immobilize them for disposal. The TRU and high-

level fractions will be vitrified for disposal in a geologic repository; the low-level fraction would be disposed of onsite in near-surface retrievable disposal vaults covered with a thick earthen barrier following evaporation and vitrification. The 242-A evaporator is a key unit in volume minimization with this process. This unit was out of service but was restarted in April 1994 after upgrades were completed. The 242-A evaporator will be replaced by the 242-H evaporator when the new liquid effluent retention facility has been completed, replacing the practice of discharge of evaporator effluent to the soil column.

Cesium and strontium salts in double-metal alloy capsules (commonly referred to as cesium [Cs-137] and strontium [Sr-90] capsules) are part of the current HLW inventory. From 1968 to 1985, most of the high-heat-emitting nuclides (Sr-90 and Cs-137, plus their daughter products) were extracted from the old tank waste, converted to solids (strontium fluoride and cesium chloride [CsCl]), placed in double-walled metal cylinders (capsules) about 50 centimeters (cm) (20 inches [in]) in length and 5 cm (2 in) in diameter, and stored in the Waste Encapsulation and Storage Facility in water-filled pools.

The total number of Cs capsules produced is 1,577. As of August 19, 1993, the number of known dismantled Cs capsules is 249. These have been put to beneficial use and are not expected to be returned. The total number of remaining capsules requiring disposal is 1,328. Of the 1,328 remaining capsules, 959 are in storage at Hanford and 369 capsules have been leased for beneficial use. One of these capsules developed a small leak, and others have shown signs of bulging, so current plans are to bring all leased capsules back to Hanford (DOE 1995o:4-119).

The total number of Sr capsules produced is 640. As of August 19, 1993, the number of known dismantled Sr capsules was 35. These have been put to beneficial use and are not expected to be returned. The total number of remaining capsules requiring disposal is 605. Of the 605 remaining capsules, 601 are in storage at Hanford, and 4 have been leased offsite for beneficial use (DOE 1995o:4-119).

Therefore, at present 1,328 Cs capsules (2.47 m^3 [3.23 yd^3]) and 605 Sr capsules (1.08 m^3 [1.41 yd^3]) require storage. Nine hundred and fifty-nine Cs capsules and 601 Sr capsules are stored in pools of water in the Waste Encapsulation and Storage Facility. The capsules will be stored at Hanford until they can be transported to a proposed national repository (DOE 1995o:4-120). Tables E.2.1–2, E.2.1–3, and E.2.1–4 list HLW inventories and treatment and storage facilities at Hanford.

Transuranic Waste. TRU waste is primarily generated by R&D activities, Pu recovery, environmental restoration, and D&D. Most TRU waste is in solid form (for example, protective clothing, paper trash, rags, glass, miscellaneous tools, and equipment). Some TRU waste is in liquid form (sludges) resulting from chemical processing for recovery of Pu or other TRU elements.

Before 1970, all DOE-generated TRU waste was disposed of onsite in shallow, unlined trenches. From 1970 to 1986, TRU wastes were segregated from other waste types and disposed in trenches designated for retrieval. Since 1986, all TRU waste has been segregated and placed in retrievable storage pending shipment and final disposal in a permanent geologic repository.

Currently, all TRU wastes are stored in above-grade storage facilities in the Hanford Central Waste Complex and Transuranic Waste Storage and Assay Facility. The plan is to ship the stored TRU waste to WIPP near Carlsbad, New Mexico, for final disposal once WIPP can demonstrate compliance with 40 CFR 191 and 40 CFR 268. Current planning calls for all shipments to WIPP to be managed through module 1 of the Waste Receiving and Processing Facility or the proposed module 2B of the Waste Receiving and Processing Facility. If WIPP proves unsatisfactory as a TRU waste disposal facility, then another disposal facility would be selected. Should additional treatment be necessary for the disposal of TRU wastes, then Hanford would develop the appropriate treatment capability. Table E.2.1–5 lists the TRU and mixed TRU waste inventories. Tables E.2.1–6 and E.2.1–7 present the TRU and mixed TRU waste treatment and storage facilities at Hanford.

Low-Level Waste. From 1944 to 1991, approximately 558,916 m^3 (731,034 yd^3) of LLW was buried at Hanford (DOE 1995o:4-123). Between 1944 and 1986, no differentiation was made between LLW and mixed LLW.

Solid LLW is currently placed in unlined, near-surface trenches at the 200 Area LLW Burial Grounds. The site continues to receive LLW from offsite generators for disposal. Major sources of this waste are the Puget Sound Naval Shipyard in Washington, Brookhaven National Laboratory in New York, and Lawrence Berkeley Laboratory in California. Other points of origin include DOE facilities at nuclear power stations in Shippingport, Pennsylvania; Bechtel in Albany, Oregon; and Wood River in Charleston, Rhode Island. U.S. Ecology operates a licensed commercial LLW burial ground at Hanford on a site that is leased to the State of Washington. Although physically located on Hanford, it is not considered part of Hanford. The commercial LLW burial ground site area comprises 40 ha (99 acres), of which 29.5 ha (73 acres) are considered usable, with 11.9 ha (29 acres) used by the end of 1991. Through 1991, 338,500 m^3 (442,741 yd^3) of LLW had been disposed of at this site (DOE 1995o:4-123).

The LLW resulting from the tank waste remediation system waste pretreatment program will be vitrified by the end of 2035, under the tank waste remediation system LLW (vitrification) program. As a near-term contingency, the grout facility will be maintained in a standby condition. The program will utilize commercially available melters and other key processing technologies as much as possible. The program has contracts in place with several commercial melter vendors, and melter tests with Hanford waste simulants are currently being conducted. From the results of these tests, the reference melter and reference low-level glass formulation will be selected and incorporated into the design of the LLW vitrification facility. The current program baseline calls for the following: (1) initiation of hot operations of the LLW vitrification facility by June 2005 and (2) completion of vitrification of Hanford tank LLW by December 2035. The vitrified LLW will be disposed of onsite in the 200 Areas at Hanford by the tank waste remediation system program.

Mixed Low-Level Waste. Mixed LLW includes a variety of contaminated materials, including air filters, cleaning materials, engine oils and grease, paint residues, photographic materials, soils, building materials, and decommissioned plant equipment. The following special nuclear material production and site restoration activities have generated, or may generate, mixed waste:

- Fabrication of reactor fuel elements
- Operation of the production reactors
- Processing of irradiated fuel
- Separation and extraction of Pu and uranium
- Preparation of Pu metal
- Environmental restoration
- R&D support projects
- Maintenance and operations support

Between 1987 and 1991, 16,745 m^3 (21,901 yd^3) of mixed LLW were buried at Hanford (between 1944 and 1986, no differentiation was made between LLW and mixed LLW). Another 4,225 m^3 (5,526 yd^3) of mixed waste has been accumulating in storage in the Central Waste Complex, located in the 200 West Area (DOE 1995o:4-123).

Hanford also receives defueled submarine reactor compartments that are contaminated with PCBs and lead. These compartments are managed as mixed waste. In 1993, seven defueled submarine reactor compartment disposal packages were received and placed in Trench 94 of the 200-East Area LLW waste burial grounds. The Naval Nuclear Propulsion Program will prepare an EIS for its proposal to bury additional reactor compartments at Hanford. As of November 1993, there were a total of 35 submarine reactor compartments stored in Trench 94.

In 1993, 5,260 m^3 (6,880 yd^3) of mixed LLW were generated. The 78 mixed LLW streams at Hanford make up 85,000 m^3 (111,175 yd^3) of the mixed LLW. Ninety-six percent of the total is beta/gamma-emitting waste, mostly in the form of aqueous liquid in the double-shell tanks. One stream (double-shell tank miscellaneous waste) accounts for 40,000 m^3 (52,318 yd^3) of the mixed LLW, and in combination, the double-shell tank double-shell slurry feed, double-shell tank complex concentrate, and double-shell tank double-shell slurry make up another 34,500 m^3 (45,124 yd^3). Three mixed LLW streams related to the 183-H solar evaporation basin cleaning contain 2,500 m^3 (3,269 yd^3) (DOE 1995o:4-121). These inorganic sludge/particulate wastes have been neutralized and treated for packaging.

It is expected that 49 percent of all the mixed LLW at Hanford cannot be treated until the technology is modified or verified. The remaining 51 percent is to be processed through the 242-A Evaporator (a closed system in which distillates are passed through an ion-exchange system to remove Cs). Treatment for these wastes is being evaluated as part of the design of the Effluent Treatment Facility (ETF) and the Waste Receiving and Processing Facility. The Waste Receiving and Processing Facility, to be located near the Central Waste Complex, would provide size reduction, decontamination, condensation, melting, amalgamation, incineration, ash stabilization, and shipping for Hanford mixed waste. The Waste Receiving and Processing Facility will be constructed in two phases: module 1 and module 2 (2A and 2B). The separation of module 2 into the 2A and 2B components has not been formally approved through the Tri-Party Agreement change request process. Module 1 will be designed to prepare retrieved and stored TRU and would be operational in 1999. Module 2A, or the proposed commercial treatment alternative, would be designed to process LLW, TRU wastes, mixed LLW, and mixed TRU wastes, and would be operational in 1997. Module 2B, if authorized, would be designed to process LLW, TRU wastes, mixed LLW, and mixed TRU wastes with a dose rate greater than 200 millirem (mrem)/hour (hr). Module 2B has an undetermined startup date. Other technologies and plans are also being considered and will be the subject of appropriate NEPA documentation during the selection process. In a recent modification to the Tri-Party Agreement, DOE has agreed to begin design of a vitrification facility to treat liquid mixed LLW in the future.

[Text deleted.]

The RCRA components of mixed waste at Hanford are mainly the following listed wastes: D002B (alkaline liquids, 22 streams), D006B (cadmium, 29 streams), D007 (chromium, 34 streams), D008B (lead, 30 streams), and F003 (nonchlorinated solvents, 30 streams). Waste sources are primarily the separation and extraction processes that were used to produce special nuclear material. Inventory, treatment, disposal, and storage facilities for LLW and mixed LLW are listed in Tables E.2.1–8, E.2.1–9, E.2.1–10, and E.2.1–11.

Hazardous Waste. Hazardous wastes are categorized by Washington Administrative Code, *Dangerous Waste Regulations*, as dangerous waste and extremely hazardous waste. As of March 15, 1993, Hanford contained 64 interim-status treatment, storage, or disposal units. Present plans are that final RCRA permits will be sought for 24 of these 64 units, 34 units will be closed, and 6 units will be dispositioned through other regulatory options. Future circumstances may cause these numbers to change. The treatment, storage, or disposal units within the Hanford facility include, but are not limited to, tank systems, surface impoundments, container storage areas, waste piles, landfills, and miscellaneous units. Other RCRA permits, such as research, development, and demonstration permits (for example, the 200 Area Liquid ETF), are also being pursued. A summary of the hazardous waste treatment and storage facilities at Hanford is shown in Tables E.2.1–12 and E.2.1–13.

The principal present waste management practice for newly generated hazardous waste is to ship it offsite for treatment, recycling, recovery, and disposal. Table E.2.1–14 lists the hazardous waste quantities shipped offsite

in 1994. The Nonradioactive Dangerous Waste Storage Facility (Building 616) and the 305-B waste storage facility are the only active facilities storing hazardous waste (other than the less-than-90-day storage areas and two boxes (one containing mixed and one containing hazardous waste) stored in the 222-S laboratory complex).

Nonhazardous (Sanitary) Waste. Onsite treatment facilities (such as septic tanks, subsurface soil absorption systems, and a sanitary treatment plant) treat an average of 0.60 million l (0.158 million gal) of sewage per day (DOE 1995cc:4-55). The 200 Area Treated Effluent Disposal Facility industrial sewer will collect the treated wastewater streams from various plants in the 200 Areas and dispose of the clean effluent at two new 20,235-square meters (m^2) (5-acre) ponds permitted by the State of Washington. The 300 Area Treated Effluent Disposal Facility provides collection, treatment, and disposal for laboratory wastewater, boiler blowdown, steam condensate, spent softener regenerant, and heating, ventilation, and air conditioning generated in the 300 Area. The treated wastewater is discharged to the Columbia River under the conditions of a NPDES permit. Solid wastes are disposed of in the 600 Area Central Landfill. Coal waste is disposed of in landfills near the 200 East and 200 West Area powerhouses. A quantity of 246,051,000 l (64,999,793 gal) of liquid sanitary waste and 43,006 m^3 (56,249 yd^3) of solid sanitary waste are estimated to be generated each year at Hanford.

Other Nonhazardous Wastes. Solid wastes are generated in all areas of Hanford. Nonhazardous solid wastes include the following:

- Construction debris, office trash, cafeteria waste/garbage, empty containers and packaging materials, medical waste, inert materials, bulky items such as appliances and furniture, solidified filter backwash and sludge from the treatment of river water, failed and broken equipment and tools, air filters, uncontaminated used gloves and other clothing, and certain chemical precipitates such as oxalates
- Nonradioactive friable asbestos (regulated under CAA)
- Ash generated from powerhouses
- Nonradioactive demolition debris from decommissioning projects

The active Hanford Site Solid Waste Landfill, located in the 200 Area, began operation in 1973. In 1992, 22,213 m^3 (29,053 yd^3) of solid waste and 1,017 m^3 (1,330 yd^3) of asbestos were deposited in the solid waste section of the landfill (DOE 1995o:4-127). Pit 10 was opened for disposal of inert material as defined in Washington Administrative Code 173-304, and 11,389 m^3 (14,896 yd^3) of waste were disposed of there. The landfill is currently scheduled for closure in 1997.

Table E.2.1–1. Spent Nuclear Fuel Inventory at Hanford Site

Storage Facility	Spent Nuclear Fuel Source/Type	1995 Heavy Metal Volume (m^3)	1995 Discharged Heavy Metal (t)[a]
Area 200	Miscellaneous Fuel Residues	21.77	0.33
Bldg. 308	Training Reactor Isotopes, General Atomics	0.08	0.02
Bldgs. 324,325, 327	DOE and Commercial Fuel	1.30	2.30
Fast Flux Test Facility	Fast Flux Test Facility driver fuel, assemblies and test driver fuel assemblies	16.51	11.01
PUREX	N-Reactor Mark and 1A Fuel	0.23	3.14
T-Plant	Shippingport PWR Core II	9.45	15.82
105-K East Basin	N-Reactor	112.05	1,146.34
105-K West Basin	N-Reactor	93.22	953.89
Hanford Mass Total		254.61	2,132.85

[a] For spent fuel, mass is reported to provide better assurances of accountability. Spent fuel is reported in units of metric tons of initial heavy metal (original mass of the actinide elements of the fuel) to avoid difficulties and confusion arising from the need to estimate ranges of varied heavy-metal content that result from different levels of enrichment and reactor fuel burnup.

Source: DOE 1995kk.

Table E.2.1–2. High-Level Waste Inventory at Hanford Site

Waste Matrix	Number of Waste Streams	Inventory as of December 31, 1994 (m^3)	Number of Waste Streams, 5-Year Projection	Total Generation, 5-Year Projection (m^3)
Remote-Handled				
Aqueous liquids slurries	8	64,507	4	89,116
Organic liquids	2	14,194	1	2,029
Inorganic process residues	1	160,240	1	0
Total	11	238,941	6	91,145

Source: DOE 1995gg.

Table E.2.1–3. High-Level Waste Treatment Facilities at Hanford Site

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
242-A Evaporator	Evaporation, ion exchange (Cs removal)	HLW aqueous liquid	HLW sludge, salt, slurry	50,000	The 242-A was restarted April 1995 after upgrades were completed.
Waste Vitrification Plant	Vitrification	HLW aqueous slurry liquid, inorganic sludge/particulate	HLW solid borosilicate glass	2,190	Planned available 1999
244 AR Vault	Liquid/solid separation (decanting) pretreatment of PUREX HLW and neutralized cladding removal waste	HLW, mixed TRU liquid sludge, contact- handled, corrosive, TCLP	HLW sludge to vitrification at the Hanford Waste Vitrification Plant, HLW supernate to B-Plant polishing filtration	Planned	Planned but not funded.

[a] For those facilities in use a normal operating capacity; whereas, for facilities under design or construction this is a design capacity. Schedules and capacities for facilities under or construction are subject to changes based on the availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1993h; DOE 1994k; DOE 1995gg.

Table E.2.1–4. High-Level Waste Storage Facilities at Hanford Site

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
241-AN Tank Farm	HLW, mixed LLW, mixed-TRU corrosive, TCLP, ignitable, listed, reactive liquid sludge	30,410	Operational
241-AP Tank Farm	HLW, mixed LLW, mixed-TRU corrosive, TCLP, ignitable, listed, reactive liquid sludge	34,640	Operational
241-AW Tank Farm	HLW, mixed LLW, mixed-TRU corrosive, TCLP, ignitable, listed, reactive liquid sludge	25,980	Operational
241-AY Tank Farm	HLW, mixed LLW, mixed-TRU corrosive, TCLP, ignitable, listed, reactive liquid sludge	7,570	Operational
241-AZ Tank Farm	HLW, mixed LLW, mixed-TRU corrosive, TCLP, ignitable, listed, reactive liquid sludge	7,570	Operational
241-SY Tank Farm	HLW, mixed LLW, mixed-TRU corrosive, TCLP, ignitable, listed, reactive liquid sludge	12,990	Operational

[a] Schedules and capacities for facilities under design or construction are subject to changes based on the availability of funds and permit issuance.

Source: DOE 1994k.

Table E.2.1–5. Transuranic and Mixed Transuranic Waste Inventory at Hanford Site

Waste Matrix	Number of Waste Streams	Inventory as of December 31, 1994 (m^3)	Number of Waste Streams, 5-Year Projection	Total Generation, 5-Year Projection (m^3)
Homogeneous Solids				
TRU	4	4.28	3	2.5
Mixed-TRU	2	0.63	0	0
Soil/Gravel				
TRU	4	74.59	1	612.73
Mixed-TRU	2	11.93	1	0.83
Debris Waste				
TRU	81	10,760.48	27	1,169.65
Mixed-TRU	61	258.40	29	131.46
Lab Packs				
TRU	0	0	0	0
Mixed-TRU	3	4.30	2	8.11
Special Waste				
TRU	0	0	0	0
Mixed-TRU	5	3.27	1	21.36
Total TRU	89	10,839.35	31	1,784.88
Total Mixed-TRU	73	278.53	33	161.76
Total	162	11,117.88	64	1,946.64

Source: DOE 1995gg.

Table E.2.1–6. Transuranic and Mixed Transuranic Waste Treatment Facilities at Hanford Site

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (m^3)	Comment
Waste Receiving and Processing Facility 1	Repacking	Solid mixed TRU, TRU, mixed LLW, LLW, corrosive, ignitable, listed, reactive, TCLP	Containerized LLW to low- level burial grounds, WIPP-certified TRU and mixed TRU to WIPP, containerized mixed LLW to storage/treatment	1,870	Startup planned 3/97 for LLW only.
Waste Stabilization Contract	Stabilization and repackaging	Solid mixed LLW, corrosive, ignitable, listed, reactive, TCLP	Containerized mixed LLW to containerized mixed waste disposal facility	9,000	Treatment beginning in 1999.
Waste Thermal Treatment Contract	Thermal Treatment, Stabilization, Vitrification	Solid mixed LLW, corrosive, ignitable, listed, reactive, TCLP	Containerized mixed LLW to containerized mixed waste disposal facility	5,000	Planned treatment beginning 2001.

[a] For those facilities in use, this is a normal operating capacity; whereas, for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to change based on the availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1994k; DOE 1995gg.

Table E.2.1–7. Transuranic and Mixed Transuranic Waste Storage Facilities at Hanford Site

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
Central Waste Complex	Solid mixed TRU waste and TRU waste (remote-handled), mixed LLW and LLW, PCBs, corrosive, TCLP, ignitable, listed, reactive	22,710	Operational, RCRA Part B Interim Status
Retrievable Storage Units	Solid mixed TRU waste (contact-handled) and mixed LLW, corrosive, TCLP, ignitable, listed, reactive	1,171,938	Operational, RCRA Part B Interim Status
TRU Waste Storage and Assay Facility	Solid mixed TRU waste and TRU waste (remote-handled), corrosive, TCLP, ignitable, listed, reactive	416	Operational, RCRA Part B Interim Status

[a] Schedules and capacities for facilities under design or construction are subject to changes based on the availability of funds and permit issuance.

Source: DOE 1994k.

Table E.2.1–8. Mixed Low-Level Waste Inventory at Hanford Site

Waste Matrix	Number of Waste Streams	Inventory as of December 31, 1994 (m^3)	Number of Waste Streams, 5-Year Projection	Total Generation, 5-Year Projection (m^3)
Organic liquids	1	0.21	0	0
Homogeneous solids	47	2,657.47	23	1,466
Soil/gravel	21	459.06	13	541.20
Debris waste	60	2,708.31	32	2,408.50
Lab packs	27	263.45	19	1,016.30
Special waste	15	222.42	7	148.90
Elemental lead	9	210.81	3	133.40
Total	180	6,521.73	97	5,714.30

Source: DOE 1995gg.

Table E.2.1–9. Low-Level Waste and Mixed Low-Level Waste Treatment Facilities at Hanford Site

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a]	Comment
242-A Evaporator	Adsorption Resin (ion exchange), evaporation	Liquid mixed LLW contact-handled, corrosive, TCLP, ignitable, listed, reactive	Concentrated evaporator bottoms are stored in the double shell tanks. The evaporator distillate is passed through an ion exchange column to remove Cs. Once-saturated the ion exchange resin is slurried to the double shell tanks	50,000 m^3/yr	Will be replaced by the 242-H evaporator
Grout Treatment Facility	Solidification	Liquid mixed LLW contact-handled, corrosive, TCLP	Solidified grout LLW, contact-handled, to grout vaults	Design Feedrate: 15,000 m^3/yr	The Grout Treatment Facility processes the waste in campaigns. One campaign is 3,785,400 l of waste (before grouting).
LLW/Low Reading Compactor	Compaction	Solid LLW job waste	Compacted LLW	The unit compacts one (1) 55-gal drum at a time	Operational
LLW Compactor	Compaction	Solid LLW paper, plastic	Compacted LLW	Design feedrate 2 m^3/hr, daily 5 days per week, 8 hr/day	Operational
Maintenance and Storage Facility	Oxidation	Solid mixed LLW, contact-handled, reactive, ignitable	Liquid LLW to grout vault; solid residuals to containerized mixed low-level waste disposal facility	This is a batch treatment system (26 batches/yr maximum) via cask transfer. This process can treat up to 20 l/day of dangerous waste	Operational
Mixed Waste Treatment Facility	Distillation neutralization, solidification	Solid and liquid mixed LLW, contact-handled, listed, TCLP, corrosive	Solid mixed LLW, contact-handled, listed, TCLP to containerized mixed waste disposal facility	Waste are batched into the unit in small volumes, i.e., no container larger than a 55-gal drum	Operational

Table E.2.1–9. Low-Level Waste and Mixed Low-Level Waste Treatment Facilities at Hanford Site—Continued

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a]	Comment
PUREX/242-A Effluent Treatment	Adsorption, evaporation, separation, membrane process oxidation	Liquid mixed LLW, liquid LLW, contact-handled, listed	Liquid mixed LLW sludge, listed	Design feedrate: 34 m^3/hr	Planned and Funded; Date Available; 12/01/94 Termination Date: 06/01/2022
Shielded Analytical Lab Waste Treatment Unit	Neutralization, solidification, precipitation	Liquid mixed LLW, contact-handled, listed, corrosive, TCLP	Liquid, solid mixed LLW, contact-handled, listed, TCLP. Liquid to 204AR, Solid to Central Waste Complex	Design feedrate: 4 kilogram/hr	Operational

[a] For those facilities in use, a normal operating capacity; whereas, for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under or construction are subject to changes based on the availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1994k.

Table E.2.1–10. Low-Level Waste and Mixed Low-Level Waste Disposal Facilities at Hanford Site

Disposal Unit	Input Capability	Capacity (m^3)	Comment
Grout vaults	Solidified grout, LLW, contact-handled	230,000	Operational, the vaults are covered under the same RCRA permit as the Grout Treatment Facility
Mixed LLW disposal Facility-Project W-025	Solid mixed LLW, solid LLW, listed PCBs, contact-handled	14,200	Construction complete. Facility design is a double-lined trench with a leachate collection system in compliance with RCRA requirements for hazardous waste disposal
LLW Burial Grounds	Solid mixed LLW, solid LLW, contact-handled, reactive, ignitable, listed, corrosive, TCLP	888,109	Operational

Source: DOE 1994k.

Table E.2.1–11. Low-Level Waste and Mixed Low-Level Waste Storage Facilities at Hanford Site

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
305-B Storage Facility	Liquid and solid mixed LLW, liquid and solid LLW, hazardous waste, PCBs, corrosive, TCLP, ignitable, listed, reactive	20	Operational, RCRA Part B
4843 Alkali Metal Storage Facility	Liquid and solid mixed LLW, reactive, ignitable	83.3	Operational, RCRA Part B Interim status
B-Plant Canyon Waste Pile	Solid LLW, metal	5	Operational, RCRA Part B Interim status
B-Plant Container Storage	Solid mixed LLW, reactive, ignitable, TCLP	51	Operational, RCRA Part B Interim status
PUREX Canyon Waste Pile	Solid mixed LLW, TCLP	432	Operational, RCRA Part B Interim status
PUREX Tunnel 1	Solid mixed LLW, solid LLW, TCLP, metal, contact-handled	4,141	Operational, RCRA Part B Interim status
PUREX Tunnel 2	Solid mixed LLW, solid LLW, TCLP, ignitable, metal, contact-handled	19,528	Operational, RCRA Part B Interim status
Single-Shell Tanks	Mixed LLW, sludge (contact-handled), listed, corrosive, TCLP	347,766	Nonoperational due to pending closure

[a] Schedules and capacities for facilities under design or construction are subject to changes based on the availability of funds and permit issuance.

Source: DOE 1994k.

Table E.2.1–12. Hazardous Waste Treatment Facilities at Hanford Site

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a]	Comment
Hexone Incineration	Incineration	Liquid hazardous waste, listed, hexone	Incineration off-gas, gas, sanitary	Design feedrate: 0.79 m^3/hr	Planned but not funded
Interim Hazardous Waste Treatment Facility	Distillation, neutralization, solidification	Liquid hazardous waste, listed, corrosive, TCLP	High and low boiling point organics, liquid sanitary waste	Batch treatment	Operational, RCRA Part B Application was submitted August 1992

[a] For those facilities in use, this is a normal operating capacity; whereas, for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes based on the availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1994k.

Table E.2.1–13. Hazardous Waste Storage Facility at Hanford Site

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
Nonradioactive dangerous waste storage	Liquid and solid RCRA hazardous wastes, corrosive, ignitable	100.30	Operational, RCRA permit submitted 07/31/1989

[a] Schedules and capacities for facilities under design or construction are subject to changes based on the availability of funds and permit issuance.

Source: DOE 1994k.

Table E.2.1–14. Hazardous Waste Quantities Shipped Offsite in 1994 at Hanford Site

Description	Number of Shipments Containing Description	Quantity (kg)	Estimated Volume (m^3)[a]
Aerosols	13	458	0.5
Barium compounds, n.o.s.	1	<1	<1
Batteries, dry, containing potassium hydroxide solid	5	959	0.6
Caustic alkali liquids, n.o.s.	12	2,386	2.4
Combustible liquids, n.o.s.	11	18,320	18.3
Compounds, cleaning liquid	5	45	<0.1
Compressed gases, flammable, n.o.s.	1	17	<0.1
Corrosive liquids, n.o.s.	12	4,005	4.0
Corrosive solids, n.o.s.	12	3,052	2.0
Environmentally hazardous substances, solid, n.o.s.	123	2,267,942	1,512.0
Flammable liquids, corrosive, n.o.s.	3	10	<0.1
Flammable liquids, n.o.s.	13	1,476	1.5
Flammable liquids, poisonous, n.o.s.	1	<1	<0.1
Flammable solid, n.o.s.	2	70	<0.1
Hazardous waste, liquid, n.o.s.	19	20,956	21.0
Hazardous waste, solid, n.o.s.	44	475,691	317.1
Lead dioxide, n.o.s.	1	53	<0.1
Non-RCRA waste liquid	16	88,426	88.4
Non-RCRA waste solid	13	12,280	8.2
Organic peroxide type B, solid	1	1	<0.1
Organic peroxide type D, liquid	1	10	<0.1
Oxidizing substances, solid, n.o.s.	5	353	0.2
Paint	8	1,659	1.7
Paint related material	5	866	0.6
Poisonous liquids, corrosive, n.o.s.	1	78	<0.1

Table E.2.1–14. Hazardous Waste Quantities Shipped Offsite in 1994 at Hanford Site—Continued

Description	Number of Shipments Containing Description	Quantity (kg)	Estimated Volume (m^3)[a]
Poisonous liquids, n.o.s.	4	70	<0.1
Poisonous solids, corrosive, solid	1	<1	<0.1
Poisonous solid, n.o.s.	3	96	<0.1
Polychlorinated biphenyls	24	224,597	149.7
Sodium	6	286	0.2
Sodium hydroxide, solid	1	3	<0.1
Substances which in contact with water emit flammable gases, solid	1	<1	<0.1
Substances which in contact with water emit flammable gases, liquid	1	<1	<0.1

[a] For those shipments in which only a mass quantity was provided, a volume estimate was made based on density factors of 500 kg/m^3 for compressed gases, 1,000 kg/m^3 for liquids, and 1,500 kg/m^3 for solids.

Note: kg=kilogram; n.o.s.=not otherwise specified.

Source: DOE 1995h.

E.2.2 NEVADA TEST SITE

After underground nuclear tests at NTS, radioactive and hazardous materials were extracted and analyzed. These activities have resulted in the accumulation of low-level, hazardous, and mixed wastes that must be treated, stored, and disposed of. The *Site Book for Waste Management* (May 1994), the *Waste Management Plan for the Nevada Test Site* (February 1995), the *NTS Site Treatment Plan and Federal Facility Compliance Act Consent Order* (March 1996), and the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/EIS 0243) (NTS Site-Wide EIS) detail waste management activities at NTS.

Radioactive and hazardous wastes (according to the current definition of hazardous wastes) generated from past nuclear testing activities were disposed of in Areas 2, 3, 5, 6, 8, 9, 12, and 23. These were mixed wastes and LLW composed of debris, drilling mud, decontamination wastes, laboratory, and classified wastes. Areas 3 and 5 are still currently active for waste storage and disposal. Area 3 receives offsite and onsite bulk waste for disposal in subsidence craters. An RCRA closure plan for this facility has been submitted to the Nevada Division of Environmental Protection. The Radioactive Waste Management Site in the north of Area 5 contains LLW management units and receives packaged classified and unclassified LLW. NTS also has TRU waste from Lawrence Livermore National Laboratory (LLNL) in storage and a hazardous waste storage unit. The NTS currently is not accepting mixed wastes from any locations. Mixed waste could be accepted from Defense-related generators within the State of Nevada; however, there is no mixed waste ready for disposal that meets the land disposal restrictions of RCRA. Mixed waste from out-of-state generators has been disposed at NTS in the past. This practice is planned for the future contingent on approval and permitting (RCRA Part B) of future mixed waste disposal units and on actions resulting from the ROD for the Waste Management PEIS.

In the past, NTS hazardous waste was disposed of in landfills, through underground injection, in leachfields, and offsite. A goal of the NTS Environmental Restoration Project is to remove or immobilize hazardous substances, pollutants, and contaminants while achieving compliance with environmental laws and regulations. Environmental restoration activities will be guided by the ROD from the NTS Site-Wide EIS and the NTS Site Treatment Plan.[Text deleted.]

Pollution Prevention. The DOE Nevada Operations Office is an active participant in DOE's national waste minimization and pollution prevention program. A comprehensive waste minimization plan for NTS, completed in 1991, defines specific goals, methods, responsibility, and achievements for organizations. A waste minimization organization promotes waste minimization and pollution prevention and ensures compliance with DOE orders at NTS. A report on waste generation and waste minimization progress is published annually.

The DOE Nevada Operations Office publishes sitewide plans and guidance, and each contractor develops its own implementation plan. Plans and procedures have been developed limiting the number and types of hazardous materials used on the site. Since initiation of the waste minimization program, several steam-cleaning operations have been eliminated, and half of the hazardous solvents used at NTS have been replaced with nonhazardous solvents. Recycling and reclamation activities have been established to reuse lead, silver, lubricating oil, and trichlorotrifluoroethane. Automatic decontamination equipment, recycling fabrication tool coolant systems, and continuous oil change and reburn systems have been placed in service to reduce hazardous waste generation. Closed-loop effluent recycling for steam cleaning has eliminated the production of 17.8 million l (4.7 million gal) of wastewater annually and reduced hazardous waste generation by 90 percent. Two solvent waste stills recycle 85 percent of all solvents and thinners used. Nonhazardous aqueous solution parts cleaners have eliminated the need for parts cleaning solvents.

The procurement of all materials is also reviewed for the opportunity to reduce the purchase of hazardous materials for NTS operations. [Text deleted.] In addition, an education and training program for all site personnel and for the surrounding community is helping to increase awareness of practices and lessons learned in waste reduction.

Transuranic Waste. TRU and mixed TRU waste at NTS, which was generated at LLNL and shipped to NTS between 1974 and 1990, is stored on the TRU Waste Storage Pad in Area 5. All NTS TRU and mixed TRU waste is expected to be certified for disposal at WIPP in Carlsbad, NM, or at another suitable repository should WIPP prove to be unsatisfactory. The DOE Nevada Operations Office has the option to construct a TRU Waste Certification Building for breaching, sampling, and certifying containers of TRU waste to meet the WIPP waste acceptance criteria, which is expected to be finalized by June 1997 (NT DOE 1996b:BV-37). Other technologies, such as mobile characterization capabilities, are also being considered. This waste inventory consists of 612 m^3 (800 yd^3) of heterogeneous debris. The TRU waste is stored in the TRU Pad Cover Building on the TRU Waste Storage Pad to protect the containers from the environment. [Text deleted.] In addition, TRU and suspected TRU wastes from weapons tests were emplaced in boreholes. Decisions to retrieve this waste or leave it in place will be based on performance assessments required by 40 CFR 191 and/or on risk assessments required by the *CERCLA National Contingency Plan* or RCRA corrective action. Table E.2.2–1 lists the mixed TRU waste storage units at NTS.

Low-Level Waste. Contaminated soils created from past atmospheric nuclear weapons tests occur at various locations on NTS. Some of this surface contamination has been, or is planned to be, removed and disposed of as waste. Although the debris from underground weapons tests remains underground, samples of this debris brought to the surface for analysis must be disposed of as waste. The majority of LLW generated at NTS is disposed in subsidence craters in Area 3. This area also receives substantial quantities of containerized bulk waste from offsite DOE facilities. Some waste disposal units are being closed in this area, while others are being readied for future use. Area 5 receives low-level radioactive waste from both onsite and offsite generators. New disposal capacity is planned for this area, and the offsite generators will be required to meet the NTS waste acceptance criteria (which includes periodic reviews by the DOE Nevada Operations Office) to permit them to ship LLW for disposal at NTS.

Historically, the volume of waste received from offsite is approximately equal to or slightly greater than the volume of waste generated onsite. Onsite waste generation (other than environmental restoration waste) has declined due to cessation of nuclear testing with offsite receipts now dominating waste disposal activities. Remediation activities at NTS will produce waste streams that will have to be treated, stored, and disposed. Any incoming offsite waste shipments must meet NTS waste acceptance criteria. Fifteen generators currently ship LLW to NTS and nine additional generators are applying or are waiting for approval (NT DOE 1996c:4-48,4-49). The LLW disposal capacity in use or planned at NTS is listed in Table E.2.2–2.

Mixed Low-Level Waste. Mixed LLW is generated by Defense-related support activities, environmental restoration activities, and activities supporting TRU waste disposal at WIPP or at another suitable repository should the WIPP prove to be unacceptable. Wastes were generated by the analytical activities supporting weapons tests and consist of drilling muds and debris generated from tunnel reentry and rehabilitation. Additional wastes result from radiochemical analysis and from the decontamination of equipment and facilities used in sample extraction and analysis. NTS has received mixed wastes from other DOE sites and may receive additional waste in the future, pending the completion of the Site Treatment Plans for all DOE sites and issuance of proper permits. Mixed waste generated in the State of Nevada that meets the land disposal restrictions of RCRA can be disposed of in the Area 5 Mixed Waste Disposal Unit, Pit 3. Mixed wastes not meeting the land disposal restrictions requirements can be stored on the TRU Waste Storage Pad. A RCRA Part B Permit application for a new mixed waste storage unit was submitted in January 1995. Mixed LLW streams are being characterized to fully determine what technologies and capabilities are required for safe, environmentally sound, and compliant disposal. [Text deleted.]

Table E.2.2–2 lists mixed LLW storage and disposal facilities at NTS. Table E.2.2–3 lists the mixed LLW streams inventory and 5-year projected generation at NTS. The total volume is 296 m^3 (388 yd^3), including a 20,425-kilogram (kg) (45,000-pound [lb]) empty spent shipping cask. [Text deleted.]

Hazardous Waste. Hazardous waste is generated from ongoing operations at NTS. This waste consists of solvents, lubricants, fuel, lead, metals, and acids and is accumulated at various sites around NTS while awaiting shipment offsite to an RCRA-permitted facility. Over the next 5 years, additional satellite storage locations are planned. A separate accumulation site is located across the road from Area 5 to avoid potential cross-contamination with radioactive waste. The generation of hazardous waste at NTS is expected to decrease significantly because of the cessation of nuclear testing, the completion of environmental restoration activities, and the impact of waste minimization activities. Hazardous waste is stored on a 279-m^2 (365-square yard [yd^2]) covered pad in Area 5 (NT REECO 1995a:33).

Nonhazardous Waste. Nonhazardous sanitary waste is expected to be generated at the current rate for several more years, then at a lower rate due to the cessation of nuclear weapons testing. Recycling of paper, metals, glass, plastics, and cardboard has already resulted in some decrease in waste quantities. NTS has several sanitary landfills and construction landfills in operation.

Table E.2.2–1. Mixed Transuranic Waste Storage Facility at Nevada Test Site

Storage Unit	Input Capability	Total Area (m^2)	Comment
Asphalt Storage Pad	Mixed TRU solid, mixed LLW	8,300 (1,995 in TRU pad cover building)	Available storage capacity on the TRU Pad to be used for storage of future, onsite-generated mixed LLW that does not meet RCRA Land Disposal Restriction provisions.

Source: NT DOE 1996b.

Table E.2.2–2. Low-Level and Mixed Low-Level Waste Storage and Disposal Facilities at Nevada Test Site

Disposal Unit	Input Capability	Total Capacity[a] (m^3)	Comment
Mixed Waste, P03U Management Unit	Mixed LLW solid	118,908	Interim status. Onsite use only. RCRA Part A 1988. Environmental Assessment published, withdrawn. Considered in Site-Wide EIS.
LLW Disposal, P05U	LLW solid, wood, metal, rubble, debris	66,946	Operational. Additional 616,300 m^3 capacity available for expansion.
LLW Disposal, P06U	LLW solid	27,002	Operational, reserved for future use.
Classified Shallow Land Burial, T02C	LLW solid, metal in approved containers	1,698	Operational, no remaining capacity.
Shallow Land Burial, T03U	LLW solid, metal, debris, unclassified	7,086	Reserved for LLW disposal.
Classified Shallow Land Burial, T04C	LLW solid, metal in approved containers	1,518	Operational.
Mixed Waste Storage Pad	Mixed LLW solid	6,040[b]	Planned. RCRA Part B submitted in 1992.
Bulk LLW Disposal, U3AHAT	LLW solid, wood, metal, soil, biological	424,800	Operational.

[a] Schedules and capacity for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

[b] Estimated assuming no aisle space and containers stacked 2-m high.

Source: NT DOE 1996b; NT REECO 1994a.

Table E.2.2–3: Mixed Low-Level Waste Inventories at Nevada Test Site

Waste Matrix	Number of Waste Streams	Inventory Reported March 1996 (m^3)	5-Year Projection	
			Number of Waste Streams	Total Generation
PCB contaminated soil	1	0.11	0	0
Lead contaminated soil	1	29.8	0	0
Bulk lead waste	4	2.49	0	0
Solvent sludge (Area 12)	1	0.11	0	0
Shipping cask	1	2.2	0	0
Treatability Test Facility solvent	1	0.21	0	0
Analytical Services solvent	1	<0.1	0	0
PICO Fluor	1	0	1	0.3
Cotter Concentrate (A)	1	260	0	0
Cotter Concentrate (B)	1	1.4	0	0
[Text deleted.]				

Source: NT DOE 1996b.
[Text deleted.]

E.2.3 IDAHO NATIONAL ENGINEERING LABORATORY

Activities associated with the development of reactor technology and the extraction of useful nuclear materials at INEL have produced radioactive, mixed, and hazardous wastes that are treated, stored, or disposed of on the site. The Argonne National Laboratory-West (ANL-W) facilities generate and treat TRU, LLW, hazardous, and nonhazardous wastes that are disposed of by INEL per agreement between the DOE Idaho and Chicago Operations Offices. The ROD for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (60 FR 28680), as amended (61 FR 9441), lists decisions dealing with site-wide environmental restoration and waste management programs at INEL.

Pollution Prevention. The DOE Idaho Operations Office has an active Waste Minimization and Pollution Prevention Program to reduce the total amount of waste generated and disposed of at INEL. This is accomplished by eliminating waste through source reduction or material substitution, by recycling potential waste materials that cannot be minimized or eliminated, and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The DOE Idaho Operations Office published its first waste minimization plan in 1990, which defined specific goals, methodology, responsibility, and achievements of programs and organizations. The achievements and progress have since been updated at least annually.

Spent Nuclear Fuel. The inventory of spent nuclear fuel at INEL is cited here in metric tons (t) of heavy metal based on currently available references. There are 109 t (120 tons) of spent nuclear fuel stored at ICPP, 129 t (142 tons) at the Test Area North (TAN), 30 t (32.6 tons) at ANL-W, and 6 t (6.6 tons) at the Naval reactors, test reactors, and power burst facilities. Spent nuclear fuel is stored in facilities designed for a specific fuel type; therefore, storage capacities are not additive for the site. There are 11.6 t (12.8 tons) of graphite reactor fuel, 10.2 t (11.2 tons) of naval reactor fuel, and 252.2 t (278 tons) of commercial and research reactor fuels in the inventory (DOE 1995j:2-7,2-8,3-7). Naval Reactor Facility and Test Reactor Area fuel will be sent to the ICPP for storage. The TAN fuel pool is nearing its design life expectancy. The Three Mile Island core debris stored there will be repackaged and placed in dry storage. Experimental Breeder Reactor-II at ANL-W has its own fuel reconstitution facility to process waste.

The treatment of spent nuclear fuel for long-term storage and disposal is expected to continue at INEL for the next 40 years. Existing rulings designate spent nuclear fuel as a recoverable resource; as such, waste regulations for treatment, storage, and disposal do not apply. There are no plans to dispose of spent nuclear fuel at INEL. Figure E.2.3–1 illustrates spent nuclear fuel management at INEL. As a result of the amended ROD (61 FR 9441) from the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F), non-aluminum-clad fuels and naval spent fuel will be shipped to INEL for storage. This will increase the spent nuclear fuel to be managed at INEL from 274 t (302 tons) to 381 t (420 tons). INEL will make 114 shipments of aluminum clad spent nuclear fuel to SRS and receive 1,133 shipments of non-aluminum-clad spent nuclear fuel from other DOE sites.

High-Level Waste. HLW has been generated during the reprocessing of spent nuclear fuel at the ICPP. Most of this fuel was from the naval reactors program. The liquid HLW is concentrated by evaporation and converted to metallic oxides by calcination in a fluidized bed. These are then stored in a stable granular solid form. This waste form is stored in stainless steel bins in concrete vaults, where it can be held long enough that the short half-life isotopes have decayed and its activity is reduced. This waste form is a mixed HLW because of the toxic metals it contains.

Liquid HLW in acidic solution is stored in stainless steel tanks. All of this waste will be calcined to allow INEL to meet requirements of a December 9, 1991, Consent Order with the State of Idaho and EPA to cease the use of existing storage tanks without building new tanks. The Department proposes to construct a facility to treat the calcined waste (and any remaining liquid waste) in accordance with RCRA on a schedule to be negotiated

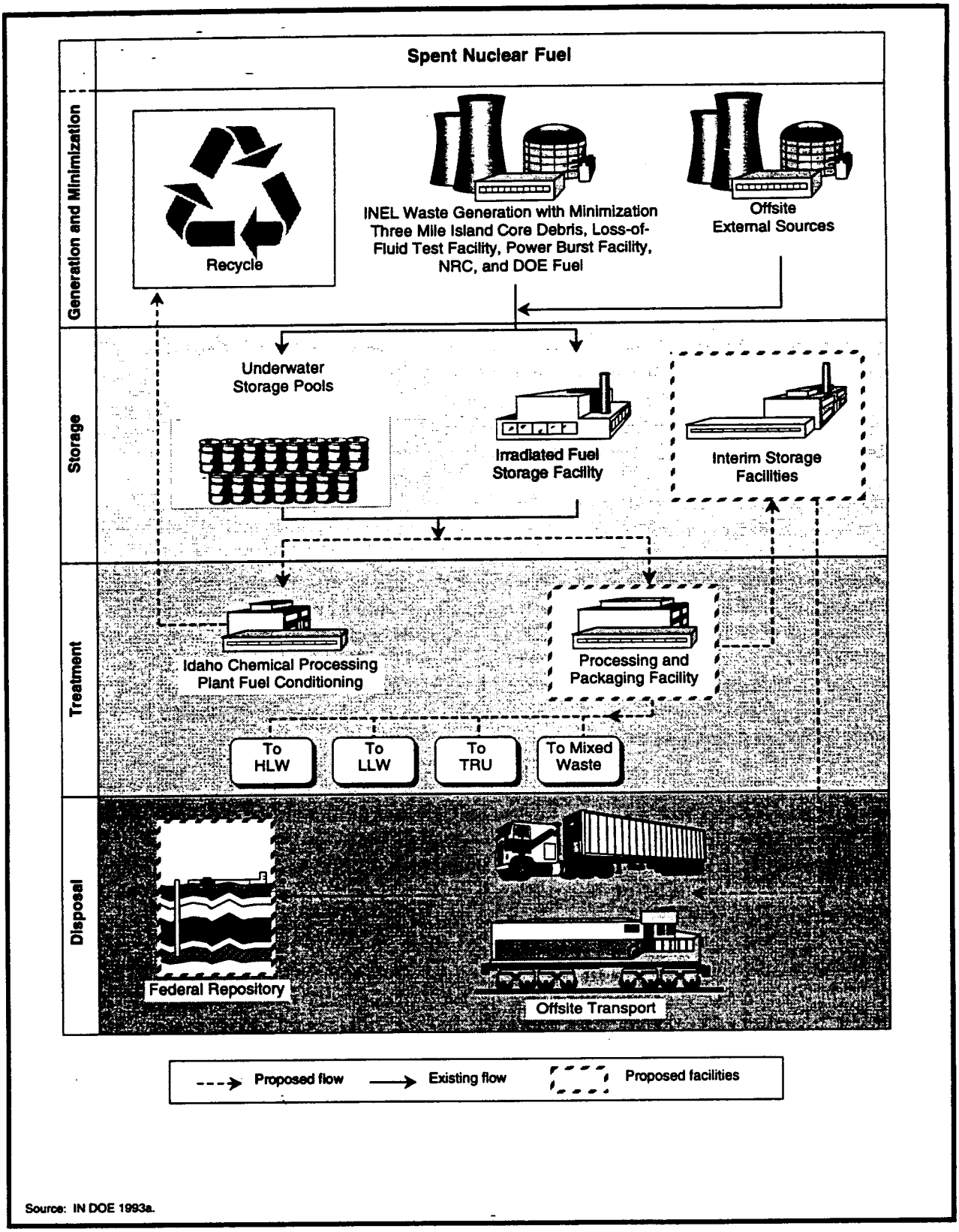


Figure E.2.3–1. Spent Nuclear Fuel Management at Idaho National Engineering Laboratory.

with the State of Idaho under the *Federal Facility Compliance Act*. The Department has selected radionuclide partitioning followed by grouting to immobilize the low-activity waste and vitrification to immobilize the high-activity waste. The HLW inventory, treatment and storage facilities (for example, the High Efficiency Particulate Air [HEPA] Filter Storage Facility) at INEL are listed in Tables E.2.3–1, E.2.3–2, and E.2.3–3. Figure E.2.3–2 illustrates HLW management at INEL.

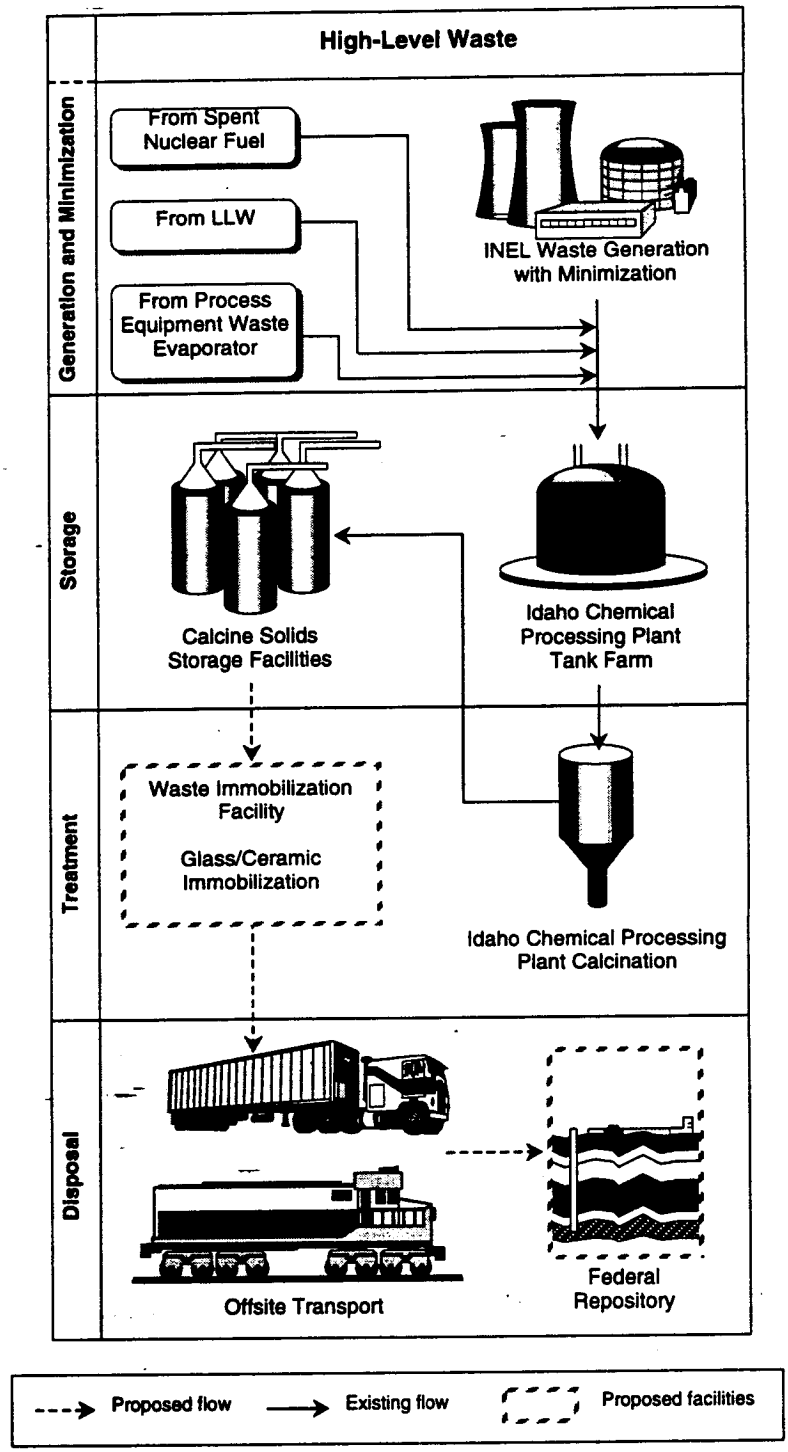
Transuranic Waste. TRU and mixed TRU wastes are stored at the Radioactive Waste Management Complex (RWMC). Prior to 1970, when the Atomic Energy Commission determined that TRU waste required segregation from other wastes, TRU waste was buried in earthen trenches. Since that time, TRU waste has been segregated into contact-handled and remote-handled categories, then packaged and stored for ultimate retrieval and transport to an offsite repository at WIPP. INEL contains 58 percent of DOE's TRU waste. The majority of TRU waste at INEL was shipped from other sites, particularly Rocky Flats Plant (now known as the Rocky Flats Environmental Technology Site [RFETS]), but this practice was stopped in 1989.

The existing treatment facilities for TRU waste at INEL are limited to testing, characterization, and repackaging. The Idaho Waste Characterization Facility, now in the planning phase, will characterize TRU waste and either reclassify it (if it is found to be LLW) for disposal onsite, or prepare it so that it meets the WIPP waste acceptance criteria. The use of commercial treatment facilities is being considered. Modifications of the RWMC to support commercial treatment of alpha-contaminated mixed LLW, the construction of the Advanced Mixed Waste Treatment Project and the Mixed LLW Disposal Facility, and the Plasma Hearth Process Project are being considered subject to funding restraints and additional NEPA review.

The TRU waste at INEL is being stored pending the outcome of the WIPP program. Assuming WIPP is determined to be a suitable repository for these wastes, pursuant to the requirements of 40 CFR 191 and 40 CFR 268, these wastes will be transported there for disposal. DOE will begin discussions with the State of Idaho regarding treatment options for mixed TRU waste in January 1998, if the Secretary of Energy does not decide to operate WIPP as a disposal facility by that time; or at such earlier time as DOE determines that (1) there will be a delay in the opening of WIPP substantially beyond 1998 or (2) the No-Migration Variance Petition is not granted by the EPA. DOE will propose modification to the INEL Site Treatment Plan for approval by the State of Idaho within a timeframe agreed upon between DOE and the State of Idaho. These modifications will describe planned activities and schedules for the new mixed TRU waste strategy. Figure E.2.3–3 illustrates TRU waste management at INEL. Tables E.2.3–4, E.2.3–5, and E.2.3–6 list the TRU and mixed TRU wastes inventory, and treatment and storage facilities at INEL. Some TRU waste at INEL will never meet WIPP waste acceptance criteria and therefore cannot be sent to WIPP. Other options will have to be developed for these wastes. Approximately one-half of the TRU waste is expected to be reclassified as alpha-contaminated LLW in the future. This waste does not meet INEL waste acceptance criteria for LLW and therefore will be managed as TRU waste. Additionally, INEL may accept TRU waste from other sites for treatment. The treated waste would be returned to the generator or sent to an offsite disposal facility (assumed to be WIPP).

Low-Level Waste. LLW is generated in various forms at INEL facilities. This waste is disposed of at the RWMC. Most of this waste is processed onsite or offsite before disposal by incineration, compaction, or sizing to reduce volume and to stabilize the waste to the maximum extent possible. Some LLW does not meet criteria for onsite disposal. This waste is stored temporarily until treatment and disposal options are developed. Liquid LLW is either evaporated and processed to calcine, or solidified and disposed of. The volume of LLW disposed of at INEL's RWMC is 145,000 m^3 (189,600 yd^3). As of 1991, the facility had an 180,000-m^3 (235,345-yd^3) capacity, with an additional 67,000 m^3 (88,000 yd^3) of expansion capacity available (DOE 1995j:4.14-2). Figure E.2.3–4 illustrates LLW management at INEL.

Mixed Low-Level Waste. Mixed LLW is generated in small quantities at INEL and is stored in several areas onsite (ANL-W, ICPP, Special Power Excursion Reactors Test). INEL may also receive limited volumes of mixed LLW from other sites for treatment, with the residuals being returned to the generator. The Waste Experimental Reduction Facility, the Waste Reduction Operations Complex, the ICPP, ANL-W and TAN will



Source: IN DOE 1993a.

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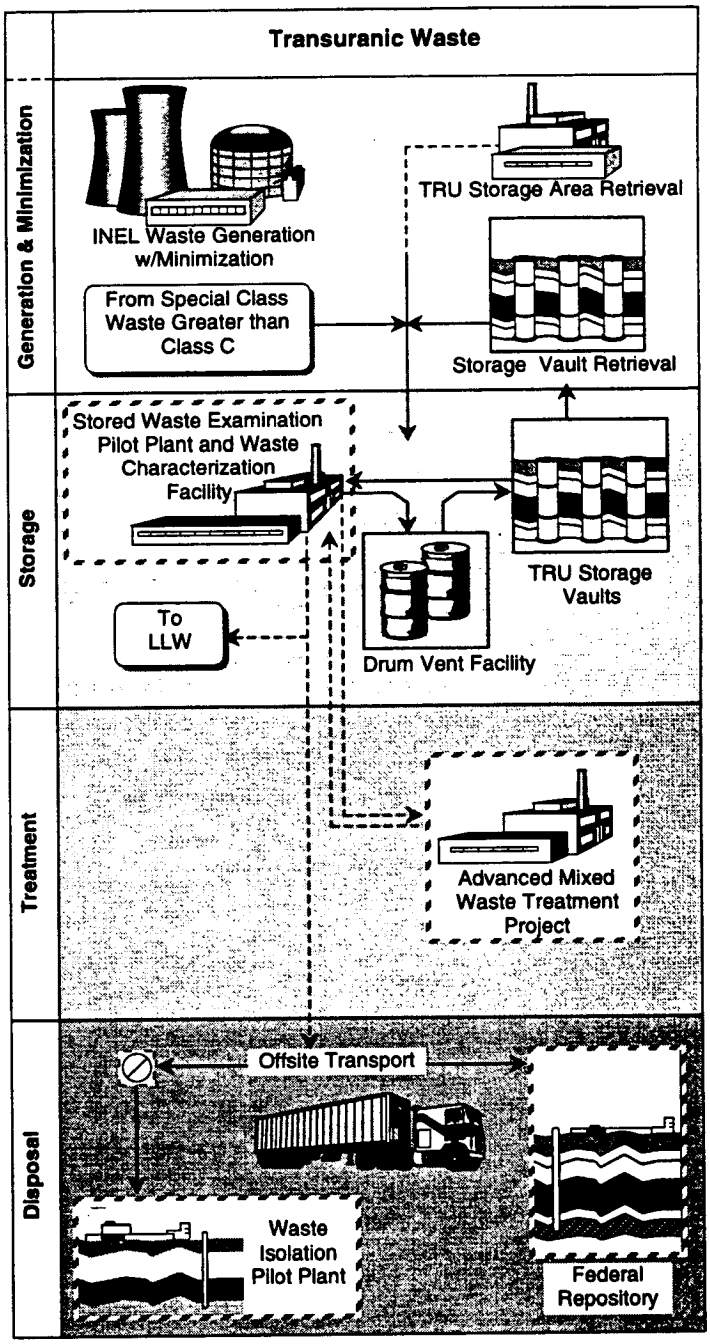
Figure E.2.3–2. High-Level Waste Management at Idaho National Engineering Laboratory.



Source: IN DOE 1993a; IN DOE 1995d.

2626/FMD

Figure E.2.3–3. Transuranic Waste Management at Idaho National Engineering Laboratory.

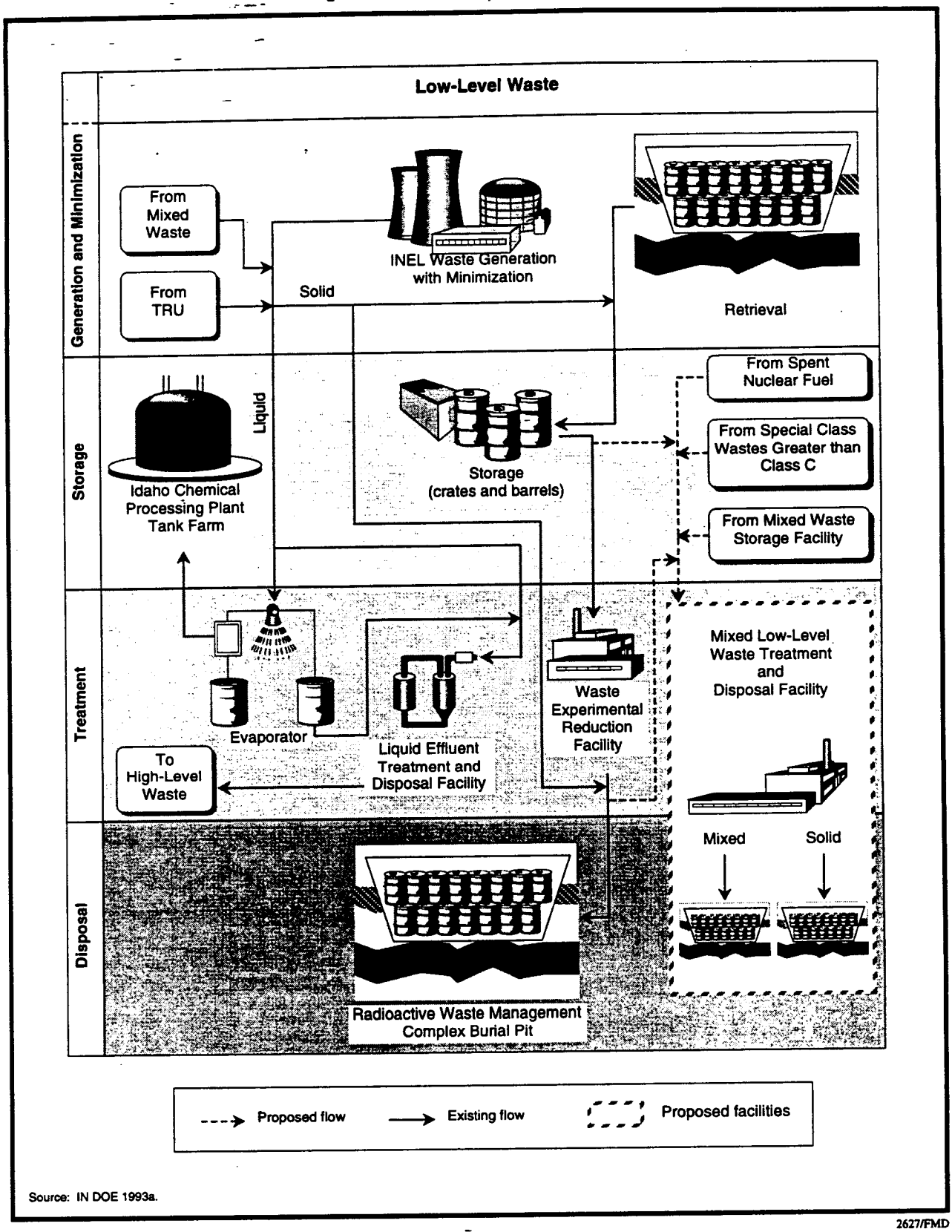


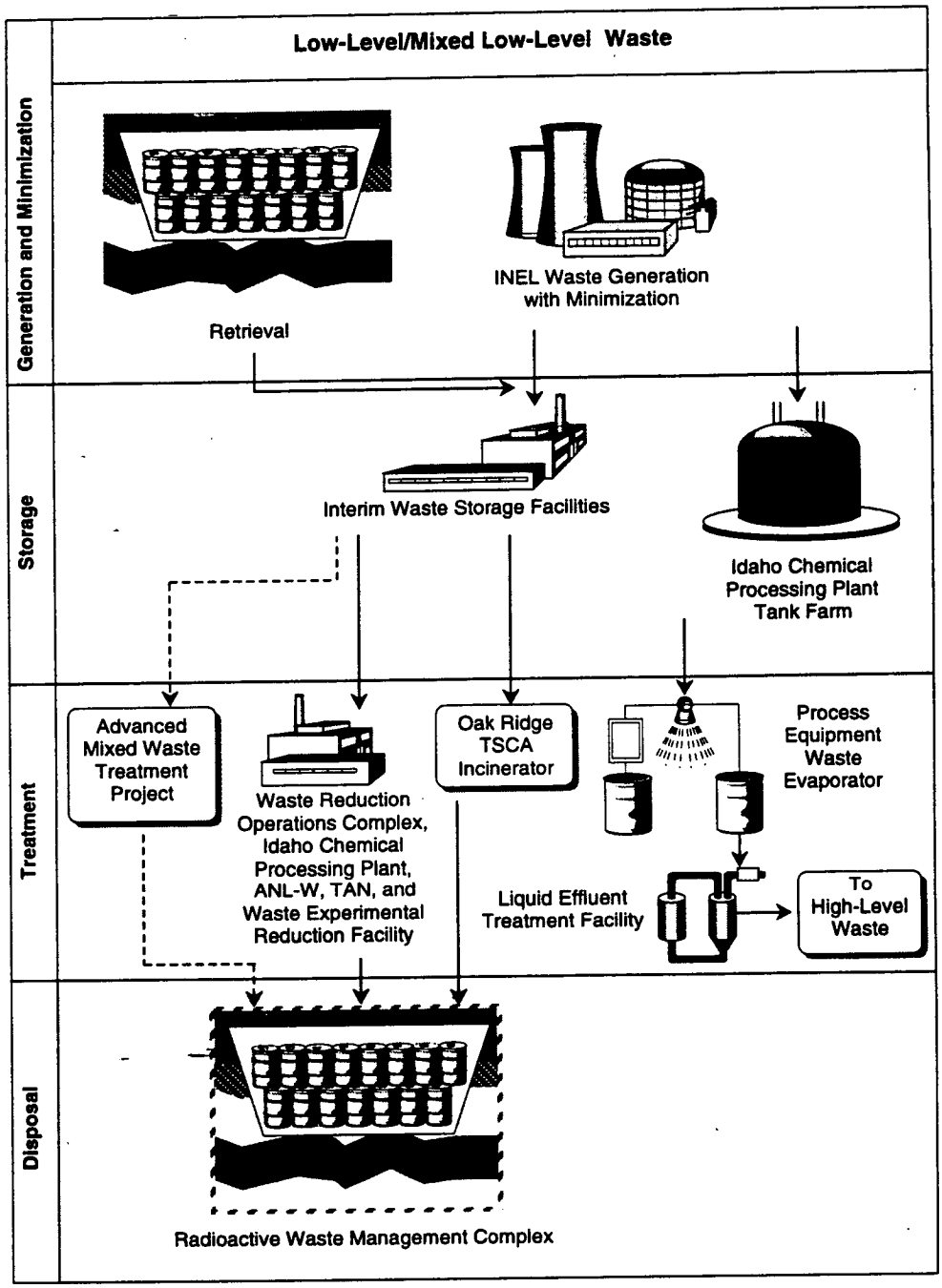
Figure E.2.3–4. Low-Level Waste Management at Idaho National Engineering Laboratory.

process mixed LLW. [Text deleted.] Additional facilities (Advanced Mixed Waste Treatment Project, Mixed/LLW Disposal Facility, and Remote Mixed Waste Treatment Facility) planned for INEL would be able to treat mixed waste and render it acceptable for disposal. Figure E.2.3–5 illustrates mixed waste management at INEL.

Although mixed liquid and solid wastes generated from past operations are stored in many locations at INEL, the bulk of that volume is solid waste stored at the RWMC. Its volume is approximately 66 percent of the TRU waste volume also stored there and is 11 percent of the total volume of waste stored or disposed of at that facility. The inventory of mixed LLW, and treatment and storage facilities at INEL are listed in Tables E.2.3–7, E.2.3–8, and E.2.3–9.

Hazardous Waste. Hazardous waste is staged in a RCRA-permitted building at the Central Facilities Area (CFA) prior to shipment to an offsite commercial RCRA-permitted facility. Table E.2.3–10 lists the hazardous waste quantities shipped offsite in 1994. The INEL waste minimization program is expected to significantly reduce the quantities of hazardous wastes generated at INEL over the next 5 years. By that time, the use of nonhazardous chemicals and the recycle of those for which there is no substitute should nearly eliminate the generation of hazardous waste.

Nonhazardous Waste. Nonhazardous (industrial and sanitary) wastes are processed at each facility on the INEL site and disposed of at the CFA or at the Bonneville County landfill. Wastes are segregated into sanitary, industrial, and asbestos wastes before emplacement. Increased recycling is expected to reduce nonhazardous waste generation by 50 percent by 1997. A new multipurpose facility is planned to be in operation at ANL-W by 1996 to collect, monitor, and consolidate ANL-W nonhazardous wastes before shipment to the CFA. INEL will continue its existing industrial waste program in the future; this will require expansion of the 4.8 ha (12 acres) CFA landfill by 91 ha (225 acres) to provide capacity for the next 30 years (60 FR 28680).



Source: IN DOE 1993a; IN DOE 1995d.

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Figure E.2.3–5. Mixed Waste Management at Idaho National Engineering Laboratory.

Table E.2.3–1. High-Level Waste Inventory at Idaho National Engineering Laboratory

Waste Matrix	Number of Waste Streams	Inventory Reported March 30, 1995 (m^3)	Number of Waste Streams 5-Year Projection	Total Generation Inventory 5-Year Projection (m^3)
Remote-Handled				
Aqueous liquids/slurries	1	7,097	1	2,690
Inorganic process residues (calcined solids)	1	3,741	1	962[a]
Total	2	10,838	2	3,652

[a] Maximum if all calcined directly. Preferred alternative, radionuclide partitioning, will decrease this amount with an increase in LLW to be disposed of.

Source: DOE 1995j; IN DOE 1995d.

Table E.2.3–2. High-Level Waste Treatment Facilities at Idaho National Engineering Laboratory

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
High-efficient particulate air Filter Leach Facility	Chemical extraction	HLW remote-handled-alpha, inorganic debris	Concentrated liquid HLW (to calcine), LLW solid	11.3	Under repair; final RCRA 1990, interim NESHAP 1999
Idaho Chemical Processing Plant Decontamination Facility	Water washing, CO_2 decontamination	HLW remote-handled-debris	HLW remote-handled-solid HLW-remote-handled, LLW liquids	227	Operational 1993
Idaho Waste Immobilization Facility	Vitrification	HLW remote-handled-calcine solids	HLW remote-handled-solid, stabilized	3,020	Unapproved, planned
New Waste Calcining Facility Evaporator	Evaporation	HLW remote-handled-aqueous liquids	HLW remote-handled-aqueous liquids	140,000	Available 2000; interim RCRA 1990
New Waste Calcining Facility	Calcination	HLW remote-handled-aqueous liquid, toxic organic, metals with mercury	HLW remote-handled-solid, (calcine)	44,400[b]	Operational; interim RCRA 1990

[a] For those facilities already in use, this is a normal operating capacity; whereas, for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

[b] Input capacity including high fraction of additives. Unit is rated on output of calcine solids at 470 m^3/yr.

Source: IN DOE 1995d.

Table E.2.3–3. High-Level Waste Storage Facilities at Idaho National Engineering Laboratory

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
Idaho Chemical Processing Plant Tank Farm	HLW remote-handled—liquid, corrosive, toxic, listed	13,400	Operational; interim RCRA 1990; to be closed
New Waste Calcine Facility Tanks	HLW remote-handled—liquid, corrosive, toxic, listed	258	Operational; staging tanks for calcined feed; interim RCRA 1990
CPP Calcine Bin Sets	HLW remote-handled—solid, toxic, listed (calcine)	7,114	Operational; State final permit 1992; RCRA Part B submitted 1994. Permit applications for new storage bins (#8 and #9) to be submitted.
Fluorinal and Storage Facility and New Waste Calcine Facility High-Efficiency Particulate Air Filter Storage Facilities	HLW remote-handled—solid, toxic	166	Operational; RCRA Part B submitted 1993

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: DOE 1993b; IN DOE 1995d.

Table E.2.3–4. Transuranic and Mixed Transuranic Waste Inventory at Idaho National Engineering Laboratory

Waste Matrix	Number of Waste Streams	Inventory Reported March 30, 1995 (m^3)	Number of Waste Streams 5-Year Projection	Total Generation 5-Year Projection (yd^3)
Inorganic process residues	53	7,300	0	0
Organic Process Residues	3	57	0	0
Contaminated soils/debris	1	38	0	0
Metal debris	22	8,307	0	0
Combustible debris	17	9,887	0	0
Heterogeneous debris	32	5,210	1	17.7
Unknown/other	7	8,659	0	0
Total	135	39,457	1	17.7

Source: DOE 1995gg.

Table E.2.3–5. Transuranic and Mixed Transuranic Waste Treatment Facilities at Idaho National Engineering Laboratory

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
Idaho Chemical Processing Plant	Water washing	HLW, TRU, LLW, mixed LLW, alpha	HLW, TRU, LLW, mixed LLW	114	Operational
	High-efficiency particulate air filter leach	HLW, TRU, LLW, mixed LLW	HLW, TRU, LLW, mixed LLW	11.3	Existing, plan to use
Advanced Mixed Waste Treatment Project	Amalgamate, compaction, decontaminate, incinerate, encapsulate, size, stabilize, desorb, vitrify	TRU, mixed TRU, LLW, mixed LLW, alpha, liquid, and solid	Mixed TRU, LLW	Planned	Unapproved, planned
New Waste Calcining Facility	Calcify	HLW, TRU, LLW, mixed LLW, alpha, liquid	HLW, TRU, LLW, mixed LLW	470	Operational; RCRA interim 1990
Remote Treatment Facility	Melt, drain, evaporate, compact, macroencapsulate, neutralize, incinerate, decontaminate	TRU, LLW, alpha	TRU, LLW	42	Unapproved, planned
Waste Immobilization Facility	Vitrify or stabilize in ceramic	HLW, TRU, LLW, mixed LLW, alpha	HLW, TRU, LLW	3,020	Unapproved, planned

[a] For those facilities already in use, this is a normal operating capacity, whereas for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

[Text deleted.]

Source: IN DOE 1995d.

Table E.2.3–6. Transuranic and Mixed Transuranic Waste Storage Facilities at Idaho National Engineering Laboratory

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
ANL-W Sodium Storage	Mixed TRU solid	19	RCRA Part B submitted 1994
ANL-W Scrap	Mixed TRU solid	193	RCRA Part B submitted 1994
Idaho Chemical Processing Plant High Efficiency Particulate Air Filters	Mixed TRU solid	142	RCRA Part B submitted 1993
Radioactive Waste Management Complex TSA-1, 2, 3	Mixed TRU solid	64,900[b]	Partial closure, RCRA Part B submitted 1994
Radioactive Waste Management Complex Waste Storage	Mixed TRU solid	112,400	RCRA Part B submitted 1991
Radioactive Waste Management Complex Intermediate-Level TRU Storage	Mixed TRU solid	100	RCRA Part B submitted 1991
RE Retrieval Modification Facility	Mixed TRU solid	93,400	RCRA Part B submitted 1994

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

[b] 108 m^3 usable, 3/30/95.

Note: TSA=TRU Storage Assay

Source: IN DOE 1995d.

Table E.2.3–7. Mixed Low-Level Waste Inventory at Idaho National Engineering Laboratory

Waste Matrix	Number of Waste Streams	Inventory Reported March 30, 1995 (m^3)	Number of Waste Streams, 5-Year Projection	Total Generation, 5-Year Projection (m^3)
Aqueous liquids	11	13	3	14.5
Organic liquids	20	13	6	6.4
Homogenous solids	45	3,934	13	87
Soils/Gravel	10	223	0	0
Debris	81	17,662	15	610
Labpacks	5	4	5	3
Special waste	10	446	13	136
Elemental hazardous materials	8	446	11	136
[Text deleted.]				
Total	190	22,741	66	993

Source: DOE 1995gg.

Table E.2.3–8. Mixed Low-Level Waste and Low-Level Waste Treatment Facilities at Idaho National Engineering Laboratory

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
High Efficiency Particulate Air Filter Leach (CPP-659)	Acid leach	HLW, TRU, mixed LLW-contact-handled, remote-handled, alpha, solid, debris	LLW solid to RWMC, concentrated liquid to tank farm, nonhazardous to sanitary landfill	11	Under modification; RCRA final 1990; interim NESHAP to 1999
ICPP debris treatment and containment	Water wash, carbon dioxide, abrasion	HLW, TRU, mixed LLW-contact-handled, remote-handled alpha, solid, debris	Mixed LLW, HLW, TRU solid, liquid	227	Water wash operational, carbon dioxide existing, plan to use.
Advanced Mixed Waste Treatment Project	Amalgamation, compaction, incineration, macroencapsulation, stabilization, thermal desorption, vitrification	Mixed TRU, mixed LLW, contact-handled, remote-handled alpha	Mixed TRU, mixed LLW, LLW solid	26,900	Unapproved, planned
INEL waste treatment, 40 CFR 262.34	Absorption, neutralization, solidification	Mixed LLW-contact-handled, aqueous liquid, solid, debris	Mixed LLW, LLW	Planned	Operational
Liquid Effluent Treatment and Disposal Facility	Fractionation, evaporation	Mixed LLW-contact-handled, remote-handled liquid (PEW evaporator)	Mixed LLW-contact-handled, remote-handled liquid to acid recycle for New Waste Calcining Facility, or tank farm	12,200	Operational; RCRA final 1990; NESHAP final and State Prevention of Significant Deterioration 1988
Mixed LLW Treatment Facility	Amalgamation, decontamination, incineration, macroencapsulation, neutralization, precipitation, sizing, stabilization	Mixed LLW-contact-handled liquid, solid	Mixed LLW-contact-handled	401	Approved, planned
New Waste Calcining Facility	Calcification	Mixed LLW, HLW, mixed TRU remote-handled liquid	HLW-remote-handled solid	470	Operational; RCRA interim 1990
Portable Water Treatment System	Adsorption, filtration, neutralization	Mixed LLW-contact-handled, aqueous liquid	Mixed LLW	126	Existing, plan to use.

Table E.2.3–8. Mixed Low-Level Waste and Low-Level Waste Treatment Facilities at Idaho National Engineering Laboratory—Continued

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
Remote Mixed Waste Treatment Facility	Melt, drain, evaporate	Mixed LLW remote-handled, alpha	Mixed LLW, remote-handled, alpha	42	Unapproved, planned
Sodium Processing Facility	Water reaction	Mixed LLW contact-handled	Mixed LLW contact-handled, decontaminated sodium	698	Existing, needs modification
TAN cask dismantlement	Disassembly, recovery	Mixed LLW contact-handled	Mixed LLW contact-handled	11	Operational
Waste Reduction Operations Complex	Amalgamation	Mixed LLW contact-handled, solid	LLW solid	0.4	Planned, approved
Waste Reduction Operations Complex	Debris sizing	Mixed LLW, LLW contact-handled, solid	Mixed LLW, LLW solid	23	Planned, approved
Waste Reduction Operations Complex	Neutralization	Mixed LLW contact-handled	LLW	4.2	Planned, approved
Waste Experimental Reduction Facility	Incineration, stabilization, macroencapsulation	Mixed LLW contact-handled, liquid, solid	LLW, mixed LLW solid to RWMC (stabilized solids and grout)	Input 49,610; output 236 grout and 2,770 stabilized solids to RWMC	Interim NESHAP 1987, 1992; RCRA interim 1987, 1992; State final 1992. Shut down. Expect operation in 1996.
Waste immobilization	Vitrification or ceramic fusion	HLW, mixed TRU, mixed LLW solid	HLW solid ceramic	3,020	Unapproved, planned

[a] For those facilities already in use, this is a normal operating capacity, whereas for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

[Text deleted.]

Source: IN DOE 1995d.

Table E.2.3–9. Mixed Low-Level Waste and Low-Level Waste Storage Facilities at Idaho National Engineering Laboratory

Storage Unit	Input Capability	Total Capacity [a] (m^3)	Comment
ANL-W radioactive sodium storage	Mixed LLW-TRU	19	RCRA Part B 1994
ANL-W sodium storage	Mixed LLW-TRU	303	RCRA Part B 1994
ANL-W scrap storage	Mixed LLW-TRU	193	RCRA Part B submitted 1994
ANL-W sodium boiler drain tank	Mixed LLW	49	RCRA Part A submitted 1994
Idaho Chemical Processing Plant high-efficiency particulate air filter storage	Mixed LLW	25	RCRA Part B submitted 1993
Idaho Chemical Processing Plant CPP-1619 storage	Mixed LLW	45	RCRA Part B submitted 1995
Idaho Chemical Processing Plant CPP-1617 staging	Mixed LLW	510	RCRA Part B submitted 1995
Idaho Chemical Processing Plant New Waste Calcining Facility high-efficiency particulate air filter storage	Mixed LLW, TRU	141	RCRA Part B submitted 1993
Power Burst Facility Waste Engineering Development Facility storage	Mixed LLW	4	RCRA Part B submitted 1995
Power Burst Facility mixed LLW storage	Mixed LLW	85	RCRA Part B submitted 1993
[Text deleted.]			
Portable storage at SPERT IV	Mixed LLW	237	RCRA Part B submitted 1993
Power Burst Facility Waste Experimental Reduction Facility storage	Mixed LLW	288	RCRA Part B submitted 1993
RWMC TRU modules	Mixed LLW, alpha LLW, TRU	112,400	RCRA Part B submitted 1990, interim TSCA 1992
RWMC intermediate-level storage	Mixed LLW, alpha LLW, TRU	100	RCRA Part B submitted 1991
[Text deleted.]			
Test Area North 647 waste storage	Mixed LLW	104	RCRA Part B submitted 1996
Test Area North 628 SMC container storage	Mixed LLW	125	RCRA Part B submitted 1993

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: IN DOE 1995d.

Table E.2.3–10. Hazardous Waste Quantities Shipped Offsite in 1994 at Idaho National Engineering Laboratory

Description	Number of Shipments Containing Description	Quantity (kg)	Estimated Volume (m^3)[a]
Butanols	1	210	0.1
Caustic alkali liquids, n.o.s.	3	395	0.4
Combustible liquid, n.o.s.	5	409	0.4
Compounds, cleaning liquid	2	196	0.2
Corrosive liquids, n.o.s.	12	2,683	0.3
Corrosive liquids, poisonous, n.o.s.	1	13	<0.1
Corrosive solid, n.o.s.	12	3,683	2.5
Environmentally hazardous substances, solid, n.o.s.	5	64,794	43.2
Flammable liquids, corrosive, n.o.s.	6	206	0.2
Flammable liquids, n.o.s.	20	5,750	5.7
Flammable liquids, poisonous, corrosive, n.o.s.	3	387	0.4
Flammable solids, n.o.s.	1	6	<0.1
Flammable solids, poisonous,n.o.s.	1	6	<0.1
Hazardous waste, liquid, n.o.s.	22	10,735	10.7
Hazardous waste, soil, n.o.s.	29	11,730	7.8
Insecticide gases, n.o.s.	1	5	<0.1
Metal powders, flammable, n.o.s.	1	27	<0.1
Organic peroxide, type D, liquid	1	3	<0.1
Oxidizing substances, liquid, corrosive, n.o.s	1	8	<0.1
Oxidizing substances, solid, poisonous, n.o.s	1	5	<0.1
Oxidizing substances, solid, corrosive, n.o.s	1	322	0.2
Oxidizing substances, solid, n.o.s	6	411	0.3
Poisonous liquids, corrosive, n.o.s.	1	5	<0.1
Poisonous liquids, flammable, n.o.s.	1	32	<0.1
Poisonous liquids, n.o.s.	5	364	0.4
Poisonous solid, n.o.s.	8	240	0.2
Polychlorinated biphenyls	6	3,184	2.1
Substances which in contact with water emit flammable gases, solid	1	5	<0.1

[a] For those shipments in which only a mass quantity was provided, a volume estimate was made based on density factors of 500 kg/m^3 for gases, 1,000 kg/m^3 for liquids and 1,500 kg/m^3 for solids.

Note: n.o.s.=not otherwise specified.

Source: DOE 1995h.

E.2.4 PANTEX PLANT

This section describes the baseline conditions and specific waste management operations at Pantex. As part of its normal operations, Pantex generates low-level, mixed low-level, hazardous, and nonhazardous wastes. Tables E.2.4–1 and E.2.4–2 present a detailed description of treatment and storage facilities with estimated capacities.

Pantex's goals regarding the management of LLW, mixed LLW, and hazardous wastes are as follows:

- Minimize the volumes of low-level radioactive, mixed low-level, and hazardous wastes generated to the extent technologically and economically practicable
- Recycle those wastes applicable to the best available technology
- Minimize contamination of existing or proposed real property and facilities
- Ensure safe and efficient long-term management of all wastes

Pollution Prevention. Pantex has a waste minimization program that was created to define an effective waste minimization system for the site. A committee provides awareness of the program, identifies tasks, and provides liaison between the site and outside entities. Some of the accomplishments of this program are as follows:

- Compactor used to compact 1,200 drums to approximately 250 drums. Disposal cost savings of approximately $300,000 was achieved.
- Separation of radioactive and hazardous waste materials when shearing weapons components. Reclamation of gold from this process netted $243,000 in the first year.
- Reclamation of oil, antifreeze, and refrigerant.
- Substitution of scintillation solution that is nonhazardous.
- Reuse of explosives and solvents.
- Repackaging of paint into smaller containers.
- Substitution of naphtha with nonhazardous biodegradable cleaning solution.

Transuranic Waste. No TRU waste or mixed TRU waste is currently generated at Pantex during normal operation. However, there is a potential for an off-normal event to generate small amounts of contact-handled TRU waste or mixed TRU waste during a weapon-dismantlement activity. Three drums of TRU waste were generated several years ago from an incident during weapon dismantlement. Ultimately, Pantex plans to ship its TRU waste to a DOE-approved storage site when available. In the interim, approximately 1 m^3 (1.3 yd^3) of TRU waste is temporarily stored in Building 12-42 (DOE 1995gg).

Low-Level Waste. The following options are available for the management of LLW streams:

- Continue to ship to an approved DOE disposal site such as NTS
- Compact solid waste, if possible

- Continue improvements to computerized tracking of radioactive waste
- Implement improved segregation program

Solid LLW generated at Pantex consists of contaminated parts from weapons assembly and disassembly functions and waste materials associated with these functions, such as protective clothing, cleaning materials, filters, and other similar materials. The compactible components of this waste are processed at the Pantex Solid Waste Compaction Facility and staged along with the noncompactible components for shipment to a DOE-approved disposal site. Table E.2.4–3 lists Pantex's LLW streams, how they are generated, primary radioactive constituents, and method of storage or disposal. Table E.2.4–4 presents the inventory of LLW at Pantex as of December 2, 1994, as well as a 5-year projection.

Mixed Low-Level Waste. The following options are available for the management of mixed LLW streams:

- Store onsite pending treatment to satisfy LDR requirements. This is the current option now being used at Pantex (PX DOE 1996b:4-193).
- Treat to satisfy LDR requirements and ship to an approved commercial facility or other DOE-approved facility for storage or disposal.
- Ship off site for treatment and disposal.

Pantex manages its mixed waste in accordance with the *Pantex Plant Federal Facility Compliance Act Compliance Plan*. Pantex generates solid mixed LLW during weapons component testing functions. These wastes consist primarily of depleted uranium and beryllium residue and fragments from explosive components tests, contaminated soils, cleaning materials, and protective clothing associated with these operations. Other mixed LLW streams include cleaning materials from weapons assembly and disassembly operations. Mixed LLW (high explosives [HE] contaminants only) is currently treated at the Burning Ground, which has a permitted capacity of 180 m^3/yr (236 yd^3/yr) (DOE 1995gg). The Hazardous Waste Treatment and Processing Facility is being planned to treat mixed waste in mobile treatment units. Table E.2.4–5 lists Pantex's primary mixed waste streams, composition, method of process, and treatment alternatives. Table E.2.4–6 lists organic liquid mixed LLW stream candidates that are being evaluated for commercial treatment and/or disposal. Table E.2.4–7 lists the mixed waste storage inventory as of September 1995, as well as a 5-year projection.

Hazardous Waste. The following options are available for the management of hazardous waste streams:

- Continue to ship to approved hazardous waste disposal facilities
- Encapsulate solid waste and ship to a DOE-approved disposal site
- Treat onsite for neutralization of corrosive wastes

Table E.2.4–8 presents the inventory for hazardous waste at Pantex as of December 2, 1994, as well as a 5-year projection. The treatment of hazardous waste is done at the following facilities:

- The Burning Ground is an open-burning area where explosives, explosive-contaminated waste, and explosive-contaminated spent solvents are burned. A large volume reduction is attained by this treatment, and some wastes are rendered nonhazardous due to elimination of the HE reactivity hazard.

- The Hazardous Waste Treatment and Processing Facility will house liquid-phase and solid-phase hazardous, low-level, and mixed waste processing activities. The facility has been planned and approved and should be available in 2000.

Not all of the hazardous waste is treated at Pantex. The amount of hazardous waste shipped offsite in 1994 is shown in Table E.2.4–9. There are several separate storage facilities for hazardous wastes.

- In the Hazardous Waste Drum Storage Area, all liquid drums are placed in spill-containment pans. The facility is inspected weekly for leakers. Small lab samples of hazardous waste are stored in two chemical storage containers in this area. The materials stored in the area include asbestos, mercury-contaminated wastes, Burning Ground ash, and electroplating sludge.

- At Building 16-1, used crank case oil is stored underground until sufficient quantities are generated for offsite processing.

Class 1 non-RCRA-hazardous waste includes asbestos-contaminated materials, PCBs with a concentration greater than 50 parts per million (ppm), and oils with a total petroleum hydrocarbon concentration greater than 1,500 ppm. Table E.2.4–10 presents the Class 1 non-RCRA hazardous waste streams, current inventories as of December 2, 1994, and projected generation volumes.

Medical waste is defined as any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals; in research; or in the production or testing of biologicals. This waste includes cultures and stocks, pathological wastes, human blood and blood products, sharps, animal waste, and isolation wastes. Pantex currently generates approximately two boxes per week, each with a capacity of 0.142 m^3 (0.186 yd^3). The annual generation rate of medical waste at Pantex is approximately 15 m^3 (19 yd^3) (PX DOE 1995i:14–15). Medical waste is dispositioned through a commercial vendor who picks up and transports the medical facility's biomedical and infectious waste.

Nonhazardous Waste. The Sewage Treatment Quality Upgrade is a 1996 project at Pantex. This project would upgrade the Pantex sanitary system to ensure that wastewater standards are met through secondary/tertiary treatment. Included in this project is the upgrade of the existing sewage treatment lagoon, repair and replacement of existing deteriorated sewer lines, construction of a closed system to eliminate the use of open ditches for conveyance of industrial wastewater discharges, and implementation of a plant stormwater management system.

Class 2 nonhazardous waste (general refuse) is collected at each building from trash cans and placed in dumpsters. This includes cardboard, computer paper, white paper, colored paper, mixed steel, steel and aluminum cans, mixed metal, mixed plastic, foam rubber, and glass. Currently, telephone directories, paper, certain plastics, and some steel and aluminum cans are being recycled. The weights of Class 2 nonhazardous waste disposed from 1989 to 1994, and the estimated amounts for 1995 through 1999, are given in Table E.2.4–11.

Table E.2.4–1. Waste Treatment Facilities and Capabilities at Pantex Plant

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
Batch Master Hazardous Waste Tank System (Building 12-68)	Filtration, neutralization, and precipitation	Building 12-5C metal cleaning bath, plating process waste, sodium hydroxide radiator cleaner, and spent electrolyte solutions	Metal precipitates to Hazardous Waste Storage Pad and effluent to Wastewater Treatment Plant	Process as needed	Nonoperational due to pending closure
Building 11-15A	Immobilization	Mixed LLW	To be determined	185	Planned
Building 11-9	Immobilization	Mixed LLW	To be determined	185	Planned
Building 11-9S	Stabilization and macroencapsulation	Mixed LLW and hazardous waste	Sent to Hazardous Waste Treatment and Processing Facility when completed.	2 m^3/treatment	Also used as 90-day accumulation area for hazardous and mixed LLW. Maximum inventory of waste for facility is 6 m^3.
Building 11-50 (Wastewater Treatment Facility)	Filtration of organics and undissolved HE particles	HE machining operations	Playa 2	684	
Building 12-43 (HE Filtration Facility)	Filtration of HE and carbon	Explosive machining operations in Building 12-24	Playa 1	180	Sock filter and carbon filter
Building 12-73	Settlement and filtration	HE-contaminated water	Sanitary sewage system	Variable	Settling tank and fabric filter system
Burning ground: one cage, one tray, and one pan	Open burning or detonation	Solid mixed LLW and hazardous waste	Ash to 11-7N Storage Pad	909	Design capacity until 2001. Interim
Closed-loop decontamination system	Reduction	Contaminated lead (solid mixed LLW)	Acid bath (liquid mixed LLW), pH adjusted, and then solidified	Campaign	One process per year. Standby mode.
Compactor (Building 12-42)	Hydraulic ram compactor-in-drum compaction	Solid LLW (gloves, kimwipes, paper)	Compacted LLW in 17H 55-gal drums to storage magazine 4-56	Process as needed	No TRU waste, waste greater than Class C, mixed waste, free liquids, or gases
Hazardous Waste Treatment and Processing Facility	Immobilization repackaging, neutralization compaction, shredding, sorting, and solidification	Liquid and solid LLW, mixed LLW and hazardous waste	To be determined, may be stabilized solids	500	Available for treating mixed waste by 2000

Table E.2.4–1. Waste Treatment Facilities and Capabilities at Pantex Plant—Continued

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
Mobile Macroencapsulation	Immobilization	Solid mixed LLW	Macroencapsulated forms	125	Design capacity. Planned portable system.
Mobile Stabilization Treatment Process (Skid)	Precipitation and solidification	LLW	Immobilized forms	60	Mobile treatment planned
Sanitary Sewage Treatment System	Aeration and anaerobic microbial action	Sanitary sewage and industrial waste	Lagoon (chlorine treatment before release	2,460,000 l/day	Permitted flow. Operational flow about 1,610,000 l/day

[a] For those facilities already in use, this is a normal operating capacity; whereas, for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability funds and permit issuance.

Source: DOE 1993h; DOE 1994n; DOE 1995gg; PX DOE 1995i; PX DOE 1996b.

Table E.2.4–2. Waste Storage Facilities at Pantex Plant

Storage Unit	Input Capability	Total Capacity (m^3)[a]	Comment
Buildings 4-46, 4-72 and 4-74	Liquid and solid mixed LLW	187	Permitted capacity. Operating capacity is 120 m^3.
Buildings 11-7A and 11-7B	Liquid and solid mixed LLW	402	Permitted and operating storage capacity
Building 11-7N Pad	Liquid/solid hazardous waste, mixed LLW, and LLW	125	Interim Permit dated February 16, 1996. Permitted and operating capacity.
Building . 11-9N	Various liquid and solid hazardous wastes	379	Permit dated February 16, 1996. Permitted capacity. Operating capacity is 252 m^3.
Conex containers WM-1 to WM-8	Containerized solid mixed LLW and silver photo wastes	575	Permit dated February 16, 1996. Permitted capacity. Operating capacity is 120 m^3.
Conex containers WM-1A, WM-1B, WM-3A, WM-5A, WM-5B	Containerized liquid and solid LLW	377	Permitted capacity. Operating capacity is 75 m^3.
Conex containers (25)	Solid LLW	1,800	Each conex can store 72 55-gal drums (15 m^3) for an operating capacity of 375 m^3.
Magazine 4-50	Liquid/solid mixed LLW, hazardous waste and LLW	421	Permit dated February 16, 1996. Permitted capacity. Operating capacity is 40 m^3.
Magazine 4-56	Liquid and solid LLW	421	Temporary storage before shipping to NTS. Operating capacity is 40 m^3.
RCRA Hazardous Staging Facility (Building 16-16)	Containerized liquid/solid LLW and mixed LLW	1,050	Permitted capacity. Operating capacity is 333 m^3. Currently under construction.

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: DOE 1994n; PX DOE 1995i; PX DOE 1996b.

Table E.2.4–3. Low-Level Waste Streams at Pantex Plant

Sources	Waste Description	Radioactive Constituents	Primary Materials	Disposition
Assembly/ dismantlement operations	Debris from demilitarization and sanitization operations	Thorium, U–238, tritium	Generally noncompactible crushed/ granulated plastic and metal debris	Disposed of at DOE-approved offsite facility
Assembly/ dismantlement/ stockpile surveillance	Compactible material from normal assembly/dismantlement/stockpile surveillance	U–238, tritium, thorium, and plutonium	Lab wipes and other support materials	Disposed of at DOE-approved offsite facility
Assembly/ dismantlement and stockpile surveillance operations	Radiological materials from normal operations associated with weapons assembly, dismantlement, facility surveillance, container monitoring and routine sample counting operations	U–238, tritium, thorium, and plutonium	Protective clothing, wipes, swipes, tape, plastic and other material in the radiation protection program	Disposed of at DOE-approved offsite facility
Weapon component testing and evaluation	Debris generated during past testing of mock devices associated with any known waste stream	Depleted U–238 residue	Contaminated soil and gravel, additional miscellaneous materials	Stored onsite pending eventual shipment to DOE-approved disposal site
Decontamination products	Materials generated during the decontamination of a concrete assembly work cell (one-time generation).	Tritium	Protective clothing, concrete rubble, solidified liquids, tools, equipment, plastic and paper products containing tritium	Stored onsite pending eventual shipment to DOE-approved disposal site

Note: U=uranium.
Source: PX DOE 1995i.

Table E.2.4–4. Low-Level Waste Inventory at Pantex Plant

Waste Stream Name	Inventory as of December 2, 1994 (m^3)	Total Generation, Five-Year Projection (m^3)
Beryllium waste, radioactive	114[a]	0
Tritium contaminated waste (solid/liquid)	55	179
Lab packs, nonregulated radioactive (solid)	1	1
Contaminated soil, radioactive	8	0
Waste water	7	9
Contaminated metal, radioactive	2	0.02
Desiccant, radioactive	0.2	22
Plant refuse (paper, foam, rags, cardboard), radioactive	105	711
Miscellaneous ash, radioactive	9	0
Total	301	922

[a] One-time event; no further generation is expected.

Source: PX DOE 1995i.

Table E.2.4–5. Mixed Low-Level Waste Streams at Pantex Plant

Treatability Group	Waste Stream Name	Composition[a]	Process Description	Treatment Alternatives
Organic liquids	Paint waste—organic liquids	Paint and solvent	Stripping, surface preparation, and repainting	Planning packed bed reactor (Mobile Treatment Unit)
	Spent solvents	Freon, methyl ethyl ketone, HE, and dimethyl sulfoxide	Cleaning dissolution of HE	Planning hydrothermal oxidation (Mobile Treatment Unit) or offsite by commercial vendor
	Contaminated oils	Mercury-contaminated oil	Vacuum pump oil change	Planning packed bed reactor/silent discharge plasma (Mobile Treatment Unit)
Aqueous liquids	Wastewater	Water, HE, chromium, lead	Water-jet and thermal shock activities	Planning evaporative oxidation and stabilization (Mobile Treatment Unit)
	Alodine solution	Chromic acid, fluoride salt, and iron cyanide	Surface preparation before paint removal	Planning plating waste treatment (Mobile Treatment Unit)
	Metal cleaning waste	Water, iodine, nitric acid, uranium, thorium, cadmium, chromium, lead, and mercury	Etching and cleaning of metals	Planning plating waste treatment (Mobile Treatment Unit)
Homogenous solids	Wastewater sludge from explosives	Explosive contaminated solids, dimethyl sulfoxide	Filtering of wastewater with HE	Open-air burning
	Process residues	Residues resulting from treatment of mixed waste	Waste not generated until onsite mixed waste treatment commences in 2000	Planning stabilization by Mobile Treatment Unit
	Burning Ground ash	Inorganic ash residue, metals, and some unburned organic material	Burning of HE and HE-contaminated materials	Planning stabilization/barium sulfate (Mobile Treatment Unit)
Soils/gravels	Environmental Restoration potential mixed waste (soils)	Contaminated soils from solid waste management units, spill cleanup, drill cuttings, sample wastes, etc.	Environmental Restoration program site contaminated soils	Planning thermal desorbtion and stabilization
Debris waste	Solvent-contaminated solid material	Alcohol, kimwipes, filters, rags, leads, solvents	Weapon dismantlement and maintenance	Planning macroencapsulation
	Contaminated scrap metal	Contaminated scrap metal from demilitarized and sanitized weapons parts	Demilitarization and sanitation activities	Planning macroencapsulation
	Lead-contaminated waste	Seals and tape intermixed with gloves and paper	Demilitarization and sanitation activities	Planning macroencapsulation
	Mercury-contaminated solids	Glass bulbs, mercury-contaminated solids	Maintenance of lighting	Planning macroencapsulation

Table E.2.4–5. Mixed Low-Level Waste Streams at Pantex Plant—Continued

Treatability Group	Waste Stream Name	Composition[a]	Process Description	Treatment Alternatives
	Heterogeneous debris-metal contaminated waste	Metals, alodine, light ballasts, beryllium	Maintenance and special activities	Planning macroencapsulation
	Heterogenous debris	Solid wipes, gloves, and anti-C suits	Painting, paint removal, maintenance testing and disarmament activities	Planning macroencapsulation
	Plutonium contaminated solids	Personnel protection equipment, epoxy, floor sweepings, paint, and paint thinners	Dismantlement operations in Building 12-98	Planning macroencapsulation
	Contaminated support material and contaminated explosives	Support materials with HE residue, mercury, and solvents	Assembly/disassembly process	Planning macroencapsulation
Lab Packs	Lab Packs	Epoxy, uranium, acid, lead, thorium nitrate crystals	Disposal of chemicals from testing labs	Proposed radioactive surveying followed by preparation and onsite treatment is unable to reclassify hazardous wastes
	Miscellaneous organic liquids	Halogenated and nonhalogenated solvents	Paint, solvent, and special product material storage	Planning hydrothermal oxidation (Mobile Treatment Unit)
	Scintillation fluids	Scintillation fluids packaged with vermiculite	Radioactivity testing	Commercial treatment. Fluids need to be bulked first.
Special wastes	Used batteries	Nickel, cadmium, lead, silver, mercury, and asbestos	Dismantlement activities	Decontamination and downgrade to hazardous waste
	Lead waste	Portion of lead drum liners	Removal of lead liner from drum	Proposed treatment utilizing decontamination, macroencapsulation (Mobile Treatment Unit)
	Aerosol containers	Discarded spray paint cans	General maintenance	Decontamination

[a] Typical radionuclides that may be present in the mixed waste include uranium, thorium, and tritium.

Source: DOE 1994k; DOE 1995gg.

Table E.2.4–6. Organic Liquid Waste Streams Candidates for Commercial Treatment and/or Disposal

Waste Stream	Quantities of Waste (l)	Treatable Volume (l)	Composition[a]	Process Description
Lab packs[b]	4,030	988	Scintillation vials packed in cardboard boxes in vermiculite	Laboratory waste packages
Organic debris; solvent-contaminated	163	163	Joint test assembly cleanup water, oil, water	Support material
Spent solvent	3,920	1,740	Scintillation vials packed in cardboard boxes in vermiculite; joint test assembly cleanup water; freon with HE	Spent solvents
Mercury-contaminated liquids	492	492	Oil contaminated with mercury	Discarded oil from vacuum pumps in laboratory equipment; source of mercury contamination from samples analyzed in lab equipment
Total	8,605	3,383		

[a] Mixed LLW stream may include uranium, thorium, tritium, and Pu.

[b] Cardboard boxes and vermiculite used to packed scintillation vials will be recontainerized and treated as separate sampling lots.

Source: PX DOE 1995i.

Table E.2.4–7. Mixed Low-Level Waste Inventory at Pantex Plant

Treatability Group	Number of Waste Streams	Inventory as of September 1995 (m^3)	Total Generation, 5-Year Projection (m^3)
Aqueous liquids	4	2	24
Organic liquids	5	7	2
[Text deleted.]			
Inorganic solids	2	19	8
Compressed gases	1	0.004	None
Soils	1	None	190
Batteries	1	0.05	1
Debris waste	7	84	634
Liquid mercury	1	0.001	None
Lab Packs	1	2	2
Explosives	2	13	58
Total	25	127	919

Source: PX DOE 1995h.

Table E.2.4–8. Hazardous Waste Inventory at Pantex Plant

Waste Stream Name	Inventory as of December 2, 1994 (m^3)	Total Generation, Five-Year Projection (m^3)
Explosive-contaminated solid waste	4	23
Burning ground waste from thermal treatment	1	7
Lab packs (solid)	0.4	6
Photographic film	0	0.7
Lead waste	0	0.08
Spent halogenated and non-halogenated solvents and mixtures	0.7	34
Heavy metal contaminated parts	0	0.8
Contaminated soil[a]	0	14,800
Sodium hydroxide waste (solid)	0	8
Paint sludge	2	3
Wastewater from operations and monitoring[a]	0.4	34
Metal cleaner and photographic waste	0.05	13
Recyclable and non-recyclable used batteries	0.4	197
Solvent-contaminated solids	3	29
Mercury (solid/liquid)	0	0.01
Sandblasting waste	0.6	1
Lead-contaminated waste	0	0.7
Miscellaneous organics (solid/liquid)	0.4	15
Contaminated engine oil	0.1	2
Oil filter waste	0.02	0.5
Miscellaneous discards contaminated with heavy metals	23	356
Empty organic compressed gas cylinders	0.3	24
Recyclable scrap metal with precious metals	0.2	1
Total	36	15,556[b]

[a] These streams are primarily associated with Environmental Restoration activities.

[b] Of this total, approximately 550 m^3 is directly from weapon activities (components plus support materials), and the balance is from other plant activities.

Source: PX DOE 1995i.

Table E.2.4–9. Hazardous Quantities Shipped Offsite in 1994 at Pantex Plant

Description	Number of Shipments Containing Description	Quantity (kg)	Estimated Volume[a] (m^3)
Hazardous waste, solid, n.o.s.	9	14,200	9
Corrosive liquids, n.o.s.	2	538	0.5
Flammable liquids, n.o.s.	1	202	0.2
Hazardous waste, liquid, n.o.s.	2	149	0.2
Oxidizing substances, solid, corrosive, n.o.s.	1	166	0.1
Oxidizing substances, solid, poisonous, n.o.s.	1	6	<0.1
Poisonous liquids, n.o.s.	1	28	<0.1

[a] For those shipments in which only a mass quantity was provided, a volume estimate was made based on density factors of 1,000 kg/m^3 for liquids and 1,500 kg/m^3 for solids.

Note: n.o.s.=not otherwise specified.

Source: DOE 1995h.

*Table E.2.4–10. Class 1 Non-*Resource Conservation and Recovery Act *Hazardous Waste Inventory at Pantex Plant*

Waste Stream	Inventory as of December 2, 1994 (m^3)	Total Generation, 5-Year Projection (m^3)
Beryllium waste	0	740
Empty containers	142	985
PCB-contaminated solids	0.05	0.05
Crank case oil	1	260
Asbestos solids	13	24
PCB-contaminated oil	0	0.06
Paint residue	3	53
Contaminated soil[a]	5	2,354
Metal cleaning waste (solid)	0	0.3
Wastewater[a]	24	1,601
Recyclable and nonrecyclable photographic waste	0.02	0.3
Contaminated metal	0.1	0.7
Antifreeze and engine coolants	0.3	337
Desiccant	0	4
Plant refuse, such as paper, foam, rags, and cardboard	51	543
Used oil filters generated during maintenance	3	23
Miscellaneous ash	4	5
Resins, tar, or tarry sludge (excess material from laboratories)	3	36
Total	249	6,966

[a] These waste streams are primarily associated with Environmental Restoration activities.

Source: PX DOE 1995i.

Table E.2.4–11. Class 2 Nonhazardous Waste Disposal in Amarillo Landfill From Pantex Plant

Year	Total Disposal (kg)	Total Volume of Disposal (m^3)
1989[a]	79,600	53
1990	335,000	223
1991	307,000	205
1992	371,000	247
1993[b]	428,000	285
1994	589,000	393
1995-1999 (estimate)[c]	2,610,000	1,740

[a] Contract for disposal began in 1989 and included only approximately 3 months.

[b] Recycling was stopped midyear because of low cost-effectiveness.

[Text deleted.]

[c] Waste minimization efforts are expected to provide an average reduction of 4 percent each year.

Source: PX DOE 1995i.

E.2.5 OAK RIDGE RESERVATION

The Oak Ridge Reservation consists of three operating industrial complexes in and around the City of Oak Ridge. The Energy Systems Waste Management Organization provides the waste management oversight for ORR. It also provides guidance to each of the operating facility waste management divisions that are responsible for operating and managing their respective waste management facilities and activities.

Y–12 Plant

Laboratory, maintenance, construction, demolition, and cleanup activities; machining operations; and waste produced in the purification of uranium for recycle are the primary waste generation activities at the Y–12 Plant (Y–12). In addition, metal-plating operations generate plating waste solutions, while various laboratory activities generate reactive wastes and waste laboratory chemicals. Liquid process waste and the sludge resulting from their treatment are generated throughout the plant. Waste oils and solvents are generated from machining and cleaning operations. Daily operations, such as janitorial services and floor sweepings, generate both noncontaminated and uranium-contaminated industrial trash.

Pollution Prevention. The Y–12 Pollution Prevention Awareness Program Plan describes the overall program in detail. The program is designed to maintain the flow of information pertaining to waste minimization and pollution prevention and to facilitate activities to implement real reductions in waste generation. A summary description of the four key elements of the Waste Minimization and Pollution Prevention Program includes a promotional campaign, information exchange, a waste tracking system, and waste assessment performance.

One goal of the program is to sustain an effective pollution prevention effort by improving the employee awareness of waste minimization opportunities and activities. Improved awareness is accomplished through including training, posters, publications, seminars, promotional campaigns, and recognition of individuals and teams for activities that reduce waste generation. Waste minimization activities at other ORR sites and other weapons sites provide useful input to the program. Using ideas developed by others is an important aspect that can save time and resources.

Tracking waste generation in a manner that lends itself to waste minimization reporting is a prerequisite to documenting successes or failures in waste minimization efforts. Y–12 is improving its ability to record and track waste shipments. Process waste assessments are being conducted as part of the ongoing program to identify, screen, and analyze options to reduce the generation of waste. This determines the amount of material in a workplace that is disposed of as waste during work operations. The assessment provides a summary of hazardous materials usage and waste production, and it identifies those processes and operations that need to be improved or replaced to promote waste minimization.

Spent Nuclear Fuel. Y–12 does not generate any spent nuclear fuel; however, it does store and safeguard a small amount of reactor-irradiated nuclear material in Building 9720-5, a large warehouse facility containing numerous vaults for storage. Some features of the facility are classified and it is distinguished by its high level of security. Operations consist of transfers, storage, and inventory of highly enriched uranium (HEU) in containers of various types.

High-Level Radioactive Waste. Y–12 does not generate or manage HLW.

Transuranic Waste. Y–12 does not generate or manage TRU waste.

Low-Level Waste. Machining operations that use stock materials including steel, stainless steel, aluminum, depleted uranium, and other materials produce machine turnings and fines as waste products. Waste treatment provides controlled conversion of these waste streams to an environmentally acceptable, or more efficiently handled or stored, form. This activity includes continuing operation and maintenance of facilities that treat

wastewaters and solid waste generated from production and production support activities. Waste minimization and planned treatment facilities are expected to reduce the magnitude of these wastes. In 1994, Y–12 treated approximately 899,000 l (237,000 gal) of liquid LLW and 2,730 m^3 (3,580 yd^3) of solid LLW (OR LMES 1996a:5-6). Table E.2.5–1 summarizes the LLW treatment facilities at Y–12. The major facilities are described below.

The Uranium Chip Oxidation Facility thermally oxidizes depleted and natural uranium (less than 1-percent enrichment) machine chips under controlled conditions to a stable uranium oxide. Upon arrival, chips are weighed, placed into an oxidation chamber, and ignited. The oxide is transferred to drums and transported to the uranium oxide storage vaults. Since the facility is not designed to treat uranium sawfines, these are currently blended with uranium oxide and placed in the oxide vaults as a short-term treatment method.

The Waste Feed Preparation Facility processes and prepares solid LLW for volume reduction through incineration by an outside contractor or storage at Y–12. The facility utilizes a 200 t capacity baler to reduce the waste volume to one-eighth of its original size. Waste comes to the facility from areas known to generate contaminated material, or from dumpsters that were analyzed at the trash monitoring station and deemed to be above the radioactive acceptability limits for the sanitary landfill. The compacted bales are placed in DOT-approved metal boxes and staged in an adjacent warehouse prior to offsite shipment for incineration or storage at Y–12.

The Uranium Treatment Unit is near Building 9206 and was used to treat uranium-contaminated nitrate waste solutions that were generated in enriched uranium recovery operations in Buildings 9212 and 9206. The RCRA closure plan for this unit was issued in March 1995 and is awaiting approval from the State.

The Waste Coolant Processing Facility is a biodegradation and storage facility for waste coolants that may be LLW. It uses the following equipment for coolant treatment:

- Three storage tanks
- Feed tank
- Waste processing reactor/clarifier
- Sludge holding tank
- Two sludge blenders/dryers
- Effluent holding tank
- Transfer pumps

Microorganisms biodegrade approximately 114,000 l (30,000 gal) of waste coolant per month into harmless products. Each batch of coolant takes approximately 30 days to treat. After treatment, the clarifier separates the wastes into three process streams: floating oily solids, liquid effluent, and settled biological solids. Floating solids are dewatered in the dryer/ribbon blender and are transferred to drums. Liquid effluent is sent to the Central Pollution Control Facility or West End Treatment Facility/West Tank Farm for final treatment prior to NPDES discharge. Biological solids are further treated in the aeration tank and then recycled or sent through the blender for dewatering. Nonrecycled solids are currently pumped into tankers for storage. This practice will continue until adequate treatment and disposal methods are established.

Long-term storage options include warehouses, tanks, and vaults, as well as storage of Y–12 wastes in buildings at K–25. The major Y–12 LLW storage facilities, described below, are summarized in Table E.2.5–2. As of June

1995, approximately 2,320 m^3 (3,040 yd^3) of LLW and 4,740 m^3 (6,200 yd^3) of uranium-contaminated scrap metal were stored at Y–12 (OR LMES 1996a:5-12).

The Classified Waste Storage Facility will provide for the permitted storage of solid LLW and mixed LLW, which is classified for national security purposes under provisions of the AEA. These wastes are currently being stored by the waste generators. The facility, located in Building 9720-25, will meet plant security requirements for classified waste management and guidelines for the management of LLW and mixed LLW.

The Containerized Waste Storage Area near Buildings 9206 and 9212 provide storage for cans of ash resulting from the combustion of uranium-contaminated solid wastes. Combustible solid wastes contaminated with enriched uranium are ashed during the uranium recovery process. The cans of ash are stored until uranium accountability results have been obtained and the material can be returned to the uranium recovery process for further processing to recover the enriched uranium.

The Depleted Uranium Oxide Storage Vaults I and II are on Chestnut Ridge, northeast of Building 9213. The vaults are constructed of reinforced concrete and provide a retrievable storage repository for uranium oxide, uranium metal, and a blended mixture of uranium sawfines and oxide. The vaults contain a negative-pressure exhaust system that operates during material entry. The exhaust is filtered and monitored prior to its release to the atmosphere. The facility uses forklift trucks, electric hoists, and a motorized drum dumper during operation. Depleted uranium oxide and blended sawfines are delivered in sealed 113- and 208-l (30- and 55-gal) drums, with a weight limit of 386 kg (850 lb).

The Old Salvage Yard contains both low-level uranium-contaminated and nonradioactive scrap metal. Most scrap currently sent to this facility is contaminated. The Contaminated Scrap Metal Storage Area of the Old Salvage Yard is used to store uranium-contaminated scrap metal. Contaminated scrap is placed in approved containers and eventually will be transferred to above-ground storage pads. Noncontaminated scrap is sold when offsite shipments are allowed. This facility is at the west end of Y–12.

Y–12 has no current onsite LLW disposal capability. All disposal activities at the Bear Creek Burial Ground were terminated on June 30, 1991. This landfill was used to dispose of radiologically contaminated solid waste. These wastes are currently containerized and stored at Y–12 in above-grade storage pads or are shipped offsite for incineration. In 1994, approximately 1,710 m^3 (2,240 yd^3) of solid nonmetallic LLW were sent offsite to be compacted or incinerated and the ash returned to Y–12 for storage (OR LMES 1996a:5-8). Also, 1,630 m^3 (2,140 yd^3) of contaminated scrap were sent offsite to be smelted. The proposed LLW disposal facilities project would provide new disposal facilities at a centralized ORR location. The proposed LLW disposal facilities would use state-of-the-art disposal technologies, including lined trenches with leachate collection treatment capabilities and tumulus confinement disposal units. The Class-II facility, for wastes contaminated with very low concentrations of short (less than 30 years) half-life radionuclides, is expected to be operational in 2002. DOE has indefinitely postponed construction of the Class-I facility, for wastes contaminated with very low concentrations of predominantly long (greater than 30 years) half-life radionuclides.

Mixed Low-Level Waste. Mixed LLW is generated from the development, metal preparation, fabrication, and assembly/industrial engineering functions at Y–12. Mixed LLW is hazardous waste such as solvents, degreasers, biodegradable coolants, organic and inorganic acids, biodenitrification sludge, and wastewater that is contaminated with enriched and/or depleted uranium. There is no disposal of mixed waste at Y–12; however, future plans include disposal of mixed waste at a permitted offsite commercial facility. Mixed wastes are put in storage awaiting treatment or disposal, treated at Y–12, or sent to another ORR facility for treatment or disposal. Table E.2.5–3 presents the inventory of mixed LLW at Y–12 as of December 1994, along with a 5-year projection. In 1994, approximately 766,000 l (202,000 gal) of liquid mixed LLW was treated at Y–12 (OR LMES 1996a:7-6). The Y–12 Waste Management Division operates several mixed LLW treatment facilities, which are described below and are summarized in Table E.2.5–1.

The Groundwater Treatment Facility treats wastewater from the liquid storage facility at Y–12 and seepwater collected at K–25 to remove volatile and nonvolatile organic compounds and iron. The facility is part of the disposal area remedial action program to collect and treat contaminated groundwater from the Bear Creek Burial Grounds. The facility, located at the far west end of Y–12 adjacent to the West End Treatment Facility, utilizes an air stripping operation to remove volatile organics. In addition, carbon adsorption eliminates nonvolatile organics and PCBs. Iron removal equipment is also operational. After treatment, wastewater is sampled and recycled if additional processing is required. Wastewater that meets discharge specifications is pumped into East Fork Poplar Creek through an NPDES monitoring station. The Groundwater Treatment Facility treated and discharged approximately 1,206,000 l (319,000 gal) during 1992 (DOE 1994k).

The West End Treatment Facility/West Tank Farm treats the following nitrate-bearing wastes generated by Y–12 production operations: nitric acid wastes, nitrate-bearing rinsewaters, mixed acid wastes, waste coolants, mop water, caustic wastes, and biodenitrification sludges. Treatment operations consist of biological denitrification, biological oxidation, metals precipitation, coagulation, flocculation, clarification, filtration, pH adjustment, degassification, and carbon adsorption. Wastes are received at the West End Treatment Facility/West Tank Farm in 18,900-l (5,000-gal) tankers, 2,270-l (600-gal) polytanks, and in smaller, approved waste transportation containers such as drums, bottles, and carboys. Detailed waste analysis documentation is used to determine the treatment scheme and temporary storage location of each shipment. The West End Treatment Facility effluent polishing system facilitates the removal of uranium, trace metals, and suspended solids. The treated wastewater is then discharged to East Fork Poplar Creek through an NPDES monitoring station. Sludges, spent carbon and spent filter material generated during the treatment processes are currently stored in 1,890,000-l (500,000-gal) tanks. A major modification to the West End Treatment Facility/West Tank Farm is currently in the design phase. This modification will remove all heavy metals up front, thus separating the hazardous sludge from the nonhazardous sludge. Approximately two-thirds of the current sludge volume generated can then be disposed of as nonhazardous waste.

The Y–12 Cyanide Treatment Unit provides storage and treatment of waste solutions containing metallic cyanide compounds from spent plating baths and precious metal recovery operations or other areas. The cyanide reduction process is currently performed in 208-l (55-gal) containers. After waste is treated at the Cyanide Treatment Unit, it is transferred to the West End Treatment Facility, where it is further treated then discharged to the East Fork Poplar Creek.

As of June 1995, approximately 15,000 m^3 (19,600 yd^3) of mixed LLW were projected to be stored at Y–12 (OR LMES 1996a:7-21). Table E.2.5–2 summarizes the mixed LLW storage facilities at Y–12 that are described below.

The Containerized Waste Storage Area consists of three concrete pads covering approximately 2,320 m^2 (24,800 square feet [ft^2]). These pads provide storage for LLW, RCRA hazardous, and mixed LLW. An impermeable dike surrounding each pad provides 0.3 m (1 foot) of spill containment. Fire protection at this facility will be upgraded, contingent on funding.

The Building 9811-1 RCRA Storage Facility (OD7 and OD8) contains a diked tank storage area (OD7) and an enclosed containers storage area (OD8) with a capacity of 1,000 drums. OD7 contains four 114,000-l (30,000-gal) tanks, two 37,900-l (10,000-gal) tanks, and associated piping and pumps. At OD8, RCRA waste oil/solvent mixtures containing various concentrations of chlorinated and nonchlorinated hydrocarbon solvents, uranium, trace PCBs, and water for specific chemical constituents are stored in 208-l (55-gal) drums and 1,140-l (300-gal) Tuff-tanks to await sampling and analytical results. Wastes deemed compatible with OD7 materials are pumped into the OD8 Tuff-tanks. Noncompatible wastes are transported to other facilities.

The Waste Oil/Solvent Storage Facility (OD9), a permitted RCRA/TSCA hazardous waste storage facility, consists of a diked area supporting five 151,000-l (40,000-gal) tanks, a tanker transfer station with five centrifugal transfer pumps, and a drum storage area. Three tanks house PCB wastes contaminated with uranium,

one tank contains nonradioactive PCB wastes, and one tank holds RCRA hazardous wastes. A diked and covered pad furnishes space for 33 m^3 (43 yd^3) of containerized wastes. Wastes assigned to this facility are first stored at OD8 (Building 9811-1 RCRA storage facility) to await laboratory results. The diked area has additional space for a sixth 151,000-l (40,000-gal) tank. This facility is projected to be used until 2010, due to the anticipated lack of disposal outlets for uranium-contaminated organic liquids.

The Liquid Organic Waste Solvent Storage Facility (OD10) contains four 24,600-l (6,500-gal) and two 11,400-l (3,000-gal) stainless steel tanks for storage of ignitable nonreactive liquids, including those contaminated with PCBs and uranium. In addition, a diked and covered storage area provides space for 40,000 l (10,600 gal) of containerized waste. The facility is capable of segregating various spent solvents for collection and storage. Major solvent waste streams are transferred to tanks until final disposition.

The Building 9720-9 Storage Area has a drum storage area for mixed and PCB wastes, including an area designed to contain flammable wastes. The western half of the facility, with space for approximately 1,500 drums, stores both PCB and RCRA hazardous waste. The facility's eastern half is not currently in use. Upgrades are under way on ventilation, diking, and fire-suppression systems to comply with RCRA, TSCA, and DOE standards and to allow for mixed and PCB waste storage.

The RCRA Staging and Storage Facility (Building 9720-31) prepares solid, liquid, and sludge wastes for offsite shipment. The facility consists of seven storage rooms and seven staging rooms, each with a separate ventilation system. The staging rooms house small containers that are packed with compatible materials and shipped. The storage rooms hold larger containers, such as 208-l (55-gal) drums. Each room, which can hold up to 90 drums, accommodates a different class of hazardous waste.

The RCRA and PCB Container Storage Area (Building 9720-58) is a warehouse facility used for staging prior to treatment or disposal of PCB-contaminated equipment (transformers, capacitors, and electrical switchgear) and nonreactive, nonignitable RCRA waste contaminated with uranium. Waste containers received at Building 9720-58 include 114- and 208-l (30- and 55-gal) drums, 1,250- and 2,500-l (330- and 660-gal) portable tanks, B-25 boxes, and self-contained PCB equipment.

The Solid Storage Facility provides 1,630 m^2 (17,500 ft^2) of storage space for PCB- and uranium-contaminated soil. The facility also has a synthetic liner for leachate collection and a leak detection system. Collected leachate is transferred to the liquid storage facility for pretreatment. The solid storage facility is currently undergoing the RCRA Part B permitting process. No additional wastes are being added to the facility.

Hazardous Waste. Plating rinsewaters; waste oil and solvents from machining and cleaning operations; contaminated soil, soil solutions, and soil materials from RCRA closure activities; and waste contaminated with hazardous constituents from construction/demolition activities are the major sources of hazardous waste at Y–12. In 1994, approximately 15,500,000 l (4,090,000 gal) of hazardous liquid were treated (OR LMES 1996a:6-3). [Text deleted.] In 1994, approximately 190 m^3 (250 yd^3) of PCB hazardous material was shipped offsite for treatment (DOE 1995h). The Y–12 Waste Management Division operates several hazardous treatment facilities that are described below and are summarized in Table E.2.5–4.

The Plating Rinsewater Treatment Facility treats dilute plating rinsewaters contaminated primarily with chromium, copper, nickel, and zinc. It can also treat cyanide-bearing wastes and remove chlorinated hydrocarbons. The design capacity for this facility is 30.3 million l/yr (8 million gal/yr). Under normal conditions, the facility treats 852,000 l (225,000 gal) of plating rinsewater per year (DOE 1995gg). The facility is across the street from the Building 9401-2 Plating Shop, which produces most of Y–12's rinsewaters. The facility neutralization, equalization, and cyanide destruction equipment is located outdoors in a diked basin. The remainder of the process is located in Building 9623. Rinsewaters are received via a direct pipeline from the plating shop, but they can also be received in tankers, polytanks, or in any acceptable waste shipping container. The Plating Rinsewater Treatment Facility performs the following treatment operations: potential of

hydrogen (pH) adjustment, flow equalization, heavy metal removal by electrochemical precipitation, flocculation, and clarification. After the clarification operation, the rinsewater is transferred to the Central Pollution Control Facility. That facility provides the carbon adsorption operation, final filtration, and discharge to East Fork Poplar Creek through an NPDES monitoring station. Treated rinsewater is sometimes recycled for use as makeup water for Central Pollution Control Facility processes. Sludge from the clarification process is transferred to the Central Pollution Control Facility, then taken to the West Tank Farm for interim storage.

The Steam Plant Wastewater Treatment facility treats approximately 233 million l/yr (61.5 million gal/yr) of wastewater from steam plant operations, demineralizers, and coal pile runoff (OR LMES 1996a:8-4). Treatment processes include wastewater collection/sedimentation, neutralization, clarification, pH adjustment, and dewatering. The facility, which is managed by the Y–12 utilities department, uses automated processes for continuous operation. All solids generated during treatment are nonhazardous and are disposed of in the sanitary landfill. The treated effluent is monitored prior to NPDES discharge to the East Fork Poplar Creek.

Hazardous waste is being stored until the management and operations contractor and DOE approve shipment for offsite disposal under the DOE "No Rad Added" performance objective. As of June 1995, approximately 34 m^3 (44 yd^3) of hazardous waste was stored at Y–12 (OR LMES 1996a:6-6). Table E.2.5–5 summarizes some of the major existing Y–12 hazardous waste storage facilities described below.

The Oil Landfarm Soils Storage Facility contains approximately 420 m^3 (550 yd^3) of soil contaminated with PCBs and volatile organics (OR DOE 1993a:9-21). The soil was excavated from the oil landfarm and tributary 7 in 1989. The soil is contained in a covered, double-lined concrete dike with a leak-detection system. The leak-detection system will soon be modified to enhance detection capabilities.

The Liquid Storage Facility of the Disposal Area Remedial Actions Liquid Storage Treatment Unit is a hazardous waste storage facility built during the Bear Creek Burial Ground closure activities. It is located in Bear Creek Valley approximately 3.2 kilometers (2 miles) west of Y–12. It collects and stores groundwater and other wastewaters received from the seep collection lift station, the solid storage facility, tankers, polytanks, and the diked area rainfall accumulation. Feed streams may contain oil contaminated with PCBs, volatile and nonvolatile organic compounds, and heavy metals. Processing and storage equipment include:

- Two 284,000-l (75,000-gal) bulk storage tanks
- 22,700-l (6,000-gal) oil storage tank
- Gravity separator
- Filtering unit
- Composite sampling station
- Tanker transfer station

The wastewater travels through the gravity separator, cartridge filters, and composite sampling station prior to storage in the bulk tanks. A reinforced concrete dike surrounds all equipment to provide spill containment. After sufficient wastewater accumulates in the bulk storage tanks, it is processed at the groundwater treatment facility. A new leachate collection system collects and pumps hazardous waste seepage from the burial ground to the Liquid Storage Facility.

The Y–12 Waste Management Division operates Industrial Landfill V, which is used for disposal of industrial and institutional solid waste and special waste, such as asbestos materials, empty aerosol cans, materials contaminated with glass, fly ash, coal pile runoff sludge, empty pesticide containers, and steam plant wastewater

treatment facility sludge. The landfill area is on Chestnut Ridge, near the eastern end of the plant, and serves Y–12, Oak Ridge National Laboratory (ORNL), K–25, and other DOE prime contractors at Oak Ridge. The landfill utilizes shallow land burial by the area fill method and is permitted by the State of Tennessee. Requests are filed with the state to provide disposal for additional materials as needed.

The Chestnut Ridge borrow area waste pile (Industrial Waste Landfill III) consists of mercury-contaminated soil removed from the Oak Ridge Civic Center area and deposited at Y–12 Chestnut Ridge. No other waste has been disposed of at this site.

Nonhazardous Waste. Major waste-generating activities include construction and demolition activities that produce large volumes of noncontaminated wastes, including lumber, concrete, metal objects, soil, and roofing materials. Industrial trash is generated by daily operations throughout the plant. These operations include janitorial services, floor sweepings in production areas, and production activities. In 1994, the Y–12 Plant generated 228 million l (60.3 million gal) of industrial and sanitary liquid waste that included oils and solvents, operational wastewater, Central Pollution Control Facility/Plating Rinsewater Treatment Facility wastewater, steam plant wastewater, environmental restoration waste, and liquid waste received from ORNL and K–25 (OR LMES 1996a:8-3). The waste storage facility in Building 9720-25 has a solid waste baler with an 8:1 compaction ratio (DOE 1994n). Approximately 41,700 m^3 (54,700 yd^3) of solid nonhazardous waste was compacted and/or stored during 1994 (OR LMES 1996a:8-3).

The Sludge Handling Facility (T-118) was designed and constructed to provide water filtration and sludge dewatering in support of a storm sewer cleaning and relining project. Filtered water was reused by the sewer-cleaning contractor, and the dewatered sludge was stored in specially constructed containers for future disposal. The facility is currently being used to store containers of LLW.

The Steam Plant Ash Disposal Facility is used to collect, dewater, and dispose of sluiced bottom ash generated during operation of the coal-fired steam plant. An additional trench was constructed for the disposal of sanitary and industrial wastes generated by ORNL, K–25, and Y–12. In order to comply with environmental regulations for landfill operations, the Steam Plant Ash Disposal Facility includes a leachate collection system, a transfer system to discharge the collected leachate into the Oak Ridge public sewage system, groundwater monitoring wells, and a gas migration/ventilation system.

In 1992, approximately 677 m^3 (887 yd^3) of clean scrap metal was stored at Y–12 (OR DOE 1993b:9-6). The New Salvage Yard is used for the staging and public sale of nonradioactive, nonhazardous scrap metal. Sales have been suspended, however, until procedures to meet the DOE "No Rad Added" performance objective have been approved. The New Salvage Yard provides accumulation and sorting activities for nonradiologically contaminated scrap metal. Plans are in place to provide an automotive lead cell battery repository for used batteries until recycling options are initiated. This facility is located near the Bear Creek Burial Ground.

The new Industrial Landfill V and Construction Demolition Landfill VI permit disposal of 93,500 m^3/year (yr) (122,000 yd^3/yr) of industrial and sanitary waste (OR LMES 1996a:8-7). The facilities were designed and are operated in accordance with Tennessee solid waste disposal regulations. A baler, located in Building 9720-25, is used to compact sanitary/industrial waste destined for Industrial Landfill V.

Oak Ridge National Laboratory

Because ORNL is a research facility, it has many diverse waste-generating activities, each of which may produce only a small quantity of waste. Isotope production, utilities, and support functions such as photography are additional sources of waste. The radioactive wastes produced by each activity reflect the nature of its operation. A large number of radioisotopes are handled in isotope production and packaging, in reactor and accelerator operations, in reprocessing studies on nuclear fuel, and in investigations into the interactions of

radioactivity with living systems. The radioactive wastes generated by these activities can be classified as follows:

- Concentrates generated by the treatment of intermediate-level wastes, which are disposed of by hydrofracture.
- LLW contaminated with beta/gamma-emitting radioactivity. These wastes, which have a low surface dose rate, are compacted if possible and disposed of in earthen trenches; those wastes which exhibit a high surface dose rate are disposed of in augered holes.
- TRU wastes, which are retrievably stored.
- Low-level alpha-emitting wastes, which are evaluated for criticality hazards before disposal in augered holes.

Pollution Prevention. Waste segregation is used to minimize the generation of solid LLW. By providing collection barrels for both radioactive and nonradioactive wastes, the volume of wastes that requires handling as radioactive waste has been reduced. Before these procedures were implemented, radioactive and nonradioactive wastes were discarded in the same barrel. This contaminated the nonradioactive portion and inflated the amount of waste that required special disposal.

Spent Nuclear Fuel. ORNL generates small quantities of spent nuclear fuel. Several facilities are used to house spent nuclear fuel (DOE 1993r:28-29):

- The Irradiated Fuels Examination Laboratory (Building 3525) only contains hot cells. Disassembly and examination of irradiated fuel and components continue to be the mission of the facility.
- The High Level Radiochemical Laboratory (Building 4501) contains centrally located hot cells supported by various laboratories capable of handling radioactive material. It has been used in performing work on fission gas release in light water reactor fuel rods. The spent nuclear fuel is in dry storage.
- The Radiochemical Engineering Development Center (Building 7920) is a multipurpose hot cell facility with the appropriate equipment, shielding, and containment provisions to safely process and store large quantities of highly radioactive fuel elements. It was specifically built to prepare and process targets for the High Flux Isotope Reactor.
- The Bulk Shielding Reactor, a pool-type research reactor, is currently shut down and its core is stored in racks. Fuel assemblies from the Oak Ridge research reactor are also stored in the pool.
- The High Flux Isotope Reactor is an 85-megawatt (MW), beryllium-reflected, light-water-moderated, flux-trap-type research reactor with associated support equipment and a storage pool. Missions include production of isotopes for medical and industrial applications, neutron-scattering experiments, and various material irradiation experiments. This is the only reactor that is still generating fuel elements that will need storage in the future.
- The Molten Salt Reactor Experiment is an 8-MW, homogeneous reactor consisting of uranium fluoride fuel in molten lithium salt. Its purpose was to test the practicality of a molten-salt reactor concept for central power station applications. The fuel is being stored in the salt storage tanks beneath the reactor.

- The Tower Shielding Reactor is a reactor facility where experiments were conducted outdoors on a remote hilltop. It is a spherically symmetric 1-MW plate-type reactor. The purpose of the facility was to conduct large-scale experiments to test shielding design methods and obtain associated data. The original core is located in the reactor. Four fuel plates are stored in the underground site, and 1,200 low-enriched fuel pins are stored in DOT shipping containers.

- Wells 7823A/7827/7829 are stainless-steel dry wells placed in the ground to provide shielded, retrievable storage facilities. They are currently closed to further storage. The wells were used to store irradiated fuel and associated fission products from 1972 to 1989.

- Waste Area Grouping 7 (Homogeneous Reactor Experiment wells) consists of seven augered holes that were drilled in 1964 to store 511 l (135 gal) of a 40-molar fuel solution. Each well was filled to ground level with soil and marked by a concrete plug and brass plaque.

- The Classified Burial Ground is now closed to operations but in the past, fuel materials were buried there. The exact quantity and location of all this material is not known.

- Solid Waste Storage Area 6 houses the suspension test reactor fuel. Seven of the underground dry-storage units are empty, although one unit has been found to contain water and another contains moist sand. These units are, therefore, not available for additional storage.

- The Building 9720-5 Vault houses the fissile components of the health physics research reactor, a DOE demonstration reactor, and the Space Nuclear Auxiliary Power-10A reactor. The building also stores HEU, which would require significant coordination with safeguards and security as well as transportation personnel.

A summary table of the inventory of reactor-irradiated nuclear material is shown in Table E.2.5–6.

High-Level Radioactive Waste. ORNL does not generate or manage HLW.

Transuranic Waste. Table E.2.5–7 presents the inventory of TRU and mixed TRU wastes at ORNL as of December 31, 1994, along with a 5-year projection. As of December, 1994, approximately 654 m^3 (857 yd^3) of contact-handled TRU waste were stored at ORNL. The amount of remote-handled TRU waste was approximately 59 m^3 (78 yd^3) (DOE 1995gg). Approximately 748 m^3 (973 yd^3) and 1,656 m^3 (2,153 yd^3) is contact and remote-handled mixed TRU, respectively. The bulk of ORNL's mixed TRU waste is in three liquid/sludge waste streams that are currently stored in tanks. Each tank's wastes must be remotely handled because of the high radioactivity. ORNL's underground storage tank management program includes implementation of leak detection, corrosion protection, spill and overflow protection, annual tightness testing, operational controls, record keeping, reporting, and replacement of those systems that cannot be upgraded by 1998. The program also addresses the immediate removal from service and remediation of sites with tanks found to be leaking, and it implements any required closures, corrective actions, and any upgrading and/or replacement of affected tanks in accordance with the regulatory requirements. Status of the tanks managed under the *Underground Storage Tank Program* is as follows:

- Twenty-six tanks have been excavated or permanently taken out of service (20 have been approved by Tennessee as closed; 6 require additional investigation and/or corrective action before final closure approval).

- Twenty-four tanks are deferred from 40 CFR 280. These will be taken out of service or upgraded.

- Two tanks were upgraded in 1990 to meet the current leak-detection requirements.

- Two tanks contain heating oil and are excluded from regulation under 40 CFR 280.
- Five tanks contain waste oil contaminated with radionuclides and are excluded under 40 CFR 280.

Solid TRU waste consisting of filters, paper, metals, and other items is generated at ORNL through laboratory, pilot plant, and reactor operations. This includes both contact-handled and remote-handled waste contaminated with lead and, in some cases, mercury. Since there is no TRU waste treatment facility at ORNL, generated TRU waste is being placed in retrievable storage. Contact-handled TRU waste is predominantly packaged in drums, while remote-handled waste is packaged in concrete casks. In 1994, approximately 105 m^3 (138 yd^3) of contact-handled and 63 m^3 (83 yd^3) of remote-handled TRU waste were placed in storage (OR LMES 1996a:4-4a). Current activities center around certification of contact-handled waste, planning and designing of a repackaging and certification facility for remote-handled wastes, and planning for shipment of wastes to WIPP or another suitable repository should WIPP prove to be unsatisfactory. The repackaging facility, located in Building 7880, is called the waste handling and packaging plant and is planned for 2001. Tables E.2.5–8 and E.2.5-9 summarize the storage and treatment facilities for TRU and mixed TRU wastes at ORNL.

The ORNL Waste Examination and Assay Facility, Building 7824, is used primarily for nondestructive examination and assay of the contents of waste containers of TRU wastes and LLW to verify compliance with the receiving (storage or disposal) facility waste acceptance criteria. The facility is also used for the nondestructive assay of nonwaste materials. It is located within the confines of SWSA-5 in the Melton Valley area of ORNL.

Low-Level Waste. Isotope production and research activities generate a variety of liquid LLW, including low-level wastewater. Sources of solid LLW include contaminated equipment, filters, paper, rags, plastic, and glass and sludge from the process waste treatment plant. Table E.2.5–9 shows the LLW treatment facilities that are operating at ORNL. In 1994, 143 m^3 (187 yd^3) of solid LLW were received prior to compaction and 189,000 l (49,800 gal) of liquid LLW were solidified at ORNL (OR LMES 1996a:5-7). Approximately 462 m^3 (605 yd^3) were sent offsite to be compacted and/or incinerated (OR LMES 1996a:5-8).

Solid LLW, including scrap metal, is placed in storage prior to disposal. As of June 1995, approximately 1,690 m^3 (2,210 yd^3) of solid LLW and 2,970 m^3 (3,890 yd^3) of radioactive scrap metal were in storage awaiting disposal at ORNL (OR LMES 1996a:5-13). Table E.2.5–10 lists the LLW and mixed LLW storage facilities currently operating at ORNL.

The SWSA-6 area at ORNL is the only active onsite disposal unit at ORR. It receives solid LLW from ORNL only, including radioactively contaminated asbestos. As of the end of 1995, approximately 340 m^3 (445 yd^3) of solid LLW were buried at SWSA-6 (OR LMES 1996a:5-16). This does not include 355 m^3 (465 yd^3) buried at three silos and a trench that was closed at the end of 1993 (OR MMES 1995c:5-29). Table E.2.5–11 lists the LLW disposal facilities at SWSA-6.

Mixed Low-Level Waste. Mixed wastes are generated by research projects and some facility operations. Isotope production and research activities generate a variety of mixed low-level and mixed TRU wastes. Table E.2.5–12 presents the inventory of mixed LLW at ORNL as of December 31, 1994, along with a 5-year projection.

As shown in Table E.2.5–9, three facilities are currently treating mixed waste at ORNL: the Process Waste Treatment Plant, the Liquid LLW Evaporation Facility, and the Melton Valley LLW Immobilization Facility (DOE 1995gg). One other treatment facility, the Nonradiological Wastewater Treatment Plant, is operating and could be used to treat mixed waste.

The Process Waste Treatment Plant is designed to treat process wastewaters, groundwater, and evaporator condensate wastewaters that contain low levels of radioactivity. Small concentrations of radioactive materials

have occasionally been processed. Process wastewaters may contain small quantities of radionuclides, metals, anions, and organic chemicals. Under normal operating conditions, the process waste treatment plant can process wastewater at a rate of 492 l/minute (min) (130 gal/min). The design capacity is 757 l/min (200 gal/min) (DOE 1993h:26.2-5). Wastewaters can contain organic materials and low levels of radioactivity. The facility can treat waste streams with some heavy metals but not streams containing PCBs.

The Liquid LLW Evaporation Facility treats liquid LLW and mixed LLW using evaporation. It operates in a semicontinuous mode; waste is accumulated in collection tanks and transferred through underground piping to an evaporator system. The design capacity is 106,000 l/day (28,000 gal/day). The facility processes an average of 1,140 l (301 gal) of liquid wastes per day under normal operating conditions (OR DOE 1993a:9-22). The facility can treat waste streams containing organic contaminants.

Table E.2.5–10 summarizes the mixed LLW storage facilities at ORNL and estimates the capacity of these facilities. As of June 30, 1995, approximately 1,600 m^3 (2,100 yd^3) of mixed waste was projected to be in storage at ORNL (OR LMES 1996a:7-21).

The only disposal of mixed waste done at ORNL is the burial of radioactive asbestos at SWSA-6. Asbestos contaminated with low levels of radioactivity is placed in silos. In 1992, approximately 23 m^3 (30 yd^3) of contaminated asbestos were buried (OR DOE 1993b:9-4). Low-level contaminated biological waste has also been buried at SWSA-6.

Hazardous Waste. Hazardous wastes are generated in laboratory research, electroplating operations, painting and maintenance operations, descaling, demineralizer regeneration, and photographic processes. Few hazardous wastes are treated in onsite facilities. Onsite treatment at ORNL includes elementary neutralization and detonation facilities. Tables E.2.5–10 and E.2.5–13 summarize the hazardous waste storage and treatment facilities at ORNL. [Text deleted.]

The Chemical Detonation Facility treats small amounts of wastes that would be dangerous to transport offsite. Explosives such as aged picric acid are detonated in the detonation facility. Certain other wastes (for example, spent photographic processing solutions) are processed onsite into a nonhazardous state. Those wastes that are safe to transport are shipped to offsite RCRA-permitted commercial treatment/disposal facilities.

The Nonradiological Wastewater Treatment Plant is designed to reduce hazardous pollutant concentrations in nonradiological wastewaters to levels acceptable for effluent discharge. The plant operates in a continuous mode and carries out physical and chemical processing steps. The facility contains a heavy-metal removal system, where the pH of the wastewater is raised to 10.5 in a clarifier. Polymers are added to induce flocculation and settling of the metal precipitates. The wastewater is passed through a filtration system to remove particulates. An air stripper then removes volatile organics and activated carbon columns remove mercury. In 1993, approximately 23,800,000 l (6,300,000 gal) of liquid hazardous wastes were treated at the Nonradiological Wastewater Treatment Plant (OR MMES 1995c:6-6).

As of June 1995, approximately 29 m^3 (38 yd^3) of hazardous waste was stored at ORNL (OR LMES 1996a:6-6). PCB wastes are managed in storage facilities until they can be shipped offsite for treatment and/or disposal. PCB-contaminated and hazardous wastes are temporarily stored at Building 7507, and PCB-contaminated wastes are stored on the 7507W storage pad. Due to the "No Rad Added" policy, hazardous wastes are being stored as mixed waste. A listing of the hazardous waste storage facilities at ORNL is shown in Table E.2.5–14. In 1992, approximately 10 m^3 (13 yd^3) of asbestos wastes were sent to Y–12 Sanitary and Industrial Landfill II. About 12 m^3 (16 yd^3) of hazardous and PCB wastes were sent to K–25 for storage and incineration in the TSCA incinerator (OR DOE 1993b:9-5).

Nonhazardous Waste. Nonhazardous wastes result from ORNL maintenance and utilities. The steam plant and the sanitary waste treatment plant produce a sludge which is sampled to demonstrate that it is nonhazardous and

meets the Y–12 Industrial and Sanitary Landfill II waste acceptance criteria. The sewage treatment facility treats sanitary and laundry wastewater. It is an extended aeration-activated sludge unit followed by mixed-media tertiary filtration of secondary effluent dewatering. The sludge is dried onsite in open-air drying beds. In 1994, approximately 360 million l (95 million gal) of industrial and sanitary liquid waste were treated at the sewage treatment plant (OR LMES 1996a:8-4).

The Melton Valley LLW Immobilization Facility is currently treating nonhazardous liquid waste (OR DOE 1994a:A-20). The facility can be used to solidify liquid mixed LLW that has a pH greater than 12.5 and that contains some heavy metals. This liquid mixed LLW is transferred from tanks by interconnecting pipelines. Batches of waste are pumped from a liquid decantation system to a solidification system as required to provide adequate storage-tank capacity. The facility operates on a campaign basis in order to provide adequate storage capacity. Solidification is currently performed using cementation. Design capacity is 62,500 l (16,500 gal) of liquid waste per month. Under normal operating conditions, the facility can process 7,570 l/month (2,000 gal/month) as required to provide adequate storage-tank capacity (DOE 1993h:26.2-5). The facility cannot treat HLW, alpha-contaminated waste with TRU activity levels greater than 100 nanocuries per gram (nCi/g), organic wastes, or PCBs.

Scrap metals are discarded from maintenance and renovation activities and are recycled when appropriate. Construction and demolition projects also produce nonhazardous industrial wastes. All solid nonhazardous wastes and medical wastes (after they are autoclaved to render them noninfectious), except scrap metal, are sent to Y–12 Industrial and Sanitary Landfill II. Approximately 16 m^3 (21 yd^3) of scrap metal were placed in storage at ORNL in 1992. This waste will remain at ORNL until it is characterized as nonradioactive per the "No Rad Added" policy (OR DOE 1993b:9-7).

Rainfall runoff from the ORNL Steam Plant coal yard storage area, plus additional wastewater from the sulfuric acid tank diked area runoff, Steam Plant boiler blowdown, and water softener regenerate, are collocated in a basin. This waste is treated at the Coal Yard Runoff Treatment Facility.

K–25 Site

Enrichment, maintenance, decontamination, and research and development activities have generated a wide variety of waste at K–25. Because of its past uranium enrichment mission, uranium is the predominant radionuclide found in K–25 waste streams. Waste management activities are increasing. Low-level radioactive wastes from other DOE sites are placed in building vaults until a final disposition strategy is identified. Also, PCB wastes and RCRA wastes contaminated with uranium began arriving from other DOE sites in 1987 for incineration in the K-1435 TSCA incinerator. Tables E.2.5–15 and E.2.5–16 summarize the treatment and storage facilities at K–25 that are capable of treating and storing multiple categories of waste.

Pollution Prevention. K–25 policy mandates minimization of waste generated while achieving compliance with applicable environmental regulations. Five waste reduction options are used at K–25: segregation, material substitution, process innovation, mechanical volume reduction, and recycling/reuse. In recent years, some aluminum cans, worker clothing, and office furniture have been recycled for use at K–25. As of 1991, this recycling had saved approximately 1,150,000 kg (2,520,00 lbs) of materials. K–25 management supports the waste reduction program. An example of this program is the conversion to gas-fired boilers to reduce capacity excursions and, in effect, reduce or eliminate fly ash production.

Spent Nuclear Fuel. K–25 does not generate or manage spent nuclear fuel.

High-Level Radioactive Waste. K–25 does not generate or manage HLW.

Transuranic Waste. K–25 does not generate or manage TRU waste.

Low-Level Waste. Solid LLW is generated by discarding radioactively contaminated construction debris, wood, paper, asbestos and trapping media. Solid LLW is also generated by process equipment and by removing radionuclides from liquid and airborne discharges. Currently, solid LLW is being stored for future disposal. Table E.2.5–17 shows the storage facilities that deal only with LLW. [Text deleted.] Treatment of the current inventory of contaminated scrap metal at K–25 (as well as at Portsmouth, Paducah, and Fernald facilities) is expected to occur over the next 3 to 5 years as part of a comprehensive DOE scrap metal program to be managed through K–25. All contaminated scrap metal is stored aboveground at the K-770 scrap metal facility until further disposal methods are evaluated.

The Uranium Hexafluoride (UF_6) Cylinder Program is directed toward improving the safety and reliability of long-term storage for 7,000 cylinders currently at K–25. These cylinders remain from the now-terminated gaseous diffusion mission. In storage at the site are approximately 5,000 9-t (10-ton) and 13-t (14-ton) cylinders of depleted UF_6; 1,000 cylinders of normal-assay feed UF_6; 400 cylinders containing more than 23 kg (50 lb) of "enriched" material; and 600 miscellaneous empty cylinders. The UF_6 Cylinder Program is being designed to develop a clear understanding of the current conditions of the cylinders and define any near-term and long-term actions for safe storage of the cylinders pending decisions on ultimate disposition of the UF_6 material. Some of the initial actions in the program are a baseline inspection, a corrosion coupon program, and an ultrasonic thickness measurement program. The baseline inspection identified a variety of cylinder defects that will require special attention and also identified four breached cylinders. Immediate corrective actions have been taken to handle the breached cylinders, and a schedule of activities has been developed for moving and repairing the cylinders.

The cylinders containing normal-assay feed UF_6 are currently being shipped to the Paducah Gaseous Diffusion Plant. The current DOE direction for the 5,000 cylinders with depleted UF_6 is to store them until at least the year 2020, at which time conversion to oxide will be performed if no other uses have been determined. A plan for cleaning the empty cylinders and those containing more than 110 kg (50 lb) of enriched material has not yet been approved (this may be performed at K–25 or at one of the operating gaseous diffusion plants).

Currently, there are no onsite disposal facilities being operated at K–25. An ORR centralized waste management organization has been established at K–25 and assigned the responsibility of designing, constructing, and operating all new LLW disposal facilities for the ORR.

Mixed Low-Level Waste. Mixed LLW primarily consists of contaminated waste oils, solvents, sludges, soils, and acid wastes. Table E.2.5–18 presents the inventory of mixed LLW as of December, 1994, along with a 5-year projection. Sludges contaminated with low-level radioactivity were generated by settling and scrubbing operations and were stored in K-1407B and K-1407C ponds. Sludges have been removed from these ponds, and a portion has been fixed in concrete at the K-1419 sludge treatment facility and stored at the K-33 Building. These materials are considered mixed LLW and will be shipped offsite for disposal at a permitted commercial facility.

Most of the treatment of mixed waste is at the TSCA incinerator and the central neutralization facility. The majority of waste treated at the TSCA incinerator cannot be treated by commercial incinerators because of radioactive contamination. All waste sent to this facility must be fully characterized and identified. DOE has an approved chain-of-custody system for all waste received from offsite. The K-1435 TSCA incinerator is capable of incinerating waste that is mixed or contains PCBs. In 1990, a limited amount of waste was incinerated as a part of the startup testing. The incinerator began full operations in early 1991 and met all regulatory requirements in processing 1,000 m^3 (1,310 yd^3) of mixed waste. Mixed TSCA waste is being generated in the ash residue at the TSCA incinerator. Compliance issues regarding the management of the mixed PCB and radioactive waste generated in the ash are being pursued with EPA by DOE.

Most of the radioactively contaminated wastewater treated at the central neutralization facility is generated at the TSCA incinerator from the wet scrubber blowdown. Treated effluents are discharged through a designated

release point. The contaminated sludges that precipitate in the sludge-thickener tank are stored in an approved above ground storage area at K–25.

RCRA mixed, radioactive land disposal restricted waste (including some nonradiological classified land disposal restricted waste) has been stored in some areas for longer than 1 year. These wastes are currently subject to the land disposal restriction that permits storage only for accumulation of sufficient quantities to facilitate proper treatment, recycling, or disposal. This waste is being stored because of the nationwide shortage of treatment and disposal facilities for this type of waste. Private-sector technology demonstrations are being conducted that involve uranium extractions from sludge.

Uranium-contaminated PCB wastes (that is, mixed wastes) are being stored in excess of the 1-year limit imposed by TSCA because of the lack of treatment and disposal capacities. DOE and EPA have signed an FFCA, effective February 20, 1992, to bring the facility into compliance with TSCA regulations for use, storage, and disposal of PCBs. It also addressed the approximately 10,000 pieces of nonradioactive PCB-containing dielectric equipment associated with the shutdown of diffusion plant operations.

In 1989, during routine inspections of the drums of stabilized K-1407 pond sludge at the K-1417 storage facility, it was discovered that many of the drums had begun to corrode. Free liquid (waste with a pH of 12) on top of the concrete in the drums was found to be causing the corrosion (OR DOE 1993a:9-16). An action plan has been implemented to decant and/or dewater the mixed waste contained in the drums. A total of 45,000 drums of stabilized material and 32,000 drums of raw sludge must be processed and moved to storage facilities that meet regulations governing mixed wastes. All containers will be transferred to and stored in new and existing facilities at the K-1065, K-31, and K-33 buildings.

Hazardous Waste. Hazardous wastes generated at K–25 include PCB articles and items, waste oils and items, and uncontaminated asbestos waste. All hazardous wastes are managed according to applicable State and Federal regulations and DOE Orders. Several waste management facilities are already in place. Changing laws and regulations have made it necessary to upgrade several facilities and to design and construct new facilities that reflect the most recent environmental technology. The Central Neutralization Facility and the TSCA incinerator are the two major facilities that treat hazardous waste.

The Central Neutralization Facility provides pH adjustment and chemical precipitation for several aqueous streams throughout K–25. The main purpose of the facility is to treat wastewater to ensure compliance with the requirements of NPDES discharge limits on pH, heavy metal concentrations, and suspended solids. The treatment system consists of two 94,600-l (25,000-gal) reaction tanks and a 227,000-l (60,000-gal) sludge-thickener tank. Acidic wastes are neutralized with a hydrated-lime slurry, and basic wastes are neutralized with sulfuric or hydrochloric acid. The hydrated-lime bin and acid tanks are located at the facility. The treatment facility is physically divided into separate sections for treating hazardous and nonhazardous waste streams.

The TSCA Incinerator consists of storage tanks, dikes, and the incinerator. The incinerator system consists of a liquid, solid, and sludge feed system; a rotary kiln incinerator; and a secondary combustion chamber. The wastes treated at this facility include oils, solvents, chemicals, sludges, and aqueous waste.

As of June 30, 1995 approximately 76 m^3 (100 yd^3) of hazardous waste was stored at K-25 (OR LMES 1996a:6-6). In general, most of the waste stored at K–25 is designated as hazardous waste that has been contaminated with PCBs. Recyclable materials, such as mercury and silver-bearing photographic wastes, are stored before recycling, while other hazardous wastes are stored until sufficient quantity is accumulated for an offsite shipment. All offsite disposals of hazardous wastes, were halted in 1991 until procedures addressing a DOE performance objective of "No Rad Added" were developed by the sites and approved by DOE. Incineration is the preferred method for offsite treatment or disposal of wastes, particularly PCB wastes; however, landfills and other types of disposal are used as needed. On the K–25 site all hazardous waste is treated as mixed LLW.

Nonhazardous Waste. Computer paper is being recycled from the K–25 computer technology center. The paper recycling program is being reviewed for expansion into nonradiological areas. Product substitutions at the paint shop and photography lab have resulted in a decrease of waste generation. No percentage of reduction has been calculated due to the lack of baseline data.

Waste assay monitors have been purchased and are being used to screen solid, potentially radioactive waste to determine the potential to manage it as nonhazardous waste. The K-770 clean scrap yard provides storage for nonradioactive scrap metal. The scrap metal is stockpiled before being sold to the public. The solid nonhazardous waste from K–25 is sent to Y–12 Industrial Landfill V. Some materials, such as furniture, file cabinets, and paper, are disposed of through property sales.

The only nonhazardous treatment facility at K–25 is the sanitary waste treatment plant (Building K-1203). The system consists of an extended aeration treatment plant with a rate capacity of approximately 2,270,000 l/day (600,000 gal/day). The current demand is about 1,140,000 l/day (300,000 gal/day) (OR LMES 1996a:8-5). The sanitary sludge is disposed of in the Y–12 landfill. The Central Neutralization Facility does treat some nonhazardous liquid waste streams.

Table E.2.5–1. Low-Level and Mixed Low-Level Waste Treatment Facilities at Y–12 Plant

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
Biodenitrification Unit (Building 9818)	Neutralization, pH adjustment, nitrate removal	Liquid mixed LLW (nitrate solutions from enriched uranium recovery-Buildings 9212 and 9206)	Biosludge to West End Treatment Facility	2,100	RCRA permit-by-rule. Design capacity.
Central Pollution Control Facility	Filtration, carbon adsorption, oil/water separation, and sludge dewatering	Liquid LLW, mixed LLW, and hazardous waste (nonnitrate liquid wastes)	Treated wastewater discharged through NPDES outfall and solids to West Tank Farm	10,300	NPDES permit April 28, 1995. RCRA permit-by-rule. Design capacity.
Cyanide Treatment Facility (Building 9201-5N)	Chemical oxidation, cyanide destruction, neutralization	Liquid mixed LLW and hazardous waste (cyanide spent plating batches)	Wastewater to West End Treatment Facility	15	RCRA permit issued September 28, 1995. Also has 8 m^3 of mixed waste storage. Permitted capacity for mixed LLW. Processed 2,810 m^3 of LLW in 1994.
Groundwater Treatment Facility (Building 9616-7)	Carbon adsorption and air stripping	Liquid LLW and mixed LLW (Liquid Storage Facility groundwater)	Groundwater air stripper effluent, spent carbon, and sludge to depleted uranium oxide storage vaults and liquid effluent through NPDES outfall	9,450	Operating capacity. NPDES permit April 28, 1995. RCRA permit-by-rule. Maximum capacity is 17,700 m^3/yr. Facility is currently treating mixed waste but is intended for hazardous waste only.
Interim Reactive Waste Treatment Area	Open burning (slow thermal oxidation)	Solid LLW (sodium-potassium waste)	Treated residue waste to depleted uranium oxide storage vaults and treated waste to K–25	Campaign 2 times per year, 8 hours per campaign, 57 l/day.	RCRA permit submitted August 1992. Interim facility awaiting completion of Reactive Waste Treatment Facility. Design feedrate is 0.7 m^3/yr.
Liquid Storage Facility (Building 9416-35)	Oil/water separation by filter cartridges	Liquid mixed LLW (leachate from certain capped burial grounds in Bear Creek Valley)	Stored liquids to groundwater treatment facility and PCB-laden oil to TSCA incinerator	9,450	Also a storage unit. RCRA permit-by-rule. Facility is currently treating mixed waste but is intended for hazardous waste only.
Uranium Chip Oxidation Facility (Building 9401-5)	Thermal oxidation	Solid LLW (depleted and normal uranium chips)	Uranium oxide to Depleted Uranium Oxide Storage Vaults	Classified yearly treatment	Exempted from State air permitting requirements. Design feedrate is 1,000 kg/hr. Intermittent operation is about 2 days/week, 4 hr/day.

Table E.2.5–1. Low-Level and Mixed Low-Level Waste Treatment Facilities at Y–12 Plant—Continued

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
Uranium Recovery Operations (Building 9206, 9272)	Leaching, filtration, dissolution, oxidation, evaporation, extraction	Metal and organic removal from aqueous stream, aqueous neutralization, purification for recycle	All waste diverted to Acid Waste Neutralization and Recovery Facility	2,100	System is exempt from permitting requirements under agreement with the State. Same capacity as Biodenitrification Unit. System removed from consideration for treatment.
Uranium Treatment Unit (Building 9206)	Filtration and precipitation	Liquid mixed LLW (uranium-contaminated organic solvents)	Organic waste to TSCA Incinerator at K–25	2 m^3/day	Closure plan submitted March 1995.
Waste Coolant Processing Facility (Building 9983-78)	Extended activated sludge treatment, sludge drying	Liquid LLW and mixed LLW (contaminated waste coolants)	Oily solids to dewatering and drums, biological solids to dewatering, and liquid to Central Pollution Control Facility or West End Treatment Facility/West Tank Farm	756	Also a storage unit. Maximum capacity is 1,320 m^3/yr. RCRA permit-by-rule.
Waste Feed Preparation Facility (Building 9401-4)	Compaction	Compactible solid LLW	Compacted solid LLW to Y–12 Above-Grade LLW Storage Facility	19,000	Exempted from State air permitting. Design feedrate is 23 m^3/hr. Intermittent operation at 8 hr/day and 2 days/week.
West End Treatment Facility (Building 9616-7)	Absorption, anaerobic digestion, clarification, coagulation, filtration, flocculation, and precipitation	Liquid mixed LLW and hazardous waste (radioactive-contaminated and nonradioactive nitrate waste)	Liquid effluent through NPDES outfall	2,600	Permitted capacity NPDES permit issued April 28, 1995. RCRA permit-by-rule. Design capacity is 7,600 m^3/yr.

[a] For those facilities already in use, this is a normal operating capacity, whereas for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1993h; DOE 1994k; DOE 1994n; DOE 1995gg; OR DOE 1995g; OR LMES 1996a; OR MMES 1995c.

Table E.2.5–2. Low-Level and Mixed Low-Level Waste Storage Facilities at Y–12 Plant

Waste Oil/Solvent Bulk Storage Facility	Input Capability	Total Capacity[a] (m^3)	Comment
Above-Grade Storage Facility [Text deleted.]	Solid LLW	4,510	Above ground storage of low-level until Low-Level Waste Disposal Facility.
Building 9404-7 (PCB Drum Storage Facility)	Solid PCB and uranium contaminated waste	40	Storage of liquid and/or hazardous waste not permitted except for PCB waste. Capacity for 496 drums.
Building 9206, Container Storage Area	Liquid/solid LLW and Mixed LLW	15	RCRA Part B permit. Storage for solid waste is 13 m^3. RCRA permit issued September 28, 1995.
Building 9212, Container Storage Area	Liquid/solid LLW and mixed LLW	15	RCRA Part B permit. Storage for solid waste is 9 m^3. RCRA permit issued September 28, 1995.
Building 9720-25S	Liquid/solid LLW and mixed LLW	334	This is a new facility that previously stored classified waste only. RCRA permit issued September 28, 1995.
Classified Waste Storage Facility (Building 9720-25)	Solid LLW and mixed LLW waste	495	RCRA Part B permit issued September 28, 1995.
Container Storage Facility (Building 9720-12)	Solid mixed LLW	105	RCRA Part B permit issued September 28, 1995. Design capacity is 123 m^3. Also contains hazardous and nonhazardous classified waste.
Containerized Waste Storage Area	Liquid/solid LLW and mixed LLW	632	Three concrete pads. RCRA Part B permit issued September 28, 1995.
Contaminated Scrap Metal Storage Yard	Solid LLW (uranium-contaminated scrap)	4,740	
Cyanide Treatment Facility	Cyanide spent plating batches, mixed LLW	8	RCRA Part B permit issued September 28, 1995. Also treatment facility for hazardous and mixed wastes.
Disposal Area Remedial Actions Solid Storage Facility	Solid mixed LLW	5,060	RCRA interim status. Facility full as of August 1994. Currently within the Environmental Restoration Program.
Depleted Uranium Storage Vaults I and II (9825-A and B oxide vault)	Solid LLW (depleted uranium oxide and metal)	1,020	Two vaults of reinforced concrete.
East Chestnut Ridge Waste Pile	Solid mixed LLW (contaminated soil and spoil from closure of RCRA units)	901	RCRA Part B permit issued.
Liquid Organic Waste Solvent Storage Facility (Building 9720-45, OD-10)	Liquid and solid mixed LLW. Ignitable nonreactive and radioactive waste. Can also include hazardous waste	147	RCRA permit issued September 1, 1994. Consists of six storage tanks and a diked and covered storage area of approximately 186 m^3. An additional 40 m^3 of drum storage permitted.

Table E.2.5–2. Low-Level and Mixed Low-Level Waste Storage Facilities at Y–12 Plant—Continued

Waste Oil/Solvent Bulk Storage Facility	Input Capability	Total Capacity[a] (m^3)	Comment
[Text deleted.] Liquid Storage Facility (Building 9416-35)	Liquid hazardous and mixed LLW	416	RCRA permit-by-rule. Also a treatment unit. Provides temporary storage before treatment.
Oil Land Soils Containment Pond	Soil contaminated with PCBs and volatile organics	612	RCRA permit issued June 30, 1989.
PCB and RCRA Hazardous Drum Storage Facility, Building 9720-9 (western half)	PCB and RCRA hazardous waste	738	RCRA permit issued September 28, 1995. The practical capacity has decreased to 201 m^3 due to renovation currently taking place. Much of the inventory was moved to 9720-25S.
RCRA and PCB Container Storage Area (Building 9720-58)	Solid mixed LLW	580	RCRA permit issued September 28, 1995. Permitted RCRA waste materials. Hazardous waste section included in hazardous waste table.
RCRA Staging Area (Building 9720-31)	Liquid and solid mixed LLW and hazardous waste	170	RCRA permit issued September 28, 1995.
Sludge Basin	Solid LLW	2,720	
Solid Storage Facility	Solid mixed LLW and hazardous waste to include PCB-contaminated waste	3,100	RCRA permit application submitted June 1993. Contains waste pile contaminated with radioactivity. Facility is currently within the Environmental Restoration Program.
Southeast Switchgear Room, Building 9201-4 (Alpha-4)	Solid mixed LLW (Old shutdown process waste)	65	RCRA Part B storage permit issued September 28, 1995. Permitted storage capacity.
Waste Oil/Solvent Bulk & Storage Facility, Building 9811-1 (OD-7)	Liquid hazardous waste and mixed LLW (oils and solvents contaminated with uranium and PCBs)	568	RCRA permit issued September 28, 1995. Four 30,000-gal and three 10,000-gal tanks.
Waste Oil/Solvent Drum Storage Facility, Building 9811-1 (OD-8)	Liquid and solid hazardous waste, LLW and mixed LLW	402	RCRA permit issued September 28, 1995. Waste is eventually taken to OD-9 or OD-10.
Waste Oil/Solvent Storage Facility (Building 9811-8, OD-9)	Liquid mixed LLW (including PCBs) and hazardous waste	757	RCRA permit issued September 28, 1995. Site includes five storage tanks. Also includes 33 m^3 of storage for drums.
West End Tank Farm	Mixed LLW (sludge)	9480	Permit by rule.

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

[Text deleted.]

Source: DOE 1994n; OR DOE 1993a; OR DOE 1995g; OR LMES 1996a; OR MMES 1993f.

Table E.2.5–3. Mixed Low-Level Waste Inventory at Y–12 Plant

Waste Matrix	Number of Waste Streams	Inventory as of December 1994 (m^3)	Number of Waste Streams 5-Year Projection	Total Generation 5-Year Projection (m^3)
Contact-Handled				
Aqueous liquids/slurries	3	40	3	123
Organic liquids	4	314	4	383
Homogeneous solids	7	6,520	6	1,300
Soils/gravel	6	6,420	3	7
Debris waste	11	147	11	120
Lab packs	2	<1	None	None
Special waste	7	11	4	5
Other	3	9	1	<1
Total	43	13,461	32	1,938

Source: DOE 1995gg.

Table E.2.5–4. Hazardous Waste Treatment Facilities at Y–12 Plant

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity (m^3/yr)	Comment
Plating Rinsewater Treatment Facility (Building 9623)	Cyanide destruction, pH adjustment, flow equalization, electrochemical precipitation, flocculation and clarification.	Liquid hazardous (plating rinsewater) and mixed LLW	Treated wastewater discharged through Central Pollution Control Facility NPDES outfall and solids to West Tank Farm	30,300	RCRA permit-by-rule. NPDES permit does not allow more than 114,000 l in 3 days. Processed 380 m^3 of hazardous waste by 1994.
Steam Plant Wastewater Facility	Chemical treatment followed by filtration.	Liquid industrial and hazardous wastes	Treated wastewater discharged through NPDES outfall	233,000	RCRA permit-to-rule, NPDES permit. Capacity based on maximum treatment in 1994.

Source: DOE 1994n; DOE 1995gg; OR LMES 1996a.

Table E.2.5–5. Hazardous Waste Storage Facilities at Y–12 Plant

Storage Unit	Input Capability	Total Capacity (m^3)	Comment
Building 9418-9	PCB-contaminated mineral oil	53	Below-grade, diked tank.
Oil Drum Storage Area (OD3)	PCB-contaminated oils	45	Site is closed except for tanker.
Oil Landfarm Soils Storage Facility	Solid hazardous waste contaminated with PCBs and volatile organics (excavated soil from the closure of the Oil Landfarm)	612	RCRA permit application submitted June 1993. No new wastes are being stored.
PCB and RCRA Hazardous Drum Storage Facility, Building 9720-9 (eastern half)	Liquid and solid PCB waste	751	RCRA permit issued September 28, 1995 and TSCA permit approved September 24, 1991. Part of building included in mixed waste storage table.
PCB and RCRA Container Storage Area, Building 9720-58	Solid hazardous waste and mixed LLW	223	Permitted PCB waste materials. Mixed waste included in mixed LLW table. RCRA permit issued September 28, 1995.
RCRA Storage and Staging Area (Building 9720-31)	Liquid and solid hazardous waste to include PCB-contaminated waste	170	RCRA permit issued September 28, 1995.
[Text deleted.]			

Source: DOE 1994n; OR DOE 1993a; OR DOE 1995g; OR LMES 1996a.

Table E.2.5–6. Reactor-Irradiated Nuclear Material Inventory at Oak Ridge Reservation

Site	Facility	Type	Number and Form	Estimated Heavy Metal[a] (m^3)
Y–12 Plant	Building 9720-5	Space Nuclear Auxiliary Power-10 fuel	36 rods in Sodium Potassium	0.1
	Building 9720-5	Health Physics Research Reactor fuel	31 fuel pieces	3.5
	Building 9720-5	DOE Demonstration Reactor Fuel	Core assembly	0.04
ORNL	Building 3019	SRS production fuel	176 cans	2
	Building 3019	Hanford production fuel	42 cans	1.5
	Building 3019	Commercial fuel (Canada ConEd)	401 cans	20
	Building 4501	Commercial fuel[b]	40 sections	0.1
	Buildings 3525 and 7920, Dry Wells 7823A, 7827, and 7829	Research and commercial reactor fuel	Fuel samples and targets	6
	Bulk Shielding Reactor and Oak Ridge Research Reactor	Research reactor fuel	41 Bulk Shielding Reactor elements and 32 ORR elements (pool 80 percent full)	4
	Classified Burial Ground	Unknown	Unknown	Unknown
	High Flux Isotope Reactor	Research reactor fuel	43 assemblies (pool 40 percent full)	7
	Homogeneous Reactor Experiment wells	Research reactor fuel	135 gallons of Uranyl Sulphate[c]	8
	Molten Salt Reactor Experiment	Research reactor fuel	Lithium fluoride and beryllium difluoride salt mixture	4
	Solid Waste Storage Area 6	KEMA Suspension Test Reactor	1 Core Assembly	0.01
	Tower Shield Reactor No. II	Research reactor fuel	1 assembly (pool full)	0.1

[a] Based on conversion factor 52 kg/m^3 (DOE 1995kk).
[b] Fuel from H.B. Robinson, Monticello, Oconee-1, Quad City-1, and Dresden-1 commercial power reactors.
[c] Solution in seven holes.
Source: DOE 1993s; DOE 1994d; DOE 1995kk; OR LMES 1996a; OR MMES 1995c.

Table E.2.5–7. Transuranic and Mixed Transuranic Waste Inventory at Oak Ridge National Laboratory

Waste Matrix	Number of Waste Streams	Inventory as of December 1994 (m^3)	Number of Waste Streams 5-Year Projection	Total Generation 5-Year Projection (m^3)
Contact-Handled				
Multiple alpha emitters	9	1,400	1	46
Remote-Handled				
Multiple alpha emitters	6	1,720	2	62
Total	15	3,120	3	108

Source: DOE 1995gg.

Table E.2.5–8. Transuranic and Mixed Transuranic Waste Storage Facilities at Oak Ridge National Laboratory

Storage Unit	Input Capability	Total Capacity (m^3)	Comment
TRU Retrievable Drum Storage Facility (Building 7826)	Contact-handled solid mixed TRU waste	326	Interim Part A permit (included in Part B application). Mainly 55-gal drums. May contain lead. RCRA closure underway.
TRU Retrievable Drum Storage Facility (Building 7834)	Contact-handled solid mixed TRU waste	408	Interim Part A permit. Mainly 55-gal drums. May contain lead. RCRA closure underway.
TRU Retrievable Concrete Cask Storage Facility (Building 7842, SWSA-6)	Contact-handled solid mixed TRU waste	354	Interim Part A permit (included in Part B application).
TRU Concrete Cask Storage Facility (Building 7855)	Remote-handled solid mixed TRU waste	139	Interim Part A permit (included in Part B application).
TRU Retrievable Drum Storage Facility (SWSA-5N Trenches)	Remote-handled solid mixed TRU waste	717	Under CERCLA closure.
TRU Retrievable Concrete Cask Storage Facility (Building 7878)	Contact-handled solid mixed TRU waste	266	Interim Part A permit (included in Part B application).
TRU Retrievable Drum Storage Facility (Building 7879)	Contact-handled solid mixed TRU waste	306	Interim RCRA Part A permit (included on RCRA Part B application). Will store waste from Nuclear Fuel Services. Also serves as a staging facility for LLW.
TRU Retrieval Drum Storage Facility (Building 7934)	Contact-handled solid mixed TRU waste	99	Interim Part A permit. Also serves as a volume reduction facility.

Source: DOE 1994n; OR DOE 1995g; OR LMES 1996a.

Table E.2.5–9. Low-Level, Mixed Low-Level, and Transuranic Waste Treatment Facilities at Oak Ridge National Laboratory

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity (m^3/yr)	Comment
Waste Compactor Facility (Building 7831)	Compaction	Compactible solid LLW	Compacted solid LLW in B-25 3x3x4.6 m (4x4x6 ft) boxes to K–25	11,300	Design capacity
Liquid LLW Evaporation Facility (Building 2531)	Evaporation/drying	Liquid LLW and mixed LLW	Evaporator condensates to process waste treatment plant. Some evaporator bottoms are stored at Melton Valley Facility.	18	Normal operating capacity. Maximum capacity is 4,540 l/hr for 20 days per month.
Melton Valley LLW Immobilization Facility	Liquid Decantation Ion Exchange and Solidification	Liquid mixed LLW and nonhazardous liquid waste	Concrete block to storage	189	System is limited to 189,000 l (50,00 gal) per campaign.
Process Waste Treatment Plant (Building 3544)	Ion exchange, neutralization, clarification, and filter presses	Liquid LLW and mixed LLW	Solid LLW (filter cake) to storage at K–25. Wastewater is sent to Nonradiological Wastewater Treatment Plant.	265,000	Normal operating capacity. Design capacity is 390,000 m^3/yr.
TRU Processing Facility	Evaporation, microwave solidification, solid segregation and packaging	Solid remote-handled TRU	Drums and boxes	620	Planned facility. Remote-handling capability for packaging

Source: DOE 1994k; DOE 1994n; DOE 1995gg.

Table E.2.5–10. Low-Level, Mixed Low-Level, and Hazardous Waste Storage Facilities at Oak Ridge National Laboratory

Storage Unit	Input Capability	Total Capacity (m^3)	Comment
Buildings 7823B, 7823E, 7827, 7829, 7831C, 7878A, B7823C, B7823D	Solid LLW	903	No permit necessary
Buildings 7842A and 7856	Solid remote-handled LLW	949	No permit necessary
Bulk Contaminated Soil Facility (Building 7576)	Low-level contaminated soil	938	Planned and funded
Chemical Waste Storage Facility (Building 7653)	Liquid wastewater for treatment	26	RCRA Part B permit to be submitted. Used for storage of small quantities of lab chemicals and process chemical wastes.
Class L-III/IV Retrievable Storage Facilities	Class III and IV solid LLW	566	Planned and funded. RCRA Part B permit submitted March 30, 1992.
Clean Oil Storage Pad (Building 7651)	Liquid/solid hazardous wastes	27	RCRA permit. Storage pad used to store drums containing noncontaminated used oil.
Facility 7841	LLW (contaminated scrap metal)	1,020	No permit necessary
Hazardous Waste Storage Facility (Building 7652)	Liquid hazardous waste	57	RCRA Part B permit. Used for storage of bulk chemical waste.
Hazardous Waste (PCB) Storage Facility (Building 7507)	Liquid/solid PCB-contaminated materials	31	RCRA interim permit
Liquid LLW System	Liquid mixed LLW and LLW	3,230	Active portion has 1,970 m^3 of storage. Includes Melton Valley Storage Tanks, which have capacity of 1,510 m^3.
Long-Term Hazardous Waste Storage Facility (Building 7654)	Liquid/solid mixed LLW	62	Interim Part A (included in Part B application) submitted January 14, 1993.
Mixed Waste Drum Storage Pad (Building 7507W)	Solid and liquid mixed LLW	83	Interim Part B RCRA submitted May 21, 1992.
Scrap Metal Accumulations Area	Contaminated scrap metal	4,350	No permit necessary
Storage Facility-semi underground (Building 7823)	Liquid/solid mixed waste oils, solvents, and other process wastes	229	Interim Part A (included on Part B application)
Tank 7830A	Bulk mixed waste oils	19	Interim RCRA Part A (included in RCRA Part B application)

Source: DOE 1994n; OR DOE 1995g; OR LMES 1996a.

Table E.2.5–11. Low-Level Waste Disposal Facilities at Oak Ridge National Laboratory

Disposal Unit	Input Capability	Capacity (m^3)	Comment
Asbestos silos (SWSA-6)	Low-level contaminated asbestos	22	Unit accepts only Y–12 asbestos, if contaminated with other than uranium contamination, other than that no offsite waste accepted. Closed at end of 1993. Capacity is amount stored.
Biological trenches (SWSA-6)	Low-level contaminated biological waste	106	Landfill operation. Closed at end of 1993. Capacity is amount stored.
High range silos (SWSA-6)	Solid LLW (200 mrem/hr to 1 rem/hr)	23	Concrete silos inside diameter (15 ft x 8 ft). Closed at end of 1993. Capacity is amount stored.
Interim Waste Management Facility	Solid LLW B-25 boxes encased in concrete	3,590	Four Tumulus pads (18.2 x 27.4 m). Fifth under construction. Each pad provides 897 m^3 for disposal.
Low range silos (SWSA-6)	Solid LLW (<200 mrem/hr)	204	Concrete silos inside diameter (15 ft x 8 ft). Closed at end of 1993. Capacity is amount stored.

Source: DOE 1994n; OR LMES 1996a; OR MMES 1993d; OR MMES 1995c.

Table E.2.5–12. Mixed Low-Level Waste Inventory at Oak Ridge National Laboratory (Resource Conservation and Recovery Act- *and State-Regulated)*

Waste Matrix	Number of Waste Streams	Inventory as of December 1994 (m^3)	Number of Waste Streams 5-Year Projection	Total Generation 5-Year Projection (m^3)
Contact-Handled				
Aqueous liquid/slurries	3	22	3	34
Organic liquids	4	61	3	62
Homogeneous solids	6	4	5	4
Soils/gravel	3	5	3	8
Debris waste	9	7	9	22
Labpacks	4	36	4	3
Special wastes	7	2	5	2
Others	3	39	3	33
Remote-Handled				
Aqueous liquid, alpha	2	2,780	1	532
Homogeneous, solid, alpha	1	42	None	None
Total	42	2,998	36	700

Source: DOE 1995gg.

Table E.2.5–13. Hazardous Waste Treatment Facilities at Oak Ridge National Laboratory

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity[a]	Comment
Acid Neutralization Facility	Neutralization	Blowdown and demineralizer regeneration from Steam Plant	Liquid effluent to Nonradiological Wastewater Treatment Plant	44,900	Volume treated in 1992. Design feedrate is 23 m^3/hr
Chemical Detonation Facility (Building 7667)	Open burning	Solid and liquid explosive wastes (lab pack flammables)	Residue (ash) to Sludge Fixation Facility for treatment	Campaign	RCRA interim permit submitted January 4, 1993.
Leaking Gas Cylinder Area	Venting of damaged and excess gas cylinders	Hazardous gas cylinders	Returned to vendors or disposed of at Y–12 Plant Sanitary Landfill II	Campaign	Remote site consisting of clear area.
Non-radiological Wastewater Treatment Plant (Building 3608)	Clarification, filtering, air stripper, absorption, neutralization, dewatering, and ion exchange	Liquid corrosive waste in storage	Dewatered waste, carbon, liquid discharge	745,000	Normal operating capacity. Design capacity is 1,510,000 m^3/yr.

[a] For those facilities already in use, this is a normal operating capacity; for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1994n; DOE 1995gg; OR DOE 1994a; OR LMES 1996a.

Table E.2.5–14. Hazardous Waste Storage Facilities at Oak Ridge National Laboratory

Storage Unit	Input Capability	Total Capacity (m^3)	Comment
Chemical Waste Storage Facility (Building 7653)	Solid explosives, lab pack chemicals, and waste reactive metals	15	RCRA interim permit Part A (included on Part B application). Can be used for mixed waste. Permitted storage is 70 55-gal drums.
Clean Oil Storage Pad (Building 7651)	Clean oil and oil contaminated material	27	RCRA interim permit. Part A (included on Part B application). Can be used for mixed wastes. Permitted storage is 128 55-gal drums.
Hazardous Waste Storage Facility (Building 7507)	Liquid/solid mixed LLW and hazardous waste	31	RCRA interim permit Part A (included on Part B application). Permitted storage is 150 55-gal drums.
Hazardous Waste Storage Facility (Building 7652)	Hazardous bulk liquids and solids	57	RCRA Part B permit. Can be used for mixed wastes. Permitted storage is 275 55-gal drums.

Source: DOE 1994n; OR LMES 1996a; OR MMES 1995c.

Table E.2.5–15. Low-Level, Mixed Low-Level, and Hazardous Waste Treatment Facilities at K–25 Site

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity (m^3/yr)	Comment
Central Neutralization Facility (K-1407H)	Clarification, thickening, and neutralization	Liquid LLW, mixed LLW, and hazardous waste	Liquid effluent through NPDES outfall and sludge to hazardous waste storage unit	221,000	NPDES permit. RCRA permit-by-rule. Permitted capacity. Normal operation capacity is 111,000 m^3/yr.
Liquid Pretreatment Facility	Neutralization precipitation, liquid separation and chemical oxidation/reduction	Liquid aqueous and organic mixed waste	Effluent to existing wastewater facilities or TSCA Incinerator	Planned	Batch processes
Sludge Fixation Facility (Building K-1419)	Screening solidification/stabilization, centrifuging, and neutralization	Mixed waste sludges and solids	Liquid effluent to Central Neutralization Facility. Solidified containers stored at Concrete Block Casting and Storage Yard (Building K-1417)	2.5 m^3/hr	Design feedrate. RCRA permit submitted May 1989. Facility on standby.
TSCA Incinerator (K-1435)	Blending, incineration (rotary kiln)	Liquid and solid, mixed LLW, LLW and mixed LLW contaminated with PCBs	Ash (solid mixed LLW and hazardous) to hazardous waste storage unit, waste storage unit-012, ash water and blowdown water (mixed LLW and hazardous) to Central Neutralization Facility, and sludge (solid mixed LLW) to Sludge Fixation Facility	1,860 (liquid only)	State air permit approved; State RCRA permit expires September 27, 1997 and TSCA permit expires March 20, 1992. Site given continued authority to operate on old TSCA permit. Normal operating capacity. Maximum capacity is 15,700 m^3/yr.
Wastewater Treatment Facility (K-1232)	Centrifugation, neutralization, and precipitation	Liquid mixed LLW	Leachate (liquid LLW) to central neutralization facility and sludge (solid mixed LLW) to sludge fixation facility	0.8 m^3/hr	RCRA permit submitted May 18, 1989. Design feedrate. Facility not currently being utilized.

Source: DOE 1994n; DOE 1995gg; OR DOE 1994a.

Table E.2.5–16. Low Level, Mixed Low-Level, and Hazardous Waste Storage Facilities at K–25 Site

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
Buildings K-1232, K-306-2, K306-4	Mixed LLW and LLW	688	Permitted.
Buildings K-1417 and K-1419	Mixed waste (sludge)	27,100	Under RCRA closure. Pond Waste Management Project storage facility for pond waste sludge.
Combustible Liquid Storage Tanks (K-1202)	Liquid LLW, mixed LLW, and hazardous waste to include PCBs	108	RCRA permit expires September 1, 2002. Two bulk storage tanks.
Flammable Liquid Storage Unit (K-1420A)	Liquid mixed LLW, PCB waste, and hazardous waste	108	RCRA permit expires September 1, 2002. Two bulk storage tanks.
Hazardous Waste Storage Unit (K-311-1)	Solid, mixed LLW, and hazardous waste	456	RCRA permit expires September 1, 2002. Vault for radiogenic lead waste. [Text deleted.]
Hazardous Waste Storage Unit (K-310-1)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste	445	RCRA permit expires September 1, 2002. RCRA sludges and ash from operation of K-1035 incinerator. [Text deleted.]
Hazardous Waste Storage Unit (Vault 2A)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste	439	RCRA permit expires September 1, 2002. Practical capacity. [Text deleted.]
Hazardous Waste Storage Unit (K-309-3)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste	354	RCRA permit expires September 1, 2002. Has been used for RCRA, PCB, and mixed wastes from all sites at ORR. Includes contaminated scrap metal. [Text deleted.]
Hazardous Waste Storage Unit (K-301-1 Vault 4)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	430	RCRA permit expires September 1, 2002. Storage of laboratory waste acids, bases, and organics. [Text deleted.]
Hazardous Waste Storage Unit (K-301-1, Vault 4A)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	637	RCRA permit expires September 1, 2002. Waste consists of sludges and incinerator ash.
Hazardous Waste Storage Unit (K-301-2, Vault 4B)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	399	RCRA permit expires September 1, 2002. Waste consists primarily of photographic waste and incinerator ash. [Text deleted.]
Hazardous Waste Storage Unit (K-302-4)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	524	RCRA permit expires September 1, 2002. Storage of RCRA and mixed wastes from K-25 and Y-12. [Text deleted.]
Hazardous Waste Storage Unit (Vault 8A, K-302-5)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	683	RCRA permit expires September 1, 2002. Storage of hazardous wastes from K-25 and Y-12. [Text deleted.]
Hazardous Waste Storage Unit (K-302-5)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	513	RCRA permit expires September 1, 2002. Storage of RCRA and mixed wastes from K-25 and Y-12. [Text deleted.]

Table E.2.5–16. Low Level, Mixed Low-Level, and Hazardous Waste Storage Facilities at K–25 Site—Continued

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
Hazardous Waste Storage Unit (K-303-1)	Liquid and solid mixed LLW mixed LLW hazardous and non-RCRA waste to include PCBs	592	RCRA permit expires September 1, 2002.
Hazardous Waste Storage Unit (K-303-2)	Liquid and solid mixed LLW mixed LLW, hazardous and non-RCRA waste to include PCBs	496	RCRA permit expires September 1, 2002.
Hazardous Waste Storage Unit (Vault 19A) - Building K-305-6)	Liquid and solid mixed LLW, LLW, hazardous and non-RCRA waste to include PCBs.	592	RCRA permit expires September 1, 2002.
Hazardous Waste Storage Unit (K-305-6)	Liquid and solid LLW, mixed LLW, hazardous and non-RCRA waste to include PCBs	354	RCRA permit expires September 1, 2002.
Hazardous Waste Storage Unit (K-305-12)	Liquid and solid mixed LLW, LLW, hazardous and non-RCRA waste to include PCBs	439	RCRA permit expires September 1, 2002. [Text deleted.]
Hazardous Waste Storage Unit (K-306-1)	Liquid and solid LLW, mixed LLW, hazardous and non-RCRA waste to include PCBs	102	RCRA permit expires September 1, 2002. Sludges generated during treatment of Y-12 wastewaters. [Text deleted.]
Hazardous Waste Storage Unit (Vault 23A)	Liquid and solid LLW, mixed LLW, hazardous and non-RCRA waste to include PCBs	470	RCRA permit expires September 1, 2002. Sludge generated during treatment of Y–12 wastewaters at either K–1232 or Y–12 facilities. [Text deleted.]
Hazardous Waste Storage Unit (K-306-3)	Liquid and solid LLW, mixed LLW, hazardous and non-RCRA waste to include PCBs	286	RCRA permit expires September 1, 2002. Storage of RCRA, PCB, and mixed wastes from K-25, Y-12, and ORNL. [Text deleted.]
Hazardous Waste Storage Unit (K-306-4, Vault)	Liquid and solid mixed LLW, mixed LLW hazardous and non-RCRA waste to include PCBs	399	RCRA permit expires September 1, 2002. Mixed waste.
Hazardous Waste Storage Unit (Vault 25A)	Liquid and solid mixed LLW, LLW, hazardous and non-RCRA, waste to include PCBs	1,030	RCRA permit expires September 1, 2002. 286 m^3 of mixed LLW can be stored. Awaiting state approval for use as a hazardous waste storage facility.
Hazardous Waste Storage Unit (K-1036-A)	Liquid and solid LLW, mixed LLW, hazardous and non-RCRA waste to include PCBs	150	RCRA permit expires September 1, 2002. Used for solvents and waste oil storage. Oil may be contaminated. Maximum capacity 2,000 55-gal drums.

Table E.2.5–16. Low Level, Mixed Low-Level, and Hazardous Waste Storage Facilities at K–25 Site—Continued

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
Hazardous Flammable Waste Storage Unit (K-711)	Liquid and solid LLW, mixed LLW, hazardous and non-RCRA waste to include PCBs	312	RCRA permit expires September 1, 2002. Waste oils and solvents generated at other DOE facilities. Maximum capacity of 1,800 55-gal drums [Text deleted.]
Hazardous Flammable Waste Storage Unit (K-1025C)	Liquid and solid LLW, mixed LLW, hazardous and non-RCRA wastes	9	RCRA permit expires September 1, 2002. No incompatibles. Used for out-of-date or off-specification laboratory chemicals—disposed through offsite commercial facilities.
Hazardous Waste Storage Unit (K-1302)	LLW, mixed LLW, hazardous, and non-RCRA compressed gas	3	RCRA permit expires September 1, 2002. Gases are commercial products that are to be discarded or treated.
K-31 WP (stabilized sludge storage)	Hazardous/mixed waste	8,000	RCRA permit expires July 1, 2023. Storage of solidified pond waste sludge from closure of K-1407B and -C ponds. [Text deleted.]
K-33 WP (stabilized raw sludge storage)	Mixed LLW	8,510	Permitted. Storage of solidified pond waste sludge from closure of K-1470B and -C ponds. Materials continue to be shipped offsite for disposal.
K-301-4, K–25 Building, one unnamed vault and Vault 5A	Hazardous/mixed waste	377	Permitted Part B.
K 303-3/vault 10A, 11A	Solid LLW and mixed LLW	544	Permitted. Contaminated scrap metal. [Text deleted.] Awaiting letter of approval from state before use as hazardous waste storage unit.
K-306-IT, Building K–25 (vault)	Liquid/solid mixed LLW	156	Permit not necessary.
K-310-3, vault in Building K–25	Hazardous/mixed waste	527	RCRA permit expires September 1, 2002. Formerly LLW storage unit. New facility. Awaiting letter of approval from State before use as a hazardous waste storage facility.
K-402-1, process vault and Vault 31X, Building K-27	Hazardous/mixed waste	765	RCRA permit expires September 2002. Formerly LLW storage unit. Awaiting letter of approval from State before use as a hazardous waste storage facility.
K-1065-A, -B, -C, -D, -E	Mixed waste/sludge	27,400	RCRA permit expires 2023. Pond Waste Management Project storage units for pond waste sludge. Capacity of K-1065-C includes 28 m^3 of solid LLW.
RCRA storage unit, Vault 3A	Liquid and solid LLW and hazardous wastes	326	RCRA final permit expires 2002. Will be used for RCRA and mixed wastes from K–25, Y–12, and ORNL. Currently, empty PCB-contaminated containers from K–25 and Y–12 being stored in vault.
TSCA Container and Tank Storage (K-1435)	Non-PCB contaminated flammable liquid and mixed low-level that is also PCB-contaminated	509	TSCA incinerator has three storage areas. The tank farm has 3 10,000-gal and 12 5,000-gal tanks for liquid only. Area B (TSCA waste) can store 352 55-gal drums and Area C (RCRA waste) can store 496 55-gal drums. RCRA Part B permit.

Table E.2.5–16. Low Level, Mixed Low-Level, and Hazardous Waste Storage Facilities at K–25 Site—Continued

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
TSCA Storage Unit (K-33)	Liquid and solid hazardous waste (PCB)	960	No permit required.
TSCA Storage Unit (K-726)	Liquid and solid non-RCRA, nonradioactive waste contaminated with PCBs	85	No permit required to store waste when covered under TSCA. Concrete block building - PCB waste. [Text deleted.]
TSCA Storage Unit (K-303-4)	Liquid and solid non-RCRA, nonradioactive waste contaminated with PCBs	583	No permit required.
Vault 5A, Building K–25	Solid hazardous/mixed LLW	535	Permitted. Awaiting letter of approval from state before use as a hazardous waste storage facility.
Vault 24A, Building K-306-4	Solid hazardous/mixed LLW	292	Permitted. New facility awaiting letter of approval from state before use as a hazardous waste storage facility.
Waste Oil/Hazardous Wastes Storage I (K-1425 containers)	Liquid and solid LLW and mixed LLW	85	Part B permit has been issued by the State for all storage units listed as of September 30, 1992. Wastes stored include oils, solvents, water, and organics. Maximum capacity 480 55-gal drums.
Waste Oil/Hazardous Wastes Storage II (K-1425 tanks)	Liquid LLW and mixed LLW	343	Part B permit has been issued by the State for units listed as of September 30, 1992. Wastes stored include oils, solvents, water, and organics. Four 22,500-gal tanks.

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1994n; OR DOE 1993a; OR DOE 1995g; OR LMES 1996a; ORR 1993a:11.

Table E.2.5–17. Low-Level Waste Storage Facilities at K–25 Site

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
Contaminated Scrap Metal Yard (K-770)	Solid LLW (uranium-contaminated scrap metal, ferrous and nonferrous)	29,600	6.9 acres of contaminated scrap metal. Design capacity [Text deleted.] Responsibility for facility transferred to Environmental Restoration in 1994 and is no longer available for LLW storage.
K-33 LLW Container Facility	Liquid/solid LLW	1,410	No permit necessary.
K-1313A (Rubb Tents I and II)	Solid LLW	246	Permit not necessary. Used to store Y–12, ORNL, and K–25 LLW.
LLW Storage Unit (Vault 15A-Building K-25)	Solid LLW	564	RCRA interim status September 1, 1990. Awaiting letter of approval from State before use as a hazardous waste storage facility. Used for radioactively-contaminated waste from K–25, Y–12 and ORNL.
LLW Storage Unit (K-303-5)	Liquid and solid LLW	470	RCRA permit expires September 1, 2002. Construction upgrades required before storage of mixed waste. Used for radioactively-contaminated waste from K–25, Y–12 and ORNL.
LLW Storage Unit (K-306-2)	Solid LLW	246	Storage of radioactively-contaminated soil from Y–12. [Text deleted.]
LLW Storage Unit (K-306-7)	Liquid and solid LLW	314	Storage of radioactively-contaminated soil from Y–12. [Text deleted.]
LLW Storage Unit (K-309-2)	Liquid and solid LLW, non-RCRA, and nonradioactive (soils and metals)	663	Used for radioactively-contaminated waste from K–25.
LLW Storage Unit (K-310-2)	Liquid and solid LLW	654	Used for radioactively-contaminated waste generated at ORNL.
LLW Storage Unit, (K-1066-H)	Solid LLW (containerized)	4,730	Outdoor storage area.
Vault 6 (K–25 building)	Solid LLW	272	No permit necessary.

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: DOE 1994n; OR DOE 1993a; OR DOE 1995g; OR LMES 1996a.

Table E.2.5–18. Mixed Low-Level Waste Inventory at K–25 Site

Waste Matrix	Number of Waste Streams	Inventory as of December 1994 (m^3)	Number of Waste Streams 5-Year Projection	Total Generation 5-Year Projection (m^3)
Contact-Handled				
Aqueous liquids	5	442	5	169
Organic liquids	5	348	4	118
Homogeneous solids	15	27,800	8	1,380
Soils/gravel	4	272	3	49
Debris waste	12	386	12	317
Labpacks	2	22	2	5
Special wastes	7	117	4	10
Other	3	66	1	1
Total	53	29,453	39	2,049

Source: DOE 1995gg.

E.2.6 SAVANNAH RIVER SITE

The process of manufacturing useful nuclear materials has produced radioactive, mixed, and hazardous wastes that are treated, stored, or disposed of at the SRS. The *Savannah River Site Waste Management Final Environmental Impact Statement* (DOE/EIS-0217) addresses the tasks to be completed in the next 10 years to clean up existing waste units and bring current operations into compliance with applicable regulations. It deals in detail with the current conditions and provides the preferred alternatives for processing current and future waste streams. It also addresses the development and funding of processes to minimize waste generation and to safely process and dispose of future waste generation.

Pollution Prevention. Pollution prevention, previously driven by best management practices and economics, is now mandated by statutes, regulations, and agency directives. The SRS Waste Minimization and Pollution Prevention Program is designed to achieve continuous reduction of wastes and pollutant releases to the maximum extent feasible and in accord with regulatory requirements while fulfilling national security missions. The *SRS Waste Minimization and Pollution Prevention Awareness Plan* addresses wastes and potential pollutants of all types and establishes priorities for accomplishing waste minimization and pollution prevention through source reduction, recycling, treatment, and environmentally safe disposal.

Spent Nuclear Fuel. [Text deleted.] DOE will make detailed decisions for SRS concerning the treatment and stabilization of its current and future inventory of spent nuclear fuel after the completion of site-specific analysis pursuant to NEPA. SRS has been one of the receiving sites for returned domestic and foreign research reactor spent fuel, and will manage all of DOE's aluminum-clad spent fuel. The stabilization and storage of spent nuclear fuel at SRS has been addressed programmatically in the ROD (60 FR 28680), as amended (61 FR 9441), for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (Spent Nuclear Fuel EIS) (DOE/EIS-0203-F) and the ROD (61 FR 25092) for the *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (DOE/EIS-0218F). There are about 206 t (227 tons) of spent reactor fuel in storage at SRS (60 FR 28680). As a result of the ROD from the programmatic Spent Nuclear Fuel EIS, SRS will increase its inventory of aluminum-clad spent nuclear fuel to 213 t (234 tons). As a result of the *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel*, SRS will receive an additional 18.2 t (20.1 tons) of research reactor spent fuel and 0.6 t (0.7 tons) of target material.

High-Level Waste. Liquid HLW containing actinides and hazardous chemicals were generated from recovery and purification of TRU products and from spent fuel processing. These wastes were retreivably stored in 51 underground tanks. One of these tanks is out of service. The tanks are managed in compliance with Federal laws, State of South Carolina regulations, and DOE Orders. The waste is segregated by heat generation rate, neutralized to excess alkalinity, and stored to permit the decay of short-lived radionuclides before its volume is reduced by evaporation. Twenty-nine of the tanks are located in the H-Area Tank Farm, and 22 are located in the F-Area Tank Farm. The tanks are of four different designs, but all are of carbon steel. Wastes are transferred to and processed in the newer tanks, which have full-height secondary containment and forced-water cooling. Some older tanks contain old salt and sludge awaiting waste removal. Other old tanks have had waste removed, except for residue, and are used to store low-activity waste. The older tanks will be taken out of service when the contents of other tanks are transferred to the Defense Waste Processing Facility (DWPF).

High-heat liquid waste is stored for 1 to 2 years to allow decay of radionuclides before being processed through evaporators. Low-heat waste is sent directly to the evaporator feed tanks. Each tank farm has one evaporator that is used to reduce water volume and concentrate the solids. A replacement higher-capacity evaporator is planned and may be used in conjunction with the current evaporators. Liquids can be reduced to 25 to 33 percent of original volume and stored as salts or sludges. Cesium removal columns can operate in conjunction with the

evaporators. The evaporators obtain decontamination factors of 10,000 to 100,000, and the cesium removal columns can obtain another 10 to 200 decontamination factors. Decontaminated liquids (overheads) are sent to the ETF for processing before being released to Upper Three Runs Creek. The concentrated salt solution is processed to remove radionuclides, and the decontaminated solution is sent to the DWPF Saltstone Facility for solidification and storage in the saltstone vaults.

The remaining sludges and salts contain the majority of the radionuclides, and are stored separately, awaiting vitrification. Prior to vitrification, salt is precipitated in the in-tank precipitation process. The precipitate and sludge is fed into the vitrification process in the DWPF. The waste is mixed with borosilicate glass and immobilized by melting the mixture, then pouring it into stainless steel cylinders. These cylinders are stored in a shielded facility at the DWPF until a repository is available. Figure E.2.6–1 illustrates HLW management at SRS. Tables E.2.6–1, E.2.6–2, and E.2.6–3 list HLW inventories, treatment, and storage facilities at SRS.

Transuranic Waste. All TRU waste currently being generated is stored in containers on aboveground storage pads in compliance with state regulations and DOE Orders. Older TRU wastes (prior to 1965) were buried in plastic bags and cardboard boxes in earthen trenches. Wastes containing more than 0.1 Curies (Ci) per package were placed in concrete containers and buried. Wastes containing less than 0.1 Ci per package were buried unencapsulated in earthen trenches. Since 1974, TRU wastes containing more than 10 nCi/g have been stored in retrievable containers free of external contamination. Polyethylene-lined galvanized drums containing more than 0.5 Ci are additionally protected by closure in concrete culverts.

Approximately 85 percent of the TRU waste currently in storage is suspected of being contaminated with hazardous constituents. Presently, waste is characterized by onsite generators and is being stored prior to final disposal. TRU waste containing less than 100 nCi/g may be disposed of as LLW at SRS. Waste containing greater than 100 nCi/g, and meeting the final WIPP waste acceptance criteria, will be sent to WIPP, if WIPP is determined to be a suitable repository pursuant to the requirements of 40 CFR 191 and 40 CFR 268. Waste not meeting the acceptance criteria as currently packaged will be repackaged as necessary to meet the WIPP waste acceptance criteria. Should additional treatment be necessary for disposal at WIPP, SRS would develop the appropriate treatment technology, or ship this waste to another facility for treatment. Studies are under way to solve the problem of high-heat TRU waste, which is unique to SRS. Wastes with high Pu-238 fractions generate too much heat to be shipped in the TRUPACT-II. TRU waste is currently stored on 17 pads at the solid waste disposal facility in the E-Area. Figure E.2.6–2 illustrates the TRU waste management plan. Table E.2.6–4 lists the mixed TRU waste inventories, and Tables E.2.6–5 and E.2.6–6 list the TRU and mixed TRU waste treatment and storage facilities.

Low-Level Waste. Both liquid and solid LLW are treated at SRS. Liquids are managed and processed to remove and solidify the radioactive constituents and to release the balance of the liquids to permitted discharge points in compliance with state regulations. The bulk of liquid LLW is process wastewater consisting of effluent cooling water, purge water from storage basins for irradiated reactor fuel or target elements, distillate from the evaporation of process waste streams, and surface water runoff from areas where there is a potential for radioactive contamination.

Aqueous LLW streams are sent to the ETF and treated by filtration, reverse osmosis, and ion exchange to remove the radionuclide contaminants. After treatment, the effluent is discharged to Upper Three Runs Creek. The resultant wastes are concentrated by evaporation and stored in the H-Area tank farm for eventual treatment in the DWPF Saltstone Facility. In that facility, they will be processed with grout for onsite disposal. Figure E.2.6–3 illustrates the LLW processing at SRS. Treatment and storage facilities for LLW are listed in Tables E.2.6–7 and E.2.6–8.

Disposal of solid LLW at the SRS traditionally has been accomplished using engineered trenches in accordance with the guidelines and technology existing at the time of disposal. Currently, packaged LLW is deposited in the E-area vaults. These are concrete structures that meet the requirements of DOE Orders, incorporate

technological advances, and address more stringent Federal regulation and heightened environmental awareness. Four basic types of vaults/buildings are used for the different waste categories: low-activity waste vault, intermediate-level nontritium vault, intermediate-level tritium vault, and long-lived waste storage building.

The vaults are below-grade concrete structures and the storage building is a metal building on a concrete pad. Long-lived waste is being stored until a final disposition can be determined. Additional information on these facilities is given in Table E.2.6–9.

Solid LLW is segregated into several categories to facilitate proper treatment, storage, and disposal. Solid LLW that radiates less than 200 thousandths of one roentgen equivalent man (rem), also called 200 mrem, per hour at 5 cm from the unshielded container is considered low-activity waste. If it radiates greater than 200 mrem/hr at 5 cm, it is considered intermediate-activity waste. This waste is typically contaminated equipment from separations, reactors, or waste management facilities. Intermediate activity tritium waste is intermediate-activity waste with more than 10 Ci of tritium per container. Residuals from tritium operations equipment are included in this waste. Long-lived waste is contaminated with long-lived isotopes that exceed the waste acceptance criteria for disposal. Resin contaminated with carbon-14 from reactor operations is an example. Excavated soil from radiological materials areas that is potentially contaminated, and cannot be economically demonstrated to be uncontaminated, is managed as suspect soil. Solid LLW typically consists of protective clothing, contaminated equipment, irradiated hardware, residuals from tritium extraction operations, and spent deionizer resins. All LLW is disposed of in the solid waste disposal facility in the E-Area between the F- and H-Areas. Wastes are compacted and packaged for burial. Monitoring wells are located near each disposed waste area to verify performance and to monitor groundwater in the vicinity of the vaults. As of December 1994, the total inventory of LLW disposed of at SRS was 676,400 m^3 (884,700 yd^3) (DOE 1995kk).

Mixed Low-Level Waste. Management of mixed wastes includes safe storage until treatment is available. Mixed LLW is stored in the A-, E-, M-, N-, and S- Areas in various tanks and buildings. These facilities include burial-ground solvent tanks, the M-Area Process Waste Interim Treatment/Storage Facility, the Savannah River Technology Center mixed waste storage tanks, and the organic waste storage tanks. These South Carolina Department of Health and Environmental Control-permitted facilities will remain in use until appropriate treatment and disposal is performed on the waste.

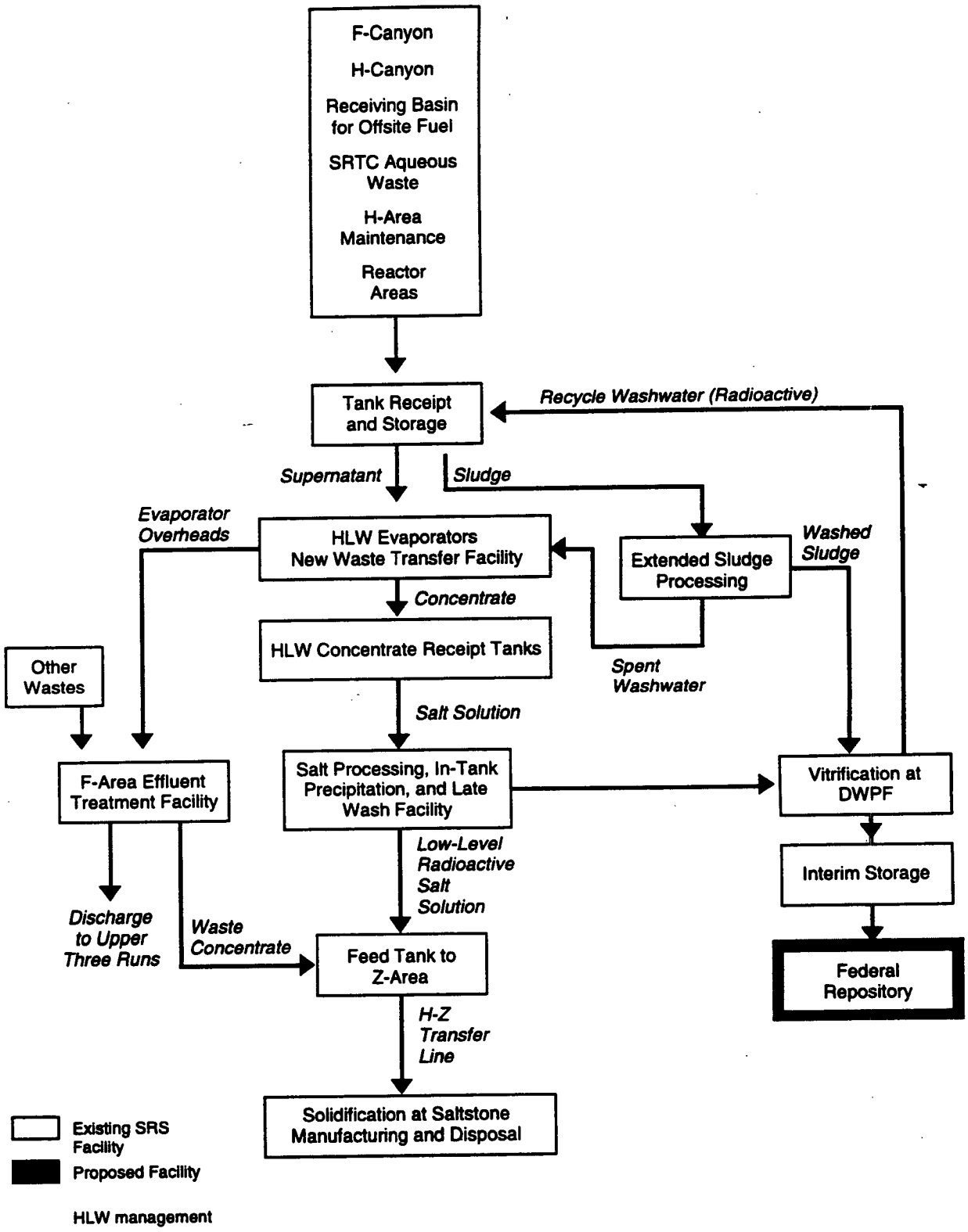
The Hazardous/Mixed Waste Treatment and Disposal Facility and the Consolidated Incineration Facility will process both mixed and hazardous wastes. The mixed waste management plan for SRS, illustrated in Figure E.2.6–4, has been reevaluated through the development of a site treatment plan in accordance with the *Federal Facility Compliance Act*. Mixed waste inventories are listed in Table E.2.6–10. Treatment facilities and processes are listed in Table E.2.6–7. Storage facilities capacity and status are listed in Table E.2.6–8.

Hazardous Waste. Typical hazardous wastes at SRS are lead, mercury, cadmium, 1,1,1-trichloroethane, leaded oil, trichlorotrifluoroethane, benzene, and paint solvents. Figure E.2.6–5 illustrates hazardous wastes management at SRS. Table E.2.6–11 lists hazardous waste storage facilities at SRS.

This waste is stored in RCRA-permitted buildings in the B- and N-Areas. Although hazardous waste was previously sent offsite for treatment and disposal, DOE imposed a moratorium on shipments of hazardous materials from radiological areas. Now, waste that is confirmed as not subject to the moratorium is shipped to an offsite vendor for processing and disposal. SRS annually publishes the tier two emergency and hazardous chemical inventory report, which lists hazardous chemicals that are present above their minimum threshold level or are extremely hazardous substances under the emergency planning community *Right-to-Know Act of 1986*. The annual reports filed under the *Superfund Amendments and Reauthorization Act for the SRS* facilities include year-to-year inventories of these chemicals.

Nonhazardous Waste. SRS-generated municipal solid waste is currently being sent to a permitted offsite disposal facility. DOE is evaluating a proposal to participate in an interagency effort to establish a regional solid waste management center at SRS (DOE/EA-0989, DOE/EA-1079). SRS disposes of other nonhazardous wastes consisting of scrap metal, powerhouse ash, domestic sewage, scrap wood, construction debris, and used railroad ties, in a variety of ways.

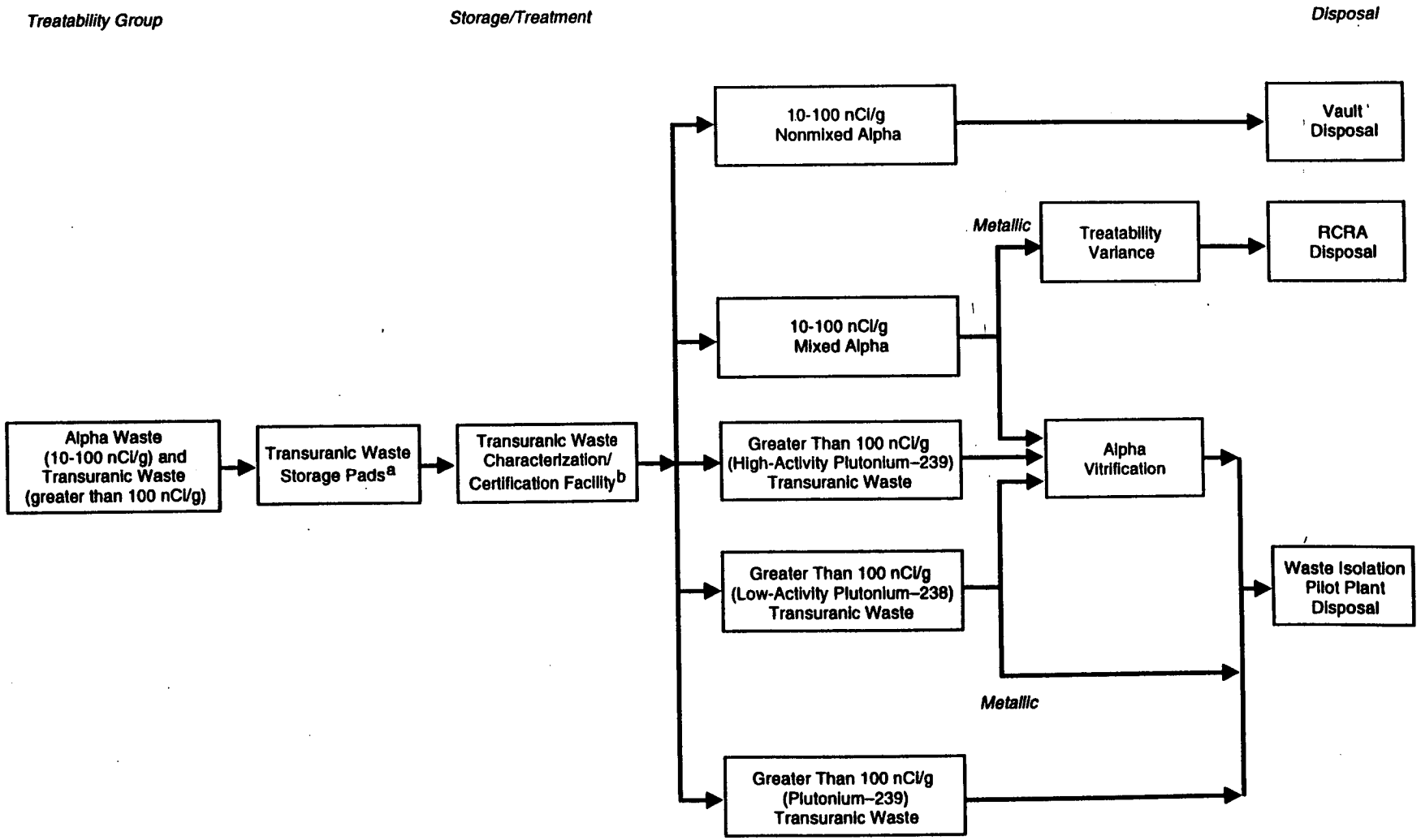
Scrap metal is sold to salvage vendors for reclamation. Powerhouse ash and domestic sewage sludge is used for land reclamation. Scrap wood is burned onsite or chipped for mulch. Construction debris is used for erosion control. Railroad ties are shipped offsite for disposal. Nonhazardous waste management is illustrated in Figure E.2.6–6.



Note: SRTC=Savannah River Technology Center
Source: SR DOE 1995b.

2705/FMD

Figure E.2.6–1. High-Level Waste Management at Savannah River Site.



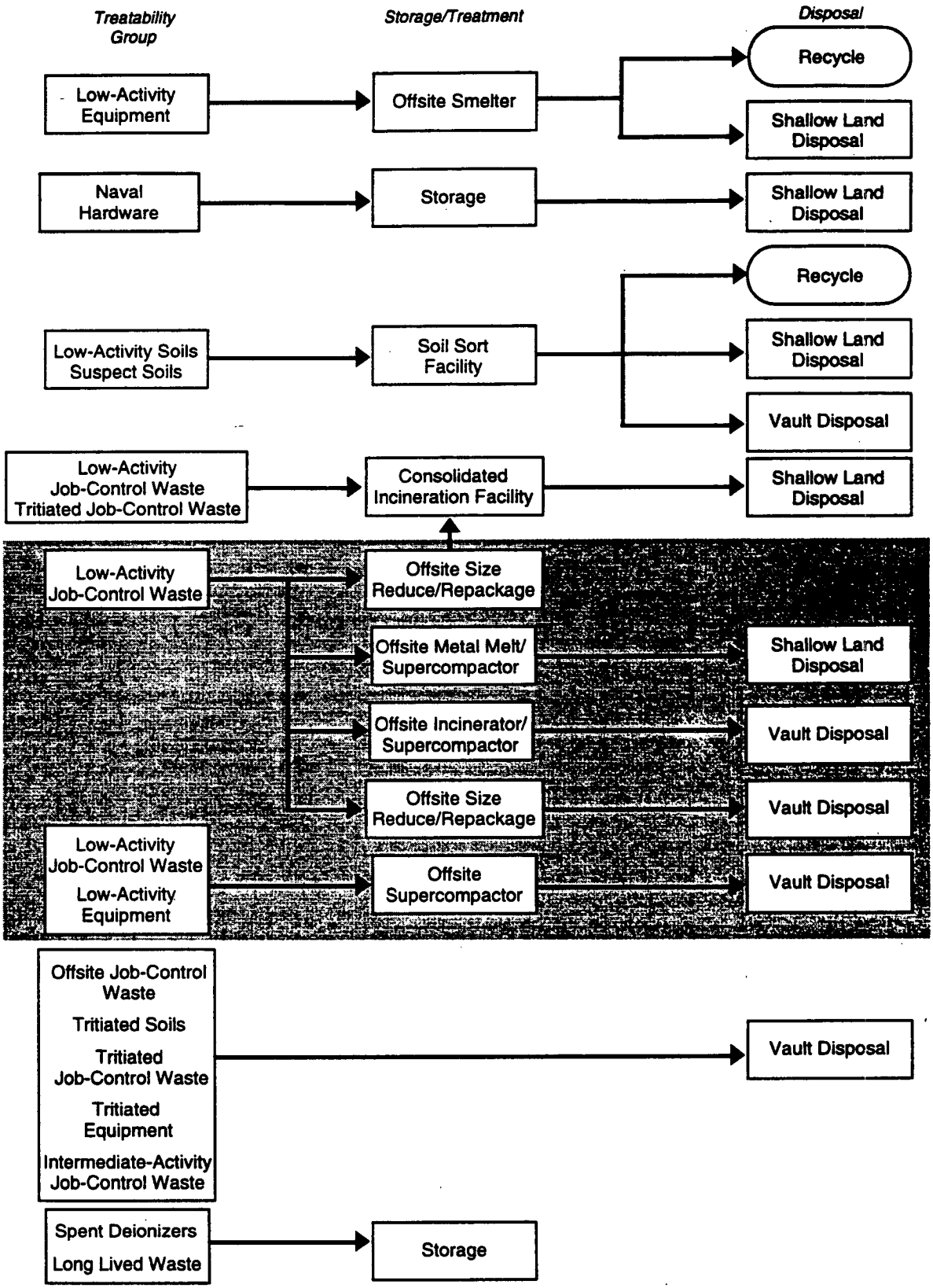
[a] Alternate storage locations are being evaluated; this analysis is based on using transuranic waste storage pads only.

[b] Waste certification activities consolidated with characterization/certification facility.

Source: SR DOE 1995b.

2806/FMD

Figure E.2.6–2. Transuranic Waste Management at Savannah River Site.

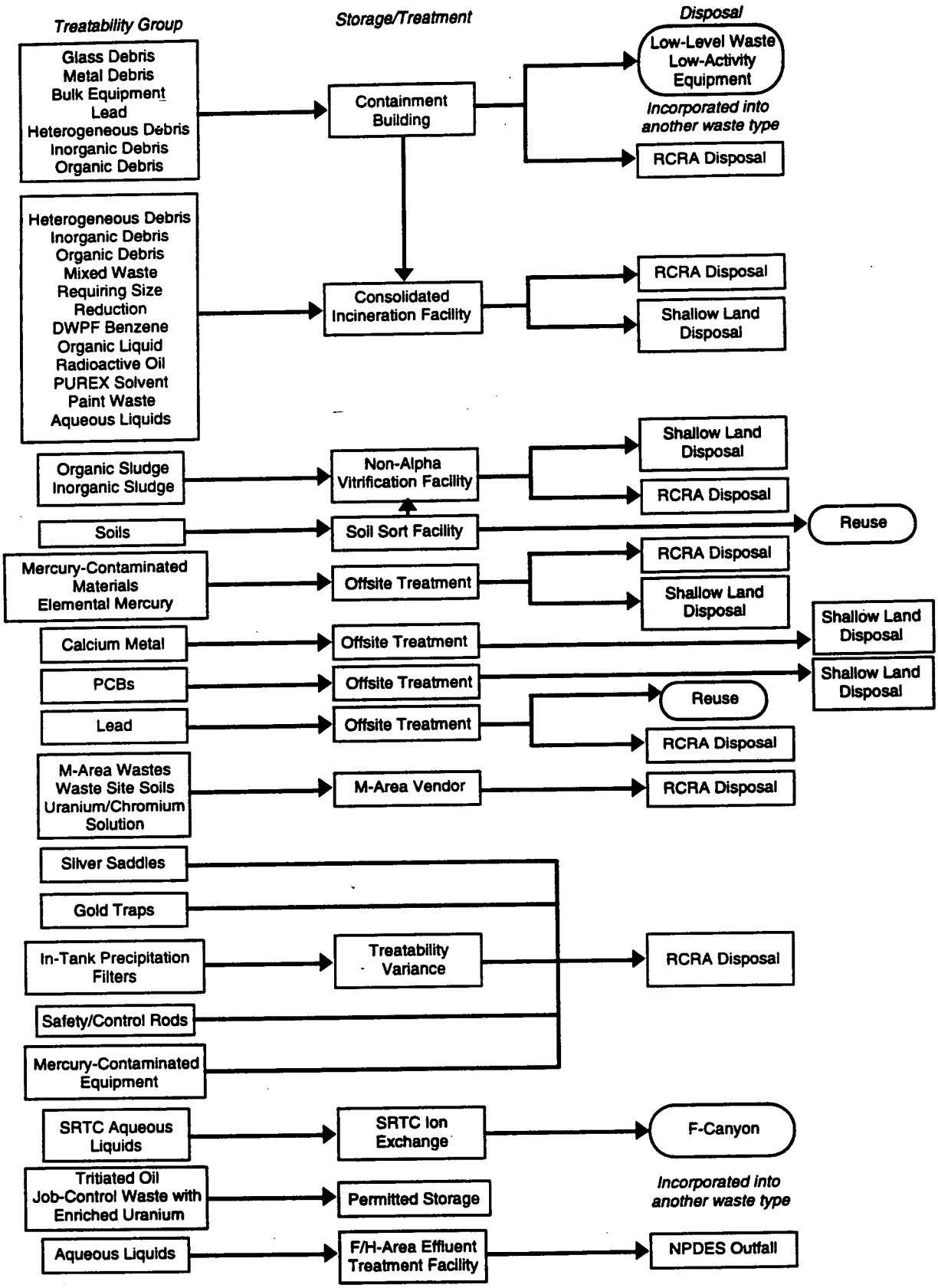


Indicates facilities affected by the low-level waste volume reduction modifications

Source: SR DOE 1995b.

2807/S&D

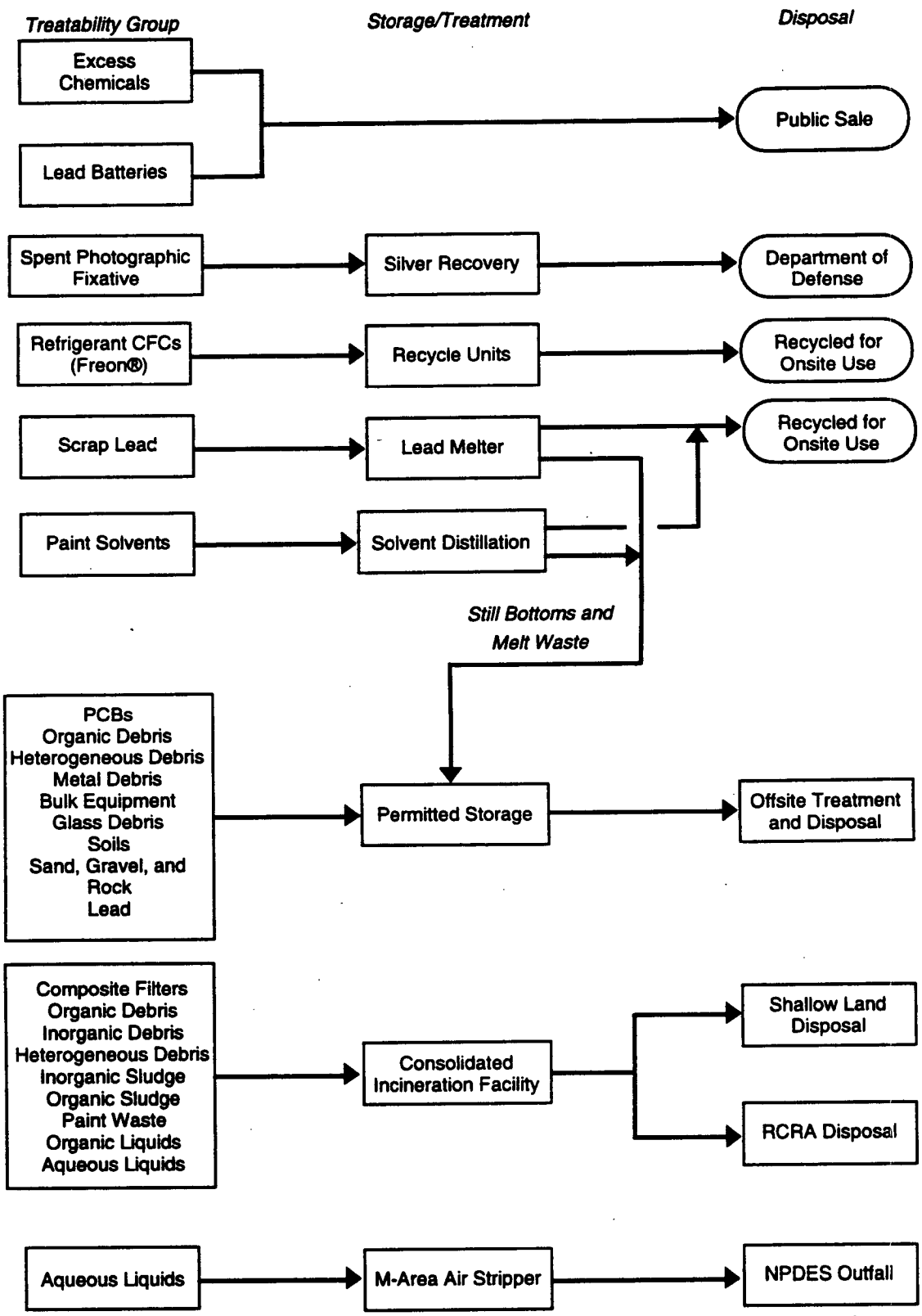
Figure E.2.6–3. Low-Level Waste Management at Savannah River Site.



Note: SRTC=Savannah River Technology Center
Source: SR DOE 1995b.

2808/S&D

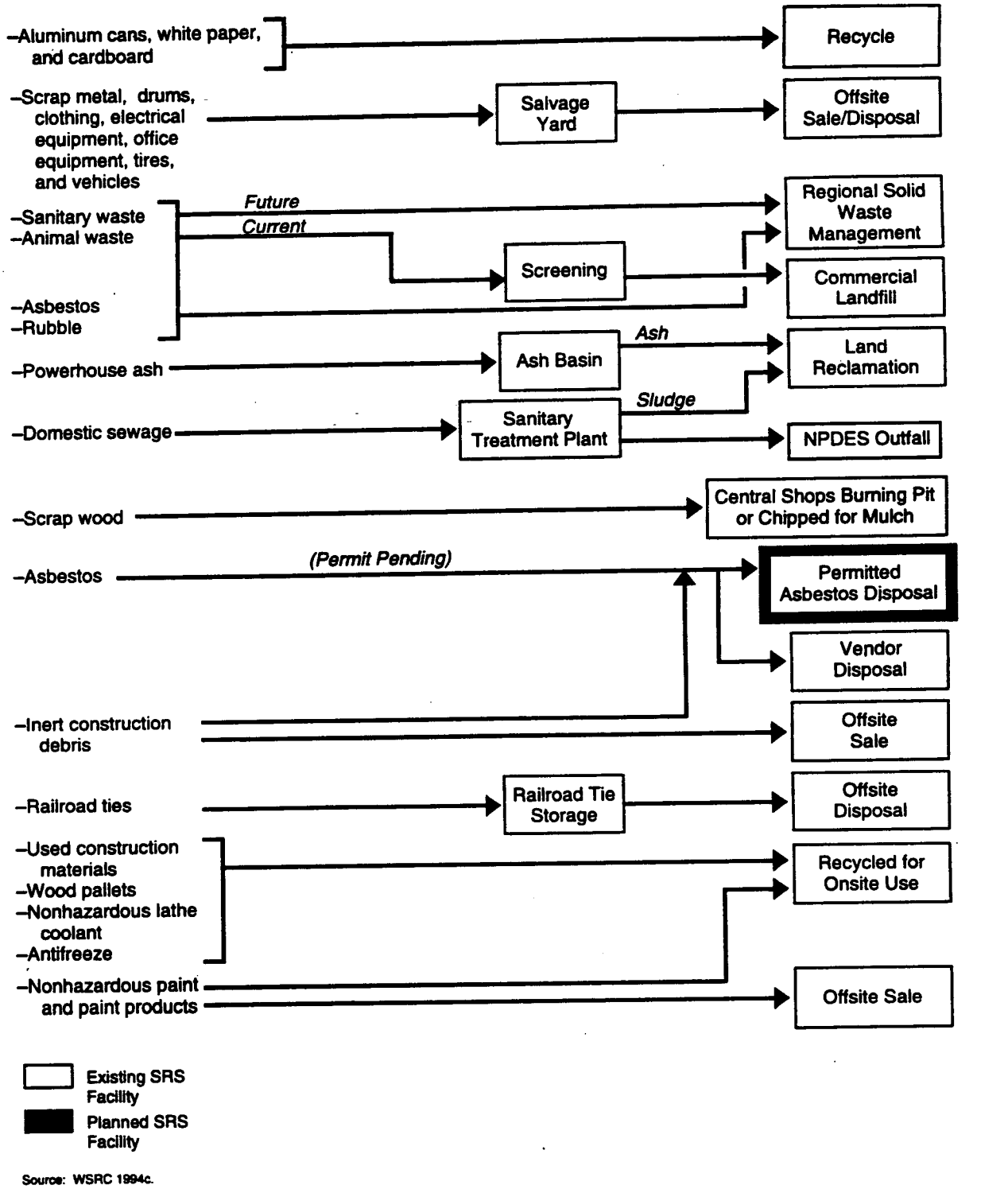
Figure E.2.6–4. Mixed Waste Management at Savannah River Site.



Source: SR DOE 1995b.

2809/FMD

Figure E.2.6–5. Hazardous Waste Management at Savannah River Site.



Source: WSRC 1994c.

2810/FMD

Figure E.2.6–6. Nonhazardous Waste Management at Savannah River Site.

Table E.2.6–1. High-Level Waste Inventory at Savannah River Site

Waste Matrix	Number of Waste Streams	Inventory as of September 1994 (m^3)	Number of Waste Streams 5-Year Projection	Total Generation 5-Year Projection (m^3)
Remote-Handled				
Aqueous liquids, slurries	2	127,040	2	15,430
[Text deleted.]				

Source: DOE 1995gg; WSRC 1995a.

Table E.2.6–2. High-Level Waste Treatment Facilities at Savannah River Site

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
F- and H-Tank Farms	Neutralization dissolution, chemical reaction	HLW aqueous liquid solutions and slurries	HLW aqueous liquid, sludge, solutions	[b]	Operational
Savannah River Technology Center high activity treatment probe	Ion exchange	HLW aqueous liquid	Mixed LLW liquid, HLW sludge	1,725	Operational
F- and H-Evaporators	Evaporation, ion exchange (cesium removal)	HLW aqueous liquid	HLW sludge, salt, slurry, organic solid	26,900[c]	Operational
Replacement Evaporator	Evaporation, ion exchange (cesium removal)	HLW aqueous liquid	HLW sludge, salt, slurry, organic solid	13,800	Design and construction phase planned for 1999
DWPF	Vitrification	HLW slurry and precipitate	HLW borosilicate	18,800	Operational
Extended Sludge Processing	Soil washing to remove soluble salts, precipitation	HLW sludge	HLW sludge	834	Operational
In-Tank Precipitation	Soil washing to remove soluble salts, precipitation	HLW salt solution	LLW salt solution, HLW precipitate slurry	Would produce 22,700 m^3 salt solution and 1,900 m^3 precipitate	Operational
Late wash	Washing to remove sodium nitrate	HLW precipitate slurry	HLW precipitate	24,600	Undergoing design and construction

[a] For those facilities already in use, this is a normal operating capacity, whereas for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies and permit issuance.

[b] Batch process; depends on available tanks and process used.

[c] Based on net tank space gained. Input volume.

Source: SR DOE 1994b; SR DOE 1995c; WSRC 1995a; WSRC 1995b.

Table E.2.6–3. High-Level Waste Storage Facilities at Savannah River Site

Storage Unit	Input Capability	Total Capacity[a]	Comment
F- and H-Area Tank Farms[b]	HLW, corrosive, toxic aqueous liquids, salt, sludge	145,000 m^3	Operational
DWPF Vitrification Plant, glass waste storage buildings	HLW solid borosilicate glass in stainless steel cylinders	4,572 canisters (7.6 t glass)	First unit available, second unit planned and approved.
DWPF Vitrification Plant, failed equipment storage	Failed melters	3,720 m^3	

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

[b] Tanks that do not meet secondary containment criteria as described in the FFCA are not included.

Source: SR DOE 1994b; SR DOE 1995c.

Table E.2.6–4. Transuranic and Mixed Transuranic Waste Inventory at Savannah River Site

Waste Matrix	Number of Waste Streams	Inventory as of September 30, 1994 (m^3)	Number of Waste Streams 5-Year Projection	Total Generation 5-Year Projection (m^3)
Contact-Handled				
Organic liquids	1	<1	0	0
Combustible debris	3	7,693	1	240
Debris	2	199	2	2,613
Ash	1	<1	0	0
Total	5	7,892	3	2,853

Source: DOE 1995gg; WSRC 1995a.

Table E.2.6–5. Transuranic and Mixed Transuranic Waste Treatment Facilities at Savannah River Site

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a]	Comment
TRU Waste Characterization/ Certification Facility	Assaying, sorting, decontamination, size reduction, welding, venting, encapsulation	Mixed and non-mixed TRU wastes	Certified forms for disposal	1,720 m^3/yr	Begin operations in 2007
Alpha Vitrification	Vitrification	TRU, Mixed-TRU waste	Certified and stabilized forms for disposal.	559 m^3/yr liquid or 2,280 m^3/yr solid	Planned

[a] For facilities under design or construction this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

Source: SR DOE 1995c; WSRC 1995a; WSRC 1995b.

Table E.2.6–6. Transuranic and Mixed Transuranic Waste Storage Facilities at Savannah River Site

Storage Unit	Input Capability	Total Capacity (m^3)	Comment
TRU Storage Pads	Miscellaneous solid TRU waste, extraction procedure toxic waste, listed waste	34,400	Operational RCRA Part A. No offsite waste planned. Buried waste to be exhumed, processed at TRU Waste Facility, and shipped to WIPP. Nineteen pads in use, 10 additional pads planned.

Source: SR DOE 1995c; WSRC 1995a.

Table E.2.6–7. Low-Level and Mixed Low-Level Waste Treatment Facilities at Savannah River Site

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
Consolidated Incineration Facility and Ashcrete Stabilization Facility	Incineration/Stabilization	LLW, mixed LLW, liquid, solid, ash, slurry	Stabilized LLW, mixed LLW, solid	4,630 (liquids) 17,830 (solids)	Planned, approved, RCRA final, available 1996
F- and H-Areas ETF	Neutralization, chemical precipitation, filtration, carbon adsorption, reverse osmosis, ion exchange, evaporation, mercury adsorption	Mixed LLW, aqueous liquids (F- & H- Area wastewater, evaporator overheads and condensate, cesium removal column effluent)	Corrosive LLW liquid concentrate, treated water effluent; used activated carbon, used ion exchange resins (solid LLW)	1,930,000	Operational, NPDES: Operating
M-, L-, and H-Area Compactors	Compaction	Solid LLW job waste	Compacted LLW	3,983	Operational
Hazardous/Mixed Waste Containment Building	Physical and Chemical decontamination, Wet chemical oxidation, encapsulation, amalgamation	Liquids and solids, mixed LLW, toxic, corrosive, reactive, metal, sludge, debris	Containment Facility	703	Planned, approved, begin operation in 2006
LLW Smelter	Off-site decontamination	LLW, equipment	Recovered metal	600	Offsite facility
Non-Alpha Vitrification Facility	Sorting, vitrification	LLW, mixed LLW, hazardous wastes	Mixed LLW	3,090	Proposed facility
Offsite Mixed Waste Treatments	Amalgamation, PCB destruction, acid bath, smelting	Mixed LLW	Solid LLW	124	Offsite facilities
M-Area Liquid ETF	Filtration, flocculation neutralization, precipitation	Liquid mixed LLW	Wastewater, solid mixed LLW, sludge	999,000	Operational, NPDES: operating
M-Area Vendor Treatment Facility	Vitrification	Aqueous liquids and slurries, mixed LLW, sludges	Wastewater, solid mixed LLW, borosilicate glass	2,470	Planned, approved, contract awarded for construction, NPDES

Table E.2.6–7. Low-Level and Mixed Low-Level Waste Treatment Facilities at Savannah River Site—Continued

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (m^3/yr)	Comment
Savannah River Technology Center Ion Exchange Treatment Probe Low Activity	Ion exchange	Mixed LLW, aqueous liquids	Aqueous liquid, solid, mixed LLW	11,200	Operational, RCRA: interim
Soil Sort Facility	Sorting, separating contaminated soils	LLW soil	Low-level contaminated and uncontaminated soil	2,540	Proposed facility
Supercompactor, offsite	Compaction	Solid LLW	Compacted solid LLW	42,400	Commercial facilities
Supercompactor, onsite	Compaction	Solid LLW	Compacted solid LLW	5,700	Proposed facility
Z-Area Saltstone Facility	Stabilization (solidification with radionuclide binders)	Liquids, mixed LLW, sludges, toxic, corrosive	Solid LLW, nonhazardous	28,400	Operational, permitted disposal, CWA, RCRA: final

[a] For those facilities already in use, this is a normal operating capacity, whereas for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

Source: SR DOE 1995c; WSRC 1995a.

Table E.2.6–8. Low-Level and Mixed Low-Level Waste Storage Facilities at Savannah River Site

Storage Unit	Input Capability	Total Capacity[a] (m^3)	Comment
Burial Ground Solvent Tanks (S23-30)	Liquid mixed LLW	727	To be closed, RCRA Part A
DWPF Organic Waste Storage Tank (430-S)	Liquid mixed LLW, ignitable, toxic	568	Operational, RCRA Part A
Liquid Waste Solvent Tanks (S33-36)	Liquid mixed LLW	454	Planned facility
M-Area Process Waste Interim Treatment/Storage Facility	Liquid mixed LLW, listed, (electroplate sludge)	8,300	Operational, RCRA Part A
Mixed Waste Storage Buildings (643-29E and 643-43E)	Liquid mixed LLW solid, toxic, listed, ignitable, metal, sludge, soil	1,300	Operational, RCRA Part A
Mixed Waste Storage Shed (316-M)	Liquid and solid mixed LLW	120	Operational, RCRA Part A
Savannah River Laboratory High Activity Storage Tanks (772-2A)	Liquid mixed LLW, toxic, Toxicity Characteristic Leaching Procedure	198	Operational, RCRA Part A
Hazardous Waste Storage Facility (645-2N)	Mixed LLW	580	Operational, RCRA Part B
Process Waste Interim Treatment	Liquid mixed LLW	8,300	Operational, RCRA Part A
Long-lived Waste Storage Buildings	Process water deionizers containing carbon-14	3,330	Planned facility

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: WSRC 1995a.

Table E.2.6–9. Waste Disposal at Savannah River Site

Disposal Unit	Input Capability	Capacity[a,b] (m^3)	Comment
Hazardous/Mixed Waste Disposal Vaults	Solid mixed LLW, listed (CIF, Ashcrete, blowdown, and vitrified)	45,600	10 vaults are planned and funded, RCRA submitted 1990, available 2002.
Intermediate-Level Waste Vaults	Solid LLW	27,000	2 vaults operational, additional 5 planned
Low Activity Waste Vaults	Solid LLW, compacted waste, contaminated equipment, filters, sediment, job control waste, process beds, soils, resins, lithium-aluminum melted forms	61,500	1 vault constructed, additional 12 planned.
LLW Disposal Facility, Slit Trenches	Solid LLW	407,000	58 trenches planned
Z-Area Saltstone Vaults	Solid LLW	1,110,000	2 vaults operational, additional 12 vaults planned

[a] Schedules and capacities for the facilities under design or construction are subject to changes such as availability of funds and permit issuance.

[b] Includes current capacity and projections through 2024.

Source: SR DOE 1994b; SR DOE 1995c; WSRC 1995a; WSRC 1995b.

Table E.2.6–10. Mixed Low-Level Waste Inventory at Savannah River Site

Waste Matrix	Number of Waste Streams	Inventory as of September 30, 1994 (m^3)	Number of Waste Streams 5-Year Projection	Total Generation 5-Year Projection (m^3)
Aqueous liquids/slurries	6	158	8	4,692
Organic liquids	3	139	4	587
Homogeneous solids	12	2,726	5	155
Debris	12	4,069	13	3,840
Lab packs	1	8	1	5
Special waste	4	83	4	32
Soil/gravel	2	17	0	0
Total	40	7,200	35	9,311

Source: DOE 1995gg; WSRC 1995a; WSRC 1995b.

Table E.2.6–11. Hazardous Waste Storage Facilities at Savannah River Site

Storage Unit	Input Capability	Capacity (m^3)	Comment
Solid Waste Storage Pads	Solid waste only	1,758	Located within fenced area of N-Area
316-M	Containerized hazardous waste	117	RCRA-permitted
710-B	Containerized hazardous waste	146	RCRA-permitted
645-N	Containerized hazardous waste	171	RCRA-permitted
645-4N	Containerized hazardous waste	426	RCRA-permitted

Source: SR DOE 1995c.

E.3 PROJECT-SPECIFIC WASTE MANAGEMENT ACTIVITIES

This section describes in detail the waste management activities at the facilities being evaluated in this PEIS for the proposed long-term storage and disposition of weapons-usable fissile materials. All facilities that would support the storage and disposition program would be designed to be fully compliant with DOE orders and all applicable Federal and State environmental regulations and statutes. Facility designs incorporate waste minimization and pollution prevention. To facilitate waste minimization, where possible, nonhazardous materials would be substituted for those materials that contribute to the generation of hazardous or mixed waste. Material from the waste streams would be treated, where possible, to facilitate disposal as nonhazardous wastes. Future D&D considerations have also been incorporated into the designs. The estimated waste quantities generated in the proposed facilities are conservative so as to provide an upper bound. Once a facility is built and operational, a significant decrease in waste generation would occur by incorporating future technologies.

Solid and liquid nonhazardous wastes generated during construction would include concrete and steel construction waste materials and sanitary wastewater. The steel construction waste would be recycled as scrap material before completing construction. The remaining nonhazardous wastes generated during construction would be disposed of as part of the construction project by the contractor. Uncontaminated wastewater would be used for soil compaction and dust control, and excavated soil would be used for grading and site preparation. Wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling. Hazardous wastes such as adhesives, motor oil, and lubricants would be packaged in DOT-approved containers and shipped offsite to commercial RCRA-permitted treatment, storage, and disposal facilities. Except for the HEU storage upgrade at Y–12, no radioactive waste would be generated during construction. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

E.3.1 FISSILE MATERIAL LONG-TERM STORAGE FACILITIES

The Preferred Alternative for the long-term storage of surplus Pu involves a combination of upgrade (SRS, ORR, and Pantex), No Action (Hanford, NTS, INEL, and LANL), and phaseout (RFETS).

This section describes the waste management activities at facilities that would provide long-term (50 years) storage for weapons-usable fissile material. Table E.3.1–1 lists the types of wastes expected to be generated from the long-term storage of Pu. There is no generation of spent nuclear fuel or HLW associated with the storage of Pu.

Table E.3.1–2 lists the types of wastes expected to be generated from the long-term storage of uranium. There is no generation of spent nuclear fuel, HLW, or TRU waste associated with the storage of uranium.

Table E.3.1–1. Waste Types Generated From Long-Term Storage of Plutonium

Plutonium Storage	
Liquid TRU	**Solid TRU**
Decontamination solutions	Damaged primary containment vessels
	Contaminated glovebox panels, windows, gaskets
Liquid Mixed TRU	**Solid Mixed TRU**
None	Leaded gloves
	Leaded windows
	Contaminated lead shielding
	Contaminated cleaning materials
Liquid LLW	**Solid LLW**
Decontamination solutions	Contaminated damaged secondary containers or overpack materials
Laboratory solutions	
Exhaust condensate	Filters (HEPA and prefilters)
Fire sprinkler effluent	Glovebox gloves
Oil and hydraulic fluids from materials handling equipment	Decontamination equipment and materials (health physics swipes, mops)
	Protective clothing
Liquid Mixed LLW	**Solid Mixed LLW**
Contaminated lubricants	Contaminated shielding
Contaminated cleaning solvents	Contaminated cleaning materials
Contaminated lube oil	
Liquid Hazardous	**Solid Hazardous**
Lubricants	Lead packing
Cleaning solvents	Wipes
Lube oil	Solid materials contaminated with oils, lubricants, and cleaning solvents
Hydraulic fluids from mechanical equipment	
Antifreeze solutions	
Paint	
Vacuum pump oils	
Liquid Nonhazardous	**Solid Nonhazardous**
Sanitary wastewater	Clean non-Pu metals
Utility wastewater	Shipping package packing materials
Process wastewater	Defective and damaged equipment, instruments, packing materials, and other materials outside of the radiation control area
Cooling system blowdown	
Stormwater runoff	Office supplies
	Industrial waste from utility and maintenance operations

Source: DOE 1996e; HF DOE 1996a; IN DOE 1996a; NT DOE 1996a; PX DOE 1996a; PX MH 1994a; SR DOE 1994e.

Table E.3.1–2. Waste Types Generated From Long-Term Storage of Uranium

Uranium Storage	
Liquid LLW	**Solid LLW**
Decontamination solutions	Packaging materials
Laboratory solutions	Filters (high-efficiency particulate air and prefilters)
Exhaust condensate	Glovebox gloves
Fire sprinkler effluent	Protective clothing
Oil and hydraulic fluids from materials	Decontamination equipment and materials (health physics swipes, mops)
Liquid Mixed LLW	**Solid Mixed LLW**
Contaminated lubricants	Contaminated shielding
Contaminated cleaning solvents	Contaminated cleaning materials
Contaminated lube oil	
Liquid Hazardous	**Solid Hazardous**
Lubricants	Lead packing
Cleaning solvents	Wipes
Lube oil	Solid materials contaminated with oils, lubricants, and cleaning solvents
Hydraulic fluids from mechanical equipment	
Antifreeze solutions	
Paint	
Vacuum pump oils	
Liquid Nonhazardous	**Solid Nonhazardous**
Sanitary wastewater	Shipping package packing materials
Utility wastewater	Defective and damaged equipment, instruments, packing materials, and other materials outside of the radiation control area
Process wastewater	
Cooling system blowdown	
Stormwater runoff	Office supplies
	Industrial waste from utility and maintenance operations

Source: DOE 1996f; NT DOE 1996a; OR MMES 1996a.

E.3.1.1 Upgrade Alternative

This section contains the construction and operational waste volumes (Tables E.3.1.1–1 through E.3.1.1–4), and waste management block diagrams (Figures E.3.1.1–1 through E.3.1.1–3) for the facilities that would provide long-term (50 years) storage for weapons-usable fissile materials through the upgrading of existing storage facilities. Tables E.3.1.1–5 through E.3.1.1–9 reflect the incorporation of all or some of the material from the RFETS or Los Alamos National Laboratory in upgraded facilities.

Table E.3.1.1–1. Estimated Waste Volumes for the Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative at Hanford Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	None	None
Solid	None	20	20
Mixed Transuranic			
Liquid	None	None	None
Solid	None	None	None
Low-Level			
Liquid	None	0.08[a]	None
Solid	None	85	42[b]
Mixed Low-Level			
Liquid	None	None	None
Solid	None	5	5
Hazardous			
Liquid	Included in solid	0.57	0.57
Solid	0.38	4	4
Nonhazardous (Sanitary)			
Liquid	3,880[c]	8,330	None
Solid	21[d]	917	459[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	None	None

[a] Liquid LLW would be treated and solidified prior to disposal.
[b] Assumes compaction of 4:1 for compactible solid LLW and nonhazardous waste.
[c] Does not include groundwater dewatering, if required.
[d] Includes concrete and 2.7 t of steel construction waste material that would be recycled as scrap metal.
Source: HF DOE 1996a.

Table E.3.1.1–2. Estimated Waste Volumes for the Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative at Idaho National Engineering Laboratory, Argonne National Laboratory-West

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.004[a]	None
Solid	None	2	1[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	1	1
Low-Level			
Liquid	None	0.79[a]	None
Solid	None	500	250[b]
Mixed Low-Level			
Liquid	None	0.015	0.015
Solid	None	27	27
Hazardous			
Liquid	5.7	0.15	0.15
Solid	23	1	1
Nonhazardous (Sanitary)			
Liquid	4,000[c]	7,600	None
Solid	34[d]	240	120[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	310[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being solidified.
[b] Assumes compaction factor of 4:1 for compactible solid TRU waste,low-level , and nonhazardous waste.
[c] Does not include groundwater dewatering, if required.
[d] Includes concrete and 6.3 t of steel construction waste material that would be recycled as scrap metal.
[e] Recyclable wastes.
Source: IN DOE 1996a.

Table E.3.1.1–3. Estimated Waste Volumes for the Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative at Pantex Plant

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	None	None
Solid	None	0.8	0.8
Mixed Transuranic			
Liquid	None	None	None
Solid	None	None	None
Low-Level			
Liquid	None	0.08[a]	None
Solid	None	138	69[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	8	8
Hazardous			
Liquid	Included in solid	1	1
Solid	0.05	1.5	1.5
Nonhazardous (Sanitary)			
Liquid	3,130[c]	12,900	12,900
Solid	1.3[d]	275	138[c]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	344[e]	None

[a] Liquid LLW would be treated with the remaining sludge being solidified.
[b] [Text deleted.] Assumes compaction factor of 4:1 for compactible solid LLW and nonhazardous waste.
[c] [Text deleted.] Does not include groundwater dewatering, if required.
[d] Includes concrete and 0.18 t of steel construction waste material that would be recycled as scrap metal.
[e] Recyclable wastes.
[Text deleted.]
Source: PX MH 1994a.

Table E.3.1.1–4. Estimated Waste Volumes for the Upgrade Alternative at Y–12 Plant

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	None	None
Solid	None	None	None
Mixed Transuranic			
Liquid	None	None	None
Solid	None	None	None
Low-Level			
Liquid	None	0.04[a]	None
Solid	8[b]	3	2[c]
Mixed Low-Level			
Liquid	None	0.02	0.02
Solid	None	0.8	0.8
Hazardous			
Liquid	None	Included in mixed LLW	Included in mixed LLW
Solid	None	Included in mixed LLW	Included in mixed LLW
Nonhazardous (Sanitary)			
Liquid	1,010	0.8	0.8
Solid	5[d]	31	15[c]
Nonhazardous (Other)			
Liquid	Included in sanitary	0.8	0.8
Solid	Included in sanitary	0.8	0.8

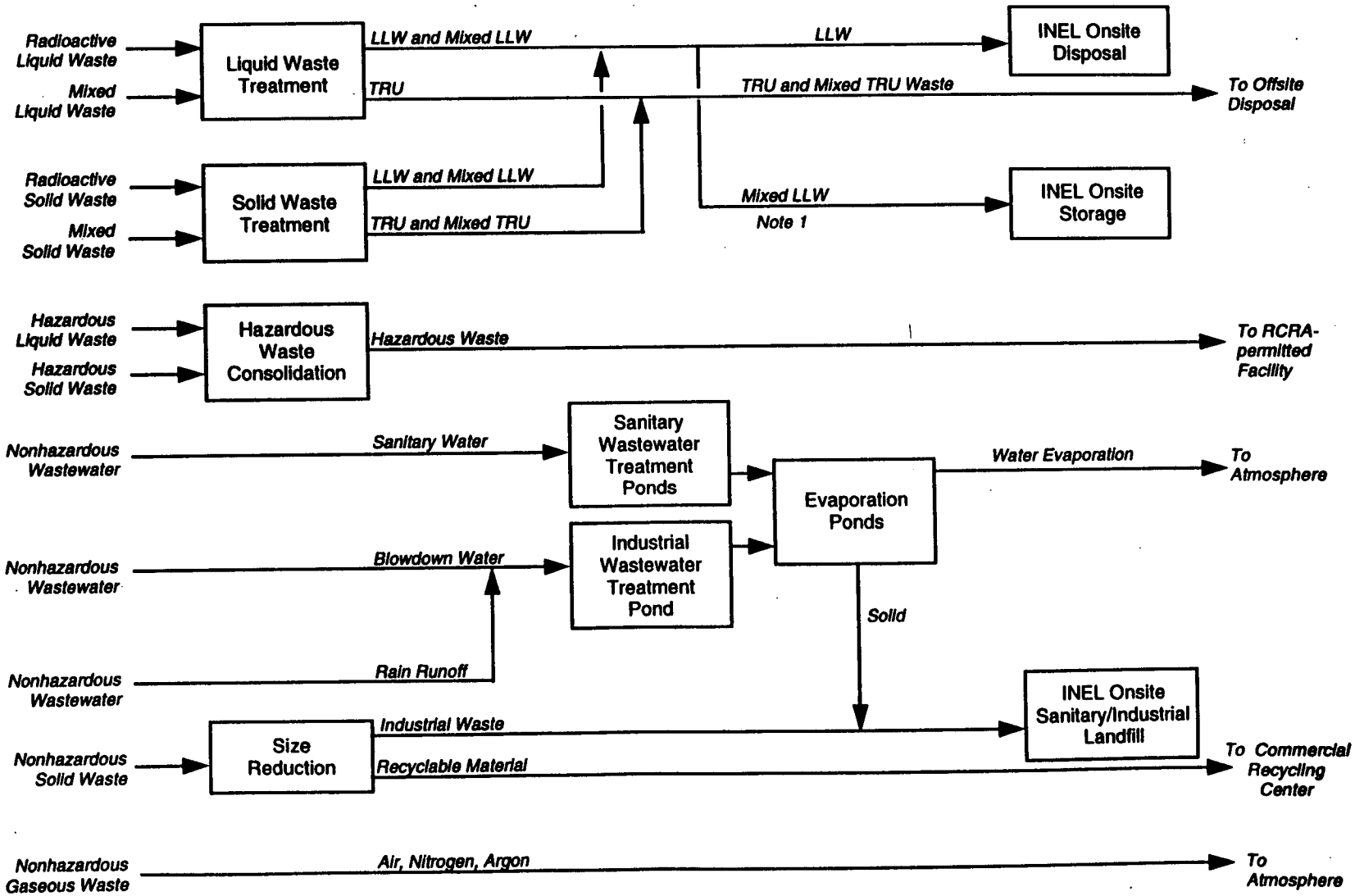
[a] Liquid LLW would be treated with the remaining sludge being solidified.

[b] Includes concrete and 3 t of steel which is contaminated.

[c] [Text deleted.] Assumes compaction factor of 4:1 for compactible solid LLW and nonhazardous waste.

[d] Includes concrete and 1.5 t of steel construction waste material that would be recycled as scrap metal.

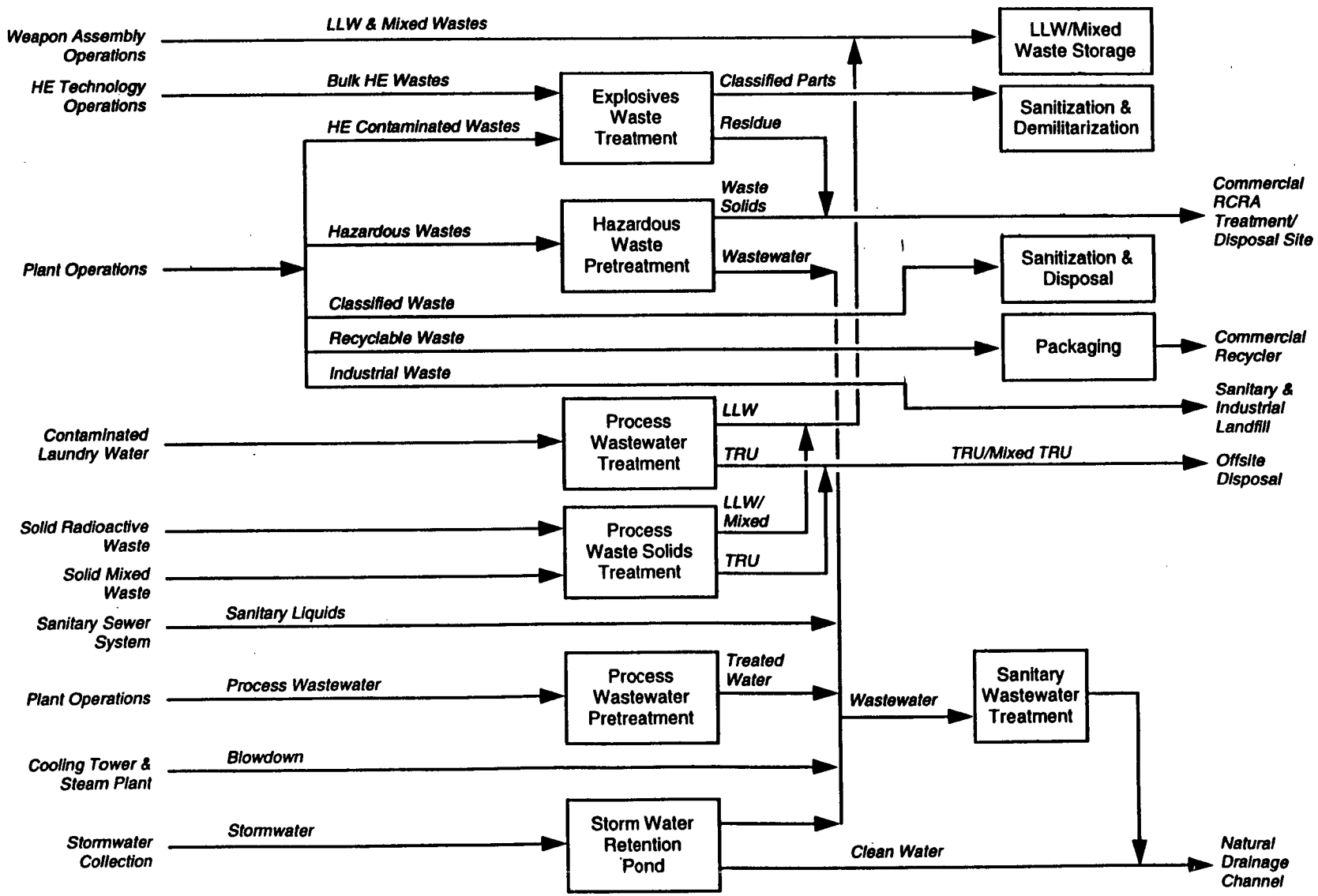
Source: OR MMES 1996a.



Note: 1. Mixed LLW would be treated and disposed of in accordance with INEL Site Treatment Plan.
Source: IN DOE 1996a.

2522/FMD

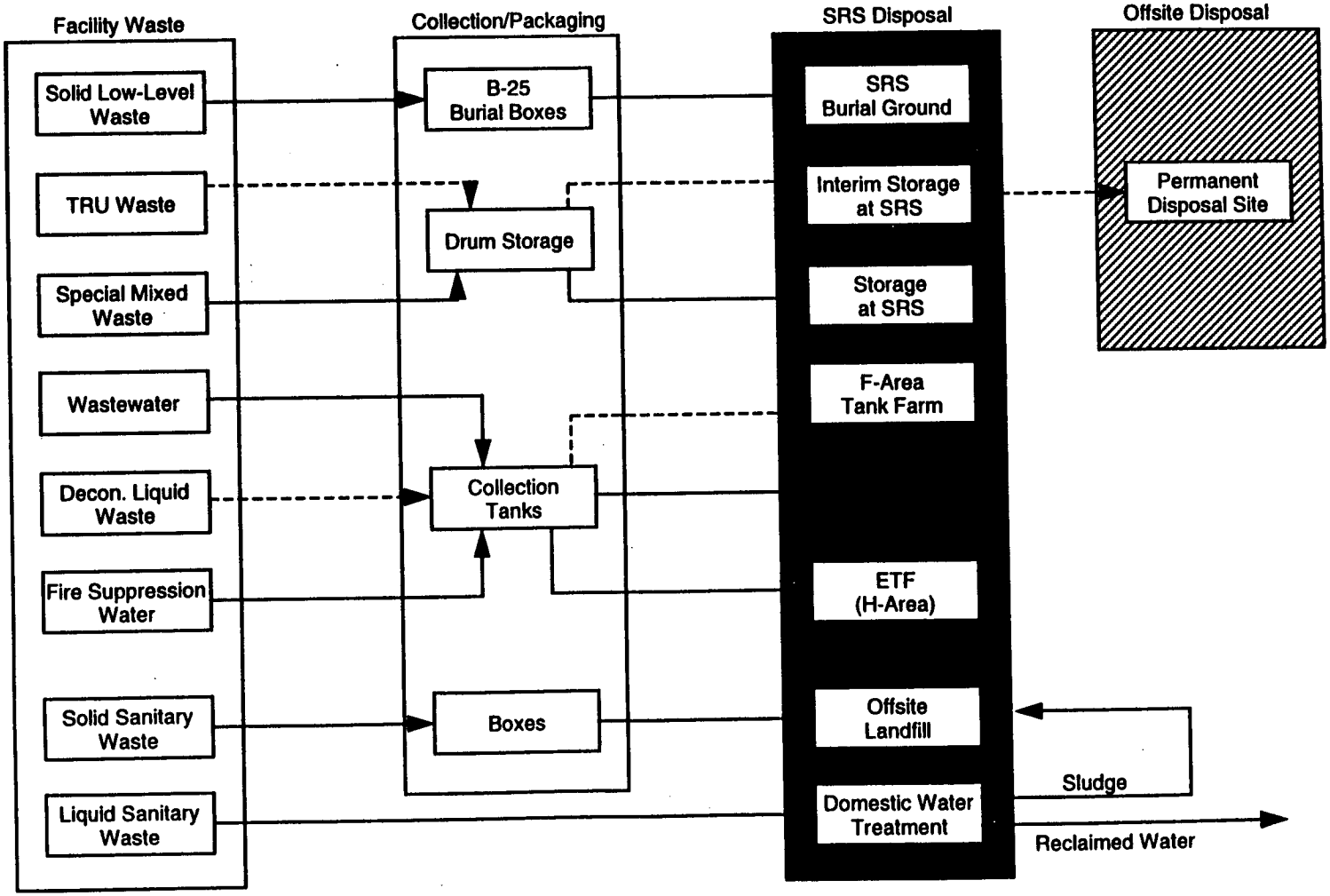
Figure E.3.1.1–1. Overall Waste Management System for the Upgrade Alternative at Idaho National Engineering Laboratory, Argonne National Laboratory-West.



Source: PX MH 1994a.

2466/FMD

Figure E.3.1.1–2. Overall Waste Management System for the Upgrade Alternative at Pantex Plant.



Source: SR DOE 1994e.

2470/FMD

Figure E.3.1.1–3. Overall Waste Management System for the Upgrade Alternative at Savannah River Site.

Table E.3.1.1–5. Estimated Waste Volumes for the Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative at Hanford Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	None	None
Solid	None	21	21
Mixed Transuranic			
Liquid	None	None	None
Solid	None	None	None
Low-Level			
Liquid	None	0.08[a]	None
Solid	None	89	45[b]
Mixed Low-Level			
Liquid	None	None	None
Solid	None	5	5
Hazardous			
Liquid	0.2	0.57	0.57
Solid	1.4	4	4
Nonhazardous (Sanitary)			
Liquid	5,880[c]	8,780	None
Solid	37[d]	967	483
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	None	None

[a] Liquid LLW would be treated and solidified prior to disposal.
[b] Assumes compaction factor of 4:1 for compactible solid LLW and nonhazardous waste.
[c] Does not include groundwater dewatering, if required.
[d] Includes concrete and 4.4 t of steel construction waste material that would be recycled as scrap metal.
[Text deleted.]
Source: HF DOE 1996a.

Table E.3.1.1–6. Estimated Waste Volumes for the Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative at Idaho National Engineering Laboratory, Argonne National Laboratory-West

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.004[a]	None
Solid	None	2	1[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	1	1
Low-Level			
Liquid	None	0.79[a]	None
Solid	None	500	250[b]
Mixed Low-Level			
Liquid	None	0.14	0.14
Solid	None	27	27
Hazardous			
Liquid	6.3	1.3	1.3
Solid	26	1	1
Nonhazardous (Sanitary)			
Liquid	6,100[c]	10,300	None
Solid	49[d]	346	173[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	440[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being solidified.
[b] [Text deleted.] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.
[c] Does not include groundwater dewatering, if required.
[d] Includes concrete and 8 t of steel construction waste material that would be recycled as scrap metal.
[Text deleted.]
[e] Recyclable wastes.
Source: IN DOE 1996a.

Table E.3.1.1–7. Estimated Waste Volumes for the Upgrade With Rocky Flats Environmental Technology Site Plutonium Pit Subalternative at Pantex Plant

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	None	None
Solid	None	0.8	0.8
Mixed Transuranic			
Liquid	None	None	None
Solid	None	None	None
Low-Level			
Liquid	None	0.08[a]	None
Solid	None	138	69[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	8	8
Hazardous			
Liquid	Included in solid	1	1
Solid	0.05	1.5	1.5
Nonhazardous (Sanitary)			
Liquid	3,130[c]	12,900	12,900
Solid	1.3[d]	275	138[e]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	344[f]	None

[a] Liquid LLW would be treated with the remaining sludge being solidified.

[b] [Text deleted.] Assumes compaction factor of 4:1 for compactible solid LLW.

[c] [Text deleted.] Does not include groundwater dewatering, if required.

[d] Includes concrete and 0.18 t of steel construction waste material that would be recycled as scrap metal.

[e] Assumes a compaction factor of 4:1 for compactible solids.

[f] Recyclable wastes.

[Text deleted.]

Note: Waste volumes for the Upgrade with All or Some RFETS and LANL Pu material are bounded by the Consolidation Alternative Modifying Existing and Constructing a New Facility in Zone 12 South at Pantex Plant (Table E.3.1.2–5).

Source: PX MH 1994a.

Table E.3.1.1–8. Estimated Waste Volumes for the Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative at Savannah River Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	None	None
Solid	None	None	None
Mixed Transuranic			
Liquid	None	None	None
Solid	None	None	None
Low-Level			
Liquid	None	None	None
Solid	None	None	None
Mixed Low-Level			
Liquid	None	None	None
Solid	None	None	None
Hazardous			
Liquid	Included in Solid	None	None
Solid	0.33	0.56	0.56
Nonhazardous (Sanitary)	1,680[a]	1,490[b]	1,480
Liquid	4.5[c]	13	11[d]
Solid			
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	13[e]	None

[a] [Text deleted.] Does not include groundwater dewatering, if required.
[b] Assumes a 350:1 wastewater/sludge ratio in the treatment of liquid sanitary waste.
[c] Includes concrete and 2.3 t of steel construction waste material that would be recycled as scrap metal.
[d] Includes sludge (5 m^3) from sanitary treatment which goes to land applicator. Compactible solids compacted by a factor of 4:1.
[e] Recyclable wastes.
Source: SR DOE 1994e; SRS 1996a:4.

Table E.3.1.1–9. Estimated Waste Volumes for the Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative at Savannah River Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	None	None
Solid	None	None	None
Mixed Transuranic			
Liquid	None	None	None
Solid	None	None	None
Low-Level			
Liquid	None	None	None
Solid	None	None	None
Mixed Low-Level			
Liquid	None	None	None
Solid	None	None	None
Hazardous			
Liquid	Included in solid	None	None
Solid	0.5	0.8	0.8
Nonhazardous (Sanitary)			
Liquid	2,370[a]	1,806[b]	1,800
Solid	19[c]	18	14[d]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	18[e]	None

[a] [Text deleted.] Does not include groundwater dewatering, if required.
[b] Assumes a 350:1 wastewater/sludge ratio in the treatment of liquid sanitary waste.
[c] Includes concrete and 2.3 t of steel construction waste material that would be recycled as scrap metal.
[d] Includes sludge (5 m^3) from sanitary treatment which goes to land applicator. Compactible solids compacted by a factor of 4:1.
[e] Recyclable wastes.
Source: SR DOE 1994e; SRS 1996a:4.

E.3.1.2 Consolidation Alternative

This section contains the construction and operational waste volumes (Tables E.3.1.2–1 through E.3.1.2–7) and waste management block diagrams (Figures E.3.1.2–1 through E.3.1.2–4) associated with the storage facilities for the consolidation alternative.

Table E.3.1.2–1. Estimated Waste Volumes for the Consolidation Alternative—Constructing a New Facility at Hanford Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2[a]	None
Solid	None	1,260	630[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	65	65
Hazardous			
Liquid	22	2	2
Solid	90	2	2
Nonhazardous (Sanitary)			
Liquid	7,670[c]	110,000	None
Solid	271[d]	1,140	570[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	1,400[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

[Text deleted.]

[d] Includes concrete and 32 t of steel construction waste material which would be recycled as scrap metal.

[e] Recyclable wastes.

Source: DOE 1996e.

Table E.3.1.2–2. Estimated Waste Volumes for the Consolidation Alternative—Modifying P-Tunnel and Constructing New Material Handling Building at Nevada Test Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2[a]	None
Solid	None	1,260	630[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	65	65
Hazardous			
Liquid	23	2	2
Solid	92	2	2
Nonhazardous (Sanitary)			
Liquid	7,830[c]	135,000	None
Solid	271[d]	1,620	810[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	2,000[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

[d] Includes concrete and 35 t of steel construction waste material which would be recycled as scrap metal.

[Text deleted.]

[e] Recyclable wastes.

Source: NT DOE 1996a.

Table E.3.1.2–3. Estimated Waste Volumes for the Consolidation Alternative—Constructing a New Facility at Nevada Test Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2[a]	None
Solid	None	1,260	630[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	65	65
Hazardous			
Liquid	23	2	2
Solid	92	2	2
Nonhazardous (Sanitary)			
Liquid	7,830[c]	114,000	None
Solid	288[d]	1,500	750[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	1,900[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

[d] Includes concrete and 35 t of steel construction waste material which would be recycled as scrap metal.

[Text deleted.]

[e] Recyclable wastes.

Source: DOE 1996e.

Table E.3.1.2–4. Estimated Waste Volumes for the Consolidation Alternative—Constructing a New Facility at Idaho National Engineering Laboratory

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2[a]	None
Solid	None	1,260	630[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	65	65
Hazardous			
Liquid	23	2	2
Solid	92	2	2
Nonhazardous (Sanitary)			
Liquid	7,830[c]	65,900	None
Solid	271[d]	1,320	660[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	1,600[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

[d] Includes concrete and 37 t of steel construction waste material which would be recycled as scrap metal.

[Text deleted.]

[e] Recyclable wastes.

Source: DOE 1996e.

Table E.3.1.2–5. Estimated Waste Volumes for the Consolidation Alternative—Modifying Existing and Constructing a New Facility in Zone 12 South at Pantex Plant

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2[a]	None
Solid	None	1,260	630[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	65	65
Hazardous			
Liquid	23	2	2
Solid	102	2	2
Nonhazardous (Sanitary)			
Liquid	8,000[c]	109,500	None
Solid	289[d]	1,560	780[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	1,900[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

[d] Includes concrete and 42 t of steel construction waste material which would be recycled as scrap metal.

[Text deleted.]

[e] Recyclable wastes.

Source: PX DOE 1996a.

Table E.3.1.2–6. Estimated Waste Volumes for the Consolidation Alternative—Constructing a New Facility at Pantex Plant

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2[a]	None
Solid	None	1,260	630[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	65	65
Hazardous			
Liquid	23	2	2
Solid	97	2	2
Nonhazardous (Sanitary)			
Liquid	8,000[c]	97,800	None
Solid	305[d]	1,440	720[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	1,800[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

[d] Includes concrete and 38 t of steel construction waste material which would be recycled as scrap metal.

[Text deleted.]

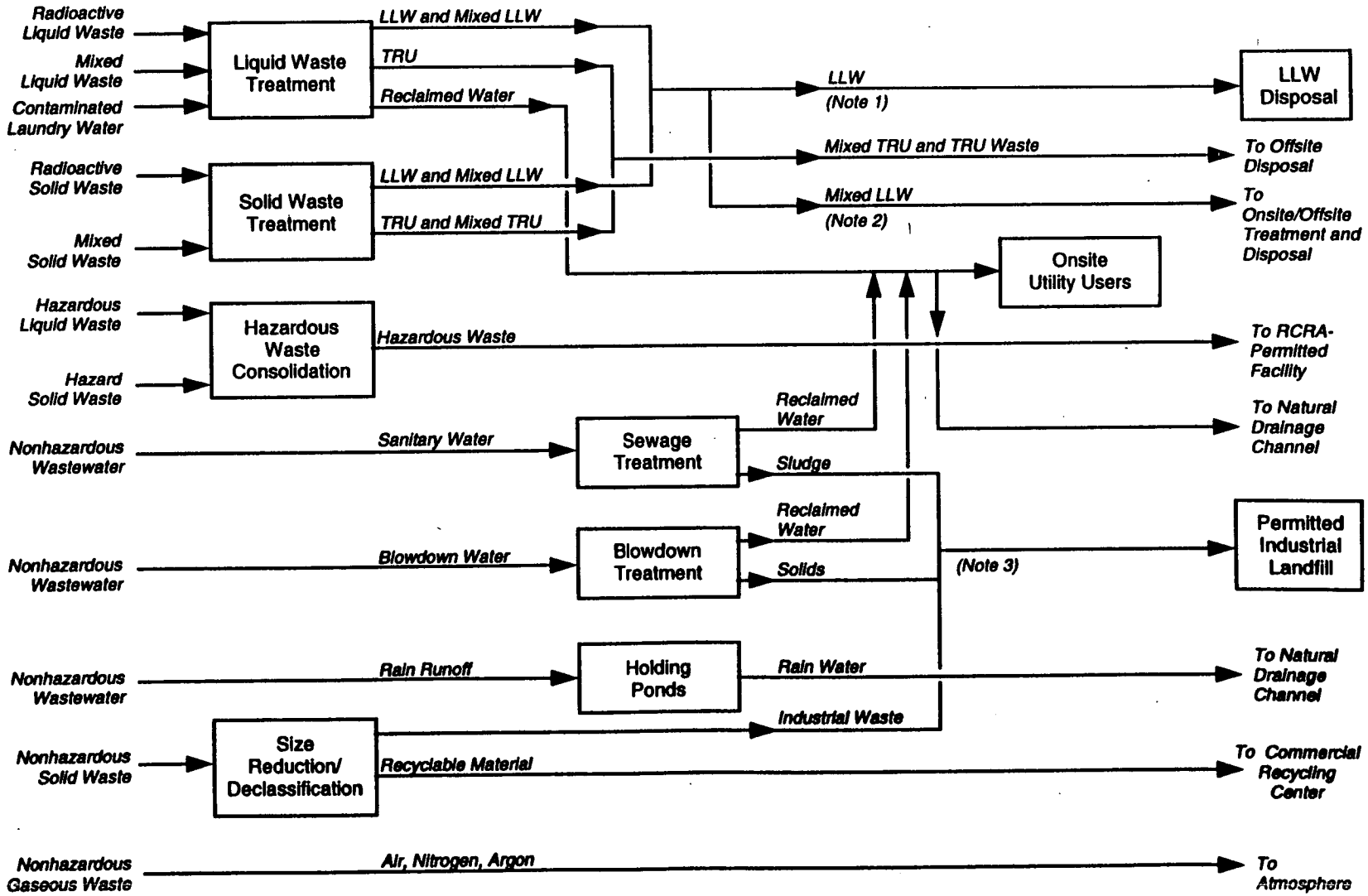
[e] Recyclable wastes.

Source: DOE 1996e.

Table E.3.1.2–7. Estimated Waste Volumes for the Consolidation Alternative—Constructing a New Facility at Savannah River Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2[a]	None
Solid	None	1,260	630[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	65	65
Hazardous			
Liquid	23	2	2
Solid	95	2	2
Nonhazardous (Sanitary)			
Liquid	8,000[c]	168,830	168,770
Solid	305[d]	1,480	740[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	1,800[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.
[Text deleted.]
[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.
[c] Does not include groundwater dewatering, if required.
[d] Includes concrete and 38.3 t of steel construction waste material which would be recycled as scrap metal.
[Text deleted.]
[e] Recyclable wastes.
Source: DOE 1996e.

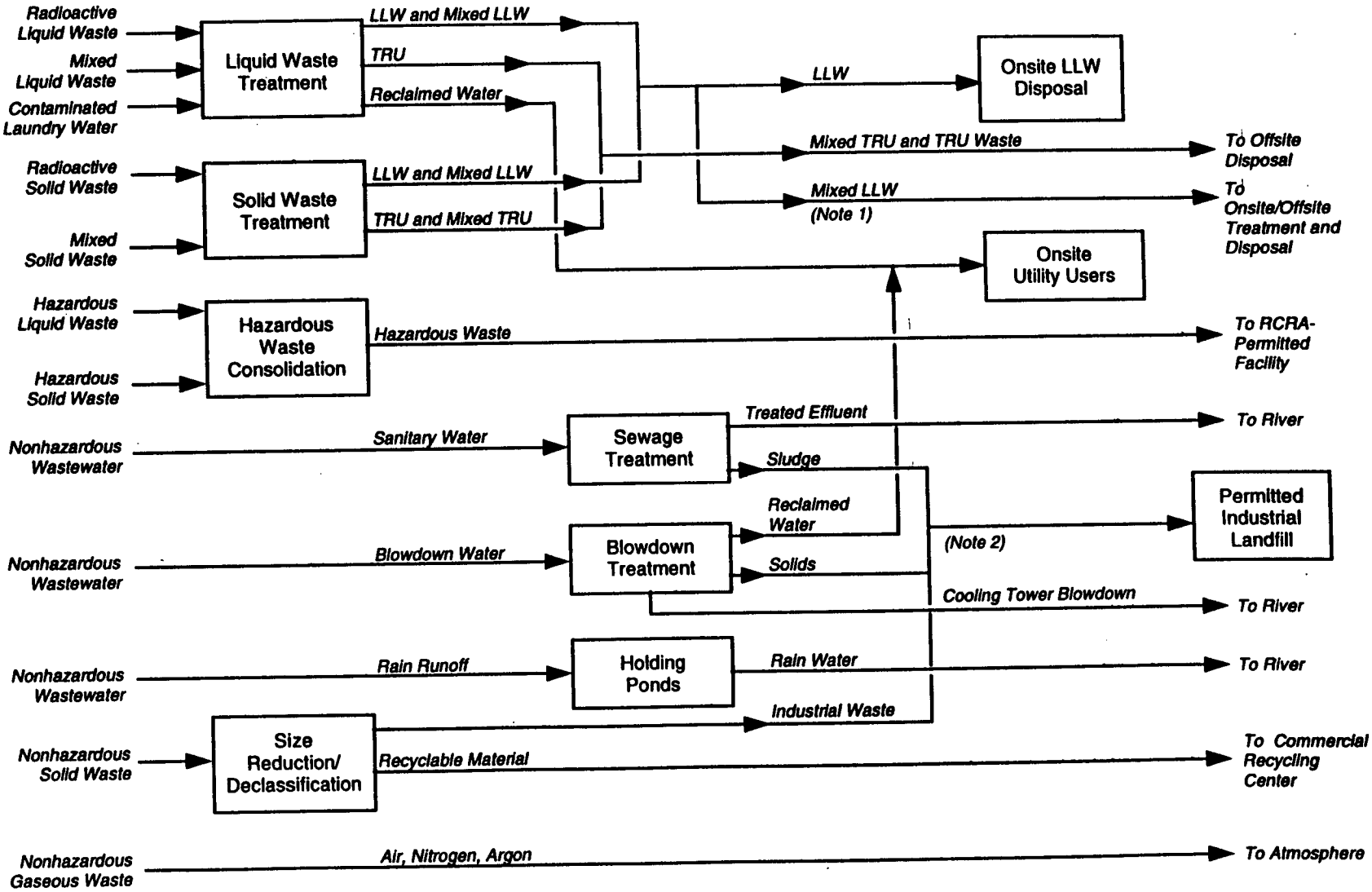


Note: 1. LLW is disposed of according to site practice: onsite at Hanford, NTS, and INEL; offsite disposal at Pantex.
2. Mixed LLW would be treated and disposed of in accordance with the site treatment plan.
3. Sanitary/industrial waste would be disposed of according to site practice: onsite at Hanford, NTS, and INEL; offsite at Pantex.

Source: DOE 1996e.

249JVS&D

Figure E.3.1.2–1. Overall Waste Management System for the Consolidation Alternative at Hanford Site, Nevada Test Site, Idaho National Engineering Laboratory, or Pantex Plant.

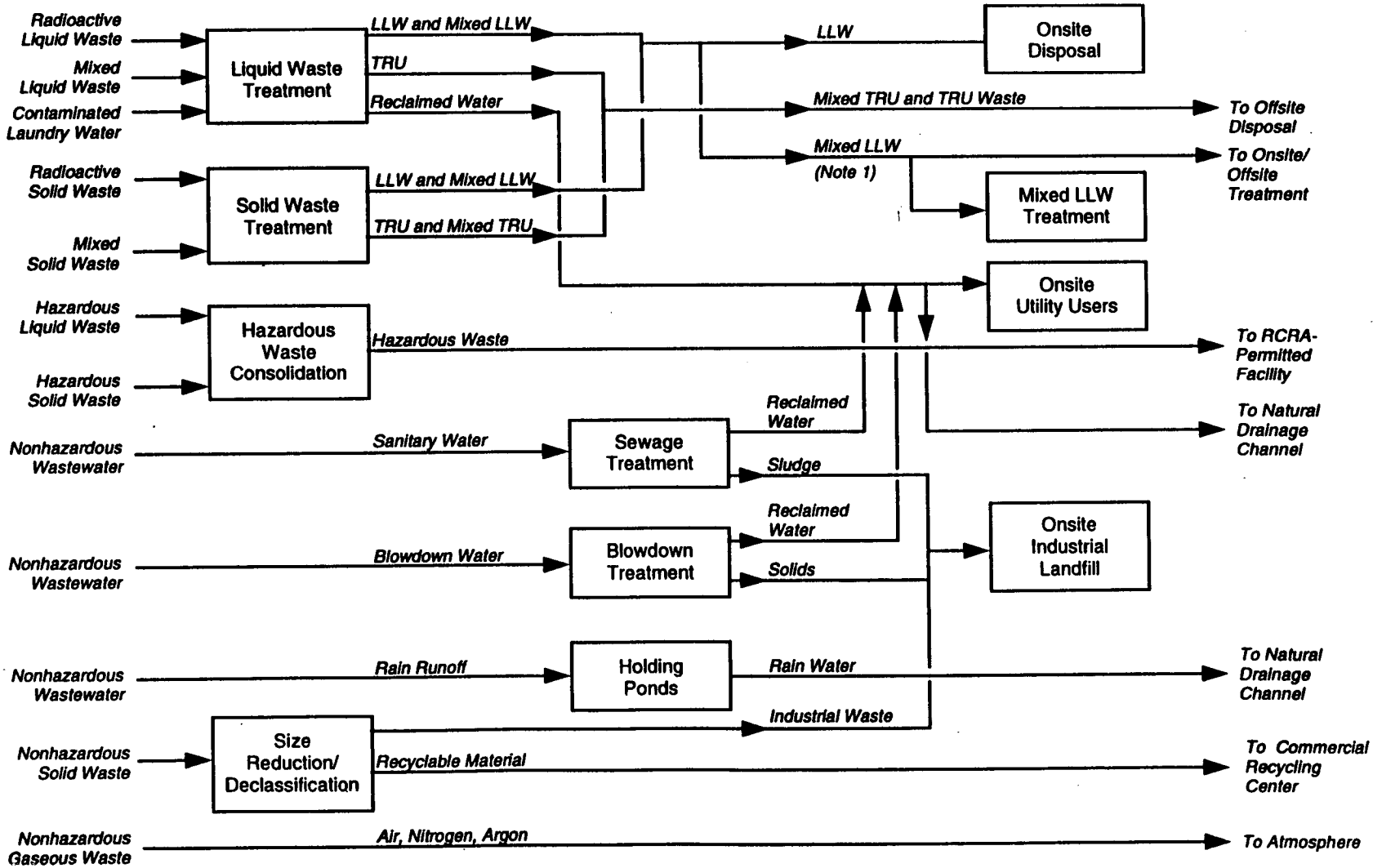


Note: 1. Mixed LLW would be treated and disposed of in accordance with the site treatment plan.
2. Sanitary/industrial waste would be disposed of according to site practice.

Source: DOE 1996e.

2494/S&D

Figure E.3.1.2–2. Overall Waste Management System for the Consolidation Alternative at Savannah River Site.

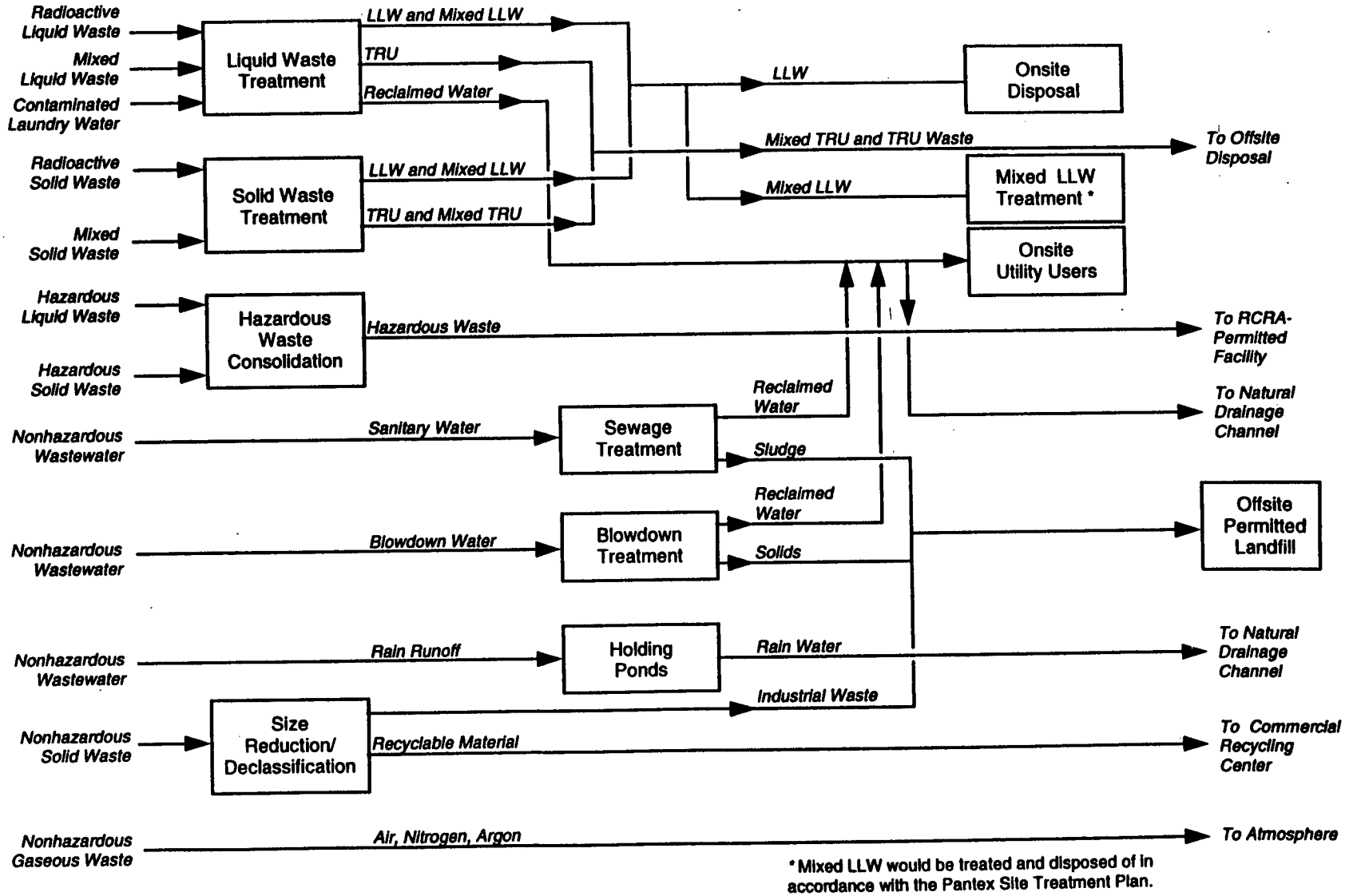


Source: NT DOE 1996a.

Note: 1. Mixed LLW would be managed in accordance with NTS Site Treatment Plan.

2476/S&D

Figure E.3.1.2–3. Overall Waste Management System for the Consolidation Alternative—Modifying P-Tunnel and Constructing



Source: PX DOE 1996a.

2507/FMD

Figure E.3.1.2–4. Overall Waste Management System for the Consolidation Alternative—Modifying Existing and Constructing New Facility in Zone 12 South at Pantex Plant.

E.3.1.3 Collocation Alternative

This section contains the construction and operational waste volumes (Tables E.3.1.3–1 through E.3.1.3–8) and waste management block diagrams (Figures E.3.1.3–1 through E.3.1.3–4) associated with the storage facilities for the collocation alternative. At ORR, a new Pu storage facility (Table E.3.1.3–6 and Figure E.3.1.3–2) would be constructed in conjunction with maintaining or upgrading HEU storage at Y–12; whereas, Table E.3.1.3–7 and Figure E.3.1.3–3 reflect a new facility for the storage of both Pu and HEU.

Table E.3.1.3–1. Estimated Waste Volumes for the Collocation Alternative—Constructing a New Facility at Hanford Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2.1[a]	None
Solid	None	1,300	650[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	66	66
Hazardous			
Liquid	31	2	2
Solid	122	2	2
Nonhazardous (Sanitary)			
Liquid	12,500[c]	146,000	None
Solid	366[d]	1,760	880[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	2,200[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.
[Text deleted.]
[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.
[c] Does not include groundwater dewatering, if required.
[d] Includes concrete and 42.5 t of steel construction waste material which would be recycled as scrap metal.
[Text deleted.]
[e] Recyclable wastes.
Source: DOE 1996f.

Table E.3.1.3–2. Estimated Waste Volumes for the Collocation Alternative—Modifying P-Tunnel and Constructing New Material Handling Building at Nevada Test Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2.1[a]	None
Solid	None	1,300	650[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	66	66
Hazardous			
Liquid	27	2	2
Solid	108	2	2
Nonhazardous (Sanitary)			
Liquid	8,670[c]	189,000	None
Solid	339[d]	1,960	980[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	2,500[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

[d] Includes concrete and 48 t of steel construction waste material which would be recycled as scrap metal.

[Text deleted.]

[e] Recyclable wastes.

Source: NT DOE 1996a.

Table E.3.1.3–3. Estimated Waste Volumes for the Collocation Alternative—Constructing a New Facility at Nevada Test Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2.1[a]	None
Solid	None	1,300	650[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	66	66
Hazardous			
Liquid	31	2	2
Solid	125	2	2
Nonhazardous (Sanitary)			
Liquid	12,600[c]	153,000	None
Solid	383[d]	1,900	950[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	2,400[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

[d] Includes concrete and 47.5 t of steel construction waste material which would be recycled as scrap metal.

[Text deleted.]

[e] Recyclable wastes.

Source: DOE 1996f.

Table E.3.1.3–4. Estimated Waste Volumes for the Collocation Alternative—Constructing a New Facility at Idaho National Engineering Laboratory

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2.1[a]	None
Solid	None	1,300	650[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	66	66
Hazardous			
Liquid	33	2	2
Solid	129	2	2
Nonhazardous (Sanitary)			
Liquid	12,800[c]	86,800	None
Solid	402[d]	1,720	860[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	2,100[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

[d] Includes concrete and 51 t of steel construction waste material which would be recycled as scrap metal.

[Text deleted.]

[e] Recyclable wastes.

Source: DOE 1996f.

Table E.3.1.3–5. Estimated Waste Volumes for the Collocation Alternative—Constructing a New Facility at Pantex Plant

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2.1[a]	None
Solid	None	1,300	650[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	66	66
Hazardous			
Liquid	33	2	2
Solid	130	2	2
Nonhazardous (Sanitary)			
Liquid	13,000[c]	129,500	None
Solid	401[d]	1,840	920[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	2,300[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

[d] Includes concrete and 52.5 t of steel construction waste material which would be recycled as scrap metal.

[Text deleted.]

[e] Recyclable wastes.

Source: DOE 1996f.

Table E.3.1.3–6. Estimated Waste Volumes for the Collocation Alternative—Constructing a New Plutonium Storage Facility; Maintaining or Upgrading Y–12 Plant

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2[a]	None
Solid	None	1,260	630[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	65	65
Hazardous			
Liquid	23	2	2
Solid	93	2	2
Nonhazardous (Sanitary)			
Liquid	7,830[c]	136,630	136,570
Solid	305[d]	1,340	670[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	1,700[e]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.
[Text deleted.]
[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.
[c] Does not include groundwater dewatering, if required.
[d] Includes concrete and 36.7 t of steel construction waste material which would be recycled as scrap metal.
[Text deleted.]
[e] Recyclable wastes.
Source: DOE 1996e.

Table E.3.1.3–7. Estimated Waste Volumes for the Collocation Alternative—Constructing a New Plutonium and Highly Enriched Uranium Storage Facility at Oak Ridge Reservation

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2.1[a]	None
Solid	None	1,300	650[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	66	66
Hazardous			
Liquid	31	2	2
Solid	127	2	2
Nonhazardous (Sanitary)			
Liquid	13,000[c]	171,840	171,770[d]
Solid	406[e]	1,740	870[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	2,200[f]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

[d] Assumes a 350:1 wastewater/sludge ratio in the treatment of liquid sanitary waste.

[e] Includes concrete and 49.5 t of steel construction waste material which would be recycled as scrap metal.

[Text deleted.]

[f] Recyclable wastes.

Source: DOE 1996f.

Table E.3.1.3–8. Estimated Waste Volumes for the Collocation Alternative—Constructing a New Facility at Savannah River Site

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.02[a]	None
Solid	None	10	5[b]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	2.1[a]	None
Solid	None	1,300	650[b]
Mixed Low-Level			
Liquid	None	0.2	0.2
Solid	None	66	66
Hazardous			
Liquid	33	2	2
Solid	130	2	2
Nonhazardous (Sanitary)			
Liquid	13,000[c]	214,890	214,820[d]
Solid	401[e]	1,880	940[b]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	2,300[f]	None

[a] Liquid TRU waste and LLW would be treated with the remaining sludge being vitrified.

[Text deleted.]

[b] Assumes compaction factor of 4:1 for compactible solid TRU, low-level, and nonhazardous waste.

[c] Does not include groundwater dewatering, if required.

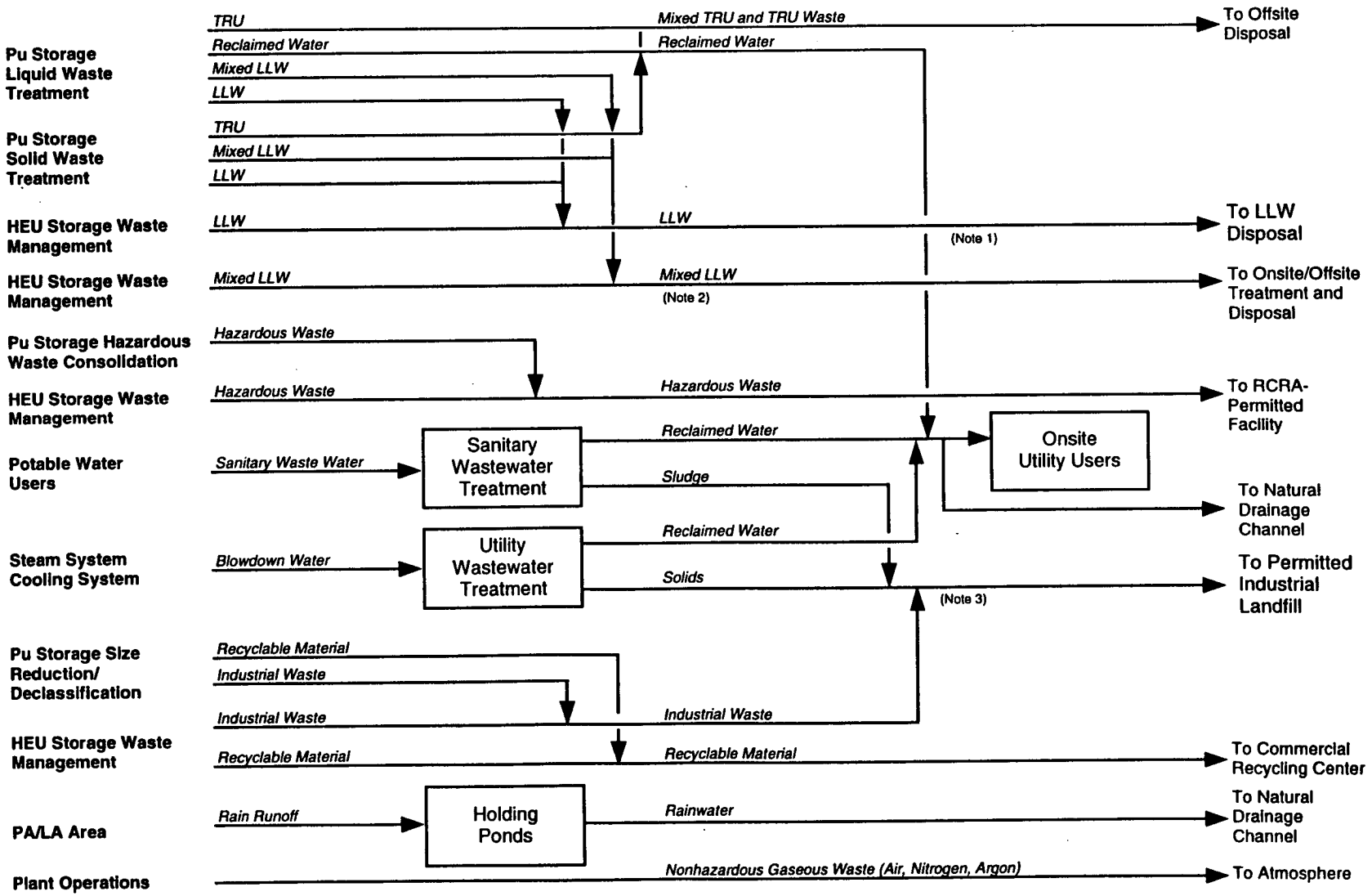
[d] Assumes a 350:1 wastewater/sludge ratio in the treatment of liquid sanitary waste.

[e] Includes concrete and 52.5 t of steel construction waste material which would be recycled as scrap metal.

[Text deleted.]

[f] Recyclable wastes.

Source: DOE 1996f.

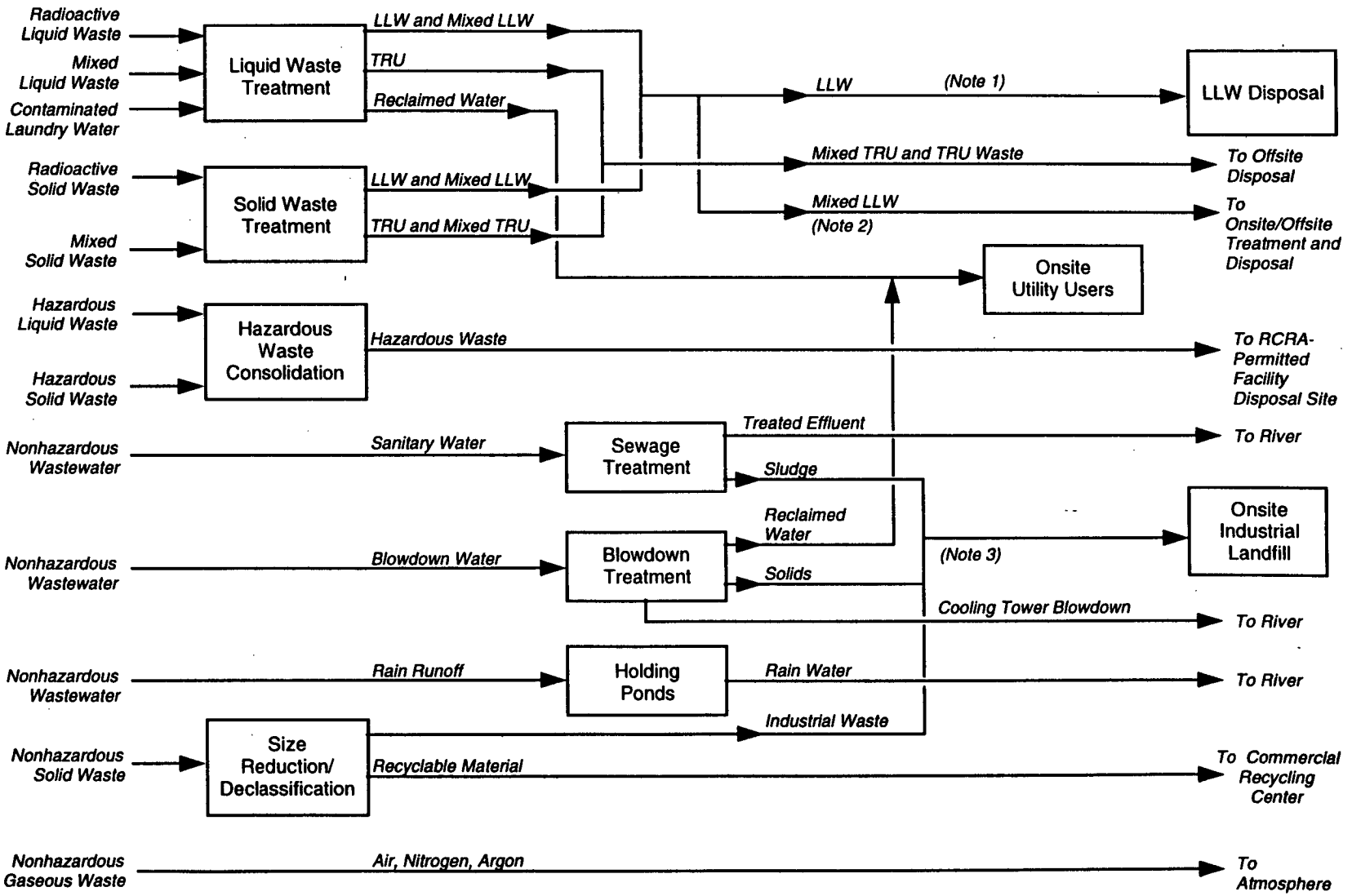


Note 1: LLW is disposed of according to site practice: onsite at Hanford, INEL and NTS; offsite at Pantex.
Note 2: Mixed LLW would be treated and disposed of in accordance with the site treatment plan.
Note 3: Sanitary/industrial waste would be disposed of according to site practice: onsite at Hanford, INEL, and NTS; offsite at Pantex.

Source: DOE 1996f.

2479/FMD

Figure E.3.1.3–1. Overall Waste Managemet System for the Collocation Alternative at Hanford Site, Idaho National Engineering Laboratory, Nevada Test Site, or Pantex Plant.

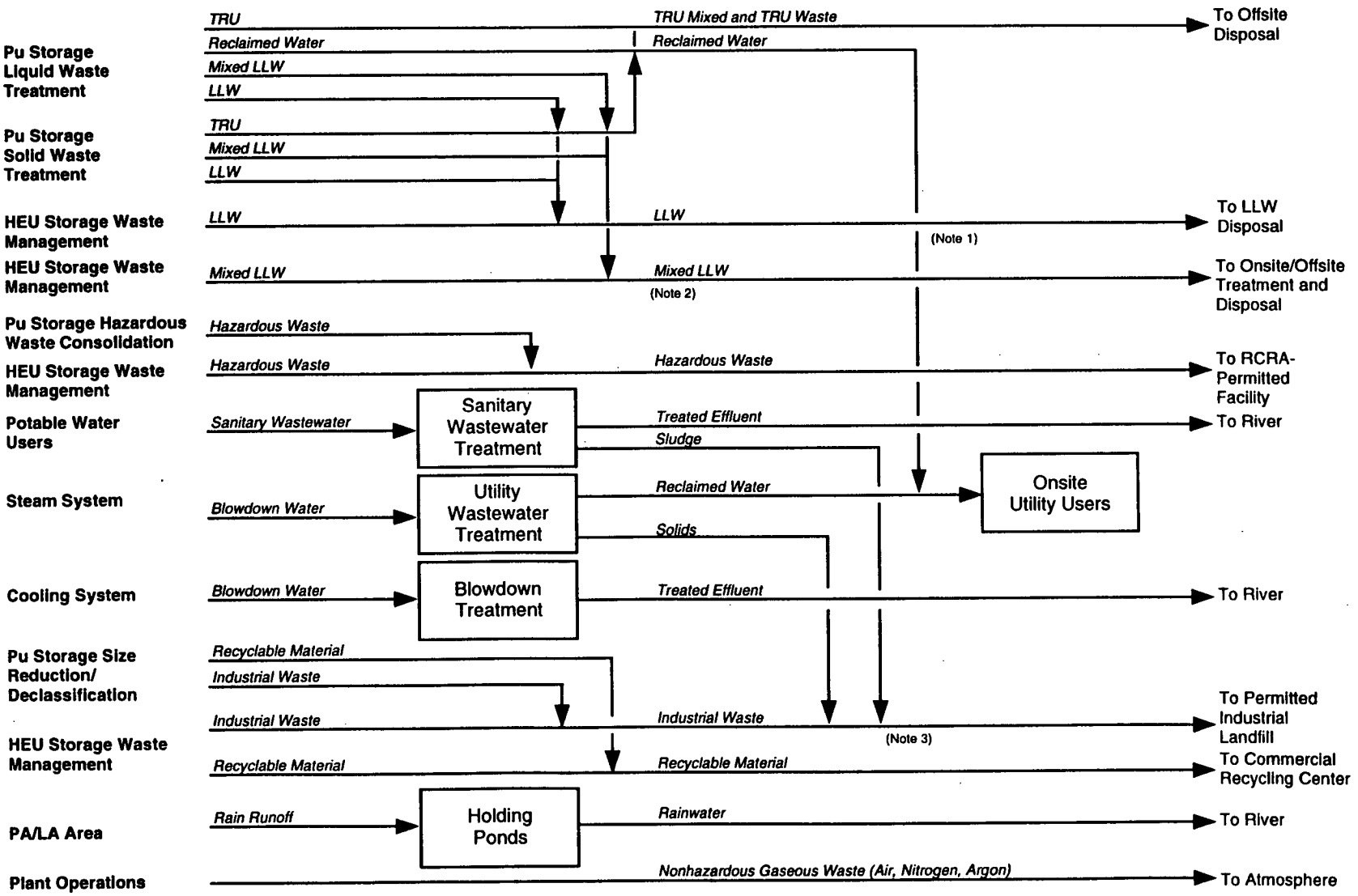


Source: DOE 1996e.

Note: 1. Onsite disposal at ORR is assumed.
2. Mixed LLW would be treated and disposed of in accordance with the ORR Site Treatment Plan.
3. Sanitary/industrial waste would be disposed of according to site practice.

3168/FMD

Figure E.3.1.3–2. Overall Waste Management System for the Collocation Alternative—Constructing a New Plutonium Storage Facility; Maintaining or Upgrading Y–12 at Oak Ridge Reservation.

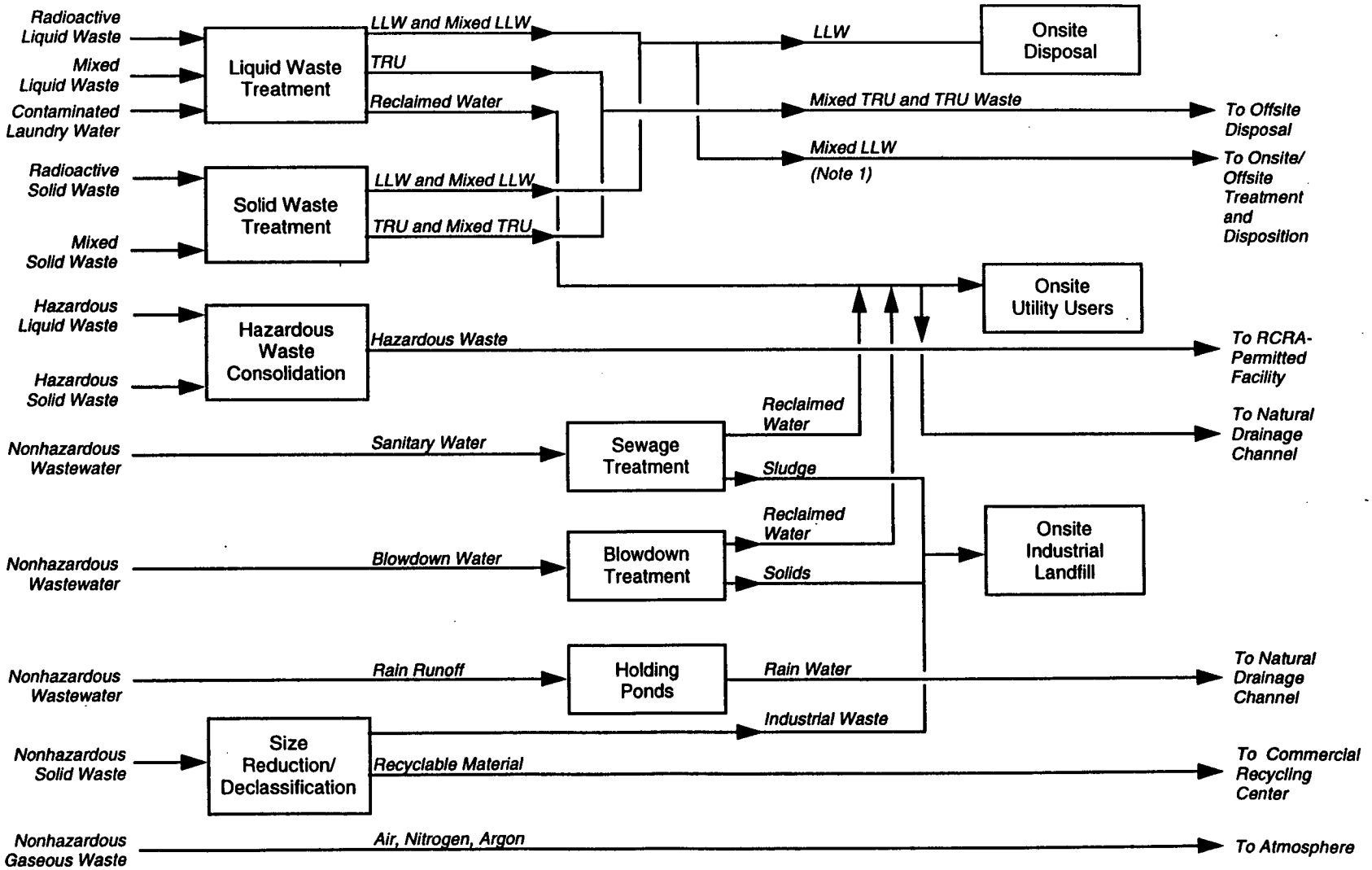


Note 1: LLW is disposed of according to site practice: onsite at SRS; onsite disposal at ORR is assumed.
Note 2: Mixed LLW would be treated and disposed of in accordance with the site treatment plan.
Note 3: Sanitary/industrial waste would be disposed of according to site practice: onsite at ORR; offsite or onsite at SRS.

Source: DOE 1996f.

2480/FMD

Figure E.3.1.3–3. Overall Waste Management System for the Collocation Alternative—Constructing a New Plutonium and Highly Enriched Uranium Storage Facility at Oak Ridge Reservation or Savannah River Site.



Source: NT DOE 1996a.

Note: 1. Mixed LLW would be managed in accordance with NTS Site Treatment Plan.

2476/S&D

Figure E.3.1.3–4. Overall Waste Management System for the Collocation Alternative—Modifying P-Tunnel and Constructing New Material Handling Building at Nevada Test Site.

E.3.2 FACILITIES COMMON TO MULTIPLE PLUTONIUM DISPOSITION ALTERNATIVES

Under the Preferred Alternative for surplus Pu disposition, the pit disassembly/conversion facility and the mixed oxide (MOX) fuel fabrication facility could each be located at either Hanford, INEL, Pantex, or SRS and the Pu conversion facility could be located at Hanford or SRS. The amount of waste generated from the construction of these alternatives could be reduced by using existing facilities for portions of the operations. The next tier of NEPA review will examine locations for the selected alternatives including the use of existing facilities.

E.3.2.1 Pit Disassembly/Conversion Facility

The design of the pit disassembly/conversion facility would place great emphasis on the minimization of both liquid and solid wastes. Where generation of a waste could not be avoided, methods would be pursued to recycle the waste. In general terms, waste management of the pit disassembly/conversion facility would include waste handling and treatment operations for processing the various wastes in aqueous, organic liquid, or solid form generated directly from pit conversion/disassembly operations or from related site activities.

Table E.3.2.1–1 presents the estimated annual waste volumes during construction and operation of the pit disassembly/conversion facility. Waste management capabilities would be provided to monitor, treat, and handle radiological wastes, industrial and chemical wastes, as well as sanitary and stormwater wastes. The treated effluent from utility, process, and sanitary wastewater treatment would be reclaimed and used as cooling system makeup water. The radioactive and nonradioactive waste management facilities would be located in the Pu processing building. This building would have space for the following: unloading and disassembly of retired Pu pits, separating of the Pu and other components, and the required processing of wastes for ultimate disposal. The waste treatment processes would include assay examination, sorting, separation, concentration, size reduction, special treatment, and thermal treatment. The wastes would be converted to either water meeting effluent standards, grouted cement, or compacted solid waste as final form products for disposal. Waste treatment processing would also perform equipment and waste container decontamination operations.

Following receipt of the retired pits, the initial phase of the processing would be disassembly and conversion. The pits would be parted and the Pu extracted and converted into metal or oxide using hydriding technology. If metal product was required, then the hydride would be converted back to metal by dehydriding. If oxide product was required, the hydride would be converted to oxide. A passivation furnace would be used in this phase to convert glovebox sweepings and residues into a stable oxide. A packaging station would be provided to package product metal or oxide and remove it from the glovebox line. The next phase would be residue recovery. Pu-contaminated components, equipment, and residues would be processed to remove the Pu. In addition, Pu residues such as passivated sweepings, crucibles, and some turnings would be processed to recover Pu. Product oxide from the residue recovery would be transferred to the disassembly/conversion area for packaging.

The wastes generated from pit disassembly/conversion and residue recovery operations would consist of low-level, mixed low-level, TRU, and mixed TRU wastes. The LLW would consist of paper and surgeon's gloves that would be discarded inside the radioactive materials area but external to gloveboxes. The TRU waste would be waste generated internal to the gloveboxes and would consist of failed equipment, stainless steel hemishells, combustibles, HEPA filters, and used vacuum pump oil. The mixed TRU waste would be principally leaded gloves.

Waste management involves the collection, assaying, sorting, treatment, packaging, storing, and shipping of radioactive, hazardous, and mixed wastes from Pu operations, and hazardous and nonhazardous waste from the support facilities. Two main subsystems, solid waste treatment and liquid waste treatment, would handle TRU, low-level, hazardous, and mixed wastes. Initial sorting of wastes would be performed at the source of generation. Wastes would be processed to ensure compliance with all applicable Federal and State statutes and regulations, as well as DOE Orders.

For solid waste treatment, as illustrated in Figure E.3.2.1–1, nonnuclear material, such as stainless steel, would be processed to form unclassified shapes and then be packaged for disposal. In addition, wastes from facility glovebox operations would be sorted, processed, and packaged for disposal. This subsystem contains nondestructive assay systems to assay waste material for Pu content and certify it as low-level or TRU waste. Following appropriate treatment, solid nonhazardous waste would be either disposed of at a permitted sanitary landfill or sent to a commercial recycling center. For liquid waste treatment, as illustrated in Figure E.3.2.1–2, solutions from the residue recovery subsystem would be treated to produce a disposable waste form. Typical processing would include: neutralization, filtration, immobilization, and certification for disposal. This subsystem would also contain the effluent and wastes from laundry facilities. Following appropriate treatment to below permitted levels, aqueous wastes would be discharged to natural drainage channels or permitted outfalls.

Any nonradiological wastes generated from operation would be monitored, collected, and treated, if necessary, before discharge to the environment. Facilities would be provided to treat chemically-contaminated wastewaters to below regulatory requirements before discharge to the environment. Holding tanks would be provided for the wastes. Nonradioactive solid wastes would be recycled where possible or transferred to approved disposal sites in accordance with accepted industrial practices and regulatory requirements.

All fire sprinkler water discharged in process areas during and after a fire would be contained, monitored, sampled, and if required, retained until disposal. Utility wastewater discharges (including cooling system and boiler blowdown) would be treated in an industrial wastewater treatment plant prior to discharge in accordance with applicable environmental standards. The facility design does not include a sanitary treatment plant to treat liquid sanitary waste; rather, the design assumes that such support infrastructure would already be in place.

High-Level Waste. The pit disassembly/conversion facility would not generate any HLW.

Transuranic Waste. TRU waste would be generated from process and facility operations, equipment decontamination, failed equipment, and used tools. Numerous processes, including those directly supporting pit disassembly and conversion, residue recovery, and analytical laboratory operation, and those managing the various waste streams, would produce used HEPA filters, retired gloveboxes, glovebox sweepings, failed equipment, declassified components, contaminated wipes and rags, combustibles, used vacuum pump oil, and other process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as TRU waste, they would be appropriately treated and stored until final disposal (assumed to be WIPP).

Transuranic waste would be treated in a waste handling facility to form grout or a compact solid waste. Should any liquid TRU waste be generated, it would be treated with the remaining TRU sludge being solidified. Treated TRU waste products would be packaged, assayed, and certified to meet the waste acceptance criteria of WIPP or alternative treatment level. Assuming WIPP is determined to be a suitable repository for these wastes, pursuant to the requirements of 40 CFR 191 and 40 CFR 268 and depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste, these wastes would be transported to WIPP for disposal.

Mixed Transuranic Waste. A very small quantity of solid mixed TRU waste, mainly protective clothing and radiological survey waste from the waste handling facility, would be generated annually during operations. This mixed TRU waste would be primarily generated from activities at the waste handling/management facilities. Mixed TRU waste would be packaged and shipped to another DOE waste management facility for temporary storage, pending final treatment and disposal in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act*. Current plans call for disposal at WIPP.

Low-Level Waste. [Text deleted.] Numerous processes, including those directly supporting pit disassembly and conversion, residue recovery, and analytical laboratory operation, and those managing the various waste

streams, would produce contaminated operator clothing, gloves, wipes, shoe covers, and process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as LLW, they would be treated by sorting, separation, concentration, and size reduction processes. Should any liquid LLW be generated, it would be treated with the remaining LLW sludge being solidified. Final LLW products would be surveyed and disposed of onsite or offsite in a shallow burial site.

Mixed Low-Level Waste. A very small quantity of liquid and solid mixed LLW, mainly protective clothing and radiological survey waste from the waste handling facility, would be generated annually during operations. This mixed LLW would be primarily generated from activities at the waste handling/management facilities. Any mixed LLW would be stored onsite on an interim basis until treatment, disposal, or offsite shipment in accordance with the site-specific treatment plan.

Hazardous Waste. Many of the pit disassembly/conversion facility processes would generate hazardous waste. This would include chemical makeup and reagents for support activities, lubricants and oils for process and support equipment, and used solvent rags. The liquid and solid hazardous waste would be collected and stored onsite on an interim basis. The hazardous waste would be recycled, or stored and packaged for offsite treatment or disposal at offsite commercial RCRA-permitted facilities.

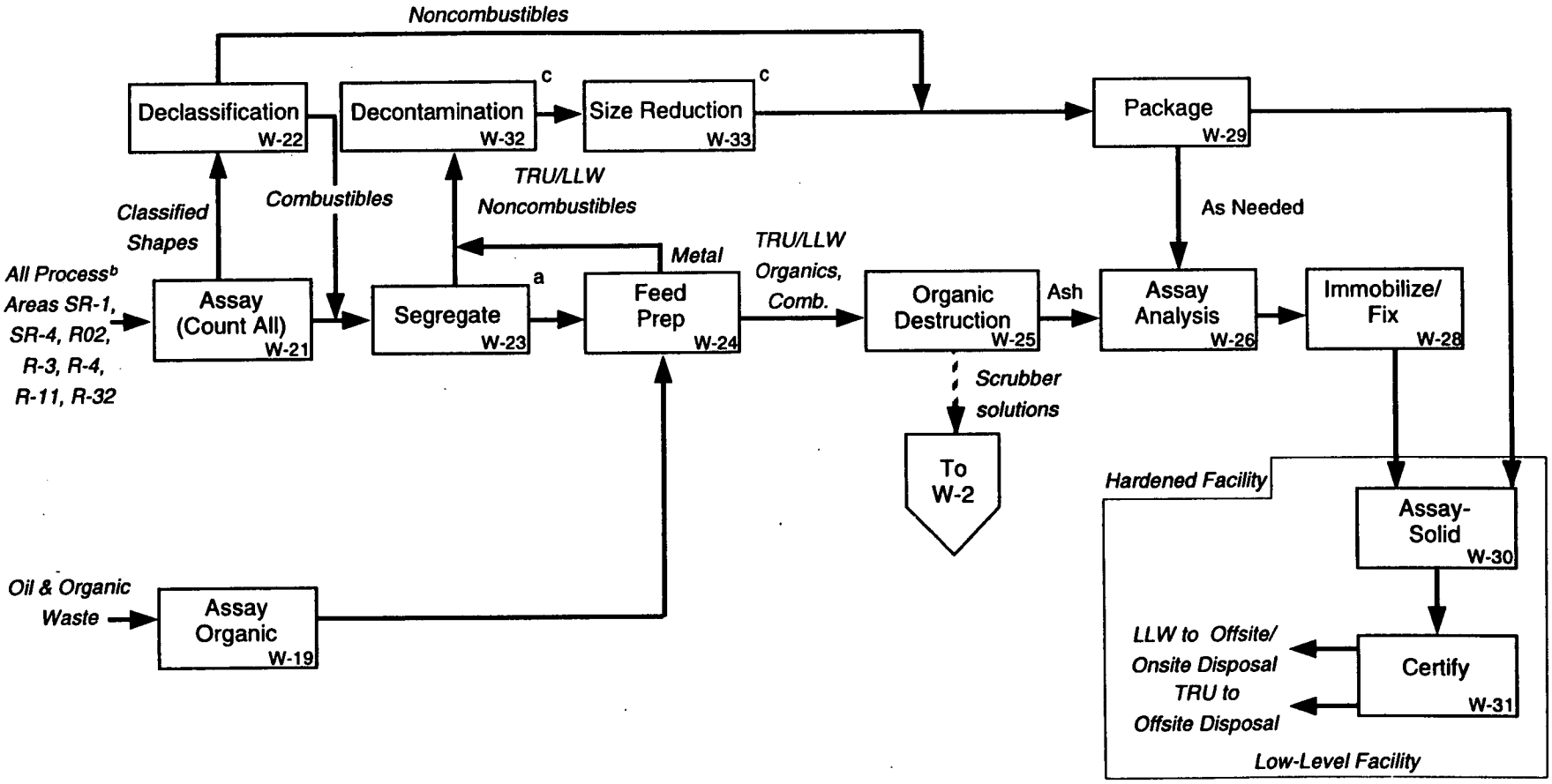
Nonhazardous (Sanitary) Waste. Liquid nonhazardous sanitary waste generated in the facility would be transferred to the sanitary waste system for treatment. Solid nonhazardous waste, such as domestic trash, office waste, cafeteria wastes, clean non-Pu wastes, and industrial wastes from utility and maintenance operations, would be transported to a permitted sanitary landfill for disposal.

Nonhazardous (Other) Waste. Other liquid nonhazardous waste generated from facilities support operations (for example, cooling system blowdown and evaporator condensate) would be collected in a catch tank and sampled before being reclaimed for other recycle use or release to the environment. The facility design includes stormwater retention ponds with the necessary NPDES monitoring equipment. Runoff within the main facility area would be collected separately, routed to the stormwater collection ponds, then sampled and analyzed before discharge to the natural drainage channels (dry site) or river (wet site). If the runoff was contaminated, it would be treated in the process wastewater treatment system. Runoff outside of the main facility area would be discharged directly into the natural drainage channel or river.

Table E.3.2.1–1. Estimated Waste Volumes for Pit Disassembly/Conversion Facility

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	None	None
Solid	None	67[a]	67[a]
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4[a]	4[a]
Low-Level			
Liquid	None	4	None
Solid	None	102[b]	102[b]
Mixed Low-Level			
Liquid	None	0.4	0.4
Solid	None	1.7[b]	1.7[b]
Hazardous			
Liquid	35[c]	2	2
Solid	140[c]	0.7[d]	0.7[d]
Nonhazardous (Sanitary)			
Liquid	1,890[e]	85,200	85,200
Solid	Included in liquid sanitary	100[d]	100[d]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	97[f]	3[d,g]	None

[a] Solid TRU and mixed TRU waste volumes were estimated using the conversion factor of 336.2 kg/m^3.
[b] Solid LLW and mixed LLW volumes were estimated using the conversion factor of 176.8 kg/m^3.
[c] Estimated from consolidated special nuclear materials storage facility (DOE 1996e).
[d] Solid waste volumes were estimated using the conversion factor of 1,500 kg/m^3.
[e] Does not include dewatering, if required.
[f] Includes 9.1 t of steel using the conversion factor of 0.127 m^3/t.
[g] Recyclable wastes.
Source: LANL 1996d.



Solid Waste

Liquid Waste

[a] Segregation Creates Six Streams: TRU, LLW, Mixed (Organic & Nonorganic).

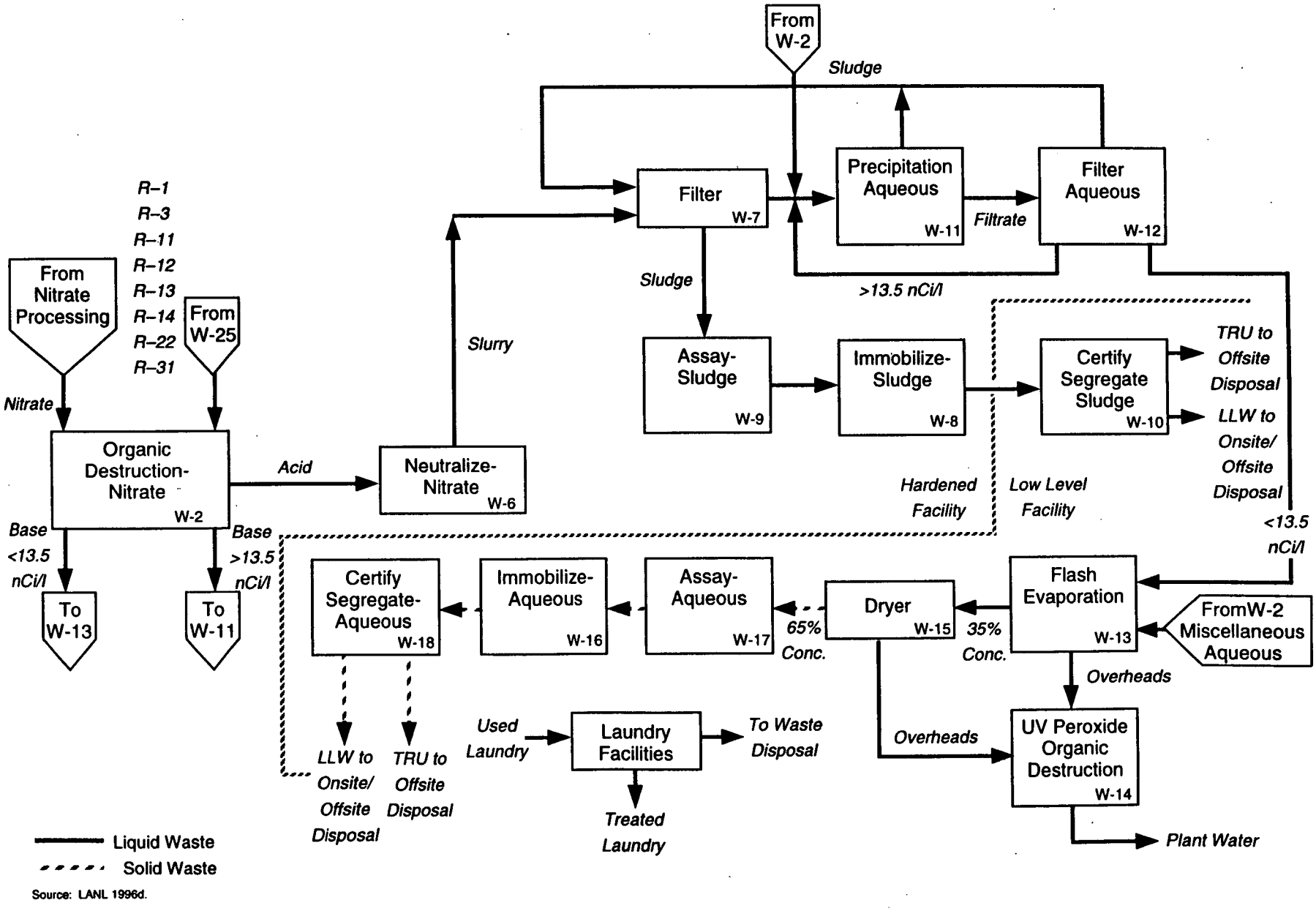
[b] Waste sorted at source location.

[c] Optional Process.

Source: LANL 1996d.

2R11/S&D

Figure E:3.2.1–1. Pit Disassembly/Conversion Facility Solid Waste Management Process Flow Diagram.



Source: LANL 1996d.

2R12/FMD

Figure E.3.2.1–2. Pit Disassembly/Conversion Facility Liquid Waste Management Process Flow Diagram.

E.3.2.2 Plutonium Conversion Facility

The design of the Pu conversion facility would place great emphasis on the minimization of both liquid and solid wastes. Where generation of a waste could not be avoided, methods would be pursued to recycle the waste, as well as any process reagents. In general terms, waste management of the Pu conversion facility would include waste handling and treatment operations for processing the various wastes in aqueous, organic liquid, or solid form generated directly from Pu conversion operations or from related site activities.

Table E.3.2.2–1 presents the estimated annual waste volumes during construction and operation of the Pu conversion facility. As illustrated in Figure E.3.2.2–1, waste management capabilities would be provided to monitor, treat, and handle radioactive wastes, industrial and chemical wastes, and sanitary and stormwater wastes. The treated effluent from utility, process and sanitary wastewater treatment would be reclaimed to be used as cooling system makeup water.

The radioactive and nonradioactive waste management capabilities that would be provided to handle the generated wastes would consist of the Process Building, Liquid Waste Treatment Facility, Long-Term Waste Storage Building, and a Sanitary Wastewater Treatment Plant. The Process Building would have space for handling and processing surplus fissile material into the accepted long- term storage form. It would also have space for support operations, including material control and accountability, safety systems, waste handling and management, repackaging, and assay and analysis. Liquid wastes collected from processing areas would be treated by the Liquid Waste Treatment Facility through neutralization, precipitation, and volume reduction via evaporation. Any sludge produced would be immobilized and packaged for disposal, while evaporated water would be recycled for use in the utility systems. The Long-Term Waste Storage Building would provide interim storage/staging for hazardous and low-level wastes. Hazardous waste would be transported from there to an approved offsite RCRA-permitted treatment and disposal facility. LLW would be transported to a DOE LLW disposal facility. In general, the wastes would be converted to either water meeting effluent standards, grouted cement, or compacted solid waste as final form products for disposal. The waste treatment processing would also perform equipment and waste container decontamination operations.

Following receipt and unpackaging of the surplus non-pit Pu, the initial phase of the processing would be material management, which would provide the interface between receiving and processing, and repackaging and storage. Material management would include sampling, nondestructive assay, feed segregation, and feed and product preparation. The wastes generated from the shipping and receiving function and the materials management function would consist of decontamination solutions, damaged primary containers, lubricants, hydraulic fluids, and process wastewater.

The direct processing steps within the Pu conversion facility would include separation, oxidation/wash and calcination, and repackaging of the oxide products in their final form prior to disposition. The separation function would use aqueous processing, including dissolution, extraction or ion exchange, precipitation, and calcination operations. The oxidation/wash function would consist of oxidizing carbonaceous components in scrap feeds, providing additional size reduction, and leaching Pu from the insoluble residue. The calcination function would convert impure feeds by oxidizing reactive metals and carbonaceous material and stabilizing the material to a uniform size and composition that would meet long-term storage criteria. The repackaging function would entail containerization and interim storage for the oxide products from the recovery processes, as well as for the surplus metal and oxides from existing facilities, in accordance with safe storage criteria.

Waste management involves the collection, assaying, sorting, treating, packaging, storing, and shipping of radioactive, hazardous, and mixed wastes generated by Pu conversion operations, and hazardous and nonhazardous waste from the support facilities. Wastes would be processed to ensure compliance with all applicable Federal and State statutes and regulations and DOE Orders.

For solid waste treatment, initial sorting of wastes would be performed at the source of generation and would involve treatment by a variety of processes to ensure regulatory compliance. Nondestructive assay systems would be provided to assay waste materials for Pu content and certify the waste as low-level or TRU. For liquid waste treatment, solutions from the various process functions would be treated to produce a disposable waste form. Processing capabilities would include: neutralization, filtration, precipitation, concentration by evaporation, immobilization, and packaging/certification for disposal. The radioactive liquid waste would be processed and recycled to the maximum extent possible at the point of generation. Following appropriate treatment to below permitted levels, aqueous wastes would be discharged to natural drainage channels or permitted outfalls.

Any nonradiological wastes generated from operation would be monitored, collected, and treated, if necessary, before discharge to the environment. Facilities would be provided to treat chemically contaminated wastewaters to below regulatory requirements before discharge to the environment. Holding tanks would be provided for the wastes. Nonradioactive solid wastes would be recycled where possible or transferred to approved disposal sites in accordance with accepted industrial practices and regulatory requirements.

All fire sprinkler water discharged in process areas during and after a fire would be contained, monitored, sampled, and if required, retained until disposal. Utility wastewater discharges, including cooling system and boiler blowdown, would be treated in an industrial wastewater treatment plant prior to discharge in accordance with applicable environmental standards. The facility design includes a sanitary treatment plant to treat liquid sanitary wastes.

High-Level Waste. The Pu conversion facility would not generate any HLW.

Transuranic Waste. TRU wastes would be generated from process and facility operations, equipment decontamination, failed equipment, and used tools. Numerous processes, including those directly supporting surplus Pu conversion and final waste form production, and those managing the various waste streams, would produce used HEPA filters, retired gloveboxes and leaded gloves, glovebox sweepings, failed equipment, contaminated wipes and rags, combustibles, used hydraulic fluids, and other process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as TRU waste, they would be appropriately treated and stored until final disposal.

Transuranic wastes would be treated in a waste handling facility to form grout or a compact solid waste. Treated TRU waste products would be packaged, assayed, and certified to meet the waste acceptance criteria of the WIPP or alternative treatment level. Assuming WIPP is determined to be a suitable repository for these wastes, pursuant to the requirements of 40 CFR 191 and 40 CFR 268 and depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste, these wastes would be transported to WIPP for disposal.

Mixed Transuranic Waste. A small quantity of solid mixed TRU waste, mainly protective clothing and radiological survey waste, would be generated annually during operations. This mixed TRU waste would be primarily generated from activities at the waste handling/management facilities. Mixed TRU would be packaged and shipped to another DOE waste management facility for temporary storage, pending final treatment and disposal in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act* of 1992. Current plans call for disposal at WIPP.

Low-Level Waste. [Text deleted.] Numerous processes, including those directly supporting surplus Pu conversion and final waste form production, and those managing the various waste streams, would produce contaminated operator clothing, gloves, wipes, shoe covers, and process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as LLW, they would be treated by sorting, separation, concentration and size reduction processes.

Any liquid LLW would be treated and the remaining LLW sludge would be solidified. Final LLW products would be surveyed and disposed of in an onsite or offsite DOE LLW disposal facility.

Mixed Low-Level Waste. A very small quantity of liquid and solid mixed LLW would be generated annually during operations. Liquid mixed LLW could originate from potentially contaminated lubricants and hydraulic fluids used for material handling equipment. Solid mixed LLW would be made up of wipes laden with contaminated oils and hydraulic fluids. Any mixed LLW would be stored onsite on an interim basis until treatment, disposal, or offsite shipment in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act* of 1992.

Hazardous Waste. Many of the Pu conversion facility processes would generate hazardous waste. This waste would include chemical makeup and reagents for support activities, lubricants and oils for process and support equipment, and used solvent rags. The liquid and solid hazardous waste would be collected at the facility and stored on an interim basis. The hazardous wastes would be recycled, or stored and packaged for offsite treatment or disposal at commercial RCRA-permitted facilities.

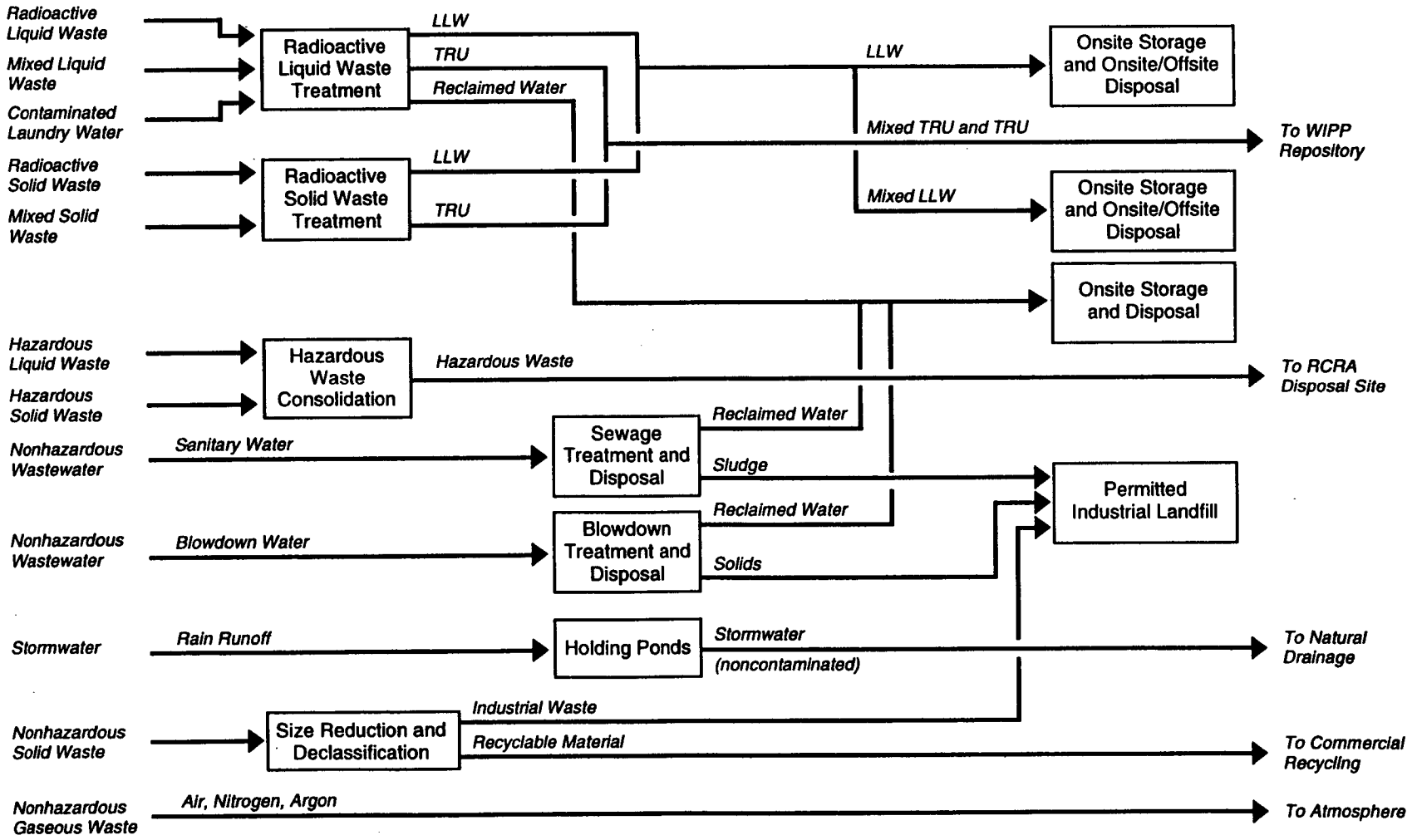
Nonhazardous (Sanitary) Waste. Nonhazardous sanitary liquid wastes generated in the facility would be transferred to the sanitary waste treatment plant for processing. Nonhazardous solid wastes, such as domestic trash, office waste, cafeteria wastes, clean non-Pu wastes, and industrial wastes from utility and maintenance operations, would be hauled to a permitted sanitary landfill for disposal.

Nonhazardous (Other) Waste. Other nonhazardous liquid wastes generated from facilities support operations (for example, cooling system blowdown and evaporator condensate) would be collected in a catch tank and sampled before being reclaimed for other recycle use or release to the environment. The facility design includes stormwater retention ponds with the necessary NPDES monitoring equipment. Runoff within the main facility area would be collected separately, routed to the stormwater collection ponds, and then sampled and analyzed before discharge to the natural drainage channels (dry site) or river (wet site). If the runoff was contaminated, it would be treated in the process wastewater treatment system. Runoff outside of the main facility area would be discharged directly into the natural drainage channel or river.

Table E.3.2.2–1. Estimated Waste Volumes for Plutonium Conversion Facility

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	3.2[a]	None
Solid	None	278	278
Mixed Transuranic			
Liquid	None	None	None
Solid	None	191	191
Low-Level			
Liquid	None	56[a]	None
Solid	None	1,743	1,743
Mixed Low-Level			
Liquid	None	0.04	None
Solid	None	191	191
Hazardous			
Liquid	24[b]	2	2
Solid	96[b]	11	11
Nonhazardous (Sanitary)			
Liquid	2,360	15,000	15,000
Solid	868[c]	2,060	2,060
Nonhazardous (Other)			
Liquid	Included in sanitary	56	56
Solid	Included in sanitary	None	None

[a] Liquid TRU waste and LLW would be treated with the remaining TRU and low-level sludge being solidified.
[Text deleted.]
[b] Estimated from consolidated special nuclear materials storage facility (DOE 1996e).
[Text deleted.]
[c] Includes 57.5 t of steel using the conversion factor of 0.127 m^3/t.
[Text deleted.]
Source: LANL 1996c.



Source: LANL 1996c.

2716/FMD

Figure E.3.2.2–1. Plutonium Conversion Facility Waste Management Process Flow Diagram.

E.3.2.3 Generic Mixed Oxide Fuel Fabrication Facility

The design of the generic MOX fuel fabrication facility would place great emphasis on the minimization of both liquid and solid wastes. Where generation of a waste could not be avoided, methods would be pursued to recycle the waste. In general terms, the waste management of the generic MOX fuel fabrication facility would include waste handling and treatment operations for processing the various wastes in aqueous, organic liquid, or solid form generated directly from MOX fuel fabrication operations or from related site activities.

Table E.3.2.3–1 presents the estimated annual waste volumes during construction and operation of the generic MOX fuel fabrication facility. Waste management capabilities would be provided to monitor, treat, and handle radioactive, industrial and chemical, and sanitary and stormwater wastes. The treated effluent from utility, process, and sanitary wastewater treatment would be reclaimed to be used as cooling system makeup water.

The fuel fabrication process would consist of the purification and conditioning of plutonium dioxide (PuO_2) that does not meet specifications; blending of PuO_2 and uranium dioxide; fabrication of fuel pellets; fabrication of fuel rods; assembly of fuel bundles; recycling of Pu-bearing scrap and materials from pellets, rods, and bundles that do not meet requirements; and management of wastes generated throughout the fuel fabrication process. The wastes would include TRU, low-level, mixed, hazardous, and nonhazardous wastes. The radioactive and nonradioactive waste management capabilities provided to handle these wastes would be located in the Waste Management Building adjacent to the Receiving and Storage Building and the Fuel Fabrication Building. The waste treatment processes would include assay examination, sorting, separation, concentration, size reduction, special treatment, and thermal treatment. The waste would be converted to either water meeting effluent standards, grouted cement, or compacted solid waste as final form products for disposal. The waste treatment processing would also perform equipment and waste container decontamination operations.

Waste would be generated during each step of the MOX fuel fabrication. As illustrated in Figures E.3.2.3–1 and E.3.2.3–2, the waste management process would involve the collection, assaying, sorting, treating, packaging, storing, and shipping of radioactive, hazardous, and mixed wastes from the Pu operations, and hazardous and nonhazardous wastes from the support facilities. Initial sorting of solid waste would be performed at the generation source. Solid waste would be treated by a variety of processes to ensure compliance with all applicable requirements. The treatment processes include passivation for reactive metals. Waste products would be immobilized and packaged to meet DOT and DOE requirements. Liquid organic waste would be separated and dispositioned, as would solid organic waste. In addition, radioactive liquid waste would be neutralized, filtered, precipitated, concentrated by evaporation, immobilized, and packaged for appropriate disposal, while mixed LLW would be stored until a decision is made to allow disposal as LLW following appropriate treatment. Mixed TRU waste would be handled like other TRU wastes. Finally, solid, nonhazardous, and aqueous and gaseous wastes would be treated in conformance with standard industrial practice and regulatory requirements. Solid nonhazardous waste would either be disposed of in a permitted sanitary landfill or sent to a commercial recycle center. Aqueous waste that was below regulatory limits would be discharged through permitted outfalls. Gaseous waste that was below regulatory limits following treatment would be released to the atmosphere.

All of the nonradioactive waste generated from operation would be strictly monitored, completely collected, and appropriately treated, if necessary, before discharge to the environment. Facilities would be provided to treat chemically-contaminated wastewaters before discharge to the environment. Holding tanks would be provided for the waste. Solid nonradioactive waste would be recycled, where possible, or transferred to approved disposal sites in accordance with accepted industrial practices.

All fire sprinkler water discharged in process areas during and after a fire would be contained, monitored, sampled, and if required, retained until disposal. Utility wastewater (including cooling system and boiler

blowdown) would be treated in an industrial wastewater treatment plant prior to discharge in accordance with applicable environmental standards. The facility design includes a sanitary treatment plant to treat liquid sanitary waste.

High-Level Waste. The generic MOX fuel fabrication facility would not generate any HLW.

Transuranic Waste. TRU waste would be generated from process and facility operations, equipment decontamination, failed equipment, and used tools. Numerous processes, including those directly supporting the Pu oxide purification, MOX fuel fabrication, fuel pellet/rod/bundle handling, material recycle, and those managing the various waste streams, would produce used ventilation air filters, resins, and Pu oxide sweepings, as well as contaminated operator clothing, gloves, glove boxes, tools, wipes and rags, shoe covers, and other process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as TRU waste, they would be appropriately treated and stored until final disposal.

The TRU waste would be treated in a waste handling facility to form grout or a compact solid waste. Treated TRU waste products would be packaged, assayed, and certified to meet the waste acceptance criteria of the WIPP or alternative treatment level. Assuming WIPP is determined to be a suitable repository for these wastes, pursuant to the requirements of 40 CFR 191 and 40 CFR 268 and depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste, these wastes would be transported to WIPP for disposal.

Mixed Transuranic Waste. A very small quantity of solid mixed TRU waste, mainly protective clothing and radiological survey water, would be generated annually during operations. This solid mixed TRU waste would be primarily generated from activities at the Waste Management Building. Mixed TRU waste would be packaged and shipped to another DOE waste management facility for temporary storage, pending final treatment and disposal in accordance with the site treatment plan that was developed to comply with the *Federal Facility Compliance Act*. Current plans call for disposal at WIPP.

Low-Level Waste. [Text deleted.] Numerous processes, including those directly supporting the Pu oxide purification, MOX fuel fabrication, fuel pellet/rod/bundle handling, and material recycling, and those managing the various waste streams, would produce contaminated operator clothing, gloves, tools, wipes and rags, shoe covers, and process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as LLW, they would be treated by sorting, separation, concentration, and size-reduction processes. Any liquid LLW would be treated with the remaining LLW sludge being solidified. Final LLW products would be surveyed and disposed of in a DOE or commercial LLW disposal facility.

Mixed Low-Level Waste. A very small quantity of solid mixed LLW, mainly protective clothing and radiological survey waste, would be generated annually during operations. This mixed LLW would be primarily generated from activities at the Waste Management Building. Any mixed LLW would be stored onsite on an interim basis until treatment, disposal, or offsite shipment in accordance with the site treatment plan that was developed to comply with the *Federal Facility Compliance Act*.

Hazardous Waste. Many of the generic MOX fuel fabrication facility processes would generate hazardous waste. This waste would include chemical makeup and reagents for support activities, and lubricants and oils for process and support equipment. Liquid waste would include cleaning solvents, vacuum pump oils, film processing fluids, hydraulic fluids from mechanical equipment, antifreeze solutions, and paint. Solid waste would include lead packing, used wipes and rags contaminated with oils, lubricants, and cleaning solvents. The liquid and solid hazardous wastes would be collected at the facility and stored on an interim basis. The hazardous waste would be recycled, or stored and packaged for offsite treatment and disposal at commercial RCRA-permitted facilities.

Nonhazardous (Sanitary) Waste. Liquid nonhazardous sanitary waste generated in the facility would be transferred to the sanitary waste system for treatment. Solid nonhazardous waste, such as domestic trash and office waste, would be hauled to a permitted sanitary landfill for disposal.

Nonhazardous (Other) Waste. Liquid nonhazardous waste generated from support operations (for example, cooling system blowdown and evaporated condensate) would be collected in a catch tank and sampled before being reclaimed for other recycle use or release to the environment. The facility design includes stormwater retention ponds with the necessary NPDES monitoring equipment. Runoff within the main facility area would be collected separately, routed to the stormwater collection ponds, and then sampled and analyzed before discharge to the natural drainage channels (dry site) or river (wet site). If the runoff was contaminated, it would be treated in the process wastewater treating system. Runoff outside of the main facility area would be discharged directly into the natural drainage channel or river.

Table E.3.2.3–1. Estimated Waste Volumes for the Generic Mixed Oxide Fuel Fabrication Facility

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	None	None
Solid	None	306	306
Mixed Transuranic			
Liquid	None	None	None
Solid	None	4	4
Low-Level			
Liquid	None	4	None
Solid	None	153	153
Mixed Low-Level			
Liquid	None	0.8	None
Solid	None	38	38
Hazardous			
Liquid	13	4	None
Solid	None	153	153
Nonhazardous (Sanitary)			
Liquid	1,890	43,300[a]	43,300[a]
Solid	Included in liquid	76	76
Nonhazardous (Other)			
Liquid	None	227	227
Solid	515[b]	84[c]	76

[a] Includes cooling water blowdown and evaporator condensate.

[b] Includes 44.6 t of steel (assuming 0.127 m^3/t).

[c] Includes 8 m^3 of recyclable wastes.

Source: LANL 1996b.

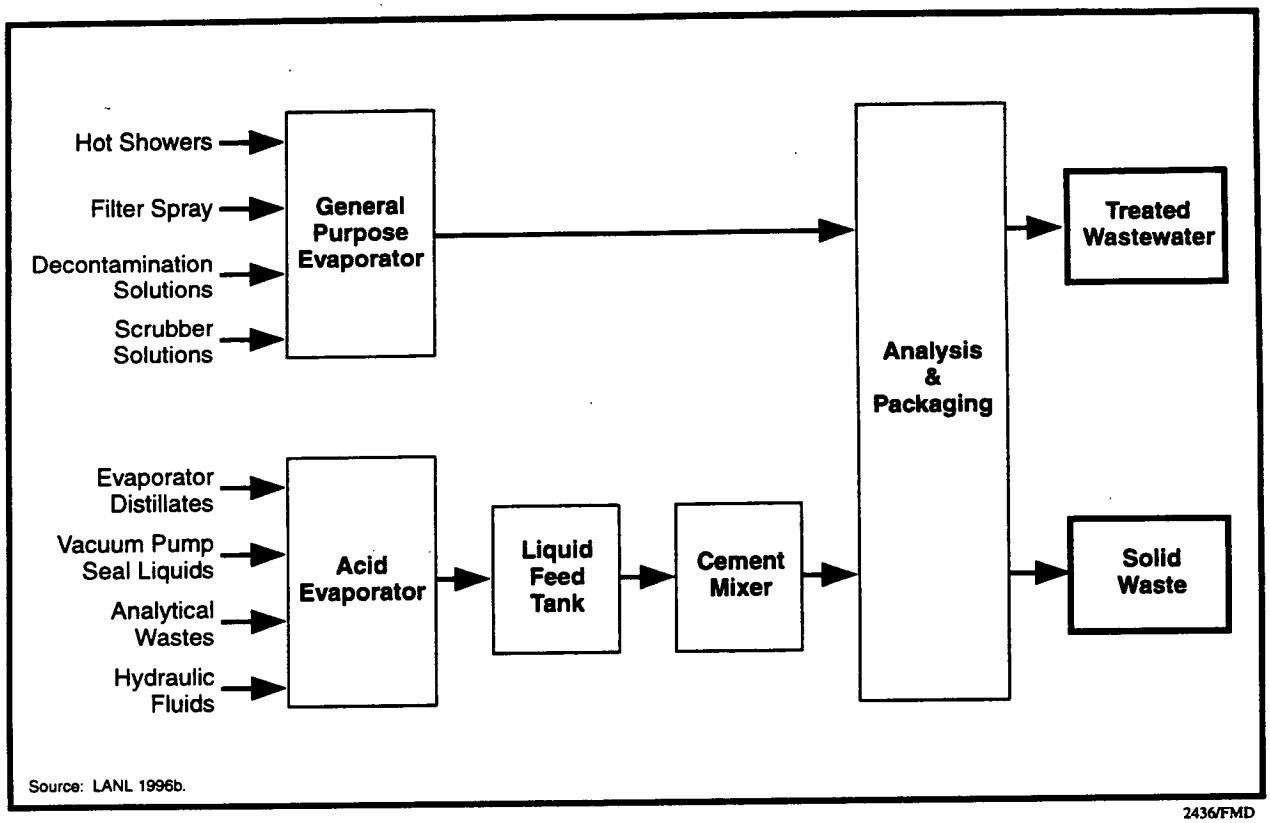


Figure E.3.2.3–1. Generic Mixed Oxide Fuel Fabrication Facility Liquid Waste Management Process Flow Diagram.

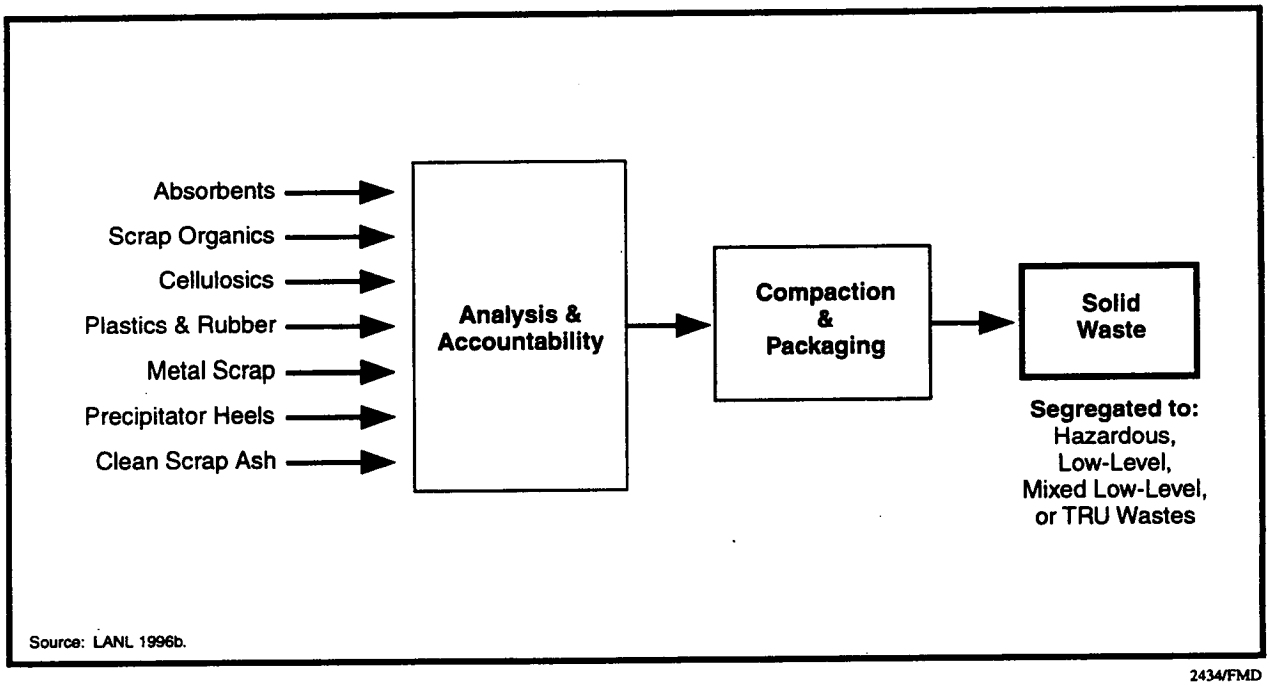


Figure E.3.2.3–2. Generic Mixed Oxide Fuel Fabrication Facility Solid Waste Management Process Flow Diagram.

E.3.3 FACILITIES TO SUPPORT FINAL DISPOSITION OF PLUTONIUM

Under the Preferred Alternative for surplus Pu disposition, the ceramic immobilization facility or the vitrification facility could be located at Hanford or SRS. The volume of waste generated from the construction of these alternatives could be reduced by existing facilities for portions of the operations. The next tier of NEPA review will examine locations for the second alternatives including the use of existing facilities.

E.3.3.1 Direct Disposition Alternative—Deep Borehole Complex

The design of the deep borehole disposal facility for direct disposition would place great emphasis on the minimization of both liquid and solid wastes. Where generation of waste could not be avoided, methods would be pursued to recycle the waste. In general terms, the waste management of the borehole facility would include waste handling and treatment operations for processing the various wastes (in aqueous, organic liquid, or solid form) generated directly from borehole disposition operations or from related site activities.

Table E.3.3.1–1 presents the estimated annual waste generation volumes during construction and operation of the deep borehole disposal facility. As illustrated in Figure E.3.3.1–1, waste management capabilities would be provided to monitor, treat, and handle radioactive, industrial, and chemical wastes, as well as sanitary and stormwater wastes. The treated effluent from utility, process, and sanitary wastewater treatment would be reclaimed to be used as cooling system makeup water. Generated wastes would include TRU, low-level, mixed, hazardous, and nonhazardous wastes. The management facilities provided to handle radioactive wastes would be located in the Process Waste Management Facility adjacent to the receiving and processing building. The waste treatment processes would include assay examination, sorting, separation, concentration, size reduction, special treatment, and thermal treatment. The wastes would be converted to water meeting effluent standards, grouted cement, or compacted solid waste as final form products for disposal. The waste treatment processing would also perform equipment and waste container decontamination operations.

Any wastes generated by the surface processing facility would be sampled for radioactivity and, if free of contamination, would be stored, pending disposal, in a permitted sanitary/industrial disposal facility. If contaminated, they would be considered low-level/TRU waste and treated accordingly. Solid waste generated from process operations at the surface facilities would include packing materials, deformed Pu shipping containers, wipes and rags, gloves, paper clothing, and HEPA filters. Liquid waste would include wash water from canister decontamination, spent pump oils, and trichloroethane cleaning solvent.

Wastes generated from the drilling facility would include a mixture of solid rock cuttings brought out of the borehole by the drilling mud and drilling mud additives. This conglomeration would be allowed to settle out in the drilling mud pit. The exact makeup of the additives and rock cuttings will not be known until the geology of the site has been ascertained. Once characterized, this cutting mixture would be disposed of by appropriate means. Any wastewater generated by the drilling process would be tested and treated, as needed, through evaporation ponds and the residual solids would be buried in the mud pits.

The Process Waste Management Facility would contain equipment and processes for the treatment of nonhazardous process, hazardous, radioactive, and mixed liquid wastes. The facility would allow treatment of any wastewater generated by the various facilities. The wastewater originating in the borehole array area would be pumped through underground pipes to the Process Waste Treatment Facility. This wastewater would primarily consist of mop waters and cleaning solutions, emplacement canister sealants and additives, drilling mud additives, grout additives, and machine coolant wastes. The drilling facility would generate a substantial amount of wastewater as overflow from drilling mud settlement ponds. In addition, water pumped out of the borehole during drilling, emplacing, and sealing operations would require appropriate treatment.

Any nonradiological wastes generated from operation would be monitored, collected, and treated, if necessary, before being designated as reclaimed water recycle and used as makeup to the cooling system. Facilities would

be provided to treat chemically-contaminated wastewaters before discharge to the environment. Holding tanks would be provided for the wastes. Nonradioactive solid wastes would be recycled, where possible, or transferred to approved disposal sites in accordance with accepted industrial practices.

All fire-sprinkler water discharged in process areas during and after a fire would be contained, monitored, sampled, and if required, retained until disposal. Utility wastewater (including cooling system and boiler blowdown) would be treated in an industrial wastewater treatment plant prior to being designated as reclaimed water recycle. The facility design includes a sanitary treatment plant to treat liquid sanitary wastes.

High-Level Waste. The deep borehole disposal facility for direct disposition would not generate any HLW.

Transuranic Waste. TRU wastes would be generated from process and facility operations, equipment decontamination, failed equipment, and used tools. Numerous processes (including those directly supporting the borehole drilling, radioactive Pu handling, and direct canister emplacement and those managing the various waste streams) would produce used ventilation air filters, resins, and sludges, as well as contaminated operator clothing, gloves, wipes, shoe covers, and other process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as TRU waste, they would be appropriately treated and stored until final disposal.

Transuranic wastes would be treated in a waste handling facility to form grout or a compact solid waste. The small amount of liquid TRU waste would be treated with the remaining TRU sludge being solidified. Treated TRU waste products would be packaged, assayed, and certified to meet the waste acceptance criteria of the WIPP or alternative treatment level. Assuming WIPP is determined to be a suitable repository for these wastes and depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste, these wastes would be transported to WIPP for disposal pursuant to the requirements of 40 CFR 191 and 40 CFR 268.

Mixed Transuranic Waste. A very small quantity of solid mixed TRU waste (mainly protective clothing and radiological survey waste from the waste handling facility) would be generated annually during operations. Mixed TRU would be packaged and shipped to another DOE waste management facility for temporary storage, pending final treatment and disposal in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act*. Current plans call for disposal at WIPP.

Low-Level Waste. [Text deleted.] Numerous processes (including those directly supporting the borehole drilling, radioactive Pu handling, and direct canister emplacement, and those managing the various waste streams) would produce contaminated operator clothing, gloves, wipes, shoe covers, and process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as LLW, they would be treated by sorting, separation, concentration, and size-reduction processes. Any liquid LLW would be treated with the remaining LLW sludge being solidified. Final LLW products would be surveyed and disposed of in a shallow land burial site.

Mixed Low-Level Waste. A very small quantity of solid mixed LLW (mainly protective clothing and radiological survey waste from the waste handling facility) would be generated annually during operations. Any mixed LLW would be stored onsite on an interim basis until treatment, disposal, or offsite shipment in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act*.

Hazardous Waste. Many of the Deep Borehole Disposal Facility processes would generate hazardous waste. This waste would include chemical makeup and reagents for support activities, lubricants and oils for process and support equipment, and used solvent rags contaminated with trichloroethane. The liquid and solid hazardous waste would be collected at the facility and stored on an interim basis. The hazardous waste would be recycled, or stored and packaged for offsite treatment or disposal at RCRA-permitted facilities.

Nonhazardous (Sanitary) Waste. Liquid nonhazardous sanitary waste generated in the facility would be transferred to the sanitary waste system for treatment. Treated wastewater would be designated as reclaimed water recycle and would be used as makeup to the cooling system. Solid nonhazardous waste (such as domestic trash and office waste) would be hauled to a permitted sanitary landfill for disposal.

Nonhazardous (Other) Waste. Other liquid nonhazardous wastes generated from facilities support operations (for example, cooling system and boiler blowdown) would be collected in a catch tank and sampled before being reclaimed for recycle use, such as makeup to the cooling system. The facility design includes stormwater retention ponds with the necessary NPDES monitoring equipment. Runoff within the main facility area would be collected separately, routed to the stormwater collection ponds, and then sampled and analyzed before discharge to the natural drainage channels (dry site) or river (wet site). If the runoff was contaminated, it would be treated in the process wastewater treatment system. Runoff outside of the main facility area would be discharged directly into the natural drainage channel or river.

Table E.3.3.1–1. Estimated Waste Volumes for the Direct Disposition Alternative—Deep Borehole Complex

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.2[a]	None
Solid	None	0.2	0.2
Mixed Transuranic			
Liquid	None	None	None
Solid	None	0.04	0.04
Low-Level			
Liquid	None	2[a]	None
Solid	None	5	5
Mixed Low-Level			
Liquid	None	None	None
Solid	None	None	None
Hazardous			
Liquid	4	110[b]	110[b]
Solid	26	17[c]	17[c]
Nonhazardous (Sanitary)			
Liquid	10,100	10,600	None[d]
Solid	331	306	306
Nonhazardous (Other)			
Liquid	1,890[e]	6,800[f]	None[d]
Solid	179[g]	1,250[h]	1,250[h]

[a] Liquid TRU waste and LLW would be treated with the remaining TRU and low-level sludge being solidified.

[b] Includes 108 m^3 of oil, antifreeze, and hydraulic fluid.

[c] Includes 1,814 kg (assuming 1,500 kg/m^3) of rags and other materials generated by the Drilling and Emplacing-Borehole Sealing Facilities.

[d] Treated wastewater would be designated as reclaimed water recycle and would be used as makeup to the cooling system.

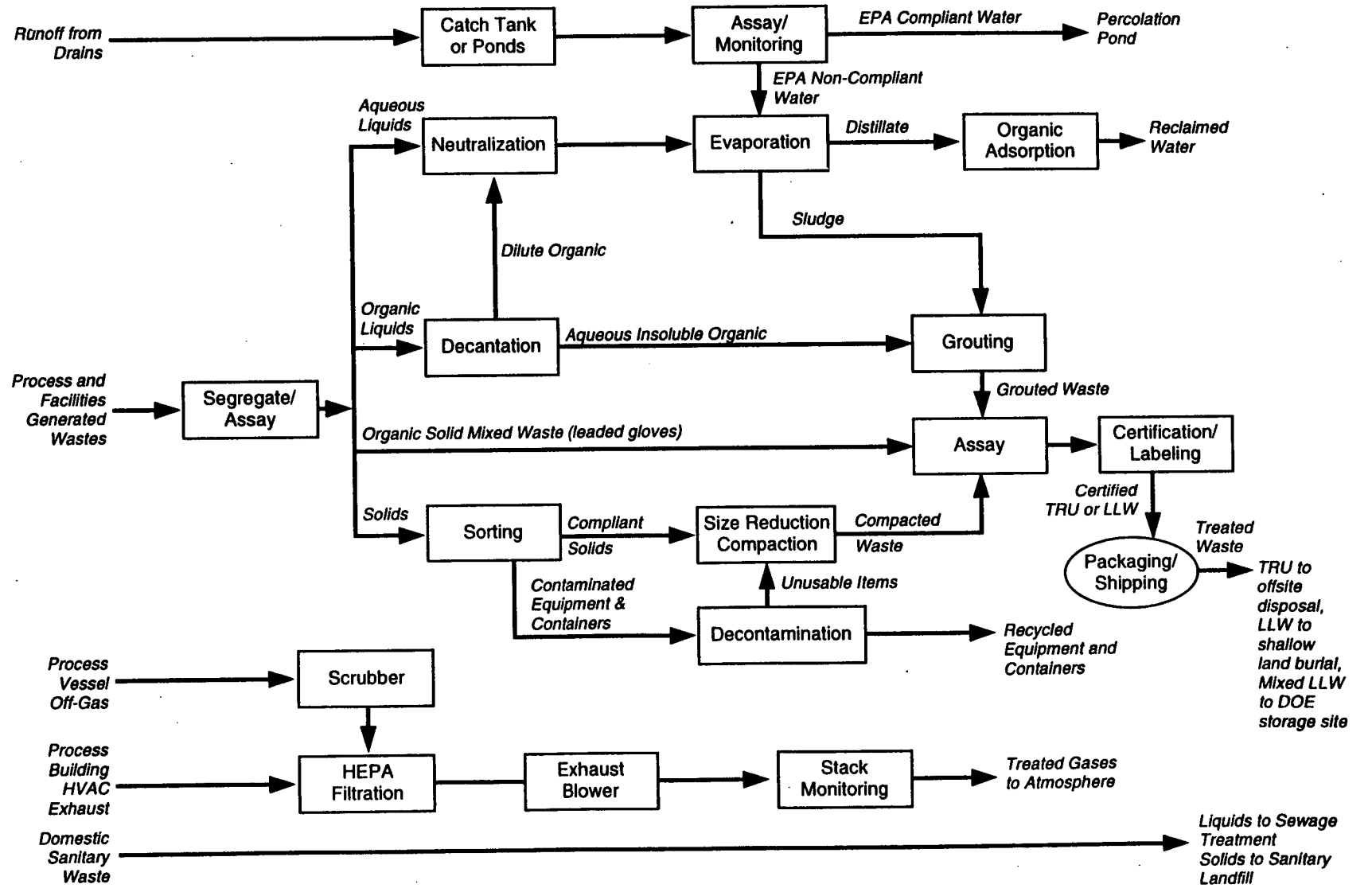
[e] Includes service water and concrete batch plant water.

[f] Includes cooling water blowdown and evaporator condensate.

[g] Includes 60 t of steel (assuming 0.127 m^3/t).

[h] Includes 38,600 kg (assuming 1,500 kg/m^3) of bentonite and polymers, and 1,220 m^3 of rock cuttings generated by the Drilling and Emplacing-Borehole Sealing Facilities.

Source: LLNL 1996a.



Source: LLNL 1996a.

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Figure E.3.3.1–1. Direct Disposition Alternative—Deep Borehole Complex Disposal Facility Waste Management Process Flow Diagram.

E.3.3.2 Immobilized Disposition Alternative—Deep Borehole Complex

The design of the deep borehole disposal facility for immobilized disposition would place great emphasis on the minimization of both liquid and solid wastes. Where generation of a waste could not be avoided, methods would be pursued to recycle the waste. In general terms, the waste management of the borehole facility would include waste handling and treatment operations for processing the various wastes in aqueous, organic liquid or solid form generated directly from borehole disposition operations or from related site activities.

Table E.3.3.2–1 presents the estimated annual waste volumes during construction and operation of the deep borehole disposal facility. As illustrated in Figure E.3.3.2–1, waste management capabilities would be provided to monitor, treat, and handle radioactive wastes, industrial, and chemical wastes, as well as sanitary and stormwater wastes. The treated effluent from utility, process and sanitary wastewater treatment would be reclaimed to be used as cooling system makeup water. The wastes would include TRU, low-level, mixed, hazardous and nonhazardous wastes. The management facilities provided to handle radioactive wastes would be located in the Process Waste Management Facility adjacent to the receiving and process building. The waste treatment processes would include assay examination, sorting, separation, concentration, size reduction, special treatment, and thermal treatment. The wastes would be converted to either water meeting effluent standards, grouted cement, or compacted solid waste as final form products for disposal. The waste treatment processing would also perform equipment and waste container decontamination operations.

Any wastes generated by the Surface Processing Facility would be sampled for radioactivity and, if free of contamination, would be stored for disposal in a permitted sanitary/industrial disposal facility. If contaminated, they would be considered low-level/TRU waste and treated accordingly. Solid waste generated from process operations at the surface facilities would include packing materials, deformed Pu-loaded ceramic pellet shipping containers, wipes and rags, gloves, paper clothing, and HEPA filters. Liquid waste would include washwater from canister decontamination, spent pump oils, and trichloroethane cleaning solvent.

Wastes generated from the drilling facility would include a mixture of solid rock cuttings brought out of the borehole by the drilling mud and drilling mud additives. This conglomeration would be allowed to settle out in the drilling mud pit. The exact makeup of the additives and rock cuttings will not be known until the geology of the site has been ascertained. Once characterized, this cutting mixture would be disposed of by appropriate means. Any wastewater generated by the drilling process would be tested and treated, as needed, through evaporation ponds and the residual solids would be buried in the mud pits.

The Process Waste Management Facility would contain equipment and processes for the treatment of nonhazardous process, hazardous, radioactive, and mixed liquid wastes. The facility would allow treatment of any wastewater generated by the Surface Processing Facility and Pellet-Grout Mix Preparation Subfacility, as well as the Emplacing-Borehole Sealing Facility processes. The wastewater originating in the borehole array area would be pumped through underground pipes to the Process Waste Treatment Facility. This wastewater would primarily consist of mopwaters and cleaning solutions, emplacement canister sealants and additives, drilling mud additives, grout additives, and machine coolant wastes. The drilling facility would generate a substantial amount of wastewater as overflow from drilling mud settlement ponds. In addition, water pumped out of the borehole during drilling, emplacing, and sealing operations would require appropriate treatment.

Any nonradiological wastes generated from operation would be monitored, collected, and treated, if necessary, before being designated as reclaimed water recycle and used as makeup to the cooling system. Facilities would be provided to treat chemically-contaminated wastewaters before discharge to the environment. Holding tanks would be provided for the wastes. Nonradioactive solid wastes would be recycled, where possible, or transferred to approved disposal sites in accordance with accepted industrial practices.

All fire sprinkler water discharged in process areas during and after a fire would be contained, monitored, sampled and if required, retained until disposal. Utility wastewater discharges (including cooling system and

boiler blowdown) would be treated in an industrial wastewater treatment plant prior to being designated reclaimed water recycle. The facility design includes a sanitary treatment plant to treat liquid sanitary wastes.

High-Level Waste. The deep borehole disposal facility would not generate any HLW.

Transuranic Waste. TRU wastes would be generated from process and facility operations, equipment decontamination, failed equipment, and used tools. Numerous processes, including those directly supporting the borehole drilling, radioactive Pu handling, and direct canister emplacement, and those managing the various waste streams, would produce used ventilation air filters, resins, and sludges, as well as contaminated operator clothing, gloves, wipes, shoe covers, and other process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as TRU waste, they would be appropriately treated and stored until final disposal.

The TRU wastes would be treated in a waste handling facility to form grout or a compact solid waste. The small amount of liquid TRU waste would be treated with the remaining TRU sludge being solidified. Treated TRU waste products would be packaged, assayed, and certified to meet the waste acceptance criteria of the WIPP or alternative treatment level. Assuming WIPP is determined to be a suitable repository for these wastes and depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste, pursuant to the requirements of 40 CFR 191 and 40 CFR 268, these wastes would be transported to WIPP for disposal.

Mixed Transuranic Waste. A very small quantity of solid mixed TRU waste, mainly protective clothing and radiological survey waste from the waste handling facility, would be generated annually during operations. Mixed TRU would be packaged and shipped to another DOE waste management facility for temporary storage, pending final treatment and disposal in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act*. Current plans call for disposal at WIPP.

Low-Level Waste. [Text deleted.] Numerous processes, including those directly supporting the borehole drilling, radioactive Pu handling, and direct canister emplacement, and those managing the various waste streams, would produce contaminated operator clothing, gloves, wipes, shoe covers, and process equipment. Following characterization, these wastes would be handled, treated and disposed of according to their level of contamination. If characterized as LLW, they would be treated by sorting, separation, concentration and size-reduction processes. Any liquid LLW would be treated with the remaining LLW sludge being solidified. Final LLW products would be surveyed and disposed of in a shallow land burial site.

Mixed Low-Level Waste. A very small quantity of solid mixed LLW, mainly protective clothing and radiological survey waste from the waste handling facility, would be generated annually during operations. Any mixed LLW would be stored onsite on an interim basis until treatment, disposal, or offsite shipment in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act*.

Hazardous Waste. Many of the deep borehole disposal facility processes would generate hazardous waste. This waste would include chemical makeup and reagents for support activities, lubricants and oils for process and support equipment, and used solvent rags contaminated with trichloroethane. The liquid and solid hazardous waste would be collected at the facility and stored on an interim basis. The hazardous wastes would be recycled, or stored and packaged for offsite treatment or disposal at commercial RCRA-permitted facilities.

Nonhazardous (Sanitary) Waste. Nonhazardous sanitary liquid wastes generated in the facility would be transferred to the sanitary waste system for treatment. Treated wastewater would be designated as reclaimed water recycle and would be used as makeup to the cooling system. Nonhazardous solid wastes, such as domestic trash and office waste, would be hauled to a permitted sanitary landfill for disposal.

Nonhazardous (Other) Waste. Other nonhazardous liquid wastes generated from facility support operations (for example, cooling system and evaporator condensate) would be collected in a catch tank and sampled before being reclaimed for recycle use such as make up water to the cooling system. Solid wastes would include rock cuttings from the boreholes and bentonite and polymers generated by the Drilling and Emplacing-Borehole Sealing Facilities. The facility design includes stormwater retention ponds with the necessary NPDES monitoring equipment. Runoff within the main facility area would be collected separately, routed to the stormwater collection ponds, and then sampled and analyzed before discharge to the natural drainage channels (dry site) or river (wet site). If the runoff was contaminated, it would be treated in the process wastewater treatment system. Runoff outside of the main facility area would be discharged directly into the natural drainage channel or river.

Table E.3.3.2–1. Estimated Waste Volumes for the Immobilized Disposition Alternative—Deep Borehole Complex

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.5[a]	None
Solid	None	0.5	0.5
Mixed Transuranic			
Liquid	None	None	None
Solid	None	0.1	0.1
Low-Level			
Liquid	None	3[a]	None
Solid	None	6	5
Mixed Low-Level			
Liquid	None	None	None
Solid	None	None	None
Hazardous			
Liquid	4	141[b]	141[b]
Solid	24	15[c]	15[c]
Nonhazardous (Sanitary)			
Liquid	10,700	9,460	None[d]
Solid	306	291	291
Nonhazardous (Other)			
Liquid	1,770[e]	6,060[f]	None[d]
Solid	162[g]	1,250[h]	1,250[h]

[a] Liquid TRU waste and LLW would be treated with the remaining TRU and low-level sludge being solidified.

[b] Includes 69.6 m^3 of decontamination water and 69.6 m^3 of oil, antifreeze, and hydraulic fluid.

[c] Includes 1,090 kg (assuming 1,500 kg/m^3) of rags and other materials generated by the Drilling and Emplacing-Borehole Sealing Facilities.

[d] Treated wastewater would be designated as reclaimed water recycle and would be used as makeup to the cooling system.

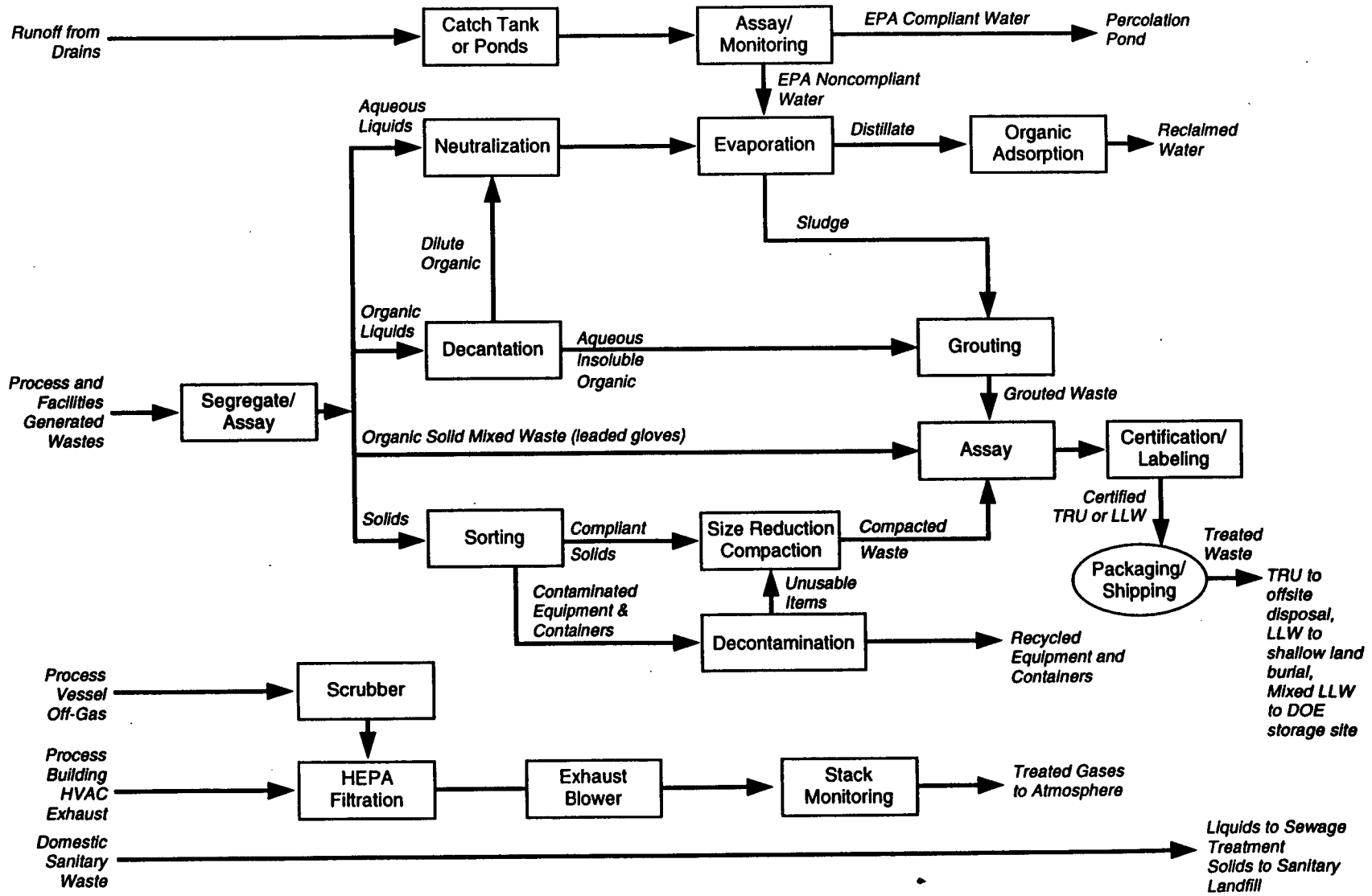
[e] Includes service water and concrete batch plant water.

[f] Includes cooling water blowdown and evaporator condensate.

[g] Includes 54 t of steel (assuming 0.127 m^3/t).

[h] Includes 38,550 kg (assuming 1,500 kg/m^3) of bentonite and polymers, and 1,220 m^3 of rock cuttings generated by the Drilling and Emplacing-Borehole Sealing Facilities.

Source: LLNL 1996h.



Source: LLNL 1996h.

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Figure E.3.3.2–1. Immobilized Disposition Alternative—Deep Borehole Complex Disposal Facility Waste Management Process Flow Diagram.

E.3.3.3 Immobilized Disposition Alternative—Ceramic Immobilization Facility

The ceramic immobilization facility using coated pellets without radionuclides includes a scrap treatment cell to allow treatment of off-specification process materials, contaminated equipment, and components to recover Pu and recycle it back into the calcination and pellet press process. The cell would be equipped with equipment suitable for size reduction and process feed makeup of off-specification ceramic material from the pellet pressing and coating operations. Decontamination and leaching equipment also would be provided to allow recovery of Pu from process equipment and to return the solutions to the calciner feed makeup process. Other off-specification materials from the process upstream of the pellet presses would be recycled to the appropriate equipment in the Pu process. The ceramic immobilization operations would be configured with minimization of waste products given high priority.

Table E.3.3.3–1 presents the estimated annual waste volumes during construction and operation of the ceramic immobilization facility. As illustrated in Figure E.3.3.3–1, waste management facilities would be provided to monitor, treat, and handle radioactive wastes, including LLW, TRU waste, and mixed waste. These management facilities would be located in the Radwaste Management Building immediately adjacent to the Plutonium Processing Building. The waste treatment processes include assay examination, sorting, separation, concentration, size reduction, organic destruction, and thermal treatment.

Process liquid radioactive waste treatment facilities include the nitric acid recovery system and the LLW/TRU radwaste solidification systems. Since these systems would handle relatively low-activity waste streams, they generally would be located in processing areas outside the main Pu processing areas. The nitric acid and water would be recovered and recycled wherever appropriate for reuse in the facility. Low-level liquid radwaste treatment systems generally would be located in nonshielded processing rooms equipped with room ventilation confinement zoning appropriate to the expected levels of contamination within the room. Mixed waste would be segregated from other waste forms, and stored for onsite or offsite treatment treatment in accordance with the site treatment plan.

Process solid radioactive waste treatment would also be performed in the Radwaste Management Building. Solid waste generated from glovebox operations for the Pu processing head end generally would be handled and processed in glovebox enclosures. Where fume or dust generation is anticipated, equipment would be installed in glovebox enclosures supplied with local filters, mist eliminators, condensers, and so forth, as required to minimize the spread of contamination to the glovebox ventilation system. Solid waste generated within the process cells would be segregated remotely into low-level contact-handled, low-level remote-handled, TRU, and mixed waste. Solid waste assay, segregation, decontamination, and volume-reduction facilities would be used to minimize the volume of waste shipped from the facility. Waste packaging and shipping facilities for both LLW and TRU waste would be provided.

Gaseous waste would be filtered, condensed, scrubbed, absorbed, and so forth, as required to meet DOE and other applicable regulatory requirements. Local condensers, mist eliminators, and sintered-metal filters with blowback to the process are intended for Pu oxidation, calcination, hot pressing, and other operations where particulate generation is expected. HEPA filters would be provided at both inlets and outlets of glovebox enclosures handling Pu.

All fire sprinkler water discharged in process areas during and after a fire would be contained, monitored, sampled, and if required, retained until disposal. Utility wastewater discharges (including cooling system and boiler blowdown, cold chemical area liquid effluents, and nonradioactive liquid ceramic additive liquid wastes) would be treated in an industrial wastewater treatment plant prior to discharge in accordance with applicable environmental standards. The facility design includes a sanitary treatment plant to treat liquid sanitary wastes.

High-Level Waste. The ceramic immobilization facility would not generate a HLW stream from processing Pu. However, the facility would produce an immobilized ceramic product. The Pu disposition mission would produce 980 drums annually (LLNL 1996e:9-2). This immobilized ceramic product would require interim storage with final disposal at the deep borehole complex.

Transuranic Waste. TRU wastes would be generated from process and facility operations, equipment decontamination, failed equipment, and used tools. The granulation, pellet pressing, pellet sintering, and drum handling functions would generate both liquid and solid TRU waste. The contaminated water from the drum decontamination would be collected and transferred to the recycle waste evaporator.

Numerous other processes, including those directly supporting the production of radioactive ceramic and those managing the various waste streams, would produce used ventilation air filters, as well as contaminated operator clothing, gloves, wipes, shoe covers, and other process equipment. The original containers and packaging associated with the Pu feed would be considered waste and would be subject to characterization. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as TRU waste, they would be appropriately treated and stored until final disposal.

The TRU wastes would be treated in a waste handling facility to form grout or compact solid waste. Any liquid TRU waste would be treated with the remaining TRU sludge being solidified. Treated waste products would be packaged, assayed, and certified to meet the WIPP waste acceptance criteria or alternative treatment level. Assuming WIPP is determined to be a suitable repository for these wastes and depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste, pursuant to the requirements of 40 CFR 191 and 40 CFR 268, these wastes would be transported to WIPP for disposal.

Mixed Transuranic Waste. A very small quantity of solid mixed TRU waste, mainly rubber gloves and leaded glovebox gloves from the waste handling facility, would be generated annually during operations. This mixed TRU waste would be placed in temporary storage, pending final treatment and disposal in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act*. This mixed TRU waste would need eventual treatment to meet the WIPP waste acceptance criteria.

Low-Level Waste. [Text deleted.] Processes directly supporting the radioactive coated ceramic pellet production, as well as those managing the various waste streams, would produce contaminated operator clothing, gloves, wipes, shoe covers, and process equipment. The original containers and packaging associated with the Pu feed would be considered waste and would be subject to characterization. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as LLW, they would be treated by sorting, separation, concentration, and size reduction processes. Any liquid LLW would be treated with the remaining LLW sludge being solidified. Final LLW products would be surveyed and disposed of in a shallow land burial site.

Mixed Low-Level Waste. A very small quantity of solid mixed LLW, mainly rubber gloves and leaded glovebox gloves from the waste handling facility, would be generated annually during operation of the ceramic immobilization facility. Any mixed LLW would be stored onsite on an interim basis until treatment, disposal, or offsite shipment to another DOE facility for treatment in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act*.

Hazardous Waste. Many of the ceramic immobilization facility processes would generate hazardous waste. This waste would include chemical makeup and reagents for support activities, and lubricants and oils for process and support equipment. The liquid and solid hazardous waste would be collected at the facility and stored on an interim basis. The hazardous wastes would be recycled, or stored and packaged for offsite treatment and disposal at commercial RCRA-permitted facilities.

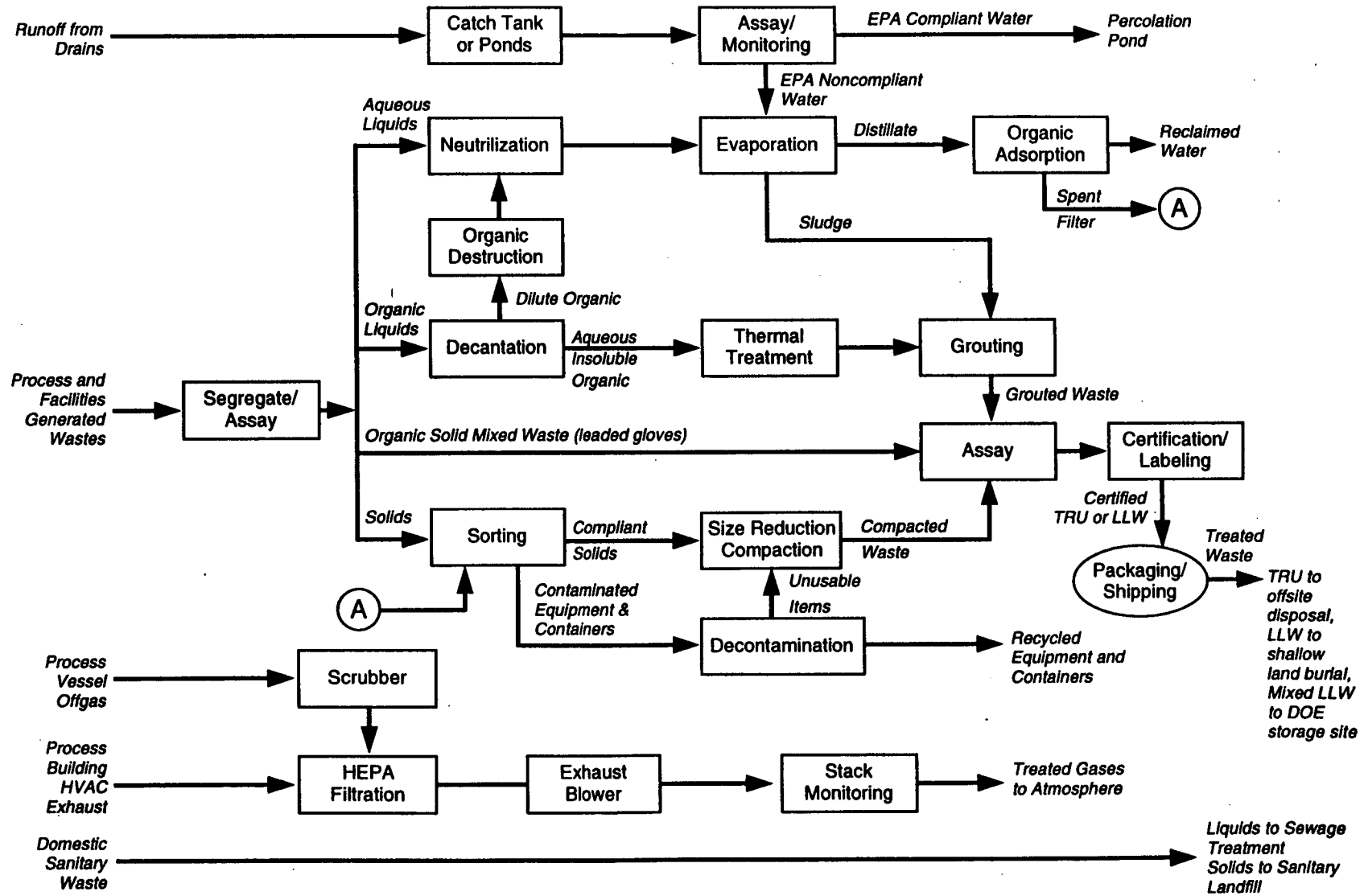
Nonhazardous (Sanitary) Waste. Nonhazardous sanitary liquid wastes generated in the facility would be transferred to a sanitary waste system for treatment. Nonhazardous solid wastes, such as domestic trash and office waste, would be hauled to a permitted sanitary landfill for disposal.

Nonhazardous (Other) Waste. Other nonhazardous liquid wastes generated from facilities support operations (for example, cooling system blowdown and evaporator condensate) would be collected in a catch tank and sampled before being reclaimed for recycle use or release to the environment. The facility design includes stormwater retention ponds with the necessary NPDES monitoring equipment. Runoff within the main facility area would be collected separately, routed to the stormwater collection ponds, and then sampled and analyzed before discharge to the natural drainage channels (dry site) or river (wet site). If the runoff was contaminated, it would be treated in the process wastewater treatment system. Runoff outside of the main facility area would be discharged directly into the natural drainage channels or river.

Table E.3.3.3–1. Estimated Waste Volumes for the Immobilized Disposition Alternative—Ceramic Immobilization Facility

Category	Annual Average Volume Generated From Construction (m^3)	Annual Average Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	110[a]	None
Solid	None	150	150
Mixed Transuranic			
Liquid	None	None	None
Solid	None	1.5	1.5
Low-Level			
Liquid	None	10[a]	None
Solid	None	23	15
Mixed Low-Level			
Liquid	None	None	None
Solid	None	0.3	0.3
Hazardous			
Liquid	17	45	45
Solid	24	23	23
Nonhazardous (Sanitary)			
Liquid	22,000[b]	43,000[b]	43,000[b]
Solid	Included in liquid	910	910
Nonhazardous (Other)			
Liquid	227,600[c]	186,900[d]	186,900[d]
Solid	147[e]	15[f]	None

[a] Liquid TRU waste and LLW would be treated with the remaining TRU and low-level sludge being solidified.
[b] Includes sewage and industrial wastewater.
[c] Includes service water, concrete batch plant water, and stormwater runoff.
[d] Includes cooling water blowdown, process wastewater, and stormwater runoff.
[e] Includes 220 t of construction material (assuming 1,500 kg/m^3).
[f] Recyclable wastes.
Source: LLNL 1996e.



Source: LLNL 1996e.

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Figure E.3.3.3–1. Immobilized Disposition Alternative—Ceramic Immobilization Facility Waste Management Process Flow Diagram.

E.3.3.4 Vitrification Alternative

The design of the vitrification facility with radionuclides would place great emphasis on the minimization of both liquid and solid wastes. Where generation of a waste could not be avoided, methods would be pursued to recycle the waste. The facility would have a remote decontamination and equipment maintenance facility that would generate contaminated liquid waste. Small amounts of liquid waste would also be generated in the vitrification process from offgas condensate and canister decontamination. These liquid wastes would be evaporated, calcined, and recycled to the melter feed in the form of calcine. Generally, failed contaminated equipment would be decontaminated, then disposed of through appropriate means. Equipment that fails during the life of the facility and could not be decontaminated, repaired, or disposed of would be stored in a failed equipment storage vault beneath the process cells. Because Pu oxide residues may become embedded in the equipment sent to the failed equipment storage vault, all equipment would have a critical safety evaluation prior to storage. The vault would be appropriately shielded to comply with radiological safety criteria. The failed equipment would be disposed of through appropriate means following the end of the operating mission.

Table E.3.3.4–1 presents the estimated annual waste volumes during construction and operation of the vitrification facility. As illustrated in Figure E.3.3.4–1, waste management capabilities would be provided to monitor, treat, and handle radioactive wastes, industrial and chemical wastes, as well as sanitary and stormwater wastes. The wastes would include TRU, low-level, mixed, hazardous, and nonhazardous. The management facilities provided to handle the radioactive wastes would be located in the Radwaste Management Building adjacent to the Vitrification Building. The waste treatment processes include assay examination, sorting, separation, concentration, size reduction, organic destruction, and thermal treatment.

Process liquid radioactive wastes generated by the vitrification facility would be collected in a drain waste collection tank. Most of this waste would be rinsewater streams, process cell sumps, flushing wastes, and condensate from the preparation of Pu-glass frit, cesium nitrate salt, and final vitrification processes. Some radioactive wastes would also be generated from chemical solutions and rinses used in the decontamination of process and maintenance equipment in the decontamination cell or Analytical Laboratory. There would be no discharge of radioactive liquid wastes to the environment. Contents of the drain waste collection tank would be recovered through reprocessing or would be treated in the Radwaste Management Building. Contaminated water would be used to make concrete for the disposal of chlorides from the CsCl process. Any mixed waste would be segregated from other waste forms and stored for offsite or onsite treatment in accordance with the site treatment plan.

Process solid radioactive waste treatment would also be performed in the Radwaste Management Building. Solid wastes generated would include spent canisters and hulls from shipment of Cs-137, chloride-containing cement from the processing of CsCl, contamination control waste, maintenance residues, dust-stop and HEPA filters, and stainless steel Pu-glass frit transfer cans. The solid waste would be controlled at the source of generation to reduce or eliminate this waste whenever possible. The waste would be handled and treated according to the type and concentration of the contamination. Solid waste would be decontaminated to the extent practical in or near the work area and would then be packaged in sealable carbon steel or cardboard containers in the Radwaste Management Building and prepared for disposal. Waste packaging and shipping facilities for both LLW and TRU waste would be provided.

Gaseous wastes generated by operations would include process vessel offgases and heating, ventilation, and air conditioning exhausts. Prior to release to the stack, these gaseous wastes would be filtered, condensed, scrubbed, absorbed, neutralized, and so forth, as required to meet DOE and other applicable regulatory requirements. Local condensers, mist eliminators, and sintered-metal filters with blowback to the process would be provided to ensure no uncontrolled release to the environment. Ventilation air and gaseous effluents from the process cells, process vessels, and melters would be contaminated with process radioactivity. These gases would be treated before discharge to the atmosphere through stacks to ensure that the concentration of radionuclides is at acceptable levels.

Any nonradiological waste generated from operation would be monitored, collected, and treated, if necessary, before discharge to the environment. Facilities would be provided to treat chemically-contaminated wastewaters before discharge to the environment. Holding tanks would be provided for the waste. Solid nonradioactive waste would be recycled, where possible, or transferred to approved disposal sites in accordance with accepted industrial practices.

All fire sprinkler water discharged in process areas during and after a fire would be contained, monitored, sampled, and if required, retained until disposal. Utility wastewater (including cooling system and boiler blowdown) would be treated in an industrial wastewater treatment plant prior to discharge in accordance with applicable environmental standards. The facility design includes a sanitary treatment plant to treat liquid sanitary waste.

High-Level Waste. The vitrification facility would not generate a HLW stream from processing Pu. However, the facility would produce a glass log. The Pu disposition would produce 60 canisters annually (LLNL 1996c:9-3). The glass logs would require interim storage until a final disposal option becomes available.

Transuranic Waste. TRU waste would be generated from process and facility operations, equipment decontamination, failed equipment, and used tools. Numerous processes, including those directly supporting the radioactive Pu-glass frit production, and those managing the various waste streams, would produce used ventilation air filters, resins, and sludges, as well as contaminated operator clothing, gloves, wipes, shoe covers, and other process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as TRU waste, they would be appropriately treated and stored until final disposal.

The TRU waste would be treated in a waste handling facility to form grout or a compact solid waste. The small amount of liquid TRU waste would be treated with the remaining TRU sludge being solidified. Treated TRU waste products would be packaged, assayed, and certified to meet WIPP waste acceptance criteria or alternative treatment level. Assuming WIPP is determined to be a suitable repository for these wastes and depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste, pursuant to the requirements of 40 CFR 191 and 40 CFR 268, these wastes would be transported to WIPP for disposal.

Mixed Transuranic Waste. A very small quantity of solid mixed TRU waste, mainly protective clothing and radiological survey waste from the waste handling facility, would be generated annually during operations. This mixed TRU waste would be generated primarily from activities at the waste handling facilities. Mixed TRU waste would be packaged and shipped to another DOE waste management facility for temporary storage, pending final treatment and disposal in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act*. Current plans call for disposal at WIPP.

Low-Level Waste. [Text deleted.] Cesium capsule processing would produce both liquid and solid LLW. Conducted in a shielded cell with manipulators, the cesium processing involves one capsule at a time. The outer capsule is cut open, decontaminated, and discarded as solid LLW. The inner capsule is sheared to expose the cesium and barium chloride solids. The sheared pieces would be leached in hot water and agitated to dissolve the solid salts. The solution would then be transferred to the ion exchange feed tank, and the capsule hull would be decontaminated and disposed of as LLW. The chloride solution would then be processed using a cation exchange column to isolate the radioactive cesium. The effluent from the exchange column would be recycled to the column as necessary to remove residual cesium. The effluent would then be neutralized and sent to waste treatment for solidification as LLW.

Numerous processes, including those directly supporting the radioactive Pu-glass frit production and those managing the various waste streams, would produce contaminated operator clothing, gloves, wipes, shoe covers, and process equipment. A substantial source of LLW would be the stainless steel cans used to transfer

the Pu-glass frit to the blend cell, as they would be decontaminated and discarded as LLW. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as LLW, they would be treated by sorting, separation, concentration, and size reduction processes. Any liquid LLW would be treated with the remaining LLW sludge being solidified. Final LLW products would be surveyed and disposed of in a shallow land burial site.

Mixed Low-Level Waste. A very small quantity of solid mixed LLW, mainly protective clothing and radiological survey waste from the waste handling facility, would be generated annually during operations. Any mixed LLW would be stored onsite on an interim basis until treatment, disposal, or offsite shipment in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act*.

Hazardous Waste. Many of the vitrification facility processes would generate hazardous waste. This waste would include chemical makeup and reagents for support activities; lubricants and oils for process and support equipment; and used solvent rags contaminated with methylene chloride, acetonitrile, and acetone. The liquid and solid hazardous wastes would be collected at the facility and stored on an interim basis. The hazardous waste would be recycled or stored and packaged for offsite treatment or disposal at an RCRA-permitted facility.

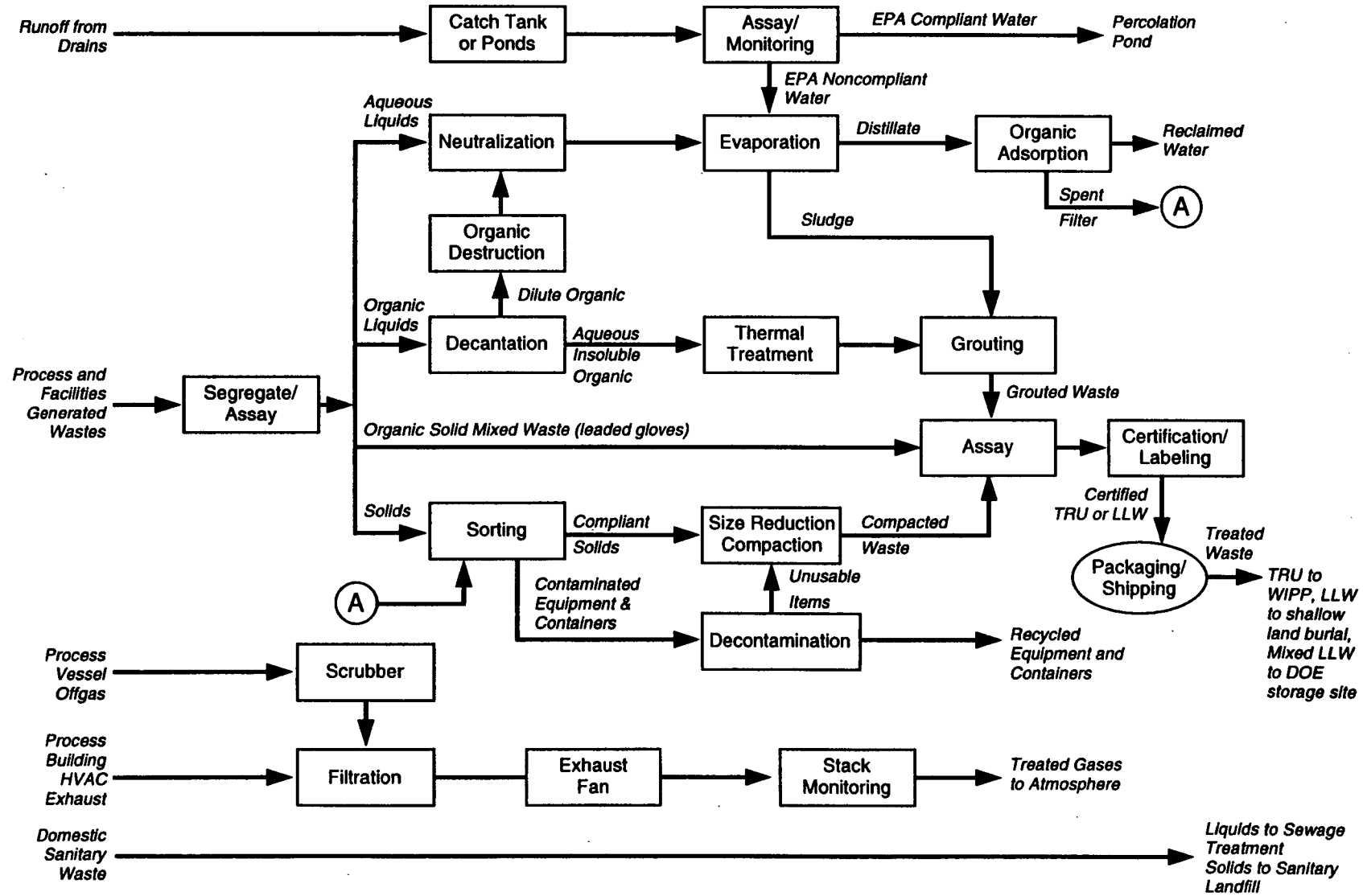
Nonhazardous (Sanitary) Waste. Liquid nonhazardous sanitary waste generated in the facility would be transferred to a sanitary waste system for treatment. Solid nonhazardous waste, such as domestic trash and office waste, would be transported to a permitted sanitary landfill for disposal.

Nonhazardous (Other) Waste. Other liquid nonhazardous waste generated from facility support operations (for example, cooling system blowdown and evaporator condensate) would be collected in a catch tank and sampled before being reclaimed for recycle use or release to the environment. The facility design includes stormwater retention ponds with the necessary NPDES monitoring equipment. Runoff within the main facility area would be collected separately, routed to the stormwater collection ponds, and then sampled and analyzed before discharge to the natural drainage channels (dry site) or river (wet site). If the runoff was contaminated, it would be treated in the process wastewater treating system. Runoff outside of the main facility area would be discharged directly into the natural drainage channels or river.

Table E.3.3.4–1. Estimated Waste Volumes for the Vitrification Alternative

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	0.8[a]	None
Solid	None	99	99
Mixed Transuranic			
Liquid	None	None	None
Solid	None	0.7	0.7
Low-Level			
Liquid	None	7[a]	None
Solid	None	14	14
Mixed Low-Level			
Liquid	None	None	None
Solid	None	0.15	0.15
Hazardous			
Liquid	0.6	19	4
Solid	3	19	19
Nonhazardous (Sanitary)			
Liquid	4,600	34,000[b]	34,000[b]
Solid	76	920	920
Nonhazardous (Other)			
Liquid	380[c]	269,000[d]	269,000[d]
Solid	18[e]	15[f]	None

[a] Liquid TRU waste and LLW would be treated with the remaining TRU and low-level sludge being solidified.
[b] Includes sewage and industrial wastewater.
[c] Includes service water, concrete batch plant water, and stormwater runoff.
[d] Includes cooling water blowdown, process wastewater, and stormwater runoff.
[e] Includes 18.2 t of steel (assuming 0.127 m^3/t).
[f] Recyclable wastes.
Source: LLNL 1996c.



Source: LLNL 1996c.

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Figure E.3.3.4–1. Vitrification Alternative—Vitrification Facility Waste Management Process Flow Diagram.

E.3.3.5 Ceramic Immobilization Alternative

The ceramic immobilization facility with radionuclides includes a scrap treatment cell to allow treatment of off-specification process materials, contaminated equipment, and components to recover Pu and recycle it back into the process. The cell would be equipped with equipment suitable for size reduction and process feed makeup of off-specification ceramic material from the hot-pressing operations. Decontamination and leaching equipment also would be provided to allow recovery of Pu from process equipment and to return the solutions to the calciner feed makeup process. Other off-specification materials from the process upstream of the hot presses would be recycled to the appropriate equipment in the Pu process. The ceramic immobilization operations would be configured with a minimization of waste products given high priority.

Table E.3.3.5–1 presents the estimated annual waste volumes during construction and operation of the ceramic immobilization facility. As illustrated in Figure E.3.3.5–1, waste management facilities would be provided to monitor, treat, and handle radioactive wastes, including low-level, TRU, and mixed waste. These management facilities would be located in the Radwaste Management Building immediately adjacent to the Plutonium Processing Building. The waste treatment processes include assay examination, sorting, separation, concentration, size reduction, organic destruction, and thermal treatment.

Process liquid waste treatment facilities include the nitric acid recovery system and the LLW/TRU radwaste solidification systems. Since these systems would handle relatively low-activity waste streams, they generally would be located in processing areas outside the main processing canyons. Low-level liquid radwaste treatment systems generally would be located in nonshielded processing rooms equipped with room ventilation confinement zoning appropriate to the expected levels of contamination within the room. Mixed waste would be segregated from other waste forms, and stored for offsite or onsite treatment in accordance with the site treatment plan.

Process solid radioactive waste treatment would also be performed in the Radwaste Management Building. Solid waste generated from glovebox operations for the Pu processing head end (upstream of the addition of cesium) would generally be handled and processed in glovebox enclosures. Where fume or dust generation is anticipated, equipment would be installed in glovebox enclosures supplied with local filters, mist eliminators, condensers, and so forth, as required to minimize the spread of contamination to the glove box ventilation system. Solid waste generated within the process cells would be segregated remotely into low-level contact-handled, low-level remote-handled, TRU, and mixed waste. Solid waste assay, segregation, decontamination, and volume-reduction facilities would be used to minimize the volume of waste shipped from the facility. Waste packaging and shipping facilities for both LLW and TRU waste would be provided.

Gaseous waste would be filtered, condensed, scrubbed, absorbed, and so forth, as required to meet DOE and other applicable regulatory requirements. Local condensers, mist eliminators, and sintered-metal filters with blowback to the process are intended for Pu oxidation, calcination, hot pressing, and other operations where particulate generation would be expected. HEPA filters would be provided at both inlets and outlets of glovebox enclosures handling Pu.

All fire sprinkler water discharged in process areas during and after a fire would be contained, monitored, sampled, and if required, retained until disposal. Utility wastewater discharges (including cooling system and boiler blowdown, cold chemical area liquid effluents, and nonradioactive liquid ceramic additive liquid wastes) would be treated in an industrial wastewater treatment plant prior to discharge in accordance with applicable environmental standards. The facility design includes a sanitary treatment plant to treat liquid sanitary wastes.

High-Level Waste. The ceramic immobilization facility would not generate a HLW stream from processing Pu. However, the facility would produce an immobilized ceramic product spiked with cesium radionuclides. The Pu disposition mission would produce 64 canisters annually (LLNL 1996d:9-2). This immobilized product would require interim storage until a final disposition option becomes available.

Transuranic Waste. TRU wastes would be generated from process and facility operations, equipment decontamination, failed equipment, and used tools. The bellows filling and closure function, as the ceramic calciner powder is assembled and prepared for compression, would generate both liquid and solid TRU waste. The contaminated water from the bellows decontamination would be collected and treated as TRU waste.

Numerous other processes, including those directly supporting the radioactive ceramic production and those managing the various waste streams, would produce used ventilation air filters, as well as contaminated operator clothing, gloves, wipes, shoe covers, and other process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as TRU waste, they would be appropriately treated and stored until final disposal.

Transuranic wastes would be treated in a waste handling facility to form grout or compact solid waste. Any liquid TRU waste would be treated with the remaining TRU sludge being solidified. Treated TRU waste products would be packaged, assayed, and certified to meet the waste acceptance criteria of the WIPP or alternative treatment level. Assuming WIPP is determined to be a suitable repository for these wastes and depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste, pursuant to the requirements of 40 CFR 191 and 40 CFR 268, these wastes would be transported to WIPP for disposal.

Mixed Transuranic Waste. A very small quantity of solid mixed TRU waste, mainly rubber gloves and leaded glovebox gloves from the waste handling facility, would be generated annually during operations. Mixed TRU would be packaged and shipped to another DOE waste management facility for temporary storage, pending final treatment and disposal in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act*. This mixed TRU waste would need eventual treatment to meet the WIPP waste acceptance criteria or alternative treatment level.

Low-Level Waste. [Text deleted.] Cesium capsule processing would produce both liquid and solid LLW. Conducted in a shielded cell with manipulators, the cesium processing involves one capsule at a time. The outer capsule is cut open, decontaminated, and discarded as solid LLW. The inner capsule is sheared to expose the cesium and barium chloride solids. The sheared pieces would be leached in hot water and agitated to dissolve the solid salts. The solution would then be transferred to the ion exchange feed tank, and the capsule hull would be decontaminated and disposed of as LLW. The chloride solution would then be processed using a cation exchange column to isolate the radioactive cesium. The effluent from the exchange column would be recycled to the column as necessary to remove residual cesium. The effluent would then be neutralized and sent to waste treatment for solidification as LLW.

Numerous processes, including those directly supporting the radioactive ceramic production and those managing the various waste streams, would produce contaminated operator clothing, gloves, wipes, shoe covers, and process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as LLW, they would be treated by sorting, separation, concentration, and size-reduction processes. Any liquid LLW would be treated with the remaining LLW sludge being solidified.

Mixed Low-Level Waste. A very small quantity of solid mixed LLW, mainly rubber gloves and leaded glovebox gloves from the waste handling facility, would be generated annually during operations. Any mixed LLW would be stored onsite on an interim basis until treatment, disposal, or offsite shipment in accordance with the site-specific treatment plan that was developed to comply with the *Federal Facility Compliance Act*.

Hazardous Waste. Many of the ceramic immobilization facility processes would generate hazardous waste. This waste would include chemical makeup and reagents for support activities and lubricants and oils for process and support equipment. The liquid and solid hazardous waste would be collected at the facility and

stored on an interim basis. The hazardous wastes would be recycled or stored and packaged for offsite treatment or disposal at commercial RCRA-permitted facilities.

Nonhazardous (Sanitary) Waste. Nonhazardous sanitary liquid wastes generated in the facility would be transferred to a sanitary waste system for treatment. Nonhazardous solid wastes, such as domestic trash and office waste, would be hauled to a permitted sanitary landfill for disposal.

Nonhazardous (Other) Waste. Other nonhazardous liquid wastes generated from facilities support operations (for example, cooling system blowdown and evaporator condensate) would be collected in a catch tank and sampled before being reclaimed for recycle use or release to the environment. The facility design includes stormwater retention ponds with the necessary NPDES monitoring equipment. Runoff within the main facility area would be collected separately, and routed to the stormwater collection ponds, and then sampled and analyzed before discharge to the natural drainage channels (dry site) or river (wet site). If the runoff was contaminated, it would be treated in the process wastewater treatment system. Runoff outside of the main facility area would be discharged directly into the natural drainage channels or river.

Table E.3.3.5–1. Estimated Waste Volumes for the Ceramic Immobilization Alternative

Category	Annual Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations (m^3)	Annual Volume Effluent From Operations (m^3)
Transuranic			
Liquid	None	75[a]	None
Solid	None	99	99
Mixed Transuranic			
Liquid	None	None	None
Solid	None	0.7	0.7
Low-Level			
Liquid	None	7[a]	None
Solid	None	14	11
Mixed Low-Level			
Liquid	None	None	None
Solid	None	0.15	0.15
Hazardous			
Liquid	13	38	38
Solid	15	19	19
Nonhazardous (Sanitary)			
Liquid	22,000	34,000[b]	34,000[b]
Solid	Included in liquid	920	920
Nonhazardous (Other)			
Liquid	157,000[c]	170,000[d]	170,000[d]
Solid	108[e]	15[f]	None

[a] Liquid TRU waste and LLW would be treated with the remaining TRU and low-level sludge being solidified.
[b] Includes sewage and industrial wastewater.
[c] Includes service water, concrete batch plant water, and stormwater runoff.
[d] Includes industrial wastewater, cooling water blowdown, process wastewater, and stormwater runoff.
[e] Includes 162 t of construction material (assuming 1500 kg/m^3).
[f] Recyclable wastes.
Source: LLNL 1996d.

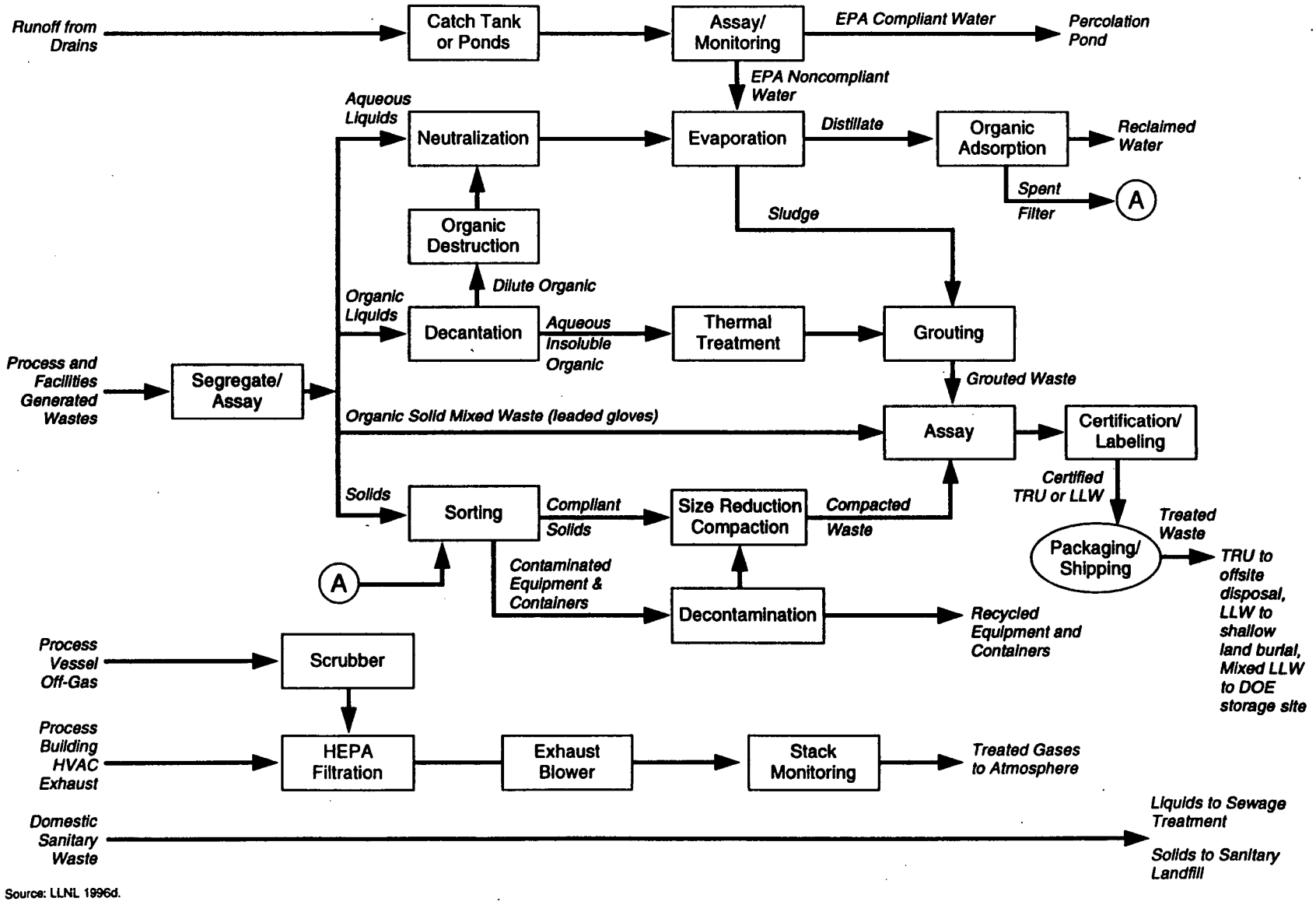


Figure E.3.3.5–1. Ceramic Immobilization Alternative—Waste Management Process Flow Diagram.

E.3.3.6 Electrometallurgical Treatment Alternative (Glass-Bonded Zeolite)

The design of the electrometallurgical treatment facility would place great emphasis on the minimization of both solid and liquid wastes. Where generation of a waste could not be avoided, methods would be pursued to recycle the waste. In general terms, waste management at the electrometallurgical treatment facility would include waste handling and treatment operations for processing the wastes generated by electrometallurgical treatment in aqueous, organic liquid, or solid form operations or by related site activities.

Table E.3.3.6–1 presents the estimated incremental annual waste volumes for the Pu disposition mission during construction and operation of the electrometallurgical treatment facility. Waste management capabilities would be provided to monitor, treat, and handle radioactive, industrial, and chemical wastes, as well as sanitary and stormwater wastes. The treated effluent from utility, process, and sanitary wastewater treatment would be reclaimed to be used as makeup to the cooling system. Other wastes generated by operations would include TRU, low-level, mixed, hazardous, and nonhazardous wastes. Management facilities for radioactive and nonradioactive waste would be located onsite.

The electrometallurgical treatment facility would utilize the waste treatment and management capabilities at INEL outlined in Appendix E.2.3. The waste treatment processes would include assay examination, sorting, separation, concentration, size reduction, special treatment, and thermal treatment. The wastes would be converted to water meeting effluent standards, grouted cement, or compacted solid waste as final form products for disposal. The waste treatment processing would also perform equipment and waste container decontamination operations.

Wastes would be generated during each step of the electrometallurgical treatment process and would be addressed under existing INEL waste operations requirements. The waste management process would involve the collecting, assaying, sorting, treating, packaging, storing, and shipping of radioactive, hazardous, and mixed wastes from Pu disposition operations, and hazardous and nonhazardous wastes from the support facilities.

Initial sorting of solid wastes would be performed at the generation source. Solid wastes would be treated by a variety of processes to ensure compliance with all applicable requirements. Solid LLW would be treated/ disposed of onsite at the Waste Experimental Reduction Facility and the RWMC. Waste products would be immobilized and packaged to meet DOT and DOE requirements. Liquid and solid organic wastes would be separated and dispositioned. The small quantity of mixed LLW would be managed in accordance with the *INEL Site Treatment Plan* that was developed to comply with the *Federal Facility Compliance Act* until a decision is made to allow disposal as radioactive waste following appropriate treatment. Mixed TRU wastes would be handled like other TRU wastes. Finally, nonhazardous, nonradioactive solid waste, and aqueous and gaseous wastes would be treated in conformance with standard industrial practice and regulatory requirements. Solid nonhazardous wastes would either be disposed of at a sanitary landfill or sent to a commercial recycle center.

Nonradioactive liquid wastes would be monitored, collected, and appropriately treated, if necessary, before discharge to the environment. Facilities would be provided to treat chemically contaminated wastewaters before discharge to the environment. Holding tanks would be provided for the wastes. Nonradioactive solid wastes would be recycled, where possible or transferred to approved disposal sites in accordance with accepted industrial practices.

All fire sprinkler water discharged in process areas during and after a fire would be contained, monitored, sampled, and if required, treated prior to disposal. Utility wastewater discharges (including cooling system and boiler blowdown) would be treated in an industrial waste pond.The facility would use the ANL-W onsite sanitary treatment system (sewage lagoons) to treat liquid sanitary wastes.

High-Level Waste. The electrometallurgical treatment facility would not generate an HLW waste stream from processing plutonium. However, the facility would produce an immobilized glass-bonded zeolite (GBZ)

product. The Pu disposition mission would produce 37 m^3 (49 yd^3) of immobilized GBZ product annually (LLNL 1996b:7-3). This immobilized glass-bonded zeolite product would require interim storage until a final disposal option becomes available.

Transuranic Waste. TRU wastes would be generated from process and facility operations, equipment decontamination, failed equipment, and used tools. Numerous processes, including those directly supporting the electrometallurgical treatment operations and those managing the various waste streams, would produce used ventilation air filters and Pu oxide sweepings, as well as contaminated operator clothing, gloves, gloveboxes, tools, wipes and rags, shoe covers, and other process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. If characterized as TRU waste, they would be appropriately treated and stored until final disposal (assumed to be WIPP).

Transuranic wastes would be treated, as appropriate, at the INEL Radioactive Scrap and Waste Facility to form grout or a compact solid waste. Treated TRU waste products would be packaged, assayed, and certified to meet the waste acceptance criteria of the WIPP or alternative treatment level. Assuming WIPP is determined to be a suitable repository for these wastes and depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste, pursuant to the requirements of 40 CFR 191 and 40 CFR 268, these wastes would be transported to WIPP for disposal.

Mixed Transuranic Waste. A very small quantity of solid mixed TRU waste, mainly protective clothing and radiological survey waste, would be generated annually during operations. This mixed TRU waste primarily would be generated from activities at the waste handling/management facilities. Mixed TRU would be packaged for temporary storage, pending final treatment and disposal in accordance with the *INEL Site Treatment Plan* that was developed to comply with the *Federal Facility Compliance Act*. Current plans call for disposal at WIPP.

Low-Level Waste. LLW would be generated from numerous operations at the facility and would be treated by sorting, separation, concentration, and size-reduction processes. The Waste Experimental Reduction Facility could be utilized. Numerous processes, including those directly supporting the electrometallurgical treatment operations and those managing the various waste streams, would produce contaminated operator clothing, gloves, tools, wipes and rags, shoe covers, and process equipment. Following characterization, these wastes would be handled, treated, and disposed of according to their level of contamination. Final LLW products would be surveyed and transported within the INEL site for shallow land burial at the LLW disposal pits at the RWMC. Any contaminated washdown water would be treated and solidified in the Radioactive Liquid Waste Treatment Facility.

Mixed Low-Level Waste. A very small quantity of solid mixed LLW, mainly protective clothing and radiological survey waste, would be generated annually during operations. This mixed LLW primarily would be generated from activities at the waste handling/management facilities. Any mixed LLW would be stored onsite on an interim basis until treatment, disposal, or offsite shipment in accordance with the *INEL Site Treatment Plan* that was developed to comply with the *Federal Facility Compliance Act*.

Hazardous Waste. Hazardous wastes would consist of chemical makeup and reagents for support activities, and lubricants and oils for process and support equipment. Solid hazardous wastes would include lead packing, and used wipes and rags contaminated with oils, lubricants, and cleaning solvents. Liquid hazardous wastes generated from the facility would include cleaning solvents, vacuum pump oils, film processing fluids, hydraulic fluids from mechanical equipment, antifreeze solutions, and paint. The liquid and solid hazardous waste would be collected at the facility and stored on an interim basis. The hazardous wastes would be recycled, where appropriate, or stored and packaged for offsite treatment or disposal at an RCRA-permitted facility in accordance with ongoing waste management procedures at INEL.

Nonhazardous (Sanitary) Waste. Nonhazardous sanitary liquid wastes generated in the facility would be treated in the existing ANL-W sanitary waste system. Nonhazardous solid wastes, such as domestic trash and office waste, would be hauled to a permitted sanitary landfill for disposal.

Nonhazardous (Other) Waste. Other nonhazardous liquid wastes generated from facilities support operations (for example, cooling system blowdown and evaporator condensate) would be collected in a catch tank and sampled before being reclaimed for recycle use or release to the environment. The facility design includes stormwater retention ponds with the necessary monitoring equipment. Runoff within the main facility area would be collected separately, routed to the stormwater collection ponds, and then sampled and analyzed before discharge to the natural drainage channels. If the runoff was contaminated, it would be treated in the process wastewater treating system. Runoff outside of the main facility area would be discharged directly into the natural drainage channel.

Table E.3.3.6–1. Estimated Waste Volumes for Electrometallurgical Treatment Alternative

Category	Annual Average Volume Generated From Modification of Electrometallurgical Treatment Facility[a] (m^3)	Annual Volume Generated by Electrometallurgical Treatment Facility (m^3)	Total Annual Volume Effluent From Electrometallurgical Treatment Facility (m^3)
Transuranic			
Liquid	None	None	None
Solid	None	6	6
Mixed Transuranic			
Liquid	None	None	None
Solid	None	0.8	0.8
Low-Level			
Liquid	None	2	None
Solid	None	55	55
Mixed Low-Level			
Liquid	None	None	None
Solid	None	0.8	0.8
Hazardous			
Liquid	None	None	None
Solid	None	0.8	0.8
Nonhazardous (Sanitary)			
Liquid	2,780	1,550	None
Solid	5,730	1,500	1,500
Nonhazardous (Other)			
Liquid	2,840	2,990[b]	None
Solid	0.4	0.8[c]	None

[a] Quantity generated to modify facility to accommodate Pu disposition mission.

[b] Includes 0.38 m^3 of recyclable wastes, and cooling system blowdown and wastewater from plant activities.

[c] Recyclable wastes.

Source: LLNL 1996b.

E.3.3.7 Evolutionary Light Water Reactor Alternative

The solid and liquid nonhazardous wastes generated during construction would include concrete and steel waste materials and sanitary wastewater. The steel waste would be recycled as scrap before completing construction. The remaining nonhazardous wastes would be disposed of as part of the construction project by the contractor. Uncontaminated wastewater would be used for soil compaction and dust control, and excavated soil would be used for grading and site preparation. Wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling. Hazardous construction wastes would consist of adhesives, oils, cleaning fluids, solvents, and coatings. This waste would be packaged in DOT-approved containers and shipped offsite to commercial RCRA-permitted treatment, storage, and disposal facilities. No radioactive waste would be generated during construction.

The reactor design considers and incorporates waste minimization and pollution prevention. Activities that generate radioactive and hazardous wastes would be segregated, where possible, to avoid the generation of mixed wastes. Where applicable, treatment to separate radioactive and nonradioactive components would reduce the volume of mixed wastes and permit for cost-effective disposal or recycle. To facilitate waste minimization, where possible, nonhazardous materials would be substituted for those materials that contribute to the generation of hazardous or mixed waste. Production processes would be configured with minimization of waste production given high priority. Where possible, material from the waste streams would be treated to facilitate disposal as nonhazardous wastes. Future D&D considerations have also been incorporated into the design.

Tables E.3.3.7–1 and E.3.3.7–2 present the estimated annual spent nuclear fuel and waste volumes during construction and operation of large and small evolutionary light water reactors (LWRs). Liquid and solid waste streams are routed to the waste management system. Figures E.3.3.7–1 and E.3.3.7–2 depict the waste management systems. Solid wastes would be characterized and segregated into LLW, hazardous, and mixed wastes, then treated to a form suitable for disposal or storage within the facility. Liquid wastes would be treated onsite to reduce hazardous/toxic and radioactive elements before discharge or transport. All fire sprinkler water discharged in process areas would be contained and treated as process wastewater, when required.

Spent Nuclear Fuel. Spent nuclear fuel would not be reprocessed. Fuel elements containing spent fuel would be stored for 3 to 10 years in water-cooled storage basins. The spent fuel storage pool must be able to accommodate fuel assemblies for 10 years after reactor discharge. The spent fuel pool would be equipped with an underwater canister loading system. Twelve spent fuel assemblies would be placed in fixed positions in a borated aluminum or stainless-steel basket for criticality safety. The basket would be contained in a canister with seal-welded lids. After the 10-year cooling period, the canisters would be drained, vacuum dried, and backfilled with helium through lid penetrations in preparation for dry storage. The canisters would be transferred in a cask to the interim spent fuel storage facility. At the storage facility each canister would be transferred to its final storage cask, which would be made of precast concrete. Casks would be placed on a concrete basemat. Periodic visual inspections of the canisters and the cask vents would be required. Periodic testing for helium leaks might also be required. The facility design would have sufficient capacity to store the spent nuclear fuel for the life of the facility, pending the availability of a geologic repository.

High-Level Waste. Under the assumption of no fuel reprocessing, the evolutionary LWR would not generate any HLW.

Transuranic Waste. Under the assumption of no fuel reprocessing, the evolutionary LWR would not generate any TRU waste.

Low-Level Waste. LLW would be generated by the operation of the reactor and support facilities and would include concentrated waste from the condensate demineralizer system. Process effluents would be temporarily stored in tanks before conversion into a solid LLW that is suitable for disposal. The liquid effluent would be

discharged through a permitted NPDES outfall. The bulk of the solid LLW, consisting of contaminated equipment pieces, plastic sheeting, and protective clothing, would be generated from reactor operations. Solid LLW would be compacted, if appropriate, and then disposed of at a DOE-approved onsite or offsite disposal facility.

Mixed Low-Level Waste. Very small amounts of liquid mixed LLW would be generated by reactor operations. Solid mixed LLW could consist of wipes laden with contaminated oils, lubricants, and solvents used to decontaminate surfaces. Mixed LLW would be stored in an onsite RCRA-permitted storage facility until treatment in accordance with the site-specific site treatment plan that was developed to comply with the *Federal Facility Compliance Act*.

Hazardous Waste. Liquid hazardous wastes would consist of cleaning solvents, cutting oils, vacuum pump oils, film processing fluids, hydraulic fluids from mechanical equipment, antifreeze solutions, and paint. A cleaning solvent would be selected from a list of nonhalogenated solvents. Liquid hazardous wastes would be collected in DOT-approved containers and sent to an onsite hazardous waste accumulation area. The accumulation area would provide a 90-day staging capacity prior to shipment in DOT-certified transportation to an offsite commercial RCRA-permitted treatment, storage, and disposal facility. Solid hazardous wastes would be generated from nonradioactive materials such as wipes contaminated with oils, lubricants, and cleaning solvents that would be used for equipment outside the main processing units. After compaction, if appropriate, the solid hazardous wastes would be packaged in DOT-approved containers and sent to a hazardous waste accumulation area for staging prior to shipment in DOT-certified transporters to an offsite commercial RCRA-permitted treatment, storage, and disposal facility.

Nonhazardous (Sanitary) Waste. Sewage wastewater would be treated in the sanitary wastewater treatment plant, site septic systems, or pretreated prior to discharge to existing municipal systems. Sewage wastewater would be kept separate from all industrial and process wastewaters and normally would contain no radioactive wastes from the reactor facility. The sewage wastewater would be routinely monitored for radioactive contaminants. The sludge would be disposed of in a permitted landfill. The treated effluent would be discharged through a permitted NPDES outfall (wet site) or recycled for cooling water makeup and other services (dry site). The treated effluent from the process wastewater treatment would be discharged to the river through an NPDES outfall (wet site) or a natural drainage channel (dry site). Other nonrecyclable, nonhazardous solid sanitary and industrial wastes would be compacted and disposed of in a permitted landfill.

Nonhazardous (Other) Waste. The reactor design includes stormwater retention facilities with the necessary NPDES monitoring equipment. Runoff within the Limited Area and Protected Area would be collected separately, routed to the stormwater collection ponds and then sampled and analyzed before discharge to the natural drainage channels (dry site) or river (wet site). If the runoff was contaminated, it would be treated in the radioactive waste treatment system. Runoff from the Property Protection Area would be discharged directly into the natural drainage channels or river. Cooling tower blowdown would be treated and discharged to the river (wet site) or recycled for reuse (dry site). The treated effluent from the utility wastewater treatment would be discharged to the river through an NPDES outfall (wet site) or a natural drainage channel (dry site). All sludges would be disposed of in a permitted landfill.

Table E.3.3.7–1. Estimated Spent Nuclear Fuel and Waste Volumes for the Evolutionary Light Water Reactor (Large) Alternative[a]

Category	Yearly Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations, Dry Site (m^3)	Annual Volume Effluent From Operations, Dry Site (m^3)	Annual Volume Generated From Operations, Wet Site (m^3)	Annual Volume Effluent From Operations, Wet Site (m^3)
Spent Nuclear Fuel	None	10[b]	10b	10b	10b
Low-Level					
Liquid	None	18,900[c]	None	18,900[c]	None
Solid	None	500	70	500	70
Mixed Low-Level					
Liquid	None	None	None	None	None
Solid	None	5	5	5	5
Hazardous					
Liquid	Included in solid	Included in solid	Included in solid	Included in solid	Included in solid
Solid	711	27	27	27	27
Nonhazardous (Sanitary)					
Liquid	102,000	342,000	341,000	23,900,000	23,800,000[d]
Solid	11,500	5,280	1,760[e]	5,280	1,760[e]
Nonhazardous (Other)					
Liquid	1,890[f]	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	4,430[g]	None	4,430[g]	None

[a] Waste volumes are per reactor. Disposition mission would require two reactors.

[b] Spent fuel per reactor per year; total spent fuel for disposition mission (two reactors) would be 337 m3. Residual heavy metal content in spent nuclear fuel would be 38.2 t per reactor per year. Total for disposition mission would be 1,300 t.

[c] Liquid LLW would be treated with the remaining LLW sludge being solidified.

[d] For the evolutionary LWR, Hanford is considered to be a wet site. However, the only liquid discharge would be from cooling tower blowdown and is estimated to be 23,470,000 m^3. All other wastewater would be recycled.

[e] Assumes overall compaction factor of 3:1.

[f] Does not include groundwater dewatering, if required.

[g] Recyclable wastes.

Source: DOE 1995f; LLNL 1996g.

Table E.3.3.7–2. Estimated Spent Nuclear Fuel and Waste Volumes for the Evolutionary Light Water Reactor (Small) Alternative[a]

Category	Yearly Average Volume Generated From Construction (m^3)	Annual Volume Generated From Operations, Dry Site (m^3)	Annual Volume Effluent From Operations, Dry Site (m^3)	Annual Volume Generated From Operations, Wet Site (m^3)	Annual Volume Effluent From Operations, Wet Site (m^3)
Spent Nuclear Fuel	None	5[b]	5[b]	5[b]	5[b]
Low-Level					
Liquid	None	2,990[c]	None	2,990[c]	None
Solid	None	270	40	270	40
Mixed Low-Level					
Liquid	None	None	None	None	None
Solid	None	5	5	5	5
Hazardous					
Liquid	Included in solid	Included in solid	Included in solid	Included in solid	Included in solid
Solid	650	27	27	27	27
Nonhazardous (Sanitary)					
Liquid	56,800	190,000	189,000	11,000,000	11,000,000[d]
Solid	7,650	3,210	1,070[e]	3,210	1,070[e]
Nonhazardous (Other)					
Liquid	1,890[f]	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	2,680[g]	None	2,680[g]	None

[a] Waste volumes are per reactor. Disposition mission would require four reactors.

[b] Spent fuel per reactor per year; total spent fuel for disposition mission (four reactors) would be 338 m^3. Residual heavy metal content in spent nuclear fuel would be 17.7 t per reactor per year. Total for disposition would be 1,200 t.

[c] Liquid LLW would be treated with the remaining LLW sludge being solidified.

[d] For the evolutionary LWR, Hanford is considered to be a wet site. However, the only liquid discharge would be from cooling tower blowdown and is estimated to be 10,600,000 m^3. All other wastewater would be recycled.

[e] Assumes overall compaction factor of 3:1.

[f] Does not include groundwater dewatering, if required.

[g] Recyclable wastes.

Source: DOE 1995f; LLNL 1996g.

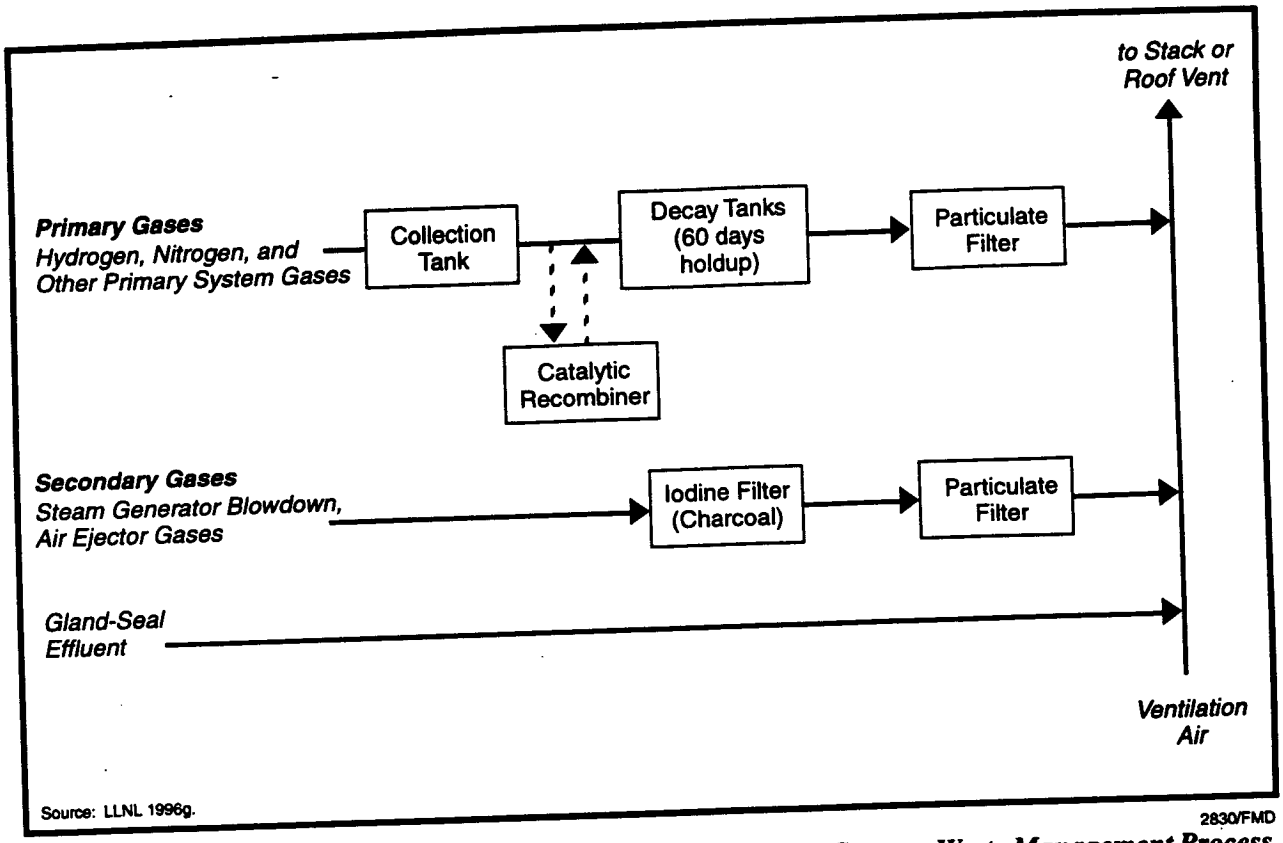


Figure E.3.3.7–1. Evolutionary Light Water Reactor Alternative—Gaseous Waste Management Process Flow Diagram.

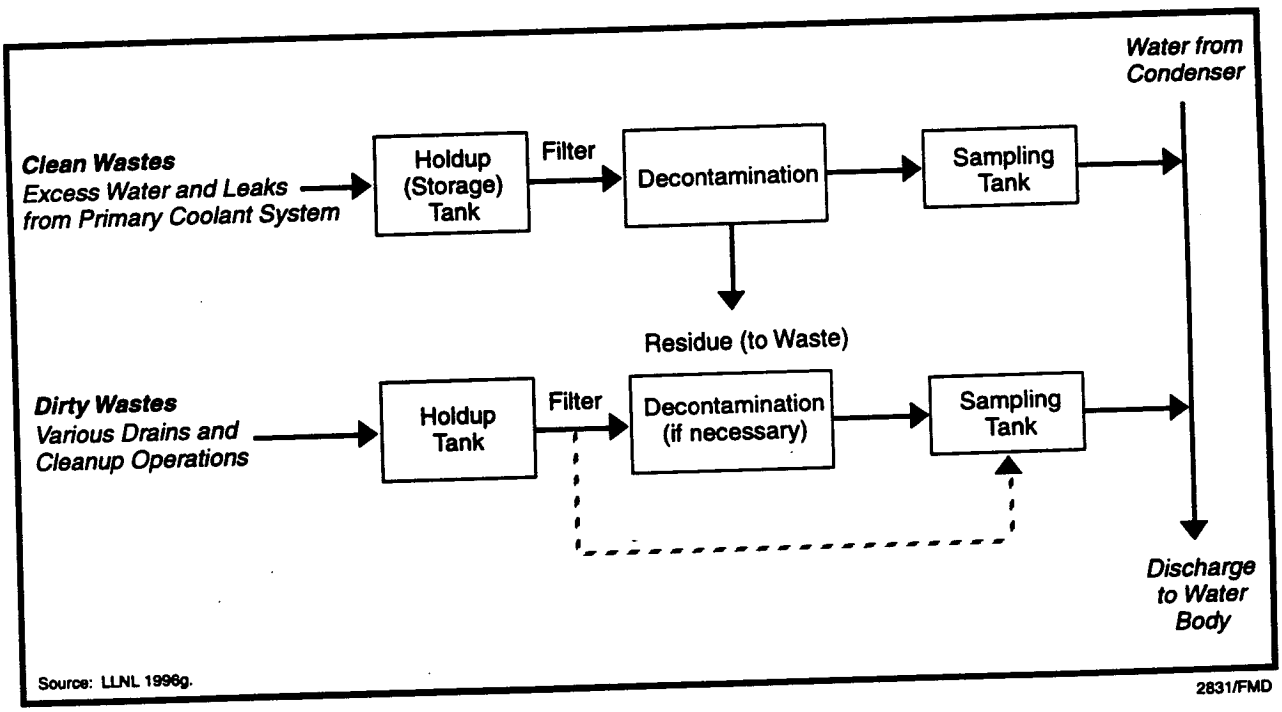


Figure E.3.3.7–2. Evolutionary Light Water Reactor Alternative—Liquid Waste Management Process Flow Diagram.

Appendix F
Air Quality and Noise

F.1 AIR QUALITY

This appendix provides detailed data that support air quality impact assessments addressed in Chapter 3, Affected Environment-Air Quality and Chapter 4, Environmental Consequences-Air Quality. The data presented include emission inventories for site-related activities and facility emissions for various alternatives. Section F.1.1 presents the methodology and models used in the air quality assessment. Section F.1.2 presents supporting data applicable to each site. Sections F.1.2.2 through F.1.2.9 contain tables of site-specific information applicable to the air quality assessments at each site and figures showing wind rose data specific to each site. Section F.1.3 presents the emission rates for the facilities considered for each alternative. Section F.2 presents sound level monitoring data for each site and summarizes relevant local noise regulations.

F.1.1 METHODOLOGY AND MODELS

The assessment of potential impacts to air quality is based upon comparison of proposed project effects with applicable standards and guidelines. The Industrial Source Complex Short-Term Model Version 2 (ISCST2) is used to estimate concentrations of pollutants from emission sources at each site. The screening model (SCREEN2) is used to estimate concentrations of pollutants at the site boundary for the generic sites, assuming a distance to the site boundary of 800 meters (m) (0.5 miles [mi]).

The air quality modeling analysis performed for the candidate sites is considered a "screening level" analysis. It applies conservative assumptions to each site to permit comparison among the sites of the impacts associated with the respective alternatives. These conservative assumptions will tend to overestimate pollutant concentrations at each site.

The assumptions applied to the air quality analysis at each site are as follows: where available, existing modeling analyses of criteria pollutant and toxic/hazardous pollutant emissions were used to determine No Action concentrations and are based on actual source locations and stack parameters; criteria pollutant and toxic/hazardous pollutant emissions were modeled for other sites and each alternative from a single source centrally located within the complex of facilities on each site assuming a 10-m (32.8-foot [ft]) stack height, a 0.3-m (1-ft) stack diameter, stack exit temperature equal to ambient temperature, and a stack exit velocity equal to 0.03 m/second (s) (0.1 ft/s) unless otherwise specified. These assumptions will tend to overestimate pollutant concentrations because they do not account for spacial and temporal variations of emission sources.

Emission sources at each facility or site and for each alternative were assumed to be in the same location as existing toxic/hazardous pollutant emission sources and assumed the modeling parameters used for those emissions.

The ISCST2 model is a revision of the ISCST model. The modeling algorithms have not been changed and the revised model will give nearly identical results to the original ISCST model for most applications. The performance of the ISCST model has not been validated with field data. However, it is an extended version of a single-stack model, CRSTER, that has been examined using field data from four large power plants. The performance of the ISCST model has been evaluated with field data for its point source submodel and for its special features, such as the gravitational settling/dry deposition option and building downwash option. From the validation studies for the single source CRSTER model, based on field data measured at four large power plants, it was concluded that the model acceptably predicts the upper percentile of the corresponding distributions of 1-hour concentrations and of the corresponding distributions of 24-hour concentrations. The highest-second-highest (a term within the model to represent the second highest concentration) 1-hour

concentrations were predicted within a factor of two at two-thirds of the field sampling sites for elevated power plant plumes. The ratio of highest-second-highest 24-hour concentration to measured concentration ranged from about 0.2 to 2.7 at about 90 percent of the sampling sites.

In other validation studies for the point source model, the CRSTER model predicted peak short-term (1-, 3-, and 24-hour) concentration values within 30 to 70 percent at a plain site (EPRI 1983a:7-1–7-7). The CRSTER model predicted peak 1-hour concentrations within 2 percent and underpredicted peak 3-hour concentrations by about 30 percent at a moderately complex terrain site (EPRI 1985a:7-1). The ISCST model overpredicts 1-hour concentrations by about 60 percent with better predictions for longer time periods at an urban site (EPRI 1988a:5-2). Uses of gravitational settling/dry deposition and building downwash options were found to improve the model performance significantly over that of the model without such features (APCA 1986a:258-264; EPA 1981a:5-1,5-2; EPA 1982a:151,152).

F.1.2 SUPPORTING DATA

F.1.2.1 Overview

This section presents supporting information for each of the eight existing DOE sites considered under the No Action Alternative, and the various storage and disposition alternatives, as appropriate. Table F.1.2.1–1 presents the air quality standards applicable to each site. Subsequent sections present supporting information used in the air quality analysis at the Hanford Site (Hanford), Nevada Test Site (NTS), Idaho National Engineering Laboratory (INEL), Pantex Plant (Pantex), Oak Ridge Reservation (ORR), Savannah River Site (SRS), Rocky Flats Environmental Technology Site (RFETS), and Los Alamos National Laboratory (LANL).

F.1.2.2 Hanford Site

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean windspeeds and direction frequencies at Hanford.

Climatology and Meteorology. Figure F.1.2.2–1 shows annual mean windspeeds and wind direction frequencies for July 1989 through June 1990 measured at the 10-m (32.8-ft) level of the Hanford Meteorology Station. The wind rose shows that the maximum wind direction frequency for 1989-1990 is from the west-northwest. The mean windspeed from the west-northwest is 4.3 m/s (9.6 miles per hour [mph]); the maximum mean windspeed is 5 m/s (11.2 mph) from the west-southwest. The historical wind data from the site indicate that the prevailing wind direction is from the west-northwest. The average annual windspeed is 3.4 m/s (7.6 mph) (HF PNL 1994b:83-84).

The average annual temperature is 11.8 degrees Celsius (°C) (53.3 degrees Fahrenheit [°F]); average monthly temperatures vary from a minimum of -1.5 °C (29.3 °F) in January to a maximum of 24.7 °C (76.5 °F) in July (HF PNL 1994b:83-84).

The average annual precipitation at Hanford is 16.0 centimeters (cm) (6.3 inches (in) (HF PNL 1994b:83-84).

Topographic features have a significant impact on the climate of Hanford. All air masses that reach the region undergo some modification resulting from their passage over the complex topography of the Pacific Northwest. The climate of the region is strongly influenced by the Pacific Ocean and the Cascade Range to the west and by the Rocky Mountains to the east and the north. The Rocky Mountains play a key role in protecting the region from the severe winter storms and extremely low temperatures associated with modified arctic air masses that move southward through Canada.

The Hanford Meteorological Station's climatological summary and the National Severe Storms Forecast Center's database list only 24 tornado occurrences within 161 kilometers (km) (100 mi) of Hanford from 1916 to 1994.

Table F.1.2.1–1. Ambient Air Quality Standards Applicable to Existing Department of Energy Sites

Pollutant	Averaging Time	Primary NAAQS[a] ($\mu g/m^3$)	Secondary NAAQS[a] ($\mu g/m^3$)	Washington (Hanford) ($\mu g/m^3$)	Nevada (NTS) ($\mu g/m^3$)	Idaho (INEL) ($\mu g/m^3$)	Texas (Pantex) ($\mu g/m^3$)	Tennessee (ORR) ($\mu g/m^3$)	Georgia and South Carolina (SRS) ($\mu g/m^3$)	Colorado (RFETS) ($\mu g/m^3$)	New Mexico (LANL) ($\mu g/m^3$)
Criteria Pollutants											
Carbon monoxide	8-hour	10,000	[b]	10,000	10,000	10,000	10,000	10,000	10,000	10,000	7,689[c]
	1-hour	40,000	[b]	40,000	40,000	40,000	40,000	40,000	40,000	40,000	11,578[c]
Lead	Calendar quarter	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	24-hour	[b]	[b]	0.5	[b]	[b]	[b]	[b]	[b]	[b]	[b]
Nitrogen dioxide	Annual	100	100	100	100	100	100	100	100	100	73[c]
	24-hour	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	145[c]
Ozone	1-hour	235	235	235	235	235	235	235	235	235	235
Particulate matter less than or equal to 10 microns in diameter	Annual	50	50	50	50	50	50	50	50	50	50
	24-hour	150	150	150	150	150	150	150	150	150	150
Sulfur dioxide	Annual	80	[b]	52	80	80	80	80	80	80	40[c]
	24-hour	365	[b]	260	365	365	365	365	365	365	202[c]
	3-hour	[b]	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300
	3-hour	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	700[d]	[b]
	1-hour	[b]	[b]	1,018	[b]	[b]	[b]	[b]	[b]	[b]	[b]
	1-hour	[b]	[b]	655[e]	[b]	[b]	[b]	[b]	[b]	[b]	[b]
	30-minute	[b]	[b]	[b]	[b]	[b]	1,045	[b]	[b]	[b]	[b]

Table F.1.2.1–1. Ambient Air Quality Standards Applicable to Existing Department of Energy Sites—Continued

Pollutant	Averaging Time	Primary NAAQS[a] (μg/m³)	Secondary NAAQS[a] (μg/m³)	Washington (Hanford) (μg/m³)	Nevada (NTS) (μg/m³)	Idaho (INEL) (μg/m³)	Texas (Pantex) (μg/m³)	Tennessee (ORR) (μg/m³)	Georgia and South Carolina (SRS) (μg/m³)	Colorado (RFETS) (μg/m³)	New Mexico (LANL) (μg/m³)
State and County Mandated Pollutants											
Beryllium	24-hour	[b]	[b]	[b]	[b]	[b]	0.01	[b]	[b]	[b]	[b]
Gaseous fluoride	30-day	[b]	[b]	0.8	[b]	[b]	0.8	1.2	0.8	[b]	[b]
	7-day	[b]	[b]	1.7	[b]	[b]	1.6	1.6	1.6	[b]	[b]
	24-hour	[b]	[b]	2.9	[b]	[b]	2.9	2.9	2.9	[b]	[b]
	12-hour	[b]	[b]	3.7	[b]	[b]	3.7	3.7	3.7	[b]	[b]
	8-hour	[b]	[b]	[b]	[b]	[b]	[b]	250	[b]	[b]	[b]
Hydrogen sulfide	1-hour	[b]	[b]	[b]	112	[b]	[b]	[b]	[b]	142	11[c]
	30-minute	[b]	[b]	[b]	[b]	[b]	111	[b]	[b]	[b]	[b]
Sulfuric acid	24-hour	[b]	[b]	[b]	[b]	[b]	15	[b]	[b]	[b]	[b]
	1-hour	[b]	[b]	[b]	[b]	[b]	50	[b]	[b]	[b]	[b]
Total reduced sulfur		[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	3
Total suspended particulates	Annual	[b]	[b]	60	[b]	60	[b]	[b]	75	75	60[c]
	30-day	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	90[c]
	7-day	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	110[c]
	24-hour	[b]	[b]	150	[b]	150	[b]	150	[b]	150	150[c]
	3-hour	[b]	[b]	[b]	[b]	[b]	200	[b]	[b]	[b]	[b]
	1-hour	[b]	[b]	[b]	[b]	[b]	400	[b]	[b]	[b]	[b]

[a] The NAAQS (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is ≤ 1. The 24-hour particulate matter standard is attained when the expected number of days with a 24-hour average concentration above the standard is ≤ 1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. The calendar quarter lead standard is not to be exceeded.

[b] There is no standard.

[c] State standard. The conversion from ppm to μg/m³ for the ambient air quality standard is calculated with the corrections for temperature (21 °C) and pressure (elevation) (7,400 ft mean sea level).

[d] State of Colorado also has an incremental standard for sulfur dioxide.

[e] The standard is not to be exceeded more than twice in any seven consecutive days.

Note: NAAQS=National Ambient Air Quality Standards; μg-microgram.

Source: 40 CFR 50; CO DPHE 1994a; ID DHW 1995a; ID DHW 1995b; ID DHW 1995c; NM EIB 1995a; NM EIB 1996a; NV DCNR 1995a; SC DHEC 1992b; TN DEC 1994a; TX NRCC 1992a; WA Ecology 1994a.

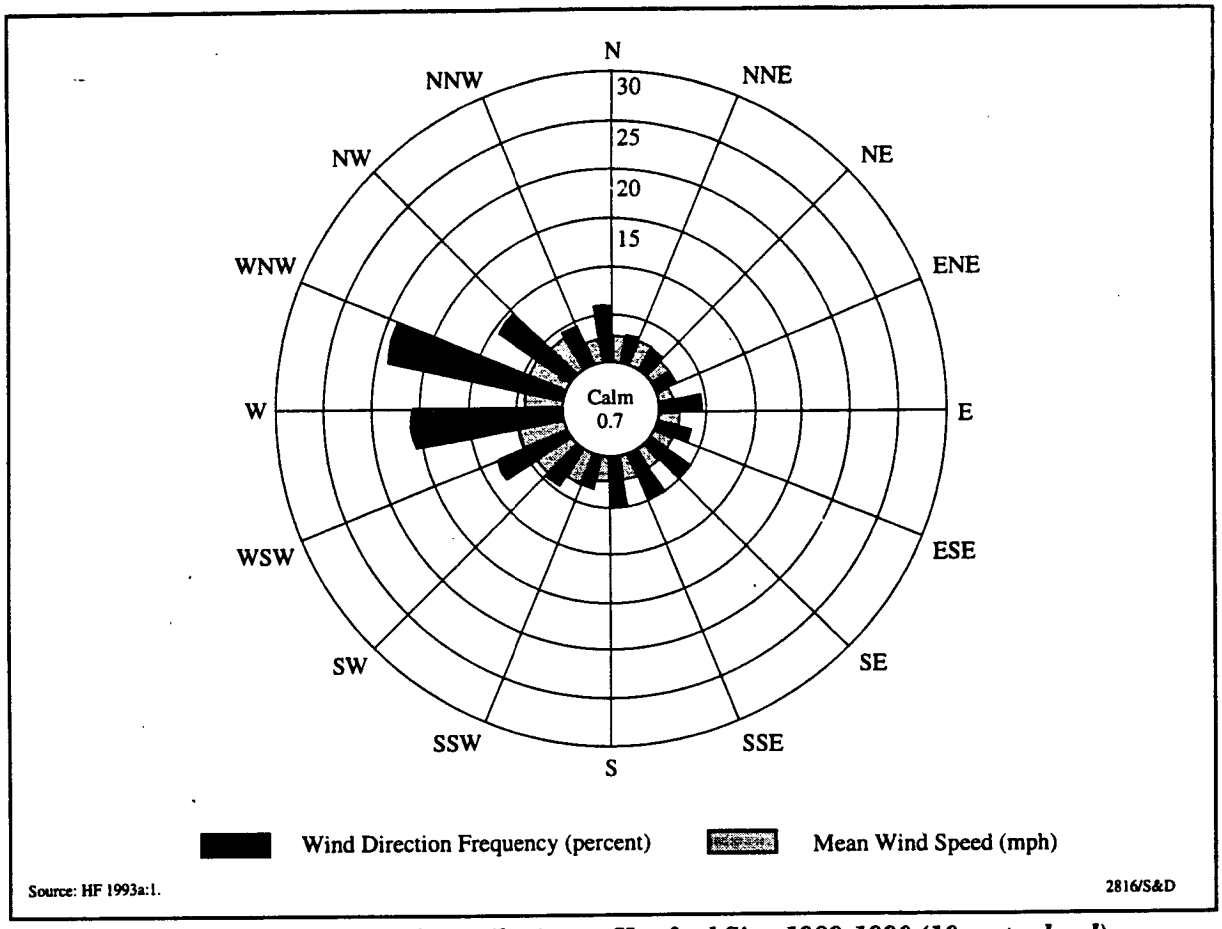


Figure F.1.2.2–1. Wind Distribution at Hanford Site, 1989-1990 (10-meter level).

Only one of these tornadoes was observed within the boundaries of Hanford (on its extreme western edge), and no damage resulted. The estimated probability of a tornado striking a point at Hanford is 9.6×10^{-6}/year (yr) (HF PNL 1994a:4.10). Because tornadoes are infrequent and generally small in the Pacific Northwest (and hurricanes do not reach this area), risks from severe winds are generally associated with thunderstorms or the passage of strong cold fronts. The greatest peak wind gust recorded at 15.2 m (50 ft) above ground level at the Hanford Meteorology Station was 36 m/s (80 mph). Observations indicate a return period of about 200 years for a peak gust in excess of 40 m/s (90 mph) at 15.2 m (50 ft) above ground level (HF PNL 1983a:V-2,V-13, XI-1).

Emission Rates. Table F.1.2.2–1 presents the emission rates for criteria and toxic/hazardous pollutants at Hanford. These emission rates were used as input into the ISCST2 model to estimate No Action pollutant concentrations.

Modeling Assumptions. In order to estimate maximum pollutant concentrations at or beyond the Hanford boundary, criteria pollutant emissions and toxic/hazardous pollutant emissions were modeled from a centrally located stack at a height of 10 m (32.8 ft), with a stack diameter of 0.3 m (1 ft), an exit velocity of 0.03 m/s (0.1 ft/s), and an exit temperature equal to ambient temperature.

Atmospheric Dispersion Characteristics. Data collected at Hanford meteorological monitoring station indicate that unstable conditions occur approximately 25 percent of the time, neutral conditions approximately 31 percent, and stable conditions approximately 44 percent, on an annual basis (HF 1993a:1).

Table F.1.2.2–1. Emission Rates of Criteria and Toxic/Hazardous Pollutants at Hanford Site[a]

Pollutant	Emission Rate (kg/yr)
Criteria Pollutants	
Carbon monoxide	11,660
Nitrogen dioxide	46,660
Particulate matter less than or equal to 10 microns in diameter[b]	4,566
Sulfur dioxide	200
Total suspended particulates[b]	4,566
Volatile organic compounds	927.8
Toxic/Hazardous Pollutants	
Ammonia	2.26

[a] For stationary sources within Hanford Site projected for 2005.

[b] Total suspended particulates emissions are assessed as particulate matter less than or equal to 10 microns in diameter.

Note: yr=year.

Source: HF 1995a:1.

F.1.2.3 Nevada Test Site

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean windspeeds and direction frequencies at NTS.

Climatology and Meteorology. Figure F.1.2.3–1 shows annual mean windspeeds and wind direction frequencies for 1991 measured at the 10-m (32.8-ft) level of the Desert Rock National Weather Service station. The wind rose shows that the maximum wind direction frequency for 1991 is from the northeast with a secondary maximum from the north-northeast. The mean windspeed from the northeast is 4.2 m/s (9.4 mph) and from the north-northeast it is 4.7 m/s (10.5 mph); the maximum mean windspeed is 6.3 m/s (14.1 mph) from the south-southwest.

Historical data indicate that predominating winds are southerly during summer and northerly during winter. The general downward slope in the terrain from north to south results in an intermediate scenario that is reflected in the characteristic diurnal wind reversal from southerly winds during the day to northerly winds at night. This north-to-south reversal is strongest in the summer and, on occasion, becomes intense enough to override the wind regime associated with large-scale pressure systems. Average annual windspeeds and direction vary with location. At higher elevations on Pahute Mesa, the average annual windspeed is 4.7 m/s (10.5 mph). The prevailing wind direction during winter months is north-northeasterly, and during summer months, winds are southerly. In Yucca Flat, the average annual windspeed is 3.1 m/s (7 mph). The prevailing wind direction during winter months is north-northwesterly and during summer months is south-southwesterly. At Mercury, Nevada, the average annual windspeed is 3.6 m/s (8 mph), with northwesterly prevailing winds during the winter months and southwesterly winds during the summer months (NT DOE 1993e:2-17,2-19).

Elevation influences temperatures on NTS. At an elevation of 2,000 m (6,560 ft) above mean sea level (MSL) on Pahute Mesa, the average daily maximum/minimum temperatures are 4.4/-2.2 °C (40/28 °F) in January and 26.7/16.7 °C (80/62 °F) in July. In Yucca Flat, 1,195 m (3,920 ft) above MSL, the average daily maximum/minimum temperatures are 10.6/-6.1 °C (51/21 °F) in January and 35.6/13.9 °C (96/57 °F) in July (NT DOE 1993e:2-17,2-19).

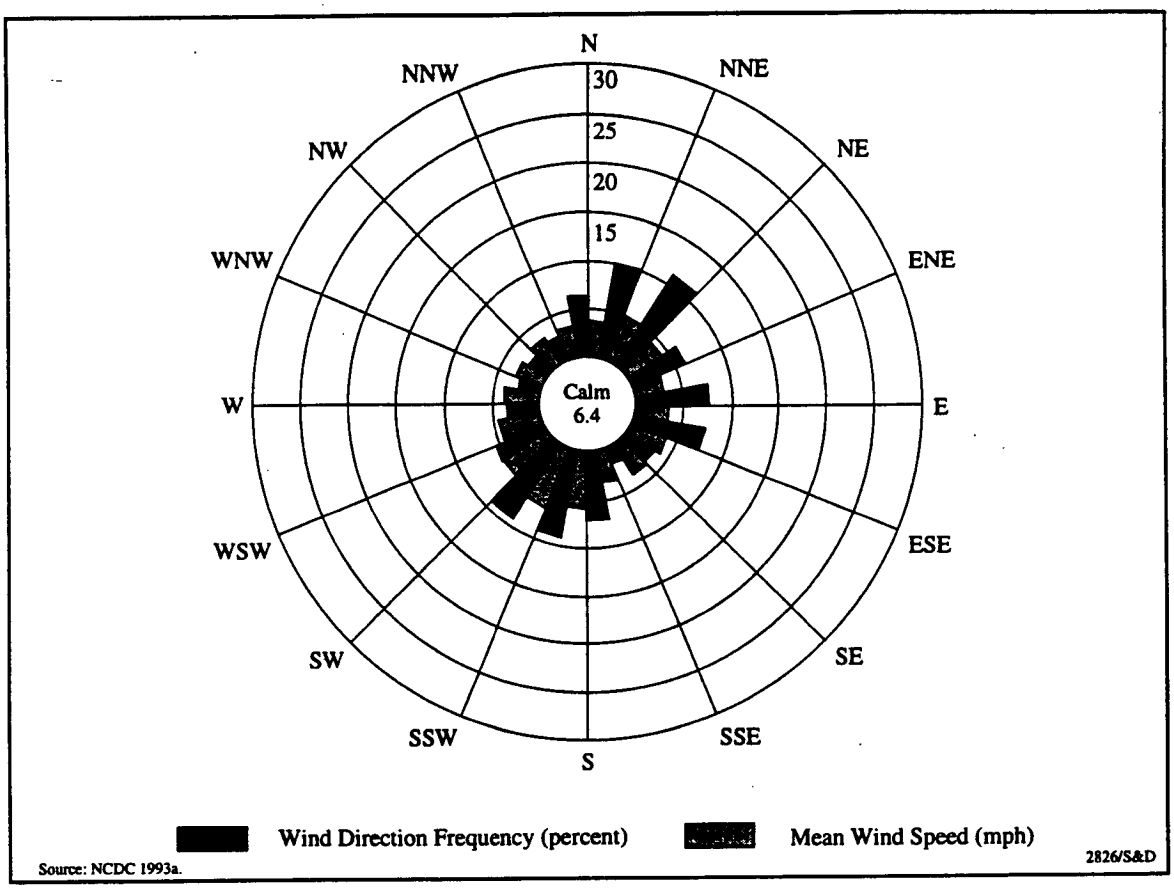


Figure F.1.2.3–1. Wind Distribution at Nevada Test Site, 1991 (10-meter level).

The average annual temperature at NTS is 19.5 °C (67.1 °F); temperatures vary from an average daily minimum of 0.9 °C (33.6 °F) in January to an average daily maximum of 41.1 °C (105.9 °F) in July. The average annual precipitation at NTS is 10.5 cm (4.13 in) (NOAA 1994d:3).

Annual precipitation in southern Nevada is very light and depends largely upon elevation. On NTS, the mesas receive an average annual precipitation of 23 cm (9 in), which includes winter snow accumulations. The lower elevations receive approximately 15 cm (6 in) of precipitation annually, with occasional snow accumulations lasting only a few days (NT DOE 1993e:2-17,2-19).

Precipitation usually falls in isolated showers with large variations in precipitation amounts within a shower area. Summer precipitation occurs mainly in July and August when intense heating of the ground below moist air masses triggers thunderstorm development. On rare occasions, a tropical storm will move northeastward from the coast of Mexico, bringing heavy precipitation during September and October.

Other than temperature extremes, severe weather in the region includes occasional thunderstorms, lightning, tornadoes, and sandstorms. Severe thunderstorms may produce high precipitation with durations of approximately 1 hour and may create a potential for flash flooding (NT DOE 1983a:26). Tornadoes have been observed in the region but are infrequent. The estimated probability of a tornado striking a point at NTS is 3.0×10^{-7}/yr (NRC 1986a:32).

Emission Rates. Table F.1.2.3–1 presents the emission rates for criteria and toxic/hazardous pollutants at NTS. These emission rates were used as input into the ISCST2 model to estimate pollutant concentrations.

Table F.1.2.3–1. Emission Rates of Criteria and Toxic/Hazardous Pollutants at Nevada Test Site[a]

Pollutant	Emission Rate (kg/yr)
Criteria Pollutants	
Carbon monoxide	[b]
Nitrogen dioxide	[b]
Particulate matter less than or equal to 10 microns in diameter[c]	86,820
Sulfur dioxide	71,125
Total suspended particulates[c]	86,820
Toxic/Hazardous Pollutants (no toxic sources indicated)	

[a] Based on permitted sources (1990-1992).

[b] No pollutant sources indicated.

[c] It is assumed that PM_{10} emissions are TSP emissions.

Note: yr=year.

Source: NV DCNR 1992a.

Modeling Assumptions. In order to estimate maximum pollutant concentrations at or beyond the NTS boundary for No Action, criteria pollutant emissions were modeled from actual stack locations using operating permit data on stack height, stack diameter, exit velocity, and exit temperature (NV DCNR 1992a).

Atmospheric Dispersion Characteristics. Data collected at the NTS meteorological monitoring station for 1991 indicate that unstable conditions occur approximately 26 percent of the time, neutral conditions approximately 37 percent, and stable conditions approximately 37 percent, on an annual basis.

F.1.2.4 Idaho National Engineering Laboratory

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean windspeeds and direction frequencies at INEL.

Climatology and Meteorology. Figure F.1.2.4–1 shows annual mean windspeeds and wind direction frequencies for 1992 measured at the 10-m (32.8-ft) level of the INEL meteorological tower. The wind rose shows that the maximum wind direction frequency is from the southwest with a secondary maximum from the north-northeast. The mean windspeed from the southwest is 5.2 m/s (11.6 mph) and from the north-northeast it is 2.8 m/s (6.3 mph); the maximum mean windspeed is 5.5 m/s (12.3 mph) from the west-southwest.

The historical wind data from the site indicate that prevailing wind directions are from the southwest to west-southwest with a secondary maximum from the north-northeast to northeast. The annual average windspeed is 3.4 m/s (7.5 mph) (IN DOE 1989b:28,30,55,77).

The average annual temperature at INEL is 5.6 °C (42.0 °F); average monthly temperatures vary from a minimum of -8.8 °C (16.1 °F) in January to a maximum of 20 °C (68 °F) in July. The average annual precipitation at INEL is 22.1 cm (8.71 in) (IN DOE 1989b:28,30,55,77).

The maximum instantaneous wind gust recorded at the Central Facilities Area Weather Station (6.1-m [20-ft] level) was 34.9 m/s (78 mph) from the west-southwest, and the maximum hourly average windspeed, also from the west-southwest, was 22.8 m/s (51 mph) (IN DOE 1989b:28,30,55,77).

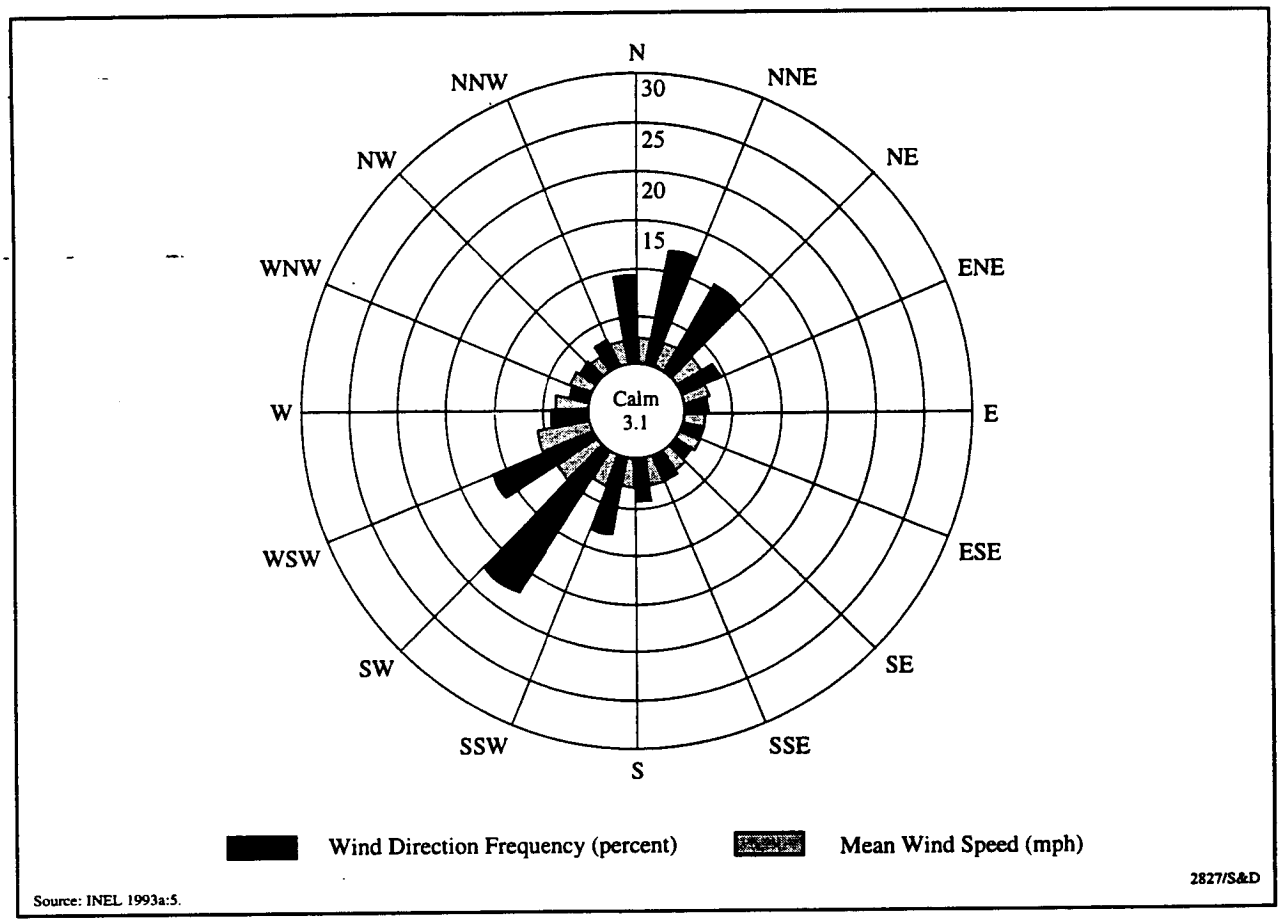


Figure F.1.2.4–1. Wind Distribution at Idaho National Engineering Laboratory, 1992 (10-meter level).

Other than thunderstorms, severe weather is uncommon. The months of June, July, and August each average two to three thunderstorm days. Hail storms occur occasionally, with the hail usually smaller than 0.64-cm (0.25-in) diameter. Tornadoes are very infrequent in the area. Between 1950 and 1989, a total of five funnel clouds and no tornadoes were sighted within the boundary of INEL (IN DOE 1989b:100-102). The estimated probability of a tornado striking a point at INEL is 6.0×10^{-7} per year (NRC 1986a:32).

Emission Rates. Table F.1.2.4–1 presents the emission rates for criteria and toxic/hazardous pollutants at INEL. These emission rates were used as input into the ISCST2 model to estimate pollutant concentrations. INEL exceeds the applicable 227,000 kilograms (kg)/yr (250 short tons (tons)/yr) emissions criterion for carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter less than or equal to 10 microns in diameter (PM_{10}), and is therefore classified as an existing major source for these pollutants. The classification of INEL as a major source may require further prevention of significant deterioration review than sites not classified as a major source.

Modeling Assumptions. In order to estimate maximum pollutant concentrations at or beyond the INEL site boundary, criteria pollutant emissions were modeled from actual stack locations using operating permit data on stack height, stack diameter, exit velocity, and exit temperature (INEL 1995a:1). Toxic/hazardous pollutant emissions were modeled from a centrally located stack at a height of 10 m (32.8 ft), with a stack diameter of 0.3 m (1 ft), an exit velocity of 0.03 m/s (0.1 ft/s), and an exit temperature equal to ambient temperature.

Table F.1.2.4–1. Emission Rates of Criteria and Toxic/Hazardous Pollutants at Idaho National Engineering Laboratory[a]

Pollutant	Emission Rate (kg/yr)
Criteria Pollutants	
CO	2,200,000
Lead	68
NO_2	3,000,000
PM_{10}[b]	900,000
SO_2	1,700,000
Total suspended particulates[b]	900,000
[Text deleted]	
Toxic/Hazardous Pollutants[c]	
1,3-Butadiene	390
[Text deleted]	
Acetaldehyde	180
Ammonia	6,500
Arsenic	24
Benzene	530
Carbon tetrachloride	28
[Text deleted.]	
Chromium-hexavalent	26
Cyclopentane	350
[Text deleted.]	
Formaldehyde	3,300
Hydrazine	8.3
[Text deleted]	
Hydrogen chloride	1,500
[Text deleted]	
Mercury	200
Methylene chloride	1,100
Naphthalene	16
Nickel	1,000
Nitric acid	97,000
Perchloroethylene	980
Phosphorous	210
Potassium hydroxide	2,100
Propionaldehyde	110
Styrene	4.7
Toluene	580
Trichloroethylene	4.5
Trimethylbenzene	87
Trivalent chromium	38

[a] Emissions from historical data (1990) are assumed for No Action (2005).

[b] It is assumed that PM_{10} emissions are TSP emissions.

[c] Hazardous/toxic air pollutants that are listed in State of Idaho regulations and are emitted in quantities that exceed screening criteria.

Source: DOE 1995v; INEL 1995a:1.

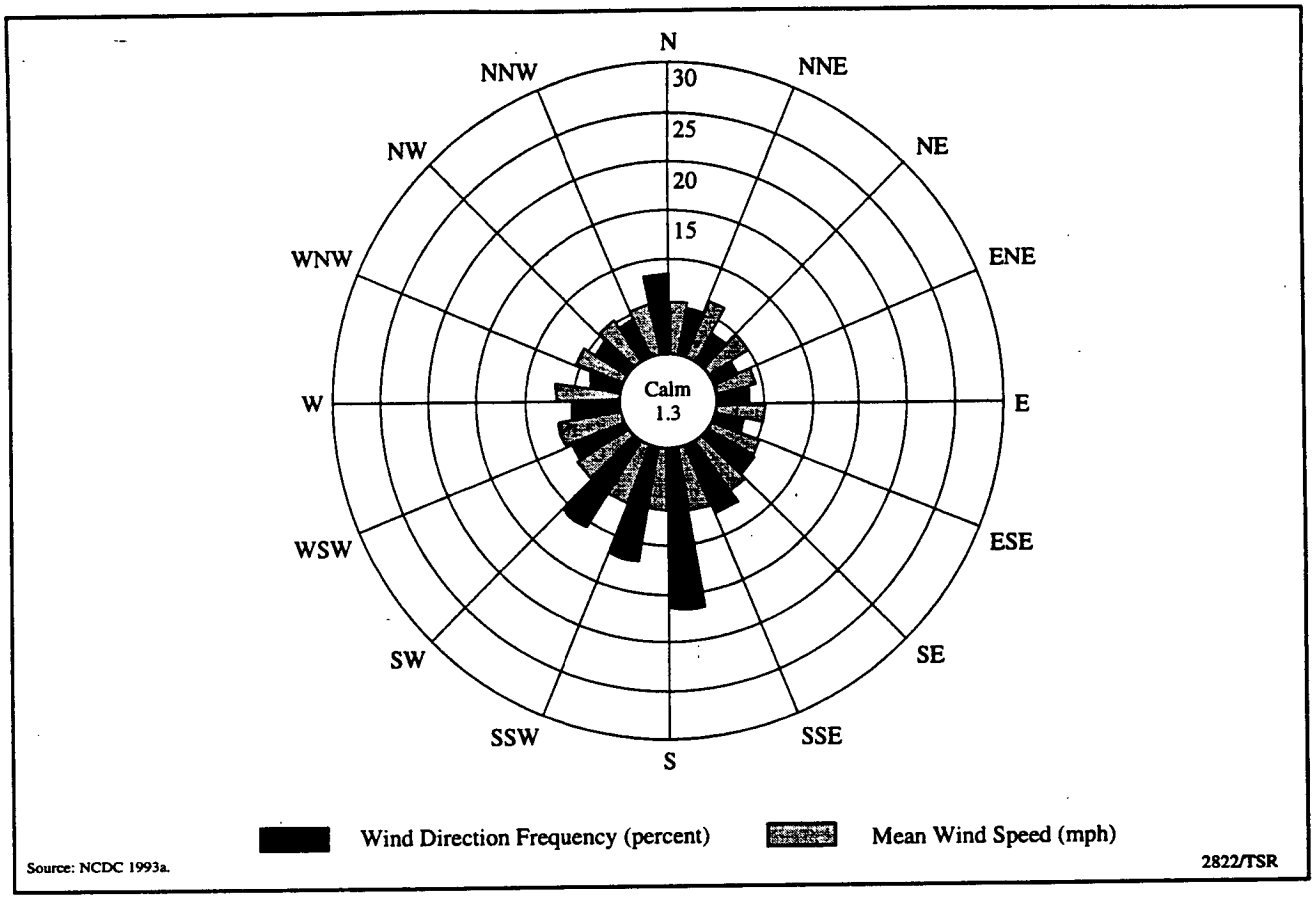


Figure F.1.2.5–1. Wind Distribution at Amarillo, 1991 (10-meter level).

Atmospheric Dispersion Characteristics. Data collected at INEL meteorological monitoring stations for 1992 indicate that unstable conditions occur approximately 22 percent of the time, neutral conditions approximately 26 percent, and stable conditions approximately 52 percent, on an annual basis.

F.1.2.5 Pantex Plant

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean windspeeds and direction frequencies at Pantex.

Climatology and Meteorology. Figure F.1.2.5–1 shows annual mean windspeeds and wind direction frequencies for 1991 measured at the 10-m (32.8-ft) level of the Amarillo National Weather Service station. The wind rose shows that the maximum wind direction frequency is from the south with a secondary maximum from the south-southwest. The mean windspeed from the south is 6.3 m/s (14.1 mph) and from the south-southwest it is 6.3 m/s (14.1 mph); the maximum mean windspeed is 6.6 m/s (14.8 mph) from the west.

Historical data indicate that prevailing wind directions are from the south to southwest. The annual average windspeed is 6.0 m/s (13.5 mph) (NOAA 1994c:3).

The average annual temperature at Pantex is 13.8 °C (56.9 °F); temperatures vary from an average daily minimum of -5.7 °C (21.8 °F) in January to an average daily maximum of 32.8 °C (91.1 °F) in July (NOAA 1994c:3).

The average annual precipitation at Pantex is 49.7 cm (19.6 in). Most of the annual precipitation falls between April and October and usually occurs from thunderstorm activity and the intrusion of warm, moist tropical air from the Gulf of Mexico. Snowfall has occurred in the area from October to April and averages nearly 42.9 cm (16.9 in) annually. The maximum 24-hour rainfall with a 100-year recurrence interval is approximately 16.5 cm (6.5 in). On average, the area can expect thunderstorms about 50 days/yr, hail 4 days/yr, and freezing rain 8 days/yr. During the 30-year period between 1954 and 1983, a total of 108 tornadoes were reported within a 1-degree latitude and longitude square area that includes Pantex. On average, fewer than four tornadoes occur in an area of 10,096 square kilometers (km^2) (3,898 square miles [mi^2]) surrounding Pantex per year. The estimated probability of a tornado striking a point at Pantex is 2.3×10^{-4}/yr (NRC 1986a:32).

Emission Rates. Table F.1.2.5–1 presents the emission rates for criteria and toxic/hazardous pollutants at Pantex.

Table F.1.2.5–1. Emission Rates of Criteria and Toxic/Hazardous Pollutants at Pantex Plant

Pollutant	Emission Rate (kg/yr)
Criteria Pollutants	
CO	22,493
NO_2	54,056
Lead	185
PM_{10}	8,439
SO_2	0.1
Total suspended particulates	[a]
Hydrogen fluoride	1,176
Toxic/Hazardous Pollutants	
1,1,1-Chloroethane	22.74
[Text deleted]	
1,1,2-Trichloroethane	3.78
2-Nitropropane	1.71
[Text deleted]	
Alcohols	1,184
[Text deleted]	
Benzene	91.38
Carbon disulfide	27.05
Carbon tetrachloride	15.59
Chlorobenzene	1.79
Chromium	2.14
Cresol	0.05
Cresylic acid	0.05
[Text deleted]	
Dibenzofuran	0.07
[Text deleted]	
Ester glycol ethers	0.86
Ethyl benzene	1.51
Ethylene dichloride	1.33
Formaldehyde	57.89
Hydrogen chloride	1,106.11

Table F.1.2.5–1. Emission Rates of Criteria and Toxic/Hazardous Pollutants at Pantex Plant—Continued

Pollutant	Emission Rate (kg/yr)
Toxic/Hazardous Pollutants (continued)	
[Text deleted]	
Ketones	0.28
Mercury	0
Methanol	1,095.57
Methyl ethyl ketone	7,067.62
Methyl isobutyl ketone	0.62
Methylene chloride	182.07
Naphthalene	0.41
Nickel	0.16
Nitrobenzene	0.05
Phenol	2.23
[Text deleted]	
Tetrachloroethylene	6.44
Toluene	465.29
Trichloroethene	1.56
Trichloroethylene	19.50
Triethylamine	0
Xylene	222.15

[Text deleted.]

[a] Not available.
Source: PX DOE 1996b.

Modeling Assumptions. Baseline and No Action concentrations were based on actual source locations and stack parameters. In order to estimate maximum pollutant concentrations for alternatives at or beyond the Pantex boundary, criteria pollutant emissions and toxic/hazardous pollutant emissions were modeled from a centrally located stack in the Pantex complex at a height of 10 m (32.8 ft), with a stack diameter of 0.3 m (1.0 ft), an exit velocity of 0.03 m/s (0.1 ft/s), and an exit temperature equal to ambient temperature.

Atmospheric Dispersion Characteristics. Data collected at the Amarillo meteorological monitoring station for 1991 indicate that unstable conditions occur approximately 14 percent of the time, neutral conditions approximately 64 percent, and stable conditions approximately 22 percent, on an annual basis.

F.1.2.6 Oak Ridge Reservation

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean windspeeds and direction frequencies at ORR.

Meteorology and Climatology. The wind direction above the ridge tops and within the valley at ORR tends to follow the orientation of the valley. On an annual basis, the prevailing winds at the National Weather Service (NWS) station in the city of Oak Ridge are either up-valley, from west to southwest, or down-valley, from east to northeast. Figure F.1.2.6–1 shows mean windspeeds and direction frequencies for 1990 measured at the 30-m (100-ft) level of the ORR meteorology tower. The wind rose shows that the maximum wind direction frequency is from the east-northeast with a secondary maximum from the northeast. The mean windspeed from the east-northeast is 1.7 m/s (3.8 mph) and from the northeast it is 2.3 m/s (5.1 mph); the maximum mean windspeed is 3.3 m/s (7.4 mph) from the southwest.

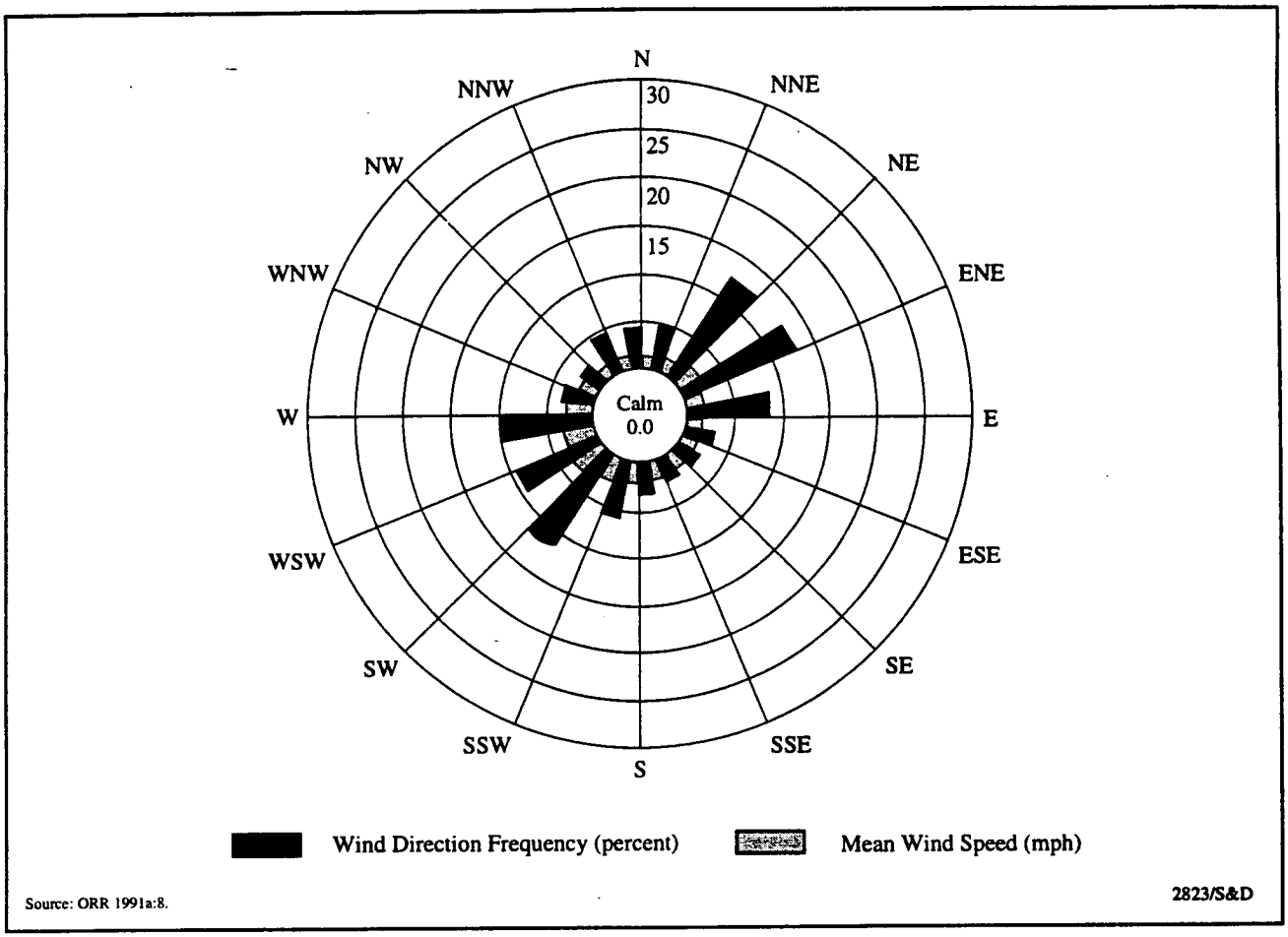


Figure F.1.2.6–1. Wind Distribution at Oak Ridge Reservation, 1990 (30-meter level).

The historical data indicate that prevailing wind directions are from the southwest and northeast quadrants. Mean annual windspeeds measured in the region are relatively low, averaging 2.0 m/s (4.4 mph) at the Oak Ridge NWS station at the 14-m (46-ft) level and 2.1 m/s (4.7 mph) at the 10-m (32.8-ft) level at the ORR Bethel Valley monitoring station (ORNL 1982a:2-95 – 2-113).

The average annual temperature at ORR is 13.7 °C (56.6 °F); temperatures vary from an average daily minimum of -3.8 °C (25.1 °F) in January to an average daily maximum of 30.4 °C (86.7 °F) in July. Relative humidity readings taken four times per day range from 51 percent in April to 92 percent in August and September (NOAA 1994c:3).

The average annual precipitation measured at ORR in Bethel Valley is 130.8 cm (51.5 in), while the average annual precipitation for the Oak Ridge NWS station is 136.6 cm (53.8 in). The maximum monthly precipitation recorded at the Oak Ridge NWS station was 48.95 cm (19.27 in) in July 1967, while the maximum rainfall in a 24-hour period was 19.0 cm (7.48 in) in August 1960. The average annual snowfall as measured at the Oak Ridge NWS station is 24.9 cm (9.8 in).

Damaging winds are uncommon in the region. Peak gusts recorded in the area range from 26.8 m/s (60 mph) to 30.8 m/s (69 mph) for the months of January through July; from 21.9 to 26.8 m/s (49 to 60 mph) for August, September, and December; and 16.1 to 20.1 m/s (36 to 45 mph) in October and November (ORNL 1982a:2-72). The fastest mile windspeed (the 1 mi [1.6 km] passage of wind with the highest speed for the day) recorded at the Oak Ridge NWS station for the period of 1958 through 1979 was 26.4 m/s (59 mph) in January 1959 (NOAA 1994c:3)

The extreme mile windspeed at a height of 9.1 m (30 ft) that is predicted to occur near ORR once in 100 years is approximately 39.8 m/s (89 mph). The approximate values for occurrence intervals of 10, 25, and 50 years are 28.6, 33.1, and 34.0 m/s (64, 74, and 76 mph), respectively (ORNL 1981a:3.3-7).

Between 1916 and 1972, 25 tornadoes were reported in the counties of Tennessee having borders within about 64 km (40 mi) of ORR (ORNL 1981a:3.3-7). The probability of a tornado striking a particular point in the vicinity of ORR is estimated to be 3.6×10^{-4} per year (ORNL 1982a:2-125).

On February 21, 1993, a tornado passed through the northeastern edge of ORR and caused considerable damage to a large number of structures in the nearby Union Valley Industrial Park. Damage to ORR from this tornado was relatively light. The windspeeds associated with this tornado ranged from 17.9 m/s (40 mph) to nearly 58 m/s (130 mph) (OR DOE 1993c:iii).

Emission Rates. Table F.1.2.6–1 presents the emission rates for criteria and toxic/hazardous pollutants at ORR. The emission rates were used as input into the ISCST2 model to estimate pollutant concentrations. ORR exceeds the applicable 227,000 kg/yr (250 tons/yr) emissions criterion for NO_2 and SO_2 and is therefore classified as an existing major source for these pollutants. The classification of ORR as a major source may require further prevention of significant deterioration review than sites not classified as a major source.

Table F.1.2.6–1. Emission Rates of Criteria and Toxic/Hazardous Pollutants at Oak Ridge Reservation[a]

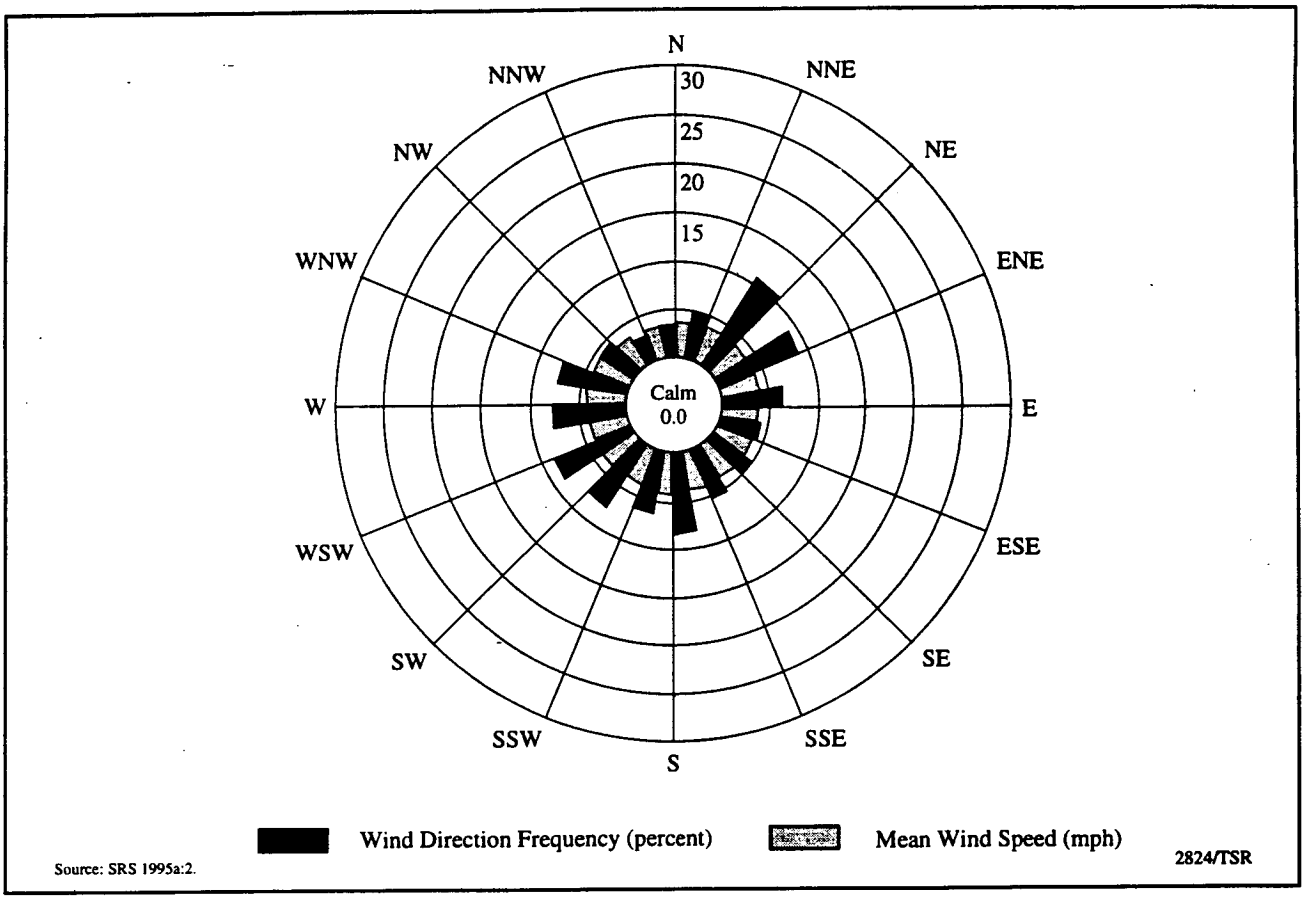
Pollutant	Emission Rate (kg/yr)
Criteria Pollutants	
CO	95,000
NO_2	870,000
PM_{10}	8,300
SO_2	972,000
Total suspended particulates	1,125,000
Toxic/Hazardous Pollutants	
1,1,1-Trichloroethane	220
Acetic acid	1
Chlorine	1,750
Hydrogen chloride	6,420
Hydrogen fluoride	70
Hydrogen sulfide	[b]
Methyl alcohol	26,400
Nitric acid	9,500
Sulfuric acid	2,500

[a] Emissions from historical data (1992) are assumed for No Action (2005).

[b] No sources of this pollutant have been identified.

Source: OR LMES 1996i.

Modeling Assumptions. In order to estimate maximum pollutant alternatives for concentrations at or beyond the ORR site boundary, criteria pollutant emissions and toxic/hazardous pollutant emissions were modeled from a centrally located stack in the Y–12 complex at a height of 10 m (32.8 ft), with a stack diameter of 0.3 m (1 ft), exit velocity of 0.03 m/s (0.1 ft/s), and exit temperature equal to ambient temperature.



Source: SRS 1995a:2.

Figure F.1.2.7–1. Wind Distribution at Savannah River Site, 1991 (61-meter level).

Atmospheric Dispersion Characteristics. Data collected at the ORR meteorological monitoring station (Y–12 Plant east tower) for calendar year 1990 indicate that unstable conditions occur approximately 23 percent of the time, neutral conditions approximately 31 percent, and stable conditions approximately 46 percent, on an annual basis.

F.1.2.7 Savannah River Site

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean windspeeds and direction frequencies at SRS.

Climatology and Meteorology. Figure F.1.2.7–1 shows annual mean windspeeds and wind direction frequencies for 1991 measured at the 61-m (200-ft) level of the SRS H-Area Weather Station. The wind rose shows that the maximum wind direction frequency is from the northeast with a secondary maximum from the east-northeast. The mean windspeed from the northeast is 3.8 m/s (8.5 mph) and from the east-northeast it is 3.8 m/s (8.5 mph); the maximum mean windspeed is 4.1 m/s (9.2 mph) from the west-northwest.

The historical wind data from the site indicate that there is no predominant wind direction at SRS. The highest directional frequency is from the northeast. The average annual windspeed is 3.75 m/s (8.4 mph).

The average annual temperature at SRS is 17.3 °C (63.2 °F); temperatures vary from an average daily minimum of 0 °C (32 °F) in January to an average daily maximum of 33.2 °C (91.7 °F) in July. Relative humidity readings taken four times per day range from 45 percent in April to 92 percent in August and September.

The average annual precipitation at SRS is 113.4 cm (44.7 in). Precipitation is distributed fairly evenly throughout the year, with the highest precipitation in summer, 32.7 cm (12.87 in), and the lowest in autumn, 21.2 cm (8.34 in). Although snow can fall from November through April, the average annual snowfall is only 2.8 cm (1.1 in); large snowfalls are rare.

Winter storms in the SRS area occasionally bring strong, gusty surface winds with speeds as high as 22.8 m/s (51 mph). Thunderstorms can generate winds with speeds as high as 21.5 m/s (48.1 mph) and even stronger gusts. The fastest 1-minute windspeed recorded at Augusta between 1952 and 1993 was 27.7 m/s (62 mph) (NOAA 1994c:3).

The average number of thunderstorm days per year at SRS is 56. From 1954 to 1983, 37 tornadoes were reported in a 1-degree square of latitude and longitude that includes SRS. This frequency of occurrence amounts to an average of about one tornado per year. The estimated probability of a tornado striking a point at SRS is 7.1×10^{-5} per year (NRC 1986a:32). Since operations began at SRS in 1953, nine tornadoes have been confirmed on or near SRS. Nothing more than light damage was reported in any of these storms, with the exception of a tornado near SRS. Nothing more than light damage was reported in any of these storms, with the exception of a tornado in October 1989. That tornado caused considerable damage to timber resources in an undeveloped wooded area of SRS (WSRC 1990b:1).

From 1899 to 1980, 13 hurricanes occurred in Georgia and South Carolina, for an average frequency of about 1 hurricane every 6 years. Three hurricanes were classified as major. Because SRS is about 160 km (99.4 mi) inland, the winds associated with hurricanes have usually diminished below hurricane force (below a sustained speed of 33.5 m/s [75.0 mph]) before reaching the site (DOE 1992e:4-115).

Emissions Rates. Table F.1.2.7–1 presents the emission rates for criteria and toxic/hazardous pollutants at SRS. SRS exceeds the applicable 227,000 kg/yr (250 tons/yr) emissions criterion for CO, NO_2, SO_2 and PM_{10} and is therefore classified as an existing major source for these pollutants. The classification of SRS as a major source may require further prevention of significant deterioration review than sites not classified as a major source.

Modeling Assumptions. Emission rates for baseline and No Action for criteria and toxic/hazardous pollutants were based upon the latest sitewide emissions inventory data for the year 1990. Baseline and No Action concentrations were based on actual source locations and stack parameters. In order to estimate maximum criteria and toxic/hazardous pollutant concentrations at or beyond the SRS site boundary for the various storage and disposition alternatives, criteria pollutant emissions and toxic/hazardous pollutant emissions were modeled from a centrally located stack at a height of 10 m (32.8 ft), with a stack diameter of 0.3 m (1 ft), exit velocity of 0.03 m/s (0.1 ft/s), and exit temperature equal to ambient temperature.

Atmospheric Dispersion Characteristics. Data collected at SRS meteorological monitoring station for 1991 indicate that unstable conditions occur approximately 38 percent of the time, neutral conditions approximately 43 percent, and stable conditions approximately 19 percent, on an annual basis (SRS 1995a:2).

F.1.2.8 Rocky Flats Environmental Technology Site

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean windspeeds and direction frequencies at RFETS.

Climatology and Meteorology. Figure F.1.2.8–1 shows annual mean windspeeds and wind direction frequencies for 1990 measured at the 61.0-m (200-ft) level of the 61-m (200-ft) tower in the west buffer zone. The wind rose shows that the maximum wind direction frequency is west-northwest with a secondary maximum from the west. The mean windspeed from the west-northwest is 6.3 m/s (14.1 mph); the maximum mean windspeed is 5.7 m/s (12.8 mph) from the west.

Table F.1.2.7–1. Emission Rates of Criteria and Toxic/Hazardous Pollutants at Savannah River Site[a]

Pollutant	Emission Rate (kg/yr)	
Criteria Pollutants		
CO	404,449	
NO_2	4,278,380	
PM_{10}	1,963,180	
SO	9,454,199	
Total suspended particulates	4,430,890	
Hydrogen fluoride	16,690	
Toxic/Hazardous Pollutants	**Point & Volume Source (kg/yr)**	**Area Source[b] (kg/yr/m²)**
3,3-Dichlorobenzidine	211.0	[c]
Acrolein	[c]	1.94×10^{-3}
Benzene	129,772.3	0.21
Bis (chloromethyl) ether	211.0	[c]
Cadmium oxide	243.0	[c]
Chlorine	21,146.7	10.11
Chloroform	1,035,006	13.6
Cobalt	5,970.2	4.58×10^{-4}
Formic acid	46,949.5	[c]
Manganese	27,882.1	2.61
Mercury	917.5	1.15×10^{-3}
Nickel	23,022.5	6.02
Nitric acid	1,150,525.8	[c]
Parathion	[d]	[d]
Phosphoric acid	14,859.8	[c]

[a] Emissions from historical data (1990) are assumed for No Action (2005).
[b] Some toxic/hazardous pollutant sources were modeled as area sources, the remainder were modeled as point or volume sources.
[c] No sources of this pollutant have been identified.
[d] Data not available.
Source: SRS 1995a:10; WSRC 1993c.

The historical data indicate that the predominant wind direction is from the west-northwest. The average annual windspeed is 3.8 m/s (8.6 mph) (NOAA 1994a:3).

The average annual temperature at RFETS is 10.2 °C (50.3 °F); temperatures vary from an average daily minimum of -8.8 °C (16.1 °F) in January to an average daily maximum of 31.2 °C (88.2 °F) in July. The average annual precipitation at RFETS is 39.1 cm (15.4 in) (NOAA 1994a:3).

Winter storms in the RFETS area can generate winds with speeds as high as 21.5 m/s (48 mph) and even stronger gusts. The fastest 1-minute windspeed recorded in Denver, Colorado, was 20.6 m/s (46 mph) (NOAA 1994a:3).

The average number of thunderstorm days per year at RFETS is 42. From 1954 to 1983, 13 tornadoes were reported for a 1-degree square of latitude and longitude that includes RFETS. This frequency of occurrence amounts to an average of less than one tornado per year. The estimated probability of a tornado striking a point at RFETS is 2.0×10^{-5} per year (NRC 1986a:32).

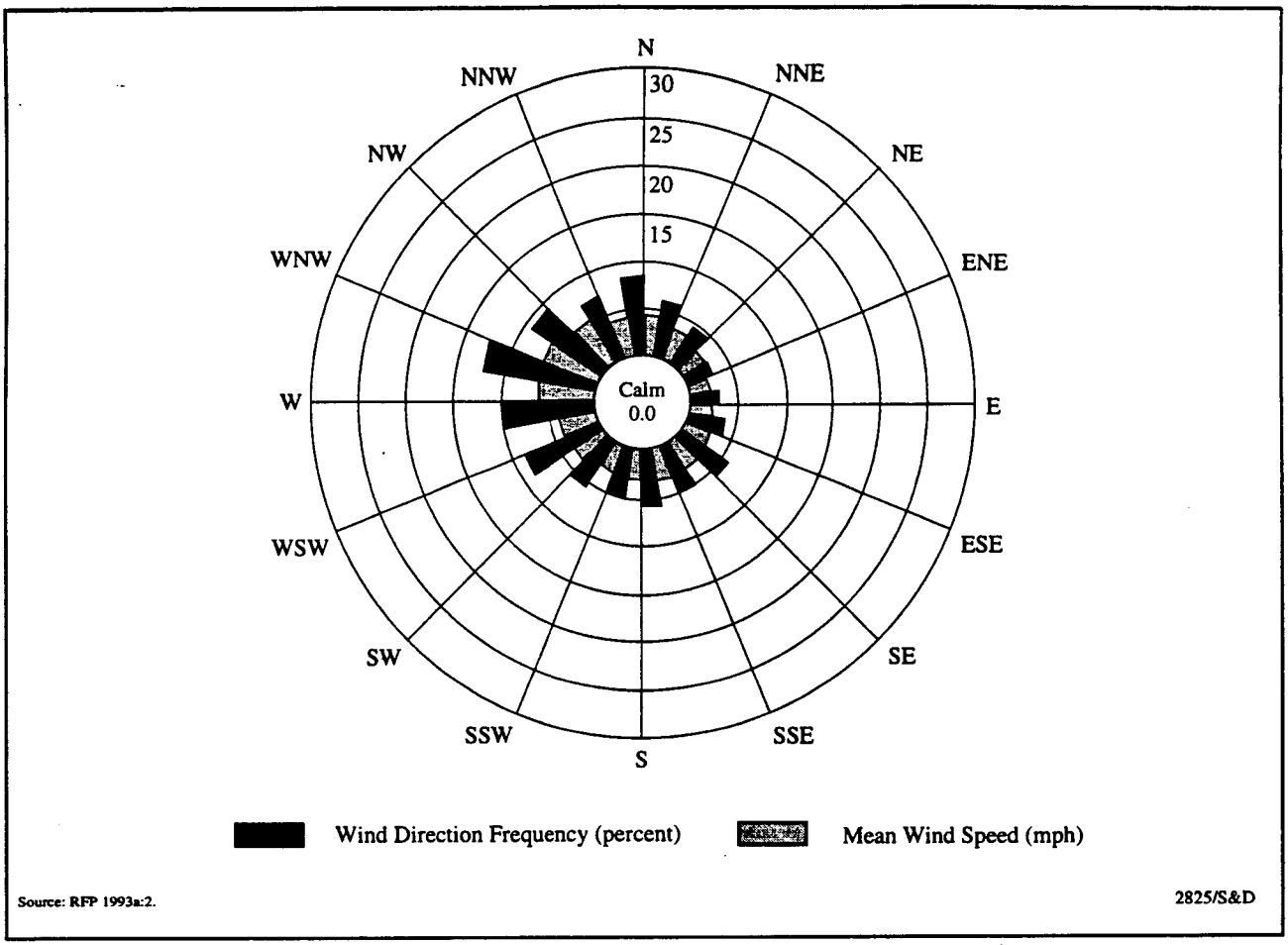


Figure F.1.2.8–1. Wind Distribution at Rocky Flats Environmental Technology Site, 1990 (61-meter level).

Emission Rates. Table F.1.2.8–1 presents the emission rates for criteria and toxic/hazardous pollutants at RFETS. These emission rates were used as input into the ISCST2 model to estimate pollutant concentrations.

Modeling Assumptions. In order to estimate maximum pollutant concentrations at or beyond the RFETS site boundary, criteria pollutant emissions and toxic/hazardous pollutant emissions were modeled from a centrally located stack in RFETS at a height of 10 m (32.8 ft), with a stack diameter of 0.3 m (1 ft), an exit velocity of 0.03 m/s (0.1 ft/s), and an exit temperature equal to ambient temperature.

Atmospheric Dispersion Characteristics. Data collected at RFETS meteorological monitoring station for 1990 indicate that unstable conditions occur approximately 59 percent of the time, neutral conditions approximately 26 percent, and stable conditions approximately 15 percent, on an annual basis.

F.1.2.9 Los Alamos National Laboratory

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean windspeed and direction frequencies at LANL.

Climatology and Meteorology. Figure F.1.2.9–1 shows annual mean windspeed and wind direction frequencies for 1991 measured at the 11.5-m (37-ft) level of the Technical Area (TA)-6 meteorological tower. The wind

Table F.1.2.8–1. Emission Rates of Criteria and Toxic/Hazardous Pollutants at Rocky Flats Environmental Technology Site[a]

Pollutant	Emission Rate (kg/yr)
Criteria Pollutants	
CO	39,200
NO_2	183,000
PM_{10}	10,400
SO_2	13,100
State Mandated Pollutants	
Hydrogen sulfide	0.467
Total suspended particulates	12,600
Toxic/Hazardous Pollutants[b]	
1,1,2-Trichloro-1,2,2-trifluoroethane	109
Carbon tetrachloride	53.5
Methylene chloride	53.3
Trichloroethane	136

[a] Emissions from historical data (permits 1991-1994) are assumed for No Action (2005).

[b] Only those emitted at rates greater than 45 kg/yr are listed.

Source: RFETS 1995a:1.

rose shows that the maximum wind direction frequency is from the west-northwest with a secondary maximum from the west. The mean windspeed from the west-northwest is 3.2 m/s (7.2 mph), which is also the maximum mean windspeed. The mean windspeed is 3 m/s (6.7 mph) from the west.

The historical wind data from the site indicate that the prevailing wind directions are from the south through northwest. The average annual windspeed measured is 2.8 m/s (6.3 mph) (LANL 1995s:II-11).

The average annual temperature at LANL is 8.8 °C (47.8 °F). In July, the average daily high temperature is 27.2 °C (81 °F), and the average nighttime low temperature is 12.8 °C (55 °F). The highest recorded temperature is 35 °C (95 °F). The average daily January high is 4.4 °C (40 °F), and the average nighttime low is -8.3 °C (17 °F). The lowest recorded temperature is -27.8 °C (-18 °F). Monthly average values of the dew point temperature range from -9.4 °C (15.0 °F) in January to 8.9 °C (48 °F) in August, when moist subtropical air invades the region. Fog is rare in Los Alamos, occurring on fewer than 5 days per year (LANL 1995s:II-8,II-11).

The average annual precipitation at LANL is 47.6 cm (18.7 in). Most of the annual precipitation falls during the months of July and August and usually occurs from convective storms. Snowfall averages nearly 150 cm (59 in). The maximum 24-hour rainfall is approximately 8.8 cm (3.5 in) (LANL 1994a:II-11).

The average number of thunderstorm days per year is 58, with most occurring during the summer. The estimated probability of a tornado striking a point at LANL is 2×10^{-5} per year (NRC 1986a:32). Historically, no tornadoes have been reported to have touched down in Los Alamos County (LANL 1993b:II-9).

Emission Rates. Table F.1.2.9–1 presents the emission rates for criteria and toxic/hazardous pollutants at LANL. These emission rates were used as input into the ISCST2 model, to estimate pollutant concentrations.

Modeling Assumptions. Additional model input used to estimate maximum pollutant concentrations at or beyond the LANL site boundary include the following: criteria pollutant emissions were modeled from actual

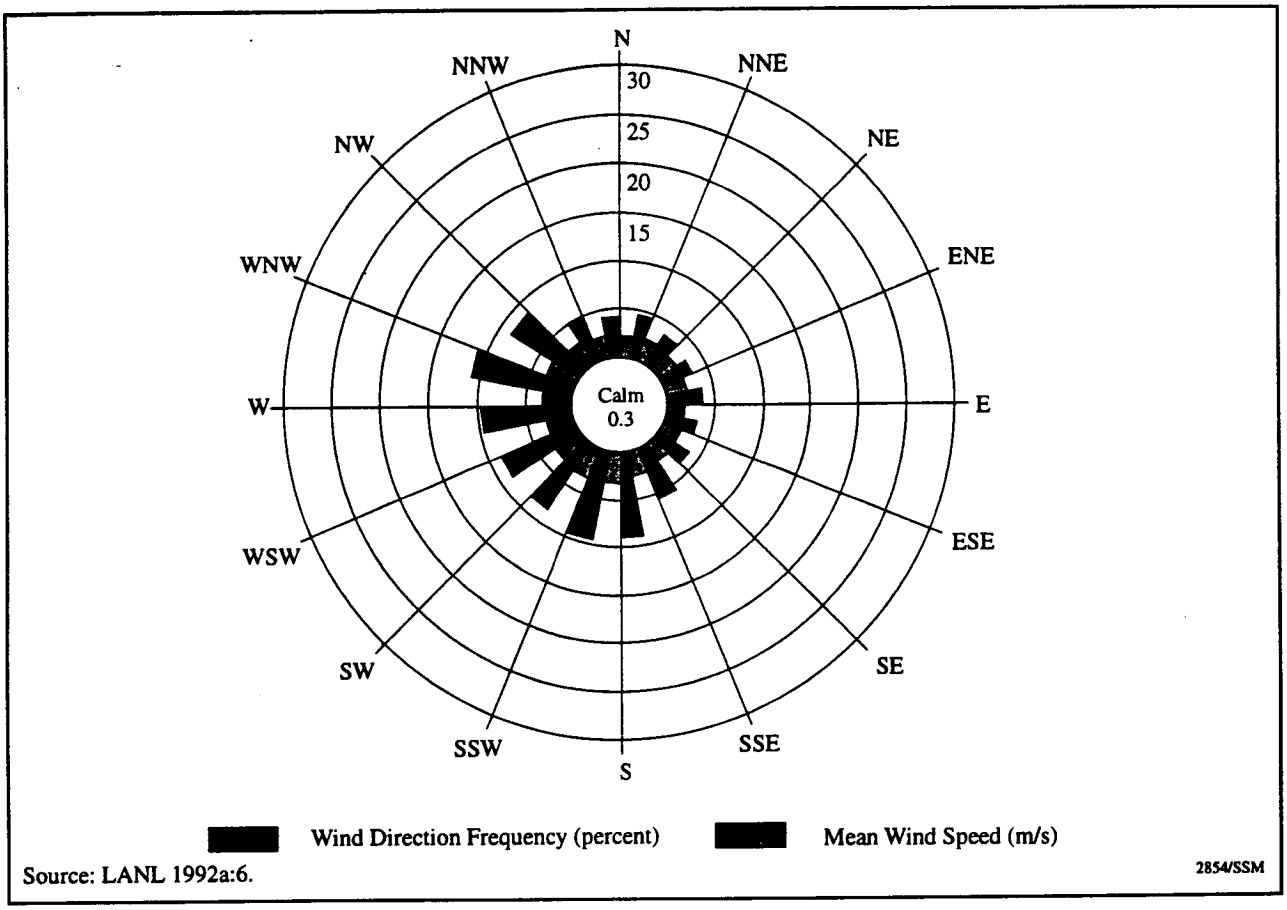


Figure F.1.2.9–1. Wind Distribution at Los Alamos National Laboratory, 1991 (11.5-meter level).

stack locations using actual stack heights, stack diameter, exit velocity, and exit temperature, taken from operating permits; toxic/hazardous pollutant emissions were modeled from a centrally located stack in the LANL facility at a height of 10 m (32.8 ft), stack diameter of 0.3 m (1 ft), exit velocity of 0.03 m/s (0.1 ft/s), and exit temperature equal to ambient temperature.

Atmospheric Dispersion Characteristics. Data collected at the TA-6 meteorological tower for 1991 indicate that unstable conditions occur approximately 45 percent of the time, neutral conditions approximately 21 percent of the time, and stable conditions approximately 34 percent of the time, on an annual basis.

Table F.1.2.9–1. Emission Rates of Criteria and Toxic/Hazardous Pollutants at Los Alamos National Laboratory[a]

Pollutant	Emission Rate (kg/yr)
Criteria Pollutant	
CO	21,583
Lead	26
NO_2	55,314
PM_{10}	2,983
SO_2	704.6
Total suspended particulates[b]	2,983
Hazardous and Other Toxic Compounds	
1, 1, 2-Trichloroethane	927
2-Butoxyethanol	123
Acetic acid	537
Ammonia	799
Chloroform	533
Ethyl acetate	89
Ethylene glycol	72
Formaldehyde	49
Heptane (n-heptane)	1,849
Hexane (n-hexane)	77
Hydrogen chloride	638
Hydrogen fluoride (as F)	242
Isopropyl alcohol	539
Kerosene	260
Methyl alcohol	589
Methyl ethyl ketone	1,864
Methylene chloride	1,104
Nickel	55
Nitric acid	661
Nitrogen oxide	428
Propane sultone	205
Stoddard solvent	264
Toluene	2,483
Trichloroethylene	210
Tungsten (as W) (insoluble)	109
VM&P naptha	613
Xylene (o-, m-, p-isomers)	1,762

[a] Emissions from historical data (1990) are assumed for No Action (2005).

[b] It is assumed that PM_{10} emissions are total suspended particulates emissions.

Source: LANL 1994a.

F.1.3 AIR POLLUTANT EMISSIONS

Potential ambient air quality impacts of the emissions due to operation of the various storage and disposition facilities at each site were analyzed using ISCST2 as described in Section F.1.1. The source of the facility emissions is assumed to be that which is described under the Modeling Assumptions subsection in each of the preceding descriptions of the sites. The model input data include the emission inventories for each of the facilities as presented in Tables F.1.3–1 through F.1.3–14.

Table F.1.3–1. Emission Rates of Pollutants for Upgrade of Existing Facilities

		INEL			Pantex			SRS[a]	
Pollutant	Hanford[b] (kg/yr)	Without RFETS or LANL Material (kg/yr)	With RFETS and LANL Material (kg/yr)	With RFETS Pits (kg/yr)	Without RFETS or LANL Material (kg/yr)	With RFETS and LANL Material (kg/yr)	ORR (kg/yr)	With RFETS Non-pit Material (kg/yr)	With RFETS and LANL Material (kg/yr)
Criteria Pollutants									
CO	51.7	900	920	0	0	3,700	[c]	91	122
NO_2[d]	200	3,000	3,000	0	0	4,600	[c]	2,951	4,037
PM_{10}[e]	4.54	1,000	1,100	0	0	1,200	[c]	227	308
SO_2	3.36	4,900	5,200	0	0	85	[c]	8,626	11,884
Total suspended particulates[e]	4.54	1,000	1,100	0	0	1,200	[c]	227	308
Volatile organic compounds	50.8	84	86	0	0	550	[c]	23	32
Toxic/Hazardous Pollutants				0	0				
Ammonia	0	0	0	0	0	0	0	0	0
Chlorine	0	<1	<1	0	0	5	[c]	0	0
Hydrazine	0	<1	<1	0	0	<1	[c]	0	0
Hydrogen chloride	0	1	1	0	0	0	11.3	0	0
Hydrogen fluoride	0	1	1	0	0	0	11.3	0	0
Nitric acid	0	0	0	0	0	6	113.4	0	0
Phosphoric acid	0	<1	<1	0	0	<1	[c]	0	0
Sulfuric acid	0	<1	<1	0	0	<1	[c]	0	0

[a] Applies only to the incremental emissions associated with the upgrade subalternatives (RFETS non-pit subalternative and RFETS and LANL subalternative). The emissions associated with the storage of SRS plutonium in the Actinide Storage and Packaging Facility are included in the No Action emissions.

[b] Applies to both with and without RFETS and LANL Pu material.

[c] No sources of this pollutant have been identified.

[d] For some upgrades, the associated data report states the emission is NO_x. In these instances, NO_x is conservatively assumed to be NO_2.

[e] It is assumed that PM_{10} emissions are total suspended particulate emissions.

Source: DOE 1996e; FDI 1996a:1; HF DOE 1995e:1; HF DOE 1996a; IN DOE 1996a; OR MMES 1996a; PX MH 1994a; SR DOE 1994e; SRS 1996a:4.

Table F.1.3–2. Emission Rates of Pollutants for the Consolidated Plutonium Storage Facility

Pollutant	Hanford (kg/yr)	NTS: New Facility and Modify P-Tunnel (kg/yr)	NTS: New Facility (kg/yr)	INEL (kg/yr)	Pantex: New Facility and Modify Zone 12 South (kg/yr)	Pantex: New Facility (kg/yr)	SRS (kg/yr)
Criteria Pollutants							
CO	520	2,500	2,300	3,400	3,700	3,300	1,600
NO_2	2,000	3,600	3,400	97,000	4,600	4,300	38,000
PM_{10}[a]	50	780	700	6,900	1,200	1,100	2,600
SO_2	34	70	62	160,000	85	79	61,000
Total suspended particulates[a]	50	780	700	6,900	1,200	1,100	2,600
Volatile organic compounds	58	370	330	400	550	500	190
Toxic/Hazardous Pollutants							
Chlorine	5	8	5	3	5	4	8
Hydrazine	<1	<1	<1	<1	<1	<1	<1
Nitric acid	6	5	6	6	6	6	6
Phosphoric acid	<1	<1	<1	<1	<1	<1	<1
Sulfuric acid	<1	<1	<1	<1	<1	<1	<1

[a] It is assumed that PM_{10} emissions are TSP emissions.

Source: DOE 1996e; NT DOE 1996a; PX DOE 1996a.

Table F.1.3–3. Emission Rates of Pollutants for the Collocated Plutonium and Highly Enriched Uranium Storage Facilities

	NTS					ORR			
Pollutant	**Hanford (kg/yr)**	**New Facility and Modify P-Tunnel (kg/yr)**	**New Facility (kg/yr)**	**INEL (kg/yr)**	**Pantex (kg/yr)**	**New Pu Storage Facility Only (kg/yr)**	**New Pu Storage Facility and Upgrade Y–12 (kg/yr)**	**New Pu and HEU Facilities (kg/yr)**	**SRS (kg/yr)**
Criteria Pollutants									
CO	520	2,800	2,500	4,000	3,800	1,900	1,900	2,100	1,700
NO_2	2,000	3,800	3,600	120,000	4,600	48,000	48,000	55,000	42,000
PM_{10}[a]	50	890	780	8,200	1,300	3,300	3,450	3,800	2,900
SO_2	34	70	66	200,000	86	79,000	79,000	90,000	69,000
Total suspended particulates[a]	50	890	780	8,200	1,300	3,300	3,300	3,800	2,900
Volatile organic compounds	58	420	370	470	570	220	220	250	200
Toxic/Hazardous Pollutants									
Chlorine	6	8	6	4	5	6	6	8	10
Nitric acid	95	5	95	95	95	6	119	95	95
Hydrazine	<1	<1	<1	<1	<1	<1	<1	<1	<1
Hydrogen chloride	9.0	9.0	9.0	9.0	9.0	[b]	11.3	9.0	9.0
Hydrogen fluoride	9.0	9.0	9.0	9.0	9.0	[b]	11.3	9.0	9.0
Phosphoric acid	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sulfuric acid	<1	<1	<1	<1	<1	<1	<1	<1	<1

[a] It is assumed that PM_{10} emissions are total suspended particulates emissions.

[b] No sources of this pollutant have been identified.

Source: DOE 1996e; DOE 1996f; NT DOE 1996a; OR MMES 1996a.

Table F.1.3–4. Emission Rates of Pollutants for the Pit Disassembly/Conversion Facility

Pollutant	Hanford (kg/yr)	NTS (kg/yr)	INEL (kg/yr)	Pantex (kg/yr)	ORR (kg/yr)	SRS (kg/yr)
Criteria Pollutants						
CO	a	a	a	a	a	a
NO_2	a	a	a	a	a	a
PM_{10}	a	a	a	a	a	a
SO_2	a	a	a	a	a	a
Total suspended particulates	a	a	a	a	a	a
Volatile organic compounds	1,500	1,500	1,500	1,500	1,500	1,500
Toxic/Hazardous Pollutants						
Cleaning solvents	750	750	750	750	750	750

[a] No sources of this pollutant have been identified. The pit disassembly/conversion process involves pure Pu materials that would not require chemical processing. The emissions estimates for the facility are based on data from similar processes at LANL's TA-55 facility. The ventilation system for the pit disassembly/conversion facility would be used specifically for contamination control and would use a large volume of air to assure contamination control. Primary confinement would be provided by a glove box system and associated zone air-handling system. There would be four stages of HEPA filters on the glovebox exhaust that would eliminate (or reduce below detection limits) a minimum of 99.95 percent of nonradioactive particulates. Radioactive particulate emissions are discussed in Section 4.3.1.9. The glovebox exhaust would be mixed with room air exhaust, which also has two stages of HEPA filters. The use of HEPA filters would not reduce VOC emissions because VOCs are not in a particulate form. There would also be process-specific scrubbers, vacuum traps, and filters that reduce the chance of criteria or toxic/hazardous pollutants releases from occurring. Because of the processing technology (which does not create some of the criteria pollutants), the defense-in-depth for Pu processing systems, and the extensive HEPA filtration (which removes the remaining criteria pollutants), emissions for criteria pollutants other than VOCs are expected to be below detection limits.

Source: LANL 1996d.

Table F.1.3–5. Emission Rates of Pollutants for the Plutonium Conversion Facility

Pollutant	Hanford (kg/yr)	NTS (kg/yr)	INEL (kg/yr)	Pantex (kg/yr)	ORR (kg/yr)	SRS (kg/yr)
Criteria Pollutants						
CO	4,000	4,000	4,000	4,000	4,000	4,000
NO_2[a]	4,500	4,500	4,500	4,500	4,500	4,500
PM_{10}[b]	12	12	12	12	12	12
SO_2	10	10	10	10	10	10
Total suspended particulates[b]	12	12	12	12	12	12
Toxic/Hazardous Pollutants						
Ammonia	10	10	10	10	10	10
Chlorine	7.5	7.5	7.5	7.5	7.5	7.5
Ethanol	20	20	20	20	20	20
Hydrogen chloride	12	12	12	12	12	12
Hydrogen fluoride	0.8	0.8	0.8	0.8	0.8	0.8
Hydrazine	<1	<1	<1	<1	<1	<1
Toxic/Hazardous Pollutants (continued)						
Nitric Acid	3	3	3	3	3	3
Phosphoric acid	<1	<1	<1	<1	<1	<1
Sulfuric acid	<1	<1	<1	<1	<1	<1
Trichloroethylene	450	450	450	450	450	450
Cleaning solvents	100	100	100	100	100	100

[a] The data report states the emission is NO_x but has been conservatively assumed to be NO_2.

[b] It is assumed that PM_{10} emissions are TSP emissions.

Source: LANL 1996c.

Table F.1.3–6. Emission Rates of Pollutants for the Generic Mixed Oxide Fuel Fabrication Facility

Pollutant	Hanford (kg/yr)	NTS (kg/yr)	INEL (kg/yr)	Pantex (kg/yr)	ORR (kg/yr)	SRS (kg/yr)	Generic (kg/yr)
Criteria Pollutants							
CO	a	a	a	a	a	a	a
NO_2	a	a	a	a	a	a	a
PM_{10}	a	a	a	a	a	a	a
SO_2	a	a	a	a	a	a	a
Total suspended particulates	a	a	a	a	a	a	a
Volatile organic compounds	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Toxic/Hazardous Pollutants							
Cleaning solvents	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500

[a] No sources of this pollutant have been identified. The MOX fuel fabrication process involves pure Pu materials that would require minimal chemical processing. The emissions estimates for the facility are based on operational experience at European MOX facilities, the glovebox ventilation system design, and the actual process. Feed material preparation and fabrication of fuel pellets would be done in gloveboxes to control contamination for normal operations. The ventilation system for the MOX fuel fabrication facility would be used specifically for contamination control and would use a large volume of air to assure contamination control. There would be essentially four stages of HEPA filters on the glovebox exhaust that would eliminate (or reduce below detection limits) a minimum of 99.95 percent of nonradioactive particulates. Radioactive particulate emissions are discussed in Section 4.3.5.1.9. The glovebox exhaust would be mixed with room air exhaust, which also has two stages of HEPA filters for further filtration before release to the environment. The use of HEPA filters would not reduce VOC emissions because VOCs are not in a particulate form. There would be process-specific scrubbers, vacuum traps, and filters that reduce the chance of criteria or toxic/hazardous pollutant releases from occurring. Because of the processing technology (which does not create some of the criteria pollutants), the defense-in-depth for Pu processing systems, and the extensive HEPA filtration (which removes the remaining criteria pollutants), emissions for criteria pollutants other than VOCs are expected to be below detection limits.

Source: LANL 1996b.

Table F.1.3–7. Emission Rates of Pollutants for the Direct Disposition Alternative—Deep Borehole Complex

Pollutant	Generic[a] (kg/yr)
Criteria Pollutants	
CO	11,263
NO_2[b]	30,898
PM_{10}[c]	11,812
SO_2	2,822
Total suspended particulates[c]	11,812
Toxic/Hazardous Pollutants	
Hydrocarbons	2,831

[a] Includes the surface processing and the drilling and emplacing-borehole sealing facilities.

[b] The data report states the emission is NO_x but has been conservatively assumed to be NO_2.

[c] It is assumed that PM_{10} emissions are total suspended particulate emissions.

Source: LLNL 1996a.

Table F.1.3–8. Emission Rates of Pollutants for the Immobilization Disposition Alternative—Ceramic Immobilization Facility and Deep Borehole Complex

Pollutant	Hanford (kg/yr)	NTS (kg/yr)	INEL (kg/yr)	Pantex (kg/yr)	ORR (kg/yr)	SRS (kg/yr)	Generic Borehole (kg/yr)
Criteria Pollutants							
CO	32,000	32,000	32,000	32,000	32,000	32,000	11,235
NO_2[a]	9,000	9,000	9,000	9,000	9,000	9,000	31,344
PM_{10}[b]	400	400	400	400	400	400	11,340
SO_2	500	500	500	500	500	500	2,799
Total suspended particulates[b]	400	400	400	400	400	400	11,340
Volatile organic compounds	95	95	95	95	95	95	trace
Toxic/Hazardous Pollutants							
Hydrocarbons	950	950	950	950	950	950	2,806

[a] The data report states the emission is NO_x but has been conservatively assumed to be NO_2.

[b] It is assumed that PM_{10} emissions are TSP emissions.

Source: LLNL 1996e; LLNL 1996h.

Table F.1.3–9. Emission Rates of Pollutants for the Vitrification Alternative

Pollutant	Hanford (kg/yr)	NTS (kg/yr)	INEL (kg/yr)	Pantex (kg/yr)	ORR (kg/yr)	SRS (kg/yr)
CO	72,000	72,000	72,000	72,000	72,000	72,000
NO_2	72,000	72,000	72,000	72,000	72,000	72,000
PM_{10}[a]	573	573	573	573	573	573
SO_2	1,845	1,845	1,845	1,845	1,845	1,845
Total suspended particulates[a]	573	573	573	573	573	573
Volatile organic compounds	14,500	14,500	14,500	14,500	14,500	14,500

[a] It is assumed that PM_{10} emissions are TSP emissions.

Source: LLNL 1996c.

Table F.1.3–10. Emission Rates of Pollutants for the Ceramic Immobilization Alternative

Pollutant	Hanford (kg/yr)	NTS (kg/yr)	INEL (kg/yr)	Pantex (kg/yr)	ORR (kg/yr)	SRS (kg/yr)
CO	250,000	250,000	250,000	250,000	250,000	250,000
NO_2[a]	660,000	660,000	660,000	660,000	660,000	660,000
PM_{10}[b]	770	770	770	770	770	770
SO_2	68.0	68.0	68.0	68.0	68.0	68.0
Total suspended particulates[b]	770	770	770	770	770	770
Volatile organic compounds	81	81	81	81	81	81

[a] The data report states the emission is NO_x but has been conservatively assumed to be NO_2.

[b] It is assumed that PM_{10} emissions are total suspended particulate emissions.

Source: LLNL 1996d.

Table F.1.3–11. Emission Rates of Pollutants for the Electrometallurgical Treatment Alternative

Pollutant	(kg/yr)
CO	42
NO_2[a]	191
PM_{10}[b]	15
SO_2	20
Total suspended particulates[b]	15
Volatile organic compounds	45

[a] The data report states the emission is NO_x but has been conservatively assumed to be NO_2.

[b] It is assumed that PM_{10} emissions are total suspended particulate emissions.

Source: LLNL 1996b.

Table F.1.3–12. Emission Rates of Pollutants for the Existing Light Water Reactor

Pollutant	Uranium Fuel (kg/yr)[a]	MOX Fuel (kg/yr)[b]
Criteria Pollutants		
CO	40.8	40.8
NO_2	114,307	114,307
PM_{10}[c]	8,755	8,755
SO_2	85,731	85,731
Total suspended particulates[c]	8,755	8,755
Toxic/Hazardous Pollutants		
Hydrocarbons	2,223	2,223

[a] [Text deleted.] Emissions rates from the partially completed LWR are representative for existing LWRs.

[b] No increase in nonradioactive air pollutant emission is expected. During operation, concentrations of criteria and toxic/hazardous air pollutants are expected to continue to be in compliance with Federal, State, and local air quality regulations or guidelines. No additional operation or testing of diesel generators or emissions from support facilities would be expected to occur from the use of MOX fuel. Pollutant concentrations from operating an existing LWR with a MOX core rather than a uranium core would not change. The process would remain the same, because criteria and toxic/hazardous emissions are not related to the type of fuel being used (NRC 1996b:2-22).

[c] It is assumed that PM_{10} emissions are total suspended particulate emissions.

Source: ORNL 1995b; derived from TVA 1974a.

Table F.1.3–13. Emission Rates of Pollutants for the Partially Completed Light Water Reactor

Pollutant	(kg/yr)
Criteria Pollutants	
CO	40.8
NO_2	114,307
PM_{10}[a]	8,755
SO_2	85,731
Total suspended particulates[a]	8,755
Toxic/Hazardous Pollutants	
Hydrocarbons	2,223

[a] It is assumed that PM_{10} emissions are total suspended particulate emissions.

Note: Emission rates estimated for one operating unit.

Source: Derived from TVA 1974a.

Table F.1.3–14. Emission Rates of Pollutants for the Evolutionary Light Water Reactor

Pollutant	Hanford (kg/yr)	NTS (kg/yr)	INEL (kg/yr)	Pantex (kg/yr)	ORR (kg/yr)	SRS (kg/yr)
CO	<45	<45	<45	<45	<45	<45
NO_2	2,630	2,630	2,630	2,630	2,630	2,630
PM_{10}[a]	0	0	0	0	0	0
SO_2	450	450	450	450	450	450
Total suspended particulates[a]	0	0	0	0	0	0

[a] It is assumed that PM_{10} emissions are total suspended particulates emissions.

Source: LLNL 1996g.

F.2 NOISE

This section summarizes local noise regulations and presents available sound level monitoring data for the sites. A discussion of operation noise sources and the potential for noise impacts is provided in PEIS Chapter 3, Affected Environment, and Chapter 4, Environmental Consequences. Any further analysis of operation noise impacts, including traffic noise impacts and impacts from outside sources, has been deferred to the tiered, site-specific *National Environmental Policy Act* documents.

The Occupational Safety and Health Administration standards for occupational noise exposure (29 CFR 1910.95) are applicable for worker protection at each site.

F.2.1 HANFORD SITE

Studies of noise at Hanford are discussed in Chapter 3 and in detail in *Hanford Site National Environmental Policy Act Characterization* (PNL-6415 Rev. 6, August 1994).

The State of Washington Department of Ecology has adopted regulations in Washington Administrative Code 173-60 through 173-70 which limit environmental noise levels. Maximum noise levels are defined for zoning of an area in accordance with Environmental Designation for Noise Abatement (EDNA). The Hanford Site is classified as a Class C EDNA on the basis of industrial activities. Unoccupied areas are also classified as Class C areas by default because they are neither Class A (residential) nor Class B (commercial). Maximum noise levels are established based on the EDNA classification of the receiving area and the source area (Table F.2.1–1) (HF PNL 1994a:4.144).

Table F.2.1–1. Applicable State Noise Limitations for Hanford Site Based on Source and Receptor Environmental Designation for Noise Abatement (dBA)

Source Hanford Site	Receptor		
	Class A Residential	Class B Commercial	Class C Industrial
Class C - Day	60	65	70
Class C - Night	50	-	-

Source: HF PNL 1994a.

F.2.2 NEVADA TEST SITE

No environmental noise survey data are available for NTS. The State of Nevada and Nye County have not established any regulations that specify acceptable community noise levels with the exception of general prohibitions on nuisance noise.

F.2.3 IDAHO NATIONAL ENGINEERING LABORATORY

Studies of noise at INEL are limited primarily to noise measurements along roadways. These are discussed in Chapter 3 and in *NPR Environmental Impacts at the INEL: Air Quality, Cooling Towers, and Noise* (NPRD-90-059). The State of Idaho and the counties in which the INEL is located have not established any regulations that specify acceptable community noise levels, with the exception of general prohibitions on nuisance noise.

F.2.4 PANTEX PLANT

A study of sound levels near Pantex consists of data collected along roads for short periods of time during peak traffic and for specific noise events at Pantex. Neither the State of Texas nor the local government have established regulations that specify acceptable sound levels applicable to Pantex, with the exception of general prohibitions on nuisance noise.

F.2.5 OAK RIDGE RESERVATION

Sound level measurements have been recorded at various locations within and near ORR as discussed in Chapter 3 and documented by Cleaves (ORR 1991a:2) and Knazovich (ORR 1991a:6). Maximum allowable noise limits for the city of Oak Ridge are presented in Table F.2.5–1.

Table F.2.5–1. City of Oak Ridge Maximum Allowable Noise Limits Applicable to Oak Ridge Reservation

Adjacent Use	Where Measured	Maximum Sound Level (dBA)
All residential districts	Common lot line	50
Neighborhood business district	Common lot line	55
General business district	Common lot line	60
Industrial district	Common lot line	65
Major street	Street lot line	75
Secondary residential street	Street lot line	60

Note: dBA=decibel A-weighted.
Source: OR City 1985a.

F.2.6 SAVANNAH RIVER SITE

Ambient sound level data collected at SRS in 1989 and 1990 are summarized in *Sound-Level Characterization of the Savannah River Site* (NUS-5251). The States of Georgia and South Carolina, and the counties where SRS is located, have not yet established noise regulations that specify acceptable community noise levels except for a provision of the Aiken County Nuisance Ordinance that limits daytime and nighttime noise by frequency band (Table F.2.6–1).

Table F.2.6–1. Aiken County Maximum Allowable Noise Levels[a]

Frequency Band (Hz)	Nighttime Sound Pressure Levels[b]	
	Nonresidential Lot Line (dB)	Residential Lot Line (dB)
20-75	69	65
75-150	60	50
150-300	56	43
300-600	51	38
600-1,200	42	33
1,200- 2,400	40	30
2,400-4,800	38	28
4,800-10,000	35	20

[a] Daytime (7:00 a.m. - 9:00 p.m.) sound pressure levels: apply one of the following corrections (dB) to the nighttime levels above: daytime operation only, +5; source operates less than 20 percent of any 1-hour period, +5; source operates less than 5 percent of any 1-hour period, +10; source operates less than 1 percent of any 1-hour period, +15; noise of impulsive character, -5; noise of periodic character, -5.

[b] For the purpose of this ordinance, nighttime is the period 9:00 p.m. to 7:00 a.m.

Note: dB=decibel.

Source: SR County 1991a.

F.2.7 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

No sound level measurements have been made in the area near RFETS. Neither the State of Colorado nor the local government have established regulations that specify acceptable sound levels applicable to RFETS, with the exception of general prohibitions on nuisance noise.

F.2.8 LOS ALAMOS NATIONAL LABORATORY

No environmental noise survey data are available for LANL. The State of New Mexico has not established any regulation that specifies acceptable community noise levels with the exception of general prohibitions on nuisance noise.

Los Alamos County has adopted a noise ordinance that specifies maximum sound levels in residential areas. Sound levels at a residential property line are limited to 65 decibel A-weighted (dBA) during the hours 7 a.m. to 9 p.m., and to 53 dBA during the hours 9 p.m. to 7 a.m. The 65 dBA limit may be exceeded by up to 10 dBA for up to 10 minutes of any hour between 7 a.m. and 9 p.m.

Appendix G
Intersite Transportation

This appendix supplements Section 4.4. It describes the methodology used for intersite transportation risk analysis and provides estimated health risks from the transport of materials, historical shipment data for the affected sites, and other supporting documentation. Intrasite transportation of pits between Zone 4 and Zone 12 at Pantex to support storage of RFETS pits for the Preferred Alternative is described in Appendix Q.

G.1 TRANSPORTATION RISK ANALYSIS METHODOLOGY

G.1.1 TRUCK AND RAIL TRANSPORTATION RISK

This assessment addresses the intersite transport of plutonium (Pu), highly enriched uranium (HEU), cesium, Pu oxide (PuO_2), uranium oxide, mixed oxide fuel (MOX), low-level waste (LLW), transuranic waste, and immobilized material. Pu, including MOX fuel, and HEU would be transported in truckload shipments by safe secure trailer (SST). The other materials would be transported by commercial truck, except for immobilized Pu with radionuclides (vitrified glass logs, ceramic disks, or glass-bonded zeolite in canisters), which would be transported to a repository by rail. For overseas shipments, this assessment includes port handling and ocean transport. This assessment compares transportation impacts for the alternatives considered.

For this analysis, the isotopic composition of Pu was assumed to be 93 percent Pu-239, 6 percent Pu-240, and 1 percent other Pu isotopes. The isotopic composition of HEU was assumed to be 93 percent uranium-235. For the other radioactive materials to be transported, the isotopic compositions were estimated based on data provided from the facility designers.

Handling risk involves the loading and unloading of transport vehicles, which was estimated on a per-vehicle (truckload/rail carload) basis. One loading and unloading operation was assumed for each shipment. It was estimated that there would be two cargo handlers and 35 other workers within 50 meters (m) (164 feet [ft]) of the loading/unloading operations. Because of the low speeds, less than 8 kilometers per hour (km/hr) (5 miles per hour [mph]), involved in transferring Pu and uranium between a storage facility and the transport vehicles and because the rigid design standards used for the Type B packagings allow them to withstand an accident (for example, a fork lift puncture), it is extremely unlikely that a Type B package would be breached. The estimated probability of a package being damaged so severely (for example, by forklift puncture, high winds, or tornados) that the inner and outer containers would fail and some fraction of the contents would be dispersed is extremely low (that is, less than 1.0×10^{-12}). However, design-basis and beyond-design-basis accidents with frequencies in the range of 10^{-2} to 10^{-7} are evaluated under facility accidents. Detailed analyses and test results including a puncturing forklift accident which serves as a bounding value, are presented in Section M.5. The risk factor from transferring Pu and HEU between the storage facility and the transport vehicles is so low as to be inconsequential. Therefore, it is unlikely that a worker or member of the public fatality would occur as a result of an accident during the transfer of Pu or HEU. The collective dose due to accident-free radiological exposure to cargo handlers and other workers for each loading operation is estimated to be 0.06 person-roentgen equivalent man (rem) and 0.004 person-rem, respectively. Because the loading would occur onsite in a secure area, there would be no exposure to the public.

For the transportation analysis, materials were assumed to be in shippable forms that have been stabilized and packaged for shipment at the originating site and meet Department of Transportation (DOT), Nuclear Regulatory Commission (NRC), and Department of Energy (DOE) requirements. The health impacts from the transport of materials were estimated using an assumed population distribution along specific routes when sites were known or along an assumed route distribution of 84-percent rural, 15-percent suburban and 1-percent urban for generic sites; average container, truckload, or rail carload of material; and a standard unit of measure

for traffic fatalities (the risk per kilometer). Potential impacts are presented for both accident and accident-free scenarios.

The RADTRAN Version 4 computer code, developed and maintained by Sandia National Laboratories at Albuquerque, NM, was used to estimate health risks in terms of potential total fatalities from the transport of radioactive materials. The RADTRAN code combines user-determined demographic, transportation, packaging, and material factors with health physics data to calculate the expected radiological consequences of accident-free and accident transportation scenarios.

The transportation accident model in RADTRAN assigns accident probabilities to a set of accident categories. For the truck analysis, the eight accident-severity categories defined in NRC's *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes* (NUREG-0170, December 1977) were used. The least severe accident category (Category I) represents low magnitudes of crush force, accident-impact velocity, fire duration, or puncture-impact speed. The most severe category (Category VIII) represents a large crush force, high accident-impact velocity, long fire duration, and high puncture-impact speed, such as an 88-km/hr (55-mph) collision into the side of the vehicle, and a 982 degrees Centigrade (°C) (1,800 degrees Fahrenheit [°F]) fire lasting 1.5 hr to produce a release of the material. The release fractions for Category VIII accidents were conservatively estimated to be 0.1 for the strictly controlled SST shipments and 1.0 for other shipments.

A unit dose per shipment was calculated using RADTRAN for each type of radioactive material to be transported between sites and for each alternative. The distance and fraction of rural, suburban, and urban population for each route was estimated using the INTERSTAT routing code for truck transport and INTERLINE for rail transport. These two routing codes are integrated with the RADTRAN code. For sea transport, the actual distance was used between an East Coast port (hypothetically, the U.S. Army port at Sunny Point, NC) to ports in the United Kingdom and France, 6,297 km (3,400 nautical miles) and 6,112 km (3,300 nautical miles), respectively. For land transport by SST to facilities without a specific site, a potential bounding risk was established for distances of 1,000 kilometers (km) (620 miles [mi]), 2,000 km (1,240 mi), and 4,000 km (2,480 mi), assuming rural, suburban, and urban population distributions of 84, 15, and 1 percent, respectively along the route. Under the European MOX fuel fabrication variant, the impacts from the transport of Pu materials from DOE origins (that is, existing storage, pit disassembly/conversion site, or Pu conversion site) to placement of the material aboard ship, were considered. For the assessment, the representative port was assumed to be at distances of 1,000 km (620 mi); 2,000 km (1,240 mi); or 4,000 km (2,480 mi) from the origin.

The transport index is a regulatory characteristic of a package and is equal to the radiation dose rate in mrem per hour at a distance of 1 m (3.3 ft) from the outside of the package (49 CFR 173.403). The transport index values were estimated to be the maximum allowed by regulatory requirements, as indicated by regulatory checks incorporated in RADTRAN. These regulatory checks limit the product of the number of packages and the transport index (of each package) to a value of about 16. This value was used as a bounding value for evaluating impacts. The quantity of material per package, number of packages per truckload, and number of truckloads (shipments) for the life of the project were based on estimates for each storage and disposition alternative.

To determine the transportation accident and accident-free impacts, the unit dose (the derived radiation dose for each shipment) was converted to a unit risk factor per shipment by multiplying the occupational accident-free dose by 4.0×10^{-4} cancers per person-rem and the public accident and accident-free dose by 5.0×10^{-4} cancers per person-rem (ICRP 1991a:22).

Nonradiological impacts from accident-free (air pollution) and highway accidents were also assessed. Fatalities from potential air pollution were estimated using 1.0×10^{-7} cancer fatalities per urban kilometer. Highway accident fatalities were estimated from national statistics using 1.5×10^{-8} rural, 3.7×10^{-9} suburban, and 2.1×10^{-9} urban for

occupational risks per km, and 5.3×10^{-8} rural, 1.3×10^{-8} suburban, and 7.5×10^{-9} urban for nonoccupational risks per km (SNL 1986a:167). The combined resultant health risks are presented as potential fatalities.

The estimated impacts for each alternative were derived by summing the health effects for the materials to be transported for each transportation segment required by the alternative.

G.1.2 Risk Associated With Port Handling and Global Commons for European Mixed Oxide Fuel Fabrication

For the Existing Light Water Reactor Alternative, MOX fuel could be produced in existing European facilities to meet interim needs, pending availability of a domestic MOX fuel fabrication plant. Therefore, this programmatic environmental impact statement (PEIS) considered transportation impacts at the ports and global commons. The methodologies for the various cases are explained in the following sections.

G.1.2.1 Port Transit and Intermodal Handling Analysis (Accident-Free Conditions)

The materials to be shipped under this action (Pu oxides and fresh MOX fuel assemblies) emit low radiation levels. Consequently, the self-shielding and the shielding afforded by the external walls of the shipping containers are sufficient to reduce the estimated maximum dose rate at 1 m (3.3 ft) from the package to zero for the 6M package (with 2R inner container) and to less than 1.5×10^{-4} millirem/hr for the MO-1 package. [Text deleted.]

G.1.2.2 Port Transit and Intermodal Handling Analysis (Accident Conditions)

For the shipment of Pu oxide from lag storage to an overseas MOX fuel fabrication site and the return shipment of reactor fuel assemblies, (1) material would be transported by SST to or from the selected U.S. port and (2) shipping containers would be transferred between the SST and the ships. The Pu oxide would be contained in 6M-2R, Type B packaging which would be placed in groups of eight or fewer packages in a cargo restraint transporter (CRT) to facilitate loading and securing in the SST. For ship transport, the 6M-2R packagings would be placed in International Standards Organization (ISO) intermodal containers that are compatible with the common handling and securing facilities available. The returning fuel assemblies would be shipped in MO-1 casks that meet Type B certification requirements.

The shipping schedule projects two shipments of Pu oxide per year and a maximum of four shipments of fresh MOX fuel assemblies per year. Facilities for transferring CRTs from the SST to the ISO containers and staging of returning fuel casks unloaded from ships to multiple SST convoys would be available in the immediate port area. Handling and short-term storage in these facilities do not involve significant accident risks apart from the remote possibility of a major fire. All other mishaps that might occur during the shipping, handling, and inspection operations are subsumed in the accident rate per port transit of a ship, which is described in Section G.1.2.3. Transportation risks associated with SST operations are treated separately.

During port transit, loading, and unloading, the occurrence probability of an accident of any type can be assigned from reported statistics. In this analysis, all accidents involving a container breach and fire on a ship are modeled as occurring at pier side. This approach is highly conservative in that it ignores both the high probability of a greater stand-off distance and the fact that transits to ports are typically through low population density areas. Additionally, in the absence of prevailing wind data, the radioactive cloud (plume) is modeled as traveling over the port area and out to a distance of 80 km (50 mi). In reality, the prevailing winds might blow the plume away from populated areas. Without detailed population density data, the accident model treats the port population density as continuing out for the full 80 km (50 mi).

G.1.2.3 Modal Considerations

Maritime accident rate data indicate that the basic accident rate in and near ports is approximately 3.0×10^{-4} per port transit; that is, three accidents per 10,000 port visits (DOE 1991s:22). The conditional occurrence probabilities of each accident severity have been developed as well. A conditional probability is defined as the probability, given that an accident has occurred, that it will be of a certain severity. In order to calculate overall probability of an accident of a particular severity, the base accident probability (accident rate) must be multiplied by the conditional probability. For Type B packages containing the materials contemplated in this action (Pu oxide and fresh MOX fuel assemblies), the highest conditional probability, for an accident resulting in the release of package contents, yields an overall maximum accident probability of 5.0×10^{-9} per port transit (DOE 1996n:D-191; SNL 1995b:3). The resultant overall probability is, therefore, approximately 3.0×10^{-8}/year (yr) (that is, number of accidents per transit multiplied by number of transits per year [six]).

Activities or conditions that affect material release from packages in the event of an accident include, but are not limited to, the following:

- **Container Drops During Intermodal Transfer.** Berths at all ports considered in this action are likely to consist of either concrete aprons constructed on friction pilings driven into the sediment or tamped earth contained within sheet pilings and surfaced with concrete. Both are yielding surfaces, and the water and the deck of a ship are even more yielding than a dock surface. Previous studies have shown that a Type B package can be dropped onto a yielding surface from at least 10 m (30 ft) (as specified for Type B packaging) without sustaining damage (IAEA 1987a:551; SNL 1975a:7,15). Information describing Type B package testing is contained in Section G.5.

  Container drops are infrequent, and such a drop would be considerably less severe than the certification drop test conditions, even if the container was dropped from greater than 10 m (30 ft), because of the yielding nature of the surfaces onto which they might fall. Therefore, container drops during intermodal transfers are not considered a threat to Type B packaging, and they need not be considered further in this analysis. Since truck velocities within the immediate confines of a port are low and container movements are preceded by a port authority police escort vehicle, truck accidents in port also are not considered further. Port accidents that are considered consist mainly of vessel accidents, including accidents in which a moored ship is struck, usually by another ship (SNL 1980a:4-1,4-2).

- **Packaging Response to Thermal Conditions.** The packaging considered for this action is designed to survive the thermal load specified in the Type B packaging certification tests with no release of contents. Total heat input to a package is more important than peak temperature. A fire that meets or exceeds the regulatory fire temperature of 800 °C (1,470 °F) may have no effect whatsoever on the package if it does not engulf the cask (that is, if it does not satisfy the test condition of the entire package being exposed to the fire) and/or if it does not last at least as long as the 30 minutes specified in the regulatory test (NRC 1987b:2-24).

  The likelihood that a shipboard fire will occur in the same location as the cargo is relatively small; many ship fires are confined to engine rooms, galleys, etc., and do not affect cargo areas (SNL 1980a:4-19). Fire-duration is also unlikely to be a factor. Although shipboard fires have been described as burning for days, that is not, by itself, sufficient information to determine whether any particular location as small in volume as a single container is exposed to fire at all, much less "for days." Indeed, shipboard fires are often traveling fires, which progress through a ship during the course of a fire and during which no single location in the fire's path is exposed for a prolonged period of time. Fires involving tanker ships are not directly relevant to conditions onboard container ships; tanker fires are discussed in *Tanker Accident Rates and Expected Consequences in U.S. Ports*

and High Seas Regions (TRB 1985a:164). In a rare historical accident involving the collision of an oil tanker and a cargo ship, conditions onboard the tanker and container ships were quite different (DOT 1975a:1; NTSB 1975a:1).

- **Atmospheric Dispersal.** Atmospheric dispersal is usually the means of spreading any material released during a severe accident beyond the immediate vicinity and into the human environment. Dispersal is affected by the degree of turbulence in the atmosphere, which can vary from unstable (Class A) to extremely stable (Class F). The Pasquill system of atmospheric stability classes is commonly used to describe this variation, although there are other systems (NRC 1983a:2-18). A conservative representation of atmospheric conditions at ports generated by the DIFOUT dispersion code for Class D, which has been used in previous port analyses, was used for this analysis (SNL 1969a:19).

G.1.2.4 Port Handling Impacts

Accident-risk estimates were calculated using the RADTRAN 4 computer code. Overall probabilities for accidents of sufficient severity to release radioactive materials to the environment during a port transit and associated handling were obtained from "Radiological Consequences of Ship Collisions That Might Occur in U.S. Ports During the Shipment of Foreign Research Reactor Spent Nuclear Fuel to the United States in Break-Bulk Freighters." Package releases were modeled in accord with shipment of powdered material of fissile assemblies (taking account of their unirradiated state). Since specific ports have not been identified, population density in the vicinity of a nominal port was set at a mean urban value of 3,861 square kilometers (10,000 square miles), which is very conservative for most U.S. ports. Impacts, calculated in terms of dose risk and latent cancer fatalities, for all shipments in 1 year (2 export; 4 import) are presented in Table G.1.2.4–1 together with the separate export and import risks. The health risks are based on a value of 5.0×10^{-4} fatalities per person-rem for the general public (workers are included with the public for accident conditions).

If any of the alternatives in the reactor category were selected, MOX fuel would have to be fabricated. No decision has been made as to where MOX fuel would be fabricated or to where the fuel would be transported for use. However, if the decision were to make any of the MOX fuel in Europe, DOE would ship Pu by sea through ocean ports and would receive MOX fuel shipped by sea from Europe, again through ocean ports. The selection of which ports, after additional environmental reviews under NEPA, would be part of the larger DOE transportation planning process that would also determine shipment schedules, port or ports of entry and exit, modes of transport to and from the ports, emergency preparedness plans and contacts, and communications strategies based on current capabilities. Because there is uncertainty associated with the future nature of port activities and their capabilities for handling Pu and MOX fuel 10 or more years into the future, no specific ports were analyzed for this PEIS. For determining the distance between a port on the eastern U.S. coast and a port in the Great Britain or France, Sunny Point, NC, was used. The distance between Sunny Point, NC, and the European ports is stated in Section G.1.1.

In selecting transportation routes, including any ports, the safety of the public and security of the cargo are of primary consideration. To ensure these primary considerations are achieved, DOE would evaluate the ports to be used based on a set of criteria that would include adequacy of harbor and dock characteristics to satisfy the Pu container carrying ship requirements; adequacy of facilities for safe receipt, handling, and transhipment of Pu and MOX fuel; overall port security; availability of safe and secure lag storage; adequacy of overland transportation systems from ports to the reactor and from the Pu site(s); availability of a skilled labor force with routine experience in safe and secure handling of hazardous cargo; emergency preparedness status and response capabilities at the port and the nearby communities; quality of intermodal access for truck or rail shipments to and from the port; proximity to the proposed pit disassembly/conversion facility and reactor sites; local restrictions or regulations on movement of hazardous cargo; absence of significant environmental restrictions from the port; and the size of human population at the ports and along transportation routes.

Table G.1.2.4–1. Annual Accident Risks Due to Export of Plutonium Oxide and Import of Mixed Oxide Fuel

	Annual Shipments	Annual Dose-Risk (person-rem)	Health Effect[a]
PuO_2–export	2	3.3	1.6×10^{-3}
MOX fuel–import	4	3.6×10^{-7}	1.8×10^{-10}
Total annual effect		3.3	1.6×10^{-3}

[a] Estimated latent cancer fatalities per year.
Source: RADTRAN model results.

The total health risk of 1.6×10^{-3} latent cancer fatalities per year is a highly conservative estimate, as the population density surrounding actual ports may be smaller by as much as a factor of 10. Also, one-half of the 6M-2R packages in the particular ship hold impacted during an accident are modeled as being affected in severe accidents; this is considered to be very unlikely. The major reason the risk associated with the PuO_2 shipments is higher than that for the MOX fuel is the physical state of the material, a fine powder, which is 100 percent dispersible upon release. If the PuO_2 is shipped as pellets, as in the case for fuel rods, the annual risk for the PuO_2 shipments is reduced to 1.6×10^{-7}person-rem or 8.2×10^{-11} latent cancer fatalities.

G.1.2.5 Effects on the Global Commons

European MOX fuel fabrication, which could be used on a short-term basis to provide lead test assemblies and other MOX fuel, would option involves the shipment of Pu oxide on an ocean-going vessel to Europe, where it would be fabricated and loaded into MOX fuel assemblies and returned by ship to the United States. The frequency of a severe maritime accident, sufficient to release radioactive materials resulting in catastrophic consequences, is less than 1.0×10^{-6}/yr. Nevertheless, this discussion addresses concerns that could arise over potential impacts to the global commons from an accident involving the shipment of Pu oxide or MOX fuel.

However unlikely, there is always a potential for maritime accidents during the ocean shipment of Pu and MOX fuel. The severity of maritime accidents ranges from immersion to collision to fire and collision. Accidents in the port egress areas have a greater potential for public consequences than accidents on the open seas because of the proximity to populated areas. Studies performed for recent *National Environmental Policy Act* (NEPA) of 1969 documents conclude that the probability of a maritime accident of sufficient severity to cause significant release of radioactive materials resulting in catastrophic consequences is extremely small, on the order of 1.0×10^{-8} per port call (DOE 1993x:A-3) to 1.0×10^{-9} per port call (DOE 1996n:D-191). Assuming six shipments per year, the probability of a maritime accident would be in the order of 1.0×10^{-7}/yr to 1.0×10^{-8}/yr.

An environmental assessment of the import of Russian Pu-238 shows that collision accidents on the open seas are more severe than those in inland waterways because of higher speeds, but less frequent because of lighter ship traffic (DOE 1993x:A-2). As a vessel nears port, it enters more congested waters and its speed decreases, but accident frequencies increase because of the increased ship traffic and relative proximity of one vessel to another. If PuO_2 were to be released in water in port areas or open seas, the study indicates that the oxide nature of the fuel results in a very low dissolution rate; and the aquatic chemistry of Pu is such that it preferentially binds with the sediment rather than remaining dissolved (DOE 1993x:A-3). The DOE study concluded that fire alone is not a credible means of causing a release, and any accident sequence that resulted in a release of contents must include exposure of the package containing the Pu to mechanical forces great enough to cause failure (that is, forces greater than required in Federal certification testing) (DOE 1993x:A-4). The probability of a severe ship collision, followed by a fire, is on the order of 1.0×10^{-8} per port call (DOE 1993x:A-3). Although the environmental assessment studies were performed specifically for the shipment of Pu-238, the results and conclusions are considered generally applicable to the shipment of Pu-239 and MOX fuel.

G.1.2.6 Security Considerations in the Global Commons, and at European MOX Facilities

The elements of security measures would be incorporated in the transportation plan DOE would complete for the shipment of PuO_2 to European MOX fuel fabrication sites, and for the return of fresh MOX fuel assemblies. The movement of these materials in the United States is addressed in Section 4.4.2.2 on the use of the SST transportation system. The safeguarding of the Pu to be shipped—from the time it leaves the SST in 6M-2R, Type B packaging in CRTs, through its loading into ISO containers, movement by port facility tractors, staging in the dock facilities, movement to its transport location on board, and unloading, staging, handling, and shipment to the MOX fuel fabrication facilities—would be addressed in the procedures specified in a transportation plan that DOE would prepare in accord with its guidance documents. This transportation plan would also address compliance with DOT, NRC, International Atomic Energy Agency (IAEA) regulations, safeguards and standards, and any additional measures deemed necessary to ensure that the transportation would be carried out in the most secure manner, considering the relative risks involved, and that recovery measures adequately mitigate the consequences in the event that security is breached. The DOT is the U.S. Competent Authority designated to carry out the provisions of the IAEA standards, and DOE would be responsible for the transportation plan to address the entire Pu transportation system for this campaign, from the point of origin in the United States to the delivery of the MOX fuel assemblies. In addition, the transportation plan would address Federal, State, and local regulations of the country where the MOX fuel fabrication facility is located.

Physical security of the Pu in transit would be provided in compliance with a security system referred to in the transportation plan. The DOT and NRC are responsible for the assessment of security measures for ship transport. The security system would include procedures for coping with circumstances that pose a threat to the Pu shipments and with other safeguards emergencies, and instructions for surveillance and escort requirements. These procedures would address the detection of abnormal presence of unauthorized persons, vehicles, or vessels in the vicinity of PuO_2 or MOX fuel shipments; the monitoring of the progress of the shipments; the notification of requirement for emergency actions; the maintenance of records required for verification that security has not been breached; and the documentation that proper procedures have been followed. Arrangements would be made with authorities at ports, and those along the routes to the MOX fuel fabrication facility responsible for responding to a security event or call for assistance. These arrangements would be approved in advance by the NRC, DOT, and State and local authorities. A shipment vessel in port would be protected by two armed escorts stationed on board or on the dock at a location permitting observation of the shipment. At sea, an authorized ship's officer would be responsible for providing the appropriate level of security and maintaining communication with the NRC.

The physical security threat to spent nuclear fuel in transport was recently evaluated by DOE in the *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Fuel* (DOE/EIS-0218, Volumes 1 and 2, Appendices D and H). The environmental impacts evaluated therein resulting from accidents and malicious attacks (explosion, breach of containment, fire) are relevant to the shipment of MOX fuel. Those analyses indicate that the consequences of the act to breach the packaging containment (explosions, penetration, fire) create a much higher injury and health risk than the release of the radioactive materials from the package. The packaging is designed so that the Pu is not present in sufficient quantities to create a nuclear criticality in the event of breach of the package containments. A nearby explosion unrelated to the Pu would not release Pu from the packages, and a penetration device (shaped charge, armor piercing projectiles) would most likely only rupture a single container, thus severely limiting the radioactive material hazard resulting from a malicious destructive act. The accident analyses described in this appendix address the risks associated with accidents resulting from a breach of security during transportation of PuO_2 and MOX (DOE 1996n:D-252–D-256; H-8–H-10).

Additional information on the shipment of Pu by sea can be found in *Safety of Shipments of Plutonium by Sea*, DOE/EM-0103, September 1993. This document was completed by DOE pursuant to Section 2904 of the *Energy Policy Act* of 1992, and addresses the shipment of Pu from one foreign port to another, and cites the conventions, treaties, and practices under which such shipments have been carried out and the codes and

standards used to ensure the safe and secure transport of Pu by sea. It notes that the shipment of Pu from France to Japan was done on a dedicated special purpose vessel that was accompanied by an armed escort ship capable of providing emergency support to the transport vessel.

For actions associated with this PEIS, transport of Pu by ship would be done by dedicated British Nuclear Fuel, Limited or COGEMA ships from military seaports in the United States to seaports in Great Britain or France. The transport would meet applicable IAEA requirements and the International Maritime Organization code. While in temporary storage at the seaports and during transport on the ship, appropriate escort security measures would be implemented.

G.2 HISTORICAL INTERSITE TRANSPORTATION SHIPMENT DATA

Table G.2–1 presents a 5-year (1990 through 1994) summary of the nonhazardous and hazardous cargo shipped by commercial carriers to and from each of the eight DOE sites included in this PEIS.

Table G.2–2 presents a summary, by chemical name, of all hazardous material shipped to and from Hanford Site, Idaho National Engineering Laboratory, Los Alamos National Laboratory, and Nevada Test Site for 1994. Table G.2–3 present a summary, by chemical name, of all hazardous material shipped to and from Oak Ridge Reservation, Pantex Plant, Rocky Flats Environmental Technology Site, and Savannah River Site for 1994.

G.3 HIGHWAY DISTANCE

Table G.3–1 shows the highway distance between the eight DOE sites being evaluated.

G.4 TRANSPORTATION EQUIPMENT

Packaging refers to a container and all accompanying components or materials necessary to perform its containment function. Packagings used by DOE for hazardous materials shipments are either certified to meet specific performance requirements or built to specifications described in DOT hazardous materials regulations (49 *Code of Federal Regulations* [CFR] Subchapter C). For relatively low-level radioactive materials, DOT Specification Type A packagings are used. These packagings are designed to retain their contents under normal transportation conditions. More sensitive radioactive materials shipments require use of highly sophisticated Type B packaging, designed and tested to prevent the release of contents under all credible transportation accident conditions.

Plutonium and HEU are DOE-unique hazardous materials that require special protection. In addition to meeting the stringent Type B containment and confinement requirements of the NRC's 10 CFR 71 and DOT's 49 CFR, packaging for nuclear weapons and components must be certified separately by DOE. DOE employs a closed, Government-owned and -operated Transportation Safeguards System for the intersite transport of nuclear weapons and components, including Pu and HEU. Specially designed SSTs are utilized to ensure high levels of safety and physical protection. Limited-life components are transported almost exclusively by DOE's contract air carrier.

As a representation of a typical Type B packaging used to transport weapons components, the testing sequence for the 6M, Type B packaging used for the shipment of HEU is described below. Pu packaging requires a similar, high level of protection. Most other radioactive and hazardous materials, such as LLW, would be transported by commercial truck. Figures G.4–1 through G.4–6 illustrate packaging types and a CRT used for the transport of materials.

Table G.2–1. Five-Year Summary of Cargo Shipments by Commercial Carrier To and From Department of Energy Sites

Site	1990		1991		1992		1993		1994	
	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)
Hanford										
Hazardous	1,434	6,900,276	970	6,987,898	1,138	2,703,286	1,069	1,475,251	1,170	1,348,258
Nonhazardous	44,535	42,740,651	48,881	42,828,946	60,301	32,069,447	71,303	38,498,165	74,448	15,414,828
All cargo	45,969	49,640,927	49,851	49,816,844	61,439	34,772,733	72,372	39,973,416	75,618	16,763,086
INEL										
Hazardous	1,598	19,601,146	1,672	23,719,753	1,641	18,553,980	1,864	22,006,964	1,852	16,108,334
Nonhazardous	31,150	19,774,939	34,586	10,824,950	37,379	12,590,160	40,122	19,569,410	41,419	11,825,648
All cargo	32,748	39,376,085	36,258	34,544,703	39,020	31,144,140	41,986	41,576,374	43,271	27,933,982
LANL										
Hazardous	851	544,668	680	316,974	1,089	363,818	1,133	345,403	692	214,510
Nonhazardous	28,266	4,129,802	28,757	3,943,075	36,805	1,855,129	46,663	2,617,906	49,453	3,327,743
All cargo	29,117	4,674,470	29,437	4,260,049	37,894	2,218,947	47,796	2,963,309	50,145	3,542,253
[Text deleted.]										
NTS										
Hazardous	1,742	20,627,008	1,325	15,777,433	1,432	17,834,469	1,143	15,845,750	1,324	22,384,272
Nonhazardous	23,107	38,455,253	21,898	36,197,342	19,938	31,944,034	16,568	10,622,714	14,839	21,567,339
All cargo	24,849	59,082,261	23,223	51,974,775	21,370	49,778,503	17,711	26,468,464	16,163	43,951,611
ORR										
Hazardous	2,141	3,592,513	1,433	2,254,290	3,896	8,546,187	3,130	11,765,312	3,169	6,438,748
Nonhazardous	55,921	8,176,837	57,217	6,905,370	69,771	7,448,941	74,479	5,409,370	75,684	7,409,628
All cargo	58,062	11,769,350	58,650	9,159,660	73,667	15,995,128	77,609	17,174,682	78,853	13,848,376
Pantex										
Hazardous	1,869	407,622	1,339	462,842	1,124	601,087	1,080	597,720	612	328,329
Nonhazardous	8,494	1,262,617	10,085	1,314,989	10,191	1,317,023	11,135	1,733,062	11,760	1,732,379
All cargo	10,363	1,670,239	11,424	1,777,831	11,315	1,918,110	12,215	2,330,782	12,372	2,060,708
RFETS										
Hazardous	1,031	9,063,839	620	3,072,285	553	3,394,375	640	3,409,414	671	3,389,440
Nonhazardous	14,841	5,749,752	15,409	4,284,776	14,427	4,002,657	13,555	4,573,259	13,612	4,204,062
All cargo	15,872	14,813,591	16,029	7,357,061	14,980	7,397,032	14,195	7,982,673	14,283	7,593,502

Table G.2–1. Five-Year Summary of Cargo Shipments by Commercial Carrier To and From Department of Energy Sites—Continued

Site	1990 Shipments (number)	1990 Gross Weight (kg)	1991 Shipments (number)	1991 Gross Weight (kg)	1992 Shipments (number)	1992 Gross Weight (kg)	1993 Shipments (number)	1993 Gross Weight (kg)	1994 Shipments (number)	1994 Gross Weight (kg)
SRS										
Hazardous	1,151	4,049,534	643	3,192,682	1,462	2,625,821	1,386	2,508,277	1,147	2,754,435
Nonhazardous	36,012	227,513,797	33,870	151,211,460	34,348	136,905,940	34,816	224,005,944	25,915	241,279,894
All cargo	37,163	231,563,331	34,513	154,404,142	35,810	139,531,761	36,202	226,514,221	27,062	244,034,329

Note: Gross weight includes the weight of the package.

Source: SAIC 1995a:1.

Table G.2–2. Summary of Hazardous Materials Shipped To and From Department of Energy Sites–1994

Commodity	Hanford Shipments (number)	Hanford Gross Weight (kg)	INEL Shipments (number)	INEL Gross Weight (kg)	LANL Shipments (number)	LANL Gross Weight (kg)	NTS Shipments (number)	NTS Gross Weight (kg)
Acetylene gas	1	22			1	95		
Aluminum nitrate	2	1,087	9	152,335			2	144
Aluminum sulfate, solid	1	4,798	1	3	1	142		
Ammonia, anhydrous	6	242	4	383	1	41	1	1,487
Ammonium fluoride								
Ammonium hydroxide			3	44				
Ammonium sulfate			1	3			1	13
Argon	11	1,313	2	284	3	354	20	5,975
Asbestos articles	2	5,516	2	1	1	1		
Asphalt			1	513			6	3,288,218
Beryllium metal					1	3		
Beryllium metal or powder								
Cadmium nitrate			3	23				
Cadmium sulfate			1	3				
Calcium nitrate			1	142				
Chlorine	11	17,824	5	429	1	3	1	5,670
Class A poison	13	590	4	190	3	18	2	296
Class B poison	5	2,900	1	107				

Table G.2–2. Summary of Hazardous Materials Shipped To and From Department of Energy Sites–1994—Continued

Commodity	Hanford		INEL		LANL		NTS	
	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)
Combustible liquid, n.o.s.	9	3,592	9	346	6	1,529	10	55,477
Corrosive material, n.o.s.	116	106,517	222	157,841	28	2,458	29	6,205
Dry ice	4	19			49	427		
Empty haz. cntrs. (Non-ram)	10	2,463	2	6,078			76	292,447
Enriched boric acid			2	817				
Env haz. subst. (Marine pollutant)							1	5,443
Env. hazardous substance	4	162	3	59				
Etiologic agent, n.o.s.					1	4		
Explosives, n.o.s. (Class 1.1)			2	349	8	426	3	4,891
Explosives, n.o.s. (Class 1.2)								
Explosives, n.o.s. (Class 1.3)								
Explosives, n.o.s. (Class 1.4)	2	148	3	1,195	7	376		
Ferrous sulfamate							1	5
Ferrous sulfate			1	2				
Flammable gas, n.o.s.	24	2,664	21	7,298	43	35,757	3	178
Flammable liquid, n.o.s.	97	28,101	102	31,629	23	4,162	21	2,169
Flammable solid, n.o.s.	1	51	12	18,586	14	285	2	214
Fluoboric acid								
Fuel oil (Diesel, 1-6, etc.)			336	9,681,302	5	7,146	122	4,093,274
Gasoline			60	1,592,185	1	2	94	2,741,403
Hazardous waste (Non-ram)	1	7,258			1	66	2	12
Helium	20	7,145	13	2,326	27	18,439	5	1,278
Hydrocarbon gas, compressed or liquefied								

Table G.2–2. Summary of Hazardous Materials Shipped To and From Department of Energy Sites–1994—Continued

Commodity	Hanford		INEL		LANL		NTS	
	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)
Hydrochloric acid	14	910	10	35	2	2,169	5	724
Hydrofluoric acid			1	5			3	633
Hydrofluoric acid solution, spent	3	256	1	481	1	1	3	74
Hydrogen gas	2	181			1	33		
Hydrogen peroxide	6	8,216	1	32			2	343
Irritant, n.o.s.					2	2		
Isobutane, compressed or liquefied					2	1,134	1	3
Lithium metal	6	224	1	1	3	5		
Lubricating oil			39	2,826	2	182	33	31,307
Magnesium, powder, metal strip					2	11		
Mercuric nitrate					1	15	1	1
Methanol, liquid							1	40
Methyl isobutyl ketone			3	4,193			7	150,547
Misc. hazardous material			3	1,341				
N-dodecane								
Natural gas, compressed or liquefied							1	1,270
Nitric acid (incl. fuming)	25	3,167	9	614	1	1	5	1,098
Nitric acid (over 40%)	1	40	2	43,500			1	334
Nitric acid, fuming	3	291						
Nitrogen	4	3,606	110	1,623,986	8	277	20	14,370
Non-flammable gas, n.o.s.	145	62,388	122	13,025	91	28,603	25	16,682
Organic peroxide, n.o.s.	1	1	1	1	1	1,194		
Orm A, n.o.s.								
Orm B, n.o.s.								
Orm D, consumer commodity			2	554				

Table G.2–2. Summary of Hazardous Materials Shipped To and From Department of Energy Sites–1994—Continued

Commodity	Hanford		INEL		LANL		NTS	
	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)
Orm E, n.o.s.			1	7,521				
Other regulated material, liquid			4	269				
Other regulated material, solid			9	660			3	3,612
Oxidizer, n.o.s.	91	11,693	18	1,363	4	3,023	5	271
Oxygen	9	1,273	19	289,616	3	166	4	704
Poison, liquid, n.o.s.	7	400	29	1,375	9	1,026		
Poison, solid, n.o.s.	14	235	15	587	7	98	1	19
Propane, compressed or liquefied			1	21	1	272	2	158
RAM, empty pkgs	30	156,726	41	224,474	49	35,462	1	1,016
RAM, fissile, <20% U-235								
RAM, fissile, >20% U-235								
RAM, fissile, HRCQ	3	65,317						
RAM, fissile, HRCQ, IR PINS			1	100				
RAM, fissile, HRCQ, UNIR PINS	1	21,772						
RAM, fissile, n.o.s.	1	73	5	17,327	10	669		
RAM, fissile, UNIR PINS			9	63,539				
RAM, fissile, waste								
RAM, HRCQ, special	7	107,002						
RAM, instr. & articles	25	688	2	41	1	154		
RAM, LSA, n.o.s.	6	14,590	101	866,798	5	4,651		
RAM, LSA, UF_6					1	277		
RAM, LSA, waste	34	443,212					688	11,291,791
RAM, ltd. quant, n.o.s.	161	5,429	234	785,852	124	3,257	3	3,570
RAM, medical isotopes					6	31		
RAM, n.o.s.	131	28,340	80	225,191	75	21,660	25	2,169
RAM, n.o.s., HRCQ			2	13,395	1	16,329		

Table G.2–2. Summary of Hazardous Materials Shipped To and From Department of Energy Sites–1994—Continued

Commodity	Hanford		INEL		LANL		NTS	
	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)
RAM, n.o.s., special	27	2,338	91	38,863	5	3,889	8	5,708
RAM, n.o.s., waste	12	161,664						
RAM, U-metal, pyrop					1	1		
RAM, UO_x, n.o.s.			1	1				
Small arms ammunition			1	36			1	387
Sodium hydroxide (caustic soda)	13	28,331	13	77,621	7	8,218	7	8,389
Sodium metal, (non-RAM)	3	315	5	44				
Sodium nitrate	10	1,667			1	5	1	3
Spontaneously combustible material	3	4	3	30	3	47		
Sulfuric acid	9	23,408	13	141,353	2	403	1	1
Toxic gas, inhalation hazard	13	284	7	655	26	7,500		
Trichloroethane 1,1,1			2	220				
Wet cell batteries	10	1,804	14	6,322	9	2,013	64	344,251
Total	1,170	1,348,257	1,852	16,108,341	692	214,512	1,324	22,384,272

Note: Gross weight (kg) includes the weight of the package; n.o.s.=not otherwise specified.

Source: SAIC 1995a:2.

Table G.2–3. Summary of Hazardous Materials Shipped To and From Department of Energy Sites–1994

Commodity	ORR		Pantex		RFETS		SRS	
	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)
Acetylene gas	13	8,101			5	1,714	17	3,372
Aluminum nitrate	1	5			1	2	2	53
Aluminum sulfate, solid	1	378			1	962	2	6,277
Ammonia, anhydrous	3	686			2	252	4	587
Ammonium fluoride	1	1						
Ammonium hydroxide			1	34	4	397		
Ammonium sulfate								
Argon	199	430,223	8	1,250	48	797,649	33	82,713
Asbestos articles	33	37,544						
Asphalt			1	540	1	16		
Beryllium metal								
Beryllium metal or powder	1	6,638						
Cadmium nitrate	1	489			2	7		
Cadmium sulfate								
Calcium nitrate	1	1	1	2	3	16		
Chlorine	35	63,200	4	1,780	3	895		
Class A poison	2	10						
Class B poison	2	3,680	2	1,343				
Combustible liquid, n.o.s.	28	2,237	7	1,142	11	186	3	119
Corrosive material, n.o.s.	183	213,634	60	15,996	32	5,654	120	290,507
Dry ice	153	45,406			33	496		
Empty haz. cntrs. (non-RAM)	210	576,434						
Enriched boric acid								
Env haz. subst. (marine pollutant)	3	80					1	20
Env. haz. subst.	10	4,934			2	302		
Etiologic agent, n.o.s.	1	144						
Explosives, n.o.s. (Class 1.1)			27	25,058				

Table G.2–3. Summary of Hazardous Materials Shipped To and From Department of Energy Sites–1994—Continued

Commodity	ORR		Pantex		RFETS		SRS	
	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)
Explosives, n.o.s. (Class 1.2)			1	40			5	29,821
Explosives, n.o.s. (Class 1.3)			2	2,650				
Explosives, n.o.s. (Class 1.4)	7	3,870	93	14,008	6	6,588	8	4,859
Ferrous sulfamate	1	2,749	1	21				
Ferrous sulfate	2	2,041						
Flammable gas, n.o.s.	42	24,301	13	1,734	4	4,621	25	57,028
Flammable liquid, n.o.s.	140	54,056	54	6,947	20	1,278	33	28,406
Flammable solid, n.o.s.	35	360	58	6,068	1	11	1	7
Fluoboric acid	1	1						
Fuel oil (diesel, 1-6, etc.)	109	366,209			37	434,956	3	2,188
Gasoline	166	624,837			37	763,986	10	4,790
Hazardous waste (non-RAM)	3	12	1	19	2	8,865	8	1,438
Helium	33	42,913	11	640	9	104,851	21	27,444
Hydrocarbon gas, compressed or liquefied								
Hydrochloric acid	16	95	6	20	19	1,735	25	43,606
Hydrofluoric acid	2	59			3	284	7	6,885
Hydrofluoric acid solution, spent	1	4			2	495	1	27
Hydrogen gas	11	39,032	3	217	2	1,062	13	2,620
Hydrogen peroxide	8	1,911	1	2	2	54	9	3,870
Irritant, n.o.s.								
Isobutane, compressed or liquefied	2	1						
Lithium metal	24	3,290	9	845				
Lubricating oil	13	1,589	14	3,766	1	260	22	8,391
Magnesium, powder, metal strip	10	6					1	39

Table G.2–3. Summary of Hazardous Materials Shipped To and From Department of Energy Sites–1994—Continued

Commodity	ORR		Pantex		RFETS		SRS	
	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)
Mercuric nitrate								
Methanol, liquid	1	1			3	26	1	123
Methyl isobutyl ketone								
Misc. hazardous material	19	653	1	13	1	8	1	75
N-dodecane								
Natural gas, compressed or liquefied							1	373
Nitric acid (incl. fuming)	14	20,827	3	59	32	4,021	22	6270
Nitric acid (over 40%)	1	18					4	306
Nitric acid, fuming	1	2					3	1,143
Nitrogen	58	269,550	2	384	115	877,031	32	69,318
Non-flammable gas, n.o.s.	141	103,053	29	6,310	37	15,839	205	1,477,767
Organic peroxide, n.o.s.	2	2					2	11
Orm A, n.o.s.	2	7,874						
Orm B, n.o.s.					1	12,791		
Orm D, consumer commodity					1	54	10	4,619
Orm E, n.o.s.	5	11,544						
Other regulated material, liquid	3	79			4	6,373	1	626
Other regulated material, solid	1	159						
Oxidizer, n.o.s.	47	1,486	2	35	17	851	4	15,321
Oxygen	24	4,811	2	258	9	6,173	20	26,036
Poison, liquid, n.o.s.	47	5,880	4	124	11	756	1	1
Poison, solid, n.o.s.	50	258			5	393	1	1
Propane, compressed or liquefied	5	227			2	301	1	68
RAM, empty pkgs	68	313,080	88	159,735	12	4,474	17	24,540
RAM, fissile, <20% U-235	3	6,275						

Table G.2–3. Summary of Hazardous Materials Shipped To and From Department of Energy Sites–1994—Continued

Commodity	ORR		Pantex		RFETS		SRS	
	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)	Shipments (number)	Gross Weight (kg)
RAM, fissile, >20% U-235	15	2,318						
RAM, fissile, HRCQ								
RAM, fissile, HRCQ, IR PINS							17	212,305
RAM, fissile, HRCQ, UNIR PINS								
RAM, fissile, n.o.s.	10	36,770	1	1,659			2	220
RAM, fissile, UNIR PINS								
RAM, fissile, waste			1	7,254	1	7,971		
RAM, HRCQ, special	2	4,364						
RAM, instr. & articles	9	5,875	5	91				
RAM, LSA, n.o.s.	454	1,120,758	9	466	37	138,597		
RAM, LSA, UF_6	66	1,270,833						
RAM, LSA, waste	6	111,223			9	151,142		
RAM, ltd. quant., n.o.s.	209	197,911	48	57,469	18	4,201	239	64,891
RAM, medical isotopes	107	390						
RAM, n.o.s.	135	124,546	23	3,903	8	1,269	32	69,099
RAM, n.o.s., HRCQ	1	13,744						
RAM, n.o.s., special	58	38,376	6	89	1	4	6	216
RAM, n.o.s., waste	1	109						
RAM, U-metal, pyrop	3	529						
RAM, UO_x, n.o.s.	1	2						
Small arms ammunition	1	1,013	4	4,913	5	431		
Sodium hydroxide (caustic soda)	27	70,840			6	812	52	39,585
Sodium metal, (non-RAM)	3	65						
Sodium nitrate	3	233	1	2	3	331	3	169
Spontaneously combustible material	1	3			1	11		
Sulfuric acid	13	103,875			6	918	13	81,353

Table G.2–3. Summary of Hazardous Materials Shipped To and From Department of Energy Sites–1994—Continued

Commodity	ORR Shipments (number)	ORR Gross Weight (kg)	Pantex Shipments (number)	Pantex Gross Weight (kg)	RFETS Shipments (number)	RFETS Gross Weight (kg)	SRS Shipments (number)	SRS Gross Weight (kg)
Toxic gas, inhalation hazard	16	340	1	653	3	418	7	1,675
Trichloroethane 1,1,1	8	247	2	108				
Wet cell batteries	21	27,448	2	684	30	16,652	81	84,262
Total	3,169	6,438,750	612	328,331	671	3,389,442	1,152	2,754,435

Note: Gross weight (kg) includes the weight of the package; n.o.s.=not otherwise specified.
Source: SAIC 1995a:2.

Table G.3–1. Highway Distance Between Department of Energy Sites (kilometers)

Site	Hanford	NTS	INEL	Pantex	ORR	SRS	RFETS	LANL
Hanford	0	1,491	850	2,497	3,867	4,299	1,813	1,998
NTS	1,491	0	1,138	1,539	3,272	3,610	1,359	1,220
INEL	850	1,138	0	1,721	3,077	3,523	1,037	1,311
Pantex	2,497	1,539	1,721	0	1,732	2,070	726	535
ORR	3,867	3,272	3,077	1,732	0	531	2,145	2,267
SRS	4,299	3,610	3,523	2,070	531	0	2,590	2,605
RFETS	1,813	1,359	1,037	726	2,145	2,590	0	630
LANL	1,998	1,220	1,311	535	2,267	2,605	630	0

Source: DOE 1991j; DOE 1992o:3; McNally 1990a.

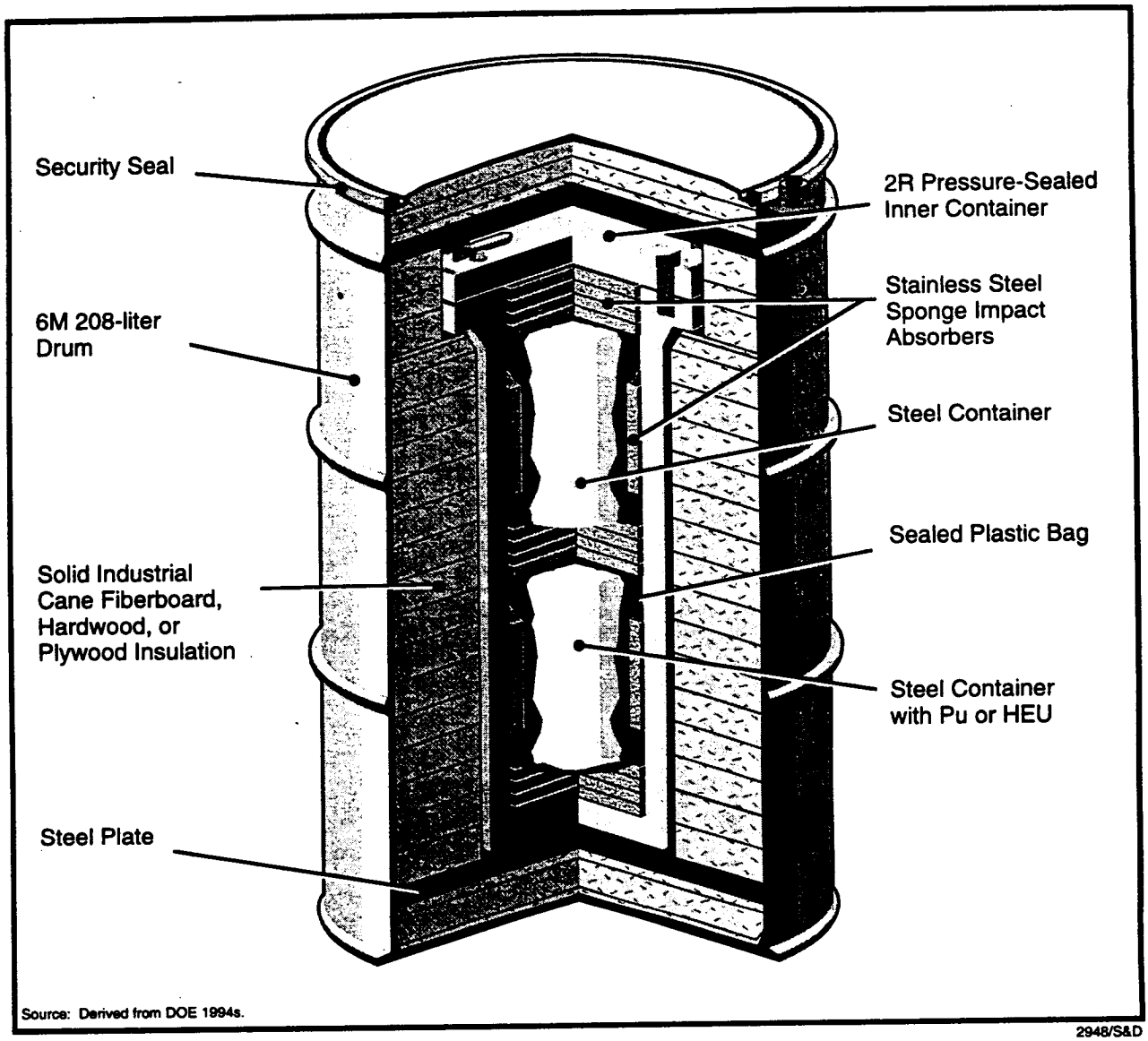
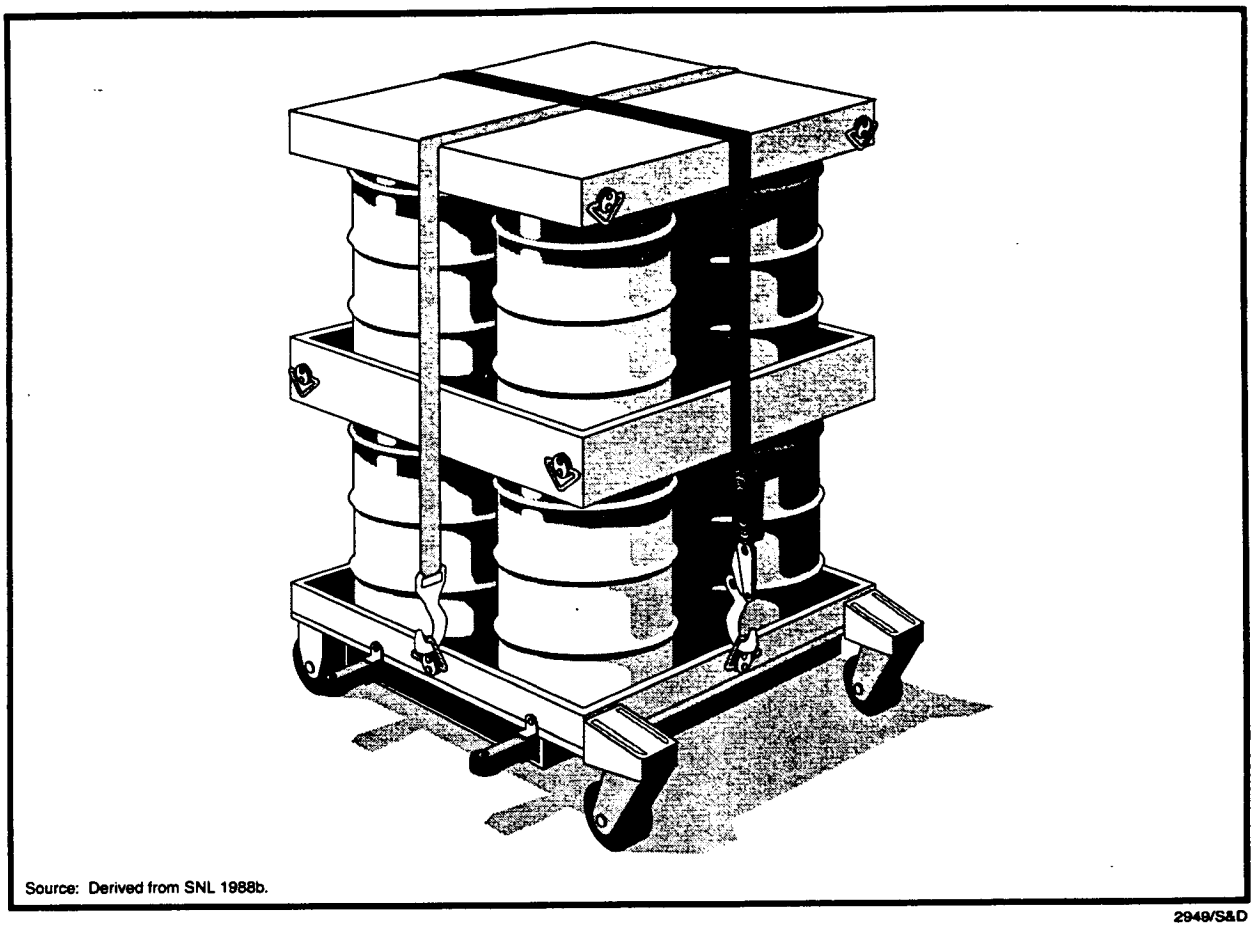


Figure G.4–1. Typical Assembly of 6M, Type B Packaging for Plutonium (Other Than Pits) or Highly Enriched Uranium



Source: Derived from SNL 1988b.

2949/S&D

Figure G.4–2. Cargo Restraint Transporter Loaded With Drums.

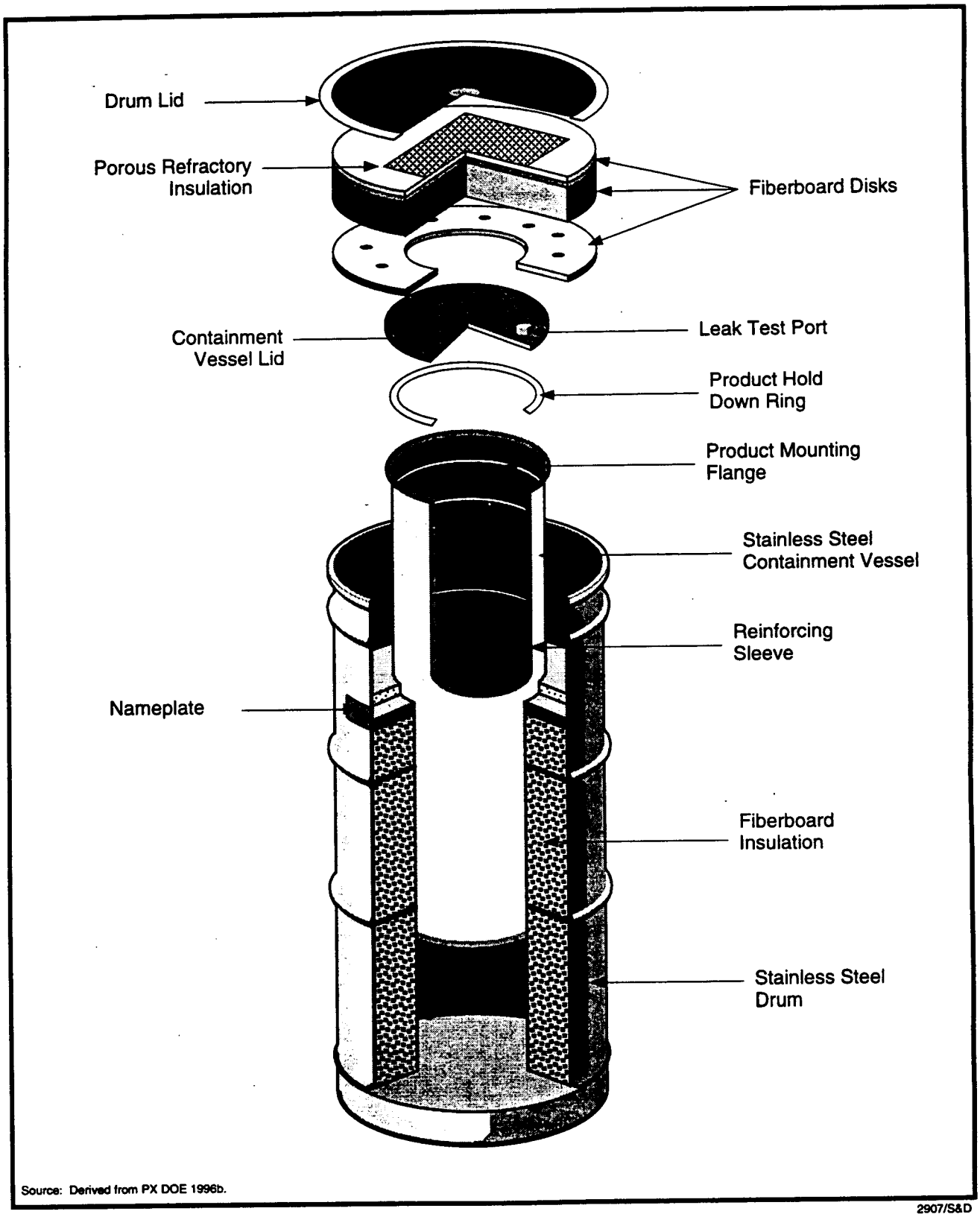
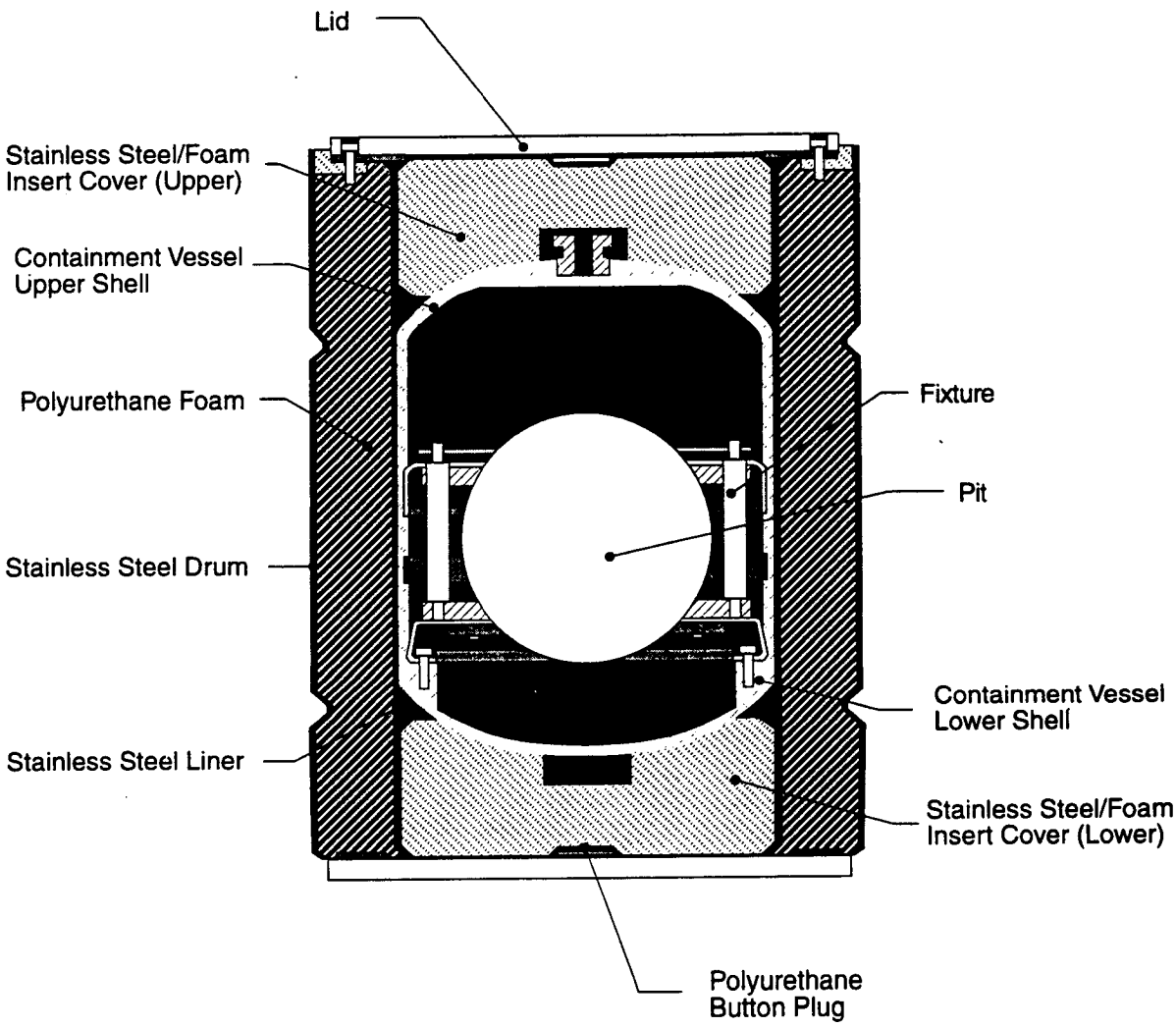


Figure G.4–3. Assembly of FL, Type B Packaging for the Transport of Plutonium Pits.



Note: Drawing not to scale.
Source: Derived from PX DOE 1996b.

3174/S&D

Figure G.4–4. AT-400A Packaging for the Transport of Plutonium Pits.

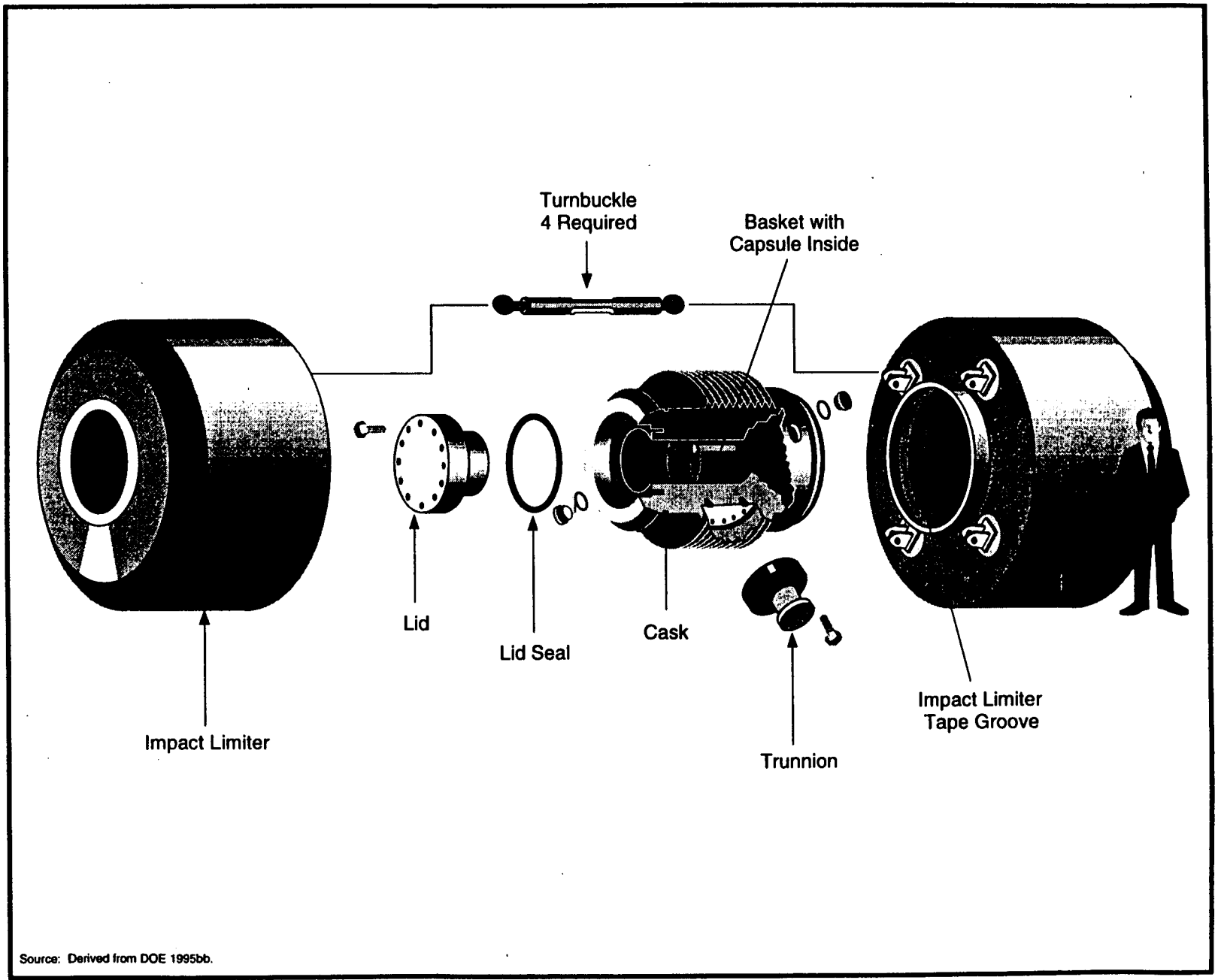


Figure G.4–5. Representation of the BUSS Cask for the Transport of Cesium Material.

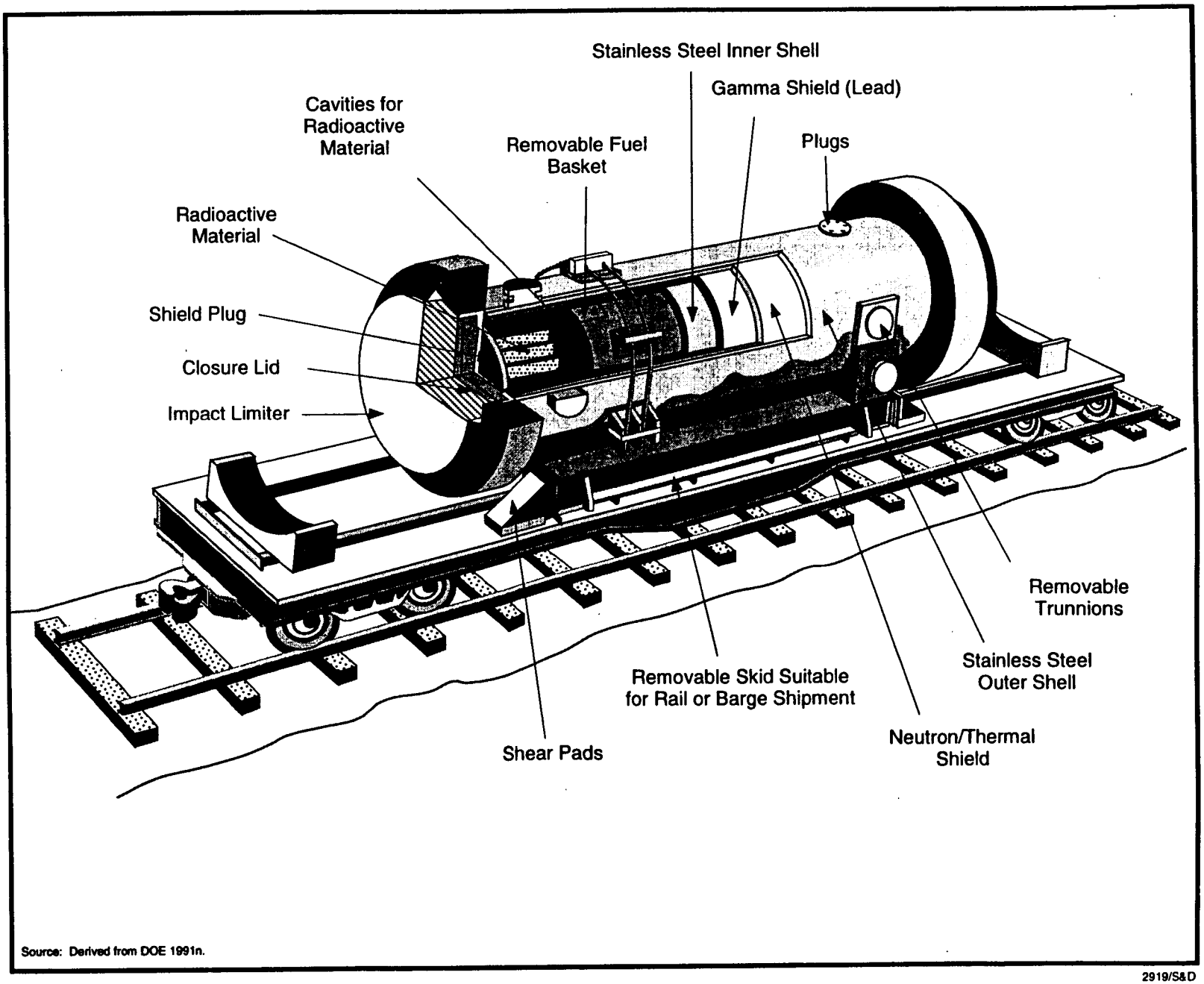


Figure G.4–6. Diagram of a Representative Spent Fuel Cask With Similar Characteristics to Be Employed for the Transport of Immobilized Plutonium.

G.5 6M, TYPE B RADIOACTIVE MATERIAL SHIPMENT PACKAGING TEST SEQUENCE

In addition to meeting DOT standards demonstrating it can withstand normal conditions of transport without loss or dispersal of its radioactive contents, the model 6M, Type B packaging used for DOE shipments must survive certain severe hypothetical accident conditions that demonstrate resistance to impact, puncture, fire, and water submersion. Test conditions do not duplicate accident environments, but rather, produce damage equivalent to extreme and unlikely accidents. The 6M, Type B packaging is judged as surviving extreme sequential testing if it retains all its contents except for minuscule allowable releases, and the dose rate outside the packaging does not exceed 1 rem/hr at a distance of 1 m (3.3 ft) from the package surface. Drum sizes (outer package) can vary from 38 to 416 liters (10 to 110 gallons).

The complete sequence of tests is listed below.

- **Drop Test.** A 9-m (30-ft) drop onto a flat, essentially unyielding, horizontal surface, striking the surface in a position for which maximum damage is expected.
- **Puncture Test.** A 1-m (3.3-ft) drop onto the upper end of a 15-centimeter (6-inch) diameter solid, vertical, cylindrical, mild steel bar mounted on an essentially unyielding, horizontal surface.
- **Thermal Test.** An exposure for no less than 30 minutes to a heat flux no less than that of a radiation environment of 800 °C (1,475 °F) with an emissivity coefficient of at least 0.9.
- **Water-Immersion Test.** A subjection to water pressure equivalent to immersion under a head of water of at least 15 m (50 ft) for no less than 8 hours.

The regulatory test conditions for the 6M, Type B packaging and other similar packaging are much more demanding than they might appear. For example, an impact on a very hard surface (desert caliche) at more than 322 km (200 mi) per hour is not as likely to deform the packaging as would a drop of 9 m (30 ft) onto an unyielding target.

A typical 6M, Type B packaging approved for use by DOE is covered by Certificate of Compliance Number 9859, dated January 5, 1994. The 6M, Type B packaging is made up of several components each with an integral engineered role in containment and confinement of the radioactive material being shipped. Although 6M, Type B packaging has been involved in severe accidents, the integrity of the packaging has never been compromised.

It is noted that there is some controversy concerning the adequacy of the Type B packaging. However, these packages are currently certified as safe for transporting radioactive materials. If the safety certification for the packaging is withdrawn, new analysis will be required.

G.6 SAFE SECURE TRANSPORT

Since 1947, DOE and its predecessor agencies have moved nuclear weapons, nuclear weapons components, and special nuclear materials by a variety of commercial and Government transportation modes. In the late 60s, worldwide terrorism and acts of violence prompted a review of procedures for safeguarding these materials. As a result, a comprehensive new series of regulations and equipment was developed to enhance the safety and security of these materials in transit. Subsequently, the Transportation Safeguards Division (TSD) was established in 1975 at the DOE Albuquerque Operations Office. TSD modified and redesigned transport equipment to incorporate features that more effectively enhance self protection and deny unauthorized access to the materials. During that time, TSD curtailed the use of commercial transportation systems and moved to a total Federal operation.

Management, control, and direction of TSD is centralized at Albuquerque Operation Office. Both the Federal officers who drive the transportation vehicles and the escorts are Nuclear Materials Couriers. There are three courier operations centers, located at Amarillo, Texas, Oak Ridge, Tennessee, and Albuquerque, New Mexico. Approximately 100 shippers and receivers of special nuclear material and other sensitive materials are served at locations throughout the continental United States.

Since its establishment in 1975, TSD has accumulated over 110 million km (70 million mi) of over-the-road experience transporting DOE-owned cargo with no accidents causing a fatality or release of radioactive material. This is due largely to the TSD philosophy that safety and security are of equal and paramount importance in the accomplishment of DOE's transportation safeguards mission.

The SST is a specially designed part of an 18-wheel rig that incorporates various deterrents to prevent unauthorized removal of cargo. The trailer has been designed to afford the cargo protection against damage in the event of an accident. This is accomplished through superior structural characteristics and a highly reliable cargo tiedown system similar to that used aboard aircraft. The thermal characteristics of the SST would allow the trailer to be totally engulfed in a fire without incurring damage to the cargo. The tractors are standard production units that have been modified to provide the couriers protection against attack. Other vehicles that make up the convoy may include Ford vans and Chevrolet Suburbans. These tractors and escort vehicles are equipped with communications, electronic, radiological monitoring, and other equipment that further enhance en route safety and security. The vehicles utilized by TSD must meet maintenance standards significantly more stringent than those for similar commercial transport equipment. All vehicles undergo an extensive maintenance check before every trip, as well as periodic preventative maintenance inspections. In addition, these vehicles are replaced more frequently than commercial shippers. As a result, TSD experiences few en route breakdowns and has had no accidents due to equipment malfunction.

The TSD makes every effort to ensure its convoys do not travel during periods of inclement weather. Should the convoys encounter adverse weather, provisions exist for the convoys to seek secure shelter at previously identified facilities. Although TSD provides sleeper berths in all vehicles, couriers accompanying TSD shipments do not exceed 32 hours of continuous travel without being afforded the opportunity for 8 hours of uninterrupted, stationary bed rest. TSD has also imposed a maximum 88-km/hr (55-mph) speed limit on its convoys, even if the posted limit is greater.

Security Communications is a nationwide communications system operated by TSD and located in Albuquerque. This system provides a capability to monitor the status and location of every convoy and maintain real-time communications 24 hours a day, 365 days a year with every convoy. The control center maintains an emergency contact directory of Federal, State, and local response organizations located throughout the contiguous United States. This capability is available to TSD 24 hours a day, 365 days a year.

Armed Nuclear Materials Couriers accompany each shipment containing special nuclear material. They also drive the highway tractors and escort vehicles while operating the communications and other convoy equipment. Couriers are non-uniformed Federal officers and are authorized by the *Atomic Energy Act* to make arrests and carry firearms in the performance of their duties. They carry both a photo identification card and shield which certify their Federal status. Couriers are required to obey all traffic laws and will cooperate fully with law enforcement officers. After careful screening and selection, courier trainees undergo a 12-week basic training course, during which they receive instruction in tractor-trailer driving, electronic and communications systems operation, and firearms. Tests in operating procedures, physical fitness, driving, firearms, and other job related subjects must be passed in order for a courier to be certified. Following basic training, the courier spends the balance of the first year in on-the-job training. The first year of employment is probationary, and the courier must successfully complete it to be retained. Couriers are given in-service training throughout their careers. These classes are designed to refresh and update the training taught during basic training, in addition to preparing couriers for demonstrations or armed attacks. Subjects such as team tactics, terrorist tactics, and new adversary

technology are taught. In addition, physical and firearm proficiency is tested. Couriers must continue to meet periodic qualification requirements relative to firearms, physical fitness, and driving proficiency. They must also undergo and pass an annual medical examination for continued certification under the DOE Personnel Assurance Program. In addition, couriers are subject to DOE's randomized drug and alcohol testing program. If a courier fails to meet any of the minimum requirements necessary for courier certification, the individual is temporarily removed from active status and provided additional training until demonstrated performance reaches an acceptable level.

The TSD has a liaison program through which it communicates with law enforcement and public safety agencies throughout the country, making them aware of these shipments. TSD has established procedures should an SST be stopped by an officer. The liaison program provides law enforcement officers information to assist them in recognizing one of these vehicles should it be involved in an accident, and what actions to take in conjunction with the actions of the couriers in the rig and the escort vehicles. Through the liaison program, TSD offers in-depth briefings at the State level (DOE 1993ff:1-4).

Appendix H
High-Level Waste Forms Comparative Analysis

H.1 METHODOLOGY

This appendix evaluates various plutonium (Pu) forms for potential disposal in a geologic repository. Although a repository site has not yet been recommended for development by the President and approved by Congress, this programmatic environmental impact statement (PEIS) assumes (for analysis purposes only) the existence of a hypothetical repository, managed by the Department of Energy (DOE) Office of Civilian Radioactive Waste Management, at the Yucca Mountain Site in southern Nevada. In accordance with the *Nuclear Waste Policy Act* (NWPA) of 1982, as amended by the NWPA Amendments of 1987 (42 USC 10101), DOE is evaluating the suitability of the Yucca Mountain Site as a potential geologic repository for the disposal of spent nuclear fuel and high-level waste (HLW). Such a repository, if approved under the provisions of the NWPA, would serve primarily as the disposal site for commercial and DOE-owned spent nuclear fuel and HLW. Certain highly radioactive material, which the Nuclear Regulatory Commission (NRC) determines by rule requires permanent isolation, may also be disposed of as HLW in a geologic repository. Such a NRC determination or legislative clarification may be required to dispose of the immobilized forms that would result from the Immobilization Alternatives. Since no waste forms are currently licensed for disposal in an HLW repository, data for forms under consideration in this PEIS for ultimate disposal in a repository are compared to data for those forms currently being evaluated for disposal in an NWPA-licensed repository (that is, commercial and DOE-owned spent nuclear fuel and vitrified HLW). The Environmental Protection Agency has specified that vitrification is the best demonstrated available technology for HLW (55 FR 22627). This approach implies that if the behavior of the Pu forms in a repository is the same or better than the commercial spent nuclear fuel or HLW, and if a repository can be licensed for commercial spent nuclear fuel and HLW, then it is possible that the proposed Pu forms could also be disposed in a repository. [Text deleted.] Due to the great amount of data and information available, U-based commercial spent nuclear fuel and vitrified HLW are used for the basis of the comparison.

If the DOE HLW Program changes its approach for disposal of commercial spent nuclear fuel, if the timeframe for acceptance of forms into the program is significantly delayed beyond Pu disposition requirements, or if the Pu immobilized forms or mixed oxide (MOX)-based spent nuclear fuel resulting from Pu disposition alternatives are determined to be unacceptable to a licensed repository, then DOE would analyze the impacts of continued storage of immobilized Pu or MOX-based spent nuclear fuel in a tiered *National Environmental Policy Act* of 1969 (NEPA) document. Simultaneously, DOE will continue its efforts to site and construct a repository that meets the requirements of the NWPA.

This appendix contains a comparative analysis of five Pu forms: (1) immobilized Pu and other radionuclides in borosilicate glass, (2) immobilized Pu and other radionuclides in ceramic disks, (3) boiling water reactor (BWR) MOX-based spent nuclear fuel, (4) pressurized water reactor (PWR) MOX-based spent nuclear fuel, and (5) immobilized Pu and other radionuclides in glass-bonded zeolite (GBZ). The purpose of this feasibility analysis is to compare the performance of these Pu forms against those currently being considered for disposal in a repository. The comparison for these Pu forms is based on information in the *Report on Evaluation of Plutonium Waste Forms For Repository Disposal*. Further, since the NWPA (as amended) identifies Yucca Mountain, Nevada, as the only location for repository site characterization studies, all candidate waste form performance analyses assume the same geological conditions (unsaturated tuff) as that site.

For each alternative, the total number of additional, if any, waste packages that would be added to the approximately 12,000 packages currently envisioned for the first HLW repository is small enough that any changes in emplacement could be accommodated within the design ratings of such a repository.

H.2 GLASS FORM WITH RADIONUCLIDES

The Pu-loaded glass form is assumed to be fabricated in a new facility using borosilicate glass as the vitrified matrix with the radioactive Cs isotope (Cesium-137) mixed in to provide a source of radiation as a barrier to theft and diversion. This PEIS analyzes only gadolinium (Gd) although boron and lithium neutron absorbers present in the borosilicate glass could be supplemented with samarium or other neutron absorbers.

H.2.1 ASSUMPTIONS

Figure H.2.1–1 shows the waste package containing the glass forms. For the purposes of the PEIS analyses, the following assumptions have been made:

- The waste is packaged as shown in Figure H.2.1–1.
- Molten glass is poured into stainless steel canisters to form encased glass logs that are similar to the Defense Waste Processing Facility (DWPF) glass logs and canisters.
- Each transportation cask holds five of these canisters; each disposal waste package holds four of these canisters.

H.2.2 CHARACTERISTICS

Each proposed glass log from a vitrification facility process consists of 1,540 kilograms (kg) (3,387 pounds [lb]) of borosilicate glass in a stainless steel canister containing 84 kg (185 lb) Pu, 1 kg (2.2 lb) Cs-137, and 55 kg (122 lb) Gd. The Gd, together with the boron and lithium in the glass, acts as a neutron absorber. Other than the addition of Pu, Cs, and Gd, the composition of this glass is assumed to be similar to the borosilicate glass candidate waste form in production at the DWPF at Savannah River Site.

H.2.3 COMPARATIVE ANALYSIS

Regulatory. Any waste form that is accepted for disposal in an HLW geologic repository must comply with the provisions of the NWPA, as amended. According to Section 2(12)A of the NWPA, the definition of HLW does not explicitly include Pu loaded into borosilicate glass. However, under Section 2(12)B of the NWPA, the NRC has the authority to classify this waste as HLW through rulemaking. Such rulemaking or clarification in authorizing legislation will be necessary before this waste form can be considered for disposal in an NWPA repository. The final disposal of this waste form will have to conform to the licensing provisions of 10 CFR 60. Further, it is current policy of the DOE not to accept into the first HLW repository any wastes that include components regulated as hazardous under the *Resource Conservation and Recovery Act* (RCRA) (DOE 1995a:6). The absence of any RCRA-regulated hazardous materials in the final glass form would have to be demonstrated prior to acceptance into the HLW repository.

Criticality. The effective neutron multiplication factor (k_{eff}) for the intact glass form, assuming credit for the neutron absorbers during the post-closure period, is calculated to be to less than 0.3, which is well below the 0.95 maximum value of k_{eff} allowed (10 CFR 60).

Thermal. As shown in Figure H.2.3–1, the results of a thermal analysis of a waste package containing four Pu glass logs indicate that the peak temperature reached by the glass package is about 200 degrees Centigrade (°C) (~400 degrees Fahrenheit [°F]), which is within 5 percent of the peak temperature predicted for the glass logs from the DWPF. These predicted temperatures are far lower than, and therefore safely away from, the glass transition temperature of 400 °C (750 °F). Such small differences in temperature and thermal output are unlikely to materially affect the thermal balance of any repository.

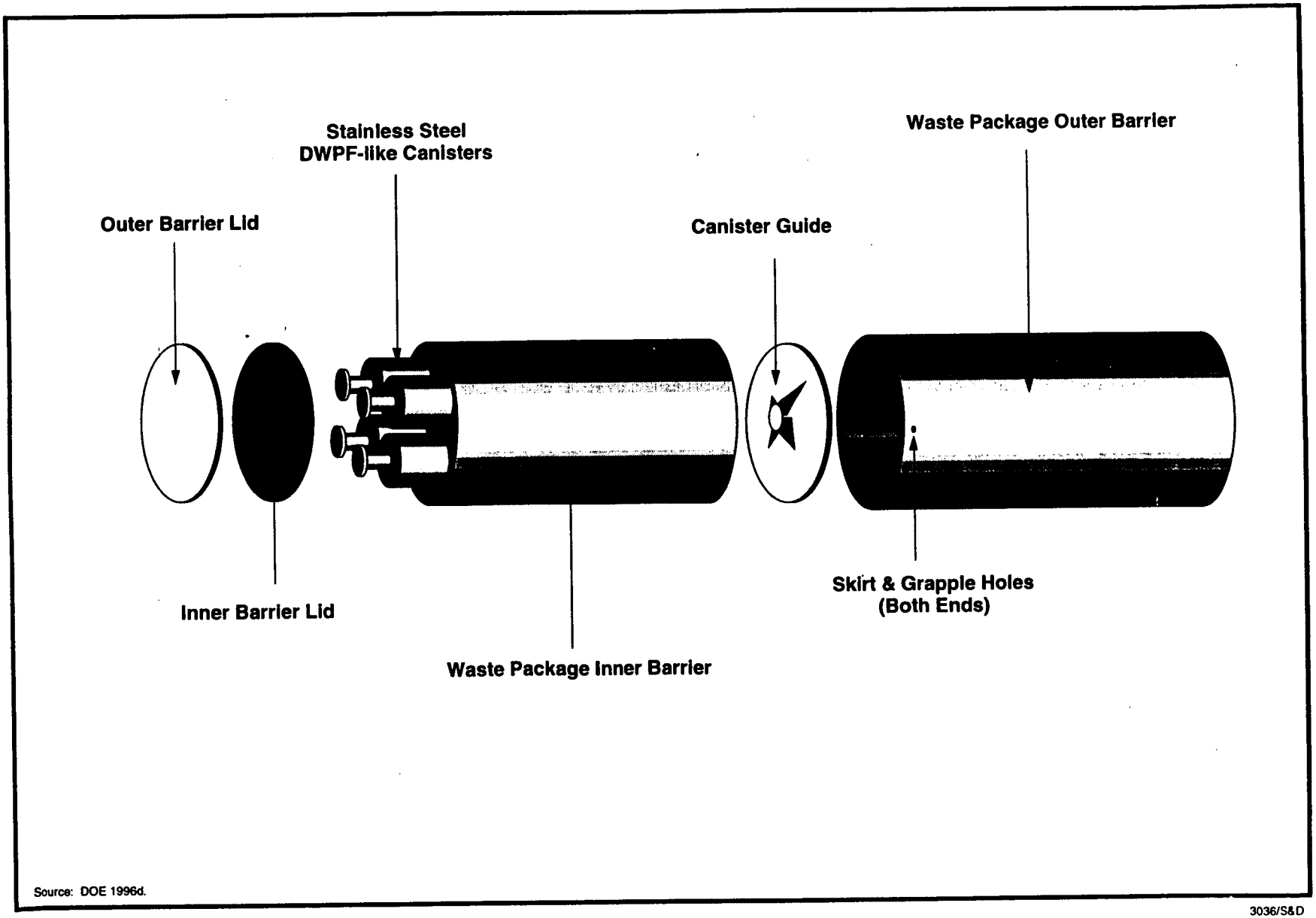


Figure H.2.1–1. Schematic of Waste Package Containing Canisters of Plutonium Immobilized in Glass.

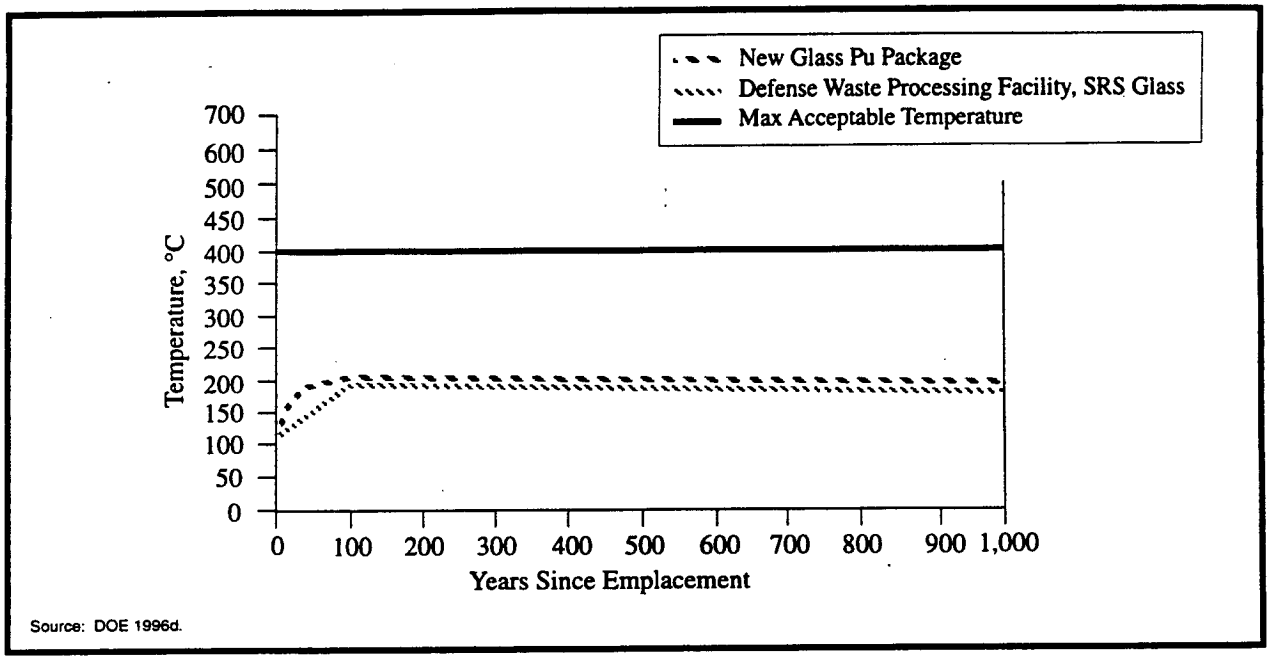


Figure H.2.3–1. Thermal Comparison of Plutonium-Loaded Glass Waste Package Versus Defense Waste Processing Facility Glass Waste Package.

Radiation. A comparison between the DWPF glass and the glass containing Pu shows that the radiation dose at the waste package surface is 81 roentgen equivalent man (rem)/hour (hr) for the DWPF glass compared to 129 rem/hr for the Pu glass. This Pu-glass radiation is above the threshold value for radiolytic corrosion. A 0.4 centimeters (cm) (0.16 inches [in]) additional thickness of the copper-nickel (Cu-Ni) alloy waste package outer barrier would be required to reduce the radiation to an acceptable (100 rad [radiation absorbed dose]/hr) level to protect the waste package from radiolysis-induced corrosion. Additional shielding is also required to protect workers. Doses at a distance of 2 meters (m) (6.6 feet [ft]) from the waste package surface show values of 12.5 rem/hr for the DWPF glass and 25 rem/hr for the Pu glass. For emplacement in the repository, only 5 cm (2 in) of lead thickness and 0.5 cm (0.2 in) of borated polyethylene neutron shielding must be added to the waste package underground transporter to reduce the radiation doses to meet the standard allowable dose of 10 millirem/hr at 2 m (7 ft) from lateral outer surfaces (49 CFR 173.441) to ensure worker protection. An alternative approach to accommodating the higher radiation from the Pu-loaded glass would be to reduce the number of canisters per waste package or the quantity of Cs-137.

Releases. The peak doses from a repository that contains commercial spent nuclear fuel, vitrified HLW, and Pu immobilized in borosilicate glass are the same as from a repository that contains only commercial spent nuclear fuel and vitrified HLW, for periods up to one million years (DOE 1996d:4-12). These results are to be expected since the quantity of Pu glass is small compared to the quantity of spent nuclear fuel in the repository.

H.3 CERAMIC IMMOBILIZED FORMS WITH RADIONUCLIDES

The Pu-loaded ceramic matrix form is assumed to be fabricated in a new facility. As in the vitrification alternative, Cs-137 is mixed in to provide a source of radiation, and Gd acts as a neutron absorber.

H.3.1 ASSUMPTIONS

Figure H.3.1–1 shows the waste package containing the ceramic forms. For the purposes of the PEIS analyses, the following assumptions have been made:

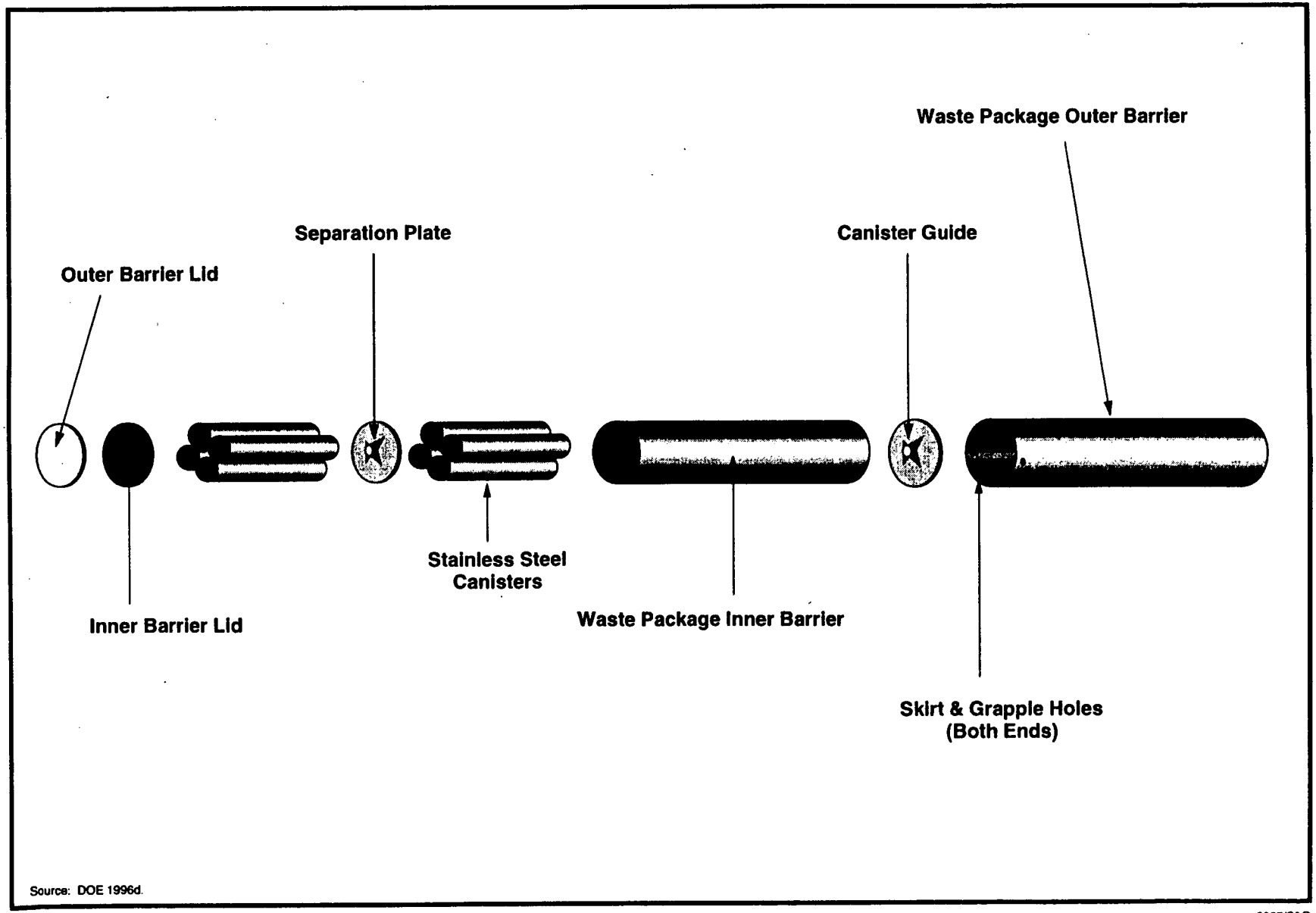


Figure H.3.1–1. Schematic of Waste Package Containing Canisters of Plutonium Immobilized in Ceramic.

- The waste is packaged as shown in Figure H.3.1–1.
- Ceramic disks will be stacked inside stainless steel canisters. These canisters are similar to the DWPF canisters.
- Each disposal waste package holds eight of these canisters.

H.3.2 CHARACTERISTICS

Each canister of the proposed waste form contains 20 ceramic disks; each disk is approximately 30 cm (12 in) in diameter, and 10 cm (4 in) thick. Each disk has stainless steel plates added to the top and bottom, and a stainless steel shell around the curved surface. The disks are stacked vertically in a stainless steel canister approximately 2.5 m (8 ft) long, and 35 cm (14 in) in diameter. The ceramic disks consist of zirconolite, hollandite, and rutile. For each disk, the zirconolite incorporates 2.6 kg (6.0 lb) of Gd, and the hollandite incorporates 4.0 kg (9.0 lb) of Pu and 0.07 kg (2.0 oz) of Cs-137. The space surrounding the stack of disks inside the canister is filled with titanium oxide powder.

H.3.3 COMPARATIVE ANALYSIS

Regulatory. Any waste form that is accepted for disposal in an HLW geologic repository must comply with the provisions of the NWPA, as amended. According to Section 2(12)A of the NWPA, the definition of HLW does not explicitly include Pu loaded into a ceramic matrix. However, under Section 2(12)B of the NWPA, the NRC has the authority to classify this waste as HLW through rulemaking. Such rulemaking or clarification in authorizing legislation would be necessary before this waste form can be considered for disposal in an NWPA repository. The final disposal of this waste form will have to conform to the licensing provisions of 10 *Code of Federal Regulations* (CFR) 60. Further, it is current policy of the DOE not to accept into the first HLW repository any wastes which include components regulated as hazardous under RCRA (DOE 1995a:6). The absence of any RCRA-regulated hazardous materials in the final ceramic form would have to be demonstrated prior to acceptance into the HLW repository.

Criticality. Preliminary criticality calculations for the intact ceramic waste package, under dry or flooded conditions, and assuming credit for the Gd neutron absorber, yields k_{eff} values of less than 0.7, which is below the 0.95 maximum value of k_{eff} allowed (10 CFR 60).

Thermal. As shown in Figure H.3.3–1, the results of a thermal analysis of Pu-loaded ceramic waste packages shows that peak temperatures are around 200 °C (~400 °F), declining as a function of time. Ceramic, unlike glass, does not have a transition temperature because it is a crystalline material. The lowest melting point temperature for the oxides of this ceramic material is around 1800 °C (3270 °F). Therefore, the calculated peak temperatures are unlikely to affect the ceramic matrix. Further, the temperature differences between the ceramic waste package and the DWPF HLW glass waste package are negligibly small.

Radiation. A comparison between the DWPF HLW glass and the Pu-loaded ceramic shows that the radiation dose at the waste package surface is 81 rem/hr for the DWPF glass compared to 309 rem/hr for the ceramic. The radiation level for the ceramic form is above the threshold value for radiolytic corrosion. Consequently, a 1-cm (0.4-in) additional thickness of the Cu-Ni alloy waste package outer barrier would be required to reduce the radiation to an acceptable level (100 rad/hr) to protect the waste package from radiolytic corrosion. Additional shielding is also required to protect workers. Doses at 2 m (6.6 ft) from the package surface show values of 12.5 rem/hr for the DWPF glass and 56.4 rem/hr for the ceramic. For emplacement in a repository, only 5 cm (2 in) of lead thickness and 0.5 cm (0.2 in) of borated polyethylene neutron shielding must be added to the waste package underground transporter to reduce the radiation doses to meet the standard allowable dose of 10 mrem/hr at 2 m (7 ft) from lateral surfaces (49 CFR 173.441) to ensure worker protection. An alternative approach to

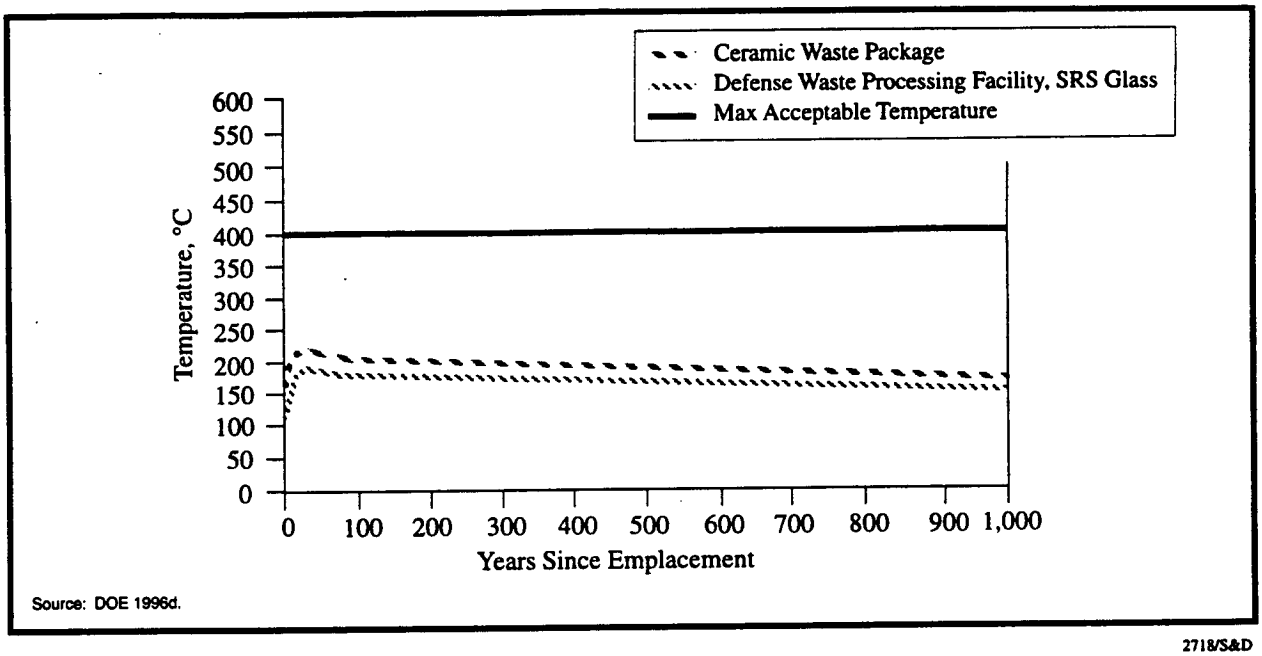


Figure H.3.3–1. Thermal Comparison of Plutonium-Loaded Ceramic Waste Package Versus Defense Waste Processing Facility Glass Waste Package.

accommodating the higher radiation fields from the Pu-loaded ceramic would be to reduce either the number of canisters per package or the quantity of Cs-137.

Releases. The peak doses from a repository that contains commercial spent nuclear fuel, vitrified HLW, and Pu immobilized in ceramic are the same as from a repository that contains only commercial spent nuclear fuel and vitrified HLW, for periods up to one million years. The difference in dose rates is insignificant between these two cases (DOE 1996d:5-12). These results are to be expected since the quantity of Pu in ceramic is small compared to the quantity of spent nuclear fuel in the repository.

H.4 BOILING WATER REACTOR—MIXED OXIDE BURNING REACTOR SPENT NUCLEAR FUEL FORM

Boiling water reactors are used in existing commercial power generation; therefore, the BWR form of the MOX spent nuclear fuel could be the output product from both the Existing LWR Alternative and the Partially Completed LWR Alternative if the latter is consistent with the BWR design. The performance of this MOX spent fuel is compared to the corresponding commercial BWR uranium-based boiling water reactors spent nuclear fuel.

H.4.1 ASSUMPTIONS

For the purposes of the PEIS analyses, the following assumptions have been made:

- The Pu will be fabricated into MOX nuclear reactor fuel and used for power generation in four boiling water reactors and allowed to cool at the reactor site(s) in the spent fuel pools for at least 10 years before shipment to a repository.
- The spent fuel will be emplaced in large (40 BWR assembly) waste packages for emplacement in a repository.

H.4.2 CHARACTERISTICS

The MOX spent fuel assembly from existing BWRs will have the following characteristics: (1) total Pu of 3.4 kg (7.5 lb), (2) Pu-239 to total Pu ratio of 0.4, (3) total heavy metal content of 172 kg (379 lbs), and (4) burn up of 37.6 gigawatt-days (GWd)/ton (t) of heavy metal. Radiation is analyzed using neutron and gamma source strengths by energy group.

H.4.3 COMPARATIVE ANALYSIS

Regulatory. An HLW repository, if approved under the provisions of the NWPA, would serve primarily as the disposal site for commercial spent nuclear fuel and defense-generated HLW. The MOX spent fuel that would be generated by this alternative falls within the definition of "spent nuclear fuel" per Section 2(23) of the NWPA and could, therefore, be considered a candidate for disposal in an NWPA repository. Licensing for the disposal of this MOX spent fuel form must follow the provisions of 10 CFR 60.

Criticality. Figure H.4.3–1 compares the results of the criticality analyses for a waste package containing all MOX spent fuel with one containing U-based spent fuel. The k_{eff} for the MOX spent fuel is below that of U-based fuels and well below the 0.95 maximum value allowed for k_{eff} (10 CFR 60).

Thermal. Figure H.4.3–2 shows the results of a thermal analysis of the MOX spent fuel element in a fully loaded, emplaced waste package. The peak cladding temperature is below the 350 °C (662 °F) limit required to maintain cladding integrity. Calculations also indicate that for the first 100 years the MOX cladding temperature continues to be lower than that of the corresponding U-based spent fuel. The slightly higher temperatures beyond the 100 years are so small as to have a negligible affect on the thermal balance of any repository.

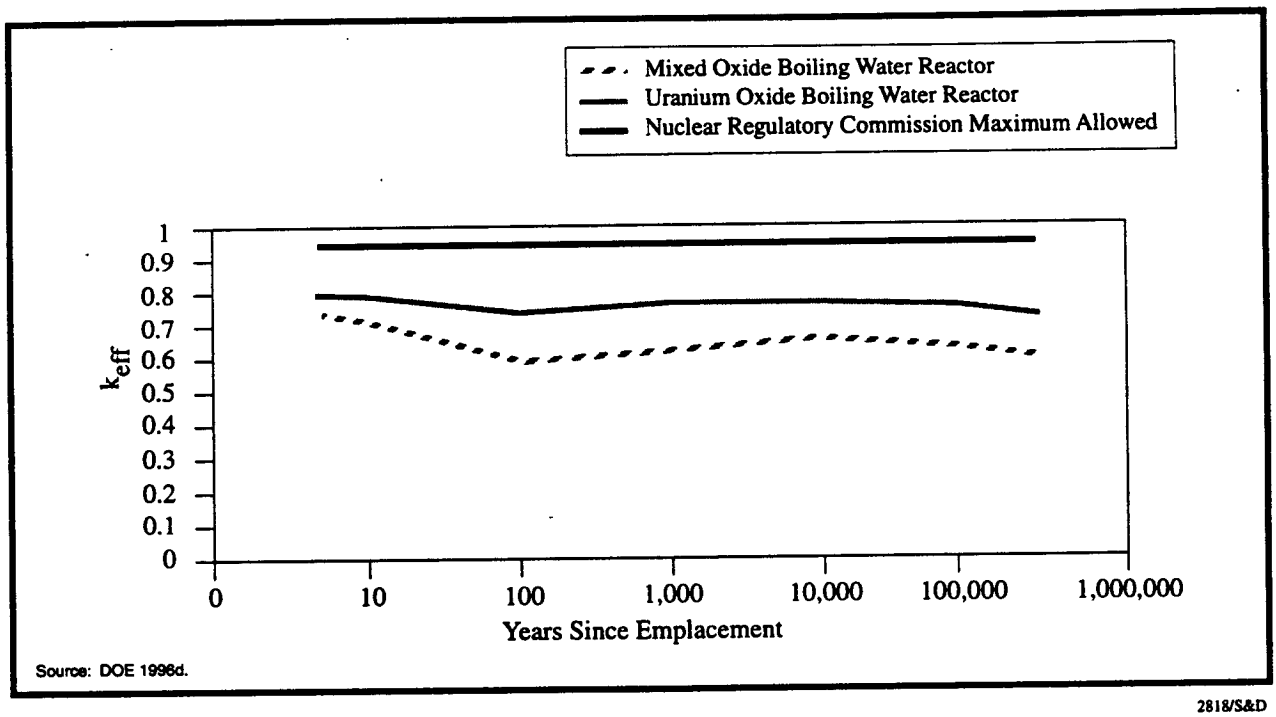


Figure H.4.3–1. Effective Multiplication Factor (k_{eff}) of a Boiling Water Reactor Spent Fuel Waste Package.

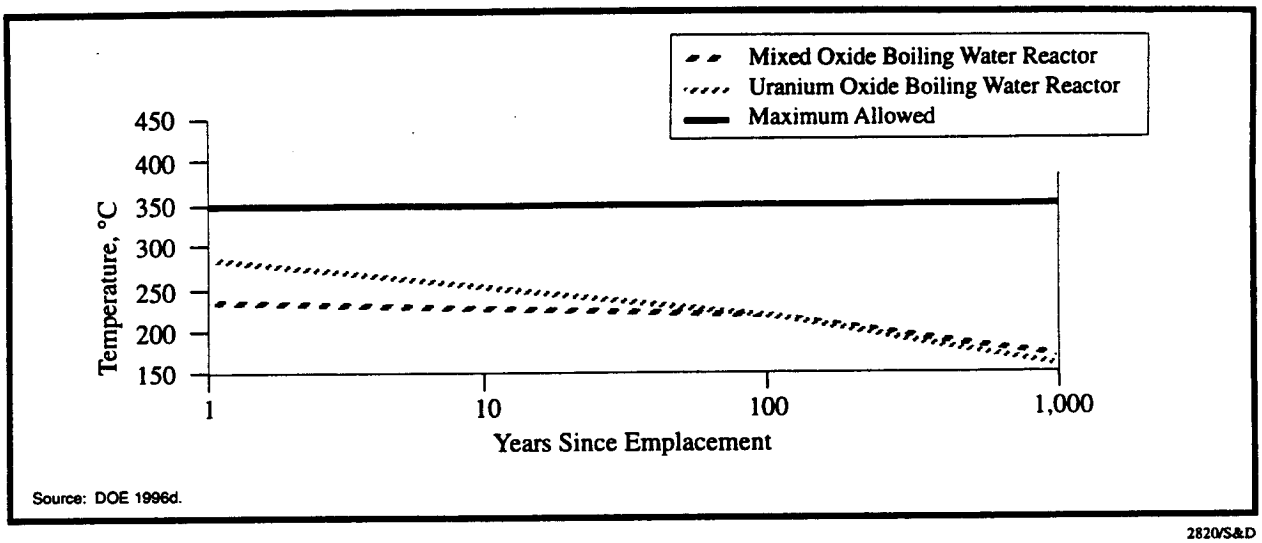


Figure H.4.3–2. Thermal Comparison of Peak Cladding Temperature of Boiling Water Reactor Fuel Element Versus Uranium-Based Reactor Fuel Element.

Radiation. Radiation calculations predict that the unshielded dose rates at a distance of 2 m (6.6 ft) are slightly higher for the waste packages containing MOX fuel than for those containing uranium-based fuels. The gamma radiation dose for the MOX fuel is 5 rem/hr versus 4 rem/hr for the U-based fuel. The neutron radiation dose is 1.54 rem/hr for the MOX as versus to 0.8 rem/hr for the uranium fuel. The higher radiation doses can be accommodated by increasing the transporter shielding thickness by 0.125 cm (0.05 in) of lead for the gamma radiation, and 1.25 cm (0.5 in) of boron-polyethylene for the neutron radiation.

Releases. The calculated doses for just the waste packages of MOX-based spent fuel are 100 times less than that for a repository that contains both MOX and (U-based) commercial spent nuclear fuels (DOE 1996d:3-8). These results support the conclusion that the performance of the repository is dominated by the presence of (U-based) commercial spent nuclear fuel and is expected since the quantity MOX-based spent nuclear fuel is small compared to the larger quantity of commercial spent nuclear fuel in the repository.

H.5 PRESSURIZED WATER REACTOR—MIXED OXIDE BURNING REACTOR SPENT NUCLEAR FUEL FORM

For the Evolutionary LWR Alternative, a PWR could be the design for burning MOX fuel. PWRs are used in existing commercial power plants; therefore, the PWR form of the spent MOX nuclear fuel could be the output product from the Evolutionary LWR Alternative, Existing LWR Alternative, and the Partially Completed LWR Alternative if the latter reactors are consistent with the PWR design. The performance of this MOX spent nuclear fuel is compared to the corresponding U-based PWR spent nuclear fuel.

H.5.1 ASSUMPTIONS

For the purposes of the PEIS analyses, the following assumptions have been made:

- The Pu will be fabricated into MOX nuclear fuel and used for power generation in two PWRs and allowed to cool at the reactor site(s) in the spent fuel pools for at least 10 years before shipment to a repository.
- The spent fuel will be emplaced in large waste packages for emplacement in a repository.

H.5.2 CHARACTERISTICS

The MOX spent fuel assembly from an evolutionary PWR will have the following characteristics: (1) total Pu of 20 kg (44 lb), (2) Pu-239 to total Pu ratio of 0.6, (3) total heavy metal content of 410 kg (900 lbs), and (4) burn up of 43 GWd/t of heavy metal. Radiation is analyzed using neutron and gamma source strengths by energy group.

H.5.3 COMPARATIVE ANALYSIS

Regulatory. An HLW repository, if approved under the provisions of the NWPA, would serve primarily as the disposal site for commercial and DOE-owned spent nuclear fuel and HLW. The MOX spent fuel that would be generated by this alternative falls within the definition of "spent nuclear fuel" per Section 2(23) of the NWPA and could, therefore, be considered a candidate for disposal in an NWPA repository. Licensing for the disposal of this MOX spent fuel form must follow the provisions of 10 CFR 60.

Criticality. Calculations for a MOX PWR spent fuel waste package show that to maintain a value below the 0.95 maximum value allowed for k_{eff} (10 CFR 60), the waste package can hold only four assemblies. This calculation assumed no additional criticality control technology. Should such technology be applied (for example, disposable control rod assemblies were added to the waste packages) calculations show that 21 assemblies could be loaded in each waste package. For either the 4 or 21 assemblies/waste package case, the k_{eff} value is expected to decline with time in a manner similar to that of the BWR spent fuel waste package as shown in Figure H.4.3–1.

Thermal. Figure H.5.3–1 shows the results of a thermal analysis of the MOX PWR spent fuel. The peak cladding temperature is below the 350 °C (662 °F) limit required to maintain cladding integrity. For the first 100 years the temperature also remains lower than that of the corresponding U-based spent fuel. The additional heat from all the spent nuclear fuel packages produced by the PWRs would be so small as to have a negligible affect on the thermal balance of any repository.

Radiation. Radiation calculations for the 21-assembly MOX PWR waste package shows that the higher dose rates from the MOX package (compared to the package containing U-based spent fuel) can be easily accommodated by increasing the transporter shielding thickness by 0.4 cm (0.16 in) of lead for the gamma radiation, and 1.25 cm (0.5 in) of boron-polyethylene for the neutron radiation. The shielding thickness requirements for a four-assembly package will be less than these values.

Releases. The calculated doses for just the waste packages of MOX-based spent fuel are 100 times less than that for a repository that contains both MOX and (U-based) commercial spent nuclear fuel (DOE 1996d:6-7). These results support the conclusion that the performance of the repository is dominated by the presence of (U-based) commercial spent nuclear fuel and is expected since the quantity of MOX-based spent fuel is small compared to the larger quantity of commercial spent fuel in the repository.

H.6 GLASS-BONDED ZEOLITE FORM

The Pu-loaded GBZ form is assumed to be fabricated in an electrometallurgical treatment process and has characteristics for long term disposability in a repository that are similar to the borosilicate glass produced in the DWPF (DOE 1996d:4-1). The GBZ waste form constitutes another immobilization alternative which would require disposal in a repository.

H.6.1 ASSUMPTIONS

For the purposes of the PEIS analyses, the following assumptions have been made:

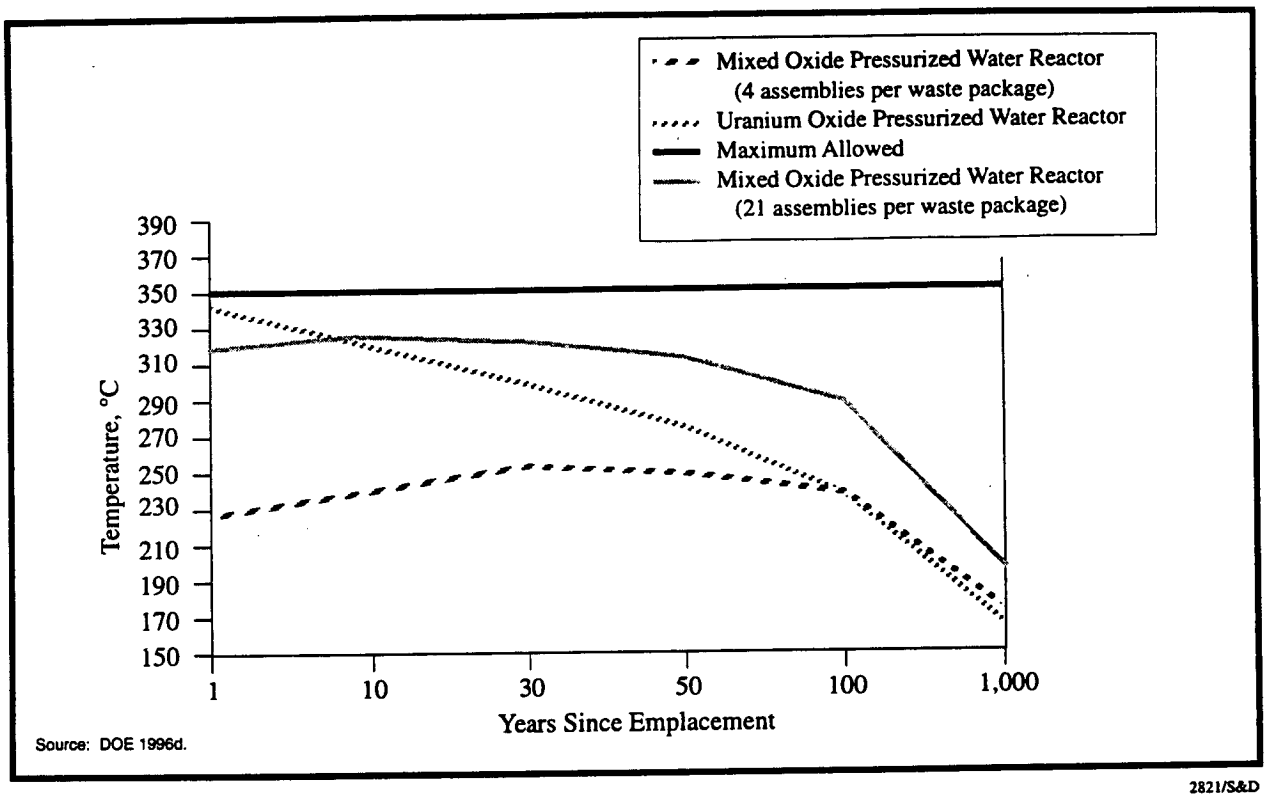


Figure H.5.3–1. Thermal Comparison of Peak Cladding Temperature of Pressurized Water Reactor Fuel Element Versus Uranium-Based Reactor Fuel Element.

- The waste form is packaged in DWPF-like canisters.
- Each transportation cask holds five of these canisters; each disposal waste package holds four of these canisters.

H.6.2 CHARACTERISTICS

The GBZ will be prepared by sorbing a molten chloride Pu salt on an anhydrous zeolite, which is then blended with a glass frit. The whole mixture is heated in a mold to above the glass transition temperature and pressed to bond the zeolite to the glass. The chemical constituents of the waste form are as follows: 52 kg (114 lbs) of Pu, 21 kg (46 lbs) of Gd, 5 kg (11 lbs) of Cs, 364 kg (800 lbs) of zeolite, and 520 kg (1,144 lbs) of borosilicate glass. The remainder is made up of barium, lithium, potassium, sodium, and chlorides.

H.6.3 COMPARATIVE ANALYSIS

Regulatory. Any waste form that is accepted for disposal in an HLW geologic repository must comply with the provisions of the NWPA, as amended. According to Section 2(12)A of the NWPA, the definition of HLW does not explicitly include Pu loaded into GBZ. However, under Section 2(12)B of the NWPA, the NRC has the authority to classify this waste as HLW through rulemaking. Such rulemaking or clarification in authorizing legislation will be necessary before this waste form can be considered for disposal in an NWPA repository. The final disposal of this waste form will have to conform to the licensing provisions of 10 CFR 60. Further, it is current policy of the DOE not to accept into the first HLW repository any wastes that include components regulated as hazardous under RCRA (DOE 1995a:6). The absence of any RCRA-regulated hazardous materials in the final GBZ form would have to be demonstrated prior to acceptance into the HLW repository.

Criticality. Preliminary criticality calculations show the Pu-loaded GBZ in a dry, intact configuration has a k_{eff} of less than 0.2, which is less than the borosilicate glass form primarily because of the lower total Pu content of each waste package containing the GBZ. The k_{eff} values for the GBZ under flooded conditions are less than half the 0.3 value (0.13) calculated for the borosilicate glass form and well below the 0.95 maximum value allowed for k_{eff} (10 CFR 60).

Thermal. Because the Pu concentration in a waste package containing Pu-loaded GBZ canisters is 80 percent of the Pu concentration in a package containing Pu-loaded borosilicate glass, and because the peak temperature reached by borosilicate glass is below the 400 °C (750 °F) glass transition value, the peak temperature for the GBZ is also expected to be below the 400 °C (750 °F) glass transition temperature. More specifically, the lower Pu content of the GBZ means that the heat generation at 40 years and beyond would be much smaller than for the Pu-loaded borosilicate glass.

Radiation. A comparison between the DWPF HLW glass and the Pu-loaded GBZ shows that the radiation dose at the waste package surface is 81 rem/hr for the DWPF glass compared to 120 rem/hr for the Pu-loaded GBZ. Since the radiation level for GBZ is above the threshold value of 100 rads/hr for radiolytic corrosion, the waste package outer barrier thickness would need to be increased by 0.3 cm (0.11 in). Additional shielding is also required to protect workers. The dose rate at 2 m (6.6 ft) from the waste package is 23 rem/hr for the GBZ versus 12.5 rem/hr for DWPF glass. As in the case for the Pu-loaded borosilicate glass form, the addition of 5 cm (2 in) of lead shielding to the underground transporter would reduce the radiation doses to meet the standard allowable dose of 10 mrem/hr at 2 m (6.6 ft) from lateral outer surfaces (49 CFR 173.441) to ensure worker protection.

Releases. The peak doses from a repository that contains commercial spent nuclear fuel, vitrified HLW, and Pu immobilized in GBZ are the same as from a repository that contains only commercial spent nuclear fuel and vitrified HLW, for periods up to 1 million years (DOE 1996d:7-9). These results are to be expected since the quantity of Pu in GBZ is small compared to the quantity of spent nuclear fuel in the repository.

Appendix I
Changes in Canadian Deuterium Uranium Reactor Operations

Ontario Hydro operates 20 Canadian Deuterium Uranium (CANDU) reactors capable of using mixed oxide (MOX) at five nuclear generating stations in the Province of Ontario. Eight of these units are located at the Bruce-A and Bruce-B Nuclear Generating Stations, a 930-hectare (2,300-acre) site on Lake Huron about 300 kilometers (186 miles) northeast of Detroit, Michigan. The Bruce-A Nuclear Generating Station, which contains four 769-megawatt electric reactors, a common powerhouse with four turbine generators, a heavy water plant, a process steam transformer plant, a central services area, pumphouses, standby generators, and other support facilities, is used as the reference site for the disposition alternative evaluation. One or up to four of these units could be used for Plutonium (Pu) disposition for this alternative. The reference reactor MOX fuel cycle, adapting the standard CANDU fuel bundle in the four reactors, would dispose of approximately 2 metric tons/year (t/yr) of Pu (2.2 short tons [tons]/yr) and eliminate the mining and refining of approximately 6,000 t/yr (6,600 tons/yr) of uranium ore. The use of the CANDU reactors would be subject to the approval, policies, and regulations of the Canadian Federal and Provincial Governments. The fuel cycle is depicted in Figure I–1.

An alternate fuel bundle design using uranium fuel (the CANFLEX fuel bundle), which is currently undergoing reactor qualification, might be used. This fuel bundle has smaller diameter elements in the outer rings that would operate at a lower linear power rating, permitting higher Pu concentrations. Both designs have essentially the same Pu disposition capacity. The design is expected to reduce the number of fuel bundles and waste volumes by half.

The Bruce-A Nuclear Generating Station was selected as the reference plant for the following reasons:

- The reactor is designed without thermal neutron absorbing control rods to flatten power distribution in the central region of the core, a desirable attribute relative to thermal power margins. MOX fuel would perform in the same manner as natural uranium fuel in flattening the power distribution.
- The site is a base-load station that will maximize fuel consumption since reactors operate continually at or near their full load capability.
- The site is remote from population centers, yet relatively close to U.S.-Canadian border crossings for the shipment of MOX fuel from the United States.
- The site has current International Atomic Energy Agency approved safeguards and a Perimeter Intrusion Detection and Assessment System.

Reactor. Instead of a single large pressure vessel, the reference CANDU reactor has a horizontal, cylindrical, heavy water-filled, calandria tank containing 480 fuel channel assemblies (also referred to as tubes) and reactivity control units. Replacement of these tubes, "retubing," corresponds to core replacement in other reactors. The heavy water is the neutron moderator and reflector. This entire assembly is contained in the light water-filled shield tank to form an integral structure that provides operational and shutdown shielding.

Each fuel channel assembly consists of a zirconium-niobium alloy pressure tube contained within a zircaloy-2 calandria tube that provides a gas-filled, thermally insulated annulus separating the high pressure and high temperature heavy water coolant in the pressure tube from the low pressure and low temperature heavy water moderator in the calandria. Reactor neutron and gamma flux is attenuated through a latched steel shield plug mechanism inside the end fitting.

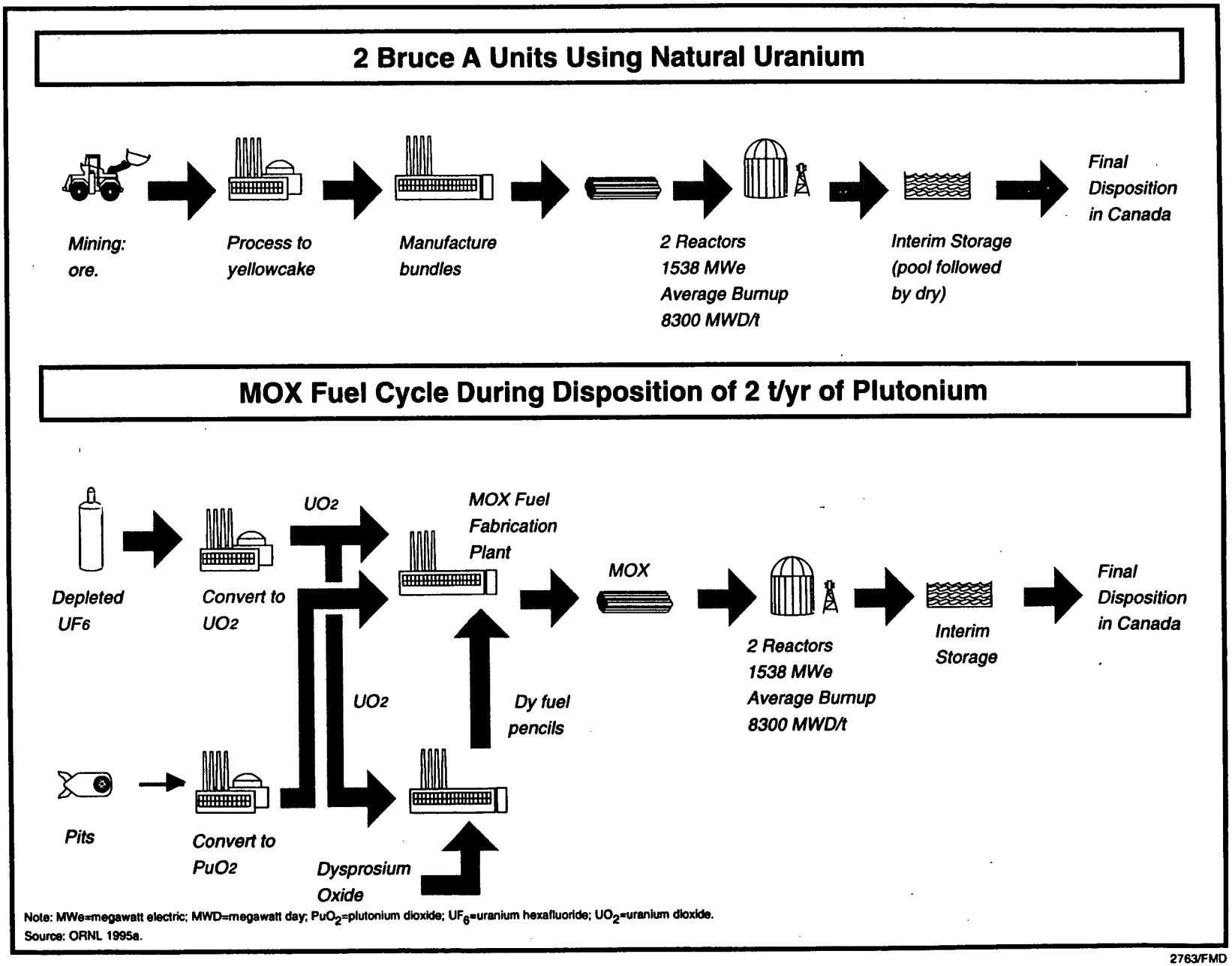


Figure I–1. Mixed Oxide Fuel Cycle.

Heat is removed by circulating heavy water coolant from the fuel channels to the steam generator, where it is transferred to the light water side. This system includes circulating pumps, headers, feeder pipes, the primary side of the steam generators, and preheaters. During operation, pressure is maintained by steam bleed valves connected to the pressurizer and immersion heaters within the pressurizer vessel.

The heavy water moderator circulates through the calandria and is cooled by heat exchangers. Moderator chemistry is maintained by the ion-exchange columns of the moderator purification circuit. Helium is the moderator cover gas.

Fourteen compartments within the reactor function as light water zone control units. These zones contain volumes of water, which are used to control reactor power. Self-powered, in-core neutron flux detectors located in each zone, along with channel thermal measurements, are used for power measurements by the reactor control system. On-power refueling and soluble neutron-absorbing material in the heavy water provide long-term reactivity control.

Steam from the secondary side of the steam generators is transferred to steam drums where it is routed to turbine generators. The turbines are tandem-compound, single-shaft machines that drive electrical generators. Each turbine has a double-flow, high-pressure chamber that discharges to a steam reheater that raises steam temperature for three double-flow, low- pressure chambers.

Fuel Handling and Storage. CANDU reactors can be refueled on-line. Operator consoles remotely control the fueling operation. A fueling duct traversed by two sets of transport trolley rails is used to move fresh MOX fuel to each reactor. In their loading area, new fuel bundles are placed in fueling machines that then pass through the containment wall port to fueling machine heads. At the reactor, the loading head is aligned with, and locks onto, the selected fuel channel end fitting. The loading head inserts new fuel bundles two at a time. At the other end of that channel, fuel bundles are displaced into a spent fuel head. After the required number of bundles has been placed in the channel the loading head is unlocked. This procedure is repeated until the designated channels are fueled. The irradiated fuel is discharged to the primary irradiated fuel storage bay. The spent fuel is stored here for a minimum of 6 months before it is transferred to the secondary irradiated fuel storage bay. The primary irradiated fuel storage bay can store 4 reactor years of fuel at an 80-percent capacity factor, while the storage capacity of the secondary bay is approximately 64 reactor years.

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Appendix J
Applicable Laws, Regulations, and Other Requirements

Compliance With Statutes, Regulations, and Other Associated Orders

Appendix J identifies the compliance requirements associated with the proposed action as specified by the major Federal and State Environment, Safety, and Health (ES&H) statutes, regulations, and orders.

Introduction and Purpose

This appendix provides enough information concerning the environmental standards and statutory requirements that impact the various alternatives for long-term storage and disposition of weapons-usable fissile materials to help make programmatic-level decisions. These statutes and regulations provide the standard with which the ability of candidate sites to meet ES&H requirements and the ability to obtain required Federal and State permits and licenses necessary to implement such decisions may be calculated. This appendix first provides an historical background on environmental protection at nuclear weapons production facilities. It then presents some of the more important requirements associated with the proposed action by identifying the applicable ES&H statutes, regulations, and orders. These are found in Federal and State statutes, regulations, permits, and approvals, as well as in Executive and Department of Energy (DOE) Orders. The remainder of this appendix explains the concept of shared Federal and State enforcement and summarizes compliance with occupational safety and health and environmental justice.

Compliance with the applicable requirements of each of the major ES&H statutes, regulations, and orders identified would allow DOE to construct and operate long-term storage and disposition facilities to meet such requirements. Sites have been selected for analysis as long-term storage locations. In contrast, since some of the proposed disposition alternatives are currently not tied to any one particular location, a "generic" site will be used for analysis. To be environmentally sound, programmatic decisions must also address the ES&H planning considerations described in Section 3.3 of the *Nuclear Weapons Complex Reconfiguration Study* (DOE/DP-0083). These considerations must also be met in order for the long-term storage and disposition alternatives to meet future ES&H requirements and to accomplish the mission in a timely and cost-effective manner.

Background

Since the majority of the past Complex facilities were constructed in the 1940s and 1950s, before the advent of today's environmental and worker health requirements, safety and the ability to satisfy national security requirements played the dominant roles in the design and operation of major industrial plants. However, with the emergence of an awareness of environmental and health-related issues and the enactment of environmental and worker health programs, DOE shifted a great deal of its resources into programs designed to achieve compliance with all applicable Federal, State, and local ES&H requirements. Today, many government agencies at the Federal, State, and local levels have regulatory authority over DOE's facility operations. DOE has entered into enforceable compliance agreements with the regulators at most of its facilities. These agreements detail specific programs, funding levels, and schedules for achieving compliance with applicable ES&H statutory and regulatory requirements. Because most of these agreements are constantly changing as subject agreements are completed, eliminated, or revised, a list has not been compiled for this programmatic environmental impact statement (PEIS).

All newly constructed and modified facilities must comply with the increasing number and complexity of environmental regulations. It is difficult to make facilities that are more than 40 years old comply quickly with constantly changing requirements. These older facilities generally do not meet all current standards for seismic

design, fire protection, and environmental protection (for example, air emissions, liquid effluents, and the management of solid and hazardous wastes). However, these facilities would be modernized to meet all applicable ES&H requirements now and into the 21st century, and a system would be developed to adequately manage the wastes generated by these facilities regardless of the proposed action addressed in this PEIS.

Environmental Statutes, Orders, and Agreements

The *Atomic Energy Act* (AEA) of 1954 authorizes DOE to establish standards to protect health and minimize dangers to life or property with respect to activities under its jurisdiction. The Nuclear Regulatory Commission (NRC) is charged under the AEA and the *Energy Reorganization Act* of 1974 with jurisdiction over commercial reactor construction and operation. NRC also licenses and regulates the possession, use, transportation, and disposal of radioactive materials, including wastes. NRC and Federal agencies such as the Department of Transportation also periodically review and revise their regulations to bring them generally to the same level as International Atomic Energy Agency regulations (Safety Series No. 6, revised 1990). This agency, under the United Nations, establishes standards for radioactive materials transportation. The Environmental Protection Agency (EPA), under authority of the AEA, has set radiation protection standards such as *Environmental Radiation Protection Standards for Nuclear Power Operations* (40 CFR 190). Most environmental regulations can be found under 40 Code of Federal Regulations (CFR). Because of their length, and for ease of reading, all tables in this chapter are presented consecutively at the end of the text. Table J–1 lists the applicable Federal environmental statutes, regulations, and Executive Orders, and also identifies the associated permit, approval, and consultation requirements generally required to implement an alternative for long term storage or disposition. Except for limited Presidential exemptions, Federal agencies must comply with all applicable provisions of Federal environmental statutes and regulations, in addition to all applicable State and local requirements. DOE is committed to complying fully with all applicable environmental statutes, regulatory requirements, and Executive and internal orders. Table J–2 lists the potential requirements imposed by the major State environmental statutes and regulations applicable to this predecisional PEIS. These requirements apply to Federal activities within the jurisdiction of the enforcing authority. Table J–2 identifies the permits, approvals, and consultations generally required to implement an alternative for long-term storage or disposition in accordance with State statutes and regulations. Table J–3 lists selected DOE ES&H Orders that apply to all sites, but which may affect each site differently. Table J–4 lists applicable NRC guidelines for the processing, use, transportation, and disposal of radioactive materials, including water.

Federal and State Environmental Enforcement

Some environmental regulatory programs are enforced through review, approval, and permitting requirements that attempt to minimize the negative impact of potential pollution sources' releases to the environment by limiting activities to established standards. Federal and State agencies share environmental regulatory authority over DOE's facility operations when Federal legislation delegates permitting or review authority to qualifying States. Some examples are the National Emission Standards for Hazardous Air Pollutants and the Prevention of Significant Deterioration under the *Clean Air Act;* the Water Quality Standards and the National Pollutant Discharge Elimination System under the *Clean Water Act;* the Hazardous Waste Programs under *Resource Conservation and Recovery Act* (RCRA); and the Drinking Water and Underground Injection Control Programs under the *Safe Drinking Water Act*. When Federal legislation allows enforcement authority to be delegated, States must set standards equal to or more stringent than those required by Federal law to obtain such authority. However, when Federal legislation does not allow enforcement authority to be delegated to the States (for example, the *Toxic Substance Control Act*), the standards are administered and enforced solely by the Federal Government.

Under various Federal environmental statutes (Table J–1), EPA may delegate the implementation and execution of the laws' various provisions to States with approved programs that are at least as stringent as the minimum

Federal requirements contained in the laws and EPA regulations. Table J–2 lists many of the States' laws and regulations, including provisions that are more stringent than the minimum requirements. In addition, the *Federal Facility Compliance Act* of 1992 waives sovereign immunity from the enforcement of RCRA at Federal facilities and thereby gives States the authority to assess fines and penalties under certain conditions.

Compliance with Occupational Safety and Health Requirements

The health and safety of all workers associated with the long-term storage and disposition alternatives is a primary consideration in this PEIS. A comprehensive nuclear and occupational safety and health initiative was announced by the Secretary on May 5, 1993, entailing closer consultation with the Occupational Safety and Health Administration (OSHA) regarding regulation of workers' safety and health at DOE's contractor-operated facilities. Regulation of workers', health and safety at DOE's contractor-operated facilities will gradually shift from DOE to OSHA. The *Occupational Safety and Health Act* of 1970, (Public Law 91-596) establishes Federal requirements for assuring occupational safety and health protection for employees. DOE's facilities also comply with the *Emergency Planning and Community Right-To-Know Act* (42 USC 11001), which requires facilities to report the release of extremely hazardous substances and other specified chemicals, provide Material Safety Data Sheets or lists thereof, and provide estimates of the amounts of hazardous chemicals onsite. The reporting and emergency preparedness requirements are designed to protect both individuals and communities.

Workplace Safety. Operations at all DOE sites expose workers to occupational hazards during the normal conduct of their work activities. Occupational safety and health training is provided for all employees at DOE facilities and includes specialized job safety and health training appropriate to the work performed. Such training also includes informing employees of their rights and responsibilities under the *Occupational Safety and Health Act* of 1970; Executive Order 12196, which established OSHA Federal Agency Standards; 29 CFR 1960, The OSHA Federal Agency Standards, which describes the safety and health programs that Federal agencies must establish and implement under Executive Order 12196; and DOE O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*. DOE provides implementation guidance in DOE O 440.1, including the requirements and guidelines for DOE employees.

DOE policy is the following:

- Provide places and conditions of employment that are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm
- Consider 29 CFR 1960 (OSHA Standards for Federal Agencies) requirements to be the minimum standards for DOE employees
- Establish programs in safety and health training for all levels of Federal employees
- Assure that employees and employee representatives shall have the opportunity to participate in the Federal Employee Occupational Safety and Health Program

Workplace Accidents. DOE O 451.1, *National Environmental Policy Act Compliance Program*; DOE Order 5480.23, *Nuclear Safety Analysis Reports*; and DOE O 430.1, *Life-Cycle Asset Management* provide the basis for reviewing all planned and existing constructions and operations for the potential for accidents and assessing the associated human health and environmental consequences should an accident occur. The results of these reviews are used as the basis for determining the need for controls or other mitigative actions to eliminate or greatly reduce the potential for, and consequences of, an accident. These reviews are required before authorization of construction or start of operation. These reviews identify hazards and analyze normal, abnormal, and accident conditions. This analysis considers natural and manmade external events including fires, floods, tornadoes, earthquakes, other severe weather events, human errors, and explosions. The sites associated with the long-term storage and disposition proposal have complied with applicable DOE Orders.

In accordance with DOE O 151.1, *Comprehensive Emergency Management System*, emergency response planning and training are provided to mitigate the consequences of potential accidents. Additionally, should an accident occur, the incident would be reported in accordance with DOE O 232.1, *Occurrence Reporting and Processing of Operations Information*. The reports would also include appropriate corrective actions and follow-up.

Worker Health. DOE's contractor operations at each site expose workers to hazardous constituents. DOE Orders require that site operations have programs for protecting workers. DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and DOE O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*, establish procedures for protecting workers against radiological and hazardous materials, respectively. DOE O 232.1, *Occurrence Reporting and Processing of Operations Information*, provides for reporting and guides appropriate corrective actions and follow-up should an exposure occur.

Consequences of the Weapons-Usable Fissile Materials Storage and Disposition Proposal on Candidate Site Workplace Safety and Accidents. Constructing and operating storage and disposition alternatives at potential candidate sites would result in site workers' increased exposure to industrial-type work hazards and accidents. In addition, the workers' level of risk in new construction increases in relation to the amount of changes required for such activities. Although constructing such facilities could result in injuries or fatalities, it is projected that the proposal for long-term storage and disposition will not cause any serious injuries or fatalities. All such incidences would be under the auspices of OSHA laws and regulations. Before implementing a long-term storage or disposition proposal at any site, however, the site's ES&H staff would be notified that a new process or facility is being planned, or that an existing process is being considered for change or modification to allow the impact of the anticipated change on the work environment to be evaluated.

Appropriate measures would be implemented to minimize work hazards and accidents based on this early evaluation. Once operational, as part of the Occupational Safety and Health Program at each site, ongoing surveillance of the new or modified processes or activities would be performed to identify potential health hazards. If potential health hazards are identified, a hazard evaluation would be conducted to determine the extent of the hazard and if required, the recommended control measures. Where feasible, engineering controls would be used to protect worker's health and safety. Appropriate administrative controls and personal protective equipment would supplement engineering controls.

Table J–1. Federal Environmental Statutes, Regulations, and Orders

Resource Category	Statute/Regulation/Order	Citation	Responsible Agency	PEIS-Level Potential Applicability: Permits, Approvals, Consultations, and Notifications
Air Resources	CAA, as amended	42 USC 7401 et seq.	EPA	Requires sources to meet standards and obtain permits to satisfy: National Ambient Air Quality Standards, State Implementation Plans, Standards of Performance for New Stationary Sources, NESHAP, and PSD.
	National Ambient Air Quality Standards/State Implementation Plans	42 USC 7409 et seq.	EPA	Requires compliance with primary and secondary ambient air quality standards governing SO_2, NO_2, CO, O_3, Pb, and PM_{10} and emission limits/reduction measures as designated in each state's State Implementation Plan.
	Standards of Performance for New Stationary Sources	42 USC 7411	EPA	Establishes control/emission standards and recordkeeping requirements for new or modified sources specifically addressed by a standard.
	NESHAPs	42 USC 7412	EPA	Requires sources to comply with emission levels of carcinogenic or mutagenic pollutants; may require a preconstruction approval, depending on the process being considered and the level of emissions that will result from the new or modified source.
	PSD	42 USC 7470 et seq.	EPA	Applies to areas that are in compliance with National Ambient Air Quality Standards. Requires comprehensive preconstruction review and the application of Best Available Control Technology to major stationary sources (emissions of 100 t/yr) and major modifications; requires a preconstruction review of air quality impacts and the issuance of a construction permit from the responsible state agency setting forth emission limitations to protect the PSD increment.
	Noise Control Act of 1972	42 USC 4901 et seq.	EPA	Requires facilities to maintain noise levels that do not jeopardize the health and safety of the public.
Water Resources	CWA	33 USC 1251 et seq.	EPA	Requires EPA or State-issued permits and compliance with provisions of permits regarding discharge of effluents to surface waters.
	NPDES (section 402 of CWA)	33 USC 1342	EPA	Requires permit to discharge effluents (pollutants) to surface waters and stormwaters; permit modifications are required if discharge effluents are altered.
	Dredged or Fill Material - (section 404 of CWA/ *Rivers and Harbors Appropriations Act* of 1899	33 USC 1344 33 USC 401 et seq.	U.S. Army Corps of Engineers	Requires permits to authorize the discharge of dredged or fill material into navigable waters or wetlands and to authorize certain structures or work in or affecting navigable waters.

Table J–1. Federal Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Statute/Regulation/Order	Citation	Responsible Agency	PEIS-Level Potential Applicability: Permits, Approvals, Consultations, and Notifications
Water Resources (continued)	*Wild and Scenic Rivers Act*	16 USC 1271 et seq.	United States Fish and Wildlife Service (USFWS), Bureau of Land Management, Forest Service, National Park Service	Consultation required before construction of any new Federal project associated with a river designated as wild and scenic or under study in order to minimize and mitigate any adverse effects on the physical and biological properties of the river.
	SDWA	42 USC 300f et seq.	EPA	Requires permits for construction/operation of underground injection wells and subsequent discharging of effluents to ground aquifers.
	Executive Order 11988: Floodplain Management	3 CFR, 1977 Comp., p. 117	Water Resources Council, Federal Emergency Management Agency, Council on Environmental Quality	Requires consultation if project impacts a floodplain.
	Executive Order 11990: Protection of Wetlands	3 CFR, 1977 Comp., p. 121	U.S. Army Corps of Engineers/USFWS	Requires Federal agencies to avoid the long- and short-term adverse impacts associated with the destruction or modification of wetlands.
	Compliance with Floodplain/Wetlands Environmental Review Requirements	10 CFR 1022	DOE	Requires DOE to comply with all applicable floodplain/wetlands environmental review requirements.
Hazardous Wastes and Soil Resources	RCRA /Hazardous and Solid Waste Amendments of 1984	42 USC 6901 et seq./PL 98-616	EPA	Requires notification and permits for operations involving hazardous waste treatment, storage, or disposal facilities; changes to site hazardous waste operations could require amendments to RCRA hazardous waste permits involving public hearings.
	CERCLA of 1980/SARA of 1986	42 USC 9601 et seq./PL 99-499	EPA	Requires cleanup and notification if there is a release or threatened release of a hazardous substance; requires DOE to enter into Interagency Agreements with EPA and State to control the cleanup of each DOE site on the NPL.
	Federal Land Policy and Management Act	43 USC 1701	Federal and State land-planning agencies	Requires Federal and/or State land-planning agencies to retain Federal ownership of public lands unless it is determined that disposal as such parcel will serve the national interest.

Table J–1. Federal Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Statute/Regulation/Order	Citation	Responsible Agency	PEIS-Level Potential Applicability: Permits, Approvals, Consultations, and Notifications
Hazardous Wastes and Soil Resources (continued)	NWPA of 1982	42 USC Section 10101-10270	Federal Agencies	Establishes a schedule for the siting, construction, and operation of repositories that will provide a reasonable assurance that the public and the environment will be protected from the hazards posed by disposal of high-level radioactive waste and SNF; establishes the Federal responsibility, and a definite Federal policy for the disposal of HLW and SNF; defines the relationship between the Federal and State government with respect to the disposal of HLW and SNF; and establishes a Nuclear Waste Fund.
	Community Environmental Response Facilitation Act	PL 102-426	EPA	Amends CERCLA (40 CFR 300) to establish a process for identifying, prior to the termination of Federal activities, property that does not contain contamination. Requires prompt identification of parcels that will not require remediation to facilitate the transfer of such property for economic redevelopment purposes.
	Farmland Protection Policy Act of 1981	7 USC 4201 et seq.	Soil Conservation Service	DOE shall avoid any adverse effects to prime and unique farmlands.
	Federal Facility Compliance Act of 1992	42 USC 6961	States	Waivers of sovereign immunity for Federal facilities under RCRA and requires DOE to develop plans and enter into agreements with states as to specific management actions for specific mixed waste streams.
Biotic Resources	*Fish and Wildlife Coordination Act*	16 USC 661 et seq.	USFWS	Requires consultation on the possible effects on wildlife if there is construction, modification, or control of bodies of water in excess of 10 acres in surface area.
	Bald and Golden Eagle Protection Act	16 USC 668 et seq.	USFWS	Consultations should be conducted to determine if any protected birds are found to inhabit the area. If so, DOE must obtain a permit prior to moving any nests due to construction or operation of storage or disposition facilities.
	Migratory Bird Treaty Act	16 USC 703 et seq.	USFWS	Requires consultation to determine if there are any impacts on migrating bird populations due to construction or operation of storage or disposition facilities. If so, DOE will develop mitigation measures to avoid adverse effects.
	Anadromous Fish Conservation Act	16 USC 757	USFWS	Requires consultation to determine if there are any impacts on anadromous fish that spawn in fresh water or estuaries and migrate to ocean waters and on anadromous fishery resources that are subject to deplete from water resource development.
	Wilderness Act of 1964	16 USC 1131 et seq.	DOC and DOI	DOE shall consult with the Department of Commerce and the Department of Interior and minimize impact.
	Wild Free-Roaming Horses and Burros Act of 1971	16 USC 1331 et seq.	DOI	DOE shall consult with the Department of Interior and minimize impact.

Table J–1. Federal Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Statute/Regulation/Order	Citation	Responsible Agency	PEIS-Level Potential Applicability: Permits, Approvals, Consultations, and Notifications
Biotic Resources (continued)	*Endangered Species Act* of 1973	16 USC 1531 et seq.	USFWS/National Marine Fisheries Service	Requires consultation to identify endangered or threatened species and their habitats, assess DOE impacts thereon, obtain necessary biological opinions and, if necessary, develop mitigation measures to reduce or eliminate adverse effects of construction or operation.
Cultural Resources	*National Historic Preservation Act* of 1966, as amended	16 USC 470 et seq.	President's Advisory Council on Historic Preservation	DOE shall consult with the State Historic Preservation Office prior to construction to ensure that no historical properties will be affected.
	Archaeological and Historical Preservation Act of 1974	16 USC 469 et seq.	DOI	DOE shall obtain authorization for any disturbance of archaeological resources.
	Archaeological Resources Protection Act of 1979	16 USC 470aa et seq.	DOI	DOE shall obtain authorization for any excavation or removal of archaeological resources.
	American Indian Religious Freedom Act of 1978	42 USC 1996	DOI	DOE shall consult with local Native American Indian tribes prior to construction to ensure that their religious customs, traditions, and freedoms are preserved.
	Native American Graves Protection and Repatriation Act of 1990	25 USC 3001	DOI	DOE shall consult with local Native American Indian tribes prior to construction to guarantee that no Native American graves are disturbed.
	Executive Order 11593: Protection and Enhancement of the Cultural Environment	3 CFR 154, 1971-1975 Comp., p. 559	DOI	DOE shall aid in the preservation of historic and archaeological data that may be lost during construction activities.
Worker Safety and Health	*Occupational Safety and Health Act*	5 USC 5108	OSHA	Agencies shall comply with all applicable worker safety and health legislation (including guidelines of 29 CFR 1960) and prepare, or have available, Material Safety Data Sheets.
	OSHA Guidelines	29 USC 660	OSHA	Agencies shall comply with all applicable worker safety and health legislation (including guidelines of 29 CFR 1960) and prepare, or have available, Material Safety Data Sheets.
	Hazard Communication Standard	29 CFR 1910.1200	OSHA	DOE shall ensure that workers are informed of, and trained to handle, all chemical hazards in the DOE workplace.
Other	*Atomic Energy Act* of 1954	42 USC 2011	DOE	DOE shall follow its own standards and procedures to ensure the safe operation of its facilities.
	NEPA	42 USC 4321 et seq.	CEQ	DOE shall comply with NEPA implementing procedures in accordance with 10 CFR 1021.
	Department of Energy NEPA Implementing Regulations	DOE 10 CFR Parts 1-199 (applicable sections), 820, 830, 835	DOE	DOE shall follow its own implementing regulations to ensure quality assurance, NRC agreements, and health and safety procedures.

Table J–1. Federal Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Statute/Regulation/Order	Citation	Responsible Agency	PEIS-Level Potential Applicability: Permits, Approvals, Consultations, and Notifications
Other (continued)	TSCA	15 USC 2601 et seq.	EPA	DOE shall comply with inventory reporting requirements and chemical control provisions of TSCA to protect the public from the risks of exposure to chemicals; TSCA imposes strict limitations on use and disposal of PCB-contaminated equipment.
	Hazardous Materials Transportation Act	49 USC 1801 et seq.	DOT	DOE shall comply with the requirements governing hazardous materials and waste transportation.
	Hazardous Materials Transportation Uniform Safety Act of 1990	49 USC 1801	DOT	Restricts shippers of highway route-controlled quantities of radioactive materials to use only permitted carriers.
	Emergency Planning and Community Right-To-Know Act of 1986	42 USC 11001 et seq.	EPA	Requires the development of emergency response plans and reporting requirements for chemical spills and other emergency release, and imposes right-to-know reporting requirements covering storage and use of chemicals that are reported in toxic chemical release forms.
	Executive Order 12088: Federal Compliance with Pollution Control Standards	3 CFR, 1978 Comp., p. 243	Office of Management and Budget (OMB)	Requires Federal agency landlords to submit to OMB an annual plan for the control of environmental pollution and to consult with EPA and State agencies regarding the best techniques and methods.
	Executive Order 11514: Protection and Enhancement of Environmental Quality	3 CFR, 1966-1970 Comp., p. 902	CEQ	Requires Federal agencies to demonstrate leadership in achieving the environmental quality goals of NEPA; provides for DOE consultation with appropriate Federal, State, and local agencies in carrying out their activities as they affect the environment.
	Pollution Prevention Act of 1990	42 USC 11001-11050	EPA	Establishes a national policy that pollution should be reduced at the source and requires a toxic chemical source reduction and recycling report for an owner or operator of a facility required to file an annual toxic chemical release form under section 313 of SARA.
	Executive Order 11988: Floodplain Management	3 CFR 1977 Comp., p. 117	Var. Agencies and EPA	Directs Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain and that floodplain impacts be avoided to the extent practicable.
	Executive Order 12114: Environment Affects Abroad Major Federal Actions	January 4, 1979	DOE	Requires officials of Federal agencies having ultimate responsibility for authorizing and approving actions encompassed by this Order to be informed of pertinent environmental considerations and to take such considerations into account, with other pertinent considerations of national policy in making decisions regarding such actions. While based on independent authority, this Order furthers the purpose of NEPA.

Table J–1. Federal Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Statute/Regulation/Order	Citation	Responsible Agency	PEIS-Level Potential Applicability: Permits, Approvals, Consultations, and Notifications
Other (continued)	Executive Order 12372: Intergovernmental review of federal programs	July 14, 1982	DOE	Requires Federal agencies to provide opportunities for consultation by elected officials of those State and local governments that would provide the non-Federal funds for or that would be directly affected by proposed Federal financial assistance or direct Federal development.
	Executive Order 12843: Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances	April 21, 1993	EPA	Requires Federal agencies to minimize procurement of ozone-depleting substances and conform their practices to comply with Title VI of CAA Amendments reference stratospheric ozone protection and to recognize the increasingly limited availability of Class I substances until final phaseout.
	Executive Order 12856: Federal Compliance with Right-To-Know Laws and Pollution Prevention Requirements	August 3, 1993	EPA	Requires Federal agencies to achieve 50 percent reduction of agency's total releases of toxic chemicals to the environment and offsite transfers, to prepare a written facility pollution prevention plan not later than 1995, and to publicly report toxic chemicals entering any waste stream from Federal facilities, including any releases to the environment, and to improve local emergency planning, response and accident notification.
	Executive Order 12873: Federal Acquisition, Recycling, and Waste Prevention	October 20, 1993	EPA	Requires Federal agencies to develop affirmative procurement policies and establishes a shared responsibility between the system program manager and the recycling community to effect use of recycled items for procurement.
	Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	February 11, 1994	EPA	Requires Federal agencies to identify and address as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.
	Executive Order 12580: Superfund Implementation	January 23, 1987	Executive Depts. and DOE	Delegates to the heads of executive departments and agencies the responsibility for undertaking remedial actions for releases, or threatened releases that are not on the NPL and removal actions other than emergencies where the release is from any facility under the jurisdiction or control of executive departments and agencies
	Executive Order 12856: Right to Know Laws and Pollution Prevention Requirements	August 3, 1993	DOE	Directs all Federal agencies to reduce and report toxic chemicals entering any wastestream; improve emergency planning, response, and accident notification; and encourage clean technologies and testing of innovative prevention technologies. The executive order also provides the Federal agencies are persons for purposes of the *Emergency Planning and Community Right-to-Know Act* (SARA Title iii), which obliges agencies to meet the requirements of the Act.

Table J–1. Federal Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Statute/Regulation/Order	Citation	Responsible Agency	PEIS-Level Potential Applicability: Permits, Approvals, Consultations, and Notifications
Other (continued)	Executive Order 10480: Further Providing for the Administration of the Defense Mobilization Program	August 1953	Federal Emergency Management Agency	Delegates to the Director, Federal Emergency Management Agency with authority to redelegate, the priorities and allocation functions conferred on the President by Title I of the *Defense Production Act* of 1950, as amended.
	Executive Order 12148: Federal Emergency Management	July 20, 1979	Federal Emergency Management Agency	Transferred functions and responsibilities associated with Federal emergency management to the Director, Federal Emergency Management Agency. The Order assigns the Director, Federal Emergency Management Agency, the responsibility to establish Federal policies for and to coordinate all civil defense and civil emergency planning, management, mitigation, and assistance functions of Executive Agencies.
	Executive Order 12472: Assignment of National Security and Emergency Preparedness Telecommunications Function	April 3, 1984	DOE	Establishes the National Communication System. The National Communication System consists of the telecommunications assets of the entities represented on the National Communication System Committee of Principals and an administrative structure consisting of the Executive Agent, the National Communication System Committee of Principals, and the Manager.
	Executive Order 12656: Assignment of Emergency Preparedness Responsibilities	November 1988	DOE	This order assigns emergency preparedness responsibilities to Federal departments and agencies.
	Low-Level Radioactive Waste Policy Act	42 USC 2021b-2021d	DOE	DOE shall dispose of LLW per compacts of the states in which it operates.

Table J–2. State Environmental Statutes, Regulations, and Orders

Resource Category	Legislation	Citation	Responsible Agency	Potential Applicability/Permits
Hanford, Washington State				
Air Resources	*Washington Clean Air Act*	Revised Code of Washington (RCW) Chapter 70.94	WA Department of Ecology	Required to register and obtain permits for new resources.
	Noise Control Act of 1974	RCW, Ch 70.107	WA Department of Ecology	Required to comply with anti-noise measures.
Water Resources	*Coastal Waters Protection Act* of 1971	RCW, Ch. 90.48	WA Department of Ecology	Water pollution control requirements; applies to all waters of the State.
	Chemical Contaminants and Water Quality	RCW, Ch. 70.142	WA Department of Ecology	Water pollution control requirements.
	Water Rights of the United States	RCW, Ch. 90.40	NA	Federal eminent domain.
Hazardous Wastes and Soil Resources	*Hazardous Waste Management Act*	RCW, Ch. 70.105	WA Department of Ecology	Permits required for various activities involving hazardous waste.
	Nuclear Energy and Radiation	RCW, Ch. 70.98	WA Department of Ecology	Licensing and permitting of radiation sources.
	Radioactive Waste Storage and Transport Act of 1980	RCW, Ch. 70.99	WA Department of Ecology	Establishes various requirements for handling and storage of rad waste.
	Radioactive Waste Act	RCW, Ch. 43.200	WA Department of Ecology	Establishes various requirements for handling and storage of rad waste.
Biotic Resources	Various Acts Concerning Fish and Game	RCW, Ch. 77	WA Department of Fish and Wildlife	May require consultation with responsible agency.
Other	*State Environmental Policy Act*	RCW, Ch. 43.21C	WA Department of Ecology	Required to prepare "detailed statement" on environmental impacts of proposed actions.
	Underground Tanks	WAC, Ch. 173-360	WA Department of Ecology	Required to follow regulations if underground storage tanks involved in project.
Cultural resources	Archaeology and Historic Preservation	RCW, Ch. 43.51A	WA Office of Archaeology and Historic Preservation	Required to follow rules designated to protect state cultural resources.
INEL, Idaho				
Air Resources	*Idaho Environmental Protection and Health Act*	ID Code, Title 39, Chapter 101	ID Department of Health and Welfare	Permit required prior to construction or modification of an air contaminant source.
	Idaho Department of Health and Welfare Rules	ID Code, Title 39, Chapter 1	ID Department of Health and Welfare	Permit required prior to construction or modification of an air contaminant source.
Water Resources	Idaho Wastewater-Land Application Permit Regulations	ID Rules/Regs., Title 1, Chapter 17	ID Department of Health and Welfare	Permit required prior to construction or modification of a water discharge source.
	Idaho Water Pollution Control Act	ID Code, Title 39, Chapter 36	ID Department of Health and Welfare	Permit required prior to construction or modification of a water discharge source.

Table J–2. State Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Legislation	Citation	Responsible Agency	Potential Applicability/Permits
	Idaho Water Quality Standards	ID Rules/Regs., Title 1, Chapter 2	ID Department of Water Resources, Resource Administration Division	Permit required prior to the construction or operation of a wastewater injection well.
	Idaho Stream Channel Protection Act	ID Code, Title 42, Chapter 38	ID Department of Water Resources	Permit required prior to dredge or fill of any stream.
	Idaho Lake Protection Act	ID Code, Section 58-142 et seq.	ID Department of Lands	Permit required prior to dredge or fill of any lake.
Hazardous Wastes and Soil Resources	*Idaho Hazardous Waste Management Act*	ID Code, Title 39, Chapter 44	ID Department of Health and Welfare	Permit required prior to construction or modification of a hazardous waste disposal facility.
	Idaho Hazardous Waste Management Regulations	ID Rules/Regs., Title 1, Chapter 5	ID Department of Health and Welfare	Permit required prior to construction or modification of a hazardous waste disposal facility.
Biotic Resources	Various Acts Regarding Fish and Game	ID Code, Title 36	ID Department of Fish and Game	May require consultation with responsible agency.
Cultural Resources	*Idaho Historic Preservation Act*	ID Code, Title 67, Chapter 46	ID Historic Preservation Commission	Consult with responsible local governing body.
Los Alamos National Laboratory, New Mexico				
Air Resources	*New Mexico Air Quality Control Act*	NM Stat., Title 74, Article 2	NM Health and Environmental Department	Permit required prior to the construction or modification of an air contaminant source.
	New Mexico Air Quality Standards and Regulations	NM Air Quality Control Regs., 100	NM Health and Environmental Department	Permit required prior to the construction or modification of an air contaminant source.
Water Resources	*New Mexico Water Quality Act*	NM Stat., Title 74, Article 6	NM Water Quality Control Com.	Permit required prior to the construction or modification of a water discharge source.
	New Mexico Water Quality Regulations	NM Water Regulations	NM Water Quality Control Com.	Permit required prior to the construction or modification of a water discharge source.
Hazardous Wastes and Soil Resources	*New Mexico Solid Waste Act*	NM Stat., Chap. 74, Article 8	NM Health and Environmental Dept.	Permit required prior to the construction or modification of a solid waste disposal facility.
	New Mexico Solid Waste Management Regulations	NM Solid Waste Mgmt. Regs.	NM Environmental Improvement Div.	Permit required prior to the construction or modification of a solid waste disposal facility.

Table J–2. State Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Legislation	Citation	Responsible Agency	Potential Applicability/Permits
	New Mexico Hazardous Waste Management Regulations	NM Hazardous Waste Mgmt. Regs.	NM Environmental Improvement Div.	Permit required prior to the construction or modification of a hazardous waste disposal facility.
	New Mexico Underground Storage Tank Regulations	NM Underground Storage Tank Regulations	NM Health and Environmental Dept.	Permit required to comply with tank requirements prior to the construction or modification of an underground storage tank.
Biotic Resources	*New Mexico Wildlife Conservation Act*	NM State Act 1978, Sections 17–2–37 through 17–2–46	NM Department of Game and Fish	Permit and coordination required if a project may disturb habitat or otherwise affect threatened or endangered species.
	New Mexico Endangered Plant Species Act	NM State Act 1978, Sections 75–6–1	NM State Forestry Department	Coordination with the department required.
Cultural Resources	*New Mexico Cultural Properties Act*	NM State Act 1978, Sections 18–6–23	NM State Historic Preservation Office	Established State Historic Preservation Office and requirements to prepare an archaeological and historic survey and consult with the State Historic Preservation Office.
Worker Safety and Health	No state-level legislation identified	NA	NA	NA
NTS, Nevada				
Air Resources	Nevada Air Pollution Control Law	NV Statutes, Title 40	NV State Environmental Commission	Permit required prior to construction or modification of an air contaminant source.
	Nevada Air Quality Regulations	NV Admin. Code, Chapter 445	NV State Environmental Commission	Permit required prior to construction or modification of an air contaminant source.
Water Resources	Nevada Water Pollution Control Law	NV Statutes, Title 40, Chapter 445	NV Department of Environmental Protection	Permit required prior to construction or modification of a water discharge source.
	Nevada Water Pollution Control Regulations	NV Admin. Code, Chapter 445	NV Department of Environmental Protection	Permit required prior to construction or modification of a water discharge source.
Hazardous Wastes and Soil Resources	Nevada Underground Storage Tank Rules	NV Admin. Code, Chapter 459	NV Department of Environmental Protection	Permit required prior to construction or modification of an underground storage tank.
	Nevada Solid Waste Disposal Law	NV Statutes, Title 40, Chapter 444	NV Department of Environmental Protection	Permit required prior to construction or modification of a solid waste disposal facility.

Table J–2. State Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Legislation	Citation	Responsible Agency	Potential Applicability/Permits
	Nevada Solid Waste Disposal Regulations	NV Admin. Code, Chapter 44	NV Department of Environmental Protection	Permit required prior to construction or modification of a solid waste disposal facility; permit for septage hauling may be required.
	Nevada Hazardous Waste Disposal Law	NV Statutes, Title 40, Chapter 459	NV Department of Environmental Protection	Permit required prior to construction or modification of a hazardous waste disposal facility.
	Nevada Hazardous Waste Facility Regulations	NV Admin. Code, Chapter 444	NV Department of Environmental Protection	Permit required prior to construction or modification of a hazardous waste disposal facility.
Biotic Resources	*Nevada Non-Game Species Act*	NV Admin. Code, Title 45, Chapter 503	NV Department of Wildlife	Consult with NV Department of Wildlife and minimize impact.
Cultural Resources	Historic Preservation and Archaeology Regulations	NV Statutes, Title 26, Chapter 381-383	NV Advisory Board for Historic Preservation and Archaeology	Permit required prior to the investigation, exploration, or excavation of a historic or prehistoric site.
ORR, Tennessee				
Air Resources	Tennessee Air Pollution Control Regulations	TN Rules, Division of Air Pollution	TN Air Pollution Control Board	Permit required to construct, modify, or operate an air contaminant source; sets fugitive dust requirements.
Water Resources	*Tennessee Water Quality Control Act*	TN Code, Title 69, Chapter 3	TN Water Quality Control Board	Authority to issue new or modify existing NPDES permits required for a water discharge source.
Hazardous Wastes and Soil Resources	Tennessee Underground Storage Tank Program Regulations	TN Rules, Chapter 1200-1-15	TN Division of UST Programs	Permit required prior to construction or modification of an underground storage tank.
	Tennessee Hazardous Waste Management Act	TN Code, Title 68, Chapter 46	TN Division of Solid Waste Management	Permit required to construct, modify, or operate a hazardous waste treatment, storage, or disposal facility.
	Tennessee Solid Waste Processing and Disposal Regulations	TN Rules, Chapter 1200-1-7	TN Division of Solid Waste Management	Permit required to construct or operate a solid waste processing or disposal facility.

Table J–2. State Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Legislation	Citation	Responsible Agency	Potential Applicability/Permits
Biotic Resources	Tennessee State Executive Order on Wetlands	TN State Executive Order	TN Division of Water Quality Control	Consultation with responsible agency.
	Tennessee Threatened Wildlife Species Conservation Act of 1974	TN Code, Title 70, Chapter 8	TN Wildlife Resources Agency	Consultation with responsible agency.
	Tennessee Rare Plant Protection and Conservation Act of 1985	TN Code, Title 70, Chapter 8-301 et seq.	TN Wildlife Resources Agency	Consultation with responsible agency.
	Tennessee Water Quality Control Act	TN Code, Title 69, Chapter 3	TN Division of Water Quality Control	Permit required prior to alteration of a wetland.
Cultural Resources	Tennessee Desecration of Venerated Objects	TN Code, Title 39, Chapter 17-311	TN Historical Commission	Forbids a person to offend or intentionally desecrate venerated objects including a place of worship or burial.
Pantex, Texas				
Air Resources	Texas Air Pollution Control Regulations	TX Admin. Code, Title 30, Chapter 101-125, 305	Texas Natural Resource Conservation Commission (TNRCC) (effective 9/1/93)	Permit required prior to construction or modification of an air contaminant source.
Water Resources	Texas Water Quality Standards	TX Admin. Code, Title 30, Chapter 305, 308-325	TNRCC (effective 9/1/93)	A permit may be required prior to any modification of waters of the State including stream alteration for the construction of intakes, discharges, bridges, submarine utility crossings, etc. discharge source.
	Texas Consolidated Permit Rules	TX Admin. Code, Title 30	TNRCC (effective 9/1/93)	Permit required prior to construction or modification of a water discharge source.
	Texas Water Quality Acts	TX Code, Title 30, Chapter 290	TNRCC (effective 9/1/93)	Permit required prior to construction or modification of a water discharge source affecting a public water supply.
Hazardous Wastes and Soil Resources	Texas Underground Storage Tanks Rules	TX Admin. Code, Title 30, Chapter 334	TNRCC (effective 9/1/93)	Permit required prior to construction or modification of an underground storage tank.
	Texas Solid Waste Management Regulations	TX Admin. Code, Title 30, Chapter 305, 335	TNRCC (effective 9/1/93)	Permit required prior to construction or modification of a solid waste disposal facility.
	Texas Solid Waste Disposal Act	TX Statutes, Article 4477-7	TNRCC (effective 9/1/93)	Permit required prior to construction or modification of a solid waste disposal facility.

Table J–2. State Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Legislation	Citation	Responsible Agency	Potential Applicability/Permits
Biotic Resources	Texas Parks and Wildlife Regulations	TX Parks and Wildlife Code, Chapters 67, 68, & 88	TX Parks and Wildlife Department	Permit required by anyone who possesses, takes, or transports endangered, threatened, or protected plants or animals.
Cultural Resources	Antiquities Code of Texas	TX Statutes, Volume 17, Article 6145	TX State Historical Survey Committee	Permit required for the examination or excavation of sites and the collection or removal of objects of antiquity.
	Tennessee Abuse of Corpse	TN Code, Title 39, Chapter 17-312	TX Historical Commission	Forbids a person from disinterring a corpse that has been buried or otherwise interred.
	Native American Indian Cemetery Removal and Reburial	TN Comp. Rules and Regulations, Chapter 400-9-1	TX Historical Commission	Requires notification if Native American Indian remains are uncovered.
	Tennessee Protective Easements	TN Code, Title 11, Chapter 15-101	TX State Government	Grants power to the State to restrict construction on land deemed as a "protective" easement.
RFETS, Colorado				
Air Resources	*Colorado Air Quality Control Act*	Colorado Revised Statutes (CRS) Title 25, Article 7	CO Air Quality Control Comm.	Required to follow emission control regulations.
Water Resources	*Colorado Water Quality Control Act*	CRS, Title 25, Article 8	CO Water Quality Control Comm.	Required to follow regulations governing water quality.
Hazardous wastes and soil resources	Hazardous waste management, storage, and disposal	CRS, Title 25, Article 15, Part 3	CO Department of Health	Permits required for various activities involving hazardous waste.
Biotic resources	*Nongame, Endangered, and Threatened Species Act*	CRS, Title 33, Article 2	CO Division of Wildlife; Wildlife Commission	May require consultation with responsible agency.
Other	Underground Storage Tanks	CRS, Title 8, Article 20, Part 5; Title 25, Article 18	CO State Inspector of Oils	Required to follow regulations concerning underground storage tanks.
Cultural Resources	State history, archives, and emblems	CRS, Title 24, Article 80	CO Historical Society	Required to follow laws to protect state historical/archaeological resources.

Table J–2. State Environmental Statutes, Regulations, and Orders—Continued

Resource Category	Legislation	Citation	Responsible Agency	Potential Applicability/Permits
SRS, South Carolina				
Air Resources	*South Carolina Pollution Control Act*/South Carolina Air Pollution Control Regulations and Standards	SC Code, Title 48, Chapter 1	SC Department of Health and Environmental Control	Permit required prior to construction or modification of an air contaminant source.
	Augusta-Aiken Air Quality Control Region	40 CFR 81.114	SC and GA Department of Health and Environmental Control	Requires SRS and surrounding communities in the two-State region to attain NAAQS.
	South Carolina Atomic Energy & Radiation Control Act	SC Code, Title 13, Chapter 7	SC Department of Health and Environmental Control	Establishes standards for radioactive air emissions.
Water Resources	*South Carolina Pollution Control Act*	SC Code, Title 48, Chapter 1	SC Department of Health and Environmental Control	Permit required prior to construction or modification of a water discharge source.
	South Carolina Water Quality Standards	SC Code, Title 61, Chapter 68	SC Department of Health and Environmental Control	Permit required prior to construction or modification of a water discharge source.
	South Carolina Safe Drinking Water Act	SC Code, Title 44, Chapter 55	SC Department of Health and Environmental Control	Establishes drinking water standards.
Hazardous Wastes and Soil Resources	*South Carolina Underground Storage Tanks Act*	SC Code, Title 44, Chapter 2	SC Department of Health and Environmental Control	Permit required prior to construction or modification of an underground storage tank.
	South Carolina Solid Waste Regulations	SC Code, Title 61, Chapter 60	SC Department of Health and Environmental Control	Permit required to store, collect, dispose, or transport solid wastes.
	South Carolina Industrial Solid Waste Disposal Site Regulations	SC Code, Title 61, Chapter 66	SC Pollution Control Authority	Permit required for industrial solid waste disposal systems.
	South Carolina Hazardous Waste Management Act	SC Code, Title 44, Chapter 56	SC Department of Health and Environmental Control	Permit required to operate, construct, or modify a hazardous waste treatment, storage, or disposal facility.
	South Carolina Solid Waste Management Act	SC Code, Title 44, Chapter 96	SC Department of Health and Environmental Control	Establishes standards to treat, store, or dispose of solid waste.
Biotic Resources	*South Carolina Nongame and Endangered Species Conservation Act*	SC Code, Title 50, Chapter 15	SC Wildlife and Marine Resources Department	Consult with Wildlife and Marine Resources Department and minimize impact.
Cultural Resources	South Carolina Institute of Archaeology and Anthropology	SC Code, Title 60, Chapter 13-210	SC State Historic Preservation Office	Consult with State Historic Preservation Office and minimize impact.

Note: NA=not applicable.

Table J–3. Selected Department of Energy Environment, Safety, and Health Orders

DOE Order	Order Title
O 151.1	Comprehensive Emergency Management System
O 210.1	Performance Indicators and Analysis of Operations Information
O 225.1	Accident Investigations
O 231.1	Environment, Safety, and Health Reporting
O 232.1	Occurrence Reporting and Processing of Operation Information
O 360.1	Training
O 420.1	Facility Safety
O 425.1	Startup and Restart of Nuclear Facilities
O 430.1	Life-Cycle Assets Management
O 440.1	Worker Protection Management for DOE Federal and Contractor Employees
O 440.2	Aviation
N 441.1	Radiological Protection for DOE Activities
O 451.1	*National Environmental Policy Act* Compliance Program
O 452.1	Nuclear Explosive and Weapons Surety
O 452.2	Safety of Nuclear Explosive Operations
O 460.1	Packaging and Transportation Safety
O 460.2	Departmental Materials Transportation and Packaging Management
O 470.1	Safeguards and Security Program
O 471.2	Information Security Program
O 472.1	Personnel Security Activities
1300.2A	Department of Energy Technical Standards Program
1360.2B	Unclassified Computer Security Program
3790.1B	Federal Employee Occupational Safety and Health Program
4330.4B	Maintenance Management Program
4700.1	Project Management System
5400.1	General Environmental Protection Program
5400.5	Radiation Protection of the Public and the Environment
5480.4	Environmental Protection, Safety, and Health Protection Standards
5480.19	Conduct of Operations Requirements for DOE Facilities
5480.20A	Personnel Selection Qualifications, Training, and Staffing Requirements at DOE Reactor and Nonreactor Nuclear Facilities
5480.21	Unreviewed Safety Questions
5480.22	Technical Safety Requirements
5480.23	Nuclear Safety Analysis Reports
5482.1B	Environment, Safety, and Health Appraisal Program
5484.1	Environmental Protection, Safety, and Health Protection Information Reporting Requirements
5530.1A	Accident Response Group
5530.3	Radiological Assistance Program
5530.4	Aerial Measuring System
5530.5	Federal Radiological Monitoring and Assessment Center
5630.12A	Safeguards and Security Inspection and Assessment Program
5630.13	Master Safeguards and Security Agreements
5632.1C	Protection and Control of Safeguards and Security Interests
5633.3B	Control and Accountability of Nuclear Materials
5700.6C	Quality Assurance
5820.2A	Radioactive Waste Management

Table J–4. Applicable Nuclear Regulatory Commission Guidelines

Guide Number	Title	Latest Rev. Date
3.3	Quality Assurance Program Requirements for Fuel Reprocessing Plants and for Plutonium Processing and Fuel Fabrication Plants	3/74
3.7	Monitoring of Combustible Gases and Vapors in Plutonium Processing and Fuel Fabrication Plants	3/73
3.10	Liquid Waste Treatment System Design Guide for Plutonium Processing and Fuel Fabrication Plants	6/73
3.12	General Design Guide for Ventilation Systems of Plutonium Processing and Fuel Fabrication Plants	8/73
3.14	Seismic Design Classification for Plutonium Processing and Fuel Fabrication Plants	10/73
3.16	General Fire Protection Guide for Plutonium Processing and Fuel Fabrication Plants	1/74
3.21	Quality Assurance Requirements for Protective Coatings Applied to Fuel Reprocessing and to Plutonium Processing and Fuel Fabrication Plants	3/74
3.28	Welder Qualifications for Welding in Areas of Limited Accessibility in Fuel Reprocessing and in Plutonium Processing and Fuel Fabrication Plants	5/75
3.29	Preheat and Interpass Temperature Control for the Welding of Low-Alloy Steel for Use in Fuel Reprocessing Plants and in Plutonium Processing and Fuel Fabrication Plants	5/75
3.35	Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Plutonium Processing and Fuel Fabrication Plant	7/79
3.39	Standard Format and Content of License Applications for Plutonium Processing and Fuel Fabrication Plants	1/76
3.40	Design Basis Floods for Fuel Reprocessing Plants and for Plutonium Processing and Fuel Fabrication Plants	12/72
3.47	Nuclear Criticality Control and Safety of Homogeneous Plutonium-Uranium Fuel Mixtures Outside Reactors	7/81

Appendix K
Biological Resources

Table K–1 contains a listing of the scientific names of common, nonthreatened, and nonendangered animal and plant species found in Chapters 3 and 4. Species are grouped and listed in alphabetical order by common name.

Table K–1. Scientific Names of Nonthreatened and Nonendangered Animal and Plant Species Referred to in the Text

Common Name	Scientific Name
Mammals	
Abert's squirrel	*Sciurus aberti*
Badger	*Taxidea taxus*
Beaver	*Castor canadensis*
Bighorn sheep	*Ovis canadensis*
Black bear	*Ursus americanus*
Black-footed ferret	*Mustela nigripes*
Black-tailed jackrabbit	*Lepus californicus*
Black-tailed prairie dog	*Cynomys ludovicianus*
Bobcat	*Lynx rufus*
[Text deleted.]	
Cactus mouse	*Peromyscus eremicus*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Desert cottontail	*Sylvilagus audubonii*
Eastern cottontail	*Sylvilagus floridanus*
Eastern gray squirrel	*Sciurus carolinensis*
Elk	*Cervus elaphus*
Feral hog	*Sus scrofa*
Gray fox	*Urocyon cinereoargenteus*
Great Basin kangaroo rat	*Dipodomys microps*
Great Basin pocket mouse	*Perognathus parvus*
Hispid cotton rat	*Sigmodon hispidus*
Javelina	*Pecari angulatus*
Long-tailed weasel	*Mustela frenata*
Merriam's kangaroo rat	*Dipodomys merriami*
Mexican woodrat	*Neotoma mexicana*
Mink	*Mustela vison*
Moose	*Alces alces*
Mountain cottontail	*Sylvilagus nuttalli*
Mountain lion	*Felis concolor*
Mule deer	*Odocoileus hemionus*
Opossum	*Didelphis marsupialis*
[Text deleted.]	
Porcupine	*Erethizon dorsatum*
Pronghorn	*Antilocapra americana*
Raccoon	*Procyon lotor*
Red squirrel	*Tamiasciurus hudsonicus*
Round-tailed ground squirrel	*Spermophilus tereticaudus*
Snowshoe hare	*Lepus americanus*
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
Townsend's ground squirrel	*Spermophilus townsendii*
White-footed mouse	*Peromyscus leucopus*
Whitetail deer	*Odocoileus virginianus*
Birds	
[Text deleted.]	
American kestrel	*Falco sparverius*
American robin	*Turdus migratorius*
Black vulture	*Coragyps atratus*
Black-throated sparrow	*Amphispiza bilineata*
Boreal chickadee	*Parus hudsonicus*
[Text deleted.]	
Canada goose	*Branta canadensis*
Carolina chickadee	*Parus carolinensis*
Common crow	*Corvus brachyrhynchos*
Common raven	*Corvus corax*
Downy woodpecker	*Picoides pubescens*
Eastern bluebird	*Sialia sialis*
Forster's tern	*Sterna forsteri*
Gambel's quail	*Callipepla gambelii*
Great blue heron	*Ardea herodias*
[Text deleted.]	
Great horned owl	*Bubo virginianus*
Greater prairie chicken	*Tympanuchus cupido*
Greater roadrunner	*Geococcyx californianus*
Horned lark	*Eremophila alpestris*
House finch	*Carduelis mexicanus*
Lesser goldfinch	*Carduelis psaltria*
Magpie	*Pica spp.*
Mourning dove	*Zenaida macroura*
Nighthawk	*Chordeiles spp.*
Northern bobwhite	*Colinus virginianus*
Northern cardinal	*Cardinalis cardinalis*
[Text deleted.]	
Northern harrier	*Circus cyaneus*
Ovenbird	*Seiurus aurocapillus*
Pelican	*Pelecanus spp.*
Pine siskin	*Carduelis pinus*
Raven	*Corvus spp.*
Red crossbill	*Loxia curvirostra*
Red-breasted nuthatch	*Sitta canadensis*
Red-tailed hawk	*Buteo jamaicensis*
Ring-billed gull	*Larus delawarensis*
Ring-necked pheasant	*Phasianus colchicus*
Rough-legged hawk	*Buteo lagopus*
Ruffed grouse	*Bonasa umbellus*
Sage grouse	*Centrocercus urophasianus*
Say's phoebe	*Sayornis saya*
Scaled quail	*Callipepla squamata*
Scrub jay	*Aphelocoma coerulescens*
Turkey vulture	*Cathartes aura*
Western meadowlark	*Sturnella neglecta*
Wild turkey	*Meleagris gallopavo*
Wood thrush	*Hylocichla mustelina*

Table K–1. Scientific Names of Nonthreatened and Nonendangered Animal and Plant Species Referred to in the Text—Continued

Common Name	Scientific Name
Worm-eating warbler	*Helmitheros vermivorus*
[Text deleted.]	
Reptiles	
Banded gecko	*Coleonyx variegatus*
[Text deleted.]	
Collared lizard	*Crotaphytus collaris*
Common bullsnake	*Pitriophis melanoleucus*
Common garter snake	*Thamnophis sirtalis*
[Text deleted.]	
Desert iguana	*Dipsosaurus dorsalis*
Eastern box turtle	*Terrapene carolina*
Eastern diamondback rattlesnake	*Crotalus adamanteus*
Eastern fence lizard	*Sceloporus undulatus*
Eastern garter snake	*Thamnophis sirtalis*
Eastern ribbon snake	*Thamnophis sauritus*
Gopher snake	*Pituophis melanoleucus*
[Text deleted.]	
Painted turtle	*Chrysemys picta*
Prairie kingsnake	*Lampropeltis calligaster*
Prairie rattlesnake	*Crotalus viridis*
Rat snake	*Elaphe obsoleta*
Ring-necked snake	*Diadophis punctatus*
Sagebrush lizard	*Sciloporus graciosus*
Short-horned lizard	*Phyrnosoma douglassi*
Side-blotched lizard	*Uta stansburiana*
Smooth green snake	*Opheodrys vernalis*
Western box turtle	*Terrapene ornata*
[Text deleted.]	
Western shovel-nosed snake	*Chionactis occipitalis*
Western skink	*Eumeces skeltonianus*
Whiptail lizard	*Cnemidophorus spp.*

Common Name	Scientific Name
Amphibians	
American toad	*Bufo americanus*
[Text deleted.]	
Chorus frog	*Pseudacris triseriata*
[Text deleted.]	
Great Plains toad	*Bufo cognatus*
[Text deleted.]	
Green frog	*Rana clamitans*
[Text deleted.]	
Pine woods treefrog	*Hyla femoralis*
Slimy salamander	*Plethodon glutinosus*
Spotted salamander	*Ambystoma maculatum*
Fish	
American shad	*Alosa sapidissima*
Banded sculpin	*Cottus carolinae*
Black crappie	*Pomoxis nigromaculatus*
Blacknose dace	*Rhinichthys atratulus*
Blueback herring	*Alosa aestivalis*
Bluegill	*Lepomis macrochirus*
Bluntnose minnow	*Pimephales notatus*
Bream	*Lepomis spp.*
Brook trout	*Salvelinus fontinalis*
Brown trout	*Salmo trutta*
Carpsucker	*Carpiodes spp.*
Central stoneroller	*Campostoma anomalum*
Channel catfish	*Ictalurus punctatus*
Chinook salmon	*Oncorhynchus tshawytscho*
Chub	*Cyprinidae*
Coho salmon	*Oncorhynchus kisutch*
Common carp	*Cyprinus carpio*
Crappie	*Pomoxis spp.*
Creek chub	*Semotilus atromaculatus*

Common Name	Scientific Name
Fathead minnow	*Pimephales promelas*
Freshwater drum	*Aplodinotus grunniens*
Golden shiner	*Notemigonus crysoleucas*
Goldfish	*Carassius auratus*
Green sunfish	*Lepomis cyanellus*
Hickory shad	*Alosa mediocris*
Kokanee salmon	*Oncorhynchus nerka*
Lake chubsucker	*Erimyzon sucetta*
Largemouth bass	*Micropterus salmoides*
Mosquitofish	*Gambusia affinis*
Mountain whitefish	*Prosopium williamsoni*
Mud sunfish	*Acantharchus pomotis*
Pickerel	*Esox spp.*
Rainbow trout	*Oncorhynchus mykiss*
Redbreast sunfish	*Lepomis auritus*
Redfin pickerel	*Esox americanus*
Redside dace	*Clinostomus elongatus*
Rock bass	*Ambloplites rupestris*
Sauger	*Stizostedion canadense*
Shorthead sculpin	*Cottus confusus*
Smallmouth bass	*Micropterus dolomieu*
Sockeye salmon	*Oncorhynchus nerka*
Speckled dace	*Rhinichthys osculus*
Steelhead trout	*Oncorhynchus mykiss*
Striped bass	*Morone saxatilis*
Sunfish	*Lepomis spp.*
Walleye	*Stizostedion vitreum*
White sturgeon	*Acipenser transmontanus*
White sucker	*Catostomus commersoni*
Plants	
American elm	*Ulmus americana*
American watercress	*Barbarea orthoceras*
Aspen	*Populus spp.*

Table K–1. Scientific Names of Nonthreatened and Nonendangered Animal and Plant Species Referred to in the Text—Continued

Common Name	Scientific Name
Bald cypress	*Taxodium distichum*
Balsam fir	*Abies balsamea*
Basswood	*Tilia americana*
Beech	*Fagus spp.*
Big sagebrush	*Artemisia tridentata*
Blackbrush	*Coleogyne ramosissima*
Blue grama	*Bouteloua gracilis*
Bluebunch wheatgrass	*Agropyron spicatum*
Bottlebrush squirreltail	*Sitanion hystrix*
Broadleaf cattail	*Typha latifolia*
Buffalo-grass	*Buchloe dactyloides*
Bulrush	*Scirpus spp.*
Canada bluegrass	*Poa canbyi*
Cattail	*Typha spp.*
Cedar	*Juniperus virginiana*
Cheatgrass	*Bromus tectorum*
Cholla	*Opuntia sp.*
Cottonwood	*Populus spp.*
Creosote bush	*Larrea tridentata*
Crested wheatgrass	*Agropyron desertorum*
Desert thorn	*Lycium pallidum*
Desert thorn	*Lycium shockleyi*
Douglas fir	*Pseudotsuga menziesii*
Fir	*Abies sp.*
Giant wildrye	*Elymus condensatus*
Gray horsebrush	*Tetradymia canescens*
Gray rabbitbrush	*Chrysothamnus nauseous*
Greasewood	*Sarcobatus vermiculatus*
Green rabbitbrush	*Chrysothamnus greenei*

Common Name	Scientific Name
Hemlock	*Tsuga canadensis*
Hickory	*Carya spp.*
Hopsage	*Grayia spinosa*
Indian ricegrass	*Oryzopsis hymenoides*
Juniper	*Juniperus spp.*
Little bluestem	*Schizachyrium scoparium*
Loblolly pine	*Pinus taeda*
Longleaf pine	*Pinus palustris*
Low sagebrush	*Artemisia arbuscula*
Maple	*Acer spp.*
Needle-and-thread grass	*Stipa comata*
Oak	*Quercus spp.*
One-seed juniper	*Juniperus monosperma*
Paper birch	*Betula papyrifera*
Peachleaf willow	*Salix amygdaloides*
Pine	*Pinus spp.*
Pinyon pine	*Pinus edulis*
Pitch pine	*Pinus rigida*
Plains cottonwood	*Populus sargentii*
Ponderosa pine	*Pinus ponderosa*
[Text deleted.]	
Poplar	*Populus spp.*
Poverty-weed	*Monolepis nuttaliana*
Prickly pear cactus	*Opuntia spp.*
Rabbitbrush	*Chrysothamnus spp.*
Red brome	*Bromus rubens*
Red oak	*Quercus rubra*
Red spruce	*Picea rubens*

Common Name	Scientific Name
[Text deleted.]	
Rush	*Juncus spp.*
Russian thisle	*Salsola kali*
Sagebrush	*Artemisia spp.*
Saltbush	*Atriplex spp.*
Sandbar willow	*Salix interior*
Sandberg's bluegrass	*Poa sandbergii*
Shortleaf pine	*Pinus echinata*
Sideoats grama	*Bouteloua curtipendula*
Slash pine	*Pinus elliottii*
Snowy buckwheat	*Eriogonum niveum*
Spike rush	*Eleocharis spp.*
Spiny hopsage	*Grayia spinosa*
Sweet gum	*Liguidambar styraciflua*
Thickspike wheatgrass	*Agropyron dasytachyum*
Threetip sagebrush	*Artemisia tripartita*
Thyme buckwheat	*Eriogonum thymoides*
Tumble mustard	*Sisymbrium altissimum*
Tupelo	*Nyssa slyvotica*
Utah juniper	*Juniperus osteosperma*
Virginia pine	*Pinus virginiana*
Watercress	*Rorippa nasturtium-aquaticum*
[Text deleted.]	
Western wheatgrass	*Agropyron smithii*
White ash	*Fraxinus americanum*
White pine	*Pinus strobus*
Willow	*Salix spp.*
Winterfat	*Eurotia lanata*

Appendix L
Socioeconomics

L.1 INTRODUCTION

Appendix L includes the supporting data used for assessing the No Action Alternative in the socioeconomics sections of this programmatic environmental impact statement. The socioeconomic analysis involved two major steps: (1) the characterization and projection of existing social, economic, and infrastructure conditions surrounding each of the candidate sites (that is, the affected environment); and (2) the evaluation of potential changes in socioeconomic conditions that could result from alternatives in the regions addressed (that is, the environmental consequences). Data and analyses used to support the assessment made for the socioeconomic sections for the No Action Alternative are presented in Tables L.1–1 to L.1–90. Data and analyses used to support the assessment of potential impacts as a result of project alternatives are contained in a separate report (Socio 1996a).

The socioeconomic environment is defined for two geographic regions: the regional economic area (REA) and the region of influence (ROI). REAs are used to assess potential effects on the regional economy, and ROIs are used to assess effects that are more localized in political jurisdictions surrounding the sites.

The REA for each site encompasses a broad market that involves trade among and between regional industrial and service sectors and is characterized by strong economic linkages between the communities in the region. These linkages determine the nature and magnitude of multiplier effects of economic activity (purchases, earnings, and employment) at each site. REAs are defined by the U.S. Bureau of Economic Analysis and consist of an economic node that serves as the center of economic activity, and the surrounding counties that are economically related and include the places of work and residences of the labor force.

Potential demographic impacts were assessed for each ROI, a smaller geographic area where the housing market and local community services would be most affected. Site-specific ROIs were identified as those counties where approximately 90 percent of the current Department of Energy and/or contractor employees reside. This residential distribution reflects existing commuting patterns and attractiveness of area communities for people employed at each site and is used to estimate the future distribution of in-migrating workers.

Table L.1–1. Department of Energy Sites' Regional Economic Areas by County

Hanford	NTS	INEL	Pantex		ORR	SRS	RFETS			LANL
Washington	**Arizona**	**Idaho**	**New Mexico**	**Texas (cont'd)**	**Tennessee**	**Georgia**	**Colorado**	**Colorado**	**Kansas**	**New Mexico**
Adams	Mohave	Bannock	Curry	Hall	Anderson	Burke	Adams	(cont'd)	Cheyenne	Guadalupe
Benton		Bingham	DeBaca	Hansford	Blount	Columbia	Arapahoe	Kit Carson	Gove	Mora
Chelan		Bonneville	Harding	Hartley	Campbell	Glascock	Boulder	Lake	Logan	Taos
Douglas	**Nevada**	Butte	Quay	Hemphill	Cocke	Jefferson	Chaffee	Larimer	Sheridan	San Miguel
Franklin	Clark	Clark	Roosevelt	Hutchinson	Grainger	Jenkins	Clear Creek	Lincoln	Sherman	Los Alamos
Grant	Esmeralda	Custer	Union	Lipscomb	Hamblen	Lincoln	Custer	Logan	Thomas	Santa Fe
Kittitas	Lincoln	Fremont		Moore	Hancock	McDuffie	Delta	Mesa	Wallace	Rio Arriba
Okanogan	Mineral	Jefferson		Ochiltree	Jefferson	Richmond	Denver	Moffat		
Yakima	Nye	Lemhi	**Texas**	Oldham	Knox	Warren	Douglas	Montrose		
		Madison	Armstrong	Parmer	Loudon	Wilkes	Eagle	Morgan	**Nebraska**	
		Power	Bailey	Potter	Morgan		El Paso	Ouray	Dundy	
	Utah	Teton	Carson	Randall	Roane		Elbert	Park		
	Beaver		Castro	Roberts	Scott	**South Carolina**	Fremont	Phillips		
	Garfield		Childress	Sherman	Sevier	Aiken	Garfield	Pitkin		
	Iron	**Wyoming**	Collingsworth	Wheeler	Union	Allendale	Gilpin	Rio Blanco		
	Piute	Teton	Cottle			Bamberg	Grand	Routt		
	Washington		Dallam			Barnwell	Gunnison	San Miguel		
			Deaf Smith			Edgefield	Hinsdale	Summit		
			Donley				Jackson	Teller		
			Gray				Jefferson	Washington		
								Weld		
								Yuma		

Source: DOC 1995a.

Table L.1–2. Distribution of Employees by Place of Residence in the Hanford Site Region of Influence, 1996

County/City	Number of Employees	Total Site Employment (percent)
Benton County	11,494	78.8
Kennewick	4,230	29.0
Richland	5,295	36.3
West Richland	1,109	7.6
Franklin County	1,298	8.9
Pasco	1,284	8.8
Yakima County	452	3.1
[Text deleted.]		
ROI Total	13,244	90.8

Note: City values are included within county totals.
Source: HF 1996a:2.

Table L.1–3. Distribution of Employees by Place of Residence in the Nevada Test Site Region of Influence, 1991

County/City	Number of Employees	Total Site Employment (percent)
Clark County	6,270	81.7
Henderson	357	4.7
Las Vegas	5,352	69.7
North Las Vegas	505	6.6
Nye County	1,173	15.3
ROI Total	7,443	97.0

Note: City values are included within county totals.
Source: NTS 1991a:1.

Table L.1–4. Distribution of Employees by Place of Residence in the Idaho National Engineering Laboratory Region of Influence, 1991

County/City	Number of Employees	Total Site Employment (percent)
Bannock County	342	5.3
Pocatello	317	4.9
Bingham County	576	8.9
Blackfoot	460	7.1
Bonneville County	4,893	75.7
Idaho Falls	4,750	73.5
Butte County	123	1.9
Jefferson County	419	6.5
Rigby	320	4.9
ROI Total	6,353	98.3

Note: City values are included within county totals. Employees do not include Westinghouse or ICPP. The percent of employees residing in each city and county in this table were used to analyze socioeconomic effects. These percentages differ from the updated percentages shown in paragraph 3.4.8 which did not include city data. City data is required to conduct the socioeconomic analysis.
Source: INEL 1991a:6.

Table L.1–5. Distribution of Employees by Place of Residence in the Pantex Plant Region of Influence, 1994

County/City	Number of Employees	Total Site Employment (percent)
Armstrong County	51	1.4
Carson County	191	5.4
Potter County	1,224	34.4
Amarillo	3,030	85.1
Randall County	1,943	54.6
ROI Total	3,409	95.8

Note: City values are included within county totals. Potter and Randall Counties each reflect a part of Amarillo.
Source: PX 1994a:2.

Table L.1–6. Distribution of Employees by Place of Residence in the Oak Ridge Reservation Region of Influence, 1990

County/City	Number of Employees	Total Site Employment (percent)
Anderson County	5,053	33.1
Clinton	1,035	6.8
Oak Ridge	3,292	21.6
Knox County	5,490	36.0
Knoxville	4,835	31.7
Loudon County	848	5.6
Lenoir City	638	4.2
Roane County	2,537	16.6
Harriman	802	5.3
Kingston	1,033	6.8
ROI Total	13,928	91.3

Note: City values are included within county totals.
Source: ORR 1991a:4.

Table L.1–7. Distribution of Employees by Place of Residence in the Savannah River Site Region of Influence, 1991

County/City	Number of Employees	Total Site Employment (percent)
Aiken County	9,978	51.9
Aiken	4,928	25.7
North Augusta	2,666	13.9
Allendale County	217	1.1
Bamberg County	329	1.7
Barnwell County	1,401	7.3
Columbia County	2,036	10.6
Richmond County	3,358	17.5
Augusta	2,780	14.5
ROI Total	17,319	90.1

Note: City values are included within county totals.
Source: SRS 1991a:3.

Table L.1–8. Distribution of Employees by Place of Residence in the Rocky Flats Environmental Technology Site Region of Influence, 1995

County/City	Number of Employees	Total Site Employment (percent)
Adams County	887	20.0
Westminster	637	14.4
Thornton	230	5.2
Arapahoe County	158	3.6
Boulder County	1,135	25.6
Broomfield	373	8.4
Longmont	227	5.1
Denver County	276	6.2
Jefferson County	1,559	35.2
Arvada	659	14.9
ROI Total	4,015	90.6

Note: City values are included within county totals.
Source: RFETS 1995a:1.

Table L.1–9. Distribution of Employees by Place of Residence in the Los Alamos National Laboratory Region of Influence, 1991

County/City	Number of Employees	Total Site Employment (percent)
Los Alamos County	4,697	48.3
Rio Arriba County	2,027	20.8
Espanola	944	9.7
Santa Fe County	1,851	19.0
Santa Fe	1,548	15.9
ROI Total	8,575	88.1

Note: City values are included within county totals.
Source: LANL 1991b:6.

Table L.1–10. Hanford Site Regional Economic Area Employment and Economy, 1995-2040

Regional Economic Area	1995	2000	2005	2010	2015	2020	2030	2040
Civilian labor force	332,000	354,100	373,700	392,200	411,200	428,300	458,500	490,700
Total employment	301,900	322,000	339,800	356,600	374,000	389,500	416,000	446,300
Unemployment rate (percent)	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
Total personal income (thousands of dollars)	11,577,987	13,168,249	14,667,279	16,157,208	17,766,227	19,272,231	22,080,020	25,296,940
Per capita income (dollars)	18,996	20,259	21,381	22,441	23,531	24,508	26,233	28,079

Source: Census 1993k; Census 1994o; Census 1995a; DOC 1994j; DOC 1995a; DOC 1996a; DOC 1996b; DOL 1991a; DOL 1995a.

Table L.1–11. Hanford Site Region of Influence Population, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Benton County	131,00	139,700	147,400	154,700	161,700	169,000	180,900	193,600
Kennewick	48,700	52,000	54,800	57,600	60,200	62,900	67,300	72,000
Richland	36,200	38,600	40,700	42,800	44,700	46,700	50,000	53,500
West Richland	5,900	6,300	6,700	7,000	7,300	7,600	8,200	8,700
Franklin County	43,300	46,100	48,700	51,100	53,400	55,800	59,700	64,000
Pasco	23,500	25,100	26,500	27,800	29,000	30,400	32,500	34,800
Yakima County	210,400	224,400	236,800	248,500	259,700	271,400	290,500	311,000
[Text deleted.]								
ROI Total	384,700	410,200	432,900	454,300	474,800	496,200	531,100	568,600

Note: City values are included within county totals.

Source: Census 1993k; Census 1994o; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b.

Table L.1–12. Hanford Site Region of Influence Total Number of Owner and Renter Housing Units, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Benton County	50,400	53,800	56,700	59,600	62,200	65,000	69,600	74,500
Kennewick	19,200	20,400	21,600	22,600	23,600	24,700	26,500	28,300
Richland	15,100	16,100	17,000	17,800	18,600	19,500	20,800	22,300
West Richland	2,200	2,400	2,500	2,700	2,800	2,900	3,100	3,300
Franklin County	14,800	15,700	16,600	17,400	18,200	19,100	20,400	21,800
Pasco	8,500	9,000	9,500	10,000	10,400	10,900	11,700	12,500
Yakima County	75,700	80,800	85,200	89,400	93,500	97,700	104,600	111,900
[Text deleted.]								
ROI Total	140,900	150,300	158,500	166,400	173,900	181,800	194,600	208,200

Note: City values are included within county totals.

Source: Census 1991d; Table L.1–11.

Table L.1–13. Hanford Site Region of Influence Total Student Enrollment, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Benton County	25,494	27,198	28,702	30,115	31,489	32,882	35,198	37,674
Finley District	1,130	1,210	1,280	1,340	1,400	1,460	1,560	1,670
Kennewick District	12,340	13,160	13,880	14,570	15,230	15,910	17,030	18,230
Kiona Benton District	1,410	1,510	1,590	1,670	1,750	1,820	1,950	2,090
Patterson District	64	68	72	75	79	82	88	94
Prosser District	2,590	2,760	2,920	3,060	3,200	3,340	3,580	3,830
Richland District	7,960	8,490	8,960	9,400	9,830	10,270	10,990	11,760
Franklin County	8,927	9,524	10,049	10,550	11,031	11,522	12,324	13,195
Kahlotus District	90	96	100	110	110	120	120	130
North Franklin District	1,760	1,880	1,980	2,080	2,180	2,270	2,430	2,610
Pasco District	7,060	7,530	7,950	8,340	8,720	9,110	9,750	10,430
Star District	17	18	19	20	21	22	24	25
Yakima County	42,470	45,310	47,800	50,180	52,430	54,790	58,630	62,790
East Valley District	2,110	2,250	2,370	2,490	2,600	2,720	2,910	3,120
Grandview District	2,630	2,810	2,960	3,110	3,250	3,390	3,630	3,890
Granger District	1,100	1,180	1,240	1,310	1,360	1,420	1,520	1,630
Highland District	1,010	1,080	1,140	1,190	1,250	1,300	1,400	1,490
Mabton District	800	850	900	940	990	1,030	1,110	1,180
Mount Adams District	1,110	1,180	1,250	1,310	1,370	1,430	1,530	1,640
Naches Valley District	1,390	1,490	1,570	1,650	1,720	1,800	1,920	2,060
Selah District	3,350	3,570	3,770	3,960	4,130	4,320	4,620	4,950
Sunnyside District	4,520	4,820	5,090	5,340	5,580	5,840	6,250	6,690
Toppenish District	2,980	3,180	3,350	3,520	3,680	3,840	4,110	4,400
Union Gap District	480	520	550	570	600	630	670	720
Wapato District	3,090	3,290	3,470	3,650	3,810	3,980	4,260	4,560
West Valley District	4,130	4,400	4,640	4,870	5,090	5,320	5,700	6,100
Yakima District	12,700	13,540	14,290	15,000	15,670	16,380	17,530	18,770
Zillah District	1,070	1,150	1,210	1,270	1,330	1,390	1,480	1,590
ROI Total	76,891	82,032	86,551	90,845	94,950	99,194	106,152	113,659

Note: Bolded areas are county totals and unbolded areas are school districts.

Source: Socio 1996a; Table L.1–11.

Table L.1–14. Hanford Site Region of Influence Total Number of Teachers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Benton County	1,303	1,388	1,467	1,540	1,607	1,680	1,800	1,925
Finley District	57	60	64	67	70	73	78	84
Kennewick District	647	690	729	765	799	835	894	957
Kiona Benton District	66	70	74	78	85	90	91	92
Patterson District	4	4	5	5	5	5	6	6
Prosser District	139	148	156	164	171	179	192	205
Richland District	390	416	439	461	481	503	539	576
Franklin County	527	563	593	623	653	682	729	780
Kahlotus District	15	16	17	18	19	20	21	22
North Franklin District	95	102	107	112	118	123	131	141
Pasco District	415	443	467	491	513	537	574	614
Star District	2	2	2	2	3	3	3	3
Yakima County	2,247	2,396	2,527	2,654	2,773	2,897	3,102	3,318
East Valley District	110	118	124	130	136	142	152	163
Grandview District	133	142	149	157	164	171	183	196
Granger District	57	61	64	67	70	73	78	84
Highland District	54	57	60	63	66	69	74	79
Mabton District	45	48	50	53	55	57	62	66
Mount Adams District	60	64	67	71	74	77	83	88
Naches Valley District	69	73	78	81	85	89	95	102
Selah District	173	185	195	205	214	223	239	256
Sunnyside District	230	245	259	272	284	297	318	340
Toppenish District	163	174	184	193	201	210	225	241
Union Gap District	27	29	31	32	34	35	38	40
Wapato District	153	163	172	181	189	197	211	226
West Valley District	205	218	230	242	253	264	283	302
Yakima District	716	763	805	845	883	923	988	1,057
Zillah District	53	56	59	62	65	68	73	78
ROI Total	4,077	4,347	4,587	4,817	5,033	5,259	5,631	6,023

Note: Bolded areas are county totals and unbolded areas are school districts.

Source: Socio 1996a; Table L.1–11.

Table L.1–15. Hanford Site Region of Influence Total Number of Sworn Police Officers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Benton County	57	60	64	67	70	73	78	84
Kennewick	67	71	75	79	83	86	92	99
Richland	45	48	50	53	55	58	62	66
West Richland	10	11	11	12	13	13	14	15
Franklin County	21	23	24	25	26	27	29	31
Pasco	44	46	49	51	54	56	60	64
Yakima County	259	277	292	306	320	335	358	383
[Text deleted.]								
ROI Total	503	536	565	593	621	648	693	742

Note: Non-ROI cities included in county number.
Source: DOJ 1995a; Table L.1–11.

Table L.1–16. Hanford Site Region of Influence Total Number of Firefighters, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Benton County	251	268	283	297	310	324	347	371
Kennewick	58	62	65	68	71	74	80	85
Richland	46	49	51	54	56	59	63	67
West Richland	32	35	36	38	40	42	45	48
Franklin County	152	162	171	179	188	196	210	225
Pasco	84	90	95	99	104	108	116	124
Yakima County	921	982	1,036	1,088	1,137	1,188	1,272	1,361
[Text deleted.]								
ROI Total	1,544	1,648	1,737	1,823	1,906	1,991	2,133	2,281

Note: Non-ROI cities included in county number.
Source: Socio 1996a; Table L.1–11.

Table L.1–17. Hanford Site Region of Influence Hospital Occupancy Rates, 1995-2040

County/City	1995 (percent)	2000 (percent)	2005 (percent)	2010 (percent)	2015 (percent)	2020 (percent)	2030 (percent)	2040 (percent)
Benton County	48	52	54	57	60	62	67	71
Franklin County	48	51	54	56	59	61	66	70
Yakima County	53	57	60	63	68	72	72	73
ROI Average	51	54	57	60	63	66	70	75

Source: AHA 1995a; Table L.1–11.

Table L.1–18. Hanford Site Region of Influence Total Number of Doctors, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Benton County	151	161	170	178	186	195	208	223
Franklin County	42	44	47	49	51	54	57	61
Yakima County	279	297	314	329	344	359	385	412
ROI Total	472	502	531	556	581	608	650	696

Source: AMA 1995a; Table L.1–11.

Table L.1–19. Nevada Test Site Regional Economic Area Employment and Economy, 1995-2040

Regional Economic Area	1995	2000	2005	2010	2015	2020	2030	2040
Civilian labor force	625,300	731,600	822,700	910,100	991,200	1,063,900	1,183,800	1,317,200
Total employment	587,000	686,800	772,300	854,400	930,500	998,700	1,111,300	1,236,600
Unemployment rate (percent)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Total personal income (thousands of dollars)	26,000,837	35,588,677	45,005,896	55,080,114	65,335,105	75,263,852	93,188,103	115,381,024
Per capita income (dollars)	21,900	25,622	28,813	31,875	34,716	37,260	41,460	46,134

Source: Census 1993f; Census 1993y; Census 1993z; Census 1994o; Census 1995a; DOC 1994j; DOC 1995a; DOC 1996a; DOC 1996b; DOL 1991a; DOL 1995a.

Table L.1–20. Nevada Test Site Region of Influence Population, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Clark County	968,100	1,132,700	1,273,700	1,409,100	1,523,500	1,647,200	1,832,900	2,039,500
Henderson	105,200	123,100	138,500	153,200	165,600	179,100	199,300	221,700
Las Vegas	338,300	395,800	445,100	492,400	532,400	575,600	640,500	712,700
North Las Vegas	66,600	77,900	87,600	96,600	104,800	113,300	126,100	140,300
Nye County	22,600	26,400	29,700	32,800	35,500	38,400	42,700	47,500
ROI Total	990,700	1,159,100	1,303,400	1,441,900	1,559,000	1,685,600	1,875,600	2,087,000

Note: City values are included within county totals.

Source: Census 1993y; Census 1994o; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b.

Table L.1–21. Nevada Test Site Region of Influence Total Number of Owner and Renter Housing Units, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Clark County	394,800	461,800	519,400	574,600	621,200	671,600	747,300	831,600
Henderson	40,000	46,800	52,700	58,300	63,000	68,100	75,800	84,300
Las Vegas	140,300	164,200	184,600	204,300	220,800	238,800	265,700	295,700
North Las Vegas	21,400	25,000	28,100	31,000	33,600	36,300	40,400	45,000
Nye County	8,900	10,500	11,800	13,000	14,100	15,200	16,900	18,900
ROI Total	403,700	472,300	531,200	587,600	635,300	686,800	764,200	850,500

Note: City values are included within county totals.

Source: Census 1991g; Table L.1–20.

Table L.1–22. Nevada Test Site Region of Influence Total Student Enrollment, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Clark County	161,330	188,750	212,260	234,820	253,880	274,490	305,430	339,860
Nye County	4,300	5,030	5,660	6,260	6,770	7,320	8,150	9,060
ROI Total	165,630	193,780	217,920	241,080	260,650	281,810	313,580	348,920

Source: Socio 1996a; Table L.1–20.

Table L.1–23. Nevada Test Site Region of Influence Total Number of Teachers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Clark County	8,217	9,613	10,811	11,960	12,930	13,980	15,556	17,309
Nye County	249	291	327	362	391	423	471	524
ROI Total	8,466	9,904	11,138	12,322	13,321	14,403	16,027	17,833

Source: Socio 1996a; Table L.1–20.

Table L.1–24. Nevada Test Site Region of Influence Total Number of Sworn Police Officers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Clark County	23	27	30	33	36	39	43	48
Henderson	158	185	208	230	248	269	299	333
Las Vegas	1,561	1,827	2,054	2,273	2,457	2,656	2,956	3,289
North Las Vegas	130	152	171	189	205	221	246	274
[Text deleted.]								
Nye County	74	87	98	108	117	126	141	157
ROI Total	1,946	2,278	2,561	2,833	3,063	3,311	3,685	4,101

Note: Incorporated cities in Clark County provide police protection. Non-ROI cities included within county number. Las Vegas Police Department also serves unincorporated Clark County.

Source: DOJ 1995a; Table L.1–20.

Table L.1–25. Nevada Test Site Region of Influence Total Number of Firefighters, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Clark County	925	1,082	1,216	1,347	1,455	1,573	1,750	1,948
Henderson	90	105	118	131	141	153	170	189
Las Vegas	330	386	434	481	520	562	625	696
North Las Vegas	71	83	94	103	112	121	135	150
Nye County	137	161	181	200	216	233	260	289
ROI Total	1,553	1,817	2,043	2,262	2,444	2,642	2,940	3,271

Note: Non-ROI cities are included within county number.
Source: Socio 1996a; Table L.1–20.

Table L.1–26. Nevada Test Site Region of Influence Hospital Occupancy Rates, 1995-2040

County/City	1995 (percent)	2000 (percent)	2005 (percent)	2010 (percent)	2015 (percent)	2020 (percent)	2030 (percent)	2040 (percent)
Clark County	63	74	83	92	99	107	119	133
Nye County	34	40	45	50	54	59	65	73
ROI Average	62	73	82	91	98	106	118	131

Source: AHA 1995a; Table L.1–20.

Table L.1–27. Nevada Test Site Region of Influence Total Number of Doctors, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Clark County	1,283	1,501	1,689	1,858	2,009	2,172	2,417	2,689
Nye County	7	8	10	11	11	12	14	15
ROI Total	1,276	1,493	1,679	1,869	2,020	2,184	2,431	2,704

Source: AMA 1995a; Table L.1–20.

Table L.1–28. Idaho National Engineering Laboratory Regional Economic Area Employment and Economy, 1995-2040

Regional Economic Area	1995	2000	2005	2010	2015	2020	2030	2040
Civilian labor force	151,400	161,300	168,100	174,400	181,200	188,200	200,700	214,000
Total employment	143,300	152,600	159,100	165,000	171,500	178,100	189,900	202,500
Unemployment rate (%)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Total personal income (thousands of dollars)	4,928,397	5,592,534	6,076,196	6,540,456	7,062,688	7,615,420	8,661,350	9,850,930
Per capita income (dollars)	17,701	18,217	18,988	19,700	20,472	21,258	22,670	24,177

Source: Census 1993n; Census 1993o; Census 1995a; DOC 1994j; DOC 1995a; DOC 1996a; DOC 1996b; DOL 1991a; DOL 1995a; INEL 1995a:1.

Table L.1–29. Idaho National Engineering Laboratory Region of Influence Population, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Bannock County	71,800	76,500	79,800	82,800	86,000	89,300	95,200	101,600
Pocatello	50,300	53,500	55,800	57,900	60,200	62,500	66,600	71,100
Bingham County	41,500	44,200	46,100	47,800	49,700	51,600	55,000	58,700
Blackfoot	10,900	11,600	12,100	12,600	13,100	13,600	14,500	15,400
Bonneville County	80,200	85,500	89,100	92,400	96,000	99,700	106,400	113,400
Idaho Falls	50,600	53,900	56,100	58,200	60,500	62,900	67,000	71,500
Butte County	3,100	3,300	3,400	3,600	3,700	3,800	4,100	4,400
Jefferson County	18,700	19,900	20,700	21,500	22,300	23,200	24,700	26,400
Rigby	3,100	3,300	3,400	3,600	3,700	3,800	4,100	4,400
ROI Total	215,300	229,400	239,100	248,100	257,700	267,600	285,400	304,500

Note: City values are included within county totals.

Source: Census 1993n; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b.

Table L.1–30. Idaho National Engineering Laboratory Region of Influence Total Number of Owner and Renter Housing Units, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Bannock County	26,800	28,600	29,800	30,900	32,100	33,300	35,600	37,900
Pocatello	19,800	21,100	22,000	22,800	23,700	24,600	26,300	28,000
Bingham County	13,200	14,100	14,700	15,200	15,800	16,400	17,500	18,700
Blackfoot	4,000	4,200	4,400	4,600	4,800	4,900	5,300	5,600
Bonneville County	27,900	29,700	30,900	32,100	33,300	34,600	36,900	39,400
Idaho Falls	19,100	20,300	21,200	22,000	22,800	23,700	25,300	26,900
Butte County	1,100	1,200	1,300	1,300	1,400	1,400	1,500	1,600
Jefferson County	5,600	6,000	6,300	6,500	6,700	7,000	7,500	8,000
Rigby	1,100	1,100	1,200	1,200	1,300	1,300	1,400	1,500
ROI Total	74,600	79,600	83,000	86,000	89,300	92,700	99,000	105,600

Note: City values are included within county totals.
Source: Census 1991n; Table L.1–29.

Table L.1–31. Idaho National Engineering Laboratory Region of Influence Total Student Enrollment, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Bannock County	15,930	16,970	17,690	18,360	19,060	19,800	21,120	22,530
Marrsh Valley	1,740	1,850	1,930	2,010	2,080	2,160	2,310	2,460
Pocatello	14,190	15,120	15,760	16,350	16,980	17,640	18,810	20,070
Bingham County	11,730	12,510	13,040	13,540	14,050	14,590	15,570	16,610
Aberdeen	1,010	1,080	1,120	1,170	1,210	1,260	1,340	1,430
Blackfoot	4,570	4,870	5,080	5,270	5,470	5,680	6,060	6,460
Firth	1,140	1,220	1,270	1,320	1,370	1,420	1,520	1,620
Snake River	2,590	2,760	2,880	2,990	3,100	3,220	3,440	3,670
Shelley	2,420	2,580	2,690	2,790	2,900	3,010	3,210	3,430
Bonneville County	19,300	20,560	21,430	22,230	23,100	23,990	25,580	27,290
Bonneville	7,780	8,290	8,640	8,960	9,310	9,670	10,310	11,000
Idaho Falls	11,420	12,170	12,680	13,160	13,670	14,200	15,140	16,150
Swan Valley	100	100	110	110	120	120	130	140
Butte County	740	790	820	850	890	920	980	1,050
Arco	740	790	820	850	890	920	980	1,050
Jefferson County	5,760	6,130	6,400	6,640	6,890	7,160	7,630	8,150
Jefferson	4,230	4,500	4,690	4,870	5,060	5,250	5,600	5,980
Ririe	760	810	850	880	910	950	1,010	1,080
West Jefferson	770	820	860	890	920	960	1,020	1,090
ROI Total	53,460	56,960	59,380	61,620	63,990	66,460	70,880	75,630

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–29.

Table L.1–32. Idaho National Engineering Laboratory Region of Influence Total Number of Teachers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Bannock County	872	929	968	1,004	1,043	1,084	1,156	1,233
Marsh Valley	105	112	117	121	126	131	140	149
Pocatello	767	817	851	883	917	953	1,016	1,084
Bingham County	629	671	697	724	753	782	834	889
Aberdeen	60	64	66	69	72	74	79	84
Blackfoot	264	282	293	304	316	329	350	374
Firth	61	65	67	70	73	76	81	86
Snake River	135	143	150	155	161	167	179	190
Shelley	109	117	121	126	131	136	145	155
Bonneville County	1,043	1,110	1,159	1,202	1,248	1,297	1,383	1,474
Bonneville	429	457	477	495	514	534	569	607
Idaho Falls	609	648	676	701	728	757	807	860
Swan Valley	5	5	6	6	6	6	7	7
Butte County	46	49	51	52	55	57	60	64
Arco	46	49	51	52	55	57	60	64
Jefferson County	300	320	333	344	359	373	397	424
Jefferson	215	229	238	247	257	267	285	304
Ririe	39	42	44	45	47	49	52	56
West Jefferson	46	49	51	52	55	57	60	64
ROI Total	2,890	3,079	3,208	3,326	3,458	3,593	3,830	4,084

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–29.

Table L.1–33. Idaho National Engineering Laboratory Region of Influence Total Number of Sworn Police Officers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Bannock County	55	58	61	63	65	68	72	77
Pocatello	80	85	89	92	96	99	106	113
Bingham County	39	42	44	45	47	49	52	56
Blackfoot	19	20	21	22	23	24	26	27
Bonneville County	47	50	52	54	56	58	62	66
Idaho Falls	83	88	92	96	99	103	110	117
Butte County	4	4	4	5	5	5	5	6
Jefferson County	11	12	12	13	13	14	15	16
Rigby	6	6	7	7	7	8	8	9
ROI Total	344	365	382	397	411	428	456	487

Source: DOJ 1995a; Table L.1–29.

Table L.1–34. Idaho National Engineering Laboratory Region of Influence Total Number of Firefighters, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Bannock County	50	53	56	58	60	62	66	71
Pocatello	71	76	79	82	85	88	94	100
Bingham County	56	60	62	65	67	70	74	79
Blackfoot	40	43	44	46	48	50	53	57
Bonneville County	35	37	39	40	42	44	46	49
Idaho Falls	88	94	98	101	105	109	117	124
Butte County	23	25	26	26	28	29	30	33
Jefferson County	90	96	100	104	108	112	119	127
Rigby	12	13	13	14	14	15	16	17
ROI Total	465	497	517	536	557	579	615	657

Source: Socio 1996a; Table L.1–29.

Table L.1–35. Idaho National Engineering Laboratory Region of Influence Hospital Occupancy Rates, 1995-2040

County/City	1995 (percent)	2000 (percent)	2005 (percent)	2010 (percent)	2015 (percent)	2020 (percent)	2030 (percent)	2040 (percent)
Bannock County	49	52	54	56	58	60	64	69
Bingham County	62	66	68	71	74	77	82	87
Bonneville County	50	53	55	57	59	62	66	70
Butte County	NA	NA	NA	NA	NA	NA	NA	NA
Jefferson County	NH	NH	NH	NH	NH	NH	NH	NH
ROI Average	51	54	57	59	61	63	68	72

Note: NA=not available. Some hospitals in Butte County unable to provide occupancy data; NH=no hospitals are located in Jefferson County.

Source: AHA 1995a; Table L.1–29.

Table L.1–36. Idaho National Engineering Laboratory Region of Influence Total Number of Doctors, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Bannock County	112	120	125	129	135	140	149	159
Bingham County	21	23	24	24	25	26	28	30
Bonneville County	131	139	145	150	156	162	173	185
Butte County	0	0	0	0	0	0	0	0
Jefferson County	3	3	3	3	4	4	4	4
ROI Total	267	285	297	306	320	332	354	378

Source: AMA 1995a; Table L.1–29.

Table L.1–37. Pantex Plant Regional Economic Area Employment and Economy, 1995-2040

Regional Economic Area	1995	2000	2005	2010	2015	2020	2030	2040
Civilian labor force	229,100	233,000	235,500	239,000	243,000	247,700	257,300	267,300
Total employment	218,100	221,800	224,200	227,500	231,300	235,800	244,900	254,400
Unemployment rate (percent)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Total personal income (thousands of dollars)	8,942,433	9,251,512	9,450,250	9,732,031	10,059,136	10,450,770	11,276,590	12,167,609
Per capita income (dollars)	19,435	19,768	19,979	20,275	20,613	21,010	21,825	22,671

Source: Census 1993m; Census 1993w; Census 1994o; Census 1995a; DOC 1994j; DOC 1995a; DOC 1996a; DOC 1996b; DOL 1995a.

Table L.1–38. Pantex Plant Region of Influence Population, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Armstrong County	2,100	2,100	2,100	2,200	2,200	2,300	2,300	2,400
Carson County	6,600	6,700	6,800	6,900	7,000	7,100	7,400	7,700
Potter County	103,300	105,000	106,200	107,700	109,700	111,600	116,000	120,500
Amarillo	165,600	168,400	170,200	172,800	175,900	179,000	186,000	193,200
Randall County	94,400	96,000	97,100	98,500	100,300	102,100	106,000	110,200
ROI Total	206,400	209,800	212,200	215,300	219,200	223,100	231,700	240,800

Note: Amarillo is divided across Potter and Randall Counties. The population shown for Amarillo is for the whole city. Potter and Randall County totals represent their share of Amarillo.

Source: Census 1993w; Census 1994o; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b.

Table L.1–39. Pantex Plant Region of Influence Total Number of Owner and Renter Housing Units, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Armstrong County	800	800	800	900	900	900	900	1,000
Carson County	2,600	2,600	2,700	2,700	2,800	2,800	2,900	3,000
Potter County	43,300	44,000	44,500	45,100	45,900	46,800	48,600	50,500
Amarillo	69,600	70,800	71,600	72,700	74,000	75,300	78,200	81,200
Randall County	38,700	39,300	39,700	40,300	41,100	41,800	43,400	45,100
ROI Total	85,400	86,700	87,700	89,000	90,700	92,300	95,800	99,600

Note: Amarillo is divided across Potter and Randall Counties. The value shown for Amarillo is for the whole city. Potter and Randall County totals each represent their share of Amarillo.

Source: Census 1991m; Table L.1–38.

Table L.1–40. Pantex Plant Region of Influence Total Student Enrollment, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Armstrong County	400	410	410	420	430	440	450	470
Claude	400	410	410	420	430	440	450	470
Carson County	1,430	1,450	1,470	1,490	1,520	1,550	1,610	1,670
Groom	230	230	240	240	240	250	260	270
Panhandle	730	740	750	760	780	790	820	850
White Deer	470	480	480	490	500	510	530	550
Potter County	2,390	2,440	2,460	2,500	2,560	2,590	2,700	2,810
Bushland	380	390	390	400	410	410	430	450
Highland Park	690	700	710	720	740	750	780	810
River Road	1,320	1,350	1,360	1,380	1,410	1,430	1,490	1,550
Amarillo	29,020	29,520	29,840	30,280	30,820	31,380	32,590	33,860
Randall County	6,480	6,590	6,660	6,760	6,880	7,000	7,270	7,550
Canyon	6,480	6,590	6,660	6,760	6,880	7,000	7,270	7,550
ROI Total	39,720	40,410	40,840	41,450	42,210	42,960	44,620	46,360

Note: Amarillo School District values not included within county totals; bolded areas are county totals, and unbolded areas are school districts.

Source: Socio 1996a; Table L.1–38.

Table L.1–41. Pantex Plant Region of Influence Total Number of Teachers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Armstrong County	33	34	34	35	35	36	37	39
Claude	33	34	34	35	35	36	37	39
Carson County	122	124	126	128	130	133	137	142
Groom	20	20	21	21	21	22	23	23
Panhandle	59	60	61	62	63	64	66	69
White Deer	43	44	44	45	46	47	48	50
Potter County	165	169	171	173	176	179	185	194
Bushland	27	28	28	28	29	29	30	32
Highland Park	57	58	59	60	61	62	64	67
River Road	81	83	84	85	86	88	91	95
Amarillo	1,746	1,776	1,795	1,821	1,854	1,887	1,961	2,037
Randall County	372	379	383	388	395	402	418	434
Canyon	372	379	383	388	395	402	418	434
ROI Total	2,438	2,482	2,509	2,545	2,590	2,637	2,738	2,846

Note: Amarillo School District values not included within county totals; bolded areas are county totals, and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–38.

Table L.1–42. Pantex Plant Region of Influence Total Number of Sworn Police Officers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Armstrong County	3	3	3	3	3	3	3	4
Carson County	5	5	5	5	5	5	6	6
Potter County	126	129	130	132	134	137	142	147
Amarillo	254	258	261	265	270	274	285	296
Randall County	76	78	78	80	81	82	86	89
ROI Total	463	473	477	485	493	501	522	542

Note: Amarillo City values not included within county totals. Non-ROI cities included within county numbers.
Source: DOJ 1995a; Table L.1–38.

Table L.1–43. Pantex Plant Region of Influence Total Number of Firefighters, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Armstrong County	39	40	41	41	42	43	44	46
Carson County	90	92	93	94	96	98	101	105
Potter County	0	0	0	0	0	0	0	0
Amarillo	214	217	220	223	227	231	240	249
Randall County	69	70	71	72	74	75	78	81
ROI Total	412	419	425	430	439	447	463	481

Note: Amarillo City values not included within county totals. Non-ROI cities included within county numbers.
Source: Socio 1996a; Table L.1–38.

Table L.1–44. Pantex Plant Region of Influence Hospital Occupancy Rates, 1995-2040

County/City	1995 (percent)	2000 (percent)	2005 (percent)	2010 (percent)	2015 (percent)	2020 (percent)	2030 (percent)	2040 (percent)
Armstrong County	NH	NH	NH	NH	NH	NH	NH	NH
Carson County	NH	NH	NH	NH	NH	NH	NH	NH
Potter County	56	57	58	59	60	61	63	66
Randall County	32	33	33	33	34	35	36	37
ROI Average	56	57	57	58	59	60	62	65

Note: NH=No hospitals located in Armstrong or Carson Counties.
Source: AHA 1995a; Table L.1–38.

Table L.1–45. Pantex Plant Region of Influence Total Number of Doctors, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Armstrong County	0	0	0	0	0	0	0	0
Carson County	0	0	0	0	0	0	0	0
Potter County	396	403	407	413	421	428	445	462
Randall County	12	12	12	13	13	13	14	14
ROI Total	408	415	419	426	434	441	459	476

Source: AMA 1995a; Table L.1–38.

Table L.1–46. Oak Ridge Reservation Regional Economic Area Employment and Economy, 1995-2040

Regional Economic Area	1995	2000	2005	2010	2015	2020	2030	2040
Civilian labor force	482,200	512,900	537,400	562,400	587,400	610,900	653,400	698,900
Total employment	458,800	488,100	511,400	535,200	558,900	681,300	621,800	665,000
Unemployment rate (percent)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Total personal income (thousands of dollars)	16,482,992	18,654,590	20,477,380	22,427,539	24,466,384	26,460,927	30,273,609	34,635,650
Per capita income (dollars)	18,190	19,351	20,275	21,218	22,162	23,047	24,652	26,368

Source: Census 1993b; Census 1995a; DOC 1994j; DOC 1995a; DOC 1996a; DOC 1996b; DOL 1991a; DOL 1995a; OR LMES 1995e.

Table L.1–47. Oak Ridge Reservation Region of Influence Population, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Anderson County	72,100	76,700	80,400	84,100	87,700	91,400	97,700	104,500
Clinton	10,400	11,000	11,500	12,100	12,600	13,100	14,000	15,000
Oak Ridge	28,600	30,400	31,800	33,300	34,700	36,200	38,700	41,400
Knox County	361,900	385,000	403,400	422,100	440,000	458,500	490,500	524,600
Knoxville	171,400	182,400	191,100	200,000	208,400	217,200	232,300	248,500
Loudon County	35,500	37,800	39,600	41,400	43,200	45,000	48,100	51,500
Lenoir City	8,800	9,300	9,800	10,200	10,700	11,100	11,900	12,700
Roane County	49,100	52,200	54,700	57,300	59,700	62,200	66,600	71,200
Harriman	7,300	7,700	8,100	8,500	8,900	9,200	9,900	10,600
Kingston	5,200	5,500	5,800	6,000	6,300	6,600	7,000	7,500
ROI Total	518,600	551,700	578,100	604,900	630,600	657,100	702,900	751,800

Note: City values are included within county totals.
Source: Census 1993b; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b.

Table L.1–48. Oak Ridge Reservation Region of Influence Total Number of Owner and Renter Housing Units, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Anderson County	30,000	31,900	33,500	35,000	36,500	38,000	40,700	43,500
Clinton	4,500	4,800	5,000	5,300	5,500	5,700	6,100	6,600
Oak Ridge	12,000	12,700	13,300	13,900	14,500	15,200	16,200	17,300
Knox County	150,600	160,200	167,900	175,700	183,100	190,800	204,100	218,300
Knoxville	76,900	81,800	85,700	89,700	93,500	97,500	104,200	111,500
Loudon County	14,200	15,100	15,900	16,600	17,300	18,000	19,300	20,600
Lenoir City	3,800	4,000	4,200	4,400	4,600	4,800	5,100	5,500
Roane County	19,900	21,200	22,200	23,200	24,200	25,200	27,000	28,800
Harriman	3,100	3,300	3,500	3,700	3,800	4,000	4,300	4,500
Kingston	2,300	2,500	2,600	2,700	2,800	2,900	3,100	3,400
ROI Total	214,700	228,400	239,500	250,500	261,100	272,000	291,100	311,200

Note: City values are included within county totals.
Source: Census 1991c; Table L.1–47.

Table L.1–49. Oak Ridge Reservation Region of Influence Total Student Enrollment, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Anderson County	12,900	13,720	14,380	15,050	15,690	16,340	17,480	18,710
Anderson County	6,890	7,320	7,670	8,030	8,370	8,720	9,330	9,980
Clinton City	1,180	1,260	1,320	1,380	1,440	1,500	1,600	1,720
Oak Ridge	4,830	5,140	5,390	5,640	5,880	6,120	6,550	7,010
Knox County	56,260	59,850	62,700	65,620	68,390	71,280	76,240	81,550
Knox County	56,260	59,850	62,700	65,620	68,390	71,280	76,240	81,550
Loudon County	6,510	6,920	7,260	7,580	7,910	8,250	8,820	9,430
Loudon County	4,590	4,880	5,120	5,350	5,580	5,820	6,220	6,650
Lenoir City	1,920	2,040	2,140	2,230	2,330	2,430	2,600	2,780
Roane County	7,670	8,160	8,550	8,950	9,320	9,710	10,390	11,120
Roane County	5,950	6,330	6,630	6,940	7,230	7,530	8,060	8,620
Harriman	1,720	1,830	1,920	2,010	2,090	2,180	2,330	2,500
ROI Total	83,340	88,650	91,890	97,200	101,310	105,580	112,930	120,810

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–47.

Table L.1–50. Oak Ridge Reservation Region of Influence Total Number of Teachers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Anderson County	912	971	1,017	1,064	1,109	1,156	1,237	1,322
Anderson County	486	517	542	567	591	616	659	704
Clinton City	78	83	87	91	95	99	106	113
Oak Ridge	348	371	388	406	423	441	472	505
Knox County	3,347	3,561	3,731	3,904	4,069	4,241	4,536	4,852
Knox County	3,347	3,561	3,731	3,904	4,069	4,241	4,536	4,852
Loudon County	389	414	434	455	473	494	528	565
Loudon County	278	296	310	325	338	353	377	404
Lenoir City	111	118	124	130	135	141	151	161
Roane County	484	516	540	566	590	615	658	703
Roane County	363	387	405	424	442	461	493	527
Harriman	121	129	135	142	148	154	165	176
ROI Total	5,132	5,462	5,722	5,989	6,241	6,506	6,959	7,442

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–47.

Table L.1–51. Oak Ridge Reservation Region of Influence Total Number of Sworn Police Officers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Anderson County	124	131	138	144	150	157	167	179
Clinton	16	17	18	19	20	21	22	23
Oak Ridge	50	53	55	58	60	63	67	72
Knox County	240	255	267	280	292	304	325	348
Knoxville	341	363	380	398	415	432	462	495
Loudon County	42	44	46	48	50	53	56	60
Lenoir City	14	15	16	17	17	18	19	21
Roane County	49	52	54	57	59	62	66	70
Harriman	13	14	15	15	16	17	18	19
Kingston	8	9	9	9	10	10	11	12
ROI Total	897	953	998	1,045	1,089	1,137	1,213	1,299

Source: DOJ 1995a; Socio 1996a; Table L.1–47.

Table L.1–52. Oak Ridge Reservation Region of Influence Total Number of Firefighters, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Anderson County	183	195	204	213	222	232	248	265
Clinton	16	17	18	19	19	20	22	23
Oak Ridge	46	49	51	54	56	58	62	67
Knox County	200	213	223	233	243	253	271	290
Knoxville	357	380	398	416	434	452	484	518
Loudon County	138	147	154	161	168	175	187	200
Lenoir City	15	16	17	17	18	19	20	22
Roane County	110	117	123	128	134	139	149	159
Harriman	18	19	20	21	22	23	24	26
Kingston	37	39	41	43	45	47	50	54
ROI Total	1,120	1,192	1,249	1,305	1,361	1,418	1,517	1,624

Source: Socio 1996a; Table L.1–47.

Table L.1–53. Oak Ridge Reservation Region of Influence Hospital Occupancy Rates, 1995-2040

County/City	1995 (percent)	2000 (percent)	2005 (percent)	2010 (percent)	2015 (percent)	2020 (percent)	2030 (percent)	2040 (percent)
Anderson County	66	70	74	77	80	84	90	96
Knox County	66	70	73	77	80	83	89	95
Loudon County	32	34	36	38	39	41	44	47
Roane County	52	55	58	61	63	66	71	76
ROI Average	65	69	72	75	78	82	87	93

Source: AHA 1995a; Table L.1–47.

Table L.1–54. Oak Ridge Reservation Region of Influence Total Number of Doctors, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Anderson County	147	156	164	171	178	186	199	213
Knox County	1,123	1,194	1,251	1,310	1,365	1,423	1,522	1,628
Loudon County	24	26	27	28	30	31	33	35
Roane County	28	30	32	33	34	36	38	41
ROI Total	1,322	1,406	1,474	1,542	1,607	1,676	1,792	1,917

Source: AMA 1995a; Table L.1–47.

Table L.1–55. Savannah River Site Regional Economic Area Employment and Economy, 1995-2040

Regional Economic Area	1995	2000	2005	2010	2015	2020	2030	2040
Civilian labor force	260,400	275,600	288,600	302,500	316,300	329,700	354,000	380,000
Total employment	242,900	257,000	269,200	282,100	295,100	307,600	330,200	354,500
Unemployment rate (percent)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Total personal income (thousands of dollars)	10,070,574	11,281,795	12,370,855	13,590,502	14,867,480	16,152,064	18,615,578	21,454,828
Per capita income (dollars)	17,332	18,334	19,209	20,134	21,059	21,950	23,564	25,297

Source: Census 1993c; Census 1993e; Census 1995a; DOC 1994j; DOC 1995a; DOC 1996a; DOC 1996b; DOL 1991a; DOL 1995a; SRS 1995a:2.

Table L.1–56. Savannah River Site Region of Influence Population, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Aiken County	133,600	141,400	148,000	155,200	162,000	169,200	181,600	195,000
Aiken	25,200	26,700	27,900	29,300	30,600	31,900	34,300	36,800
North Augusta	17,800	18,900	19,800	20,700	21,600	22,600	24,200	26,000
Allendale County	11,600	11,500	11,700	12,300	12,800	13,400	14,400	15,500
Bamberg County	16,600	16,300	16,700	17,500	18,300	19,200	20,600	22,200
Barnwell County	21,700	22,900	24,000	25,200	26,300	27,400	29,500	31,600
Columbia County	80,800	85,600	89,600	93,900	98,000	102,400	109,900	118,000
Richmond County	193,200	185,200	194,000	203,500	212,900	222,700	239,600	257,900
Augusta	42,900	41,300	43,100	45,300	47,300	49,500	53,300	57,300
ROI Total	457,500	462,900	484,000	507,600	530,300	554,300	595,600	640,200

Note: City values are included within county totals.

Source: Census 1993c; Census 1993e; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b.

Table L.1–57. Savannah River Site Region of Influence Total Number of Owner and Renter Housing Units, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Aiken County	52,000	55,000	57,600	60,400	63,000	65,800	70,600	75,800
Aiken	10,400	11,000	11,500	12,100	12,600	13,200	14,200	15,200
North Augusta	7,700	8,200	8,600	9,000	9,400	9,800	10,500	11,300
Allendale County	3,900	3,900	3,900	4,100	4,300	4,500	4,800	5,200
Bamberg County	5,700	5,600	5,700	6,000	6,300	6,600	7,100	7,600
Barnwell County	7,900	8,400	8,700	9,200	9,600	10,000	10,700	11,500
Columbia County	27,700	29,400	30,800	32,200	33,700	35,100	37,700	40,500
Richmond County	74,200	71,100	74,500	78,200	81,800	85,500	92,000	99,100
Augusta	19,300	18,600	19,400	20,400	21,300	22,300	24,000	25,800
ROI Total	171,400	173,400	181,200	190,100	198,700	207,500	222,900	239,700

Note: City values are included within county totals.
Source: Census 1991a; Census 1991b; Table L.1–56.

Table L.1–58. Savannah River Site Region of Influence Total Student Enrollment, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Aiken County	25,610	27,110	28,380	29,750	31,060	32,430	34,820	37,380
Aiken County	25,610	27,110	28,380	29,750	31,060	32,430	34,820	37,380
Allendale County	2,340	2,310	2,350	2,460	2,570	2,690	2,900	3,120
Allendale County	2,340	2,310	2,350	2,460	2,570	2,690	2,900	3,120
Bamberg County	3,130	3,080	3,160	3,310	3,460	3,620	3,900	4,190
District #1	1,820	1,790	1,840	1,930	2,010	2,110	2,270	2,440
District #2	1,310	1,290	1,320	1,380	1,450	1,510	1,630	1,750
Barnwell County	4,990	5,290	5,540	5,810	6,060	6,320	6,790	7,280
District #19	1,270	1,350	1,410	1,480	1,540	1,610	1,730	1,850
District #29	1,030	1,090	1,140	1,200	1,250	1,300	1,400	1,500
District #45	2,690	2,850	2,990	3,130	3,270	3,410	3,660	3,930
Columbia County	16,260	17,210	18,020	18,890	19,720	20,590	22,110	23,730
Columbia County	16,260	17,210	18,020	18,890	19,720	20,590	22,110	23,730
Richmond County	34,400	32,990	34,550	36,240	37,910	39,660	42,670	45,920
Richmond County	34,400	32,990	34,550	36,240	37,910	39,660	42,670	45,920
ROI Total	86,730	87,990	92,000	96,460	100,780	105,310	113,190	121,620

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–56.

Table L.1–59. Savannah River Site Region of Influence Total Number of Teachers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Aiken County	1,345	1,424	1,491	1,563	1,632	1,704	1,829	1,963
Aiken County	1,345	1,424	1,491	1,563	1,632	1,704	1,829	1,963
Allendale County	159	158	160	168	176	184	198	213
Allendale County	159	158	160	168	176	184	198	213
Bamberg County	224	221	226	237	248	259	279	300
District #1	124	122	125	131	137	143	154	166
District #2	100	99	101	106	111	116	125	134
Barnwell County	299	316	331	347	362	378	405	436
District #19	76	80	84	88	92	96	103	111
District #29	68	72	75	79	82	86	92	99
District #45	155	164	172	180	188	196	210	226
Columbia County	905	958	1,003	1,052	1,098	1,146	1,231	1,321
Columbia County	905	958	1,003	1,052	1,098	1,146	1,231	1,321
Richmond County	2,034	1,950	2,043	2,143	2,242	2,345	2,523	2,715
Richmond County	2,034	1,950	2,043	2,143	2,242	2,345	2,523	2,715
ROI Total	4,966	5,027	5,254	5,510	5,758	6,016	6,465	6,948

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–56.

Table L.1–60. Savannah River Site Region of Influence Total Number of Sworn Police Officers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Aiken County	100	106	111	116	121	127	136	146
Aiken	83	88	92	96	101	105	113	121
North Augusta	49	51	54	56	59	61	66	71
Allendale County	19	19	19	20	21	22	23	25
Bamberg County	24	23	24	25	26	28	30	32
Barnwell County	36	39	40	42	44	46	50	53
Columbia County	154	163	170	179	186	195	209	224
Richmond County	320	307	321	337	353	369	397	427
Augusta	167	161	168	176	184	193	207	223
ROI Total	952	957	999	1,047	1,095	1,146	1,231	1,322

Source: DOJ 1995a; Table L.1–56.

Table L.1–61. Savannah River Site Region of Influence Total Number of Firefighters, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Aiken County	375	397	416	436	455	475	510	547
Aiken	100	106	111	116	121	127	136	146
North Augusta	45	48	50	52	55	57	61	66
Allendale County	82	81	82	86	90	94	102	109
Bamberg County	155	152	156	164	171	179	193	207
Barnwell County	90	95	100	105	109	114	122	131
Columbia County	196	207	217	228	238	248	266	286
Richmond County	182	174	183	192	201	210	226	243
Augusta	138	133	139	146	152	159	171	184
ROI Total	1,363	1,393	1,454	1,525	1,592	1,663	1,787	1,919

Source: Socio 1996a; Table L.1–56.

Table L.1–62. Savannah River Site Region of Influence Hospital Occupancy Rates, 1995-2040

County/City	1995 (percent)	2000 (percent)	2005 (percent)	2010 (percent)	2015 (percent)	2020 (percent)	2030 (percent)	2040 (percent)
Aiken County	NA	NA	NA	NA	NA	NA	NA	NA
Allendale County	67	66	67	71	74	77	83	90
Bamberg County	72	71	73	76	80	84	90	97
Barnwell County	47	50	52	55	57	60	64	69
Columbia County	NH	NH	NH	NH	NH	NH	NH	NH
Richmond County	61	58	61	64	67	70	75	81
ROI Average	65	65	68	72	75	78	84	90

Note: NA=not available. Some hospitals in Aiken County are unable to provide occupancy data. NH=No hospitals are located in Columbia County.
Source: AHA 1995a; Table L.1–56.

Table L.1–63. Savannah River Site Region of Influence Total Number of Doctors, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Aiken County	145	153	160	168	175	183	197	211
Allendale County	6	6	6	6	7	7	7	8
Bamberg County	8	8	8	8	9	9	10	11
Barnwell County	8	9	9	9	10	10	11	12
Columbia County	212	225	235	247	258	269	289	310
Richmond County	971	931	975	1,023	1,070	1,119	1,204	1,296
ROI Total	1,350	1,332	1,393	1,461	1,529	1,597	1,458	1,848

Source: AMA 1995a; Table L.1–56.

Table L.1–64. Rocky Flats Environmental Technology Site Regional Economic Area Employment and Economy, 1995-2040

Regional Economic Area	1995	2000	2005	2010	2015	2020	2030	2040
Civilian labor force	1,900,800	2,070,300	2,219,300	2,362,800	2,502,300	2,629,900	2,854,200	3,097,500
Total employment	1,822,900	1,985,400	2,128,300	2,265,900	2,399,700	2,522,100	2,737,200	2,970,500
Unemployment rate (percent)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Total personal income (thousands of dollars)	77,373,382	91,785,863	105,476,299	119,552,501	134,090,993	148,119,250	174,451,599	205,465,262
Per capita income (dollars)	22,721	24,747	26,528	28,243	29,911	31,437	34,117	37,025

Source: Census 1993t; Census 1993u; Census 1993v; Census 1995a; CO DIS 1994a; DOC 1994j; DOC 1995a; DOC 1996a; DOC 1996b; DOL 1991a; DOL 1995a; RFETS 1995a:1.

Table L.1–65. Rocky Flats Environmental Technology Site Region of Influence Population, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Adams County	300,200	333,600	363,700	392,300	418,000	445,400	489,200	537,300
Westminster	88,800	98,800	107,600	116,100	123,700	131,800	144,800	159,000
Thornton	64,400	71,600	78,000	84,200	89,700	95,500	104,900	115,300
Arapahoe County	452,500	503,000	548,200	591,400	630,200	671,400	737,500	810,000
Boulder County	254,800	283,200	308,700	333,000	354,800	378,100	415,300	456,100
Broomfield	28,000	31,100	33,900	36,600	39,000	41,500	45,600	50,100
Longmont	57,400	63,800	69,600	75,100	80,000	85,200	93,600	102,800
Denver County	497,100	507,900	514,600	522,200	529,900	537,800	553,700	570,000
Jefferson County	487,100	541,400	590,100	636,600	678,300	722,800	793,800	871,900
Arvada	97,400	108,300	118,000	127,300	135,700	144,600	158,800	174,400
ROI Total	1,991,700	2,169,100	2,325,300	2,475,500	2,611,200	2,755,500	2,989,500	3,245,300

Note: Cities split across county lines were analyzed in the county where a majority of the population resides. All city values are included within county totals.
Source: Census 1993v; Census 1995a; CO DIS 1994a; DOC 1994j; DOC 1996a; DOC 1996b.

Table L.1–66. Rocky Flats Environmental Technology Site Region of Influence Total Number of Owner and Renter Housing Units, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Adams County	118,100	131,300	143,100	154,400	164,500	155,900	192,600	211,500
Westminster	35,100	39,000	42,500	45,800	48,900	44,800	57,200	62,800
Thornton	23,800	26,400	28,800	31,100	33,100	30,600	38,700	42,600
Arapahoe County	192,400	213,900	233,100	251,500	268,000	251,700	313,600	344,400
Boulder County	103,300	114,800	125,200	135,000	143,900	135,800	168,400	184,900
Broomfield	10,300	11,400	12,500	13,500	14,300	9,000	16,800	18,400
Longmont	22,600	25,100	27,400	29,500	31,500	30,200	36,800	40,500
Denver County	247,600	253,000	256,300	260,100	264,000	339,000	275,800	283,900
Jefferson County	193,800	215,400	234,800	253,300	269,900	255,000	315,900	346,900
Arvada	36,300	40,300	43,900	47,400	50,500	47,600	59,100	64,900
ROI Total	855,200	928,400	992,500	1,054,300	1,110,300	1,137,400	1,266,300	1,371,600

Note: City values are included within county totals.
Source: Census 1991k; Table L.1–65.

Table L.1–67. Rocky Flats Environmental Technology Site Region of Influence Total Student Enrollment, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Adams County	58,990	65,590	71,460	77,100	82,170	87,540	96,160	105,610
Adams County	6,540	7,270	7,920	8,550	9,110	9,710	10,660	11,710
Bennet	1,050	1,170	1,270	1,370	1,460	1,560	1,710	1,880
Brighton	4,410	4,900	5,340	5,760	6,140	6,540	7,190	7,890
Mappleton	4,990	5,550	6,040	6,520	6,950	7,400	8,130	8,930
Northglenn-Thornton	27,020	30,040	32,740	35,320	37,640	40,100	44,050	48,380
Strasburg	220	250	270	290	310	330	360	400
Westminster City	14,760	16,410	17,880	19,290	20,560	21,900	24,060	26,420
Arapahoe County	87,180	96,920	105,640	113,950	121,430	129,370	142,100	156,070
Adams-Arapahoe/Aurora	27,990	31,110	33,910	36,580	38,980	41,530	45,620	50,100
Byers	380	420	460	490	530	560	610	670
Cherry Creek	36,210	40,250	43,870	47,330	50,430	53,730	59,010	64,820
Englewood	4,370	4,860	5,290	5,710	6,080	6,480	7,120	7,820
Littleton	16,020	17,810	19,420	20,940	22,320	23,780	26,120	28,690
Sheridan	2,020	2,250	2,450	2,650	2,820	3,000	3,300	3,620
Deer Trail	190	220	240	250	270	290	320	350
Boulder County	41,570	46,210	50,360	54,330	57,890	61,680	67,750	74,410
Boulder Valley	25,170	27,980	30,490	32,900	35,050	37,350	41,020	45,050
St. Vrain	16,400	18,230	19,870	21,430	22,840	24,330	26,730	29,360
Denver County	63,220	64,590	65,440	66,410	67,400	68,400	70,420	72,490
Denver County	63,220	64,590	65,440	66,410	67,400	68,400	70,420	72,490
Jefferson County	85,880	95,470	104,050	112,250	119,610	127,440	139,980	153,740
Jefferson County	85,880	95,470	104,050	112,250	119,610	127,440	139,980	153,740
ROI Total	336,840	368,780	396,950	424,040	448,500	474,430	516,410	562,320

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–65.

Table L.1–68. Rocky Flats Environmental Technology Site Region of Influence Total Number of Teachers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Adams County	3,034	3,374	3,678	3,967	4,226	4,504	4,946	5,433
Adams County	318	354	386	416	443	473	519	570
Bennet	68	76	83	89	95	101	111	122
Brighton	248	276	300	324	345	368	404	444
Mapleton	334	371	404	436	465	495	544	597
Northglenn-Thornton	1,404	1,561	1,702	1,836	1,956	2,084	2,289	2,514
Strasburg	17	19	21	23	24	26	28	31
Westminster City	645	717	782	843	898	957	1,051	1,155
Arapahoe County	5,202	5,783	6,303	6,800	7,246	7,721	8,478	9,313
Adams-Arapahoe/Aurora	1,523	1,693	1,845	1,990	2,121	2,260	2,482	2,726
Byers	30	33	36	39	41	44	48	53
Cherry Creek	2,245	2,496	2,721	2,935	3,127	3,332	3,660	4,020
Englewood	278	309	336	363	387	412	452	497
Littleton	995	1,106	1,206	1,301	1,386	1,477	1,622	1,781
Sheridan	108	120	131	141	151	161	176	194
Deer Trail	23	26	28	31	33	35	38	42
Boulder County	2,220	2,468	2,689	2,901	3,091	3,295	3,618	3,974
Boulder Valley	1,403	1,560	1,700	1,834	1,954	2,083	2,287	2,512
St. Vrain	817	908	989	1,067	1,137	1,212	1,331	1,462
Denver County	3,671	3,751	3,800	3,856	3,914	3,972	4,089	4,209
Denver County	3,671	3,751	3,800	3,856	3,914	3,972	4,089	4,209
Jefferson County	3,624	4,029	4,391	4,737	5,048	5,378	5,907	6,488
Jefferson County	3,624	4,029	4,391	4,737	5,048	5,378	5,907	6,488
ROI Total	17,751	19,405	20,861	22,261	23,525	24,870	27,038	29,417

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–65.

Table L.1–69. Rocky Flats Environmental Technology Site Region of Influence Total Number of Sworn Police Officers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Adams County	142	158	172	185	198	211	231	254
Westminster	122	136	148	160	171	182	200	219
Thornton	90	100	109	117	125	133	146	161
Arapahoe County	1,001	1,113	1,213	1,309	1,394	1,486	1,632	1,792
Boulder County	181	201	219	236	252	268	294	323
Broomfield	46	51	56	60	64	68	75	82
Longmont	84	93	101	109	117	124	136	150
Denver County	1,388	1,418	1,437	1,458	1,480	1,502	1,546	1,591
Jefferson County	698	776	846	912	972	1,036	1,138	1,250
Arvada	119	133	145	156	166	177	195	214
ROI Total	3,871	4,179	4,446	4,702	4,939	5,187	5,593	6,036

Source: DOJ 1995a; Socio 1996a; Table L.1–65.

Table L.1–70. Rocky Flats Environmental Technology Site Region of Influence Total Number of Firefighters, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Adams County	1,396	1,552	1,691	1,825	1,944	2,072	2,275	2,499
Westminster	123	137	149	161	171	183	200	220
Thornton	89	99	108	116	124	132	145	159
Arapahoe County	953	1,059	1,155	1,246	1,327	1,414	1,553	1,706
Boulder County	787	875	954	1,029	1,096	1,168	1,283	1,409
Broomfield	39	43	47	51	54	58	64	70
Longmont	68	76	82	89	95	101	111	122
Denver County	875	894	906	919	933	947	975	1,003
Jefferson County	878	976	1,064	1,148	1,223	1,303	1,431	1,572
Arvada	200	222	242	261	279	297	326	358
ROI Total	5,408	5,933	6,398	6,845	7,246	7,675	8,363	9,118

Source: Socio 1996a; Table L.1–65.

Table L.1–71. Rocky Flats Environmental Technology Site Region of Influence Hospital Occupancy Rates, 1995-2040

County/City	1995 (percent)	2000 (percent)	2005 (percent)	2010 (percent)	2015 (percent)	2020 (percent)	2030 (percent)	2040 (percent)
Adams County	23	25	28	30	32	34	37	41
Arapahoe County	50	55	60	65	69	74	81	89
Boulder County	51	57	62	67	71	76	83	92
Denver County	49	60	61	62	63	64	66	68
Jefferson County	45	50	54	59	63	67	73	80
ROI Average	56	61	65	70	73	78	84	91

Source: AHA 1995a; Table L.1–65.

Table L.1–72. Rocky Flats Environmental Technology Site Region of Influence Total Number of Doctors, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Adams County	474	526	574	619	660	703	772	848
Arapahoe County	787	875	953	1,029	1,096	1,168	1,283	1,409
Boulder County	557	619	675	728	776	827	908	998
Denver County	2,668	2,726	2,762	2,803	2,844	2,886	2,972	3,059
Jefferson County	599	666	726	783	834	889	976	1,073
ROI Total	5,085	5,412	5,690	5,962	6,210	6,473	6,911	7,387

Source: AMA 1995a; L.1–65.

Table L.1–73. Los Alamos National Laboratory Regional Economic Area Employment and Economy, 1995-2040

Regional Economic Area	1995	2000	2005	2010	2015	2020	2030	2040
Civilian labor force	119,400	130,000	138,900	147,200	156,000	163,600	176,900	191,100
Total employment	112,100	122,000	130,300	138,100	146,400	153,500	165,900	179,300
Unemployment rate (percent)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Total personal income (thousands of dollars)	4,193,315	4,968,820	5,667,556	6,367,165	7,155,101	7,870,611	9,194,182	10,740,332
Per capita income (dollars)	18,259	19,875	21,227	22,499	23,850	25,014	27,036	29,221

Source: Census 1993m; Census 1995a; DOC 1994j; DOC 1995a; DOC 1996a; DOC 1996b; DOL 1991a; DOL 1995a.

Table L.1–74. Los Alamos National Laboratory Region of Influence Population, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Los Alamos County	18,800	20,500	21,900	23,200	24,500	25,800	27,900	30,200
Rio Arriba County	36,900	40,200	42,900	45,500	48,000	50,600	54,700	59,100
Espanola	10,000	10,800	11,600	12,300	12,900	13,700	14,800	15,900
Santa Fe County	114,200	124,300	132,700	140,700	148,300	156,400	169,000	182,700
Santa Fe	63,600	69,200	73,900	78,400	82,600	87,100	94,200	101,800
ROI Total	169,900	185,000	197,500	209,400	220,800	232,800	251,600	272,000

Note: City values are included within county totals.

Source: Census 1993m; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b.

Table L.1–75. Los Alamos National Laboratory Region of Influence Total Number of Owner and Renter Housing Units, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Los Alamos County	7,900	8,600	9,100	9,700	10,200	10,800	11,600	12,600
Rio Arriba County	15,400	16,800	17,900	19,000	20,000	21,100	22,800	24,700
Espanola	4,000	4,400	4,700	5,000	5,200	5,500	6,000	6,400
Santa Fe County	47,800	52,100	55,600	59,000	62,200	65,600	70,900	76,600
Santa Fe	28,100	30,600	32,700	34,600	36,500	38,500	41,600	45,000
ROI Total	71,100	77,500	82,600	87,700	92,400	97,500	105,300	113,900

Note: City values are included within county totals.
Source: Census 1991h; Table L.1–74.

Table L.1–76. Los Alamos National Laboratory Region of Influence Total Student Enrollment, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Los Alamos County	3,750	4,090	4,360	4,630	4,880	5,140	5,560	6,010
Los Alamos Public Schools	3,750	4,090	4,360	4,630	4,880	5,140	5,560	6,010
Rio Arriba County	7,280	7,920	8,470	8,980	9,460	9,970	10,790	11,660
Chama Valley Ind. School District #1	600	650	700	740	780	820	890	960
Dulce Ind. School District #21	730	790	850	900	950	1,000	1,080	1,170
Espanola Public School District	5,470	5,950	6,360	6,740	7,100	7,490	8,100	8,750
Jemez Mt. School District #53	480	530	560	600	630	660	720	780
Santa Fe County	15,280	16,640	17,770	18,830	19,860	20,940	22,630	24,460
Pojoaque Valley School District #1	1,890	2,060	2,200	2,330	2,460	2,590	2,800	3,030
Santa Fe Public School District	13,390	14,580	15,570	16,500	17,400	18,350	19,830	21,430
ROI Total	26,310	28,650	30,600	32,440	34,200	36,050	38,980	42,130

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–74.

Table L.1–77. Los Alamos National Laboratory Region of Influence Total Number of Teachers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Los Alamos County	255	278	297	315	332	350	378	409
Los Alamos Public Schools	255	278	297	315	332	350	378	409
Rio Arriba County	402	436	466	494	521	550	596	643
Chama Valley Ind. School District #1	42	45	48	51	54	57	62	67
Dulce Ind. School District #21	42	45	48	51	54	57	62	67
Espanola Public School District	289	314	336	356	375	396	428	462
Jemez Mt. School District #53	29	32	34	36	38	40	44	47
Santa Fe County	861	937	1,002	1,061	1,119	1,180	1,275	1,379
Pojoaque Valley School District #1	109	118	127	134	141	149	161	174
Santa Fe Public School District	753	819	875	927	978	1,031	1,114	1,205
ROI Total	1,518	1,651	1,765	1,870	1,972	2,080	2,249	2,431

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–74.

Table L.1–78. Los Alamos National Laboratory Region of Influence Total Number of Sworn Police Officers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Los Alamos County	42	45	48	51	54	57	62	67
Rio Arriba County	27	30	32	34	36	38	41	44
Espanola	24	27	28	30	32	33	36	39
Santa Fe County	68	74	79	84	89	93	101	109
Santa Fe	106	115	123	130	137	145	157	169
ROI Total	267	291	310	329	348	366	397	428

Source: Socio 1996a; Table L.1–74.

Table L.1–79. Los Alamos National Laboratory Region of Influence Total Number of Firefighters, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Los Alamos County	136	148	158	168	177	186	201	218
Rio Arriba County	276	300	321	340	359	378	409	442
Espanola	24	26	28	30	31	33	36	38
Santa Fe County	257	280	299	317	334	352	381	411
Santa Fe	107	116	124	132	139	147	158	171
ROI Total	800	870	930	987	1,040	1,096	1,185	1,280

Source: Socio 1996a; Table L.1–74.

Table L.1–80. Los Alamos National Laboratory Region of Influence Hospital Occupancy Rates, 1995-2040

County/City	1995 (percent)	2000 (percent)	2005 (percent)	2010 (percent)	2015 (percent)	2020 (percent)	2030 (percent)	2040 (percent)
Los Alamos County	29	32	34	36	38	40	44	47
Rio Arriba County	33	36	38	41	43	45	49	53
Santa Fe County	NA	NA	NA	NA	NA	NA	NA	NA
ROI Total	32	35	37	40	42	44	47	51

Note: NA=not available. Some hospitals in Santa Fe County are unable to provide occupancy data.
Source: AHA 1995a; Table L.1–74.

Table L.1–81. Los Alamos National Laboratory Region of Influence Total Number of Doctors, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
Los Alamos County	46	50	53	56	59	63	68	73
Rio Arriba County	22	24	26	28	29	31	33	36
Santa Fe County	248	270	289	306	322	340	367	397
ROI Total	316	344	368	390	410	434	468	506

Source: AMA 1995a; Table L.1–74.

Table L.1–82. Representative Site for the Partially Completed Reactor Facility Regional Economic Area Employment and Economy, 1995-2040

Regional Economic Area	1995	2000	2005	2010	2015	2020	2030	2040
Civilian labor force	471,400	490,900	508,000	526,500	547,100	568,500	607,700	649,600
Total employment	442,500	460,800	476,800	494,200	513,500	533,600	570,400	609,700
Unemployment rate (percent)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Total personal income (thousands of dollars)	17,003,392	18,438,982	19,741,968	21,210,463	22,899,239	24,725,301	28,251,496	32,280,578
Per capita income (dollars)	18,086	18,835	19,489	20,200	20,989	21,810	23,313	24,920

Source: BW 1995b:1; Census 1993b; Census 1993p; Census 1995a; DOC 1994j; DOC 1995a; DOC 1996a; DOC 1996b; DOL 1991a; DOL 1995a; NFS 1995b:2; OR LMES 1995e.

Table L.1–83. Representative Site for the Partially Completed Reactor Facility Region of Influence Population, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
County A	58,000	60,400	62,400	64,700	67,300	69,900	74,700	79,900
County B	50,000	52,000	53,800	55,800	58,000	60,200	64,400	68,800
County C	260,100	270,900	280,300	290,500	301,900	313,7000	335,300	358,400
City #1	159,200	155,900	159,100	165,000	171,700	178,700	191,400	204,900
City #2	20,400	21,300	22,000	22,800	23,700	24,600	26,300	28,100
ROI Total	368,100	383,300	396,500	411,000	427,200	443,800	474,400	507,100

Note: City values are included within county totals.

Source: Census 1993p; Census 1995a; DOC 1994j; DOC 1996a; DOC 1996b.

Table L.1–84. Representative Site for the Partially Completed Reactor Region of Influence Total Number of Owner and Renter Housing Units, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
County A	23,000	23,900	24,700	25,600	26,700	27,700	29,600	31,600
County B	19,400	20,300	21,000	21,700	22,600	23,500	25,100	26,800
County C	104,400	108,700	112,500	116,600	121,200	125,900	134,600	143,900
City #1	66,500	65,200	66,500	69,000	71,800	74,700	80,000	85,700
City #2	8,800	9,200	9,500	9,900	10,300	10,700	11,400	12,200
ROI Total	146,800	152,900	158,200	163,900	170,500	177,100	189,300	202,300

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Census 1991p; Table L.1–83.

Table L.1–85. Representative Site for the Partially Completed Reactor Region of Influence Total Student Enrollment, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
County A	9,890	10,300	10,660	11,050	11,480	11,930	12,760	13,630
School district #1	7,250	7,550	7,810	8,100	8,410	8,740	9,350	9,990
School district #2	2,640	2,750	2,850	2,950	3,070	3,190	3,410	3,640
County B	9,280	9,660	10,000	10,370	10,770	11,190	11,960	12,790
School district #1	6,430	6,690	6,930	7,180	7,460	7,750	8,280	8,860
School district #2	2,850	2,970	3,070	3,190	3,310	3,440	3,680	3,930
County C	41,920	43,660	45,170	46,830	48,650	50,550	54,040	57,760
School district #1	17,330	18,050	18,670	19,360	20,110	20,900	22,340	23,880
School district #2	24,590	25,610	26,500	27,470	28,540	29,650	31,700	33,880
ROI Total	61,090	63,620	65,830	68,250	70,900	73,670	78,760	84,180

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–83.

Table L.1–86. Representative Site for the Partially Completed Reactor Region of Influence Total Number of Teachers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
County A	640	667	690	715	743	772	825	882
School district #1	479	499	516	535	556	577	617	660
School district #2	161	168	174	180	187	195	208	222
County B	609	634	656	680	706	734	785	839
School district #1	399	416	430	446	463	481	515	550
School district #2	210	218	226	234	243	253	270	289
County C	2,693	2,805	2,902	3,008	3,125	3,247	3,471	3,710
School district #1	1,063	1,107	1,145	1,187	1,233	1,281	1,370	1,464
School district #2	1,630	1,698	1,757	1,821	1,892	1,966	2,101	2,246
ROI Total	3,942	4,106	4,248	4,403	4,574	4,753	5,081	5,431

Note: Bolded areas are county totals and unbolded areas are school districts.
Source: Socio 1996a; Table L.1–83.

Table L.1–87. Representative Site for the Partially Completed Reactor Region of Influence Total Number of Sworn Police Officers, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
County A	51	54	55	57	60	62	66	71
County B	33	35	36	37	39	40	43	46
County C	102	119	126	130	135	140	149	159
City #1	328	321	327	340	353	368	394	422
City #2	34	36	37	38	40	41	44	47
ROI Total	548	565	581	602	627	651	696	745

Source: DOJ 1995a; Table L.1–83.

Table L.1–88. Representative Site for the Partially Completed Reactor Region of Influence Total Number of Firefighters, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
County A	395	411	426	441	458	476	509	544
County B	465	484	501	519	540	561	599	641
County C	425	494	524	542	562	583	621	661
City #1	175	171	175	181	189	196	210	225
City #2	30	31	32	34	35	36	39	41
ROI Total	1,490	1,591	1,658	1,717	1,784	1,852	1,978	2,112

Source: Socio 1996a; Table L.1–83.

Table L.1–89. Representative Site for the Partially Completed Reactor Region of Influence Hospital Occupancy Rates, 1995-2040

County/City	1995 (percent)	2000 (percent)	2005 (percent)	2010 (percent)	2015 (percent)	2020 (percent)	2030 (percent)	2040 (percent)
County A	47	49	51	52	55	57	61	65
County B	71	73	76	79	82	85	91	97
County C	59	61	64	66	68	71	76	81
ROI Average	59	62	64	66	69	72	77	82

Source: AHA 1995a; Table L.1–83.

Table L.1–90. Representative Site for the Partially Completed Reactor Region of Influence Total Number of Doctors, 1995-2040

County/City	1995	2000	2005	2010	2015	2020	2030	2040
County A	30	31	33	34	35	36	39	42
County B	33	35	36	37	39	40	43	46
County C	466	485	502	520	541	562	600	642
ROI Total	529	551	571	591	615	638	682	730

Source: AMA 1995a; Table L.1–83.

Appendix M
Health and Safety

M.1 INTRODUCTION

This appendix presents detailed information on the potential impacts and risks to humans associated with releases of radioactivity and hazardous chemicals from the proposed storage and disposition technologies during normal operations and from postulated accidents. This information is intended to support the public and occupational health and safety assessments described in Sections 4.2 and 4.3 of this programmatic environmental impact statement (PEIS). Section M.2 provides information on normal radiological impacts, Section M.3 provides information on normal hazardous chemical impacts, Section M.4 provides information on human health and epidemiologic studies, and Section M.5 provides information on postulated facility accidents.

M.2 RADIOLOGICAL IMPACTS TO HUMAN HEALTH DURING NORMAL OPERATIONS

This section presents supporting information on the potential radiological impacts of normal operation to humans. This section provides the reader with background information on the nature of radiation (Section M.2.1), the methodology used to calculate radiological impacts (Section M.2.2), radiological releases from fissile material storage and disposition facilities (Section M.2.3), and radiological impacts from various fissile material storage and disposition facilities at each site (Sections M.2.4 through M.2.15).

A further description of the methodology used to assess the normal radiological impacts presented in this appendix and a detailed listing of the data used in the assessments are given in *Health Risk Data for Storage and Disposition of Weapons-Usable Fissile Materials* (Health Risk Data, October 1996).

M.2.1 BACKGROUND

M.2.1.1 Nature of Radiation and Its Effects on Humans

What is Radiation? Humans are constantly exposed to radiation from the solar system and from the earth's rocks and soil. This radiation contributes to the natural background radiation x ray that has always been around us. But there are also manmade sources of radiation, such as medical and dental x rays, household smoke detectors, and materials released from nuclear and coal-fired powerplants.

All matter in the universe is composed of atoms, and radiation comes from the activity of these tiny particles. Atoms are made up of even smaller particles (protons, neutrons, electrons). The number and arrangement of these particles distinguishes one atom from another.

Atoms of different types are known as elements. There are over 100 natural and manmade elements. Some of these elements, such as uranium (U), radium, plutonium (Pu), and thorium, share a very important quality: they are unstable. As they change into more stable forms, invisible waves of energy or particles, known as ionizing radiation, are released. Radioactivity is the emitting of this radiation.

Ionizing radiation refers to the fact that this energy force can ionize, or electrically charge atoms by stripping off electrons. Ionizing radiation can cause a change in the chemical composition of many things, including living tissue (organs), which can affect the way they function.

The effects on people of radiation that is emitted during disintegration (decay) of a radioactive substance depends on the kind of radiation (alpha and beta particles, and gamma and x rays) and the total amount of

radiation energy absorbed by the body. The total energy absorbed per unit quantity of tissue is referred to as absorbed dose. The absorbed dose, when multiplied by certain quality factors and factors that take into account different sensitivities of various tissues, is referred to as effective dose equivalent, or where the context is clear, simply dose. The common unit of effective dose equivalent is the roentgen equivalent man (rem) (1 rem equals 1,000 millirem [mrem]).

Alpha particles are the heaviest of these direct types of ionizing radiation, and despite a speed of about 16,000 kilometers (km)/second (s) (9,940 miles [mi]/s), they can travel only several centimeters in air. Alpha particles lose their energy almost as soon as they collide with anything. They can easily be stopped by a sheet of paper or the skin's surface.

Beta particles are much lighter than alpha particles. They can travel as much as 160,000 km/s (99,400 mi/s) and can travel in the air for a distance of about 3 meters (m) (9.8 feet [ft]). Beta particles can pass through a sheet of paper, but may be stopped by a thin sheet of aluminum foil or glass.

Gamma and x rays, unlike alpha or beta particles, are waves of pure energy. Gamma rays travel at the speed of light (300,000 km/s [186,000 mi/s]). Gamma radiation is very penetrating and requires a thick wall of concrete, lead, or steel to stop it.

The neutron is another particle which contributes to radiation exposure, both directly and indirectly. The latter is associated with the gamma rays and alpha particles which are emitted following neutron capture in matter. A neutron has about one quarter the weight of an alpha particle and can travel at speeds of up to 39,000 km/s (24,200 mi/s). Neutrons are more penetrating than beta particles, but less than gamma rays.

The radioactivity of a material decreases with time. The time it takes a material to lose half of its original radioactivity is its half-life. For example, a quantity of iodine-131, a material that has a half-life of 8 days, will lose one-half of its radioactivity in that amount of time. In 8 more days, one-half of the remaining radioactivity will be lost, and so on. Eventually, the radioactivity will essentially disappear. Each radioactive element has a characteristic half-life. The half-lives of various radioactive elements may vary from millionths of a second to millions of years.

As a radioactive element gives up its radioactivity, it often changes to an entirely different element, one that may or may not be radioactive. Eventually, a stable element is formed. This transformation may take place in several steps and is known as a decay chain. Radium, for example, is a naturally occurring radioactive element with a half-life of 1,622 years. It emits an alpha particle and becomes radon, a radioactive gas with a half-life of only 3.8 days. Radon decays to polonium and through a series of steps to bismuth and ultimately to lead.

Units of Radiation Measure. Scientists and engineers use a variety of units to measure radiation. These different units can be used to determine the amount, type and intensity of radiation. Just as heat can be measured in terms of its intensity or its effects using units of calories or degrees, amount of radiation can be measured in curies (Ci), radiation absorbed doses (rads), or rems.

The curie, named after the French scientists Marie and Pierre Curie, describes the "intensity" of a sample of radioactive material. The rate of decay of 1 gram of radium is the basis of this unit of measure. It is equal to 3.7×10^{10} disintegrations (decays)/s.

The total energy absorbed per unit quantity of tissue is referred to as absorbed dose. The rad is the unit of measurement for the physical absorption of radiation. Much like sunlight heats the pavement by giving up an amount of energy to it, radiation gives up rads of energy to objects in its path. One rad is equal to the amount of radiation that leads to the deposition of 0.01 joule of energy per kilogram of absorbing material.

A rem is a measurement of the dose from radiation based on its biological effects. The rem is used to measure the effects of radiation on the body, much like degrees Centigrade can be used to measure the effects of sunlight heating pavement. Thus, 1 rem of one type of radiation is presumed to have the same biological effects as 1 rem of any other kind of radiation. This standard allows comparison of the biological effects of radionuclides that emit different types of radiation.

An individual may be exposed to ionizing radiation externally from a radioactive source outside the body, and/or internally from ingesting radioactive material. The external dose is different from the internal dose. An external dose is delivered only during the actual time of exposure to the external radiation source. An internal dose, however, continues to be delivered as long as the radioactive source is in the body, although both radioactive decay and elimination of the radionuclide by ordinary metabolic processes decrease the dose rate with the passage of time. The dose from internal exposure is calculated over 50 years following the initial exposure.

The three types of doses calculated in this include an external dose, an internal dose, and a combined external and internal dose. Each type of dose is discussed separately below.

External Dose. The external dose can arise from several different pathways. All these pathways have in common the fact that the radiation causing the exposure is external to the body. In this PEIS, these pathways include exposure to a cloud of radiation passing overhead of the receptor, standing on ground which is contaminated with radioactivity, swimming in contaminated water, and boating in contaminated water. The appropriate measure of dose is called the effective dose equivalent. It should be noted that if the receptor departs from the source of radiation exposure, his dose rate will be reduced. It is assumed that external exposure occurs uniformly during the year.

Internal Dose. The internal dose arises from a radiation source entering the human body through either ingestion of contaminated food and water or inhalation of contaminated air. In this PEIS, pathways for internal exposure include ingestion of crops contaminated either by airborne radiation depositing on the crops or by irrigation of crops using contaminated water sources, ingestion of animal products from animals that ingested contaminated food, ingestion of contaminated water, inhalation of contaminated air, and absorption of contaminated water through the skin during swimming. Unlike external exposures, once the radiation enters the body, it remains there for various periods of time that depend on decay and biological elimination rates. The unit of measure for internal doses is the committed dose equivalent. It is the internal dose that each body organ receives from 1 "year intake" (ingestion plus inhalation). Normally, a 50- or 70-year dose-commitment period is used (i.e., the 1 year intake period plus 49 or 69 years). The dose rate increases during the 1 year of intake. The dose rate, after the 1 year of intake, slowly declines as the radioactivity in the body continues to produce a dose. The integral of the dose rate over the 50 or 70 years gives the committed dose equivalent. In this PEIS, a 50-year, dose-commitment period was used.

The various organs of the body have different susceptibilities to harm from radiation. The quantity that takes these different susceptibilities into account to provide a broad indicator of the risk to the health of an individual from radiation is called the committed effective dose equivalent. It is obtained by multiplying the committed dose equivalent in each major organ or tissue by a weighting factor associated with the risk susceptibility of the tissue or organ, then summing the totals. It is possible that the committed dose equivalent to an organ is larger than the committed effective dose equivalent if that organ has a small weighting factor. The concept of committed effective dose equivalent applies only to internal pathways.

Combined External and Internal Dose. For convenience, the sum of the committed effective dose equivalent from internal pathways and the effective dose equivalent from external pathways is also called the committed effective dose equivalent in this PEIS (note that in Department of Energy [DOE] Order 5400.1, this quantity is called the effective dose equivalent).

The units used in this PEIS for committed dose equivalent, effective dose equivalent, and committed effective dose equivalent to an individual are the rem and mrem (1/1000 of 1 rem). The corresponding unit for the collective dose to a population (the sum of the doses to members of the population, or the product of the number of exposed individuals and their average dose) is the person-rem.

Sources of Radiation. The average American receives a total of about 350 mrem/year (yr) from all sources of radiation, both natural and manmade. The sources of radiation can be divided into six different categories: cosmic radiation, terrestrial radiation, internal radiation, consumer products, medical diagnosis and therapy, and other sources (NCRP 1987a:9-15). Each category is discussed below.

Cosmic radiation is ionizing radiation resulting from energetic charged particles from space continuously hitting the earth's atmosphere. These particles and the secondary particles and photons they create are cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with altitude above sea level. For the sites considered in this PEIS, the cosmic radiation ranged from 27 to 50 mrem/yr. The average dose to the people in the United States is about 27 mrem/yr.

External terrestrial radiation is the radiation emitted from the radioactive materials in the earth's rocks and soils. The average dose from external terrestrial radiation is about 28 mrem/yr. The external terrestrial radiation for the sites in this PEIS ranged from 15 to 63 mrem/yr.

Internal radiation arises from the human body metabolizing natural radioactive material which has entered the body by inhalation or ingestion. Natural radionuclides in the body include isotopes of U, thorium, radium, radon, polonium, bismuth, potassium, rubidium, and carbon. The major contributor to the annual dose equivalent for internal radioactivity are the short-lived decay products of radon which contribute about 200 mrem/yr. The average dose from other internal radionuclides is about 39 mrem/yr.

Consumer products also contain sources of ionizing radiation. In some products, like smoke detectors and airport x ray machines, the radiation source is essential to the products' operation. In other products, such as television and tobacco, the radiation occurs incidentally to the product function. The average dose is about 10 mrem/yr.

Radiation is an important diagnostic medical tool and cancer treatment. Diagnostic x rays result in an average exposure of 39 mrem/yr. Nuclear medical procedures result in an average exposure of 14 mrem/yr.

There are a few additional sources of radiation that contribute minor doses to individuals in the United States. The dose from nuclear fuel cycle facilities such as uranium mines, mills and fuel processing plants, nuclear power plants and transportation routes has been estimated to be less than 1 mrem per year. Radioactive fallout from atmospheric atomic bomb tests, emissions of radioactive material from DOE and Nuclear Regulatory Commission (NRC) licensed facilities, emissions from certain mineral extraction facilities, and transportation of radioactive materials contributes less than 1 mrem/yr to the average dose to an individual. Air travel contributes approximately 1 mrem/yr to the average dose.

The collective (or population) dose to an exposed population is calculated by summing the estimated doses received by each member of the exposed population. This total dose received by the exposed population is measured in person-rem. For example, if 1,000 people each received a dose of 1 mrem (0.001 rem), the collective dose is 1,000 persons x 0.001 rem = 1.0 person-rem. Alternatively, the same collective dose (1.0 person-rem) results from 500 people each of whom received a dose of 2 mrem (500 persons x 2 mrem = 1 person-rem).

Limits of Radiation Exposure. The amount of manmade radiation that the public may be exposed to is limited by Federal regulations. Although most scientists believe that radiation absorbed in small doses over several years is not harmful, U.S. Government regulations assume that the effects of all radiation exposures are cumulative.

Under the *Clean Air Act*, the exposure to a member of the general public from DOE facility releases into the atmosphere is limited by the Environmental Protection Agency (EPA) to a dose of 10 mrem/yr in addition to the natural background and medical radiation normally received (40 Code of Federal Regulations [CFR] 61, Subpart H). DOE also limits to 10 mrem the dose annually received from material released to the atmosphere (DOE Order 5400.5). The EPA and DOE also limit the annual dose to a member of the general public from radioactive releases to drinking water to 4 mrem, as required under the *Safe Drinking Water Act* (40 CFR 141; DOE Order 5400.5). The annual dose from all radiation sources from a site is limited by the EPA to 25 mrem (40 CFR 190). The DOE annual limit of radiation dose to a member of the general public from all DOE facilities is 100 mrem total, from all pathways (DOE Order 5400.5).

All DOE facilities covered by this PEIS operate well below this limit. It is estimated that the average individual in the United States receives a dose of about 0.3 rem (300 mrem) per year from natural sources of radiation. For perspective, a modern chest x ray results in an approximate dose of 0.006 rem (6 mrem), while a diagnostic pelvis and hip x ray results in an approximate dose of 0.065 rem (65 mrem) (NCRP 1987a:45). A person must receive an acute (short-term) dose of approximately 600 rem (600,000 mrem) before there is a high probability of near-term death (NAS 1990a:176).

For people working in an occupation that involves radiation, DOE and the NRC limit doses to 5 rem (5,000 mrem) in any 1 year (10 CFR 20; 10 CFR 835). For NRC-licensed facilities, the applicable site dose limits depend on the facility type. For other-than-power-reactors, the EPA limits discussed above apply. For power reactors, the annual total dose limit from all releases combined is the same as the EPA limit of 25 mrem (40 CFR 190). However, to demonstrate compliance with the as low as reasonably achievable philosophy, efforts must be made to further reduce releases to the guideline values given in Appendix I to 10 CFR 50.

M.2.1.2 Health Effects

Radiation exposure and its consequences are topics of interest to the general public. For this reason, this PEIS places much emphasis on the consequences of exposure to radiation, even though the effects of radiation exposure under most circumstances evaluated in this PEIS are small. This section explains the basic concepts used in the evaluation of radiation effects in order to provide the background for later discussion of impacts.

Radiation can cause a variety of ill-health effects in people. The most significant ill-health effect to depict the consequences of environmental and occupational radiation exposure is induction of cancer fatalities. This effect is referred to as "latent" cancer fatalities because the cancer may take many years to develop and for death to occur and may not actually be the cause of death. In the discussions which follow, it should be noted that all fatal cancers are latent and the term "latent" is not used.

Health impacts from radiation exposure, whether from sources external or internal to the body, generally are identified as "somatic" (affecting the individual exposed) or "genetic" (affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects rather than genetic effects. Therefore, for this PEIS, only the somatic risks are presented. The somatic risks of most importance are the induction of cancers. Except for leukemia, which can have an induction period (time between exposure to carcinogen and cancer diagnosis) of as little as 2 to 7 years, most cancers have an induction period of more than 20 years.

For a uniform irradiation of the body, the incidence of cancer varies among organs and tissues; the thyroid and skin demonstrate a greater sensitivity than other organs. However, such cancers also produce relatively low mortality rates because they are relatively amenable to medical treatment. Because of the readily available data for cancer mortality rates and the relative scarcity of prospective epidemiologic studies, somatic effects leading to cancer fatalities rather than cancer incidence are presented in this PEIS. The numbers of cancer fatalities can be used to compare the risks among the various alternatives.

The fatal cancer risk estimators presented in this appendix for radiation technically apply only to low-linear energy transfer radiation (gamma rays and beta particles). However, on a per rem rather than a per rad basis, the fatal risk estimators are higher for this type of radiation than for high-linear energy transfer radiation (alpha particles). In this PEIS, the low-linear energy transfer risk estimators are conservatively assumed to apply to all radiation exposures.

The National Research Council's Committee on the Biological Effects of Ionizing Radiations (BEIR) has prepared a series of reports to advise the U.S. Government on the health consequences of radiation exposures. The latest of these reports, *Health Effects of Exposure to Low Levels of Ionizing Radiation BEIR V*, published in 1990, provides the most current estimates for excess mortality from leukemia and cancers other than leukemia expected to result from exposure to ionizing radiation. The BEIR V report updates the models and risk estimates provided in the earlier report of the BEIR III Committee, *The Effects of Populations of Exposure to Low-Levels of Ionizing Radiation,* published in 1980. The BEIR V models were developed for application to the U.S. population.

The BEIR V provides estimates that are consistently higher than those in BEIR III. This is attributed to several factors including the use of a linear dose response model for cancers other than leukemia, revised dosimetry for the Japanese atomic bomb survivors, and additional follow-up studies of the atomic bomb survivors and other cohorts. The BEIR III employs constant relative and absolute risk models, with separate coefficients for each of several sex and age-at-exposure groups, while BEIR V develops models in which the excess relative risk is expressed as a function of age at exposure, time after exposure, and sex for each of several cancer categories. The BEIR III models were based on the assumption that absolute risks are comparable between the atomic bomb survivors and the U.S. population, while BEIR V models were based on the assumption that the relative risks are comparable. For a disease such as lung cancer, where baseline risks in the United States are much larger than those in Japan, the BEIR V approach leads to larger risk estimates than the BEIR III approach.

The models and risk coefficients in BEIR V were derived through analyses of relevant epidemiologic data including the Japanese atomic bomb survivors, ankylosis spondylitis patients, Canadian and Massachusetts fluoroscopy patients (breast cancer), New York postpartum mastitis patients (breast cancer), Israel Tinea Capitis patients (thyroid cancer), and Rochester thymus patients (thyroid cancer). Models for leukemia, respiratory cancer, digestive cancer, and other cancers used only the atomic bomb survivor data, although results of analyses of the ankylosis spondylitis patients were considered. Atomic bomb survivor analyses were based on revised dosimetry with an assumed Relative Biological Effectiveness of 20 for neutrons, and were restricted to doses less than 400 rads. Estimates of risks of fatal cancers other than leukemia were obtained by totaling the estimates for breast cancer, respiratory cancer, digestive cancer and other cancers.

Risk Estimates for Doses Received During an Accident. The BEIR V includes risk estimates for a single exposure of 10 rem to a population of 100,000 people (1.0×10^6 person-rem). In this case, fatality estimates for leukemia, breast cancer, respiratory cancer, digestive cancer, and other cancers are given for both sexes and nine age-at-exposure groups. These estimates, based on the linear model, are summarized in Table M.2.1.2–1. The average risk estimate from all ages and both sexes is 885 excess cancer fatalities per million person-rem. This value has been conservatively rounded up to 1,000 excess cancer fatalities per million person-rem. Section M.5.1.3.2 contains additional discussions on accident risk estimators.

Although values for other health effects are not presented in this PEIS, the risk estimators for non-fatal cancers and for genetic disorders to future generations are estimated to be approximately 200 and 260 per million person-rem, respectively. These values are based on information presented in the *1990 Recommendations of the International Commission on Radiological Protection* (ICRP Publication 60) and are seen to be 20 percent and 26 percent, respectively, of the fatal cancer estimator. Thus, for example, if the number of excess fatal cancers is projected to be "X," the number of excess genetic disorders would be 0.26 times "X."

Risk Estimates for Doses Received During Normal Operation. For low doses and dose rates, a linear-quadratic model was found to provide a significantly better fit to the data for leukemia than a linear one, and leukemia risks were based on a linear-quadratic function. This reduces the effects by a factor of two over estimates that are obtained from the linear model. For other cancers, linear models were found to provide an adequate fit to the data, and were used for extrapolation to low doses. However, the BEIR V Committee recommended reducing these linear estimates by a factor between 2 and 10 for doses received at low dose rates. For this PEIS, a risk reduction factor of two was adopted for conservatism.

Table M.2.1.2–1. Lifetime Risks per 100,000 Persons Exposed to a Single Exposure of 10 rem

	Type of Fatal Cancer		
Gender	Leukemia[a]	Cancers Other Than Leukemia	Total Cancers
Male	220	660	880
Female	160	730	890
Average	**190**	**695**	**885**[b]

[a] These are the linear estimates, and are double the linear-quadratic estimates provided in BEIR V for leukemia at low doses and dose-rates.

[b] This value has been rounded up to 1,000 excess cancer fatalities per million person-rem.

Source: NAS 1990a.

Based on the above discussion, the resulting risk estimator would be equal to half the value observed for accident situations or approximately 500 excess fatal cancer per million person-rem (0.0005 excess fatal cancer per person-rem). This is the risk value used in this PEIS to calculate fatal cancers to the general public during normal operations. For workers, a value of 400 excess fatal cancers per million person-rem (0.0004 excess fatal cancer per person-rem) is used in this PEIS. This lower value reflects the absence of children (who are more radiosensitive than adults) in the workforce. Again, based on information provided in the *1990 Recommendations of the International Commission of Radiological Protection* (ICRP Publication 60), the health risk estimators for nonfatal cancer and genetic disorders among the public are 20 percent and 26 percent, respectively, of the fatal cancer risk estimator. For workers they are both 20 percent of the fatal cancer risk estimator. For this PEIS, only fatal cancers are presented.

The risk estimates may be applied to calculate the effects of exposing a population to radiation. For example, in a population of 100,000 people exposed only to natural background radiation (0.3 rem/yr), 15 latent cancer fatalities per year would be inferred to be caused by the radiation (100,000 persons x 0.3 rem/yr x 0.0005 latent cancer fatalities per person-rem = 15 latent cancer fatalities/yr).

Sometimes, calculations of the number of excess cancer fatalities associated with radiation exposure do not yield whole numbers and, especially in environmental applications, may yield numbers less than 1.0. For example, if a population of 100,000 were exposed as above, but to a total dose of only 0.001 rem, the collective dose would be 100 person-rem, and the corresponding estimated number of latent cancer fatalities would be 0.05 (100,000 persons x 0.001 rem x 0.0005 latent cancer fatalities/person-rem = 0.05 latent fatal cancers).

For latent cancer fatalities less than 1.0, the estimated 0.05 latent cancer fatalities is interpreted as a statistical estimate. That is, 0.05 is the *average* number of deaths that would result if the same exposure situation were applied to many different groups of 100,000 people. In most groups, no person (0 people) would incur a latent cancer fatality from the 0.001 rem dose each member would have received. In a small fraction of the groups, 1 latent fatal cancer would result; in exceptionally few groups, 2 or more latent fatal cancers would occur. The

average number of deaths over all the groups would be 0.05 latent fatal cancers (just as the average of 0, 0, 0, and 1 is 1/4, or 0.25). The most likely outcome is 0 latent cancer fatalities.

These same concepts apply to estimating the effects of radiation exposure on a single individual. Consider the effects, for example, of exposure to background radiation over a lifetime. The "number of latent cancer fatalities" corresponding to a single individual's exposure over a (presumed) 72-year lifetime to 0.3 rem/yr is the following:

1 person x 0.3 rem/year x 72 years x 0.0005 latent cancer fatalities/person-rem = 0.011 latent cancer fatalities.

Again, this should be interpreted in a statistical sense; that is, the estimated effect of background radiation exposure on the exposed individual would produce a 1.1-percent chance that the individual might incur a latent fatal cancer caused by the exposure over his full lifetime. Presented another way, this method estimates that approximately 1.1 percent of the population might die of cancers induced by the radiation background.

M.2.2 METHODOLOGY FOR ESTIMATING RADIOLOGICAL IMPACTS OF NORMAL OPERATION

The radiological impacts of normal operation of reactors and support facilities were calculated using Version 1.485 of the GENII computer code. Site-specific and technology-specific input data were used, including location, meteorology, population, food production and consumption, and source terms. [Text deleted.] Section M.2.2.1 briefly describes GENII and outlines the approach used for normal operations. The approach used for design basis accidents is discussed in Section M.5 of this appendix.

M.2.2.1 GENII Computer Code

The GENII computer model, developed by Pacific Northwest Laboratory for DOE, is an integrated system of various computer modules which analyze environmental contamination resulting from acute or chronic releases to, or initial contamination in, air, water, or soil. The model calculates radiation doses to individuals and populations. The GENII computer model is well documented for assumptions, technical approach, methodology, and quality assurance issues (GENII—The Hanford Environmental Radiation Dosimetry Software System, December 1988). The GENII computer model has gone through extensive quality assurance and quality control steps. These include the comparison of results from model computations against those from hand calculations, and the performance of internal and external peer reviews. Recommendations given in these reports were incorporated into the final GENII computer model, as deemed appropriate.

For this PEIS only the ENVIN, ENV, and DOSE computer modules were used. The codes are connected through data transfer files. The output of one code is stored in a file that can be used by the next code in the system. In addition, a computer code called CREGENII was prepared to aid and assist the user with the preparation of input files into GENII.

CREGENII. The CREGENII code helps the user, through a series of interactive menus and questions, to prepare a text input file for the environmental dosimetry programs. In addition, CREGENII prepares a batch processing file to manage the file handling needed to control the operations of subsequent codes and to prepare an output report.

ENVIN. The ENVIN module of the GENII code controls the reading of the input files prepared by CREGENII and organizes the input for optimal use in the environmental transport and exposure module, ENV. The ENVIN code interprets the basic input, reads the basic GENII data libraries and other optional input files, and organizes the input into sequential segments on the basis of radionuclide decay chains.

A standardized file that contains scenario, control, and inventory parameters is used as input to ENVIN. Radionuclide inventories can be entered as functions of releases to air or water, concentrations in basic environmental media (air, soil, or water), or concentrations in foods. If certain atmospheric dispersion options have been selected, this module can generate tables of atmospheric dispersion parameters that will be used in later calculations. If the finite plume air submersion option is requested in addition to the atmospheric dispersion calculations, preliminary energy-dependent finite plume dose factors also are prepared. The ENVIN module prepares the data transfer files that are used as input by the ENV module; ENVIN generates the first portion of the calculation documentation—the run input parameters report.

ENV. The ENV module calculates the environmental transfer, uptake, and human exposure to radionuclides that result from the chosen scenario for the user specified source term. The code reads the input files from ENVIN and then, for each radionuclide chain, sequentially performs the precalculations to establish the conditions at the start of the exposure scenario. Environmental concentrations of radionuclides are established at the beginning of the scenario by assuming decay of preexisting sources, considering biotic transport of existing subsurface contamination, and defining soil contamination from continuing atmospheric or irrigation depositions. Then, for each year of postulated exposure, the code estimates air, surface soil, deep soil, groundwater, and surface water concentrations of each radionuclide in the chain. Human exposures and intakes of each radionuclide are calculated for: 1) pathways of external exposure from finite atmospheric plumes; 2) inhalation; 3) external exposure from contaminated soil, sediments, and water; 4) external exposure from special geometries; and 5) internal exposures from consumption of terrestrial foods, aquatic foods, drinking water, animal products, and inadvertent intake of soil. The intermediate information on annual media concentrations and intake rates are written to data transfer files. Although these may be accessed directly, they are usually used as input to the DOSE module of GENII.

DOSE. The DOSE module reads the annual intake and exposure rates defined by the ENV module and converts the data to radiation dose. External dose is calculated with precalculated factors from the EXTDF module or from a data file prepared outside of GENII. Internal dose is calculated with precalculated factors from the INTDF module.

EXTDF. The EXTDF module calculates the external dose-rate factors for submersion in an infinite cloud of radioactive materials, immersion in contaminated water, and direct exposure to plane or slab sources of radionuclides. EXTDF was not used. Instead, the dose rate factors listed in *External Dose Rate Factors for Calculation of Dose to the Public* (DOE/EH-0070) were used for this PEIS.

INTDF. Using the *Limits for Intakes of Radionuclides by Workers* (ICRP Publication 30) model, the INTDF module calculates the internal (inhalation and ingestion) dose conversion factors of radionuclides for specific organs. The factors generated by INTDF were used for the calculations presented in this PEIS.

GENII is a general purpose computer code used to model dispersion, transport, and long-term exposure effects of specific radionuclides and pathways. Sophisticated codes such as UFOTRI and ETMOD (Environmental Tritium Model) are used exclusively for modelling tritium transport and dosimetry. The UFOTRI and ETMOD codes were not chosen for use in this PEIS due to the lack of information on detailed facility design and on the breakdown of tritium into elemental and tritiated water forms, and because these codes cannot be used for modeling the exposure effects of radionuclides other than tritium. GENII was chosen because it can model both air and surface transport pathways and is not restricted to any radionuclides.

M.2.2.2 Data and Assumptions

In order to perform the dose assessments for this PEIS, different types of data must be collected and/or generated. In addition, calculational assumptions have to be made. This section discusses the data collected and/or generated for use in the dose assessment and assumptions made for this PEIS.

Meteorological Data. The meteorological data used for all sites were in the form of joint frequency data files. A joint frequency data file is a table listing the fractions of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The joint frequency data files were based on measurements over a 1-year period at various locations and at different heights at the sites. Average meteorological conditions (averaged over the 1-year period) were used for normal operation. Meteorological data are presented in Health Risk Data, October 1996.

Population Data. Population distributions were based on *1990 Census of Population and Housing* data. Projections were determined for 2030 (approximate midlife of operations) for areas within 80 km (50 mi) of the proposed facilities at each candidate site. The site population in 2030 was assumed to be representative of the population over the operational period evaluated, and was used in the impact assessments. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances up to 80 kilometers. The grid was centered on the facility from which the radionuclides were assumed to be released. Population data are presented in Health Risk Data, October 1996.

Source Term Data. The source terms (quantities of radionuclides released to the environment over a given period) were estimated on the basis of latest conceptual designs of facilities and experience with similar facilities. The source terms used to generate the estimated impacts of normal operation are provided in Section M.2.3 for the storage and disposition facilities which could be located at the various sites. Source terms for candidate and representative sites are presented in Sections M.2.4 through M.2.15.

Food Production and Consumption Data. Data from the *1987 Census of Agriculture* was used to generate site-specific data for food production. Food production was spatially distributed on the same circular grid as was used for the population distributions. The consumption rates were those used in GENII for the maximum individual and average individual. People living within the 80 km (50 mi) assessment area were assumed to consume only food grown in that area.

Calculational Assumptions. Dose assessments were performed for members of the general public and workers. Dose assessments for members of the public were performed for two different types of receptors considered in this PEIS: a maximally exposed offsite individual and the general population living within 80 km (50 mi) of the facility. It was assumed that the maximally exposed individual (MEI) was located at a position on the site boundary that would yield the highest impacts during normal operation of a given alternative. If more than one facility was assumed to be operating at a site, the dose to a "maximum receptor" (that is, a potential site MEI) from each facility was calculated. This was accomplished by preliminarily designating each potential MEI as a maximum receptor for each facility modeled—subsequently, whichever maximum receptor was found to incur the largest dose was then ultimately selected as the MEI for the site. An 80-km (50-mi) population dose was calculated for each operating facility at a site. These doses were then added to give the total population dose at that site.

To estimate the radiological impacts from normal operation of reactors and support facilities, additional assumptions and factors were considered in using GENII, as follows:

- No prior deposition of radionuclides on ground surfaces was assumed.
- For the maximally exposed off-site individual, the annual exposure time to the plume and to soil contamination was 0.7 year (NRC 1977b:1.109-68).
- For the population, the annual exposure time to the plume and to soil contamination was 0.5 year (NRC 1977b:1.109-68).
- The exposed individual or population was assumed to have the characteristics and habits (for example; inhalation and ingestion rates) of the adult human.

- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops and animal products contaminated by either deposition of radioactivity from the air or irrigation, ingestion of fish and other aquatic food raised in contaminated water, swimming and boating in contaminated surface water, and drinking contaminated water. It should be noted that not all pathways were available at every site.

- For atmospheric releases it was assumed that ground level releases would occur for all storage and disposal facilities. For site dependent facilities, reported release heights were used and assumed to be the effective stack height. Use of the effective stack height negates plume rise thereby making the resultant doses conservative.

- The calculated doses were 50-year committed doses from 1 year of intake.

The exposure, uptake, and usage parameters used in the GENII model are provided in Tables M.2.2.2–1 through M.2.2.2–4.

Annual average doses to workers for No Action at the Hanford Site (Hanford), Nevada Test Site (NTS), Idaho National Engineering Laboratory (INEL), Pantex Plant (Pantex), Rocky Flats Environmental Technology Site (RFETS), and Los Alamos National Laboratory (LANL) were generally based on measured values received by radiation workers during the 1989 to 1992 time period. The dose values are given in a series of documents that cover this time period. Dose values for 1992 are contained in "Compilation of Doses to Workers at DOE Facilities in 1992" (DOE 1993n:7). The same type reports are used for the earlier years. The average dose received by a worker at these sites in 2005 was assumed to remain the same as the annual average during the 1989 to 1992 period. The total workforce dose in 2005 was calculated by multiplying the average worker dose by the projected number of workers in 2005. For Oak Ridge Reservation (ORR) and Savannah River Site (SRS), worker dose projections provided by the sites were used. For NRC-licensed sites, No Action worker doses were based on reported values for 1993 given in *Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities, 1993* (NUREG-0713-V15).

Doses to workers directly associated with storage and disposition facilities were taken from the reports prepared by Fluor Daniel, Inc.; Sandia National Laboratories (SNL), New Mexico; LANL; Lawrence Livermore National Laboratory (LLNL); and SRS. To obtain the total workforce dose at a site with a particular storage or disposition facility in operation, the site dose from No Action was added to that from the storage or disposition facility being evaluated. The average dose to a site worker was then calculated by dividing this dose by the total number of radiation workers at the site.

All doses to workers include a component associated with the intake of radioactivity into the body and another component resulting from external exposure to direct radiation.

A more detailed discussion of doses to workers associated with storage and disposition is given in Section M.2.3.2.

M.2.2.3 Health Effects Calculations

In this PEIS, the collective combined effective dose equivalent is the sum of the collective committed effective dose equivalent (internal dose) and the collective effective dose equivalent (external dose), as explained in Section M.2.1.1. Doses calculated by GENII were used to estimate health effects using the risk estimators presented in Section M.2.1.2. The incremental cancer fatalities in the general population and groups of workers due to radiation exposure were therefore estimated by multiplying the collective combined effective dose equivalent by 0.0005 and 0.0004 fatal cancers/person-rem, respectively.Although health risk factors are statistical factors and therefore not strictly applicable to individuals, they have been used in the past to estimate the incremental risk to an individual from exposure to radiation. Therefore, the factor of 0.0005 and 0.0004

Table M.2.2.2–1. GENII Exposure Parameters to Plumes and Soil Contamination

Maximum Individual				General Population			
External Exposure		Inhalation of Plume		External Exposure		Inhalation of Plume	
Plume (hours)	Soil Contamination (hours)	Exposure Time (hours)	Breathing Rate (cm^3/sec)	Plume (hours)	Soil Contamination (hours)	Exposure Time (hours)	Breathing Rate (cm^3/sec)
6,136	6,136	6,136	270	4,383	4,383	4,383	270

Source: HNUS 1996a.

Table M.2.2.2–2. GENII Usage Parameters for Consumption of Terrestrial Food

	Maximum Individual				General Population			
Food Type	Growing Time (days)	Yield (kg/m^2)	Holdup Time (days)	Consumption Rate (kg/yr)	Growing Time (days)	Yield (kg/m^2)	Holdup Time (days)	Consumption Rate (kg/yr)
Leafy Vegetables	90.0	1.5	1.0	30.0	90.0	1.5	14.0	15.0
Root Vegetables	90.0	4.0	5.0	220.0	90.0	4.0	14.0	140.0
Fruit	90.0	2.0	5.0	330.0	90.0	2.0	14.0	64.0
Grains/Cereals	90.0	0.8	180.0	80.0	90.0	0.8	180.0	72.0

Source: HNUS 1996a.

Table M.2.2.2–3. GENII Usage Parameters for Consumption of Animal Products

Food Type	Consumption Rate (kg/yr)	Holdup Time (days)	Stored Feed: Diet Fraction	Stored Feed: Growing Time (days)	Stored Feed: Yield (kg/m^2)	Stored Feed: Storage Time (days)	Fresh Forage: Diet Fraction	Fresh Forage: Growing Time (days)	Fresh Forage: Yield (kg/m^2)	Fresh Forage: Storage Time (days)
Maximum Individual										
Beef	80.0	15.0	0.25	90.0	0.80	180.0	0.75	45.0	2.00	100.0
Poultry	18.0	1.0	1.00	90.0	0.80	180.0				
Milk	270.0	1.0	0.25	45.0	2.00	100.0	0.75	30.0	1.50	0
Eggs	30.0	1.0	1.00	90.0	0.80	180.0				
General Population										
Beef	70.0	34.0	0.25	90.0	0.80	180.0	0.75	45.0	2.00	100.0
Poultry	8.5	34.0	1.00	90.0	0.80	180.0				
Milk	230.0	4.0	0.25	45.0	2.00	100.0	0.75	30.0	1.50	0
Eggs	20.0	18.0	1.00	90.0	0.80	180.0				

Source: HNUS 1996a.

Table M.2.2.2–4. GENII Usage Parameters for Aquatic Activities

Activity	Maximum Individual: Transit Time to Usage Point (days)	Maximum Individual: Holdup Time (days)	Maximum Individual: Usage Rate (per year)	General Population: Transit Time to Usage Point (days)	General Population: Holdup Time (days)	General Population: Usage Rate
Drinking water	0	0	730 liters	0	0	Site dependent
Swimming	0	0	100 hours	0	0	Site dependent
Boating	0	0	100 hours	0	0	Site dependent
Shoreline	0	0	500 hours	0	0	Site dependent
Ingestion of fish	0	0	40 kg	0	0	Site dependent
Ingestion of molluscs	0	0	6.9 kg	0	0	Site dependent
Ingestion of crustacea	0	0	6.9 kg	0	0	Site dependent
Ingestion of plants	0	0	6.9 kg	0	0	Site dependent

Source: HNUS 1996a.

per rem of individual committed effective dose equivalent for a member of the public and for a worker, respectively, have also been used in this PEIS to calculate the individual's incremental fatal cancer risk from exposure to radiation.

For the public, the health effects expressed in this PEIS are the risk of fatal cancers to the maximally exposed individual and the number of fatal cancers to the 80-km (50-mi) population from exposure to radioactivity released from any site over the full operational period. For workers, the health effects expressed are the risk to the average worker at a site and the number of fatal cancers to all workers at that site over the full period of site operations.

M.2.3 STORAGE AND DISPOSITION FACILITIES INFORMATION

This section presents compilations of radiological releases to the environment from facilities associated with all alternatives assessed in this PEIS except No Action. The No Action releases are presented as part of the specific site discussions in Section M.2.4 through M.2.9. This section also presents the in-plant worker doses associated with these same facilities.

M.2.3.1 Radiological Releases to the Environment

Long-Term Storage. The annual release of radioactivity to the environment associated with the alternatives for the long-term storage of Pu and highly enriched uranium (HEU) are given in Table M.2.3.1–1. The releases, by radionuclide, are given for operation of upgraded Pu storage facilities at Hanford, INEL, Pantex, and SRS and upgraded HEU storage facilities at ORR; for operation of consolidated Pu storage facilities at Hanford, NTS, INEL, Pantex, and SRS; and for operation of collocated Pu and HEU storage facilities at Hanford, NTS, INEL, Pantex, ORR, and SRS.

Front-End Processes Common to Multiple Plutonium Disposition Alternatives. The annual releases of radioactivity to the environment associated with front-end processes common to multiple Pu disposition alternatives are given in Table M.2.3.1–2. The releases, by radionuclide, include those for operation of a pit disassembly/conversion facility, a Pu conversion facility, and a mixed oxide (MOX) fuel fabrication facility. These releases are independent of site location.

Table M.2.3.1–1. Annual Radioactive Releases During Normal Operation of Long-Term Storage Facilities (curies)[a]

Facility/Radionuclides	Site			
Upgraded Pu Storage Facility	**Hanford**	**INEL**	**Pantex**	**SRS**
Pu-238	1.8×10^{-8}	2.5×10^{-9}	b	c
Pu-239	5.6×10^{-8}	9.2×10^{-8}	b	c
Pu-240	2.8×10^{-8}	2.4×10^{-8}	b	c
Pu-241	8.6×10^{-7}	8.6×10^{-8}	b	c
Pu-242	1.6×10^{-11}	3.6×10^{-12}	b	c
Am-241	3.5×10^{-8}	4.5×10^{-10}	b	c
Upgraded HEU Storage Facility	**ORR**[d]			
U-234	2.7×10^{-12}			
U-235	4.7×10^{-11}			
U-236	2.9×10^{-10}			
U-238	9.3×10^{-9}			
Consolidated Pu Storage Facility	**Hanford, NTS, INEL, Pantex, and SRS**			
Pu-238	1.5×10^{-8}			
Pu-239	5.4×10^{-7}			
Pu-240	1.4×10^{-7}			
Pu-241	5.1×10^{-7}			
Pu-242	2.1×10^{-11}			
Am-241	2.7×10^{-9}			

Table M.2.3.1–1. Annual Radioactive Releases During Normal Operation of Long-Term Storage Facilities (curies)[a] —Continued

Facility/Radionuclides	Site
Collocated Pu and HEU Storage Facility	**Hanford, NTS, INEL, Pantex, ORR, and SRS**
Pu-238	1.5×10^{-8}
Pu-239	5.4×10^{-7}
Pu-240	1.4×10^{-7}
Pu-241	5.1×10^{-7}
Pu-242	2.1×10^{-11}
Am-241	2.7×10^{-9}
U-234	2.7×10^{-12}
U-235	4.7×10^{-11}
U-236	2.9×10^{-10}
U-238	9.3×10^{-9}

[a] All releases are to the atmosphere.

[b] Radiation dose for the storage facility is calculated to be 1.8×10^{-8} for the MEI and 6.3×10^{-6} person-rem for the population within 80 km, but no radionuclide emissions are available (HNUS 1996a).

[c] Radiation dose for the storage facility is calculated to be 8.3×10^{-6} for the MEI and 3.5×10^{-4} person-rem for the population within 80 km, but no radionuclide emissions are available (SR DOE 1995e).

[d] Assumed uranium releases from Collocated Storage Facility would be applicable for the ORR Upgraded HEU Storage Facility.

Note: Am=Americium.

Source: DOE 1996e; DOE 1996f; HF 1995a:1; HNUS 1996a; IN DOE 1996a; PX MH 1995a; SRS 1996a:4.

Plutonium Disposition Alternatives. The annual releases of radioactivity to the environment associated with the Pu disposition alternatives are given in Table M.2.3.1–3 for facilities other than reactors, and in Tables M.2.3.1–4 and M.2.3.1–5 for reactors. The releases have been separated to facilitate data presentation since reactors release a much larger number of radionuclides than do the other facilities. Table M.2.3.1–3 presents the releases by radionuclide for operation of ceramic immobilization, vitrification, and the deep borehole complex. Tables M.2.3.1–4 and M.2.3.1–5 present the releases, by radionuclide, for operation of a large and a small evolutionary light water reactor (LWR), respectively.

M.2.3.2 Radiological Impacts to In-Plant Workers

Operation of each of the facilities whose releases were addressed in Section M.2.3.1 result in radiological doses and associated health effects to in-plant workers. The numbers of badged workers, the average and total worker doses, and the risks and numbers of fatal cancers are given in Table M.2.3.2–1 for workers involved with disposition activities. It should be noted that for several disposition facilities, the number of years for facility operation varies due to the fact that the duration of operation depends on the end use of that facility. For example, the MOX fuel fabrication facility could operate for either 17 years supplying fuel for evolutionary and partially completed U.S. reactors or 23 years supplying fuel for existing Canadian Deuterium Uranium reactors.

Based on a review of impacts to workers involved in similar operations, the radiological impacts to workers involved with storage activities assume an annual average dose of approximately 250 mrem per worker for the storage upgrade alternative (HF DOE 1996a:2-4; IN DOE 1996a:1-6; NT DOE 1996a:1-7. For the upgrade at Pantex, an average measurable dose of 116 mrem/yr to radiological workers was assumed to be applicable for the workers associated with storage operations (PX 1996e:2). The number of these involved workers, and therefore the total dose to the involved workforce, is site dependent. For consolidated and collocation storage alternatives that require new facilities, the annual average dose is estimated to be 258 mrem and 264 mrem per worker, respectively. For these storage facilities, the number of involved badged workers are independent of the site and would number 92 and 95, respectively; therefore, the total dose to the involved workforce is also site independent (DOE 1996e:1-6; DOE 1996f:1-8). The detailed results of worker doses associated with all storage facilities are presented in the storage public and occupational health sections of Chapter 4.

Table M.2.3.1–2. Annual Radioactive Releases During Normal Operation of Facilities for Plutonium Disposition Used by Multiple Alternatives (curies)[a]

Facility/Radionuclides	Releases
Pit Disassembly/Conversion Facility	
Pu-238	4.2×10^{-7}
Pu-239	4.3×10^{-5}
Pu-240	1.0×10^{-5}
Pu-241	3.2×10^{-5}
Pu-242	2.9×10^{-10}
Am-241	1.7×10^{-5}
Pu Conversion Facility	
Pu-238	2.3×10^{-6}
Pu-239	3.6×10^{-5}
Pu-240	1.2×10^{-5}
Pu-241	4.8×10^{-5}
Pu-242	3.8×10^{-9}
Am-241	2.6×10^{-7}
Mixed Oxide Fuel Fabrication Facility	
Pu-238	7.9×10^{-7}
Pu-239	2.9×10^{-5}
Pu-240	7.6×10^{-6}
Pu-241	2.7×10^{-5}
Pu-242	1.1×10^{-9}
Am-241	1.4×10^{-7}
U-232	1.3×10^{-7}
U-234	3.2×10^{-8}
U-235	6.2×10^{-10}
U-238	4.8×10^{-8}

[a] All releases are to the atmosphere.

Note: Am=Americium.

Source: HNUS 1996a; LANL 1996b; LANL 1996c; LANL 1996d.

Table M.2.3.1–3. Annual Radioactive Releases During Normal Operation of Non-Reactor Plutonium Disposition Facilities (curies)[a]

Facility/Radionuclides	Releases
Borehole Complex (Direct Disposition Alternative)	
Pu-238	1.2×10^{-11}
Pu-239	9.2×10^{-10}
Pu-240	2.4×10^{-10}
Pu-241	1.3×10^{-10}
Pu-242	3.6×10^{-14}
Am-241	2.0×10^{-10}
Ceramic Immobilization Facility (Immobilized Disposition Alternative)	
Pu-238	9.3×10^{-11}
Pu-239	7.0×10^{-9}
Pu-240	1.9×10^{-9}
Pu-241	9.7×10^{-10}
Pu-242	2.8×10^{-13}
Am-241	3.5×10^{-11}
Borehole Complex (Immobilized Disposition Alternative)	
Pu-238	1.4×10^{-11}
Pu-239	1.1×10^{-9}
Pu-240	2.8×10^{-10}
Pu-241	1.5×10^{-10}
Pu-242	4.1×10^{-14}
Am-241	3.0×10^{-10}
Vitrification Alternative	
Pu-238	3.7×10^{-8}
Pu-239	2.8×10^{-6}
Pu-240	7.5×10^{-7}
Pu-241	3.9×10^{-7}
Pu-242	1.1×10^{-10}
Am-241	1.4×10^{-8}
Cs-137	5.0×10^{-5}
Ceramic Immobilization Alternative	
Pu-238	9.3×10^{-11}
Pu-239	7.0×10^{-9}
Pu-240	1.9×10^{-9}
Pu-241	9.7×10^{-10}
Pu-242	2.8×10^{-13}
Am-241	3.5×10^{-11}
Cs-137	1.0×10^{-5}

[a] All releases are to the atmosphere.

Note: Am=Americium.

Source: HNUS 1996a; LLNL 1996a; LLNL 1996c; LLNL 1996d; LLNL 1996e; LLNL 1996h.

Table M.2.3.1–4. Annual Liquid and Atmospheric Radioactive Releases From the Large Evolutionary Light Water Reactor Using a Mixed Oxide Core (curies)

	Release				Release		
	Wet Site[a]		Dry Site[a]		Wet Site[a]		Dry Site[a]
Isotope	Atmospheric	Liquid	Atmospheric	Isotope	Atmospheric	Liquid	Atmospheric
H-3	6.8×10^{1}	6.0×10^{1}	1.3×10^{2}	Sr-92	7.8×10^{-4}	8.0×10^{-4}	1.6×10^{-3}
C-14	9.2	1.6×10^{-4}	9.2	Y-90	1.7×10^{-5}	1.2×10^{-6}	1.9×10^{-5}
Ar-41	6.8	0	6.8	Y-91	1.5×10^{-4}	6.7×10^{-5}	2.1×10^{-4}
Kr-83m	1.4×10^{-3}	0	1.4×10^{-3}	Y-92	4.5×10^{-4}	4.3×10^{-4}	8.8×10^{-4}
Kr-85m	2.3×10^{1}	0	2.3×10^{1}	Y-93	1.0×10^{-3}	8.3×10^{-4}	1.8×10^{-3}
Kr-85	4.9×10^{2}	0	4.9×10^{2}	Zr-95	1.0×10^{-3}	7.4×10^{-4}	1.8×10^{-3}
Kr-87	2.5×10^{1}	0	2.5×10^{1}	Nb-95	1.5×10^{-3}	8.8×10^{-4}	2.4×10^{-3}
Kr-88	3.7×10^{1}	0	3.7×10^{1}	Mo-99	1.4×10^{-2}	7.9×10^{-4}	1.5×10^{-2}
Kr-89	4.0×10^{2}	0	4.0×10^{2}	Tc-99m	3.0×10^{-4}	8.0×10^{-4}	1.1×10^{-3}
Kr-90	5.4×10^{-4}	0	5.4×10^{-4}	Ru-103	6.0×10^{-4}	2.2×10^{-4}	8.3×10^{-4}
Xe-131m	8.6×10^{1}	0	8.6×10^{1}	Rh-103m	1.1×10^{-4}	9.0×10^{-6}	1.2×10^{-4}
Xe-133m	1.4×10^{-1}	0	1.4×10^{-1}	Ru-106	3.2×10^{-5}	2.9×10^{-4}	3.2×10^{-4}
Xe-133	3.8×10^{3}	0	3.8×10^{3}	Rh-106	1.9×10^{-5}	1.7×10^{-4}	1.9×10^{-4}
Xe-135m	6.8×10^{2}	0	6.8×10^{2}	Ag-110m	6.5×10^{-7}	3.3×10^{-4}	3.3×10^{-4}
Xe-135	2.2×10^{3}	0	2.2×10^{3}	Sb-124	1.7×10^{-4}	3.6×10^{-4}	5.3×10^{-4}
Xe-137	8.6×10^{2}	0	8.6×10^{2}	Te-129m	1.7×10^{-4}	1.3×10^{-5}	1.8×10^{-4}
Xe-138	7.2×10^{2}	0	7.2×10^{2}	Te-131m	9.1×10^{-5}	4.1×10^{-5}	1.3×10^{-4}
Xe-139	6.8×10^{-4}	0	6.8×10^{-4}	I-131	2.9×10^{-1}	3.5×10^{-3}	2.9×10^{-1}
Na-24	4.1×10^{-3}	2.8×10^{-3}	6.9×10^{-3}	Te-132	2.0×10^{-5}	4.3×10^{-6}	2.5×10^{-5}
P-32	9.2×10^{-4}	1.8×10^{-4}	1.1×10^{-3}	I-132	2.3	2.8×10^{-3}	2.3
Cr-51	3.5×10^{-2}	7.7×10^{-3}	4.3×10^{-2}	I-133	1.6	9.5×10^{-3}	1.6
Mn-54	4.9×10^{-3}	2.6×10^{-3}	7.5×10^{-3}	I-134	3.6	1.6×10^{-3}	3.6
Mn-56	3.5×10^{-3}	3.8×10^{-3}	7.3×10^{-3}	Cs-134	8.9×10^{-5}	3.2×10^{-3}	3.3×10^{-3}
Fe-55	6.5×10^{-3}	5.8×10^{-3}	1.2×10^{-2}	I-135	2.4	7.5×10^{-3}	2.4
Co-56	0	5.2×10^{-3}	5.2×10^{-3}	Cs-136	1.2×10^{-4}	4.7×10^{-4}	5.8×10^{-4}
Co-57	0	7.2×10^{-5}	7.2×10^{-5}	Cs-137	4.2×10^{-4}	8.2×10^{-3}	8.6×10^{-3}
Co-58	2.4×10^{-3}	9.0×10^{-5}	2.5×10^{-3}	Cs-138	1.7×10^{-4}	1.9×10^{-4}	3.6×10^{-4}
Co-60	1.1×10^{-2}	9.1×10^{-3}	2.0×10^{-2}	Cs-139	8.2×10^{-5}	0	8.2×10^{-5}
Fe-59	6.5×10^{-4}	1.0×10^{-4}	7.5×10^{-4}	Ba-140	1.2×10^{-2}	6.1×10^{-4}	1.2×10^{-2}
Ni-63	6.5×10^{-6}	1.4×10^{-4}	1.5×10^{-4}	La-140	1.6×10^{-3}	1.5×10^{-4}	1.8×10^{-3}
Cu-64	1.0×10^{-2}	7.5×10^{-3}	1.8×10^{-2}	Ce-141	8.6×10^{-3}	1.2×10^{-4}	8.8×10^{-3}
Zn-65	8.1×10^{-3}	9.0×10^{-5}	8.2×10^{-3}	Ce-144	1.3×10^{-5}	1.3×10^{-3}	1.3×10^{-3}
Rb-89	4.3×10^{-5}	4.4×10^{-5}	8.7×10^{-5}	Pr-143	0	1.1×10^{-6}	1.1×10^{-6}
Sr-89	3.2×10^{-3}	6.3×10^{-5}	3.3×10^{-3}	Pr-144	1.9×10^{-5}	0	1.9×10^{-5}
Sr-90	2.8×10^{-5}	1.5×10^{-5}	4.3×10^{-5}	W-187	1.9×10^{-4}	9.5×10^{-5}	2.8×10^{-4}
Sr-91	6.5×10^{-4}	5.9×10^{-4}	1.2×10^{-3}	Np-239	5.9×10^{-3}	1.6×10^{-3}	7.5×10^{-3}

[a] A wet site is characterized by the potential for effluent material to be emitted either through airborne or liquid pathways. A dry site only exhibits the potential to emit effluent material via the airborne pathway. For a dry site, it was conservatively assumed that liquid and atmospheric effluents are released into the atmosphere.

Source: HNUS 1996a.

Table M.2.3.1–5. Annual Liquid and Atmospheric Radioactive Releases From the Small Evolutionary Light Water Reactor Using a Mixed Oxide Core (curies)

	Release				Release		
	Wet Site[a]		Dry Site[a]		Wet Site[a]		Dry Site[a]
Isotope	Atmospheric	Liquid	Atmospheric	Isotope	Atmospheric	Liquid	Atmospheric
H-3	$8.4x10^{1}$	$7.5x10^{2}$	$8.4x10^{2}$	Nb-95	$2.1x10^{-3}$	$1.6x10^{-3}$	$3.7x10^{-3}$
C-14	7.3	0	7.3	Mo-99	0	$7.9x10^{-4}$	$7.9x10^{-4}$
Ar-41	$3.4x10^{1}$	0	$3.4x10^{1}$	Tc-99m	0	$4.6x10^{-4}$	$4.6x10^{-4}$
Kr-85m	$3.2x10^{1}$	0	$3.2x10^{1}$	Ru-103	$1.0x10^{-4}$	$1.8x10^{-3}$	$1.9x10^{-3}$
Kr-85	$1.7x10^{2}$	0	$1.7x10^{2}$	Rh-103m	0	$1.1x10^{-3}$	$1.1x10^{-3}$
Kr-87	9.5	0	9.5	Ru-106	$1.4x10^{-4}$	$3.9x10^{-2}$	$3.9x10^{-2}$
Kr-88	$3.4x10^{1}$	0	$3.4x10^{1}$	Ag-110m	0	$1.4x10^{-3}$	$1.4x10^{-3}$
Xe-131m	$2.0x10^{3}$	0	$2.0x10^{3}$	Sb-124	0	$4.3x10^{-4}$	$4.3x10^{-4}$
Xe-133m	$8.9x10^{1}$	0	$8.9x10^{1}$	Sb-125	$6.1x10^{-5}$	0	$6.1x10^{-5}$
Xe-133	$4.7x10^{3}$	0	$4.7x10^{3}$	Te-129m	0	$3.9x10^{-5}$	$3.9x10^{-5}$
Xe-135m	9.8	0	9.8	Te-129	0	$3.8x10^{-5}$	$3.8x10^{-5}$
Xe-135	$5.4x10^{2}$	0	$5.4x10^{2}$	Te-131m	0	$1.7x10^{-4}$	$1.7x10^{-4}$
Xe-138	4.6	0	4.6	Te-131	0	$3.0x10^{-5}$	$3.0x10^{-5}$
Na-24	0	$3.2x10^{-3}$	$3.2x10^{-3}$	I-131	$7.3x10^{-2}$	$3.6x10^{-2}$	$1.1x10^{-1}$
P-32	0	$1.8x10^{-4}$	$1.8x10^{-4}$	Te-132	0	$2.1x10^{-4}$	$2.1x10^{-4}$
Cr-51	$6.1x10^{-4}$	$5.2x10^{-3}$	$5.8x10^{-3}$	I-132	0	$2.4x10^{-3}$	$2.4x10^{-3}$
Mn-54	$4.4x10^{-4}$	$4.0x10^{-3}$	$4.4x10^{-3}$	I-133	$2.4x10^{-1}$	$2.0x10^{-2}$	$2.6x10^{-1}$
Fe-55	0	$7.4x10^{-3}$	$7.4x10^{-3}$	I-134	0	$8.6x10^{-5}$	$8.6x10^{-5}$
Co-57	$8.2x10^{-6}$	0	$8.2x10^{-6}$	Cs-134	$1.5x10^{-3}$	$1.8x10^{-2}$	$1.9x10^{-2}$
Co-58	$2.3x10^{-2}$	$8.6x10^{-3}$	$3.2x10^{-2}$	I-135	0	$1.4x10^{-2}$	$1.4x10^{-2}$
Co-60	$8.7x10^{-3}$	$1.4x10^{-2}$	$2.3x10^{-2}$	Cs-136	$1.1x10^{-4}$	$2.0x10^{-3}$	$2.1x10^{-3}$
Fe-59	$7.9x10^{-5}$	$2.2x10^{-3}$	$2.3x10^{-3}$	Cs-137	$3.7x10^{-3}$	$3.8x10^{-2}$	$4.2x10^{-2}$
Ni-63	0	$1.7x10^{-3}$	$1.7x10^{-3}$	Ba-140	$3.9x10^{-4}$	$2.5x10^{-3}$	$2.9x10^{-3}$
Zn-65	0	$8.0x10^{-5}$	$8.0x10^{-5}$	La-140	0	$2.6x10^{-3}$	$2.6x10^{-3}$
Sr-89	$1.7x10^{-3}$	$6.3x10^{-5}$	$1.8x10^{-3}$	Ce-141	$3.9x10^{-5}$	$2.4x10^{-4}$	$2.7x10^{-4}$
Sr-90	$6.0x10^{-4}$	$1.0x10^{-5}$	$6.1x10^{-4}$	Ce-143	0	$2.3x10^{-4}$	$2.3x10^{-4}$
Sr-91	0	$3.2x10^{-5}$	$3.2x10^{-5}$	Ce-144	0	$3.6x10^{-3}$	$3.6x10^{-3}$
Y-91m	0	$3.0x10^{-5}$	$3.0x10^{-5}$	Pr-144	0	$5.8x10^{-4}$	$5.8x10^{-4}$
Y-91	0	$5.7x10^{-5}$	$5.7x10^{-5}$	W-187	0	$2.2x10^{-4}$	$2.2x10^{-4}$
Y-93	0	$1.7x10^{-4}$	$1.7x10^{-4}$	Np-239	0	$1.0x10^{-4}$	$1.0x10^{-4}$
Zr-95	$8.5x10^{-4}$	$1.0x10^{-3}$	$1.9x10^{-3}$				

[a] A wet site is characterized by the potential for effluent material to be emitted either through airborne or liquid pathways. A dry site only exhibits the potential to emit effluent material via the airborne pathway. For a dry site, it was conservatively assumed that liquid and atmospheric effluents are released into the atmosphere.

Source: HNUS 1996a.

Table M.2.3.2–1. Potential Radiological Impacts From Normal Operation to Involved Workers of Disposition Technology Alternatives and Common Activities

Facility	Years of Operation	Involved "Badged" Workforce	Average Worker Dose (mrem/yr)	Risk of Fatal Cancer[a]	Total Dose (person-rem/yr)	Fatal Cancers[a]
Front-End Processes (Common to Multiple Disposition Alternatives)						
Pit Disassembly and Conversion Facility [Text deleted.]	10	415	200	1.3×10^{-3}	83	0.33
Pu Conversion Facility [Text deleted.]	10	572	233	9.3×10^{-4}	133	0.53
MOX Fuel Fabrication Facility						
	17	125	250	1.7×10^{-3}	31	0.21
	23	125	250	2.3×10^{-3}	31	0.29
Plutonium Disposition Alternatives						
Direct Disposition Alternative						
Deep Borehole Complex	10	205	13	5.2×10^{-5}	2.7	0.011
Immobilized Disposition Alternative						
Ceramic Immobilization Facility	10	450	240	9.8×10^{-4}	110	0.44
Deep Borehole Complex	10	168	13	5.2×10^{-5}	2.2	8.8×10^{-3}
Vitrification Alternative	10	550	200	8.0×10^{-4}	110	0.44
Ceramic Immobilization Alternative	10	430	279	1.1×10^{-3}	120	0.48
Electrometallurgical Treatment Alternative	10	73	40	1.6×10^{-4}	2.9	0.012
Existing LWR	23	600 to 1,000	281 to 543	2.6×10^{-3} to 5.0×10^{-3}	172 to 602	1.6 to 5.5
Partially Completed LWR	23	1,050	360	3.2×10^{-3}	380	3.5
Evolutionary LWR						
Small	17	125	800	5.4×10^{-3}	100	0.68
Large	17	210	810	5.5×10^{-3}	170	1.2

[a] As the result of operations for the number of years given in the first column.

Source: LANL 1996b; LANL 1996c; LANL 1996d; LLNL 1996a; LLNL 1996b; LLNL 1996c; LLNL 1996d; LLNL 1996e; LLNL 1996g; LLNL 1996h; NRC 1995b; ORNL 1995b.

M.2.4 RADIOLOGICAL IMPACTS AT HANFORD SITE

This section presents the radiological impacts of the various storage and disposition alternatives at Hanford. Section M.2.4.1 presents the radiological releases and resulting impacts from facilities associated with No Action. Section M.2.4.2 presents the radiological releases and resulting impacts from the various alternatives.

For purposes of radiological impact modeling, Hanford was divided into seven separate areas which would release radioactivity in 2005. All potential release points in each area were aggregated into a single release point. Table M.2.4–1 presents the characteristics of each of the release points including location, release height, minimum distance, and annual average dispersion to the site boundary in each of 16 directions. In order to calculate the maximum site boundary dose (that is, the dose ultimately incurred to the site MEI), the dose from each release point to the "maximum receptor" (that is, potential MEI) associated with each of the other release points has been calculated. For further clarification on the definition of a "maximum receptor" refer to Section M.2.2.2. For example, the dose resulting from releases from the 100 Area, 200 West, 200 East, 300 Area, and the other storage and disposition alternatives (Washington Nuclear Power-1), has been determined for the maximum receptor from the 400 Area. Figure M.2.4–1 illustrates the location of each maximum receptor in relation to each release point. The maximum site boundary dose (that is, the dose ultimately incurred by the MEI) is then determined by the maximum dose to one of these maximum receptors. Table M.2.4–2 presents the distance, direction, and atmospheric dispersion from each release point to each of the maximum receptors. Annual radiological releases were assumed to remain constant during the full operational period.

Descriptions of population, food stuffs distributions, and aquatic foods for each release area are provided in a Health Risk Data report, October, 1996. The joint frequency distributions used for the dose assessment were based on measurements from the meteorological tower in the 200 East Area at the 10-m (33-ft) height during the time period of July 1, 1989 through August 30, 1990 and is contained in the Health Risk Data report.

Doses given in this section are associated with 1 year of operation because regulatory standards are given as annual limits. The health effects are presented on an annual basis in the tables, and for the projected operational period in the text. Tables M.2.4–3 through M.2.4–6 include the radiological impacts to the public from both atmospheric releases and from using the surface water for No Action and the storage and disposition alternatives.

M.2.4.1 No Action

Atmospheric Releases and Resulting Impacts to the Public. For No Action, five of the six areas have radioactive releases into the atmosphere from normal operation. Table M.2.4.1–1 presents the estimated annual atmospheric radioactive releases.

Tables M.2.4–3 and M.2.4–4 include the atmospheric radiological impacts to the maximally exposed member of the public and the offsite population within 80 km (50 mi), respectively. The MEI would receive an annual dose of 4.4×10^{-3} mrem. An estimated fatal cancer risk of 1.1×10^{-7} would result from 50 years of operation. The population within 80 km (50 mi) would receive a dose of 0.46 person-rem in 2030 (midlife of operation). An estimated 0.012 fatal cancers could result from 50 years of operation.

Liquid Releases and Resulting Impacts to the Public. For No Action, some areas may have radioactive releases to the offsite surface water from normal operation. Table M.2.4.1–2 presents the estimated annual liquid radioactive releases.

Tables M.2.4–5 and M.2.4–6, respectively, include the radiological impacts to the MEI and the offsite populations using surface water within 80 km (50 mi) downstream of Hanford. The maximally exposed member of the public would receive an annual dose of 9.5×10^{-4} mrem. An estimated fatal cancer risk of

Table M.2.4–1. Release Point Characteristics, Direction, Distance, and Chi/Q at the Hanford Site Boundary

Release Point[a]	100 Area	200 West	200 East	300 Area	400 Area	600 Area	WNP-1
Latitude	46°39'35.88"	46°33'22.33"	46°33'22.33"	46°22'14.09"	46°26'2.31"	46°23'37.94"	46°27'58.01"
Longitude	-119°36'32.33"	-119°37'43.30"	-119°32'44.96"	-119°16'40.9"	-119°21'27.50"	-119°32'0.52"	-119°18'44.30"
Release Height	12/8 m	61.0 m	61.0 m	17.9 m	14.3 m	Ground Level	Ground Level

Distance and Atmospheric Dispersion at Site Boundary														
Direction	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)
N	8,727	4.0×10^{-8}	17,234	4.6×10^{-9}	22,325	3.4×10^{-9}	9,361	2.8×10^{-8}	16,086	1.5×10^{-8}	38,245	5.7×10^{-9}	10,853	3.1×10^{-8}
NNE	12,004	2.1×10^{-8}	24,489	2.2×10^{-9}	25,670	2.1×10^{-9}	2,388	1.3×10^{-7}	12,934	1.6×10^{-8}	30,461	6.4×10^{-9}	7,855	4.0×10^{-8}
NE	17,712	2.2×10^{-8}	26,784	3.6×10^{-9}	20,224	4.9×10^{-9}	1,587	3.7×10^{-7}	9,821	4.2×10^{-8}	25,390	1.4×10^{-8}	5,295	1.2×10^{-7}
ENE	20,510	2.8×10^{-8}	24,022	6.2×10^{-9}	17,492	8.7×10^{-9}	1,413	6.5×10^{-7}	7,922	8.6×10^{-8}	22,039	2.7×10^{-8}	4,865	2.2×10^{-7}
E	20,590	4.6×10^{-8}	23,513	9.1×10^{-9}	17,205	1.3×10^{-8}	1,407	9.4×10^{-7}	7,817	1.4×10^{-7}	7,861	1.8×10^{-7}	4,216	4.5×10^{-7}
ESE	22,165	4.3×10^{-8}	28,561	8.5×10^{-9}	22,180	1.1×10^{-8}	1,492	9.8×10^{-7}	7,846	1.5×10^{-7}	5,867	2.8×10^{-7}	4,212	4.5×10^{-7}
SE	31,482	2.2×10^{-8}	24,266	9.1×10^{-9}	26,251	8.4×10^{-9}	1,883	6.9×10^{-7}	8,746	1.1×10^{-7}	2,748	7.2×10^{-7}	5,313	2.7×10^{-7}
SSE	32,668	8.5×10^{-9}	20,740	5.7×10^{-9}	21,058	5.6×10^{-9}	2,147	2.8×10^{-7}	9,120	4.2×10^{-8}	2,266	4.1×10^{-7}	7,248	7.0×10^{-8}
S	26,544	1.6×10^{-8}	14,929	9.8×10^{-9}	19,177	7.4×10^{-9}	2,137	3.5×10^{-7}	7,915	6.9×10^{-8}	2,225	5.7×10^{-7}	12,429	4.5×10^{-8}
SSW	25,867	8.7×10^{-9}	15,132	5.3×10^{-9}	16,507	4.8×10^{-9}	2,241	1.8×10^{-7}	7,482	4.1×10^{-8}	2,841	2.1×10^{-7}	12,298	2.5×10^{-8}
SW	17,092	7.2×10^{-9}	14,979	3.7×10^{-9}	17,560	3.0×10^{-9}	2,560	8.5×10^{-8}	7,422	2.0×10^{-8}	2,626	1.2×10^{-7}	12,393	1.2×10^{-8}
WSW	15,068	7.9×10^{-9}	12,638	4.0×10^{-9}	19,118	2.4×10^{-9}	3,677	4.6×10^{-8}	12,536	9.0×10^{-9}	3,709	6.4×10^{-8}	17,723	6.5×10^{-9}
W	10,665	2.7×10^{-8}	12,346	8.9×10^{-9}	18,701	5.3×10^{-9}	5,874	5.1×10^{-8}	19,209	1.1×10^{-8}	4,804	1.2×10^{-7}	25,540	8.5×10^{-9}
WNW	8,593	3.2×10^{-8}	12,546	6.9×10^{-9}	18,995	4.1×10^{-9}	27,312	5.3×10^{-9}	33,445	4.5×10^{-9}	6,527	5.0×10^{-8}	37,072	4.5×10^{-9}
NW	7,289	7.9×10^{-8}	14,910	9.9×10^{-9}	19,803	7.1×10^{-9}	46,357	5.2×10^{-9}	38,932	7.2×10^{-9}	23,021	1.7×10^{-8}	38,585	8.3×10^{-9}
NNW	7,399	7.3×10^{-8}	15,721	8.0×10^{-9}	19,540	6.2×10^{-9}	47,598	4.7×10^{-9}	39,255	6.7×10^{-9}	33,663	9.5×10^{-9}	36,707	8.5×10^{-9}

[a] See Figure M.2.4–1 for location of release points.

Note: Release from the 600 Area are conservatively assumed to be near Rattlesnake Mountain.

Source: HNUS 1996a.

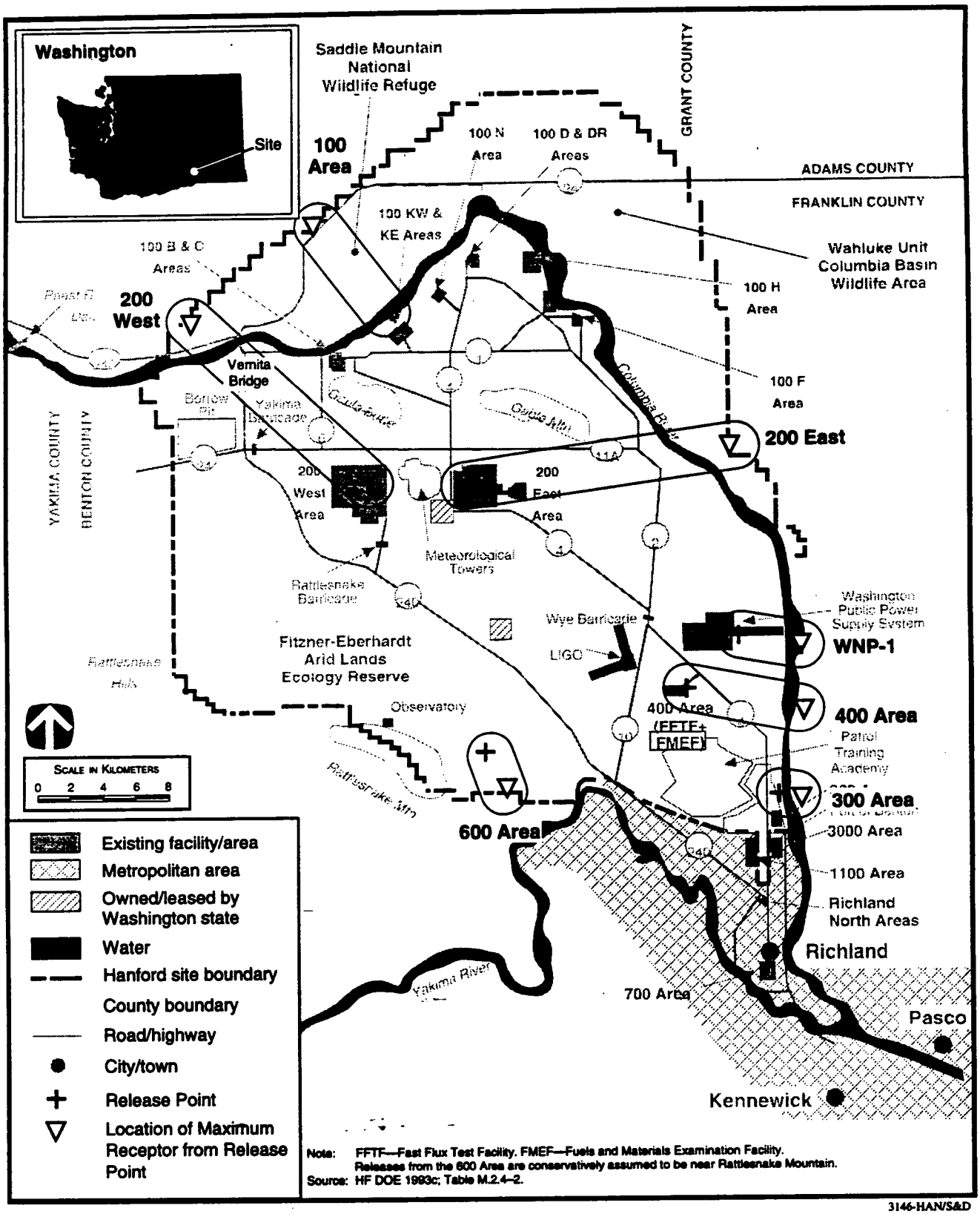

Figure M.2.4–1. Location of Release Points and Maximum Receptors at Hanford Site.

Table M.2.4–2. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Hanford Site Boundary

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: 100 Area			
100 Area	NW	7,289	7.9×10^{-8}
200 West	W	12,214	2.3×10^{-8}
200 East	ESE	23,726	3.9×10^{-8}
300 Area	SE	42,124	1.5×10^{-8}
400 Area	SE	37,783	1.8×10^{-8}
600 Area	S	32,656	1.2×10^{-8}
WNP-1	SE	34,885	1.9×10^{-8}
Release Point: 200 West			
100 Area	N	17,235	4.6×10^{-9}
200 West	NW	14,910	9.9×10^{-9}
200 East	E	23,514	9.1×10^{-9}
300 Area	SE	35,271	6.0×10^{-9}
400 Area	ESE	32,194	7.5×10^{-9}
600 Area	SSE	22,149	5.3×10^{-9}
WNP-1	ESE	30,381	7.9×10^{-9}
Release Point: 200 East			
100 Area	NNW	19,541	6.2×10^{-9}
200 West	WNW	19,965	3.9×10^{-9}
200 East	E	17,205	1.3×10^{-8}
300 Area	SE	30,363	7.1×10^{-9}
400 Area	SE	26,701	8.2×10^{-9}
600 Area	S	20,407	6.9×10^{-9}
WNP-1	ESE	34,885	6.9×10^{-9}
Release Point: 300 Area			
100 Area	NW	48,259	4.9×10^{-9}
200 West	NW	48,764	4.9×10^{-9}
200 East	N	23,223	8.4×10^{-9}
300 Area	ESE	1,493	9.8×10^{-7}
400 Area	NNE	5,963	4.0×10^{-8}
600 Area	W	18,045	1.1×10^{-8}
WNP-1	N	10,083	2.5×10^{-8}

Table M.2.4–2. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Hanford Site Boundary—Continued

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: 400 Area			
100 Area	NW	38,933	$7.2x10^{-9}$
200 West	NW	39,581	$7.0x10^{-9}$
200 East	N	16,127	$1.5x10^{-8}$
300 Area	SE	10,547	$8.3x10^{-8}$
400 Area	ESE	7,846	$1.5x10^{-7}$
600 Area	WSW	13,655	$8.0x10^{-9}$
WNP-1	ENE	8,188	$8.2x10^{-8}$
Release Point: 600 Area			
100 Area	NNW	36,551	$8.6x10^{-9}$
200 West	NNW	33,674	$9.5x10^{-9}$
200 East	NE	25,978	$1.4x10^{-8}$
300 Area	E	21,313	$4.6x10^{-8}$
400 Area	E	21,493	$4.6x10^{-8}$
600 Area	SE	2,748	$7.2x10^{-7}$
WNP-1	ENE	22,418	$2.6x10^{-8}$
Release Point: WNP-1			
100 Area	NW	38,611	$8.3x10^{-9}$
200 West	WNW	40,473	$4.0x10^{-9}$
200 East	N	12,370	$2.6x10^{-8}$
300 Area	SSE	11,643	$3.5x10^{-8}$
400 Area	SE	6,472	$2.0x10^{-7}$
600 Area	WSW	18,493	$6.2x10^{-9}$
WNP-1	E	4,216	$4.5x10^{-7}$

Source: HNUS 1996a.

$2.4x10^{-8}$ would result from 50 years of operation. The population would receive a dose of 1.1 person-rem in 2030. An estimated 0.028 fatal cancers could result from 50 years of operation.

Worker Doses and Health Effects. Based on measured values during 1991 and 1992, it is estimated that the average dose to a badged worker involved in No Action activities at Hanford in 2005 and beyond would equal 27 mrem. It is projected that in 2005 and beyond, there would be 9,300 badged workers involved in No Action activities. The annual dose among all these workers would equal 250 person-rem. From 50 years of operation, an estimated fatal cancer risk of $5.5x10^{-4}$ would result to the average worker and 5.1 fatal cancers could result among all workers.

Table M.2.4–3. Doses and Resulting Health Effects to the Maximally Exposed Individual at Hanford Site From Atmospheric Releases Associated With Annual Normal Operation

Alternative/Facility	Dose by Pathway (mrem)				Committed Effective Dose Equivalent (mrem)	Percent of Background[a]	Estimated 1-Year Fatal Cancer Risk
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	9.9×10^{-4}	2.9×10^{-3}	4.2×10^{-4}	1.4×10^{-6}	4.4×10^{-3}[b]	1.5×10^{-3}	2.2×10^{-9}
Upgraded Storage Facility-200 West[c]	3.9×10^{-7}	8.5×10^{-9}	2.3×10^{-15}	3.4×10^{-12}	4.0×10^{-7}	1.3×10^{-7}	2.0×10^{-13}
Upgraded Storage Facility-Fuels and Materials Examination Facility[c]	1.7×10^{-6}	3.8×10^{-8}	1.0×10^{-14}	1.6×10^{-11}	1.8×10^{-6}	6.0×10^{-7}	9.0×10^{-13}
Consolidated Storage Facility	2.5×10^{-6}	4.4×10^{-9}	9.6×10^{-16}	2.0×10^{-12}	2.5×10^{-6}	8.3×10^{-7}	1.2×10^{-12}
Collocated Storage Facility	2.5×10^{-6}	4.4×10^{-9}	1.0×10^{-15}	3.0×10^{-12}	2.5×10^{-6}	8.3×10^{-7}	1.2×10^{-12}
Pit Disassembly/Conversion Facility	2.8×10^{-4}	6.3×10^{-6}	1.6×10^{-12}	2.5×10^{-9}	2.9×10^{-4}	9.7×10^{-5}	1.4×10^{-10}
Pu Conversion Facility	1.8×10^{-4}	3.4×10^{-7}	7.7×10^{-14}	1.6×10^{-10}	1.8×10^{-4}	6.0×10^{-5}	9.0×10^{-11}
MOX Fuel Fabrication Facility	1.4×10^{-4}	2.4×10^{-7}	5.2×10^{-14}	2.5×10^{-10}	1.4×10^{-4}	4.7×10^{-5}	7.0×10^{-11}
Ceramic Immobilization Facility (Immobilized Disposition)	3.2×10^{-8}	5.6×10^{-11}	1.2×10^{-17}	2.5×10^{-14}	3.2×10^{-8}	1.1×10^{-8}	1.6×10^{-14}
Deep Borehole Complex (Direct Disposition)	5.3×10^{-9}	7.6×10^{-11}	2.0×10^{-17}	3.1×10^{-14}	5.3×10^{-9}	1.8×10^{-9}	2.7×10^{-15}
Deep Borehole Complex (Immobilized Disposition)	6.6×10^{-9}	1.1×10^{-10}	3.0×10^{-17}	4.5×10^{-14}	6.7×10^{-9}	2.2×10^{-9}	3.4×10^{-15}
Vitrification Facility	1.3×10^{-5}	8.6×10^{-7}	2.5×10^{-10}	1.3×10^{-7}	1.4×10^{-5}	4.7×10^{-6}	7.0×10^{-12}
Ceramic Immobilization Facility (Ceramic Immobilization)	3.6×10^{-8}	1.7×10^{-7}	5.1×10^{-11}	2.8×10^{-8}	2.3×10^{-7}	7.7×10^{-8}	1.2×10^{-13}
Advanced Boiling Water Reactor	5.4×10^{-3}	3.2×10^{-1}	1.2×10^{-1}	7.1×10^{-3}	4.5×10^{-1}	1.5×10^{-1}	2.3×10^{-7}
CE System 80+ Reactor	1.1×10^{-2}	3.1×10^{-1}	8.7×10^{-3}	1.5×10^{-4}	3.3×10^{-1}	1.1×10^{-1}	1.7×10^{-7}
[Text deleted.]							
AP600 Reactor	2.5×10^{-3}	2.1×10^{-1}	2.5×10^{-2}	1.5×10^{-3}	2.3×10^{-1}	7.7×10^{-2}	1.2×10^{-7}
RESAR 90 Reactor	8.9×10^{-3}	3.2×10^{-1}	1.0×10^{-2}	1.7×10^{-3}	3.4×10^{-1}	1.1×10^{-1}	1.7×10^{-7}

[a] Individual annual natural background radiation dose is equal to 300 mrem.

[b] The storage facility contributes 4.1×10^{-4} mrem/year.

[c] The radiological impacts for the Upgrade Alternative are calculated based on measured releases from facilities at Hanford, RFETS, and LANL.

[Text deleted.]

Source: HNUS 1996a.

Table M.2.4–4. Doses and Resulting Health Effects to the Population Within 80 Kilometers of Hanford Site From Atmospheric Releases Associated With Normal Operation in 2030

Alternative/Facility	Dose by Pathway (person-rem)				Committed Effective Dose Equivalent (person-rem)	Percent of Background[a]	Estimated 1-Year Fatal Cancer Risk
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	5.2×10^{-2}	4.1×10^{-1}	4.7×10^{-3}	1.5×10^{-4}	4.6×10^{-1}[b]	2.3×10^{-4}	2.3×10^{-4}
Upgraded Storage Facility-200 West[c]	2.8×10^{-5}	7.6×10^{-6}	1.6×10^{-13}	2.4×10^{-10}	3.5×10^{-5}	1.9×10^{-8}	1.8×10^{-8}
Upgraded Storage Facility-Fuels Materials Examination Facility[c]	3.6×10^{-5}	1.1×10^{-5}	2.1×10^{-13}	3.2×10^{-10}	4.7×10^{-5}	2.5×10^{-8}	2.4×10^{-8}
Consolidated Storage Facility	1.1×10^{-4}	2.9×10^{-6}	4.2×10^{-14}	8.8×10^{-11}	1.1×10^{-4}	5.9×10^{-8}	5.5×10^{-8}
Collocated Storage Facilities	1.1×10^{-4}	2.9×10^{-6}	4.5×10^{-14}	1.3×10^{-10}	1.1×10^{-4}	5.9×10^{-8}	5.5×10^{-8}
Pit Disassembly/Conversion Facility	1.2×10^{-2}	4.1×10^{-3}	7.2×10^{-11}	1.1×10^{-7}	1.6×10^{-2}	8.6×10^{-6}	8.0×10^{-6}
Pu Conversion Facility	8.2×10^{-3}	2.3×10^{-4}	3.4×10^{-12}	7.2×10^{-9}	8.4×10^{-3}	4.5×10^{-6}	4.2×10^{-6}
MOX Fuel Fabrication Facility	6.0×10^{-3}	1.6×10^{-4}	2.3×10^{-12}	1.1×10^{-8}	6.2×10^{-3}	3.3×10^{-6}	3.1×10^{-6}
Ceramic Immobilization Facility (Immobilized Disposition)	1.4×10^{-6}	3.6×10^{-8}	5.6×10^{-16}	1.1×10^{-12}	1.5×10^{-6}	8.0×10^{-10}	7.5×10^{-10}
Deep Borehole Complex (Direct Disposition)	2.3×10^{-7}	5.0×10^{-8}	8.8×10^{-16}	1.3×10^{-12}	2.8×10^{-7}	1.5×10^{-10}	1.4×10^{-10}
Deep Borehole Complex (Immobilized Disposition)	2.9×10^{-7}	7.4×10^{-8}	1.3×10^{-15}	2.0×10^{-12}	3.7×10^{-7}	2.0×10^{-10}	1.9×10^{-10}
Vitrification Facility	5.8×10^{-4}	2.0×10^{-4}	1.1×10^{-8}	6.1×10^{-6}	7.9×10^{-4}	4.2×10^{-7}	4.0×10^{-7}
Ceramic Immobilization Facility (Ceramic Immobilization)	1.6×10^{-6}	3.6×10^{-5}	2.2×10^{-9}	1.2×10^{-6}	3.9×10^{-5}	2.1×10^{-8}	1.9×10^{-8}
Advanced Boiling Water Reactor	2.9×10^{-2}	2.6×10^{1}	3.0×10^{-1}	3.5×10^{-2}	2.6×10^{1}	1.4×10^{-2}	1.3×10^{-2}
CE System 80+ Reactor	7.2×10^{-2}	3.0×10^{1}	4.0×10^{-2}	9.3×10^{-4}	3.0×10^{1}	1.6×10^{-2}	1.5×10^{-2}
[Text deleted.]							
AP600 Reactor	1.6×10^{-2}	2.0×10^{1}	1.3×10^{-1}	9.6×10^{-3}	2.0×10^{1}	1.1×10^{-2}	1.0×10^{-2}
RESAR 90 Reactor	5.8×10^{-2}	2.9×10^{1}	5.4×10^{-2}	1.1×10^{-2}	2.9×10^{1}	1.6×10^{-2}	1.5×10^{-2}

[a] Dose to the population within 80 km from natural background radiation in the year 2030 is equal to 186,400 person-rem.

[b] The storage facility contributes 0.047 person-rem/year.

[c] The radiological impacts for the Upgrade Alternative are calculated based on measured releases from facilities at Hanford, RFETS, and LANL.

[Text deleted.]

Source: HNUS 1996a.

Table M.2.4–5. Doses and Resulting Health Effects to the Maximally Exposed Individual at Hanford Site From Liquid Releases Associated With Annual Normal Operation

Alternative/Facility	Dose by Pathway (mrem)						Committed Effective Dose Equivalent (mrem)	Percent of Background[a]	Estimated 1-Year Fatal Cancer Risk
	Fish Ingestion	Other Food Ingestion	Drinking Water	Boating	Swimming	Shoreline			
No Action (Total Site)	5.2×10^{-4}	4.2×10^{-4}	0	1.1×10^{-8}	2.1×10^{-8}	3.2×10^{-6}	9.5×10^{-4}[b]	3.2×10^{-4}	4.8×10^{-10}
Advanced Boiling Water Reactor	4.6×10^{-3}	9.5×10^{-5}	0	1.1×10^{-7}	2.2×10^{-7}	1.2×10^{-5}	4.7×10^{-3}	1.6×10^{-3}	2.3×10^{-9}
CE System 80+ Reactor	1.4×10^{-2}	4.8×10^{-4}	0	2.1×10^{-7}	4.3×10^{-7}	3.3×10^{-5}	1.4×10^{-2}	4.8×10^{-3}	7.2×10^{-9}
AP600 Reactor	2.2×10^{-2}	7.9×10^{-4}	0	2.4×10^{-7}	4.8×10^{-7}	3.5×10^{-5}	2.4×10^{-2}	7.9×10^{-3}	1.2×10^{-8}
[Text deleted.]									
RESAR-90 Reactor	1.5×10^{-2}	8.9×10^{-4}	0	2.4×10^{-7}	4.7×10^{-7}	2.0×10^{-5}	1.6×10^{-2}	5.3×10^{-3}	7.9×10^{-9}

[a] Individual annual natural background radiation dose is equal to 300 mrem.

[b] The storage facility does not contribute to the dose.

Source: HNUS 1996a.

Table M.2.4–6. Doses and Resulting Health Effects to the Population Within 80 Kilometers of Hanford Site From Liquid Releases Associated With Normal Operation in 2030

Alternative/Facility	Dose by Pathway (person-rem)						Committed Effective Dose Equivalent (person-rem)	Percent of Background[a]	Estimated 1-Year Fatal Cancers
	Fish Ingestion	Other Food Ingestion	Drinking Water	Boating	Swimming	Shoreline			
No Action (Total Site)	1.9×10^{-4}	1.1	1.0×10^{-3}	6.8×10^{-8}	2.7×10^{-7}	1.4×10^{-5}	1.1[b]	7.3×10^{-4}	5.5×10^{-4}
Advanced Boiling Water Reactor	1.7×10^{-3}	3.3×10^{-1}	1.7×10^{-3}	6.9×10^{-7}	2.7×10^{-6}	5.2×10^{-5}	3.3×10^{-1}	2.2×10^{-4}	1.7×10^{-4}
CE System 80+ Reactor	5.1×10^{-3}	1.5	1.1×10^{-2}	1.3×10^{-6}	5.3×10^{-6}	1.4×10^{-4}	1.5	1.0×10^{-3}	7.6×10^{-4}
AP600 Reactor	8.7×10^{-3}	2.6	1.9×10^{-2}	1.5×10^{-6}	6.0×10^{-6}	1.5×10^{-4}	2.6	1.7×10^{-3}	1.3×10^{-3}
[Text deleted.]									
RESAR-90 Reactor	5.5×10^{-3}	2.7	2.4×10^{-2}	1.5×10^{-6}	6.0×10^{-6}	8.5×10^{-5}	2.7	1.8×10^{-3}	1.4×10^{-3}

[a] Dose to the population within 80 km from natural background radiation in the year 2030 is equal to 186,400 person-rem.

[b] The storage facility does not contribute to the dose.

Source: HNUS 1996a.

Table M.2.4.1–1. Annual Atmospheric Radioactive Releases From Normal Operation of No Action at Hanford Site (curies)

Isotope	100 Area	200 East	200 West[a]	300 Area	400 Area	600 Area	No Action Storage
H-3	0	0	0	11.6	2.10	0	0
[Text deleted.]							
Co-60	5.22×10^{-6}	0	0	1.40×10^{-8}	0	0	0
Sr-90	5.43×10^{-5}	1.44×10^{-4}	8.4×10^{-5}	4.15×10^{-5}	0	1.80×10^{-7}	4.4×10^{-5}
Ru-106	1.31×10^{-5}	0	0	0	0	0	0
Sb-125	6.01×10^{-6}	0	0	1.51×10^{-6}	0	0	0
I-129	0	4.85×10^{-3}	4.0×10^{-6}	0	0	0	0
Cs-134	8.89×10^{-8}	0	0	3.30×10^{-7}	0	0	0
Cs-137	1.61×10^{-4}	1.50×10^{-3}	2.3×10^{-4}	9.34×10^{-7}	8.22×10^{-6}	0	0
Pm-147	0	1.10×10^{-4}	0	0	0	0	0
Eu-154	6.28×10^{-6}	0	0	1.49×10^{-6}	0	0	0
Eu-155	2.84×10^{-6}	0	0	2.60×10^{-8}	0	0	0
Pb-212	0	9.70×10^{-4}	0	0	0	0	0
Rn-222	0	0	0	1.50	0	0	0
[Text deleted.]							
Pu-238	1.03×10^{-6}	3.20×10^{-6}	0	6.85×10^{-8}	0	0	0
Pu-239	8.21×10^{-6}	1.12×10^{-5}	3.8×10^{-5}	8.44×10^{-6}	2.38×10^{-6}	4.00×10^{-8}	5.1×10^{-4}
Pu-241	0	3.30×10^{-5}	0	0	0	0	3.4×10^{-3}
Am-241	5.41×10^{-6}	2.78×10^{-5}	5.5×10^{-6}	5.51×10^{-8}	0	0	9.4×10^{-5}

[a] Presented releases do not include those associated with storage operations.
Source: HF PNL 1994b.

Table M.2.4.1–2. Annual Liquid Releases From Normal Operation of No Action at Hanford Site (curies)

Isotope	Release[a]
H-3	0.38
Co-60	3.6×10^{-4}
Sr-90	0.11
Ru-106	1.6×10^{-3}
Sb-125	1.3×10^{-4}
Cs-134	4.7×10^{-5}
Cs-137	4.4×10^{-4}
Pu-239	1.4×10^{-7}

[a] Total site release.
Source: HF PNL 1994b.

M.2.4.2 Storage and Disposition

Atmospheric Releases and Resulting Impacts to the Public. Total site radiological impacts during operation of storage or disposition facilities can be found by adding the impacts resulting from No Action facilities to the changes in impacts resulting from storage or disposition facilities. For example, to determine the radiological impact for the addition of the AP600 reactor at Hanford, the No Action facilities doses would be summed with the AP600 reactor doses. Estimated annual atmospheric radioactive releases for the storage and disposition facilities are given in Section M.2.3. Tables M.2.4–3 and M.2.4–4 include the atmospheric radiological impacts by alternative facility.

The annual doses associated with the different alternative facilities range from 5.3×10^{-9} to 0.45 mrem to the maximally exposed member of the public and from 2.8×10^{-7} to 30 person-rem to the 80-km (50-mi) population in 2030. The associated health effects from annual operations are included in both tables.

Liquid Releases and Resulting Impacts to the Public. There are two disposition technologies that would release liquid discharges to the surface water surrounding Hanford. These are the large and small evolutionary LWRs. The liquid releases for these technologies are given in Section M.2.3. As an example of determining the total site liquid radiological impact associated with the addition of an AP600 reactor at Hanford, the No Action liquid doses must be summed with the AP600 reactor liquid doses. Tables M.2.4–5 and M.2.4–6 present the liquid radiological impacts for the applicable alternative facilities.

The annual doses associated with the different LWR's that have liquid releases range from 4.7×10^{-3} to 0.024 mrem to the maximally exposed member of the public, and range from 0.33 to 2.7 person-rem to the downstream population in 2030. The associated health effects from annual operations are included in both tables.

Worker Doses and Health Effects. For the storage and disposition alternatives, the impacts from the No Action facilities need to be added to the changes in impacts from the storage or disposition facilities to determine the impacts from total site operation (refer to the worker discussion under No Action, above, and to Table M.2.3.2–1).

M.2.5 RADIOLOGICAL IMPACTS AT NEVADA TEST SITE

This section presents the radiological impacts of the various storage and disposition alternatives at NTS. Section M.2.5.1 presents the radiological releases and resulting impacts from facilities associated with No Action. Section M.2.5.2 presents the radiological releases and resulting impacts from the various alternatives.

For purposes of radiological impact modeling, NTS was divided into six separate areas which would release radioactivity in 2005. All release points in each area were aggregated into a single release point. Table M.2.5–1 presents the characteristics of each of the release points including location, release height, and minimum distance and annual average dispersion to the site boundary in each of the 16 directions. In order to calculate the maximum site boundary dose (that is, the dose ultimately incurred to the site MEI), the dose from each release point to the "maximum receptor" (that is, potential MEI) associated with each of the other release points has been calculated. For further clarification on the definition of "maximum receptor" refer to Section M.2.2.2. For example, the dose resulting from releases for Areas 5, 9, 12, 19, and Device Assembly Facility has been determined from the maximum receptor for Area 3. Figure M.2.5–1 illustrates the location of each maximum receptor in relation to each release point. The maximum site boundary dose (that is, the dose ultimately incurred to the site MEI) is then determined by the maximum dose to one of these maximum receptors. Table M.2.5–2 presents the direction, distance, and atmospheric dispersion from each release point to each of the maximum receptors. Annual radiological releases were assumed to remain constant during the full operational period.

The population and food stuffs distributions centered on each release area are provided in a Health Risk Data report, October 1996. The joint frequency distribution used for the dose assessment was based on the meteorological measurements for 1990 from the Desert Rock at the 10-m (33-ft) height and is contained in the Health Risk Data report.

Doses given in this section are associated with 1 year of operation because regulatory standards are given as annual limits. The health effects are presented on an annual basis in the tables, and for the projected operational period in the text. Tables M.2.5–3 and M.2.5–4 include the radiological impacts to the public from atmospheric release for No Action and the storage and disposition alternatives.

Table M.2.5–1. Release Point Characteristics, Direction, Distance, and Chi/Q at Nevada Test Site

Release Point[a]	Area 3		Area 5		Area 9		Area 12		Area 19		DAF	
Latitude	37°2'52.858"		36°51'17.933"		37°7'40.938"		37°13'9.788"		37°15'14.317"		6°53'37.824"	
Longitude	-116°0'23.131"		-115°57'12.384"		-116°2'5.827"		-116°9'20.893"		-116°18'59.322"		-116°2'54.794"	
Release Height	Ground Level		Ground Level		Ground Level		Ground Level		Ground Level		Ground Level	
	Distance and Atmospheric Dispersion at Site Boundary											
Direction	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)
N	22,334	$9.6x10^{-9}$	11,017	$2.5x10^{-8}$	13,494	$1.9x10^{-8}$	3,598	$1.2x10^{-7}$	14,593	$1.7x10^{-8}$	39,497	$4.6x10^{-9}$
NNE	12,393	$2.3x10^{-8}$	4,008	$1.1x10^{-7}$	13,751	$2.0x10^{-8}$	3,666	$1.3x10^{-7}$	13,493	$2.0x10^{-8}$	19,043	$1.3x10^{-8}$
NE	8,331	$5.3x10^{-8}$	2,719	$2.7x10^{-7}$	11,367	$3.5x10^{-8}$	4,317	$1.3x10^{-7}$	13,488	$2.8x10^{-8}$	12,827	$2.9x10^{-8}$
ENE	7,092	$5.7x10^{-8}$	2,290	$3.0x10^{-7}$	9,692	$3.7x10^{-8}$	6,382	$6.6x10^{-8}$	11,870	$2.8x10^{-8}$	10,926	$3.2x10^{-8}$
E	6,970	$5.6x10^{-8}$	2,249	$2.9x10^{-7}$	9,518	$3.7x10^{-8}$	17,654	$1.6x10^{-8}$	11,646	$2.8x10^{-8}$	10,734	$3.1x10^{-8}$
ESE	7,124	$4.6x10^{-8}$	2,307	$2.4x10^{-7}$	9,727	$3.0x10^{-8}$	20,667	$1.1x10^{-8}$	35,224	$5.4x10^{-9}$	10,975	$2.5x10^{-8}$
SE	8,470	$3.3x10^{-8}$	2,736	$1.7x10^{-7}$	11,519	$2.2x10^{-8}$	24,525	$7.9x10^{-9}$	41,754	$3.9x10^{-9}$	13,007	$1.8x10^{-8}$
SSE	12,801	$2.1x10^{-8}$	4,119	$1.0x10^{-7}$	17,407	$1.4x10^{-8}$	37,017	$5.2x10^{-9}$	63,001	$2.6x10^{-9}$	19,622	$1.2x10^{-8}$
S	37,774	$6.3x10^{-9}$	12,182	$2.8x10^{-8}$	50,960	$4.3x10^{-9}$	61,111	$3.4x10^{-9}$	58,791	$3.6x10^{-9}$	27,780	$9.4x10^{-9}$
SSW	43,741	$5.7x10^{-9}$	26,724	$1.1x10^{-8}$	52,085	$4.6x10^{-9}$	46,477	$5.3x10^{-9}$	20,820	$1.5x10^{-8}$	26,284	$1.1x10^{-8}$
SW	47,205	$6.4x10^{-9}$	26,537	$4.0x10^{-9}$	44,107	$7.0x10^{-9}$	31,082	$1.1x10^{-8}$	15,876	$2.7x10^{-8}$	30,390	$1.1x10^{-8}$
WSW	40,053	$5.6x10^{-9}$	38,554	$5.9x10^{-9}$	37,377	$6.1x10^{-9}$	27,130	$9.3x10^{-9}$	15,771	$1.9x10^{-8}$	36,372	$6.3x10^{-9}$
W	39,283	$8.1x10^{-9}$	44,204	$6.9x10^{-9}$	36,657	$8.8x10^{-9}$	27,851	$1.3x10^{-8}$	16,416	$2.6x10^{-8}$	35,698	$9.1x10^{-9}$
WNW	40,055	$8.1x10^{-9}$	45,100	$7.0x10^{-9}$	40,648	$8.0x10^{-9}$	28,395	$1.3x10^{-8}$	18,231	$2.3x10^{-8}$	36,413	$9.2x10^{-9}$
NW	27,062	$7.7x10^{-9}$	53,212	$3.2x10^{-9}$	16,370	$1.5x10^{-8}$	4,360	$9.3x10^{-8}$	15,211	$1.6x10^{-8}$	42,950	$4.2x10^{-9}$
NNW	22,808	$4.2x10^{-9}$	44,582	$1.8x10^{-9}$	13,801	$8.2x10^{-9}$	3,679	$5.2x10^{-8}$	14,912	$7.4x10^{-9}$	40,381	$2.0x10^{-9}$

[a] See Figure M.2.5–1 for location of release points.

Source: HNUS 1996a.

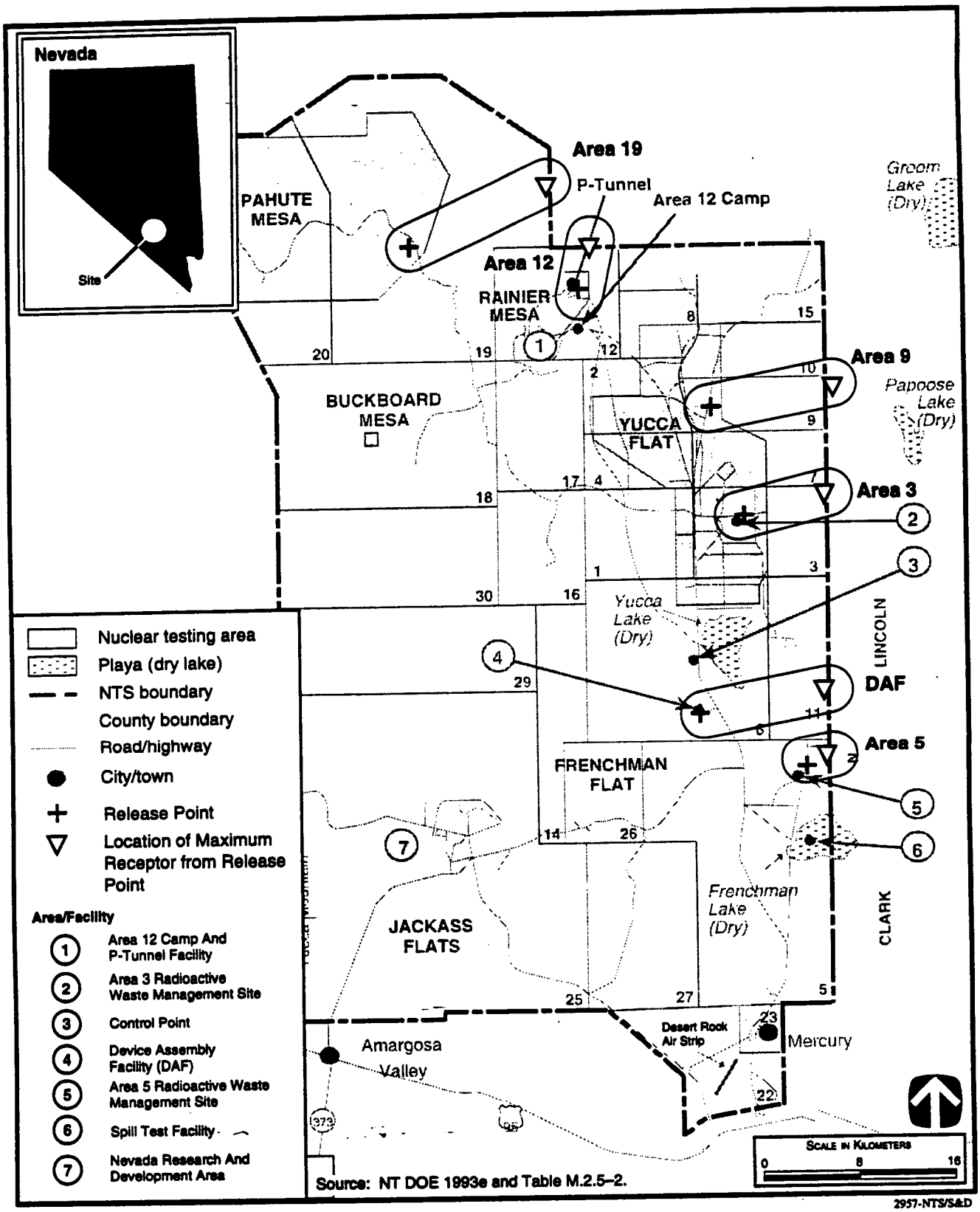

Figure M.2.5–1. Location of Release Points and Maximum Receptors at Nevada Test Site.

Table M.2.5–2. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Nevada Test Site Boundary

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: Area 3			
Area 3	ENE	7,093	$5.7x10^{-8}$
Area 5	SSE	22,117	$1.0x10^{-8}$
Area 9	NNE	12,766	$2.2x10^{-8}$
Area 12	NNW	25,015	$3.8x10^{-9}$
Area 19	NNW	29,688	$3.0x10^{-9}$
DAF	SSE	16,601	$1.5x10^{-8}$
Release Point: Area 5			
Area 3	N	22,849	$9.3x10^{-9}$
Area 5	ENE	2,291	$3.0x10^{-7}$
Area 9	N	32,178	$6.0x10^{-9}$
Area 12	NNW	46,638	$1.7x10^{-9}$
Area 19	NNW	50,866	$1.5x10^{-9}$
DAF	NNE	6,740	$5.3x10^{-8}$
Release Point: Area 9			
Area 3	SE	12,141	$2.0x10^{-8}$
Area 5	SSE	31,344	$6.4x10^{-9}$
Area 9	ENE	9,692	$3.7x10^{-8}$
Area 12	NNW	15,986	$6.8x10^{-9}$
Area 19	NW	20,987	$1.1x10^{-8}$
DAF	SSE	25,762	$8.3x10^{-9}$
Release Point: Area 12			
Area 3	SE	26,875	$7.0x10^{-9}$
Area 5	SSE	44,834	$4.0x10^{-9}$
Area 9	ESE	21,893	$1.0x10^{-8}$
Area 12	NE	4,318	$1.3x10^{-7}$
Area 19	NNW	6,614	$2.3x10^{-8}$
DAF	SSE	39,639	$4.7x10^{-9}$
Release Point: Area 19			
Area 3	ESE	40,661	$4.4x10^{-9}$
Area 5	SE	55,804	$2.7x10^{-9}$
Area 9	ESE	36,584	$5.1x10^{-9}$
Area 12	E	16,711	$1.7x10^{-8}$
Area 19	ENE	11,871	$2.8x10^{-8}$
DAF	SE	51,278	$3.0x10^{-9}$
Release Point: DAF			
Area 3	NNE	21,318	$1.1x10^{-8}$
Area 5	SSE	11,411	$2.4x10^{-8}$
Area 9	NNE	29,792	$7.4x10^{-9}$
Area 12	N	40,290	$4.5x10^{-9}$
Area 19	NNW	43,910	$1.8x10^{-9}$
DAF	ENE	10,927	$3.2x10^{-8}$

Source: HNUS 1996a.

Table M.2.5–3. Doses and Resulting Health Effects to the Maximally Exposed Individual at Nevada Test Site From Atmospheric Releases Associated With Annual Normal Operation

Alternative/Facility	Dose by Pathway (mrem)				Committed Effective Dose Equivalent (mrem)	Percent of Background[a]	Estimated 1-Year Fatal Cancer Risk
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	4.2×10^{-3}	1.2×10^{-5}	2.9×10^{-7}	2.2×10^{-9}	4.2×10^{-3}	1.3×10^{-3}	2.1×10^{-9}
Consolidated Storage Facility (P-Tunnel)	5.5×10^{-6}	9.6×10^{-9}	2.1×10^{-15}	4.4×10^{-12}	5.6×10^{-6}	1.8×10^{-6}	2.8×10^{-12}
Collocated Storage Facilities (P-Tunnel)	5.6×10^{-6}	9.6×10^{-9}	2.2×10^{-15}	6.6×10^{-12}	5.6×10^{-6}	1.8×10^{-6}	2.8×10^{-12}
Consolidated Storage Facility	1.3×10^{-6}	2.2×10^{-9}	4.9×10^{-16}	1.0×10^{-12}	1.3×10^{-6}	4.2×10^{-7}	6.5×10^{-13}
Collocated Storage Facilities	1.3×10^{-6}	2.3×10^{-9}	5.2×10^{-16}	1.6×10^{-12}	1.3×10^{-6}	4.2×10^{-7}	6.5×10^{-13}
Pit Disassembly/ Conversion Facility	1.4×10^{-4}	3.2×10^{-6}	8.6×10^{-13}	1.3×10^{-9}	1.5×10^{-4}	4.8×10^{-5}	7.5×10^{-11}
Pu Conversion Facility	9.5×10^{-5}	1.7×10^{-7}	3.9×10^{-14}	8.3×10^{-11}	9.5×10^{-5}	3.0×10^{-5}	4.8×10^{-11}
MOX Fuel Fabrication Facility	6.8×10^{-5}	1.2×10^{-7}	2.6×10^{-14}	1.3×10^{-10}	6.8×10^{-5}	2.2×10^{-5}	3.4×10^{-11}
Ceramic Immobilization Facility (Immobilized Disposition)	1.6×10^{-8}	2.8×10^{-11}	6.4×10^{-18}	1.3×10^{-14}	1.6×10^{-8}	5.1×10^{-9}	8.0×10^{-15}
Deep Borehole Complex (Direct Disposition)	2.7×10^{-9}	3.9×10^{-11}	1.0×10^{-17}	1.5×10^{-14}	2.7×10^{-9}	8.6×10^{-10}	1.4×10^{-15}
Deep Borehole Complex (Immobilized Disposition)	3.3×10^{-9}	5.8×10^{-11}	1.5×10^{-17}	2.3×10^{-14}	3.4×10^{-9}	1.1×10^{-9}	1.7×10^{-15}
Vitrification Facility	6.6×10^{-6}	4.3×10^{-7}	1.3×10^{-10}	7.1×10^{-8}	7.2×10^{-6}	2.3×10^{-6}	3.6×10^{-12}
Ceramic Immobilization Facility (Ceramic Immobilization)	1.8×10^{-8}	8.5×10^{-8}	2.5×10^{-11}	1.4×10^{-8}	1.2×10^{-7}	3.8×10^{-8}	6.0×10^{-14}
Advanced Boiling Water Reactor	4.6×10^{-4}	2.3×10^{-2}	6.2×10^{-3}	5.7×10^{-4}	3.0×10^{-2}	9.6×10^{-3}	1.5×10^{-8}
CE System 80+ Reactor	1.4×10^{-3}	2.6×10^{-2}	5.7×10^{-4}	2.2×10^{-4}	2.9×10^{-2}	9.3×10^{-3}	1.5×10^{-8}
[Text deleted.]							
AP600 Reactor	7.4×10^{-4}	2.2×10^{-2}	1.7×10^{-3}	3.4×10^{-4}	2.5×10^{-2}	8.0×10^{-3}	1.3×10^{-8}
RESAR-90 Reactor	1.2×10^{-3}	3.2×10^{-2}	7.0×10^{-4}	2.8×10^{-4}	3.4×10^{-2}	1.1×10^{-2}	1.7×10^{-8}

[a] Individual annual natural background radiation dose is equal to 313 mrem.

Source: HNUS 1996a.

Table M.2.5–4. Doses and Resulting Health Effects to the Population Within 80 Kilometers of Nevada Test Site From Atmospheric Releases Associated With Normal Operation in 2030

Alternative/Facility	Dose by Pathway (person-rem)				Committed Effective Dose Equivalent (person-rem)	Percent of Background[a]	Estimated 1-Year Fatal Cancers
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	3.7×10^{-3}	9.4×10^{-6}	3.6×10^{-6}	1.9×10^{-9}	3.7×10^{-3}	4.0×10^{-5}	1.9×10^{-6}
Consolidated Storage Facility (P-Tunnel)	1.7×10^{-6}	1.8×10^{-11}	6.6×10^{-16}	1.4×10^{-12}	1.7×10^{-6}	1.8×10^{-8}	8.5×10^{-10}
Collocated Storage Facility (P-Tunnel)	1.7×10^{-6}	1.9×10^{-11}	7.0×10^{-16}	2.1×10^{-12}	1.7×10^{-6}	1.8×10^{-8}	8.5×10^{-10}
Consolidated Storage Facility	2.6×10^{-6}	5.8×10^{-11}	1.0×10^{-15}	2.1×10^{-12}	2.6×10^{-6}	2.8×10^{-8}	1.3×10^{-9}
Collocated Storage Facilities	2.6×10^{-6}	6.2×10^{-11}	1.1×10^{-15}	3.2×10^{-12}	2.6×10^{-6}	2.8×10^{-8}	1.3×10^{-9}
Pit Disassembly/ Conversion Facility	2.9×10^{-4}	8.4×10^{-8}	1.7×10^{-12}	2.6×10^{-9}	2.9×10^{-4}	3.2×10^{-6}	1.5×10^{-7}
Pu Conversion Facility	1.9×10^{-4}	4.6×10^{-9}	8.0×10^{-14}	1.7×10^{-10}	1.9×10^{-4}	2.1×10^{-6}	9.5×10^{-8}
MOX Fuel Fabrication Facility	1.4×10^{-4}	3.4×10^{-9}	5.4×10^{-14}	2.6×10^{-10}	1.4×10^{-4}	1.5×10^{-6}	7.0×10^{-8}
Ceramic Immobilization Facility (Immobilized Disposition)	3.3×10^{-8}	7.2×10^{-13}	1.3×10^{-17}	2.7×10^{-14}	3.3×10^{-8}	3.6×10^{-10}	1.7×10^{-11}
Deep Borehole Complex (Direct Disposition)	5.3×10^{-9}	1.0×10^{-12}	2.1×10^{-17}	3.2×10^{-14}	5.3×10^{-9}	5.8×10^{-11}	2.7×10^{-12}
Deep Borehole Complex (Immobilized Disposition)	6.6×10^{-9}	1.5×10^{-12}	3.1×10^{-17}	4.8×10^{-14}	6.6×10^{-9}	7.2×10^{-11}	3.3×10^{-12}
Vitrification Facility	1.3×10^{-5}	5.2×10^{-7}	2.6×10^{-10}	1.4×10^{-7}	1.4×10^{-5}	1.5×10^{-7}	7.0×10^{-9}
Ceramic Immobilization Facility (Ceramic Immobilization)	3.7×10^{-8}	1.0×10^{-7}	5.1×10^{-11}	2.9×10^{-8}	1.7×10^{-7}	1.8×10^{-9}	8.5×10^{-11}
Advanced Boiling Water Reactor	7.3×10^{-4}	2.0×10^{-2}	5.8×10^{-3}	8.9×10^{-4}	2.7×10^{-2}	2.9×10^{-4}	1.4×10^{-5}
CE System 80+ Reactor	2.8×10^{-3}	2.0×10^{-2}	8.3×10^{-4}	4.5×10^{-4}	2.4×10^{-2}	2.6×10^{-4}	1.2×10^{-5}
[Text deleted.]							
AP600 Reactor	1.5×10^{-3}	1.7×10^{-2}	2.8×10^{-3}	6.9×10^{-4}	2.2×10^{-2}	2.4×10^{-4}	1.1×10^{-5}
RESAR-90 Reactor	2.4×10^{-3}	2.7×10^{-2}	1.2×10^{-3}	5.8×10^{-4}	3.2×10^{-2}	3.5×10^{-4}	1.6×10^{-5}

[a] Dose to the population within 80 km from natural background radiation in year 2030 is equal to 9,190 person-rem.

Source: HNUS 1996a.

M.2.5.1 No Action

Atmospheric Releases and Resulting Impacts to the Public. For No Action, five of the six areas have radioactive releases to the atmosphere from normal operation. Table M.2.5.1–1 presents the estimated annual atmospheric radioactive releases.

Table M.2.5.1–1. Annual Atmospheric Radioactive Releases From Normal Operation of No Action at Nevada Test Site (curies)

Isotope	Area 3	Area 5	Area 9	Area 12	Area 19
H-3	0	0.29	0	3.7	0
Kr-85	0	0	0	0	160
Pu-239	1.0×10^{-3}	0	7.5×10^{-4}	0	0

Source: NT DOE 1994b.

Tables M.2.5–3 and M.2.5–4, respectively, include the radiological impacts to the maximally exposed member of the public and offsite population within 80 km (50 mi). The MEI would receive an annual dose of 4.2×10^{-3} mrem. An estimated fatal cancer risk of 1.0×10^{-7} would result from 50 years of operation. The population within 80 km (50 mi) would receive a dose of 3.7×10^{-3} person-rem in 2030 (mid-life of operation). An estimated 9.3×10^{-5} fatal cancers could result from 50 years of operation.

Liquid Releases and Resulting Impacts to the Public. There are no radioactive liquid releases to the offsite environment associated with No Action. Therefore, there are no resulting impacts.

Worker Doses and Health Effects. Based on measured values during the time period of 1989 to 1992 (*Twenty-Second Annual Report Radiation Exposures for DOE and DOE Contract Employees–1989* [DOE/EH-0286P]) and subsequent yearly dose reports), the annual average dose to a badged worker at NTS was calculated to be 5 mrem. It is projected that in 2005 and beyond, there would be 619 badged workers involved in No Action activities at NTS. The annual average dose to these workers was assumed to remain at 5 mrem; the annual total dose among all these workers would then equal 3 person-rem. From 50 years of operation, an estimated fatal cancer risk of 1.0×10^{-4} would result to the average worker and 0.060 fatal cancer could result among all workers.

M.2.5.2 Storage and Disposition

Radioactive Releases and Resulting Impacts to the Public. For the storage and disposition alternatives, the impacts from the No Action facilities need to be added to the incremental impacts from the storage or disposition facilities to determine the impacts from total site operation. For example, to determine the radiological impact for the addition of an AP600 reactor at NTS, the doses from No Action facilities have to be summed with the AP600 reactor doses. Estimated annual atmospheric radioactive releases from the facilities associated with the various alternative actions are given in Section M.2.3. Tables M.2.5–3 and M.2.5–4 include the radiological impacts by alternative facility. There are no radioactive liquid releases to the offsite environment associated with any alternative action.

The annual incremental doses associated with the different alternative facilities range from 2.7×10^{-9} to 0.034 mrem to the MEI and from 5.3×10^{-9} to 0.032 person-rem to the 80-km (50-mi) population in the year 2030. The associated health effects from annual operations are included in both tables.

Worker Doses and Health Effects. For the storage and disposition alternatives, the impacts from the No Action facilities need to be added to the incremental impacts from the storage or disposition facilities to determine the impacts from total site operation (refer to the worker discussion under No Action, above, and to Table M.2.3.2–1).

M.2.6 RADIOLOGICAL IMPACTS AT IDAHO NATIONAL ENGINEERING LABORATORY

This section presents the radiological impacts of various storage and disposition alternatives at INEL. Section M.2.6.1 presents the radiological releases and resulting impacts from facilities associated with No Action. Section M.2.6.2 presents the radiological releases and resulting impacts from the various alternatives.

For purposes of radiological impact modelling, INEL was divided into nine separate areas which would release radioactivity in 2005. All release points in each area were aggregated into a single release point. Table M.2.6–1 presents the characteristics of each of the release points including location, release height, and minimum distance to and annual average dispersion to the site boundary in each of the 16 directions. In order to calculate the maximum site boundary dose (that is, the dose ultimately incurred to the site MEI), the dose from each release point to the "maximum receptor" (that is, potential MEI) associated with each of the other release points has been calculated. For further clarification on the definition of the "maximum receptor" refer to Section M.2.2.2. For example, the dose resulting from releases from the Test Reactor Area, Argonne National Laboratory-West (ANL-W), Waste Experimental Reduction Facility/Power Burst Facility Area, and the other storage and disposition alternatives, has been determined for the maximum receptor from the Central Facilities Area. Figure M.2.6–1 illustrates the location of each maximum receptor in relation to each release point. The maximum site boundary dose (that is, the dose ultimately incurred to the site MEI) is then determined by the maximum dose to one of these maximum receptors. Table M.2.6–2 presents the direction, distance, and atmospheric dispersion from each release point to each of the maximum receptors. Annual radiological releases were assumed to remain constant during the full operational period.

The population and food stuffs distributions centered on each release area are provided in a Health Risk Data report, October 1996. The joint frequency distribution used for the dose assessment was based on the meteorological measurements for the year 1986 from the GRID III tower at the 10-m (33-ft) height and is contained in the Health Risk Data report.

Doses given in this section are associated with 1 year of operation because regulatory standards are given as annual limits. The health effects are presented on an annual basis in the tables, and for the projected operational period in the text. Tables M.2.6–3 and M.2.6–4 include the radiological impact to the public from atmospheric releases for No Action and the storage and disposition alternatives.

Table M.2.6–1. Release Point Characteristics, Direction, Distance, and Chi/Q at the Idaho National Engineering Laboratory Boundary

Release Point[a]	SMC		TAN		TRA		ICPP		LWR Site	
Latitude	43°51'27.741"		43°50'56.339"		43°35'8.244"		43°34'16.091"		43°34'42.623"	
Longitude	-112°43'47.366"		-112°42'14.153"		-112°57'46.840"		-112°56'4.083"		-112°52'5.376"	
Release Height	Ground Level		51.4 m		76.2 m		76.2 m		Ground Level	
	Distance and Atmospheric Dispersion at Site Boundary									
Direction	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)
N	18,016	$1.6x10^{-8}$	18,938	$5.2x10^{-9}$	19,099	$3.3x10^{-9}$	20,722	$3.1x10^{-9}$	22,328	$1.2x10^{-8}$
NNE	16,399	$3.7x10^{-8}$	12,650	$1.8x10^{-8}$	21,737	$6.8x10^{-9}$	24,282	$6.0x10^{-9}$	44,886	$9.8x10^{-9}$
NE	13,055	$1.2x10^{-7}$	12,336	$4.4x10^{-8}$	42,901	$7.3x10^{-9}$	42,405	$7.4x10^{-9}$	37,705	$2.9x10^{-8}$
ENE	12,005	$9.9x10^{-8}$	9,884	$3.4x10^{-8}$	41,932	$4.6x10^{-9}$	39,577	$4.9x10^{-9}$	34,098	$2.5x10^{-8}$
E	11,726	$4.0x10^{-8}$	9,685	$1.3x10^{-8}$	26,374	$2.9x10^{-9}$	23,863	$3.2x10^{-9}$	19,377	$2.0x10^{-8}$
ESE	16,180	$1.2x10^{-8}$	15,770	$3.9x10^{-9}$	26,409	$1.4x10^{-9}$	24,074	$1.5x10^{-9}$	18,696	$1.0x10^{-8}$
SE	26,221	$3.3x10^{-9}$	23,757	$1.3x10^{-9}$	19,093	$1.0x10^{-9}$	16,409	$1.2x10^{-9}$	18,261	$5.2x10^{-9}$
SSE	35,151	$3.2x10^{-9}$	33,821	$1.2x10^{-9}$	15,967	$1.6x10^{-9}$	14,337	$1.7x10^{-9}$	14,690	$1.0x10^{-8}$
S	35,319	$9.6x10^{-9}$	33,731	$3.8x10^{-9}$	15,538	$5.2x10^{-9}$	13,952	$5.8x10^{-9}$	14,635	$3.1x10^{-8}$
SSW	46,586	$9.7x10^{-9}$	44,899	$4.5x10^{-9}$	15,753	$1.0x10^{-8}$	14,144	$1.1x10^{-8}$	15,028	$4.3x10^{-8}$
SW	30,060	$1.8x10^{-8}$	34,045	$7.6x10^{-9}$	18,299	$1.2x10^{-8}$	16,442	$1.3x10^{-8}$	17,459	$3.7x10^{-8}$
WSW	12,107	$2.4x10^{-8}$	14,260	$6.8x10^{-9}$	18,988	$3.3x10^{-9}$	21,409	$2.9x10^{-9}$	25,439	$8.9x10^{-9}$
W	11,779	$3.4x10^{-8}$	13,873	$9.9x10^{-9}$	17,014	$5.2x10^{-9}$	20,752	$4.2x10^{-9}$	24,305	$1.3x10^{-8}$
WNW	9,215	$1.4x10^{-8}$	11,510	$3.5x10^{-9}$	12,184	$2.2x10^{-9}$	14,992	$1.8x10^{-9}$	17,919	$5.7x10^{-9}$
NW	10,005	$2.0x10^{-8}$	12,462	$4.4x10^{-9}$	11,503	$2.9x10^{-9}$	14,283	$2.3x10^{-9}$	17,908	$9.2x10^{-9}$
NNW	14,481	$1.3x10^{-8}$	18,035	$3.4x10^{-9}$	12,204	$3.4x10^{-9}$	15,365	$2.7x10^{-9}$	20,732	$8.2x10^{-9}$

Table M.2.6–1. Release Point Characteristics, Direction, Distance, and Chi/Q at the Idaho National Engineering Laboratory Boundary —Continued

Release Point[a]	WERF		CFA		RWMC		ANL-W	
Latitude	43°33'3.443"		43°32'4.386"		43°29'58.551"		43°35'41.733"	
Longitude	-112°51'31.071"		-112°56'10.073"		-113°2'13.843"		-112°39'18.744"	
Release Height	24.4 m		Ground Level		Ground Level		42.7 m	
Distance and Atmospheric Dispersion at Site Boundary								
Direction	**Distance (m)**	**Chi/Q (s/m^3)**	**Distance (m)**	**Chi/Q (s/m^3)**	**Distance (m)**	**Chi/Q (s/m^3)**	**Distance (m)**	**Chi/Q (s/m^3)**
N	25,458	$6.7x10^{-9}$	24,783	$1.1x10^{-8}$	17,201	$1.7x10^{-8}$	32,639	$8.3x10^{-9}$
NNE	41,139	$7.5x10^{-9}$	40,101	$1.1x10^{-8}$	29,087	$1.7x10^{-8}$	24,645	$1.4x10^{-8}$
NE	39,204	$1.9x10^{-8}$	45,052	$2.3x10^{-8}$	53,829	$1.8x10^{-8}$	19,642	$1.6x10^{-8}$
ENE	32,888	$1.6x10^{-8}$	39,302	$2.0x10^{-8}$	47,686	$1.6x10^{-8}$	16,056	$1.5x10^{-8}$
E	17,582	$1.4x10^{-8}$	23,842	$1.5x10^{-8}$	32,039	$1.0x10^{-8}$	14,469	$9.4x10^{-9}$
ESE	17,857	$6.7x10^{-9}$	18,765	$1.0x10^{-8}$	11,265	$2.0x10^{-8}$	9,005	$1.5x10^{-8}$
SE	14,508	$4.5x10^{-9}$	11,856	$9.4x10^{-9}$	7,293	$1.9x10^{-8}$	5,862	$2.6x10^{-8}$
SSE	11,541	$8.4x10^{-9}$	10,161	$1.7x10^{-8}$	6,090	$3.5x10^{-8}$	5,518	$5.5x10^{-8}$
S	11,539	$2.6x10^{-8}$	9,886	$5.3x10^{-8}$	5,924	$1.1x10^{-7}$	5,571	$7.3x10^{-8}$
SSW	11,937	$3.8x10^{-8}$	10,021	$7.5x10^{-8}$	6,003	$1.6x10^{-7}$	17,065	$2.5x10^{-8}$
SW	13,872	$3.4x10^{-8}$	11,653	$6.4x10^{-8}$	6,992	$1.3x10^{-7}$	19,886	$2.1x10^{-8}$
WSW	20,227	$7.9x10^{-9}$	16,966	$1.5x10^{-8}$	10,193	$3.0x10^{-8}$	28,926	$1.1x10^{-8}$
W	26,937	$7.5x10^{-9}$	20,726	$1.6x10^{-8}$	12,661	$3.1x10^{-8}$	35,298	$6.1x10^{-9}$
WNW	21,124	$3.1x10^{-9}$	19,192	$5.2x10^{-9}$	12,803	$8.9x10^{-9}$	32,525	$5.0x10^{-9}$
NW	20,318	$4.9x10^{-9}$	17,203	$9.7x10^{-9}$	14,757	$1.2x10^{-8}$	27,828	$6.4x10^{-9}$
NNW	23,853	$4.4x10^{-9}$	17,397	$1.0x10^{-8}$	16,111	$1.1x10^{-8}$	31,167	$8.5x10^{-9}$

[a] See Figure M.2.6–1 for location of release points.

Note: TAN=Test Area North; TRA=Test Reactor Area; WERF=Waste Experimental Reduction Area.

Source: HNUS 1996a.

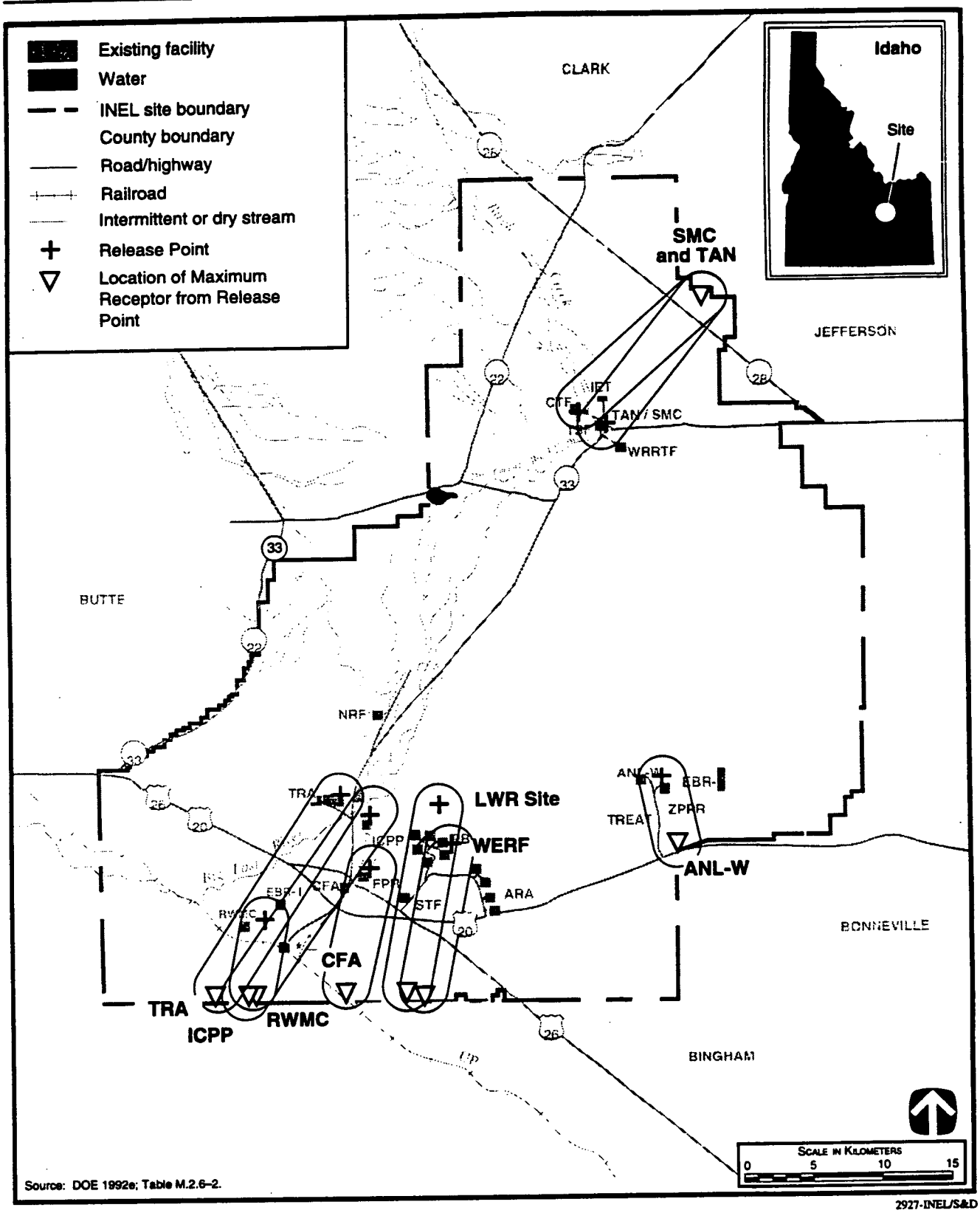

Figure M.2.6–1. Location of Release Points and Maximum Receptors at Idaho National Engineering Laboratory.

Table M.2.6–2. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Idaho National Engineering Laboratory Site Boundary

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: SMC			
SMC and TAN	NE	14,481	1.1×10^{-7}
TRA	SSW	53,888	8.1×10^{-9}
ICPP	SSW	52,249	8.4×10^{-9}
LWR Site	SSW	47,838	9.4×10^{-9}
WERF	SSW	47,497	9.5×10^{-9}
CFA	SSW	49,319	9.0×10^{-9}
RWMC	SSW	52,487	8.3×10^{-9}
ANL-W	S	35,376	9.6×10^{-9}
Release Point: TAN			
SMC and TAN	NE	12,337	4.4×10^{-8}
TRA	SW	54,224	4.4×10^{-9}
ICPP	SSW	52,464	3.8×10^{-9}
LWR Site	SSW	47,566	4.2×10^{-9}
WERF	SSW	47,165	4.3×10^{-9}
CFA	SSW	49,252	4.1×10^{-9}
RWMC	SSW	52,722	3.8×10^{-9}
ANL-W	S	34,503	3.7×10^{-9}
Release Point: TRA			
SMC and TAN	NE	48,269	6.4×10^{-9}
TRA	SW	18,299	1.2×10^{-8}
ICPP	SSW	16,796	9.4×10^{-9}
LWR Site	SSE	16,393	1.5×10^{-9}
WERF	SSE	16,850	1.5×10^{-9}
CFA	S	15,549	5.2×10^{-9}
RWMC	SSW	16,992	9.3×10^{-9}
ANL-W	E	16,415	2.9×10^{-9}
Release Point: ICPP			
SMC and TAN	NE	48,292	6.4×10^{-9}
TRA	SW	18,395	1.2×10^{-8}
ICPP	SW	16,443	1.3×10^{-8}
LWR Site	S	14,251	5.7×10^{-9}
WERF	SSE	14,570	1.7×10^{-9}
CFA	S	14,059	5.8×10^{-9}
RWMC	SW	16,712	1.3×10^{-8}
ANL-W	E	23,906	3.2×10^{-9}
Release Point: LWR Site			
SMC and TAN	NNE	44,887	9.8×10^{-9}
TRA	SW	22,811	2.6×10^{-8}
ICPP	SW	20,426	3.0×10^{-8}
LWR Site	SSW	15,029	4.3×10^{-8}
WERF	S	14,873	3.0×10^{-8}

Table M.2.6–2. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Idaho National Engineering Laboratory Site Boundary—Continued

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
CFA	SSW	16,430	3.8×10^{-8}
RWMC	SW	20,771	2.9×10^{-8}
ANL-W	ESE	18,736	1.0×10^{-8}
Release Point: WERF			
SMC and TAN	NNE	47,288	6.3×10^{-9}
TRA	WSW	21,626	7.3×10^{-9}
ICPP	SW	18,954	2.3×10^{-8}
LWR Site	SSW	12,217	3.6×10^{-8}
WERF	SSW	11,938	3.8×10^{-8}
CFA	SW	14,170	3.3×10^{-8}
RWMC	SW	19,347	2.2×10^{-8}
ANL-W	E	17,626	1.4×10^{-8}
Release Point: CFA			
SMC and TAN	NNE	51,824	8.2×10^{-9}
TRA	SW	15,468	4.3×10^{-8}
ICPP	SW	13,109	5.4×10^{-8}
LWR Site	SSE	10,331	1.6×10^{-8}
WERF	SSE	10,777	1.5×10^{-8}
CFA	SSW	10,021	7.5×10^{-8}
RWMC	SW	13,442	5.2×10^{-8}
ANL-W	E	23,916	1.5×10^{-8}
Release Point: RWMC			
SMC and TAN	NE	59,528	1.6×10^{-8}
TRA	SW	7,019	1.3×10^{-7}
ICPP	S	5,943	1.1×10^{-7}
LWR Site	ESE	12,605	1.7×10^{-8}
WERF	ESE	13,761	1.5×10^{-8}
CFA	SE	8,791	1.4×10^{-8}
RWMC	SSW	6,004	1.6×10^{-7}
ANL-W	E	32,468	1.0×10^{-8}
Release Point: ANL-W			
SMC and TAN	N	38,094	6.8×10^{-9}
TRA	WSW	38,408	7.9×10^{-9}
ICPP	WSW	35,484	8.7×10^{-9}
LWR Site	SW	25,870	1.5×10^{-8}
WERF	SW	24,903	1.5×10^{-8}
CFA	WSW	29,537	1.1×10^{-8}
RWMC	WSW	35,923	8.6×10^{-9}
ANL-W	S	5,572	7.3×10^{-8}

Note: WERF=Waste Experimental Reduction Facility; TAN=Test Area North; TRA=Test Reactor Area.
Source: HNUS 1996a.

Table M.2.6–3. Doses and Resulting Health Effects to the Maximally Exposed Individual at Idaho National Engineering Laboratory From Atmospheric Releases Associated With Annual Normal Operation

Alternative/Facility	Dose by Pathway (mrem)				Committed Effective Dose Equivalent (mrem)	Percent of Background[a]	Estimated 1-Year Fatal Cancer Risk
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	2.8×10^{-4}	1.5×10^{-2}	2.2×10^{-3}	2.9×10^{-5}	1.8×10^{-2}[b]	5.2×10^{-3}	8.9×10^{-9}
Upgrade Storage	5.1×10^{-7}	8.8×10^{-10}	1.9×10^{-16}	4.0×10^{-13}	5.1×10^{-7}	1.5×10^{-7}	2.6×10^{-13}
Consolidated Storage Facility	1.6×10^{-6}	2.8×10^{-9}	6.1×10^{-16}	1.3×10^{-12}	1.6×10^{-6}	4.7×10^{-7}	8.0×10^{-13}
Collocated Storage Facility	1.6×10^{-6}	2.8×10^{-9}	6.5×10^{-16}	1.9×10^{-12}	1.6×10^{-6}	4.7×10^{-7}	8.0×10^{-13}
Pit Disassembly/ Conversion Facility	1.8×10^{-4}	4.0×10^{-6}	1.1×10^{-12}	1.6×10^{-9}	1.8×10^{-4}	5.3×10^{-5}	9.0×10^{-11}
Pu Conversion Facility	1.2×10^{-4}	2.2×10^{-7}	5.0×10^{-14}	1.0×10^{-10}	1.2×10^{-4}	3.6×10^{-5}	6.0×10^{-11}
MOX Fuel Fabrication Facility	8.8×10^{-5}	1.5×10^{-7}	3.3×10^{-14}	1.6×10^{-10}	8.8×10^{-5}	2.6×10^{-5}	4.4×10^{-11}
Ceramic Immobilization Facility (Immobilized Disposition)	2.0×10^{-8}	3.6×10^{-11}	8.1×10^{-18}	1.6×10^{-14}	2.0×10^{-8}	5.9×10^{-9}	1.0×10^{-14}
Deep Borehole Complex (Direct Disposition)	3.3×10^{-9}	4.9×10^{-11}	1.3×10^{-17}	1.9×10^{-14}	3.4×10^{-9}	1.0×10^{-9}	1.7×10^{-15}
Deep Borehole Complex (Immobilized Disposition)	4.1×10^{-9}	7.2×10^{-11}	1.9×10^{-17}	2.9×10^{-14}	4.2×10^{-9}	1.2×10^{-9}	2.1×10^{-15}
Vitrification Facility	8.2×10^{-6}	5.5×10^{-7}	1.6×10^{-10}	9.0×10^{-8}	8.9×10^{-6}	2.6×10^{-6}	4.4×10^{-12}
Ceramic Immobilization Facility (Ceramic Immobilization)	2.3×10^{-8}	1.1×10^{-7}	3.2×10^{-11}	1.7×10^{-8}	1.5×10^{-7}	4.4×10^{-8}	7.5×10^{-14}
Advanced Boiling Water Reactor	1.2×10^{-3}	6.2×10^{-2}	1.3×10^{-2}	1.4×10^{-3}	7.8×10^{-2}	2.3×10^{-2}	3.9×10^{-8}
CE System 80+ Reactor	1.9×10^{-3}	3.6×10^{-2}	7.2×10^{-4}	3.0×10^{-4}	3.8×10^{-2}	1.1×10^{-2}	1.9×10^{-8}
[Text deleted.]							
AP600 Reactor	1.0×10^{-3}	2.9×10^{-2}	2.2×10^{-3}	4.5×10^{-4}	3.3×10^{-2}	9.8×10^{-3}	1.7×10^{-8}
RESAR-90 Reactor	1.6×10^{-3}	4.3×10^{-2}	9.0×10^{-4}	3.8×10^{-4}	4.6×10^{-2}	1.4×10^{-2}	2.3×10^{-8}

[a] Average individual annual natural background radiation is equal to 338 mrem.

[b] The storage facility contributes 1.4×10^{-5} mrem/year.

[Text deleted.]

Source: HNUS 1996a.

Table M.2.6–4. Doses and Resulting Health Effects to the Population Within 80 Kilometers of Idaho National Engineering Laboratory From Atmospheric Releases Associated With Normal Operation in 2030

Alternative/Facility	Dose by Pathway (person-rem)				Committed Effective Dose Equivalent (person-rem)	Percent of Background[a]	Estimated 1-Year Fatal Cancers
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	2.9×10^{-3}	2.4	2.1×10^{-2}	3.0×10^{-4}	2.4[b]	2.7×10^{-3}	1.2×10^{-3}
Upgrade Storage	3.1×10^{-6}	1.5×10^{-7}	1.2×10^{-15}	2.5×10^{-12}	3.2×10^{-6}	3.5×10^{-9}	1.6×10^{-9}
Consolidated Storage Facility	1.7×10^{-5}	9.1×10^{-7}	6.5×10^{-15}	1.4×10^{-11}	1.8×10^{-5}	2.0×10^{-8}	9.0×10^{-9}
Collocated Storage Facilities	1.7×10^{-5}	9.2×10^{-7}	6.9×10^{-15}	2.1×10^{-11}	1.8×10^{-5}	2.0×10^{-8}	9.0×10^{-9}
Pit Disassembly/ Conversion Facility	1.9×10^{-3}	1.3×10^{-3}	1.1×10^{-11}	1.6×10^{-8}	3.2×10^{-3}	3.5×10^{-6}	1.6×10^{-6}
Pu Conversion Facility	8.6×10^{-4}	3.1×10^{-4}	1.9×10^{-12}	3.1×10^{-9}	1.2×10^{-3}	1.3×10^{-6}	6.0×10^{-7}
MOX Fuel Fabrication Facility	9.2×10^{-4}	4.9×10^{-5}	3.5×10^{-13}	1.7×10^{-9}	9.7×10^{-4}	1.1×10^{-6}	4.9×10^{-7}
Ceramic Immobilization Facility (Immobilized Disposition)	2.2×10^{-7}	1.2×10^{-8}	8.4×10^{-17}	1.7×10^{-13}	2.3×10^{-7}	2.5×10^{-10}	1.2×10^{-10}
Deep Borehole Complex (Direct Disposition)	3.5×10^{-8}	1.6×10^{-8}	1.3×10^{-16}	2.0×10^{-13}	5.1×10^{-8}	5.6×10^{-11}	2.6×10^{-11}
Deep Borehole Complex (Immobilized Disposition)	4.4×10^{-8}	2.3×10^{-8}	2.0×10^{-16}	3.0×10^{-13}	6.7×10^{-8}	7.4×10^{-11}	3.4×10^{-11}
Vitrification Facility	8.6×10^{-5}	7.1×10^{-5}	1.7×10^{-9}	9.0×10^{-7}	1.6×10^{-4}	1.8×10^{-7}	8.0×10^{-8}
Ceramic Immobilization Facility (Ceramic Immobilization)	2.4×10^{-7}	1.3×10^{-5}	3.3×10^{-10}	1.9×10^{-7}	1.4×10^{-5}	1.5×10^{-8}	7.0×10^{-9}
Advanced Boiling Water Reactor	1.0×10^{-2}	13	7.6×10^{-2}	1.2×10^{-2}	14	1.5×10^{-2}	6.8×10^{-3}
CE System 80+ Reactor	2.1×10^{-2}	8.6	5.4×10^{-3}	3.4×10^{-3}	8.6	9.5×10^{-3}	4.3×10^{-3}
[Text deleted.]							
AP600 Reactor	1.1×10^{-2}	6.9	1.9×10^{-2}	5.1×10^{-3}	6.9	7.6×10^{-3}	3.5×10^{-3}
RESAR-90 Reactor	1.8×10^{-2}	9.6	8.2×10^{-3}	4.3×10^{-3}	9.6	1.1×10^{-2}	4.8×10^{-3}

[a] Total dose to the population within 80 km from natural background radiation in the year 2030 is equal to 90,800 person-rem.

[b] The storage facility contributes 7.6x10-5 person-rem/year.

[Text deleted.]

Source: HNUS 1996a.

M.2.6.1 No Action

Atmospheric Releases and Resulting Impacts to the Public. For No Action, eight of the nine areas have radioactive releases to the atmosphere from normal operation. Table M.2.6.1–1 presents the estimated annual atmospheric radioactive releases.

Tables M.2.6–3 and M.2.6–4 include the radiological impacts to the MEI and to the offsite population within 80 km (50 mi), respectively. The maximally exposed individual would receive an annual dose of 0.018 mrem. An estimated fatal cancer risk of 4.4×10^{-7} would result from 50 years of operation. The population within 80 km (50 mi) would receive a dose of 2.4 person-rem in 2030 (mid-life of operation). An estimated 0.061 fatal cancers could result from 50 years of operation.

Liquid Releases and Resulting Impacts to the Public. There are no radioactive liquid releases to the offsite environment associated with No Action. Therefore, there are no resulting impacts.

Worker Doses and Health Effects. Based on measured values during the time period of 1989 to 1992 (*Twenty-Second Annual Report Radiation Exposures for DOE and DOE Contractor Employees–1989* [DOE/EH-0286P] and subsequent yearly data reports), the annual average radiation dose to a badged worker at INEL was calculated to be 30 mrem. It is projected that in 2005 and beyond, there would be 7,337 badged workers involved in No Action activities at INEL. The annual average radiation dose to these workers is assumed to remain at 30 mrem; the annual total radiation dose among all these workers would then equal 220 person-rem. From 50 years of operation, an estimated fatal cancer risk of 6.0×10^{-4} would result to the average worker and 4.4 fatal cancers could result among all workers.

Table M.2.6.1–1. Annual Atmospheric Radioactive Releases From Normal Operation of No Action at Idaho National Engineering Laboratory (curies)

	SMC	TAN		TRA		ICPP		WERF		CFA	RWMC	ANL-W[a]	
Isotope	All Releases	Monitored/ Non-monitored	Diffuse Area	Monitored/ Non-monitored	Diffuse Area	Monitored/ Non-monitored	Diffuse Area	Monitored/ Non-monitored	Diffuse Area	All Releases	All Releases	Monitored/ Non-monitored	Diffuse Area
Ag-110m	0	0	0	0	0	5.1×10^{-12}	0	0	0	0	0	0	0
Am-241	0	0	0	0	5.8×10^{-7}	2.4×10^{-11}	2.2×10^{-9}	0	0	0	2.0×10^{-6}	0	0
Am-243	0	0	0	0	0	2.4×10^{-13}	0	0	0	0	0	0	0
Ar-41	0	0	0	1.3×10^{3}	0	0	0	0	0	0	0	17	0
Ba-139	0	0	0	5.4×10^{-2}	0	0	0	0	0	0	0	0	0
Ba-140	0	0	0	6.2×10^{-6}	0	0	0	0	0	0	0	2.7×10^{-3}	0
C-14	0	0	0	0	0	9.6×10^{-3}	0	0	0	0	0	0	0
Cd-113m	0	0	0	0	0	8.6×10^{-14}	0	0	0	0	0	0	0
Ce-141	0	0	0	0	0	2.5×10^{-12}	0	0	0	0	0	0	0
Ce-144	0	0	0	0	0	3.8×10^{-6}	9.2×10^{-9}	0	0	0	0	0	0
Cm-244	0	0	0	0	3.0×10^{-5}	0	0	0	0	0	0	0	0
Co-57	0	0	0	0	0	7.8×10^{-8}	0	0	0	0	0	0	0
Co-58	0	0	0	8.0×10^{-7}	0	2.4×10^{-7}	0	0	0	0	0	8.8×10^{-6}	0
Co-60	0	3.5×10^{-7}	5.7×10^{-7}	2.4×10^{-4}	3.8×10^{-4}	9.6×10^{-6}	4.5×10^{-9}	0	2.3×10^{-6}	2.0×10^{-6}	7.8×10^{-10}	1.6×10^{-5}	0
Cr-51	0	0	0	3.8×10^{-3}	7.1×10^{-7}	5.6×10^{-15}	0	0	0	0	0	0	0
Cs-134	0	0	2.9×10^{-10}	0	5.0×10^{-7}	8.8×10^{-5}	2.6×10^{-8}	0	5.6×10^{-7}	5.6×10^{-8}	0	1.5×10^{-4}	0
Cs-137	0	1.3×10^{-6}	2.7×10^{-6}	6.1×10^{-6}	8.7×10^{-4}	8.1×10^{-3}	7.6×10^{-6}	0	4.7×10^{-5}	9.0×10^{-5}	1.4×10^{-5}	8.2×10^{-4}	0
Cs-138	0	0	0	0.69	0	0	0	0	0	0	0	0	0
Eu-152	0	0	0	0	7.9×10^{-7}	8.7×10^{-5}	1.1×10^{-6}	0	0	4.7×10^{-8}	0	0	0
Eu-154	0	0	4.1×10^{-10}	0	3.7×10^{-7}	6.0×10^{-5}	0	0	0	9.1×10^{-8}	0	1.6×10^{-5}	0
Eu-155	0	0	0	0	7.1×10^{-8}	8.7×10^{-6}	0	0	0	2.2×10^{-8}	0	9.3×10^{-4}	0
Fe-55	0	0	0	0	0	4.5×10^{-9}	0	0	0	0	0	0	0
Hg-203	0	0	0	8.8×10^{-5}	0	0	0	0	0	4.7×10^{-9}	0	0	0
H-3	0	0	0	11	120	67	8.9×10^{-9}	0	0	4.4	0	34	7.9×10^{-2}
I-129	0	0	0	0	0	9.8×10^{-2}	3.8×10^{-8}	0	0	0	0	0	0
I-131	0	0	0	1.1×10^{-4}	0	0	0	0	0	0	0	0	0
I-132	0	0	0	1.1×10^{-3}	0	0	0	0	0	0	0	0	0
I-133	0	0	0	4.3×10^{-4}	0	0	0	0	0	0	0	0	0

Table M.2.6.1–1. Annual Atmospheric Radioactive Releases From Normal Operation of No Action at Idaho National Engineering Laboratory (curies)—Continued

	SMC	TAN		TRA		ICPP		WERF		CFA	RWMC	ANL-W[a]	
Isotope	All Releases	Monitored/ Non-monitored	Diffuse Area	Monitored/ Non-monitored	Diffuse Area	Monitored/ Non-monitored	Diffuse Area	Monitored/ Non-monitored	Diffuse Area	All Releases	All Releases	Monitored/ Non-monitored	Diffuse Area
Kr-85	0	0	0	0	0	0	0	0	0	0	0	70	0
Kr-85m	0	0	0	8.0	0	0	0	0	0	0	0	44	0
Kr-87	0	0	0	25	0	0	0	0	0	0	0	38	0
Kr-88	0	0	0	24	0	0	0	0	0	0	0	55	0
La-140	0	0	0	1.2×10^{-4}	0	0	0	0	0	0	0	1.5×10^{-5}	0
Mn-54	0	0	0	0	0	5.2×10^{-11}	0	0	0	0	0	5.0×10^{-5}	0
Na-22	0	0	0	0	0	0	0	0	0	0	0	3.8×10^{-5}	0
Na-24	0	0	0	5.2×10^{-3}	0	0	0	0	0	0	0	1.0×10^{-7}	0
Nb-94	0	0	0	0	0	1.1×10^{-15}	0	0	0	0	0	0	0
Nb-95	0	0	0	0	0	4.8×10^{-7}	3.1×10^{-8}	0	0	0	0	0	0
Nb-95m	0	0	0	0	0	3.4×10^{-15}	0	0	0	0	0	0	0
Ni-63	0	0	0	0	0	4.3×10^{-15}	0	0	0	0	0	0	0
Np-239	0	0	0	0	0	3.8×10^{-16}	1.6×10^{-8}	0	0	0	0	0	0
Pa-234	2.2×10^{-8}	0	0	0	0	2.3×10^{-15}	0	0	0	0	0	0	0
Pm-147	0	0	0	0	0	2.5×10^{-6}	0	0	0	0	0	0	0
Pr-144	0	0	0	0	0	4.5×10^{-6}	0	0	0	0	0	0	0
Pr-144m	0	0	0	0	0	2.6×10^{-9}	0	0	0	0	0	0	0
Pu-238	0	0	2.1×10^{-9}	0	8.2×10^{-7}	8.5×10^{-8}	1.7×10^{-8}	0	1.4×10^{-10}	0	0	0	0
Pu-239	0	6.2×10^{-8}	0	8.1×10^{-7}	3.1×10^{-6}	1.4×10^{-6}	0	8.5×10^{-8}	1.9×10^{-10}	1.8×10^{-7}	1.2×10^{-6}	1.6×10^{-6}	0
Pu-240	0	0	1.9×10^{-9}	0	0	2.3×10^{-7}	0	0	0	0	0	0	0
Pu-241	0	0	0	0	0	5.1×10^{-6}	0	0	0	0	0	0	0
Rb-88	0	0	0	0.52	0	0	0	0	0	0	0	1.3×10^{-3}	0
Rb-89	0	0	0	0.73	0	0	0	0	0	0	0	0	0
Ru-106	0	0	0	0	0	1.0×10^{-3}	7.2×10^{-8}	0	0	0	0	0	0
Sb-125	0	0	0	0	0	9.8×10^{-5}	2.4×10^{-7}	0	0	2.8×10^{-8}	0	0	0
Sn-199m	0	0	0	0	0	2.4×10^{-8}	0.0	0	0	0	0	0	0
Sr-90	0	2.9×10^{-7}	1.9×10^{-7}	3.6×10^{-4}	8.6×10^{-5}	1.4×10^{-3}	9.5×10^{-9}	4.1×10^{-8}	6.8×10^{-6}	7.8×10^{-7}	3.0×10^{-8}	2.6×10^{-3}	0
Tc-99m	0	0	0	2.2×10^{-3}	0	2.2×10^{-13}	0	0	0	0	0	0	0

Table M.2.6.1–1. Annual Atmospheric Radioactive Releases From Normal Operation of No Action at Idaho National Engineering Laboratory (curies)—Continued

	SMC	TAN		TRA		ICPP		WERF		CFA	RWMC	ANL-W[a]	
Isotope	All Releases	Monitored/ Non-monitored	Diffuse Area	Monitored/ Non-monitored	Diffuse Area	Monitored/ Non-monitored	Diffuse Area	Monitored/ Non-monitored	Diffuse Area	All Releases	All Releases	Monitored/ Non-monitored	Diffuse Area
Th-228	0	0	0	0	2.0×10^{-7}	0	0	0	0	0	0	0	0
Th-230	0	0	0	0	1.0×10^{-7}	0	0	0	0	0	0	0	0
Th-231	0	0	0	0	0	5.6×10^{-12}	0	0	0	0	0	0	0
Th-232	0	0	0	0	9.5×10^{-9}	0.0	0	0	0	0	0	0	0
Th-234	7.7×10^{-6}	0	0	0	0	7.8×10^{-13}	0	0	0	0	0	0	0
U-232	0	0	0	0	1.7×10^{-7}	0.0	0	0	0	0	0	0	0
U-233	0	0	0	0	0	1.2×10^{-14}	0	0	0	0	0	0	0
U-234	1.0×10^{-6}	0	5.0×10^{-8}	0	1.9×10^{-5}	1.4×10^{-6}	2.4×10^{-8}	0	2.4×10^{-8}	0	0	0	0
U-235	0	0	1.8×10^{-9}	0	0	5.8×10^{-8}	0	0	1.2×10^{-7}	1.4×10^{-10}	9.5×10^{-9}	3.7×10^{-9}	0
U-238	7.7×10^{-6}	0	3.8×10^{-8}	0	1.2×10^{-5}	4.8×10^{-9}	0	0	6.1×10^{-9}	0	0	5.3×10^{-10}	0
Xe-133	0	0	0	4.2	0	2.7×10^{-9}	0	0	0	0	0	490	0
Xe-135	0	0	0	28	0	0	0	0	0	0	0	310	0
Xe-135m	0	0	0	14	0	0	0	0	0	0	0	11	0
Xe-138	0	0	0	71	0	0	0	0	0	0	0	22	0
Y-90	0	0	0	0.0	0	2.9×10^{-4}	9.5×10^{-9}	0	0	0	0	0	0
Y-91m	0	0	0	1.6×10^{-3}	0	1.7×10^{-10}	0	0	0	0	0	0	0
Zn-65	0	0	0	5.7×10^{-8}	5.7×10^{-8}	0	0	4.8×10^{-7}	0	0	0	0	0
Zr-93	0	0	0	0.0	0.0	2.2×10^{-15}	0	0	0	0	0	0	0
Zr-95	0	0	0	0.0	0.0	4.1×10^{-6}	0	0	0	0	0	0	0

[a] ANL-W reported that releases from the no action storage are not measurable. For calculation purposes, it was assumed that all the Pu released from ANL-W in 1993 was released from Pu storage. This is very conservative since EBR-II, a Pu-fueled reactor, was in operation in 1993. In October 1995, the EBR-II was defueled and is no longer in operation.

Note: TAN=Test Area North; TRA=Test Reactor Area; WERF=Waste Experimental Reduction Facility.

Source: IN DOE 1994c.

M.2.6.2 Storage and Disposition

Radioactive Releases and Resulting Impacts to the Public. For the storage and disposition alternatives, the impacts from the No Action facilities need to be added to the changes in impacts from the storage or disposition facilities to determine the impacts from total site operation. For example, to determine the radiological impact for the addition of an AP600 reactor at INEL, the doses from No Action facilities have to be summed with the AP600 reactor doses. Estimated annual atmospheric radioactive releases from the facilities associated with the various alternative actions are given in Section M.2.3. Tables M.2.6–3 and M.2.6–4 include the radiological impacts by alternative facility. There are no radioactive liquid releases to the offsite environment associated with any alternative action.

The annual incremental doses associated with the different alternative facilities range from 3.4×10^{-9} to 0.078 mrem to the MEI and from 5.1×10^{-8} to 9.6 person-rem to the 80-km (50-mi) population in 2030. The associated health effects from annual operations are included in both tables.

Worker Doses and Health Effects. For the storage and disposition alternatives, the impacts from the No Action facilities need to be added to the incremental impacts from the storage or disposition facilities to determine the impacts from total site operations (refer to the worker discussion under No Action, above, and to Table M.2.3.2–1).

M.2.7 RADIOLOGICAL IMPACTS AT PANTEX PLANT

This section presents the radiological impacts of the various storage and disposition alternatives at Pantex. Section M.2.7.1 presents the radiological releases and resulting impacts from facilities associated with No Action. Section M.2.7.2 presents the radiological releases and resulting impacts from the various alternatives.

For purposes of radiological impact modeling, Pantex was divided into six areas which would release radioactivity in 2005. All release points in each area were aggregated into a single release point. Table M.2.7–1 presents the characteristics of each of the release points including location, release height, and minimum distance and annual average dispersion to the site boundary in each of 16 directions. In order to calculate the maximum site boundary dose (that is, the dose ultimately incurred to the site MEI), the dose from each release point to the "maximum receptor" (that is, potential MEI) associated with each of the other release points has been calculated. For further clarification on the definition of "maximum receptor," refer to Section M.2.2.2. For example, the dose resulting from releases from Building 12-44 Cell 1 and the other storage and disposition alternatives, has been determined from the maximum receptor from the Burning Ground. Figure M.2.7–1 illustrates the location of each maximum receptor in relation to each release point. The maximum site boundary dose (that is, the dose ultimately incurred to the site MEI) is then determined by the maximum dose to one of these maximum receptors. Table M.2.7–2 presents the distance, direction, and atmospheric dispersion from each release point to each of the maximum receptors. Annual radiological releases were assumed to remain constant during the full operational period.

Descriptions of population and food stuff distributions centered on each release area are provided in a Health Risk Data report, October 1996. The joint frequency distribution used for the dose assessment was based on the meteorological measurements for 1989 from the National Weather Service at the 10-m (33-ft) height and is contained in the Health Risk Data report.

Doses given in this section are associated with 1 year of operation because regulatory standards are given as annual limits. The health effects are presented on an annual basis in the tables and for the projected operational period in the text. Tables M.2.7–3 and M.2.7–4 include the radiological impacts to the public from atmospheric releases for the No Action and the storage and disposition alternatives.

Table M.2.7–1. Release Point Characteristics, Direction, Distance, and Chi/Q at the Pantex Plant Boundary

Release Point[a]	Bldg. 12-44 Cell 1	HE Burning Ground	Between Zones 11 and 12	Strategic Reserve	Immobilization Facility	LWR Site
Latitude	35° 18' 24.087"	35° 20' 40.781"	35° 18' 46.315"	35° 18' 22.415"	35° 19' 46.714"	35° 20' 25.520"
Longitude	-101° 33' 25.592"	-101° 35' 4.249"	-101° 33' 53.239"	-101° 33' 36.363"	-101° 34' 14.606"	-101° 36' 14.568"
Release Height	10.0 m	10.0 m	Ground Level	Ground Level	Ground Level	Ground Level

	Distance and Atmospheric Dispersion at Site Boundary											
Direction	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)
N	5,176	$1.6x10^{-7}$	931	$1.7x10^{-6}$	4,482	$2.1x10^{-7}$	5,224	$1.7x10^{-7}$	2,614	$4.8x10^{-7}$	1,380	$1.4x10^{-6}$
NNE	2,790	$2.4x10^{-7}$	950	$1.0x10^{-6}$	4,095	$1.5x10^{-7}$	3,315	$2.1x10^{-7}$	2,660	$2.9x10^{-7}$	1,406	$8.1x10^{-7}$
NE	1,831	$3.6x10^{-7}$	1,127	$7.0x10^{-7}$	2,691	$2.3x10^{-7}$	2,168	$3.3x10^{-7}$	3,141	$1.8x10^{-7}$	1,659	$5.0x10^{-7}$
ENE	1,534	$2.8x10^{-7}$	1,665	$2.5x10^{-7}$	2,247	$1.9x10^{-7}$	1,811	$2.7x10^{-7}$	2,783	$1.3x10^{-7}$	2,444	$1.6x10^{-7}$
E	1,490	$3.2x10^{-7}$	3,963	$8.1x10^{-8}$	2,185	$2.2x10^{-7}$	1,762	$3.1x10^{-7}$	2,716	$1.6x10^{-7}$	5,741	$5.2x10^{-8}$
ESE	1,516	$2.1x10^{-7}$	4,028	$5.4x10^{-8}$	2,225	$1.5x10^{-7}$	1,792	$2.1x10^{-7}$	2,761	$1.0x10^{-7}$	5,837	$3.5x10^{-8}$
SE	1,781	$2.1x10^{-7}$	4,719	$5.6x10^{-8}$	2,604	$1.5x10^{-7}$	2,091	$2.1x10^{-7}$	3,224	$1.1x10^{-7}$	6,827	$3.6x10^{-8}$
SSE	2,577	$9.5x10^{-8}$	6,942	$2.4x10^{-8}$	3,465	$7.1x10^{-8}$	2,625	$1.1x10^{-7}$	4,776	$4.4x10^{-8}$	7,587	$2.3x10^{-8}$
S	2,607	$1.8x10^{-7}$	7,473	$4.2x10^{-8}$	3,505	$1.3x10^{-7}$	2,651	$2.1x10^{-7}$	5,454	$6.9x10^{-8}$	7,270	$4.6x10^{-8}$
SSW	3,001	$9.1x10^{-8}$	5,659	$3.7x10^{-8}$	4,037	$6.6x10^{-8}$	3,055	$1.0x10^{-7}$	6,285	$3.4x10^{-8}$	2,333	$1.5x10^{-7}$
SW	4,290	$4.8x10^{-8}$	3,696	$5.9x10^{-8}$	5,768	$3.5x10^{-8}$	4,379	$5.1x10^{-8}$	5,225	$4.0x10^{-8}$	1,513	$2.7x10^{-7}$
WSW	5,643	$4.8x10^{-8}$	3,083	$1.1x10^{-7}$	4,925	$6.4x10^{-8}$	5,366	$5.6x10^{-8}$	4,368	$7.6x10^{-8}$	1,257	$5.3x10^{-7}$
W	5,495	$5.0x10^{-8}$	2,999	$1.1x10^{-7}$	4,795	$6.5x10^{-8}$	5,223	$5.8x10^{-8}$	4,254	$7.8x10^{-8}$	1,223	$5.5x10^{-7}$
WNW	5,577	$3.8x10^{-8}$	1,730	$1.9x10^{-7}$	4,873	$5.0x10^{-8}$	5,301	$4.4x10^{-8}$	4,320	$6.0x10^{-8}$	1,249	$4.2x10^{-7}$
NW	6,304	$5.1x10^{-8}$	1,142	$5.3x10^{-7}$	5,454	$6.7x10^{-8}$	6,177	$5.6x10^{-8}$	3,199	$1.5x10^{-7}$	1,462	$5.1x10^{-7}$
NNW	5,293	$6.6x10^{-8}$	955	$6.9x10^{-7}$	4,585	$8.7x10^{-8}$	5,346	$7.0x10^{-8}$	2,681	$1.9x10^{-7}$	1,417	$5.4x10^{-7}$

[a] See Figure M.2.7–1 for location of release points.

Source: HNUS 1996a.

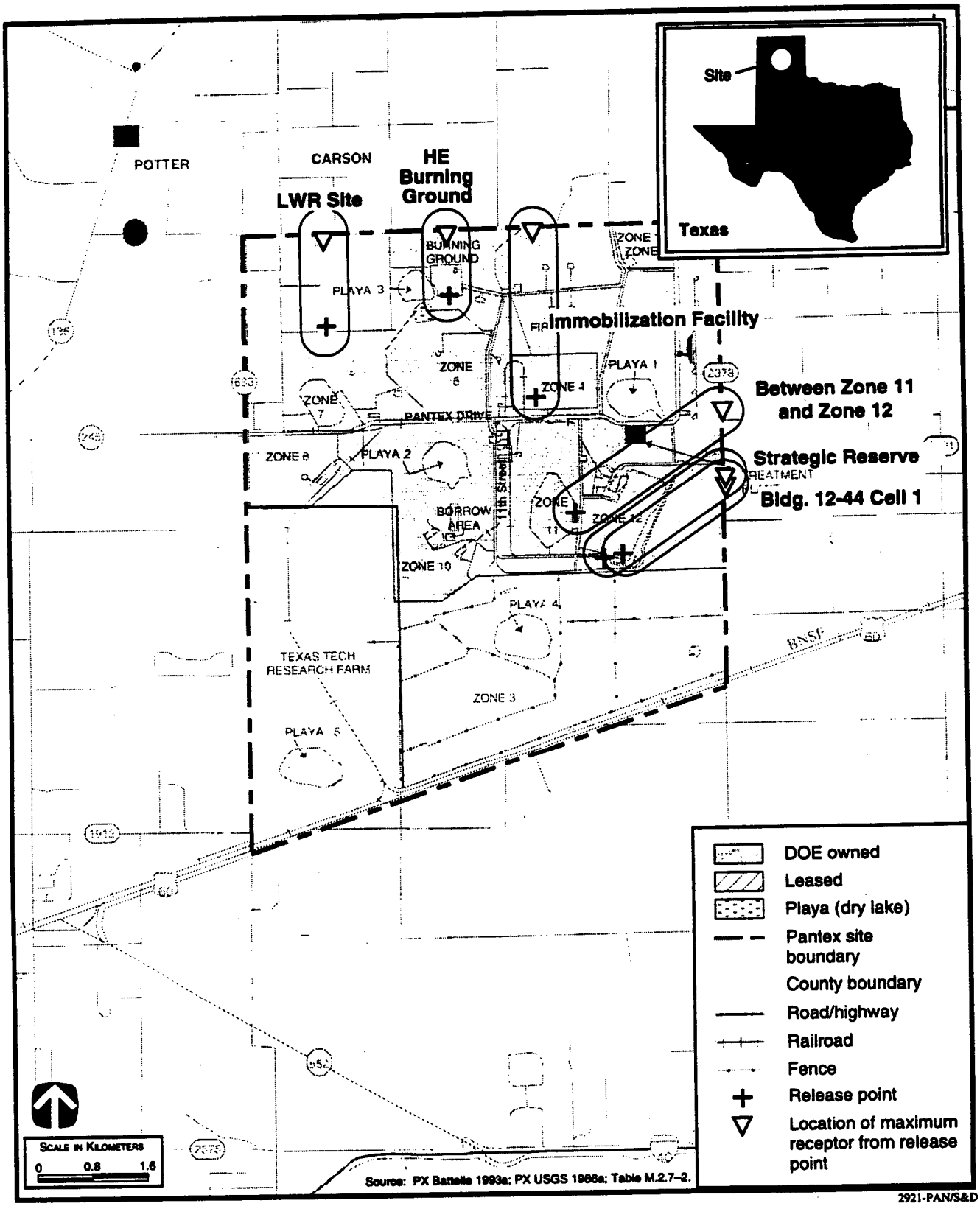

Figure M.2.7–1. Location of Release Points and Maximum Receptors at Pantex Plant.

Table M.2.7–2. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Pantex Plant Boundary

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: Bldg. 12-44 Cell 1			
Bldg. 12-44 Cell 1	NE	1,831	$3.6x10^{-7}$
HE Burning Ground	NNW	5,728	$5.9x10^{-8}$
Between Zone 11 and 12	NE	2,707	$2.0x10^{-7}$
Strategic Reserve	NE	1,922	$3.3x10^{-7}$
Immobilization Facility	NNW	5,315	$6.5x10^{-8}$
LWR Site	NW	6,695	$4.7x10^{-8}$
Release Point: HE Burning Ground			
Bldg. 12-44 Cell 1	SE	5,069	$5.0x10^{-8}$
HE Burning Ground	N	932	$1.7x10^{-6}$
Between Zone 11 and 12	ESE	4,424	4.7x10-8
Strategic Reserve	SE	4,977	$5.2x10^{-8}$
Immobilization Facility	NE	1,544	$4.5x10^{-7}$
LWR Site	WNW	2,032	$1.5x10^{-7}$
Release Point: Between Zone 11 and 12			
Bldg. 12-44 Cell 1	E	2,218	$2.2x10^{-7}$
HE Burning Ground	NNW	4,817	$8.1x10^{-8}$
Between Zone 11 and 12	NE	2,692	2.3x10-7
Strategic Reserve	ENE	2,248	$1.9x10^{-7}$
Immobilization Facility	N	4,512	$2.1x10^{-7}$
LWR Site	NW	5,722	$6.3x10^{-8}$
Release Point: Strategic Reserve			
Bldg. 12-44 Cell 1	ENE	2,085	$2.1x10^{-7}$
HE Burning Ground	NNW	5,661	$6.4x10^{-8}$
Between Zone 11 and 12	NE	2,905	2.1x10-7
Strategic Reserve	NE	2,169	$3.3x10^{-7}$
Immobilization Facility	N	5,307	$1.7x10^{-7}$
LWR Site	NW	6,564	$5.2x10^{-8}$
Release Point: Immobilization Facility			
Bldg. 12-44 Cell 1	ESE	3,098	$8.7x10^{-8}$
HE Burning Ground	NNW	2,896	$1.7x10^{-7}$
Between Zone 11 and 12	E	2,733	1.6x10-7
Strategic Reserve	ESE	3,029	$9.0x10^{-8}$
Immobilization Facility	N	2,614	$4.8x10^{-7}$
LWR Site	NW	4,009	$1.0x10^{-7}$
Release Point: LWR Site			
Bldg. 12-44 Cell 1	ESE	6,344	$3.1x10^{-8}$
HE Burning Ground	NE	2,243	$3.1x10^{-7}$
Between Zone 11 and 12	ESE	5,935	3.4x10-8
Strategic Reserve	ESE	6,282	$3.1x10^{-8}$
Immobilization Facility	ENE	3,314	$1.0x10^{-7}$
LWR Site	N	1,380	$1.4x10^{-6}$

Source: HNUS 1996a.

Table M.2.7–3. Doses and Resulting Health Effects to the Maximally Exposed Individual at Pantex Plant From Atmospheric Releases Associated With Annual Normal Operation

Alternative/Facility	Dose by Pathway (mrem)				Committed Effective Dose Equivalent (mrem)	Percent of Background[a]	Estimated 1-Year Fatal Cancer Risk
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	4.3×10^{-6}	5.7×10^{-5}	4.0×10^{-15}	0.0	6.1×10^{-5}	1.8×10^{-5}	3.1×10^{-11}
Upgraded Storage Facility[b]	[c]	[c]	[c]	[c]	1.8×10^{-8}	5.4×10^{-9}	9.0×10^{-15}
Upgraded Consolidated Storage Facility	9.5×10^{-6}	1.7×10^{-8}	3.6×10^{-15}	7.6×10^{-12}	9.5×10^{-6}	2.8×10^{-6}	4.7×10^{-12}
Consolidated Storage Facility	9.5×10^{-6}	1.6×10^{-8}	3.6×10^{-15}	7.6×10^{-12}	9.5×10^{-6}	2.8×10^{-6}	4.7×10^{-12}
Collocated Storage Facility	9.6×10^{-6}	1.7×10^{-8}	3.8×10^{-15}	1.2×10^{-11}	9.6×10^{-6}	2.9×10^{-6}	4.8×10^{-12}
Pit Disassembly/Conversion Facility	1.1×10^{-3}	2.3×10^{-5}	6.3×10^{-12}	9.4×10^{-9}	1.1×10^{-3}	3.3×10^{-4}	5.5×10^{-10}
Pu Conversion Facility	6.9×10^{-4}	1.3×10^{-6}	2.9×10^{-13}	6.1×10^{-10}	6.9×10^{-4}	2.1×10^{-4}	3.5×10^{-10}
MOX Fuel Fabrication Facility	5.2×10^{-4}	8.9×10^{-7}	2.0×10^{-13}	9.4×10^{-10}	5.2×10^{-4}	1.6×10^{-4}	2.6×10^{-10}
Ceramic Immobilization Facility (Immobilization Disposition)	2.5×10^{-7}	4.3×10^{-10}	9.6×10^{-17}	2.0×10^{-13}	2.5×10^{-7}	7.5×10^{-8}	1.2×10^{-13}
Deep Borehole Complex (Direct Disposition)	4.1×10^{-8}	5.9×10^{-10}	1.5×10^{-16}	2.4×10^{-13}	4.1×10^{-8}	1.2×10^{-8}	2.1×10^{-14}
Deep Borehole Complex (Immobilized Disposition)	5.0×10^{-8}	8.8×10^{-10}	2.3×10^{-16}	3.4×10^{-13}	5.1×10^{-8}	1.5×10^{-8}	2.6×10^{-14}
Vitrification Facility	9.8×10^{-5}	6.7×10^{-6}	1.9×10^{-9}	1.1×10^{-6}	1.1×10^{-4}	3.3×10^{-5}	5.5×10^{-11}
Ceramic Immobilization Facility (Ceramic Immobilization)	2.8×10^{-7}	1.3×10^{-6}	4.0×10^{-10}	2.1×10^{-7}	1.8×10^{-6}	5.4×10^{-7}	9.0×10^{-13}
Advanced Boiling Water Reactor	1.7×10^{-2}	0.99	0.47	2.4×10^{-2}	1.5	0.45	7.5×10^{-7}
CE System 80+ Reactor	5.9×10^{-2}	1.1	2.7×10^{-2}	9.5×10^{-3}	1.2	0.36	6.0×10^{-7}
[Text deleted.]							
AP600 Reactor	3.2×10^{-2}	0.93	7.6×10^{-2}	1.4×10^{-2}	1.0	0.30	5.0×10^{-7}
RESAR-90 Reactor	5.0×10^{-2}	1.4	3.0×10^{-2}	1.2×10^{-2}	1.5	0.45	7.5×10^{-7}

[a] Individual annual natural background radiation dose is equal to 334 mrem.

[b] For the three upgrade subalternatives including the Preferred Alternative, the dose to the MEI and the population within 80 km would decrease slightly from the No Action Alternative, although the differences are expected to be below detection limits. Therefore, the total site dose would decrease slightly but the change would be undetectable. The quantity of Pu pits at Pantex to be stored in upgraded facilities in Zone 12 would be slightly increased by the addition of RFETS pits (the Preferred Alternative) or by the addition of RFETS Pu and LANL Pu. The difference between these three subalternatives would be below detection limits. The AT-400A has both an inner container and an outer container that provides additional shielding material. The overall effect of moving Pantex and RFETS pits from Zone 4 to upgraded Zone 12 storage facilities would be lower potential releases of radioactive materials to the public, because the radiological impacts at Zone 4 would be reduced.

[c] The committed effective dose equivalent for the storage facility is calculated to be 1.8×10^{-8} mrem based upon an analysis of measured dose. The dose shown here is for the Upgrade With RFETS Pu Pits Subalternative (Preferred Alternative). The dose for the Upgrade Without RFETS Pu or LANL Pu Subalternative would be slightly less and for the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative would be slightly greater. The differences are not measurable above background.

Note: The dose shown here is for the Upgrade with RFETS Pu Pits Subalternative (Preferred Alternative). The dose for the Upgrade Without RFETS Pu or LANL Pu Subalternative would be slightly less and for the Upgrade With All or Some RGETS Pu and LANL Pu Subalternative would be slightly greater. The differences are not measurable above background.

Source: HNUS 1996a.

Table M.2.7–4. Doses and Resulting Health Effects to the Population Within 80 Kilometers of Pantex Plant From Atmospheric Releases Associated With Normal Operation in 2030

Alternative/Facility	Dose by Pathway (person-rem)				Committed Effective Dose Equivalent (person-rem)	Percent of Background[a]	Estimated 1-Year Fatal Cancers
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	6.1×10^{-6}	2.7×10^{-4}	5.7×10^{-15}	0.0	2.8×10^{-4}	2.4×10^{-7}	1.4×10^{-7}
Upgraded Storage Facility[b]	[c]	[c]	[c]	[c]	6.3×10^{-6}	5.4×10^{-9}	3.2×10^{-9}
Upgraded Consolidated Storage Facility	5.5×10^{-5}	5.4×10^{-7}	2.1×10^{-14}	4.3×10^{-11}	5.5×10^{-5}	4.7×10^{-8}	2.7×10^{-8}
Consolidated Storage Facility	5.2×10^{-5}	5.4×10^{-7}	2.0×10^{-14}	4.2×10^{-11}	5.2×10^{-5}	4.4×10^{-8}	2.6×10^{-8}
Collocated Storage Facilities	5.2×10^{-5}	5.4×10^{-7}	2.1×10^{-14}	6.3×10^{-11}	5.3×10^{-5}	4.5×10^{-8}	2.7×10^{-8}
Pit Disassembly/Conversion Facility	5.6×10^{-3}	7.5×10^{-4}	3.4×10^{-11}	5.1×10^{-8}	6.4×10^{-3}	5.5×10^{-6}	3.2×10^{-6}
Plutonium Conversion Facility	3.8×10^{-3}	4.1×10^{-5}	1.6×10^{-12}	3.4×10^{-9}	3.8×10^{-3}	3.3×10^{-6}	1.9×10^{-6}
MOX Fuel Fabrication Facility	2.8×10^{-3}	2.9×10^{-5}	1.1×10^{-12}	5.2×10^{-9}	2.8×10^{-3}	2.4×10^{-6}	1.4×10^{-6}
Ceramic Immobilization Facility (Immobilized Disposition)	6.3×10^{-7}	6.7×10^{-9}	2.4×10^{-16}	4.9×10^{-13}	6.3×10^{-7}	5.4×10^{-10}	3.1×10^{-10}
Deep Borehole Complex (Direct Disposition)	1.0×10^{-7}	9.3×10^{-9}	3.9×10^{-16}	6.0×10^{-13}	1.1×10^{-7}	9.4×10^{-11}	5.5×10^{-11}
Deep Borehole Complex (With Immobilization)	1.3×10^{-7}	1.4×10^{-8}	5.8×10^{-16}	8.6×10^{-13}	1.4×10^{-7}	1.2×10^{-10}	7.0×10^{-11}
Vitrification Facility	2.5×10^{-4}	8.7×10^{-5}	4.7×10^{-9}	2.7×10^{-6}	3.4×10^{-4}	2.9×10^{-7}	1.7×10^{-7}
Ceramic Immobilization Facility (Ceramic Immobilization)	7.0×10^{-7}	1.7×10^{-5}	9.8×10^{-10}	5.3×10^{-7}	1.9×10^{-5}	1.6×10^{-8}	9.5×10^{-9}
Advanced Boiling Water Reactor	1.5×10^{-2}	8.4	0.15	1.8×10^{-2}	8.5	7.3×10^{-3}	4.3×10^{-3}
CE System 80+ Reactor	5.1×10^{-2}	8.1	1.8×10^{-2}	8.4×10^{-3}	8.2	7.0×10^{-3}	4.1×10^{-3}
[Text deleted.]							
AP600 Reactor	2.8×10^{-2}	7.3	5.8×10^{-2}	1.3×10^{-2}	7.4	6.3×10^{-3}	3.7×10^{-3}
RESAR-90 Reactor	4.5×10^{-2}	8.8	2.4×10^{-2}	1.1×10^{-2}	8.9	7.6×10^{-3}	4.4×10^{-3}

[a] Dose to the population within 80 km from natural background radiation in 2030 is equal to 116,900 person-rem.

[b] For the three upgrade subalternatives including the Preferred Alternative, the dose to the MEI and the population within 80 km would decrease slightly from the No Action Alternative, although the differences are expected to be below detection limits. Therefore, the total site dose would decrease slightly but the change would be undetectable. The quantity of Pu pits at Pantex to be stored in upgraded facilities in Zone 12 would be slightly increased by the addition of RFETS pits (the Preferred Alternative) or by the addition of RFETS Pu and LANL Pu. The difference between these three subalternatives would be below detection limits. The AT-400A has both an inner container and an outer container that provides additional shielding material. The overall effect of moving Pantex and RFETS pits from Zone 4 to upgraded Zone 12 storage facilities would be lower potential releases of radioactive materials to the public, because the radiological impacts at Zone 4 would be reduced.

[c] The committed effective dose equivalent for the storage facility is calculated to be 1.8×10^{-8} mrem based upon an analysis of measured dose. The dose shown here is for the Upgrade With RFETS Pu Pits Subalternative (Preferred Alternative). The dose for the Upgrade Without RFETS Pu or LANL Pu Subalternative would be slightly less and for the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative would be slightly greater. The differences are not measurable above background.

Note: The dose shown here is for the Upgrade with RFETS Pu Pits Subalternative (Preferred Alternative). The dose for the Upgrade Without RFETS Pu or LANL Pu Subalternative would be slightly less and for the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative would be slightly greater. The differences are not measurable above background.

Source: HNUS 1996a.

M.2.7.1 No Action

Atmospheric Releases and Resulting Impacts to the Public. For No Action, two of the areas have radioactive releases into the atmosphere from normal operation. Table M.2.7.1–1 presents the estimated annual atmospheric radioactive releases for No Action.

Table M.2.7.1–1. Annual Atmospheric Radioactive Releases From Normal Operation of No Action at Pantex Plant (curies)

	Weapons Assembly/ Disassembly High Explosive	
Isotope	Bldg. 12-44 Cell 1	Burning Ground
Tritium (H-3)	0.16	0.14

Source: PX 1995a:1; PX DOE 1994a; PX DOE 1995d.

Tables M.2.7–3 and M.2.7–4 include the radiological impacts to the MEI and the offsite population within 80 km (50 mi), respectively. The MEI would receive an annual dose of 6.1×10^{-5} mrem. An estimated fatal cancer risk of 1.5×10^{-9} would result from 50 years of operation. The population within 80 km (50 mi) would receive a dose of 2.8×10^{-4} person-rem in 2030 (mid-life of operation). An estimated 7.0×10^{-6} fatal cancers could result from 50 years of operation.

Liquid Releases and Resulting Impacts to the Public. There are no radioactive liquid releases into the offsite environment associated with No Action. Therefore, there are no resulting impacts.

Worker Doses and Health Effects. Based on measured values during the time period from 1989 to 1992 (*Twenty-Second Annual Report Radiation Exposure for DOE and DOE Contractor Employees–1989*, DOE/EH-0286P) and subsequent yearly dose reports), the annual average dose to a badged worker at Pantex was calculated to be 15 mrem. It is projected that in 2005 and beyond, there would be 1,400 badged workers involved in No Action activities at Pantex (PX 1995a:1). The annual average dose to these workers was assumed to be 10 mrem; the annual total dose among all these workers would then equal 14 person-rem. From 50 years of operation, an estimated fatal cancer risk of 2.0×10^{-4} would result to the average worker and 0.28 fatal cancers could result among all workers.

M.2.7.2 Storage and Disposition

Radioactive Releases and Resulting Impacts to the Public. Total site radiological impacts during operation of storage or disposition facilities can be found by adding the impacts resulting from No Action facilities to the changes in impacts resulting from the storage or disposition facilities. For example, to determine the radiological impact for the addition of the AP600 reactor at Pantex, the No Action facilities doses have to be summed with the AP600 reactor doses. Estimated annual atmospheric radioactive releases for the different facilities are given in Section M.2.3. Tables M.2.7–3 and M.2.7–4 include the radiological impacts by alternative. There are no radioactive liquid releases into the offsite environment associated with any alternative action.

No change was reported in radioactive releases due to the upgrade of existing storage facilities for continued Pu storage at Pantex above those radioactive releases already included in No Action. Therefore, there are no changes in dose to the public from the upgrade of existing storage facilities at Pantex.

The annual doses associated with the different alternatives range from 0 to 1.5 mrem to the MEI and from 0 to 8.9 person-rem to the 80-km (50-mi) population in 2030. The associated health effects from annual operations are included in both tables.

Worker Doses and Health Effects. For the storage and disposition alternatives, the impacts from the No Action facilities need to be added to the changes in impacts from the storage or disposition facilities to determine the impacts from total site operations (refer to the worker discussion under No Action, above, and to Table M.2.3.2–1).

M.2.8 RADIOLOGICAL IMPACTS AT OAK RIDGE RESERVATION

This section presents the radiological impacts of the various storage and disposition alternatives at ORR. Section M.2.8.1 presents the radiological releases and resulting impacts from facilities associated with No Action. Section M.2.8.2 presents the radiological releases and resulting impacts from the various alternatives.

For purposes of radiological impact modeling, ORR was divided into seven separate areas which would release radioactivity in 2005. All potential release points in each area were aggregated into a single release point. Tables M.2.8–1 and M.2.8–2 present the characteristics of each of the release points including location, release height, minimum distance, and annual average dispersion to the site boundary in each of 16 directions. In order to calculate the maximum site boundary dose (that is, the dose ultimately incurred to the site MEI), the dose from each release point to the "maximum receptor" (that is, potential MEI) associated with each of the other release points has been calculated. For further clarification on the definition of the "maximum receptor," refer to Section M.2.2.2. For example, the dose resulting from releases from the Oak Ridge National Laboratory (ORNL), Y–12 Plant (Y–12), High Flux Isotope Reactor Areas, and the other storage and disposition alternatives, has been determined for the maximum receptor from the K–25 Site (K–25) incinerator. Figure M.2.8–1 illustrates the location of each maximum receptor in relation to each release point. The maximum site boundary dose (that is, the dose ultimately incurred to the site MEI) is then determined by the maximum dose to one of those maximum receptors. Tables M.2.8–3 and M.2.8–4 present the distance, direction, and atmospheric dispersion from each release point to each of the maximum receptors. Annual radiological releases were assumed to remain constant during the full operational period.

Descriptions of population, foodstuffs distributions, and aquatic foods for each release area are provided in a Health Risk Data report, October 1996. The joint frequency distributions used for the dose assessment were based on 1990 meteorological measurements from five meteorological towers (Tower 1 for K–25, Tower 2 for ORNL, Tower 4 for the High Flux Isotope Reactor and Radiochemical Engineering Development Center, Tower 5 for Y–12, and Tower 6 for the proposed Tritium Supply Site location) at the 10-m (33-ft) height and are contained in the Health Risk Data report.

Doses given in this section are associated with 1 year of operation because regulatory standards are given as annual limits. The health effects are presented on an annual basis in the tables and for the projected operational period in the text. Tables M.2.8–5 through M.2.8–8 include the radiological impacts to the public from both atmospheric release and from using the surface water for No Action and the storage and disposition alternatives.

Table M.2.8–1. Release Point Characteristics, Direction, Distance, and Chi/Q at the Oak Ridge Reservation Boundary (Without Presence of the Clinch River Breeder Reactor Site)

Release Point[a]	Immobilization Facility		K-25		X-10	
Latitude	35°55'59.139"		35°56'15.444"		35°55'39.169"	
Longitude	-84°20'55.855"		-84°22'54.796"		-84°18'55.580"	
Release Height	Ground Level		Ground Level		Ground Level	
	Distance and Atmospheric Dispersion at Site Boundary					
Direction	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)
N	3,200	$2.2x10^{-7}$	3,037	$1.7x10^{-7}$	4,218	$2.1x10^{-7}$
NNE	2,996	$5.8x10^{-7}$	3,919	$3.2x10^{-7}$	5,872	$2.3x10^{-7}$
NE	4,624	$6.2x10^{7}$	4,360	$5.0x10^{-7}$	8,512	$2.0x10^{-7}$
ENE	9,494	$2.9x10^{-7}$	4,633	$4.8x10^{-7}$	3,935	$4.4x10^{-7}$
E	6,806	$1.5x10^{-7}$	9,767	$1.1x10^{-7}$	4,337	$2.3x10^{-7}$
ESE	6,782	$1.2x10^{-7}$	9,643	$6.1x10^{-8}$	4,390	$1.9x10^{-7}$
SE	5,900	$6.9x10^{-8}$	4,931	$1.1x10^{-7}$	4,029	$2.5x10^{-7}$
SSE	3,558	$6.1x10^{-8}$	2,313	$4.0x10^{-7}$	4,367	$2.0x10^{-7}$
S	3,417	$8.7x10^{-8}$	2,414	$6.1x10^{-7}$	4,296	$1.7x10^{-7}$
SSW	3,851	$3.2x10^{-7}$	3,303	$4.8x10^{-7}$	3,752	$2.4x10^{-7}$
SW	2,903	$1.1x10^{-6}$	3,897	$2.6x10^{-7}$	3,750	$4.5x10^{-7}$
WSW	4,897	$2.1x10^{-7}$	2,892	$5.9x10^{-7}$	5,340	$2.6x10^{-7}$
W	5,700	$5.6x10^{-8}$	3,600	$2.1x10^{-7}$	8,677	$4.5x10^{-8}$
WNW	4,299	$4.7x10^{-8}$	2,775	$1.2x10^{-7}$	7,267	$3.8x10^{-8}$
NW	4,788	$3.9x10^{-8}$	2,374	$1.3x10^{-7}$	4,474	$8.1x10^{-8}$
NNW	4,767	$4.7x10^{-8}$	1,856	$2.6x10^{-7}$	3,900	$9.4x10^{-8}$

Table M.2.8–1. Release Point Characteristics, Direction, Distance, and Chi/Q at the Oak Ridge Reservation Boundary (Without Presence of the Clinch River Breeder Reactor Site)—Continued

Release Point[a]	Y–12		MOX Fuel Fabrication		Pit Disassembly/Conversion	
Latitude	35°59'8.409"		35°59'.676"		35°58'50.204"	
Longitude	-84°15'38.488"		-84°15'43.725"		-84°16'13.244"	
Release Height	20.0 m		Ground Level		Ground Level	
	Distance and Atmospheric Dispersion at Site Boundary					
Direction	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)
N	675	$7.7x10^{-7}$	824	$1.9x10^{-6}$	839	$2.1x10^{-6}$
NNE	879	$1.0x10^{-6}$	1,070	$3.2x10^{-6}$	1,082	$3.1x10^{-6}$
NE	1,618	$9.8x10^{-7}$	1,982	$1.6x10^{-6}$	1,683	$3.0x10^{-6}$
ENE	2,360	$6.6x10^{-7}$	2,671	$8.3x10^{-7}$	3,396	$1.3x10^{-6}$
E	2,963	$3.4x10^{-7}$	2,765	$8.4x10^{-7}$	2,970	$5.2x10^{-7}$
ESE	2,283	$2.8x10^{-7}$	2,268	$2.0x10^{-7}$	2,837	$4.4x10^{-7}$
SE	2,329	$2.1x10^{-7}$	3,663	$5.3x10^{-8}$	3,719	$1.4x10^{-7}$
SSE	3,726	$1.3x10^{-7}$	3,570	$1.2x10^{-7}$	4,276	$4.6x10^{-8}$
S	4,682	$1.5x10^{-7}$	4,432	$8.9x10^{-8}$	4,100	$6.6x10^{-8}$
SSW	9,589	$7.2x10^{-8}$	9,563	$5.7x10^{-8}$	10,586	$7.5x10^{-8}$
SW	11,872	$3.8x10^{-8}$	11,602	$1.6x10^{-7}$	10,901	$1.7x10^{-7}$
WSW	3,454	$2.4x10^{-7}$	3,733	$7.3x10^{-7}$	3,306	$3.8x10^{-7}$
W	1,082	$5.3x10^{-7}$	1,370	$1.2x10^{-6}$	1,349	$5.7x10^{-7}$
WNW	810	$4.8x10^{-7}$	974	$6.4x10^{-7}$	921	$6.4x10^{-7}$
NW	688	$5.2x10^{-7}$	862	$6.6x10^{-7}$	801	$7.8x10^{-7}$
NNW	619	$7.1x10^{-7}$	798	$9.1x10^{-7}$	772	$1.1x10^{-6}$

[a] See Figure M.2.8–1 for location of release points.

Source: HNUS 1996a

Table M.2.8–2. Release Point Characteristics, Direction, Distance, and Chi/Q at the Oak Ridge Reservation Boundary (With Presence of the Clinch River Breeder Reactor Site)

Release Point[a]	LWR Site		Immobilization Facility		K-25		X-10	
Latitude	35°54'9.137"		35°55'59.139"		35°56'15.444"		35°55'39.169"	
Longitude	-84°22'45.671"		-84°20'55.855"		-84°22'54.796"		-84°18'55.580"	
Release Height	Ground Level		Ground Level		Ground Level		Ground Level	
	Distance and Atmospheric Dispersion at Site Boundary							
Direction	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)
N	930	$2.5x10^{-6}$	3,199	$2.2x10^{-7}$	3,041	$1.7x10^{-7}$	4,206	$2.1x10^{-7}$
NNE	1,209	$2.7x10^{-6}$	2,995	$5.8x10^{-7}$	3,936	$3.2x10^{-7}$	5,852	$2.3x10^{-7}$
NE	8,444	$2.0x10^{-7}$	4,646	$6.2x10^{7}$	4,362	$5.0x10^{-7}$	8,512	$2.0x10^{-7}$
ENE	11,141	$9.5x10^{-8}$	9,893	$2.7x10^{-7}$	4,634	$4.8x10^{-7}$	5,162	$2.9x10^{-7}$
E	2,171	$6.8x10^{-7}$	7,827	$1.2x10^{-7}$	10,817	$9.6x10^{-8}$	4,863	$2.0x10^{-7}$
ESE	898	$2.5x10^{-6}$	7,133	$1.1x10^{-7}$	9,987	$5.8x10^{-8}$	4,707	$1.7x10^{-7}$
SE	830	$3.4x10^{-6}$	6,077	$6.7x10^{-8}$	5,089	$1.0x10^{-7}$	4,385	$2.2x10^{-7}$
SSE	979	$2.3x10^{-6}$	4,081	$4.9x10^{-8}$	2,306	$4.0x10^{-7}$	4,586	$1.9x10^{-7}$
S	2,154	$5.0x10^{-7}$	3,788	$7.5x10^{-8}$	2,418	$6.1x10^{-7}$	4,483	$1.6x10^{-7}$
SSW	1,863	$7.2x10^{-7}$	4,000	$3.0x10^{-7}$	3,436	$4.5x10^{-7}$	3,956	$2.2x10^{-7}$
SW	998	$3.9x10^{-6}$	2,903	$1.1x10^{-6}$	3,897	$2.6x10^{-7}$	4,134	$3.9x10^{-7}$
WSW	897	$4.5x10^{-6}$	5,279	$1.9x10^{-7}$	2,892	$5.9x10^{-7}$	5,340	$2.6x10^{-7}$
W	939	$1.6x10^{-6}$	5,700	$5.6x10^{-8}$	3,618	$2.1x10^{-7}$	8,677	$4.5x10^{-8}$
WNW	854	$1.2x10^{-6}$	4,294	$4.7x10^{-8}$	2,782	$1.2x10^{-7}$	7,259	$3.8x10^{-8}$
NW	755	$1.5x10^{-6}$	4,787	$3.9x10^{-8}$	2,355	$1.3x10^{-7}$	4,460	$8.1x10^{-8}$
NNW	764	$1.4x10^{-6}$	4,769	$4.7x10^{-8}$	1,855	$2.6x10^{-7}$	3,900	$9.4x10^{-8}$

Table M.2.8–2. Release Point Characteristics, Direction, Distance, and Chi/Q at the Oak Ridge Reservation Boundary (With Presence of the Clinch River Breeder Reactor Site)—Continued

Release Point[a]	Y–12		MOX Fuel Fabrication		Pit Disassembly/Conversion	
Latitude	35°59'8.409"		35°59'.676"		35°58'50.204"	
Longitude	-84°15'38.488"		-84°15'43.725"		-84°16'13.244"	
Release Height	20 m		Ground Level		Ground Level	
	Distance and Atmospheric Dispersion at Site Boundary					
Direction	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)
N	657	7.9×10^{-7}	821	1.9×10^{-6}	826	2.1×10^{-6}
NNE	897	1.0×10^{-6}	1,087	3.1×10^{-6}	1,067	3.1×10^{-6}
NE	1,639	9.7×10^{-7}	2,000	1.5×10^{-6}	1,658	3.0×10^{-6}
ENE	2,344	6.6×10^{-7}	2,658	8.3×10^{-7}	3,380	1.3×10^{-6}
E	2,936	3.5×10^{-7}	2,772	8.4×10^{-7}	2,978	5.2×10^{-7}
ESE	2,286	2.8×10^{-7}	2,273	2.0×10^{-7}	2,844	4.4×10^{-7}
SE	2,320	2.1×10^{-7}	4,125	4.4×10^{-8}	4,241	1.1×10^{-7}
SSE	4,229	1.1×10^{-7}	4,085	9.5×10^{-8}	5,014	3.6×10^{-8}
S	5,423	1.3×10^{-7}	5,197	7.0×10^{-8}	5,193	4.6×10^{-8}
SSW	11,713	5.5×10^{-8}	11,444	4.4×10^{-8}	10,902	7.2×10^{-8}
SW	12,181	3.7×10^{-8}	11,898	1.5×10^{-7}	11,310	1.6×10^{-7}
WSW	3,433	2.4×10^{-7}	3,712	7.4×10^{-7}	3,330	3.8×10^{-7}
W	1,067	5.3×10^{-7}	1,353	1.2×10^{-6}	1,327	5.9×10^{-7}
WNW	803	4.9×10^{-7}	963	6.6×10^{-7}	911	6.5×10^{-7}
NW	687	5.2×10^{-7}	868	6.5×10^{-7}	795	8.0×10^{-7}
NNW	621	7.1×10^{-7}	805	9.0×10^{-7}	773	1.1×10^{-6}

[a] See Figure M.2.8–1 for location of release points.

Source: HNUS 1996a.

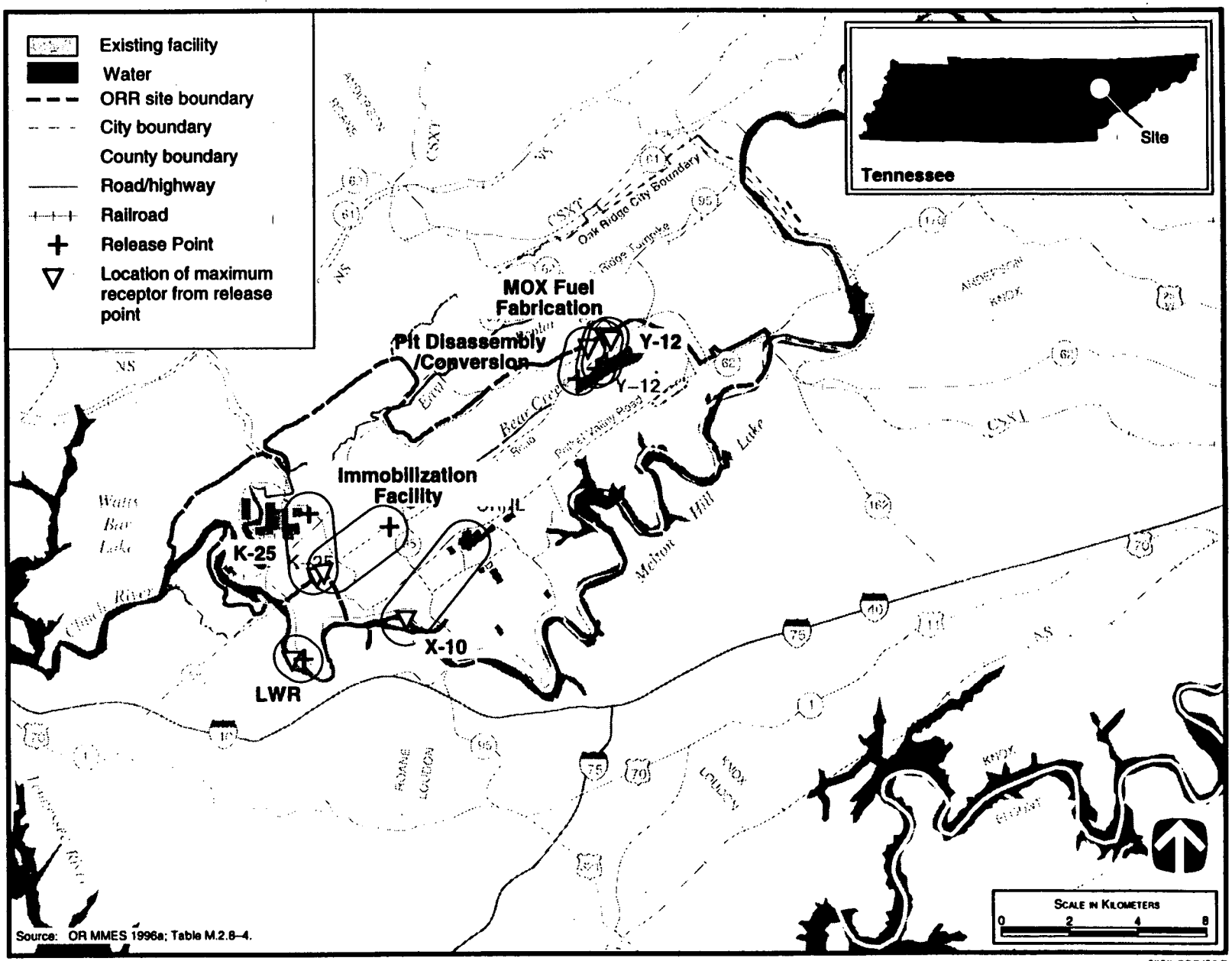

Figure M.2.8–1. Location of Release Points and Maximum Receptors at Oak Ridge Reservation.

Table M.2.8–3. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Oak Ridge Reservation Site Boundary (Without Presence of the Clinch River Breeder Reactor Site)

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: Immobilization			
Immobilization Facility	SW	2,903	1.1×10^{-6}
K–25	SW	3,189	9.7×10^{-7}
X–10	SSE	3,582	6.0×10^{-8}
Y–12	NE	10,548	1.9×10^{-7}
MOX Fuel Fabrication	NE	10,449	1.9×10^{-7}
Pit Disassembly/Conversion	NE	9,699	2.1×10^{-7}
Release Point: K–25			
Immobilization Facility	SSE	2,315	4.0×10^{-7}
K–25	S	2,415	6.1×10^{-7}
X–10	SE	5,421	9.3×10^{-8}
Y–12	ENE	12,739	1.1×10^{-7}
MOX Fuel Fabrication	ENE	12,639	1.1×10^{-7}
Pit Disassembly/Conversion	ENE	11,863	1.2×10^{-7}
Release Point: X–10			
Immobilization Facility	WSW	5,468	2.5×10^{-7}
K–25	WSW	5,735	2.3×10^{-7}
X–10	SW	3,750	4.5×10^{-7}
Y–12	NNE	8,933	1.2×10^{-7}
MOX Fuel Fabrication	NNE	8,842	1.3×10^{-7}
Pit Disassembly/Conversion	NNE	8,184	1.4×10^{-7}
Release Point: Y–12			
Immobilization Facility	SW	12,769	3.4×10^{-8}
K–25	SW	13,055	3.3×10^{-8}
X–10	SW	11,875	3.8×10^{-8}
Y–12	NNE	879	1.0×10^{-6}
MOX Fuel Fabrication	N	812	6.4×10^{-7}
Pit Disassembly/Conversion	NW	772	4.5×10^{-7}

Table M.2.8–3. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Oak Ridge Reservation Site Boundary (Without Presence of the Clinch River Breeder Reactor Site)—Continued

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: MOX Fuel Fabrication Facility			
Immobilization Facility	SW	12,523	$1.4x10^{-7}$
K–25	SW	12,809	$1.4x10^{-7}$
X–10	SW	11,606	$1.6x10^{-7}$
Y–12	NN	1,143	$2.8x10^{-6}$
MOX Fuel Fabrication	NNE	1,071	$3.1x10^{-6}$
Pit Disassembly/Conversion	NW	863	$6.6x10^{-7}$
Release Point: Pit Disassembly/ Conversion			
Immobilization Facility	SW	11,735	$1.5x10^{-7}$
K–25	SW	12,021	$1.5x10^{-7}$
X–10	SW	10,902	$1.7x10^{-7}$
Y–12	NE	1,776	$2.7x10^{-6}$
MOX Fuel Fabrication	NE	1,683	$3.0x10^{-6}$
Pit Disassembly/Conversion	NNE	1,083	$3.1x10^{-6}$

Source: HNUS 1996a.

Table M.2.8–4. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Oak Ridge Reservation Site Boundary (With Presence of the Clinch River Breeder Reactor Site)

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: LWR Site			
LWR Site	WSW	897	4.5×10^{-6}
Immobilization Facility	NNE	1,728	1.5×10^{-6}
K–25	N	1,518	1.1×10^{-6}
X–10	E	3,420	3.4×10^{-7}
Y–12	NE	14,878	9.2×10^{-8}
MOX Fuel Fabrication	NE	14,780	9.2×10^{-8}
Pit Disassembly/Conversion	NE	13,996	1.0×10^{-7}
Release Point: Immobilization			
LWR Site	SSW	4,244	2.8×10^{-7}
Immobilization Facility	SW	2,903	1.1×10^{-6}
K–25	SW	3,198	9.7×10^{-7}
X–10	S	4,027	6.8×10^{-8}
Y–12	NE	10,571	1.9×10^{-7}
MOX Fuel Fabrication	NE	10,472	1.9×10^{-7}
Pit Disassembly/Conversion	NE	9,674	2.2×10^{-7}
Release Point: K–25 TSCA Incinerator			
LWR Site	S	4,244	2.6×10^{-7}
Immobilization Facility	SSE	2,306	4.0×10^{-7}
K–25	S	2,419	6.1×10^{-7}
X–10	SE	5,747	8.5×10^{-8}
Y–12	ENE	12,761	1.1×10^{-7}
MOX Fuel Fabrication	ENE	12,663	1.1×10^{-7}
Pit Disassembly/Conversion	ENE	11,836	1.3×10^{-7}
Release Point: X–10 (ORNL)			
LWR Site	WSW	7,297	1.6×10^{-7}
Immobilization Facility	WSW	5,471	2.5×10^{-7}
K–25	WSW	5,743	2.3×10^{-7}
X–10	SW	4,135	3.9×10^{-7}
Y–12	NNE	8,956	1.2×10^{-7}
MOX Fuel Fabrication	NNE	8,863	1.3×10^{-7}
Pit Disassembly/Conversion	NNE	8,163	1.4×10^{-7}

Table M.2.8–4. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Oak Ridge Reservation Site Boundary (With Presence of the Clinch River Breeder Reactor Site)—Continued

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: Y–12			
LWR Site	SW	14,978	2.8×10^{-8}
Immobilization Facility	SW	12,769	3.4×10^{-8}
K–25	SW	13,064	3.3×10^{-8}
X–10	SW	12,259	3.6×10^{-8}
Y–12	NNE	898	1.0×10^{-6}
MOX Fuel Fabrication	N	827	6.2×10^{-7}
Pit Disassembly/Conversion	NW	785	4.4×10^{-7}
Release Point: MOX Fuel Fabrication Facility			
LWR Site	SW	14,726	1.1×10^{-7}
Immobilization Facility	SW	12,523	1.4×10^{-7}
K–25	SW	12,818	1.4×10^{-7}
X–10	SW	11,989	1.5×10^{-7}
Y–12	NNE	1,163	2.7×10^{-6}
MOX Fuel Fabrication	NNE	1,087	3.1×10^{-6}
Pit Disassembly/Conversion	NW	868	6.5×10^{-7}
Release Point: Pit Disassembly/ Conversion			
LWR Site	SW	13,950	1.2×10^{-7}
Immobilization Facility	SW	11,735	1.5×10^{-7}
K–25	SW	12,030	1.5×10^{-7}
X–10	SSW	11,293	6.9×10^{-7}
Y–12	NE	1,798	2.7×10^{-6}
MOX Fuel Fabrication	NE	1,705	2.9×10^{-6}
Pit Disassembly/Conversion	NNE	1,067	3.1×10^{-6}

Source: HNUS 1996a.

Table M.2.8–5. Doses and Resulting Health Effects to the Maximally Exposed Individual at Oak Ridge Reservation From Atmospheric Releases Associated With Annual Normal Operation

Alternative/Facility	Dose by Pathway (mrem)				Committed Effective Dose Equivalent (mrem)	Percent of Background[a]	Estimated 1-Year Fatal Cancer Risk
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	1.4	1.7×10^{-2}	3.2×10^{-2}	5.3×10^{-4}	1.5	5.0×10^{-1}	7.4×10^{-7}
Upgrade HEU Storage	2.2×10^{-7}	5.3×10^{-10}	8.8×10^{-16}	1.7×10^{-11}	2.2×10^{-7}	7.5×10^{-8}	1.1×10^{-13}
[Text deleted.]							
Collocated Storage Facility	4.4×10^{-5}	8.0×10^{-8}	1.8×10^{-14}	5.5×10^{-11}	4.5×10^{-5}	1.5×10^{-5}	2.3×10^{-11}
Pit Disassembly/Conversion Facility	1.3×10^{-2}	3.0×10^{-4}	7.9×10^{-11}	1.2×10^{-7}	1.4×10^{-2}	4.7×10^{-3}	7.0×10^{-9}
Pu Conversion Facility	9.1×10^{-3}	1.7×10^{-5}	3.9×10^{-12}	8.2×10^{-8}	9.2×10^{-3}	3.1×10^{-3}	4.6×10^{-9}
MOX Fuel Fabrication Facility	6.8×10^{-3}	1.2×10^{-5}	2.6×10^{-12}	1.2×10^{-8}	6.8×10^{-3}	2.3×10^{-3}	3.4×10^{-9}
Ceramic Immobilization Facility (Immobilized Disposition)	5.9×10^{-7}	1.0×10^{-9}	2.2×10^{-16}	4.6×10^{-13}	5.9×10^{-7}	2.0×10^{-7}	3.0×10^{-13}
Deep Borehole Complex (Direct Disposition)	9.3×10^{-8}	1.4×10^{-9}	3.7×10^{-16}	5.6×10^{-13}	9.4×10^{-8}	3.2×10^{-8}	4.7×10^{-14}
Deep Borehole Complex (Immobilized Disposition)	1.2×10^{-7}	2.0×10^{-9}	5.4×10^{-16}	7.9×10^{-13}	1.2×10^{-7}	4.1×10^{-8}	6.0×10^{-14}
Vitrification Facility	2.3×10^{-4}	1.5×10^{-5}	4.4×10^{-9}	2.5×10^{-6}	2.5×10^{-4}	8.5×10^{-5}	1.3×10^{-10}
Ceramic Immobilization Facility (Ceramic Immobilization)	6.5×10^{-7}	3.0×10^{-6}	9.1×10^{-10}	4.9×10^{-7}	4.2×10^{-6}	1.4×10^{-6}	2.1×10^{-12}
Advanced Boiling Water Reactor	4.9×10^{-2}	3.2	1.5	6.7×10^{-2}	4.8	1.6	2.4×10^{-6}
CE System 80+ Reactor	1.1×10^{-1}	3.1	8.9×10^{-2}	1.4×10^{-3}	3.3	1.1	1.7×10^{-6}
[Text deleted.]							
AP600 Reactor	2.5×10^{-2}	2.1	2.5×10^{-1}	1.5×10^{-2}	2.3	7.8×10^{-1}	1.2×10^{-6}
RESAR-90 Reactor	9.0×10^{-2}	3.2	1.0×10^{-1}	1.7×10^{-2}	3.5	1.2	1.8×10^{-6}

[a] Individual annual natural background radiation dose is equal to 295 mrem.

[Text deleted.]

Source: HNUS 1996a.

Table M.2.8–6. Doses and Resulting Health Effects to the Population Within 80 Kilometers of Oak Ridge Reservation From Atmospheric Releases Associated With Normal Operation in 2030

Alternative/Facility	Dose by Pathway (person-rem)				Committed Effective Dose Equivalent in 2030 (person-rem)	Percent of Background[a]	Estimated 1-Year Fatal Cancers
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	26	0.41	2.3	5.7×10^{-2}	29	7.7×10^{-3}	1.5×10^{-2}
Upgrade HEU Storage	3.4×10^{-6}	8.0×10^{-10}	1.4×10^{-14}	2.7×10^{-10}	3.4×10^{-6}	9.0×10^{-10}	1.7×10^{-9}
[Text deleted.]							
Collocated Storage Facilities	8.7×10^{-4}	1.4×10^{-7}	3.5×10^{-13}	1.0×10^{-9}	8.7×10^{-4}	2.3×10^{-7}	4.4×10^{-7}
Pit Disassembly/Conversion Facility	0.12	1.7×10^{-4}	6.9×10^{-10}	1.0×10^{-6}	0.12	3.2×10^{-5}	6.0×10^{-5}
Pu Conversion Facility	7.4×10^{-2}	9.3×10^{-6}	3.2×10^{-11}	6.6×10^{-8}	7.4×10^{-2}	2.0×10^{-5}	3.7×10^{-5}
MOX Fuel Fabrication Facility	4.8×10^{-2}	6.3×10^{-6}	1.9×10^{-11}	9.1×10^{-8}	4.8×10^{-2}	1.3×10^{-5}	2.4×10^{-5}
Ceramic Immobilization Facility (Immobilized Disposition)	1.1×10^{-5}	1.7×10^{-9}	4.2×10^{-15}	8.5×10^{-12}	1.1×10^{-5}	2.9×10^{-9}	5.5×10^{-9}
Deep Borehole Complex (Direct Disposition)	1.8×10^{-6}	2.3×10^{-9}	6.9×10^{-15}	1.1×10^{-11}	1.8×10^{-6}	4.7×10^{-10}	9.0×10^{-10}
Deep Borehole Complex (Immobilized Disposition)	2.2×10^{-6}	3.4×10^{-9}	1.0×10^{-14}	1.5×10^{-11}	2.2×10^{-6}	5.8×10^{-10}	1.1×10^{-9}
Vitrification Facility	4.3×10^{-3}	5.0×10^{-5}	8.7×10^{-8}	4.7×10^{-5}	4.4×10^{-3}	1.2×10^{-6}	2.2×10^{-6}
Ceramic Immobilization Facility (Ceramic Immobilization)	1.2×10^{-5}	9.8×10^{-6}	1.7×10^{-8}	9.6×10^{-6}	3.2×10^{-5}	8.4×10^{-9}	1.6×10^{-8}
Advanced Boiling Water Reactor	0.16	3.1	1.7	0.19	5.1	1.3×10^{-3}	2.6×10^{-3}
CE System 80+ Reactor	0.39	2.8	0.21	4.9×10^{-3}	3.4	9.0×10^{-4}	1.7×10^{-3}
[Text deleted.]							
AP600 Reactor	8.7×10^{-2}	1.9	0.69	5.2×10^{-2}	2.8	7.4×10^{-4}	1.4×10^{-3}
RESAR-90 Reactor	0.31	3.0	0.29	5.8×10^{-2}	3.6	9.5×10^{-4}	1.8×10^{-3}

[a] Dose to the population within 80 km from natural background radiation in year 2030 is equal to 379,000 person-rem.

[Text deleted.]

Source: HNUS 1996a.

Table M.2.8–7. Doses and Resulting Health Effects to the Maximally Exposed Individual at Oak Ridge Reservation From Liquid Releases Associated With Annual Normal Operation

	Dose by Pathway (mrem)								
Alternative/ Facility	Fish Ingestion	Other Food Ingestion	Drinking Water	Boating	Swimming	Shoreline	Committed Effective Dose Equivalent (mrem)	Percent of Background[a]	Estimated Risk of 1-Year Fatal Cancers
No Action (Total Site)	1.6	1.0×10^{-1}	1.2×10^{-2}	1.5×10^{-5}	3.0×10^{-5}	6.1×10^{-3}	1.7	5.8×10^{-1}	8.6×10^{-7}
Advanced Boiling Water Reactor	2.7×10^{-2}	1.0×10^{-3}	3.2×10^{-2}	2.6×10^{-6}	5.3×10^{-6}	2.9×10^{-4}	6.0×10^{-2}	2.0×10^{-2}	3.0×10^{-8}
CE System 80+ Reactor	9.0×10^{-2}	6.7×10^{-3}	2.0×10^{-1}	5.1×10^{-6}	1.0×10^{-5}	8.0×10^{-4}	3.0×10^{-1}	1.0×10^{-1}	1.5×10^{-7}
[Text deleted.]									
AP600 Reactor	1.0×10^{-1}	1.1×10^{-2}	3.6×10^{-1}	5.7×10^{-6}	1.1×10^{-5}	8.5×10^{-4}	4.7×10^{-1}	1.6×10^{-1}	2.4×10^{-7}
RESAR-90 Reactor	8.0×10^{-2}	1.4×10^{-2}	4.5×10^{-1}	5.7×10^{-6}	1.1×10^{-5}	4.9×10^{-4}	5.4×10^{-1}	1.8×10^{-1}	2.7×10^{-7}

[a] Individual annual natural background radiation dose is equal to 295 mrem.

Source: HNUS 1996a.

Table M.2.8–8. Doses and Resulting Health Effects to the Population Downstream of Oak Ridge Reservation From Liquid Releases Associated With Normal Operation in 2030

Alternative/ Facility	Dose by Pathway (person-rem)						Committed Effective Dose Equivalent (person-rem)	Percent of Background[a]	Estimated 1-Year Fatal Cancers
	Fish Ingestion	Other Food Ingestion	Drinking Water	Boating	Swimming	Shoreline			
No Action (Total Site)	2.3	2.3	0	6.8×10^{-4}	5.8×10^{-4}	4.8×10^{-2}	4.7	1.2×10^{-3}	2.3×10^{-3}
Advanced Boiling Water Reactor	5.2×10^{-2}	2.3×10^{-2}	0	1.2×10^{-4}	1.1×10^{-4}	2.3×10^{-3}	7.8×10^{-2}	2.1×10^{-5}	3.9×10^{-5}
CE System 80+ Reactor	1.4×10^{-1}	1.5×10^{-1}	0	2.4×10^{-4}	2.1×10^{-4}	6.4×10^{-3}	3.0×10^{-1}	7.9×10^{-5}	1.5×10^{-4}
[Text deleted.]			0						
AP600 Reactor	2.3×10^{-1}	2.6×10^{-1}	0	2.7×10^{-4}	2.3×10^{-4}	6.8×10^{-3}	5.0×10^{-1}	1.3×10^{-4}	2.5×10^{-4}
RESAR-90 Reactor	1.5×10^{-1}	3.2×10^{-1}	0	2.6×10^{-4}	2.3×10^{-4}	3.9×10^{-3}	4.8×10^{-1}	1.3×10^{-4}	2.4×10^{-4}

[a] Total dose to the population within 80 km from natural background radiation in year 2030 is equal to 379,000 person-rem.

Source: HNUS 1996a.

Doses given in this section are associated with 1 year of operation because regulatory standards are given as annual limits. The health effects are presented on an annual basis in the tables and for the projected operational period in the test.

M.2.8.1 No Action

Atmospheric Releases and Resulting Impacts to the Public. For No Action, three of the five areas have radioactive releases into the atmosphere from normal operation. Table M.2.8.1–1 presents the estimated annual atmospheric radioactive releases.

Tables M.2.8–5 and M.2.8–6 include the atmospheric radiological impacts to the maximally exposed member of the public and the offsite population within 80 km (50 mi), respectively. The maximally exposed individual would receive an annual dose of 1.5 mrem. An estimated fatal cancer risk of 3.7×10^{-5} would result from 50 years of operation. The population within 80 km (50 mi) would receive a dose of 29 person-rem in 2030 (midlife of operation). An estimated 0.73 fatal cancers could result from 50 years of operation.

Liquid Releases and Resulting Impacts to the Public. For No Action, two of the five areas have radioactive releases to the offsite surface water from normal operation. Table M.2.8.1–2 presents the estimated annual liquid radioactive releases.

Tables M.2.8–7 and M.2.8–8 include the radiological impacts to the maximally exposed individual and the offsite populations using surface water within 80 km (50 mi) downstream of ORR, respectively. The maximally exposed member of the public would receive an annual dose of 1.7 mrem. An estimated fatal cancer risk of 4.3×10^{-5} would result from 50 years of operation. The population would receive a dose of 4.7 person-rem in 2030. An estimated 0.12 fatal cancers could result from 50 years of operation.

Worker Doses and Health Effects. Based on measured values during 1991 and 1992 (Dose Reports for 1991 and 1992), it is estimated that the average dose to a badged worker involved in No Action activities at ORR in 2005 and beyond would equal 2.6 mrem. It is projected that in 2005 and beyond, there would be 17,215 badged workers involved in No Action activities. The annual dose among all these workers would equal 44 person-rem. From 50 years of operation, an estimated fatal cancer risk of 5.2×10^{-5} would result to the average worker and 0.88 fatal cancers could result among all workers.

Table M.2.8.1–1. Annual Atmospheric Radioactive Releases From Normal Operation of No Action at Oak Ridge Reservation (curies)

Isotope	K–25	X-10	Y–12	No Action HEU Storage[a]
H-3	0	$2.4x10^{2}$	0	0
Be-7	0	$3.8x10^{-4}$	0	0
K-40	$4.0x10^{-2}$	0	0	0
Ar-41	0	$1.8x10^{3}$	0	0
Co-57	$1.2x10^{-4}$	0	0	0
Co-60	$4.4x10^{-3}$	$2.6x10^{-6}$	0	0
Sr-90	0	$3.8x10^{-4}$	0	0
Tc-99	0.12	0	0	0
Ru-106	$4.5x10^{-3}$	0	0	0
Cd-109	$7.6x10^{-3}$	0	0	0
I-129	0	$2.5x10^{-4}$	0	0
I-130	0	$5.5x10^{-5}$	0	0
I-131	0	$5.3x10^{-2}$	0	0
I-132	0	0.93	0	0
I-133	0	0.20	0	0
I-135	0	0.47	0	0
Xe-135	0	$5.0x10^{1}$	0	0
Xe-138	0	$7.1x10^{1}$	0	0
Cs-134	0	$5.2x10^{-7}$	0	0
Cs-137	$5.0x10^{-3}$	$5.1x10^{-4}$	0	0
Cs-138	0	$7.1x10^{1}$	0	0
Ba-140	0	$4.9x10^{-4}$	0	0
Ce-141	$2.0x10^{-4}$	0	0	0
Eu-152	0	$1.7x10^{-6}$	0	0
Eu-154	0	$2.5x10^{-6}$	0	0
Eu-155	0	$5.2x10^{-6}$	0	0
Os-191	0	0.17	0	0
Pb-212	0	0.37	0	0
Th-228	$3.8x10^{-4}$	$1.5x10^{-6}$	0	0
Th-230	$5.9x10^{-5}$	$5.7x10^{-8}$	0	0
Th-232	$1.1x10^{-4}$	$3.3x10^{-8}$	0	0
Th-234	$1.8x10^{-2}$	0	0	0
U-234	$4.0x10^{-3}$	$8.7x10^{-6}$	$4.7x10^{-2}$	$4.7x10^{-5}$
U-235	$1.8x10^{-4}$	$4.7x10^{-7}$	$1.5x10^{-3}$	$1.5x10^{-6}$
U-236	0	0	$1.9x10^{-4}$	$1.9x10^{-7}$
U-238	$4.2x10^{-3}$	$2.8x10^{-5}$	$6.5x10^{-3}$	$6.5x10^{-6}$
Np-237	$5.7x10^{-4}$	0	0	0
Pu-238	$2.5x10^{-4}$	$2.8x10^{-6}$	0	0
Pu-239	$5.7x10^{-5}$	$8.0x10^{-6}$	0	0
Am-241	0	$4.6x10^{-6}$	0	0
Cm-244	0	$7.3x10^{-5}$	0	0

[a] No Action HEU storage release is assumed equal to 0.001 of Y–12 releases.

Source: OR DOE 1994c.

Table M.2.8.1–2. Annual Liquid Releases From Normal Operation of No Action at Oak Ridge Reservation (curies)

Isotope	K-25	X-10
H-3	0	$1.8x10^{-3}$
K-40	0.019	0
Co-60	0	0.55
Sr-90	0	6.7
Tc-99	0.030	0
Ru-106	0.038	0
Cs-137	$1.2x10^{-3}$	0.018
Ce-143	0.20	0.040
Th-228	0.20	0
Th-230	$2.4x10^{-5}$	0
Th-234	0.036	0
U-234	$7.7x10^{-3}$	$9.5x10^{-4}$
U-235	0.014	0.056
U-236	$5.8x10^{-4}$	0
U-238	$6.0x10^{-3}$	4.5
Np-237	$1.2x10^{-3}$	0
Pu-238	$1.6x10^{-4}$	0

Source: OR DOE 1994c.

M.2.8.2 Storage and Disposition

Atmospheric Releases and Resulting Impacts to the Public. Total site radiological impacts during operation of storage or disposition facilities can be found by adding the impacts resulting from No Action facilities to the incremental impacts resulting from storage or disposition facilities. For example, to determine the radiological impact for the addition of the AP600 reactor at ORR, the No Action facilities doses would be summed with the AP600 reactor doses. Estimated annual atmospheric radioactive releases for the storage and disposition facilities are given in Section M.2.3. Tables M.2.8–5 and M.2.8–6 present the atmospheric radiological impacts by alternative facility.

The annual dose associated with the different alternative facilities range from $9.4x10^{-8}$ to 4.8 mrem to the maximally exposed member of the public and from $1.8x10^{-6}$ to 5.1 person-rem to the 80-km (50 mi) population in the year 2030. The associated health effects from annual operations are included in both tables.

Liquid Releases and Resulting Impacts to the Public. There are two disposition technologies that would release liquid discharges to the surface water surrounding ORR. These are the large and small evolutionary Advanced LWRs. The liquid releases for these technologies are given in Section M.2.3. As an example of determining the total site liquid radiological impact associated with the addition of an AP600 reactor at ORR, the No Action liquid doses must be summed with the AP600 reactor liquid doses. Tables M.2.8–7 and M.2.8–8 present the liquid radiological impacts for the applicable alternative facilities.

No change was reported in liquid radioactive releases due to the upgraded or new HEU storage facilities for continued HEU storage at ORR above those radioactive releases already included in No Action. Therefore, there are no changes in dose to the public from the upgraded or new HEU storage facilities at ORR.

The annual incremental doses associated with the different LWR's that have liquid releases range from 0.060 to 0.54 mrem to the maximally exposed member of the public, and range from 0.078 to 0.50 person-rem to the downstream population in 2030. The associated health effects from annual operations are included in both tables.

Worker Doses and Health Effects. For the storage and disposition alternatives, the impacts from the No Action facilities need to be added to the changes in impacts from the storage or disposition facilities to determine the impacts from total site operations, refer to the worker discussion under No Action, above, and to Table M.2.3.2–1).

M.2.9 RADIOLOGICAL IMPACTS AT SAVANNAH RIVER SITE

This section presents the radiological impacts of the various storage and disposition alternatives at SRS. Section M.2.9.1 presents the radiological releases and resulting impacts from facilities associated with No Action. Section M.2.9.2 presents the radiological releases and resulting impacts from the various alternatives.

For purposes of radiological impact modeling, SRS was divided into thirteen separate areas which would release radioactivity in 2005. All potential release points in each area were aggregated into a single release point. Table M.2.9–1 presents the characteristics of each of the release points including location, release height, and minimum distance and annual average dispersion to the site boundary in each of 16 directions. In order to calculate the maximum site boundary dose (that is, the dose ultimately incurred to the site MEI), the dose from each release point to the "maximum receptor" (that is, potential MEI) associated with each of the other release points has been calculated. For example, the dose resulting from releases from F-, H-, S-Areas, the K- and L-Reactors and other storage and disposition alternatives, has been determined for the maximum receptor from the Savannah River Technology Center Laboratory in A-Area. Figure M.2.9–1 illustrates the location of each maximum receptor in relation to each release point. The maximum site boundary dose (that is, the dose ultimately incurred to the site MEI) is then determined by the maximum dose to one of these maximum receptors. Table M.2.9–2 presents the direction, distance, and atmospheric dispersion from each release point to each of the maximum receptors. For further clarification on the definition of the "maximum receptor," refer to Section M.2.2.2. Annual radiological releases were assumed to remain constant during the full operational period.

Descriptions of population and foodstuffs distributions centered on each release area are provided in a Health Risk Data report, October, 1996. The joint frequency distribution used for the dose assessment was based on the meteorological measurements for 1985 from the meteorological tower at SRS at the 61-m (201-ft) height and is contained in the Health Risk Data report.

Doses given in this section are associated with 1 year of operation because regulatory standards are given as annual limits. The health effects are presented on an annual basis in the tables and for the projected operational period in the text. Tables M.2.9–3 through M.2.9–6 include the radiological impacts to the public from both atmospheric releases and from using the surface water for No Action and the storage and disposition alternatives.

Table M.2.9–1. Release Point Characteristics, Direction, Distance, and Atmospheric Dispersion at the Savannah River Site Boundary

Release Point[a]	A-Area		HEU Storage		C-Area		D-Area		LWR Site		F-Area		MOX Fuel Fab	
Latitude	33°20' 24.303"		33°17' 44.436"		33°14' 59.126"		33°12' 18.645"		33°15' 26.202"		33°17' 11.230"		33°14' 34.932"	
Longitude	-81°44' 6.652"		-81°37' 3.675"		-81°40' 37.760"		-81°44' 14.929"		-81°38' 14.347"		-81°40' 34.560"		-81°34' 49.733"	
Release Height	31 m		10 m		61 m		16 m		10 m		61 m		10 m	
	Distance and Atmospheric Dispersion at Site Boundary													
Direction	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)
N	1,895	$7.3x10^{-7}$	11,484	$2.1x10^{-7}$	14,591	$3.6x10^{-8}$	14,804	$1.2x10^{-7}$	15,162	$1.5x10^{-7}$	10,898	$4.8x10^{-8}$	17,092	$1.2x10^{-7}$
NNE	3,252	$5.4x10^{-7}$	11,609	$2.5x10^{-7}$	17,178	$3.7x10^{-8}$	20,525	$9.3x10^{-8}$	16,006	$1.6x10^{-7}$	12,665	$5.0x10^{-8}$	15,559	$1.7x10^{-7}$
NE	5,443	$3.4x10^{-7}$	13,248	$2.4x10^{-7}$	20,171	$3.3x10^{-8}$	25,502	$8.1x10^{-8}$	17,442	$1.7x10^{-7}$	14,770	$4.5x10^{-8}$	12,020	$2.7x10^{-7}$
ENE	12,398	$1.5x10^{-7}$	13,622	$2.6x10^{-7}$	18,137	$4.6x10^{-8}$	22,616	$1.1x10^{-7}$	14,346	$2.4x10^{-7}$	18,525	$4.5x10^{-8}$	8,089	$5.3x10^{-7}$
E	21,471	$8.7x10^{-8}$	12,267	$3.4x10^{-7}$	16,523	$5.7x10^{-8}$	21,665	$1.3x10^{-7}$	12,854	$3.2x10^{-7}$	17,118	$5.5x10^{-8}$	7,520	$6.7x10^{-7}$
ESE	23,860	$5.4x10^{-8}$	12,030	$2.5x10^{-7}$	17,942	$3.7x10^{-8}$	16,442	$1.3x10^{-7}$	15,287	$1.8x10^{-7}$	16,943	$4.0x10^{-8}$	9,794	$3.3x10^{-7}$
SE	27,210	$2.6x10^{-8}$	15,615	$1.0x10^{-7}$	15,532	$2.2x10^{-8}$	14,573	$8.8x10^{-8}$	15,156	$1.0x10^{-7}$	19,771	$1.7x10^{-8}$	10,298	$1.8x10^{-7}$
SSE	25,918	$1.8x10^{-8}$	17,503	$5.6x10^{-8}$	15,180	$1.7x10^{-8}$	9,140	$1.1x10^{-7}$	14,542	$7.2x10^{-8}$	18,933	$1.4x10^{-8}$	10,942	$1.1x10^{-7}$
S	14,851	$3.5x10^{-8}$	18,113	$5.5x10^{-8}$	14,871	$1.6x10^{-8}$	6,536	$1.7x10^{-7}$	14,883	$7.1x10^{-8}$	18,516	$1.3x10^{-8}$	11,773	$9.8x10^{-8}$
SSW	7,325	$1.2x10^{-7}$	20,688	$6.5x10^{-8}$	13,136	$2.8x10^{-8}$	5,091	$3.4x10^{-7}$	16,175	$9.1x10^{-8}$	15,467	$2.4x10^{-8}$	13,372	$1.2x10^{-7}$
SW	5,305	$3.1x10^{-7}$	16,729	$1.4x10^{-7}$	9,329	$6.9x10^{-8}$	2,584	$1.4x10^{-6}$	14,672	$1.7x10^{-7}$	11,525	$5.6x10^{-8}$	17,355	$1.3x10^{-7}$
WSW	3,421	$5.8x10^{-7}$	15,252	$1.9x10^{-7}$	9,272	$7.7x10^{-8}$	1,990	$2.3x10^{-6}$	12,907	$2.4x10^{-7}$	9,645	$7.4x10^{-8}$	17,206	$1.6x10^{-7}$
W	2,580	$6.0x10^{-7}$	14,818	$1.6x10^{-7}$	9,879	$5.7x10^{-8}$	2,217	$1.6x10^{-6}$	13,125	$1.9x10^{-7}$	9,416	$6.0x10^{-8}$	17,678	$1.3x10^{-7}$
WNW	1,743	$6.8x10^{-7}$	13,150	$1.5x10^{-7}$	9,583	$4.7x10^{-8}$	2,676	$9.8x10^{-7}$	13,373	$1.4x10^{-7}$	9,847	$4.6x10^{-8}$	18,889	$8.9x10^{-8}$
NW	1,603	$5.6x10^{-7}$	12,226	$1.3x10^{-7}$	11,859	$2.9x10^{-8}$	7,920	$1.8x10^{-7}$	14,281	$1.0x10^{-7}$	9,448	$3.6x10^{-8}$	18,982	$7.1x10^{-8}$
NNW	1,385	$6.3x10^{-7}$	11,505	$1.4x10^{-7}$	12,763	$2.7x10^{-8}$	7,897	$1.9x10^{-7}$	14,678	$1.0x10^{-7}$	9,972	$3.5x10^{-8}$	18,119	$7.7x10^{-8}$

Table M.2.9–1. Release Point Characteristics, Direction, Distance, and Atmospheric Dispersion at the Savannah River Site Boundary—Continued

Release Point[a]	H-Area	K-Area	L-Area	M-Area	P-Area	S-Area
Latitude	33°17' 10.880"	33°12' 42.145"	33°12' 38.484"	33°20' 17.321"	33°13' 42.293"	33°17' 42.592"
Longitude	-81°38' 25.118"	-81°39' 49.356"	-81°37' 26.480"	-81°44' 15.593"	-81°34' 53.420"	-81°38' 34.989"
Release Height	61 m	61 m	61 m	10 m	61 m	10 m

Distance and Atmospheric Dispersion at Site Boundary

Direction	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)	Distance (m)	Chi/Q (s/m^3)
N	12,288	4.3×10^{-8}	19,103	2.7×10^{-8}	20,707	2.5×10^{-8}	1,764	2.9×10^{-6}	18,709	2.8×10^{-8}	11,294	2.2×10^{-7}
NNE	12,852	4.9×10^{-8}	21,410	2.9×10^{-8}	21,148	2.9×10^{-8}	2,980	1.7×10^{-6}	16,156	3.9×10^{-8}	11,975	2.4×10^{-7}
NE	14,883	4.5×10^{-8}	21,710	3.1×10^{-8}	15,504	4.3×10^{-8}	5,744	7.6×10^{-7}	10,712	6.2×10^{-8}	14,232	2.2×10^{-7}
ENE	15,959	5.2×10^{-8}	15,635	5.4×10^{-8}	12,053	7.0×10^{-8}	12,796	2.8×10^{-7}	7,832	1.0×10^{-7}	15,664	2.2×10^{-7}
E	14,047	6.7×10^{-8}	15,628	6.0×10^{-8}	13,327	7.1×10^{-8}	21,924	1.6×10^{-7}	7,757	1.2×10^{-7}	14,622	2.7×10^{-7}
ESE	13,688	4.9×10^{-8}	13,430	5.0×10^{-8}	11,163	6.1×10^{-8}	24,035	9.8×10^{-8}	9,846	6.9×10^{-8}	14,219	2.0×10^{-7}
SE	17,629	2.0×10^{-8}	11,432	3.0×10^{-8}	9,888	3.5×10^{-8}	26,982	4.9×10^{-8}	9,253	3.7×10^{-8}	18,437	8.1×10^{-8}
SSE	17,662	1.5×10^{-8}	10,837	2.5×10^{-8}	9,295	2.9×10^{-8}	25,603	3.4×10^{-8}	9,658	2.8×10^{-8}	18,667	5.1×10^{-8}
S	18,109	1.3×10^{-8}	11,120	2.1×10^{-8}	9,588	2.5×10^{-8}	14,346	7.5×10^{-8}	10,160	2.4×10^{-8}	19,114	5.1×10^{-8}
SSW	18,481	2.0×10^{-8}	10,680	3.5×10^{-8}	12,155	3.1×10^{-8}	7,012	2.8×10^{-7}	11,769	3.2×10^{-8}	19,045	7.3×10^{-8}
SW	14,355	4.4×10^{-8}	10,612	6.1×10^{-8}	12,500	5.1×10^{-8}	5,099	7.2×10^{-7}	15,824	4.0×10^{-8}	14,549	1.7×10^{-7}
WSW	14,212	5.0×10^{-8}	9,142	7.8×10^{-8}	13,517	5.3×10^{-8}	3,289	1.6×10^{-6}	16,741	4.2×10^{-8}	12,874	2.4×10^{-7}
W	12,763	4.4×10^{-8}	8,855	6.3×10^{-8}	12,507	4.5×10^{-8}	2,500	1.9×10^{-6}	16,724	3.3×10^{-8}	12,465	2.0×10^{-7}
WNW	12,643	3.6×10^{-8}	12,325	3.6×10^{-8}	15,669	2.8×10^{-8}	2,277	1.7×10^{-6}	18,799	2.3×10^{-8}	11,487	1.7×10^{-7}
NW	11,889	2.9×10^{-8}	13,275	2.5×10^{-8}	17,079	1.9×10^{-8}	1,659	2.1×10^{-6}	20,240	1.6×10^{-8}	10,979	1.5×10^{-7}
NNW	11,749	3.0×10^{-8}	17,092	2.0×10^{-8}	19,328	1.8×10^{-8}	1,485	2.5×10^{-6}	19,686	1.7×10^{-8}	10,740	1.5×10^{-7}

[a] See Figure M.2.9–1 for location of release points.

Source: HNUS 1996a.

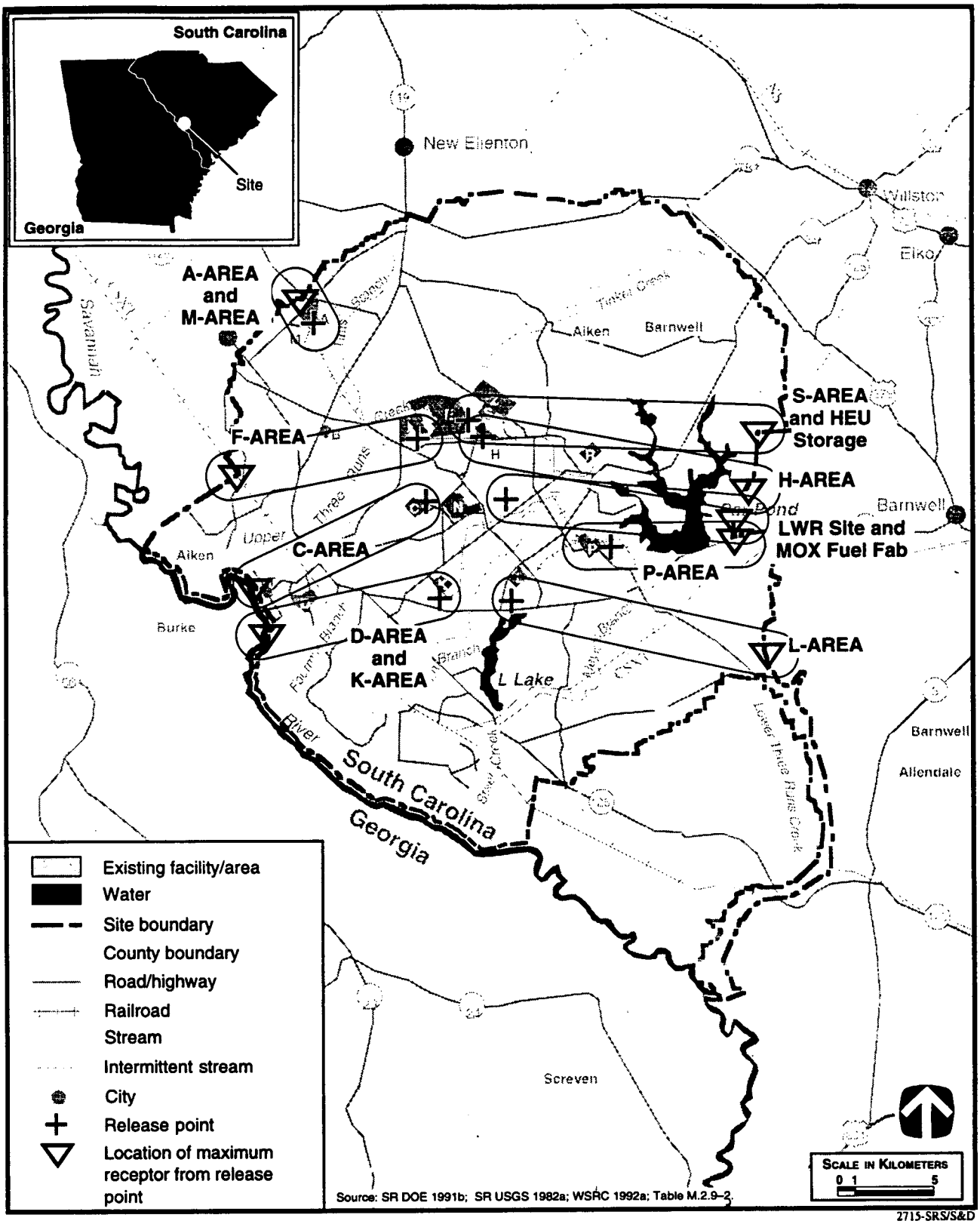

Figure M.2.9–1. Location of Release Points and Maximum Receptors at Savannah River Site.

Table M.2.9–2. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Savannah River Site Boundary

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: A-Area			
A-Area and M-Area	N	1,896	7.3×10^{-7}
HEU Storage and S-Area	ESE	23,860	5.4×10^{-8}
C-Area	SSW	14,089	5.6×10^{-8}
D-Area and K-Area	S	15,711	3.3×10^{-8}
LWR Site and MOX Fuel Fab	ESE	24,185	5.3×10^{-8}
F-Area	SSW	8,869	9.9×10^{-8}
H-Area	ESE	24,206	5.3×10^{-8}
L-Area	SE	28,504	2.4×10^{-8}
P-Area	ESE	24,607	5.2×10^{-8}
Release Point: HEU Storage			
A-Area and M-Area	WNW	13,188	1.5×10^{-7}
HEU Storage and S-Area	E	12,267	3.4×10^{-7}
C-Area	WSW	16,571	1.7×10^{-7}
D-Area and K-Area	SW	16,844	1.4×10^{-7}
LWR Site and MOX Fuel Fab	ESE	12,193	2.4×10^{-7}
F-Area	W	15,195	1.6×10^{-7}
H-Area	ESE	12,254	2.4×10^{-7}
L-Area	SE	16,820	9.1×10^{-8}
P-Area	ESE	12,637	2.3×10^{-7}
Release Point: C-Area			
A-Area and M-Area	NNW	13,204	2.6×10^{-8}
HEU Storage and S-Area	ENE	18,313	4.5×10^{-8}
C-Area	WSW	9,273	7.7×10^{-8}
D-Area and K-Area	SW	9,345	6.9×10^{-8}
LWR Site and MOX Fuel Fab	E	16,526	5.7×10^{-8}
F-Area	WNW	9,583	4.7×10^{-8}
H-Area	E	17,287	5.4×10^{-8}
L-Area	ESE	19,141	3.5×10^{-8}
P-Area	E	16,599	5.6×10^{-8}
Release Point: D-Area			
A-Area and M-Area	N	16,816	1.0×10^{-7}
HEU Storage and S-Area	ENE	25,191	9.4×10^{-8}
C-Area	WNW	3,112	8.0×10^{-7}
D-Area and K-Area	WSW	1,991	2.3×10^{-6}
LWR Site and MOX Fuel Fab	ENE	22,651	1.1×10^{-7}
F-Area	NNW	7,949	1.8×10^{-7}
H-Area	ENE	23,721	1.0×10^{-7}
L-Area	E	23,820	1.1×10^{-7}
P-Area	E	22,520	1.2×10^{-7}
Release Point: LWR Site			
A-Area and M-Area	NW	14,555	1.0×10^{-7}
HEU Storage and S-Area	ENE	14,510	2.4×10^{-7}
C-Area	WSW	13,026	2.3×10^{-7}
D-Area and K-Area	WSW	12,917	2.4×10^{-7}

Table M.2.9–2. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Savannah River Site Boundary—Continued

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
LWR Site and MOX Fuel Fab	E	12,855	$3.2x10^{-7}$
F-Area	W	13,125	$1.9x10^{-7}$
H-Area	E	13,531	$3.0x10^{-7}$
L-Area	ESE	16,000	$1.7x10^{-7}$
P-Area	E	12,995	$3.2x10^{-7}$
Release Point: F-Area			
A-Area and M-Area	NW	9,759	$3.5x10^{-8}$
HEU Storage and S-Area	E	17,703	$5.3x10^{-8}$
C-Area	SW	11,589	$5.5x10^{-8}$
D-Area and K-Area	SW	12,260	$5.2x10^{-8}$
LWR Site and MOX Fuel Fab	ESE	16,985	$4.0x10^{-8}$
F-Area	WSW	9,646	$7.4x10^{-8}$
H-Area	E	17,349	$5.4x10^{-8}$
L-Area	ESE	20,708	$3.2x10^{-8}$
P-Area	ESE	17,266	$3.9x10^{-8}$
Release Point: MOX Fuel Fab			
A-Area and M-Area	NW	19,432	$6.9x10^{-8}$
HEU Storage and S-Area	ENE	10,158	$3.9x10^{-7}$
C-Area	W	17,750	$1.3x10^{-7}$
D-Area and K-Area	WSW	17,210	$1.6x10^{-7}$
LWR Site and MOX Fuel Fab	E	7,538	$6.7x10^{-7}$
F-Area	W	18,577	$1.2x10^{-7}$
H-Area	ENE	7,502	$5.9x10^{-7}$
L-Area	ESE	10,573	$3.0x10^{-7}$
P-Area	E	7,565	$6.6x10^{-7}$
Release Point: H-Area			
A-Area and M-Area	NW	12,076	$2.8x10^{-8}$
HEU Storage and S-Area	E	14,356	$6.6x10^{-8}$
C-Area	WSW	14,239	$5.0x10^{-8}$
D-Area and K-Area	SW	14,567	$4.3x10^{-8}$
LWR Site and MOX Fuel Fab	ESE	13,766	$4.9x10^{-8}$
F-Area	W	12,939	$4.3x10^{-8}$
H-Area	E	14,047	$6.7x10^{-8}$
L-Area	SE	17,852	$1.9x10^{-8}$
P-Area	ESE	14,102	$4.8x10^{-8}$
Release Point: K-Area			
A-Area and M-Area	NNW	17,560	$2.0x10^{-8}$
HEU Storage and S-Area	ENE	18,629	$4.5x10^{-8}$
C-Area	W	9,755	$5.8x10^{-8}$
D-Area and K-Area	W	8,871	$6.3x10^{-8}$
LWR Site and MOX Fuel Fab	ENE	15,793	$5.3x10^{-8}$
F-Area	WNW	12,336	$3.6x10^{-8}$
H-Area	ENE	16,942	$4.9x10^{-8}$
L-Area	E	17,014	$5.5x10^{-8}$
P-Area	E	15,629	$6.0x10^{-8}$

Table M.2.9–2. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Savannah River Site Boundary—Continued

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: L-Area			
A-Area and M-Area	NNW	19,433	$1.8x10^{-8}$
HEU Storage and S-Area	NE	15,504	$4.3x10^{-8}$
C-Area	W	13,455	$4.2x10^{-8}$
D-Area and K-Area	W	12,529	$4.5x10^{-8}$
LWR Site and MOX Fuel Fab	ENE	12,290	$6.8x10^{-8}$
F-Area	WNW	15,677	$2.8x10^{-8}$
H-Area	ENE	13,557	$6.2x10^{-8}$
L-Area	E	13,327	$7.1x10^{-8}$
P-Area	ENE	12,058	$7.0x10^{-8}$
Release Point: M-Area			
A-Area and M-Area	N	2,078	$2.3x10^{-6}$
HEU Storage and S-Area	ESE	24,035	$9.8x10^{-8}$
C-Area	SSW	13,829	$1.1x10^{-7}$
D-Area and K-Area	S	15,468	$6.8x10^{-8}$
LWR Site and MOX Fuel Fab	ESE	24,305	$9.6x10^{-8}$
F-Area	SSW	8,574	$2.2x10^{-7}$
H-Area	ESE	24,347	$9.6x10^{-8}$
L-Area	SE	28,576	$4.5x10^{-8}$
P-Area	ESE	24,719	$9.4x10^{-8}$
Release Point: P-Area			
A-Area and M-Area	NW	20,454	$1.6x10^{-8}$
HEU Storage and S-Area	NE	11,137	$6.0x10^{-8}$
C-Area	W	17,456	$3.2x10^{-8}$
D-Area and K-Area	W	16,737	$3.3x10^{-8}$
LWR Site and MOX Fuel Fab	ENE	7,915	$1.0x10^{-7}$
F-Area	WNW	18,800	$2.3x10^{-8}$
H-Area	ENE	9,137	$9.1x10^{-8}$
L-Area	ESE	9,953	$6.8x10^{-8}$
P-Area	E	7,758	$1.2x10^{-7}$
Release Point: S-Area			
A-Area and M-Area	NW	11,264	$1.4x10^{-7}$
HEU Storage and S-Area	E	14,623	$2.7x10^{-7}$
C-Area	SW	14,591	$1.7x10^{-7}$
D-Area and K-Area	SW	15,046	$1.6x10^{-7}$
LWR Site and MOX Fuel Fab	ESE	14,336	$1.9x10^{-7}$
F-Area	WSW	12,875	$2.4x10^{-7}$
H-Area	ESE	14,510	$1.9x10^{-7}$
L-Area	S	18,625	$8.0x10^{-8}$
P-Area	ESE	14,719	$1.9x10^{-7}$

Source: HNUS 1996a.

Table M.2.9–3. Doses and Resulting Health Effects to the Maximally Exposed Individual From Atmospheric Releases Associated With Annual Normal Operation at Savannah River Site

Alternative/Facility	Dose by Pathway (mrem)				Committed Effective Dose Equivalent (mrem)	Percent of Background[a]	Estimated 1-Year Fatal Cancer Risk
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	4.4×10^{-2}	3.9×10^{-1}	1.1×10^{-7}	3.6×10^{-5}	4.2×10^{-1}	1.4×10^{-1}	2.1×10^{-7}
Upgraded Storage Facility[b]	c	c	c	c	6.2×10^{-6}	2.2×10^{-6}	3.1×10^{-12}
Consolidated Storage Facility	1.4×10^{-5}	2.5×10^{-8}	5.5×10^{-15}	1.1×10^{-11}	1.4×10^{-5}	4.7×10^{-6}	7.0×10^{-12}
Collocated Storage Facilities	1.4×10^{-5}	2.4×10^{-8}	5.7×10^{-15}	1.7×10^{-11}	1.4×10^{-5}	4.7×10^{-6}	7.0×10^{-12}
Pit Disassembly/Conversion Facility	1.6×10^{-3}	3.5×10^{-5}	9.3×10^{-12}	1.4×10^{-8}	1.6×10^{-3}	5.4×10^{-4}	8.0×10^{-10}
Pu Conversion Facility	1.0×10^{-3}	1.9×10^{-6}	4.4×10^{-13}	9.1×10^{-10}	1.0×10^{-3}	3.4×10^{-4}	5.0×10^{-10}
MOX Fuel Fabrication Facility	1.5×10^{-3}	2.5×10^{-6}	5.6×10^{-13}	2.7×10^{-9}	1.5×10^{-3}	5.0×10^{-4}	7.5×10^{-10}
Ceramic Immobilization Facility (Immobilized Disposition)	1.8×10^{-7}	3.2×10^{-10}	7.0×10^{-17}	1.4×10^{-13}	1.8×10^{-7}	6.0×10^{-8}	9.0×10^{-14}
Deep Borehole Complex (Direct Disposition)	2.7×10^{-8}	3.9×10^{-10}	1.0×10^{-16}	1.6×10^{-13}	2.8×10^{-8}	9.4×10^{-9}	1.4×10^{-14}
Deep Borehole Complex (Immobilized Disposition)	3.4×10^{-8}	5.9×10^{-10}	1.5×10^{-16}	2.3×10^{-13}	3.4×10^{-8}	1.1×10^{-8}	1.7×10^{-14}
Vitrification Facility	7.1×10^{-5}	4.9×10^{-6}	1.4×10^{-9}	7.7×10^{-7}	7.7×10^{-5}	2.6×10^{-5}	3.9×10^{-11}
Ceramic Immobilization Facility (Ceramic Immobilization)	2.0×10^{-7}	9.5×10^{-7}	2.8×10^{-10}	1.5×10^{-7}	1.3×10^{-6}	4.4×10^{-7}	6.5×10^{-13}
Advanced Boiling Water Reactor	3.1×10^{-3}	2.3×10^{-1}	2.9×10^{-2}	3.7×10^{-3}	2.6×10^{-1}	8.7×10^{-2}	1.3×10^{-7}
CE System 80+ Reactor	8.1×10^{-3}	2.0×10^{-1}	4.2×10^{-3}	1.0×10^{-4}	2.1×10^{-1}	7.0×10^{-2}	1.1×10^{-7}
[Text deleted.]							
AP600 Reactor	1.8×10^{-3}	1.5×10^{-1}	1.4×10^{-2}	1.1×10^{-3}	1.6×10^{-1}	5.4×10^{-2}	8.0×10^{-8}
RESAR-90 Reactor	6.5×10^{-3}	2.1×10^{-1}	5.9×10^{-3}	1.2×10^{-3}	2.3×10^{-1}	7.7×10^{-2}	1.2×10^{-7}

[a] Individual annual natural background radiation dose is equal to 298 mrem.

[b] Dose and health effect results are based on a capacity of 5,000 Pu storage positions in the APSF (SR DOE 1995e). Because the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative and the Upgrade With RFETS Non-Pit Pu Subalternative both call for fewer than 5,000 Pu storage positions in the APSF, dose and health effects for these two subalternatives would be less. The dose shown here is for the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative. The dose for the Upgrade With RFETS Non-Pit Pu Subalternative would be slightly less, and would be below detection limits.

[c] Number reflected as a component in the Committed Effected Dose Equivalent.

Source: HNUS 1996a.

Table M.2.9–4. Doses and Resulting Health Effects to the Population Within 80 Kilometers of Savannah River Site From Atmospheric Releases Associated With Normal Operation in 2030

Alternative/Facility	Dose by Pathway (person-rem)				Committed Effective Dose Equivalent (person-rem)	Percent of Background[a]	Estimated 1-Year Fatal Cancer
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	3.9	3.6×10^{1}	2.5×10^{-5}	5.1×10^{-3}	40×10^{1}	1.5×10^{-2}	2.0×10^{-2}
Upgraded Storage Facility[b]	c	c	c	c	2.9×10^{-4}	1.1×10^{-7}	1.5×10^{-7}
Consolidated Storage Facility	9.2×10^{-4}	2.6×10^{-6}	3.6×10^{-13}	7.4×10^{-10}	9.2×10^{-4}	3.5×10^{-7}	4.6×10^{-7}
Collocated Storage Facilities	8.8×10^{-4}	2.7×10^{-6}	3.6×10^{-13}	1.1×10^{-9}	8.8×10^{-4}	3.3×10^{-7}	4.4×10^{-7}
Pit Disassembly/Conversion Facility	0.10	3.6×10^{-3}	6.2×10^{-10}	9.1×10^{-7}	0.11	4.1×10^{-5}	5.5×10^{-5}
Pu Conversion Facility	6.6×10^{-2}	2.0×10^{-4}	2.8×10^{-11}	5.9×10^{-8}	6.6×10^{-2}	2.5×10^{-5}	3.3×10^{-5}
MOX Fuel Fabrication Facility	4.4×10^{-2}	1.6×10^{-4}	1.6×10^{-11}	7.8×10^{-8}	4.4×10^{-2}	1.7×10^{-5}	2.2×10^{-5}
Ceramic Immobilization Facility (Immobilized Disposition)	1.2×10^{-5}	3.2×10^{-8}	4.6×10^{-15}	9.2×10^{-12}	1.2×10^{-5}	4.5×10^{-9}	6.0×10^{-9}
Deep Borehole Complex (Direct Disposition)	1.7×10^{-6}	4.7×10^{-8}	6.6×10^{-15}	9.8×10^{-12}	1.7×10^{-6}	6.4×10^{-10}	8.5×10^{-10}
Deep Borehole Complex (Immobilized Disposition)	2.1×10^{-6}	6.8×10^{-8}	9.5×10^{-15}	1.5×10^{-11}	2.2×10^{-6}	8.3×10^{-10}	1.1×10^{-9}
Vitrification Facility	4.7×10^{-3}	2.3×10^{-4}	9.1×10^{-8}	5.1×10^{-5}	5.0×10^{-3}	1.9×10^{-6}	2.5×10^{-6}
Ceramic Immobilization Facility (Ceramic Immobilization)	1.3×10^{-5}	4.4×10^{-5}	1.9×10^{-8}	1.0×10^{-5}	6.7×10^{-5}	2.5×10^{-8}	3.4×10^{-8}
Advanced Boiling Water Reactor	1.8×10^{-1}	30	1.2	1.9×10^{-1}	32	1.2×10^{-2}	1.6×10^{-2}
CE System 80+ Reactor	5.1×10^{-1}	27	1.8×10^{-1}	5.9×10^{-3}	28	1.1×10^{-2}	1.4×10^{-2}
[Text deleted.]							
AP600 Reactor	1.1×10^{-1}	23	6.5×10^{-1}	6.5×10^{-2}	24	9.0×10^{-3}	1.2×10^{-2}
RESAR-90 Reactor	4.0×10^{-1}	29	3.0×10^{-1}	7.5×10^{-2}	29	1.1×10^{-2}	1.5×10^{-2}

[a] Total dose to the population within 80 km from natural background radiation in year 2030 is equal to 266,000 person-rem.

[b] Dose and health effect results are based on a capacity of 5,000 Pu storage positions in the APSF (SR DOE 1995e). Because the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative and the Upgrade With RFETS Non-Pit Pu Subalternative both call for fewer than 5,000 Pu storage positions in the APSF, dose and health effects for these two subalternatives would be less. The dose shown here is for the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative. The dose for the Upgrade With RFETS Non-Pit Pu Subalternative would be slightly less, and would be below detection limits.

[c] Number reflected as a component in the Committed Effective Dose Equivalent.

Source: HNUS 1996a.

Table M.2.9–5. Doses and Resulting Health Effects to the Maximally Exposed Individual From Liquid Releases Associated With Annual Normal Operation at Savannah River Site

Alternative/Facility	Dose by Pathway (mrem)						Committed Effective Dose Equivalent (mrem)	Percent of Background[a]	Estimated 1-Year Fatal Cancer Risk
	Fish Ingestion	Other Food Ingestion	Drinking Water	Boating	Swimming	Shoreline			
No Action (Total Site)	0.27	8.1×10^{-2}	2.3×10^{-2}	2.0×10^{-6}	4.0×10^{-6}	5.9×10^{-4}	0.37	0.13	1.9×10^{-7}
Upgrade Storage Facility[b]	[c]	[c]	[c]	[c]	[c]	[c]	6.1×10^{-7}	2.1×10^{-6}	3.0×10^{-13}
Advanced Boiling Water Reactor	1.4×10^{-2}	4.3×10^{-4}	1.3×10^{-4}	6.1×10^{-7}	1.2×10^{-6}	1.3×10^{-4}	1.5×10^{-2}	4.9×10^{-3}	7.3×10^{-9}
CE System 80+	4.7×10^{-2}	2.9×10^{-3}	7.9×10^{-4}	2.1×10^{-6}	4.1×10^{-6}	3.5×10^{-4}	5.2×10^{-2}	1.7×10^{-2}	2.6×10^{-8}
[Text deleted.]									
AP600 Reactor	6.1×10^{-2}	4.9×10^{-3}	1.4×10^{-3}	2.0×10^{-6}	3.9×10^{-6}	3.7×10^{-4}	6.7×10^{-2}	2.3×10^{-2}	3.4×10^{-8}
RESAR-90 Reactor	4.3×10^{-2}	6.1×10^{-3}	1.8×10^{-3}	1.9×10^{-6}	3.8×10^{-6}	2.1×10^{-4}	5.1×10^{-2}	1.7×10^{-2}	2.5×10^{-8}

[a] Individual annual natural background radiation dose equal to 298 mrem.

[b] Dose and health effect results are based on a capacity of 5,000 Pu storage positions in the APSF (SR DOE 1995e). Because the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative and the Upgrade With RFETS Non-Pit Pu Subalternative both call for fewer than 5,000 Pu storage positions in the APSF, dose and health effects for these two subalternatives would be less. The dose shown here is for the Upgrade With All Or Some RFETS Pu and LANL Pu Subalternative. The dose for the upgrade with RFETS Non-Pit Pu Subalternative would be slightly less.

[c] Number reflected as a component in the Committed Effective Dose Equivalent.

Source: HNUS 1996a.

Table M.2.9–6. Doses and Resulting Health Effects to the Population Downstream of Savannah River Site From Liquid Releases Associated With Normal Operation in 2030

Alternative/Facility	Dose by Pathway (person-rem)					Committed Effective Dose Equivalent (person-rem)	Percent of Background[a]	Estimated 1-Year Fatal Cancers
	Fish Ingestion	Drinking Water	Boating	Swimming	Shoreline			
No Action (Total Site)	9.0×10^{-1}	2.7	2.2×10^{-5}	6.4×10^{-6}	1.2×10^{-3}	3.6	1.3×10^{-3}	1.8×10^{-3}
Upgrade Storage Facility[b]	[c]	[c]	[c]	[c]	[c]	1.0×10^{-5}	3.5×10^{-9}	5.0×10^{-9}
Advanced Boiling Water Reactor	8.2×10^{-2}	1.4×10^{-2}	6.8×10^{-6}	2.0×10^{-6}	2.4×10^{-4}	9.6×10^{-2}	3.4×10^{-5}	4.8×10^{-5}
CE System 80+	2.3×10^{-1}	9.2×10^{-2}	2.3×10^{-5}	6.7×10^{-6}	6.7×10^{-4}	3.2×10^{-1}	1.1×10^{-4}	1.6×10^{-4}
[Text deleted.]								
AP600 Reactor	2.3×10^{-1}	1.6×10^{-1}	2.2×10^{-5}	6.2×10^{-6}	7.2×10^{-4}	3.9×10^{-1}	1.4×10^{-4}	2.0×10^{-4}
RESAR-90 Reactor	1.6×10^{-1}	2.0×10^{-1}	2.1×10^{-5}	6.2×10^{-6}	4.1×10^{-4}	3.6×10^{-1}	1.3×10^{-4}	1.8×10^{-4}

[a] Natural background radiation dose to the population within 80 km plus the people who use the Savannah River for drinking water at the Port Wentworth and Beaufort-Jasper location is: 285,000 person-rem in the year 2030.

[b] Dose and health effect results are based on a capacity of 5,000 Pu storage positions in the APSF (SR DOE 1995e). Because the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative and the Upgrade With RFETS Non-Pit Pu Subalternative both call for fewer than 5,000 Pu storage positions in the APSF, dose and health effects for these two subalternatives would be less. The dose shown here is for the Upgrade With All or Some RFETS Pu and LANL Pu Subalternative. The dose for the Upgrade With RFETS Non-Pit Pu Subalternative would be slightly less.

[c] Number reflected as a component in the Committed Effective Dose Equivalent.

Source: HNUS 1996a.

M.2.9.1 No Action

Atmospheric Releases and Resulting Impacts to the Public. For No Action, all of the areas have radioactive releases in to the atmosphere from normal operation. Table M.2.9.1–1 presents the estimated annual atmospheric radioactive releases.

Tables M.2.9–3 and M.2.9–4 include the atmospheric radiological impacts to the maximally exposed member of the public and the offsite population within 80 km (50 mi), respectively. The MEI would receive an annual dose of 0.42 mrem. An estimated fatal cancer risk of 1.1×10^{-5} would result from 50 years of operation. The population within 80 km (50 mi) would receive a dose of 40 person-rem in 2030 (midlife of operation). An estimated 1.0 fatal cancers would result from 50 years of operation.

Liquid Releases and Resulting Impacts to the Public. For No Action, some areas may have radioactive releases to the offsite surface water from normal operation. Table M.2.9.1–2 presents the estimated annual liquid radioactive releases.

Tables M.2.9–5 and M.2.9–6 include the radiological impacts to the MEI and the offsite populations using water from the Savannah River downstream of SRS to the Atlantic Ocean. The maximally exposed member of the public would receive an annual dose of 0.37 mrem. An estimated fatal cancer risk of 9.3×10^{-6} would result from 50 years of operation. The population would receive a dose of 3.6 person-rem in 2030. An estimated 0.09 fatal cancers would result from 50 years of operation.

Worker Doses. It is projected that in 2005 and beyond, there would be 7,069 badged workers involved in No Action activities. The annual average dose among these workers would be 36 mrem and the annual dose among all these workers would equal 259 person-rem. From 50 years of operation, an estimated fatal cancer risk of 7.2×10^{-4} would result to the average worker and 5.2 fatal cancers could result among all workers.

Table M.2.9.1–1. Annual Atmospheric Radioactive Releases From Normal Operation of No Action at Savannah River Site (curies)

Isotope	SRTC	K-Reactor	L-Reactor	F-Area		H-Area		RBOF	Tritium Facilities
				Canyon Releases	Waste Management	Canyon Releases	Waste Management		
H-3	0	3.5×10^{3}	1.9×10^{2}	0	0	0	1.7×10^{0}	0	2.2×10^{4}
C-14	0	0	0	7.4×10^{-3}	0	1.1×10^{-3}	0	0	0
S-35	0	0	0	0	0	0	0	0	0
[Text deleted.]									
Cr-51	0	0	0	0	0	0	0	0	0
Co-60	0	0	0	0	5.9×10^{-9}	0	0	0	0
Ni-63	0	0	0	0	0	0	0	0	0
Se-79	0	0	0	0	0	0	0	0	0
Sr-89	0	0	0	0	0	0	0	0	0
Sr-90	1.2×10^{-5}	1.9×10^{-7}	1.8×10^{-5}	8.1×10^{-4}	0	1.3×10^{-4}	0	0	0
Y-90	0	0	0	0	0	0	0	0	0
Y-91	0	0	0	0	0	0	0	0	0
Zr-95	0	0	0	0	0	0	0	0	0
Nb-95	0	0	0	0	0	0	0	0	0
Tc-99	0	0	0	0	0	0	0	0	0
Ru-106	0	0	4.0×10^{-7}	0	0	0	5.8×10^{-9}	0	0
Sn-126	0	0	0	0	0	0	0	0	0
Sb-125	0	0	0	0	0	0	0	0	0
Te-125m	0	0	0	0	0	0	0	0	0
Te-127m	0	0	0	0	0	0	0	0	0
Te-127	0	0	0	0	0	0	0	0	0
I-129	0	0	0	1.3×10^{-3}	0	1.2×10^{-3}	0	0	0

Table M.2.9.1–1. Annual Atmospheric Radioactive Releases From Normal Operation of No Action at Savannah River Site (curies)—Continued

Isotope	SRTC	K-Reactor	L-Reactor	F-Area		H-Area		RBOF	Tritium Facilities
				Canyon Releases	Waste Management	Canyon Releases	Waste Management		
I-131	5.9×10^{-5}	0	0	1.5×10^{-6}	0	4.3×10^{-5}	0	0	0
I-133	2.0×10^{-3}	0	0	0	0	0	0	0	0
[Text deleted.]									
Xe-135	3.2×10^{-2}	0	0	0	0	0	0	0	0
Cs-134	0	0	0	6.9×10^{-7}	0	0	1.1×10^{-7}	0	0
Cs-135	0	0	0	0	0	0	0	0	0
Cs-137	1.5×10^{-6}	1.1×10^{-7}	1.0×10^{-5}	2.3×10^{-4}	3.8×10^{-6}	2.0×10^{-5}	2.2×10^{-5}	2.1×10^{-7}	0
Ce-144	0	0	0	0	0	0	0	0	0
Pr-144	0	0	0	0	0	0	0	0	0
Pm-147	0	0	0	0	0	0	0	0	0
Sm-151	0	0	0	0	0	0	0	0	0
Eu-152	0	0	0	0	0	0	0	0	0
Eu-154	0	0	0	0	0	0	0	0	0
Eu-155	0	0	0	0	0	0	0	0	0
U-235	2.9×10^{-8}	0	0	8.8×10^{-4}	2.1×10^{-6}	4.7×10^{-5}	0	0	0
Pu-238	1.0×10^{-8}	0	0	1.6×10^{-4}	3.2×10^{-7}	4.4×10^{-4}	0	0	0
Pu-239	9.4×10^{-6}	4.4×10^{-9}	4.1×10^{-7}	4.3×10^{-4}	2.6×10^{-7}	1.0×10^{-4}	0	0	0
Pu-240	0	0	0	0	0	0	0	0	0
Pu-241	0	0	0	0	0	0	0	0	0
Am-241	1.3×10^{-6}	0	0	3.1×10^{-5}	1.0×10^{-7}	4.0×10^{-5}	0	0	0
Cm-244	6.8×10^{-6}	0	0	2.2×10^{-5}	0	3.3×10^{-6}	0	0	0

Table M.2.9.1–1. Annual Atmospheric Radioactive Releases from Normal Operation of No Action at Savannah River Site (curies)—Continued

Isotope	DWPF	M–Area	CIF	P–Reactor	C–Reactor	D–Area	Diffuse Area
H-3	2.0×10^{1}	0	1.2×10^{3}	1.3×10^{3}	1.5×10^{2}	4.5×10^{2}	4.3×10^{1}
C-14	2.1×10^{-2}	0	0	0	0	0	4.0×10^{-6}
S-35	0	0	0	0	0	0	2.0×10^{-6}
[Text deleted.]							
Cr-51	0	0	1.5×10^{-2}	0	0	0	0
Co-60	6.1×10^{-8}	0	1.4×10^{-4}	0	0	0	3.3×10^{-17}
Ni-63	0	0	0	0	0	0	2.0×10^{-7}
Se-79	8.8×10^{-9}	0	0	0	0	0	0
Sr-89	0	0	6.0×10^{-4}	0	0	0	0
Sr-90	2.3×10^{-5}	8.3×10^{-5}	2.2×10^{-2}	0	0	7.2×10^{-6}	1.1×10^{-4}
Y-90	2.4×10^{-5}	0	7.6×10^{-5}	0	0	0	0
Y-91	0	0	4.5×10^{-4}	0	0	0	0
Zr-95	0	0	4.7×10^{-4}	0	0	0	2.4×10^{-14}
Nb-95	0	0	1.5×10^{-3}	0	0	0	0
Tc-99	3.8×10^{-7}	0	0	0	0	0	0
Ru-106	3.2×10^{-5}	0	1.8×10^{-4}	0	0	0	5.0×10^{-12}
Sn-126	6.9×10^{-8}	0	0	0	0	0	0
Sb-125	6.7×10^{-7}	0	0	0	0	0	7.3×10^{-15}
Te-125m	1.0×10^{-5}	0	0	0	0	0	0
Te-127m	4.5×10^{-9}	0	0	0	0	0	0
Te-127	4.4×10^{-9}	0	0	0	0	0	0
I-129	8.2×10^{-5}	0	0	0	0	0	6.9×10^{-7}
I-131	0	0	0	0	0	0	0
I-133	0	0	0	0	0	0	0
[Text deleted.]							

Table M.2.9.1–1. Annual Atmospheric Radioactive Releases from Normal Operation of No Action at Savannah River Site (curies)—Continued

Isotope	DWPF	M–Area	CIF	P–Reactor	C–Reactor	D–Area	Diffuse Area
Xe-135	0	0	0	0	0	0	0
Cs-134	2.9×10^{-5}	0	0	0	0	0	1.4×10^{-17}
Cs-135	9.4×10^{-7}	0	0	0	0	0	0
Cs-137	4.1×10^{-3}	0	2.4×10^{-4}	0	0	0	4.3×10^{-11}
Ce-144	3.0×10^{-6}	0	2.3×10^{-4}	0	0	0	1.1×10^{-13}
Pr-144	3.1×10^{-6}	0	2.3×10^{-4}	0	0	0	0
Pm-147	7.6×10^{-6}	0	9.1×10^{-4}	0	0	0	0
Sm-151	1.6×10^{-7}	0	0	0	0	0	0
Eu-152	1.4×10^{-9}	0	0	0	0	0	0
Eu-154	2.3×10^{-7}	0	0	0	0	0	3.4×10^{-13}
Eu-155	1.6×10^{-7}	0	0	0	0	0	1.6×10^{-13}
U-235	0	1.6×10^{-5}	0	0	0	0	4.7×10^{-5}
Pu-238	7.9×10^{-7}	0	1.4×10^{-4}	0	0	0	4.6×10^{-12}
Pu-239	7.1×10^{-9}	3.5×10^{-6}	5.2×10^{-7}	0	0	8.4×10^{-7}	4.7×10^{-7}
Pu-240	4.8×10^{-9}	0	0	0	0	0	0
Pu-241	7.7×10^{-7}	0	0	0	0	0	0
Am-241	8.6×10^{-9}	0	0	0	0	0	8.9×10^{-13}
Cm-244	2.7×10^{-8}	0	0	0	0	0	7.3×10^{-12}

Note: SRTC=Savannah River Technology Center; RBOF=Receiving Basin Offsite Fuel.
Source: WSRC 1994d.

Table M.2.9.1–2. Annual Liquid Releases From Normal Operation of No Action at Savannah River Site (curies)

Isotope	Release[a]
H-3	1.3×10^{4}
Sr-90	0.48
I-129	0.022
Cs-137	0.25
Pm-147	7.0×10^{-3}
U-235	1.1×10^{-5}
Pu-239	9.6×10^{-3}

[a] Total Site release.
Source: WSRC 1994d.

M.2.9.2 Storage and Disposition

Atmospheric Releases and Resulting Impacts to the Public. Total site radiological impacts during operation of storage or disposition facilities can be found by adding the impacts resulting from No Action facilities to the changes in impacts resulting from storage or disposition facilities. For example, to determine the radiological impact for the addition of an AP600 reactor at SRS, the No Action facilities doses would be summed with the AP600 reactor doses. Estimated annual atmospheric radioactive releases for the storage and disposition facilities are given in Section M.2.3. Tables M.2.9–3 and M.2.9–4 include the atmospheric radiological impacts by alternative facility.

Virtually, no change is anticipated in radioactive releases due to the upgraded or new Pu storage facilities for continued Pu storage at SRS above those radioactive releases already included in No Action. Therefore, there are no changes in dose to the public from the upgraded or new Pu storage facilities at SRS.

The annual doses from total site operations associated with the different alternative facilities range from 0 to 0.26 mrem to the maximally exposed member of the public and from 0 to 32 person-rem to the 80-km (50-mi) population in 2030. The associated health effects from annual operations are included in both tables.

Liquid Releases and Resulting Impacts to the Public. There are two disposition technologies that would release liquid discharges to the surface water surrounding SRS. These are the large and small evolutionary LWRs. The liquid releases for these two technologies are given in Section M.2.3. As an example of determining the total site liquid radiological impact associated with the addition of an AP600 reactor at SRS, the No Action liquid doses must be summed with the AP600 reactor liquid doses. Table M.2.9–5 and M.2.9–6 present the liquid radiological impacts for the applicable alternative facilities.

The annual doses associated with the different LWRs that have liquid releases range from 0.015 to 0.067 mrem to the maximally exposed member of the public, and range from 0.096 to 0.39 person-rem to the downstream population in 2030. The associated health effects from annual operations are included in both tables.

Worker Doses and Health Effects. For the storage and disposition alternatives, the impacts from the No Action facilities need to be added to the changes in impacts from the storage or disposition facilities to determine the impacts from total site operations (refer to the worker discussion under No Action, above, and to Table M.2.3.2–1).

M.2.10 RADIOLOGICAL IMPACT AT ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

The results of the radiological consequence assessments for the RFETS and the sources of data used in the assessments are given in Section 4.2.7.9.

M.2.11 RADIOLOGICAL IMPACT AT LOS ALAMOS NATIONAL LABORATORY

The results of the radiological consequence assessments the LANL and the source of data used in the assessments are given in Section 4.2.8.9.

M.2.12 DEEP BOREHOLE DISPOSITION GENERIC SITE

The results of the radiological consequence assessments for the generic borehole site are given in Sections 4.3.3.1.9 and 4.3.3.2.2.9. The sources of data used in the assessments are given in Health Physics Data, October 1996.

M.2.13 GENERIC MIXED OXIDE FUEL FABRICATION SITE

The results of the radiological consequence assessments for the generic MOX fuel fabrication facility are given in Section 4.3.5.1.9. The sources of data used in the assessments are given in Health Physics Data, October 1996.

M.2.14 EXISTING LIGHT-WATER REACTOR GENERIC SITE

The results of the radiological consequence assessments for the generic existing light-water reactor facility are given in Section 4.3.5.2.9. The sources of data used in the assessments are given in Health Physics Data, October 1996.

M.2.15 PARTIALLY COMPLETED REACTOR GENERIC SITE

The results of the radiological consequence assessments for the generic partially completed reactor site are given in Section 4.3.5.3.9. The sources of data used in the assessments are given in Health Physics Data, October 1996.

M.3 HAZARDOUS CHEMICAL IMPACTS TO HUMAN HEALTH

M.3.1 BACKGROUND

Two general types of adverse human health effects are assessed for hazardous chemical exposure in this PEIS. These are carcinogenic and non-carcinogenic effects. For this reason, two tables were developed to assist the risk assessor in the evaluation process. Table M.3.2–1, the Table of Chemical Toxicity Profiles, characterizes each chemical in terms of physical properties, potential exposure routes, and the effects on target tissues/organs that might be expected. The risk assessor will use it qualitatively to determine how exposure might occur (exposure route), what tissue or organ system might be affected (for example, central nervous system dysfunction or liver cancer) and whether the chemical might possess other properties affecting its bioavailability in a given matrix (that is, air, water, or soil). Table M.3.3–1, the Table of Exposure Limits, provides the risk assessor with the necessary information to calculate risk or expected effects should an individual be exposed to a hazardous chemical for a long time at low levels (chronic exposure) or to higher concentrations for a short time (acute). Where a dose effect calculation is required (milligram [mg]/kilogram [kg]/day), the Reference Dose (RfD) is applicable, and where an inhalation concentration effect is required, the Reference Concentration (for example, Reference Concentration [RfC] in mg/cubic meter) is applicable for chronic exposures. The Permissible Exposure Limit (PEL) value, which regulates worker's exposures over 8-hour (hr) periods, determines the concentration allowed for occupational exposures that would be without adverse acute effects. Other values, such as the Threshold Limit Value, are presented for the reader's information, because they are prepared by the American Conference of Governmental Industrial Hygienists (ACGIH) for guidance on exposures of 8-hr periods, and can be used to augment PELs or serve as exposure levels in the absence of a PEL. All currently regulated chemicals associated with each site and every hazardous chemical are presented in Table M.3.2–1 and Table M.3.3–1.

It was assumed that under normal operation conditions, members of the public would only receive chronic exposures at low levels in the form of air emissions from a centrally located source term at each site; since hazardous chemicals are not released into surface or ground waters or into soil, inhalation is assumed to be the only route of exposure. However, all chemical quantities are accounted for as air emissions, which are several orders of magnitude greater than by all other possible routes combined. It was further assumed that the MEI member of the public would be at the site boundary and this assumption was used when calculating all public exposures, which under normal operating conditions are expected to be chronic and at very low levels. For worker exposures to hazardous chemicals, it was assumed that individuals were exposed only to low air emission concentrations during an 8-hr day for a 40-hr week for a maximum working lifetime of 40 years. The point of exposure chosen was 100 m (328 ft) from a centrally located source term, since the precise placement of source terms onsite could not be made. Further, it could not be determined where the involved and non-involved workers would be relative to the emission sources.

For every site involved in the analysis, Hazard Indexes (HIs) were calculated for every alternative action relative to the site. The exposure concentrations of hazardous chemicals for the public and the onsite workers were developed using the Industrial Source Complex Short Term Model for point, area, and volume sources. This model, which estimates dispersion of emissions from these sources, has been field tested and recommended by the EPA. The modeled concentrations were compared to the unique RfC and PEL values unique to each chemical to yield Hazard Quotients (HQs) for the public and onsite workers, respectively. The HQs were summed to give the HIs for each alternative action at each site, as well as total HIs (that is, No Action HI + alternative-incremental HI). For cancer risk estimation, the inhaled concentrations were converted to doses in mg/kg/day, which were then multiplied by the slope factors unique to each identified carcinogen. The risks for all carcinogens associated with each alternative (incremental risk) at each site were summed, and the No Action cancer risk for each site was added in order to show the total risk should that alternative action be implemented at a given site. We apply this conservative approach to all sites using the guidance under the *Comprehensive Environmental Response Compensation and Liability Act*, which applies to Superfund sites. The first

assessment in risk analysis is considered a screening step. Under this guidance, if the HI is less than, or equal to 1.0, all non-cancer exposure values meet Occupational Safety and Health Administration (OSHA) standards; if the cancer risk is less than or equal to 1.0×10^{-6}, no further analysis is done. A cancer risk of 1.0×10^{-6} from other sources cannot be distinguished from the cancer risk for an individual member of the general population.

M.3.2 CHEMICAL TOXICITY PROFILES

Table M.3.2–1 provides the reader with pertinent facts about each chemical that is included in this PEIS's human health risk assessment. This includes the Chemical Abstracts Service number, which aids in a search for information available on any specific chemical and ensures a positive identity regardless of which name or synonym is used. It also contains physical information (that is, solubility, vapor pressure, and flammability) as well as presenting incompatibility data that is useful in determining whether a hazard might exist and the nature of the hazard. The route of exposure, target organs/tissues, and carcinogenicity provide an abbreviated summary on how individuals might get exposed, what body functions could be affected, and whether chronic exposure could lead to increased cancer incidence in an exposed population.

Table M.3.2–1. Chemical Toxicity Profiles

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Acetaldehyde	75-07-0	Miscible[d]	740 mm[d]	Class IA Flammable liquid[d]	Strong oxidizers, acids, bases, alcohols, ammonia, amines, phenols, ketones, HCN, H_2S (Prolonged contact with air may form peroxides that may explode: Easily polymerizes)[d]	Inh, ing con[d]	Eyes, skin, resp sys, kidneys, repro sys (In animals: nasal cancer)[d]	EPA Group B2[e]
Acetic acid	64-19-7	Miscible[d]	11 mm[d]	Class II Combustible liquid[d]	Strong oxidizers, strong caustics, corrosive to metals[d]	Inh, con[d]	Eyes, skin, resp sys, teeth[d]	Not Classified
Acetone	67-64-1	Miscible[d]	180 mm[d]	Class IB[d]	Oxidizers, acids[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS[d]	EPA Group D[e]
Acetonitrile	75-05-8	Miscible[d]	73 mm[d]	Class IB[d]	Strong oxidizers[d]	Inh, abs, ing, con[d]	Resp sys, CVS, CNS, liver, kidneys[d]	Not Classified
Acetylene	74-86-2	2%[d]	44.2 atm[d]	Flammable gas[d]	Zinc; Oxygen and other oxidizing agents such as halogens[d]	Inh, con (liq)[d]	CNS, resp sys[d]	Not Classified
Aluminum	7429-90-5	Insoluble[d]	0 mm (approx)[d]	Combustible solid, finely divided dust is easily ignited[d]	Strong oxidizers, acids, halogenated hydrocarbons[d]	Inh, con[d]	Eyes, skin, resp sys[d]	Not Classified
Aluminum welding fumes	None	Insoluble[d]	0 mm (approx)[d]	Noncombustible solid, but dust may form explosive mixtures in air[d]	Chlorine, trifluoride, hot chlorinated rubber, acids, oxidizers[d]	Inh, ing, con[d]	Eyes, skin, resp sys[d]	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Ammonia	7664-41-7	34%[d]	8.5 atm[d]	Treat as a flammable gas[d]	Strong oxidizers, acids, halogens, salts of Ag and Zn[d]	Inh, ing (soln), con (soln/liq)[d]	Eyes, skin, resp sys[d]	EPA Group D[e]
Ammonium hydroxide	1336-21-6	Soluble[f]	None Found	None Found	Strong oxidizers, acids, halogens, salts of Ag[f]	Inh, abs, ing con[f]	Eyes, skin, resp sys[f]	Not Classified
Antimony (Nonradionuclide)	7440-36-0	Insoluble[d]	0 mm (approx)[d]	Noncombustible as solid bulk; moderate explosion hazard as dust exposed to flame[d]	Strong oxidizers, acids, halogenated acids[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CVS[d]	EPA Group D[e]
Arsenic (Insol cmpds/metal)	7440-38-2	Insoluble[d]	0 mm (approx)[d]	Metal: Noncombustible as solid bulk; slight explosion hazard as dust exposed to flame[d]	Strong oxidizers, bromine azide[d]	Inh, abs, con, ing[d]	Liver, kidneys, skin, lungs, lymphatic sys (lung and lymphatic cancer)[d]	EPA Group A[e]
Barium	7440-39-3	None Found	10 mm (1049 °C)[f]	Flammable solid spontaneously combustible; dangerous when wet[f]	Water, acids, carbon tetrachloride, fluorotrichloromethane, trichloroethylene, and tetrachloroethylene[f]	None Found	None Found	Not Classified
Benzene	71-43-2	0.07%[d]	75 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers, many fluorides and perchlorates, nitric acid[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys, blood, CNS, bone marrow (leukemia)[d]	EPA Group A[e]

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Beryllium (metal)	7440-41-7	Insoluble[d]	0 mm[d]	Metal: Noncombustible as solid bulk; slight explosion as dust[d]	Acids, caustics, chlorinated hydrocarbons, oxidizers, molten Li[d]	Inh, con[d]	Eyes, skin, resp sys, (lung cancer)[d]	EPA Group B[e]
Bismuth	7440-69-9	Insoluble[g]	1 mm (1021 °C)[f]	Flammable when exposed to flame[f]	Incompatible with Al, BrF_3, acids, NOF, ammonium nitrate, perchloric acid, chloride, IF_5, nitric acid[f]	None Found	None Found	Not Classified
Boric acid	10043-35-3	1g in 18 ml cold water[g]	Volatile with steam[g]	None Found	K, acetic anhydride[f]	Inh, abs, inq, con[f]	Eyes, skin, resp sys, GI[f]	Not Classified
1,3-Butadiene	106-99-0	Insoluble[d]	2.4 atm[d]	Class I Flammable liquid[d]	Phenol, chlorine dioxide, Cu, crotonaldehyde[d]	Inh, con (liq)[d]	Eyes, skin, resp sys, CNS, repro sys (Hemato cancer)[d]	EPA Group B2[e]
n-Butane	106-97-8	Slightly soluble[d]	2.05 atm[d]	Class IA Flammable liquid[d]	Strong oxidizers, chlorine, fluorine, (Ni carbonyl+O_2)[d]	Inh, con (liq)[d]	CNS[d]	Not Classified
1-Butene (butylene)	106-98-9	None Found	3,480 mm[f]	Flammable gas[f]	Aluminium hydroborate[f]	Simple asphyxiant[f]	None Found	Not Classified
2-Butoxyethanol	111-76-2	Miscible[d]	0.8 mm[d]	Class IIIA Combustible liquid[d]	Strong oxidizers, strong caustics[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys, blood, kidneys, liver, lymphoid sys[d]	Not Classified
n-Butyl alcohol (1-butanol)	71-36-3	9%[d]	6 mm[d]	Class IC Flammable liquid[d]	Strong oxidizers, strong mineral acids, alkali metals, halogens[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys, CNS[d]	EPA Group D[e]
Butyl lactate	138-22-7	Slightly soluble[d]	0.4 mm[d]	Class IIIA Combustible liquid[d]	Strong acids, bases, oxidizers, heat, sparks, open flames[d]	Inh, ing, con[d]	Eyes, skin, resp. sys, CNS[d]	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Cadmium dust (Nonradionuclide)	7440-43-9	Insoluble[d]	0 mm (approx)[d]	Noncombustible as solid bulk; will burn as powder[d]	Strong oxidizers, elemental S, Se, and Te[d]	Inh, ing[d]	Resp sys, kidneys, prostate, blood (prostatic and lung cancer)[d]	EPA Group B1[e]
Cadmium oxide (fume)	1306-19-0	Insoluble[d]	0 mm (approx)[d]	Noncombustible solid[d]	Not applicable[d]	Inh[d]	Resp sys, kidneys, prostate, blood (prostatic and lung cancer)[d]	Not Classified
Calcium	7440-70-2	Reacts with water[g]	10 mm (983 °C)[h]	Flammable solid, Spontaneously combustible[f]	Strong oxidizing agents, acids, water, alkali metal hydroxides or carbonates, halogens, Ph, Si, Hg[f]	None Found	None Found	Not Classified
Carbon dioxide	124-38-9	Sublimes[d]	56.5 atm[d]	Non-flammable gas[d]	Dusts of metals (eg. Mg, Zr, Ti, Al, Cr, and Mn) are ignitable and explosive when suspended in CO_2[d]	Inh, con (liq/soln)[d]	Resp sys, CVS[d]	Not Classified
Carbon disulfide	75-15-0	0.3%[d]	297 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers; chemically-active metals (eg. Na, K, and Zn); azides; rust; halogens; amines[d]	Inh, abs, ing, con[d]	CNS, PNS, CVS, eyes, kidneys, liver, skin, repro sys[d]	Not Classified
Carbon monoxide	630-08-0	2%[d]	>35 atm[d]	Flammable gas[d]	Strong oxidizers, bromine trifluoride, chlorine trifluoride, Li[d]	Inh, con (liq)[d]	CVS, lungs, blood, CNS[d]	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Carbon tetrachloride	56-23-5	0.05%[d]	91 mm[d]	Non-combustible liquid[d]	Chemically-active metals (eg. Na, K, and Mg), F_2, Al[d]	Inh, abs, ing, con[d]	CNS, eyes, lungs, liver, kidneys, skin (In animals: liver cancer)[d]	EPA Group B2[e]
Chloride (Sodium chloride)	77647-14-5	Soluble[f]	1 mm (865 °C)[f]	Decomposes[f]	Potentially explosive reaction with dichloromaleic anhydride+urea; Violent reaction with BrF_3[f]	Inh, abs, ing, con, ipr, sca[f]	Eyes, skin, GI tract, repro sys, resp sys[f]	Not Classified
Chlorine	7782-50-5	0.7%[d]	6.8 atm[d]	Non-flammable gas[d]	Reacts explosively or forms explosive cmpds with many common substances (e.g., acetylene, ether, turpentine, ammonia, fuel gas, hydrogen and finely divided metals)[d]	Inh, con[d]	Eyes, skin, resp sys[d]	EPA Group D[e]
Chlorobenzene	108-90-7	0.05%[d]	9 mm[d]	Class IC Flammable liquid[d]	Strong oxidizers[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS, liver[d]	Not Classified
Chloroform	67-66-3	0.5% (77 °F)[d]	160 mm[d]	Non-combustible liquid[d]	Strong caustics, chemically active metals (e.g., Al or Mg powder, Na, and K), strong oxidizers[d]	Inh, abs, ing, con[d]	Liver, kidneys, heart, skin, CNS (In animals: liver and kidney cancer)[d]	EPA Group B2[e]
bis-Chloromethyl ether	542-88-1	Reacts in water (68 °F)[d]	30 mm (72 °F)[d]	Class IB Flammable liquid[d]	Acids, water[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys[d]	EPA Group A[e]

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Chromium (Hexavalent); Chromium[VI] oxide	18540-29-9; 1333-82-0 (CrO_3; acid)	None Found	Decomp, 61.7 g/100cc (0 °C)[f]	Corrosive crystal[f]	N,N-Dimethylformamide, explosive reaction or ignites with organic materials and solvents, alcohols and alkali metals (e.g., acetaldehyde, benzene, ethyl acetate, and heat + acetic acid or acetic anhydride, acetone, methanol, butanol, Na, and K)[f]	Inh, abs, ing, con, ipr[f]	Eyes, skin, resp sys, repro sys (Human cancer of nasal cavity and lungs)[f]	EPA Group A[e]
Chromium (Trivalent)	16065-83-1	Varies with cmpd[d]	Varies with cmpd[d]	Varies with cmpd[d]	Varies with cmpd[d]	Inh, ing, con[d]	Eyes, skin[d]	Not Classified
Cobalt (Metal dust and fume)	7440-48-4	Insoluble[d]	0 mm (approx)[d]	Noncombustible solid in bulk form; fine dust burns at high temp[d]	Strong oxidizers, ammonium nitrate[d]	Inh, ing, con[d]	Skin, resp sys[d]	Not Classified
Copper (Dusts and mists)	7440-50-8	Insoluble[d]	0 mm (approx)[d]	Noncombustible solid in bulk; powder may ignite[d]	Oxidizers, alkalis, sodium azide, acetylene[d]	Inh, ing, con[d]	Eyes, skin, resp sys, liver, kidneys (Increase risk with Wilson's disease)[d]	EPA Group D[e]
Cresol (*m*-cresol, cresylic acid)	108-39-4	2%[d]	0.14 mm (77 °F)[d]	Class IIIA Combustible liquid[d]	Strong oxidizers, acids[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys, liver, kidneys, CNS, pancreas, CVS[d]	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Cyclohexane	110-82-7	Insoluble[d]	78 mm[d]	Class IB Flammable liquid[d]	Oxidizers[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS[d]	Not Classified
Cyclohexanone	108-94-1	15%[d]	5 mm[d]	Class IIIA Combustible liquid[d]	Oxidizers, nitric acid[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys, CNS, liver, kidneys[d]	Not Classified
Cyclopentane	287-92-3	Insoluble[d]	400 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers (e.g., chlorine, bromine, fluorine)[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS[d]	Not Classified
Diacetone alcohol	123-42-2	Miscible[d]	1 mm[d]	Class II Combustible liquid[d]	Strong oxidizers, strong alkalis[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS, liver[d]	Not Classified
Dibenzofuran	132-64-9	None Found	None Found	None Found	None Found	None Found	None Found	None Found
Dibutyl phosphate	107-66-4	Insoluble[d]	1 mm (approx)[d]	Class IIIB Combustible liquid[d]	Strong oxidizers[d]	Inh, ing, con[d]	Eyes, skin, resp sys[d]	Not Classified
o-Dichlorobenzene	95-50-1	0.01%[d]	1 mm[d]	Class IIIA Combustible liquid[d]	Strong oxidizers, Al, chlorides, acids, acid fumes[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys, liver, kidneys[d]	Not Classified
3,3-Dichlorobenzidine	91-94-1	7% (59 °F)[d]	None Found	None Found	None Found	Inh, abs, ing, con[d]	Bladder, liver, lung, GI tract (In animals: liver and bladder cancer)	EPA Group B2[e]
Dichlorodifluoromethane	75-71-8	0.03% (77 °F)[d]	5.7 atm[d]	Nonflammable gas[d]	Chemically active metals (e.g., Na, K, Ca, powdered Al, Zn, and Mg)[d]	Inh, con (liq)[d]	CVS, PNS	EPA Group D[e]

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Dichloromethane (Methylene chloride)	75-09-2	2%[d]	350 mm[d]	Combustible liquid[d]	Strong oxidizers, caustics, chemically active metals (eg., Al, Mg powders, K and Na), conc nitric acid[d]	Inh, abs, ing, con[d]	Eyes, skin, CVS, CNS, (In animals: lung, liver, salivary and mammary gland tumors)[d]	EPA Group B2[e]
Dimethylformamide (DMF)	68-12-2	Miscible[d]	3 mm[d]	Class II Combustible liquid[d]	Carbon tetra chloride, other halogenated cmpds when in contact with iron; strong oxidizers, alkyl aluminums, inorganic nitrates[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys, liver, kidneys, CVS[d]	Not Classified
2,4-Dinitrotoluene	25321-14-6	Insoluble[d]	1 mm[d]	Combustible solid, but difficult to ignite[d]	Strong oxidizers, caustics, metals such as tin and zinc[d]	Inh, abs, ing, con[d]	Blood, liver, CVS, repro sys (In animals: liver, skin, and kidney tumors)[d]	Not Classified
1,4-Dioxane	123-91-1	Miscible[d]	29 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers, decaborane, triethynyl aluminum	Inh, abs, ing, con[d]	Eyes, skin, resp sys, liver, kidneys (In animals: lung, liver and nasal cavity tumors)[d]	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Di-sec octyl phthalate	117-81-7	0.00003% (75 °F)[d]	<0.01 mm[d]	Class IIIB Combustible liquid[d]	Nitrates, strong oxidizers, acids and alkalis[d]	Inh, ing, con[d]	Eyes, resp sys, CNS, liver, repro sys, GI tract (In animals: liver tumors)[d]	Not Classified
Dodecane	112-40-3	None Found	None Found	None Found	None Found	None Found	None Found	Not Classified
Ethane	74-84-0	Soluble (20 °C)[d]	None Found	Flammable asphyxiant[f]	None Found	Simple asphyxiant[f]	None Found	Not Classified
Ethanol (ethyl alcohol)	64-17-5	Miscible[d]	44 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers, potassium dioxide, bromine pentafluoride, acetyl bromide, acetyl chloride, Pt, Na[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS, liver, blood, repro sys[d]	Not Classified
Ethyl acetate	141-78-6	10% (77 °F)[d]	73 mm[d]	Class IB Flammable liquid[d]	Nitrates, strong oxidizers, alkalis and acids[d]	Inh, ing, con[d]	Eyes, skin, resp sys[d]	Not Classified
Ethyl benzene	100-41-4	0.01%[d]	7 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS[d]	EPA Group D[e]
Ethylene	74-85-1	20% (0 °C)[g]	None Found	Flammable[g]	None Found	Simple asphyxiant[f]	None Found	Not Classified
Ethylene dichloride	107-06-2	0.9%[d]	64 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers & caustics; chemically-active metals (e.g., Mg or Al powder), Na and K; liquid ammonia[d]	Inh, abs, ing, con[d]	Eyes, skin, kidneys, liver, CNS, CVS (In animals: fore-stomach, mammary gland & circulatory sys cancer)[d]	Not Classified
Ethyl ether	60-29-7	8%[d]	440 mm[d]	Class IA Flammable liquid[d]	Strong oxidizers, halogens, sulfur, sulfur cmpds[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS[d]	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Ethylene glycol	107-21-1	Miscible[d]	0.06 mm[d]	Class III B Combustible liquid[d]	Strong oxidizers, chromium trioxide, potassium permanganate, sodium peroxide (hygroscopic)[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS[d]	EPA Group D[e]
Ethylene glycol monoethyl ether (2-ethoxyethanol, Cellosolve®)	110-80-5	Miscible[d]	4 mm[d]	Class II Combustible liquid[a]	Strong oxidizers[d]	Inh, abs, ing, con[d]	Eyes, resp, kidneys, liver, repro sys, hemato sys[d]	Not Classified
Ethyltriacetyoxysilane	None Found	None Found	None Found	None Found	None Found	None Found	None Found	Not Classified
Fluoride	None Found	Varies with cmpd[d]	Varies with cmpd[d]	Varies with cmpd[d]	Varies with cmpd[d]	None Found	None Found	Not Classified
Formaldehyde	50-00-0	Miscible[d]	>1 atm[d]	Flammable gas[d]	Strong oxidizers, alkalis; acids; phenols, urea, (Tends to polymerize; Reacts with HCl to form bis-chloromethyl ether)[d]	Inh, con[a]	Eyes, resp sys, (nasal cancer)[d]	EPA Group B1[e]
Formic acid	64-18-6	Miscible[d]	35 mm[d]	Class II Combustible liquid[d]	Strong oxidizers, strong caustics, concentrated sulfuric acid[d]	Inh, ing, con[d]	Eyes, skin, resp sys[d]	Not Classified
n-Heptane	142-82-5	0.0003%[d]	40 mm (72 °F)[d]	Class 1B Flammable liquid[d]	Strong oxidizers[d]	Inh, ing, con[d]	Skin, resp sys, CNS[d]	EPA Group D
n-Hexane	110-54-3	0.002%[d]	124 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers[d]	Inh, ing, con[d]	Skin, eyes, CNS, PNS, resp sys[d]	EPA Group D[i]

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Hydrazine	302-01-2	Miscible[d]	10 mm[d]	Class IC Flammable liquid[d]	Oxidizers, hydrogen peroxide, nitric acid, metallic oxides, acids (Can ignite spontaneously on contact with oxidizers or porous materials such as earth, wood and cloth)[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys, CNS, liver, kidneys (In animals: tumors of lung, liver, blood vessels and intestines)[d]	EPA Group B2[e]
Hydrogen chloride (hydrochloric acid)	7647-01-0	67% (86 °F)[d]	40.5 atm[d]	Non-flammable gas[d]	Hydroxides, amines, alkalis, Cu, brass, Zn (Highly corrosive to metals)[d]	Inh, ing (soln), con[d]	Resp sys, skin, eyes[d]	Not Classified
Hydrogen cyanide	74-90-8	Miscible[d]	630 mm[d]	Class IA Flammable gas[d]	Amines, oxidizers, acids, sodium hydroxide, calcium hydroxide, sodium carbonate, water, caustics, ammonia (Can polymerize at 122-140 °F)[d]	Inh, abs, ing, con[d]	CNS, CVS, thyroid, blood[d]	Not Classified
Hydrogen fluoride (hydrofluoric acid)	7664-39-3	Miscible[d]	783 mm[d]	Non-flammable gas[d]	Metals, water or steam (Corrosive to metals. Will attack glass and concrete)[d]	Inh, abs(liq), ing (soln), con[d]	Eyes, skin, resp sys, bones[d]	Not Classified
Hydrogen peroxide	7722-84-1	Miscible[d]	5 mm (86 °F)[d]	Noncombustible liquid, but a powerful oxidizer[d]	Oxidizable materials, Fe, Cu, brass, bronze, Cr, Zn, Pb, Ag, Mn[d]	Inh, ing, con[d]		Not Classified
Hydrogen sulfide	7783-06-4	0.4%[d]	17.6 atm[d]	Flammable gas[d]	Strong oxidizers, strong nitric acid, metals[d]	Inh, con[d]	Resp sys, CNS, eyes[d]	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Iron salts (Soluble as Fe)	None	Varies with cmpd[d]	Varies with cmpd[d]	Non-combustible solids[d]	Varies with cmpd[d]	Ing, ing, con[d]	Eyes, skin, liver, resp sys, GI tract[d]	Not Classified
Isobutane	75-28-5	Slight[d]	3.1 atm (70 °F)[d]	Class IA Flammable gas[d]	Strong oxidizers (e.g., nitrates and perchlorates), chlorine, fluorine (Ni carbonyl + O_2)[d]	Inh, con (liq)[d]	CNS[d]	Not Classified
Isobutanol (Isobutyl alcohol)	78-83-1	10%[d]	9 mm[d]	Flammable[g]	Strong oxidizers[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS[d]	Not Classified
Isobutyl acetate	110-19-0	0.6% (77 °F)[d]	13 mm[d]	Class 1B Flammable liquid	Nitrates, strong oxidizers, alkalis, acids[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS[d]	Not Classified
Isopropyl alcohol	67-63-0	Miscible[d]	33 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers, acetaldehyde, chlorine, ethylene oxide, acids, isocyanates	Inh, ing, con[d]	Eyes, skin, resp sys, CNS[d]	Not Classified
Kerosene	8008-20-6	Insoluble[d]	5 mm (100 °F)[d]	Class II Combustible liquid[d]	Strong oxidizers[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS[d]	IARC Group 2A (suspect carcinogen)
Lead	7439-92-1	Insoluble[d]	0 mm (approx)[d]	Non-combustible solid in bulk form[d]	Strong oxidizers, hydrogen peroxide, acids[d]	Inh, ing, con[d]	Eyes, GI tract, CNS, kidneys, blood, gingival tissue[d]	EPA Group B2[e]
Lead chromate	7758-97-6[f]	0.000007 (20 °C)[h]	Not Applicable	None Found	Potentially explosive reactions with azo-dye stuffs; Violent reaction with Al + dinitro-naphthalene + heat[f]	Con, ing, scu, ipr[f]	GI tract[f]	Confirmed carcinogen
Lithium	7439-93-2	None Found	None Found	None Found	None Found	None Found	Kidneys[g]	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Lithium hydride	7580-67-8	Reacts with water[d]	0 mm (approx)[d]	Combustible solid that can form airborne dust clouds which may explode on contact with flame heat, or oxidizers[d]	Strong oxidizers, halogenated hydrocarbons, acids, water (May ignite spontaneously in air)[d]	Inh, ing, con[d]	Skin, eyes, resp sys, CNS[d]	Not Classified
Magnesium (oxide fume)	1309-48-4	0.009% (86 °F)[d]	0 mm (approx)[d]	Non-combustible solid[d]	Chlorine trifluoride, phosphorus pentachloride[d]	Inh, con[d]	Eyes, resp sys[d]	Not Classified
Manganese (cmpds as fume; as Mn)	7439-96-5	Insoluble[d]	0 mm (approx)[d]	Metal: Combustible solid[d]	Oxidizers (Will react with water to produce H_2)[d]	Inh, ing[d]	Resp sys, blood, CNS, kidneys[d]	EPA Group D[e]
Mercury (Cmpds except organo alkyls; as Hg)	7439-97-6	Insoluble[d]	0.0012 mm[d]	Metal: Non-combustible liquid[d]	Acetylene, ammonia, chlorine dioxide, azides, calcium, sodium carbide, Li, Rb, Cu[d]	Inh, abs, inh, con[d]	Eyes, skin, resp sys, CNS, kidneys[d]	EPA Group D[e]
Methanol (methyl alcohol)	67-56-1	Miscible[d]	96 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys, CNS, GI tract[d]	Not Classified
Methyl chloride	74-87-3	0.5%[d]	5.0 atm[d]	Flammable gas[d]	Chemically-active metals (e.g., Al, Zn, and Mg), water[d]	Inh, con (liq)[d]	CNS, liver, kidneys, repro sys[d]	Not Classified
Methylene chloride (dichloromethane)	75-09-2	2%[d]	350 mm[d]	Combustible liquid[d]	Strong oxidizers; caustics; chemically active metals (e.g. Al, Mg powders, K and Na), conc nitric acid[d]	Inh, abs, ing, con[d]	Skin, CVS, eyes, CNS (In animals: lung, liver, salivary gland, and mammary gland tumors)[d]	EPA Group B2[e]

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Methyl ethyl ketone (MEK; 2-butanone)	78-93-3	28%[d]	78 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers, amines, ammonia, inorganic acids, caustics, Cu, isocyanates, pyridines[d]	Inh, ing, con[d]	CNS, resp sys, skin, eyes[d]	EPA Group D[e]
Methyl isobutyl ketone (MIBK; Hexone)	108-10-1	2%[d]	16 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers, potassium tert-butoxide[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS, liver, kidneys[d]	Not Classified
Naphthalene (naphthene)	91-20-3	0.003%[d]	0.08 mm[d]	Combustible solid, but will take some effort to ignite[d]	Strong oxidizers, chromic anhydride[d]	Inh, abs, ing, con[d]	Eyes, skin, blood, liver, kidneys, CNS[d]	EPA Group D[e]
Nickel (refinery dust)	7440-02-0	Insoluble[d]	0 mm (approx)[d]	Metal: Combustible solid; Ni sponge catalyst ignites spontaneously in air[d]	Strong acids, S, Se, wood and other combustibles, nickel nitrate[d]	Inh, ing, con[d]	Lungs, skin, nasal cavities (lung and nasal cancer)[d]	EPA Group A[e]
Nitric acid	7697-37-2	Miscible[d]	48 mm[d]	Noncombustible liquid, but increases flammability of combustible materials	Combustible materials; metallic powders; hydrogen sulfide; carbides; alcohols (Corrosive to metals)[d]	Inh, ing, con[d]	Eyes, resp sys, skin, teeth[d]	Not Classified
Nitrobenzene	98-95-3	0.2%[d]	0.3 mm (77 °F)[d]	Class IIIA Combustible liquid[d]	Conc. nitric acid, nitrogen tetroxide, caustics, phosphorous pentachloride, chemically-active metals (e.g., Sn, Zn)[d]	Inh, abs, ing, con[d]	Eyes, skin, blood, liver, kidneys, CVS, repro sys[d]	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
2-Nitropropane	74-46-9	2%[d]	13 mm[d]	Class IC Flammable liquid[d]	Amines; strong acids, alkalis & oxidizers; metal oxides; combustible materials[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS, liver, kidneys (In animals: liver tumors)[d]	EPA Group B2[d]
Octanol	None Found	None Found	None Found	None Found	None Found	None Found	None Found	Not Classified
Oxalic acid	144-62-7	14%[d]	<0.001 mm[d]	Combustible solid[d]	Strong oxidizers, silver cmpds, strong alkalis, chlorites[d]	Inh, ing, con[d]	Eyes, skin, resp sys, kidneys[d]	Not Classified
Ozone	10028-15-6	0.001% (32 °F)[d]	>1 atm[d]	Nonflammable gas, but a powerful oxidizer[d]	All oxidizable materials (inorganic and organic)[d]	Inh, con[d]	Eyes, resp sys[d]	Not Classified
Phenol	108-95-2	9% (77 °F)[d]	0.4 mm	Sp. Gr: 1.06 Combustible solid	Strong oxidizer, calcium hypochlorite, aluminum, chloride, acids)	Inh, abs, ing, con[d]	Eyes, skin, resp sys, liver, kidneys	EPA Group D[e]
Phosphoric acid	7664-38-2	Miscible[d]	0.03 mm[d]	Noncombustible liquid[d]	Strong caustics, most metals (Do not mix with solutions containing bleach or ammonia)[d]	Inh, ing, con[d]	Eyes, skin, resp sys[d]	Not Classified
Phosphorous (yellow)	7723-14-0	0.0003%[d]	0.03 mm[d]	Flammable solid[d]	Air, oxidizers (Including elemental S and strong caustics), halogens (Ignites spontaneously in moist air)[d]	Inh, ing, con[d]	Eyes, skin, resp sys, liver, kidneys, jaw, teeth, blood[d]	Not Classified
Phosgene	75-44-5	Slight[d]	1.6 atm[d]	Non-flammable gas[d]	Moisture, alkalis, ammonia, alcohols, Cu[d]	Inh, con (liq)[d]	Eyes, skin, resp sys[d]	Not Classified
Plutonium oxide	None Found	None Found	None Found	None Found	None Found	None Found	None Found	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Potassium chromate (VI)	7789-00-6	Soluble in 1.6 parts cold water[g]	None Found	None Found	None Found	None Found	None Found	Confirmed carcinogen[f]
Potassium hydroxide	1310-58-10	107% (59 °F)[d]	1 mm (1317 °F)[d]	Noncombustible solid, may react with H_20 and other substances and generate sufficient heat to ignite combustible materials[d]	Acids, water, metals (When wet), halogenated hydrocarbons, maleic anhydride[d]	Inh, ing, con[d]	Eyes, skin, resp sys[a] (throat, esophagus, mucous membranes)[f]	Not Classified
Propane	74-98-6	0.01%[d]	8.4 atm (70 °F)[d]	Flammable gas[d]	Strong oxidizers[d]	Inh, con (liq)[d]	CNS[d]	Not Classified
Propene (propylene)	115-07-1	None Found	7-8 atm[g]	Flammable gas[g]	None Found	Simple ashyxiant[g]	None Found	Not Classified
Propionaldehyde	123-38-6	Miscible[f]	None Found	Flammable liquid[f]	Oxidizers, vigorous polymerization reaction with methyl methacrylate[f]	Inh, ing, abs, con[f]	Skin, GI tract, resp sys[f]	Not Classified
Propylene oxide	75-56-9	41%[d]	445 mm[d]	Class 1A Flammable liquid[d]	Anhydrous metal chlorides; Fe; strong acids, caustics and peroxides[d]	Inh, ing, con[d]	Eyes, skin, resp sys[d]	EPA Group B2[e]
Pyridine	110-86-1	Miscible[d]	16 mm[d]	Class IB combustible liquid[d]	Strong oxidizers, strong acids[d]	Inh, ing, abs, con[d]	Eyes, skin, CNS, liver, kidneys, GI tract[d]	Not Classified
Pyrene	129-00-0	Insoluble[g]	None Found	None Found	None Found	None Found	None Found	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Selenium	7782-49-2	Insoluble[d]	0 mm (approx)[d]	Combustible solid[d]	Acids, strong oxidizers, chromium trioxide, potassium bromate, Cd[d]	Inh, ing, con[d]	Eyes, skin, resp sys, liver, kidneys, blood, spleen[d]	EPA Group D[e]
Silicon	7440-21-3	Insoluble[d]	0 mm (approx)[d]	Combustible solid in powder form[d]	Chlorine, fluorine, oxidizers, calcium, cesium carbide, alkaline carbonates[d]	Inh, ing, con[d]	Skin, eyes, resp sys[d]	Not Classified
Silver	7440-22-4	Insoluble[d]	0 mm (approx)[d]	Metal: Non-combustible solid, but flammable as dust or powder[d]	Acetylene, ammonia, hydrogen peroxide, bromoazide, chlorine, trifluoride, ethyleneimine, oxalic acid, tartaric acid[d]	Inh, ing, con[d]	Nasal septum, skin, eyes[d]	EPA Group D[e]
Stoddard Solvent	8052-41-3	Insoluble	None Found	Class II Combustible liquid[d]	Strong oxidizers[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS, kidneys[d]	Not Classified
Styrene	100-42-5	0.03%[d]	5 mm[d]	Class IC Flammable liquid[d]	Oxidizers, catalysts for vinyl polymers, peroxides, strong acids, aluminum chloride (May polymerize if contaminated or subjected to heat)[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys, CNS, liver, repro sys[d]	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Sulfuric acid	7664-93-9	Miscible[d]	0.001 mm[d]	Noncombustible liquid, but capable of igniting finely divided combustible materials[d]	Organic materials, chlorates, carbides, fulminates, water, powdered metals[d]	Inh, ing, con[d]	Resp sys, eyes, skin, teeth[d]	Not Classified
Tetrachloroethylene	127-18-4	0.02%[d]	14 mm[d]	Noncombustible liquid, but decomposes in a fire to HCl and phosgene[d]	Strong oxidizers, chemically-active metals (e.g., Li, Be & Ba), caustic soda, sodium hydroxide, potash[d]	Inh, abs, ing, con[d]	Eyes, skin, resp sys, liver, kidneys, CNS (In animals: liver tumors)[d]	Not Classified
Tetrahydrofuran (THF)	109-99-91	Miscible[d]	132 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers, Li-Al alloys[d]	Inh, ing, con[d]	Eyes, resp sys, CNS[d]	Not Classified
Titanium	7440-32-6	None Found	None Found	None Found	None Found	None Found	None Found	Not Classified
Toluene	108-88-3	0.07% (74 °F)[d]	21 mm[d]	Class IB Flammable liquid[d]	Strong oxidizers[d]	Inh, abs, ing, con[d]	CNS, eyes, resp sys, liver, kidneys, skin[d]	EPA Group D[e]
Tributyl phosphate	126-73-8	0.6%[d]	0.004 mm (77 °F)[d]	Class III B[d]	Alkalis, oxidizers, water, moist air	Inh, ing, con[d]	Eyes, skin, resp. sys.	Not Classified
1,1,1-Trichloroethane (TCA; methyl chloroform)	71-55-6	0.4%[d]	100 mm[d]	Combustible liquid, but burns with difficulty[d]	Strong caustics; strong oxidizers; chemically-active metals (e.g., Zn, Al, Mg powders, Na, and K); water[d]	Inh, ing, con[d]	CNS, eyes, skin, liver, CVS[d]	EPA Group D[e]

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
1,1,2-Trichloroethane	79-00-5	0.4%[d]	19 mm[d]	Combustible liquid, forms dense soot[d]	Strong oxidizers & caustics; chemically-active metals (e.g., Al, Mg powders, Na, and K)[d]	Inh, abs, ing, con[d]	Eyes, resp sys, CNS, liver, kidneys (In animals: liver cancer)[d]	Not Classified
Trichloroethylene (TCE, trichloroethene)	79-01-6	0.0001% (77 °F)[d]	58 mm[d]	Combustible liquid, but burns with difficulty[d]	Strong caustics & alkalis; chemically-active metals (e.g., Ba, Li, Na, Mg, Ti, and Be)[d]	Inh, abs, ing, con[d]	Eyes, resp sys, heart, liver, CNS, skin (In animals: liver and kidney cancer)[d]	EPA Group B2[i]
Trichlorotrifluoroethane (Freon 113)	76-13-1	0.02% (77 °F)[d]	285 mm[d]	Noncombustible liquid at ordinary temp, but will ignite and burn weakly at 1256 °F[d]	Chemically-active metals (e.g., Ca, powdered Al, Zn, Mg and Be)[d]	Inh, ing, con[d]	Skin, heart, CNS, CVS[d]	Not Classified
1,2,4-Trimethylbenzene	95-63-6	0.006%[d]	1 mm (56 °F)[d]	Class II Flammable liquid[d]	Oxidizers, nitric acid[d]	Inh, ing, con[d]	Eyes, skin, resp sys, CNS, blood[d]	Not Classified
Tungsten (insoluble compounds)	7440-33-7	Insoluble[d]	0 mm (approx)[d]	Combustible as fine powder; may ignite spontaneously[d]	Bromine trifluoride, chlorine trifluoride, F_2, I_2, pentafluoride[d]	Inh, ing, con[d]	Eyes, skin, resp sys, blood[d]	Not Classified
VM&P Naphtha	8032-32-4	Insoluble	2-20 mm	Class IB Flammable liquid[d]	None Found	Inh, ing, con[d]	Eyes, skin, resp sys, CNS[d]	Not Classified

Table M.3.2–1. Chemical Toxicity Profiles—Continued

Compound	CAS No.	Solubility	Vapor Pressure	Flammability[a]	Incompatibilities	Route of Exposure[b]	Target Organs	Carcinogenicity[c]
Welding fumes	ZC2550000	Varies with component of fumes[d]	Varies with component of fumes[d]	Varies with component of fumes[d]	Varies with component of fumes[d]	Inh, con[d]	Eyes, skin, resp sys, CNS[d]	Not Classified
Xylene (o-, m-, p- mixture)	o: 95-47-6 m:108-38-3 p: 106-42-3	o: 0.02%[d] m: slight[d] p: 0.02%[d]	o: 7 mm[d] m 9 mm[d] p: 9 mm[d]	o-, m-, p-: Class IC Flammable liquids[d]	o-, m-, p-: Strong oxidizers, strong acids[d]	o-, m-, p-: inh, abs, ing, con[d]	o-, m-, p-: Eyes, skin, resp sys, CNS, GI tract, liver, blood, kidneys[d]	Not Classified
Zinc	7440-66-6	None Found	None Found	Combustible solid[g]	None Found	Inh[g]	None Found	Not Classified

[a] Flammable liquids are classified by OSHA (29 CFR 1910.106) as follows:
Class IA...flash point below 73 °F and boiling point below 100 °F.
Class IB...flash point below 73 °F and boiling point at or above 100 °F.
Class IC...flash point at or above 73 °F and below 140 °F.
Class II... flash point at or above 100 °F and below 140 °F.
Class IIIA... flash point at or above 140 °F and below 200 °F.
Class IIIB...flash point at or above 200 °F.
DHHS 1992a.

[b] Routes of exposure abbreviated as follows:
inh-inhalation
abs-skin absorption
ing-ingestion
con-skin and/or eye contact
ipr-intraperitoneal
scu-subcutaneous.

[c] EPA Groups for carcinogenicity are classified as follows:
EPA Group A: Human Carcinogen
EPA Group B1: Probable Human Carcinogen-limited evidence in human studies
EPA Group B2: Probable Human Carcinogen-sufficient evidence from animal studies, inadequate evidence or no data from human studies
EPA Group C: Possible Human Carcinogen
EPA Group D: Not Classifiable as to Human Carcinogenicity.

[d] NIOSH 1994a.

[e] ORNL 1994b.

[f] Lewis 1992a.

[g] Merck 1989a.

[h] Lange 1967a.

[i] EPA 1993a.

M.3.3 REGULATED EXPOSURE LIMITS

Hazardous chemicals are regulated by various agencies in order to provide protection to the public (EPA regulated) and to workers OSHA, while others (National Institute for Occupational Safety and Health [NIOSH] and the ACGIH) provide guidelines. The RfDs and RfCs set by EPA represent exposure limits for long-term (chronic) exposure at low doses and concentrations, respectively, that can be considered safe from non-cancerous effects. The PEL represents concentration levels set by OSHA that are safe for 8-hr exposures without causing non-cancerous effects. The slope factor, or the unit risk, is used to convert the daily uptake of a carcinogenic chemical averaged over a lifetime to the incremental risk of an individual developing cancer. Table M.3.3–1 presents the information on exposure limits used to develop HQs for each of the hazardous chemicals and the HIs derived from their summation and the slope factors used to calculate cancer risk for each chemical at the exposure concentrations identified at the various sites or associated with a proposed alternative action.

Table M.3.3–1. Table of Exposure Limits

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Acetaldehyde	75-07-0	0.003[d]	$9x10^{-3}$[e]	EPA Group B2[e]	none found	OSHA-PEL: 360 mg/m^3 ACGIH-TLV: 180 mg/m^3, STEL: 270 mg/m^3 NIOSH-REL: 3,660 mg/m^3
Acetic acid	64-19-7	0.175[f]	0.6125[g]	not classified	none found	OSHA-PEL: 25 mg/m^3 ACGIH-TLV: 25 mg/m^3, STEL: 37 mg/m^3 NIOSH-REL: 25 mg/m^3, STEL: 37 mg/m^3 IDLH: 125 mg/m^3
Acetone	67-64-1	0.1[e]	0.35[g]	EPA Group D[e]	none found	OSHA-PEL: 2,400 mg/m^3 ACGIH-TLV: 1,780 mg/m^3 NIOSH-REL: 590 mg/m^3 STEL: 2,380 mg/m^3 IDLH: 6,050 mg/m^3
Acetonitrile	75-05-8	0.006[e]	0.021[g]	not classified	none found	OSHA-PEL: 70 mg/m^3 ACGIH-TLV: 67 mg/m^3 STEL: 101 mg/m^3 NIOSH-REL: 34 mg/m^3 IDLH: 855 mg/m^3
Acetylene	74-86-2	18.634[h]	65.219[g]	not classified	none found	OSHA-PEL: 2,662 mg/m^3[i] NIOSH-REL: 2,662 mg/m^3
Aluminum	7429-90-5	0.105[f]	0.368[g]	not classified	none found	OSHA-PEL: 15 mg/m^3 ACGIH-TLV: 10 mg/m^3, (dust) NIOSH-REL: 10 mg/m^3
Aluminum welding fumes	none	0.035[h]	0.1225[g]	not classified	none found	NIOSH-REL: 5 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Ammonia	7664-41-7	$2.86x10^{-2}$[d], (34 mg/L, chronic)[j]	0.1[e]	EPA Group D[k]	none found	OSHA-PEL: 35 mg/m^3 ACGIH-TLV: 17 mg/m^3, STEL: 24 mg/m^3 NIOSH-REL: 18 mg/m^3, STEL: 27 mg/m^3 IDLH: 213 mg/m^3
Ammonium hydroxide	1336-21-6	0.014[l]	0.049[g]	not classified	none found	LD50 (oral-rat): 350 mg/kg[i] PEL: 2 mg/m^3[m]
Antimony (nonradionuclide)	7440-36-0	$4x10^{-4}$[e]	$1.4x10^{-3}$[g]	EPA Group D[k]	none found	OSHA-PEL: 0.5 mg/m^3 ACGIH-TLV: 0.5 mg/m^3 NIOSH-REL: 0.5 mg/m^3, IDLH: 50 mg/m^3, IDLH: 50 mg/m^3
Arsenic	7440-38-2	$3x10^{-4}$[e]	$1.05x10^{-3}$[g]	EPA Group A[e]	50 (inhal)[j]	OSHA-PEL: 0.01 mg/m^3[i] ACGIH-TLV: 0.2 mg/m^3 NIOSH-REL: 0.002 mg/m^3 (ceiling), IDLH: 5 mg/m^3
Barium	7440-39-3	0.07[n]	0.245[g]	not classified	none found	OSHA-PEL: 0.5 mg/m^3[i] ACGIH-TLV: 0.5 mg/m^3 (sol. cmpds. as Ba)
Benzene	71-43-2	$2.28x10^{-2}$[f]	0.0798[g]	EPA Group A	0.029 (oral)[e] 0.029 (inhal)[j]	OSHA-PEL: 3.25 mg/m^3, STEL: 16.25 mg/m^3 ACGIH-TLV: 32 mg/m^3 NIOSH-REL: 0.325 mg/m^3, STEL: 3.25 mg/m^3, IDLH: 5 mg/m^3
Beryllium	7440-41-7	$5x10^{-3}$[e]	0.0175[g]	EPA Group B2	4.3 (oral)[e] 8.4 (inhal)[j]	OSHA-PEL: 0.002 mg/m^3, 0.005 mg/m^3 (ceiling) ACGIH-TLV: 0.002 mg/m^3 NIOSH-REL: 0.0005 mg/m^3, IDLH: 4 mg/m^3
Bismuth	7440-69-9	none found	none found	not classified	none found	none found
Boric acid	10043-35-3	$5.7x10^{-3}$[f]	0.02[g]	not classified	none found	PEL: 0.816 mg/m^3[m] LD50 (oral, rat): 2,660 mg/kg[i]

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
1,3-Butadiene	106-99-0	15.4[f]	53.9[g]	EPA Group B2[e]	1.8 (inhal)[j]	OSHA-PEL: 2,200 mg/m^3 ACGIH-TLV: 22 mg/m^3 NIOSH-REL: 4,500 mg/m^3
Butane	106-97-8	13.3[h]	46.55[g]	not classified	none found	NIOSH-REL: 1,900 mg/m^3 ACGIH-TLV: 1,900 mg/m^3 PEL: 1900 mg/m^{3m}
1-Butene	106-98-9	none found	none found	not classified	none found	none found
2-Butoxyethanol	111-76-2	1.68[f]	5.88[g]	not classified	none found	OSHA-PEL: 240 mg/m^3 (skin) ACGIH-TLV: 121 mg/m^3 NIOSH-REL: 24 mg/m^3 (skin) IDLH: 3,437 mg/m^3
n-Butyl alcohol (1-Butanol)	71-36-3	0.10[e]	0.35[g]	EPA Group D[e]	none found	OSHA-PEL: 300 mg/m^3 ACGIH-TLV: 152 mg/m^3 (skin, ceiling) NIOSH-REL: 150 mg/m^3 (skin), IDLH: 4,312 mg/m^3
Butyl lactate	138-22-7	0.21[f]	0.74[g]	not classified	none found	PEL: 30 mg/m^3 ACGIH-TLV: 30.0 mg/m^3 NIOSH-REL: 25.0 mg/m^3
Cadmium oxide (fume, as Cd)	1306-19-0	$3.5x10^{-5}$[f]	$1.23x10^{-4}$[g]	not classified	none found	OSHA-PEL: 0.005 mg/m^3 ACGIH-TLV: 0.05 mg/m^3 (ceiling) NIOSH-STEL: 9 mg/m^3
Cadmium dust (nonradionuclide)	7440-43-9	$5x10^{-4}$[e]	$1.75x10^{-3}$[g]	EPA Group B1[e]	$6.3x10^{-3}$[o] (Unit Risk: $1.8x10^{-6}$ mg/m^3)[n]	OSHA-PEL: 0.005 mg/m^3 ACGIH-TLV: 0.05 mg/m^3
Calcium	7440-70-2	none found	none found	not classified	none found	none found
Carbon dioxide	124-38-9	63[f]	221[g]	not classified	none found	OSHA-PEL: 9,000 mg/m^3 ACGIH-TLV: 9,000 mg/m^3, STEL: 54,000 mg/m^3 NIOSH-REL: 9,000 mg/m^3, STEL: 54,000 mg/m^3, IDLH: $7.3x10^4$ mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Carbon disulfide	75-15-0	0.1[e]	0.35[g]	not classified	none found	OSHA-PEL: 63.2 mg/m^3 ACGIH-TLV: 31 mg/m^3 (skin) NIOSH-REL: 3 mg/m^3, STEL: 30 mg/m^3, IDLH: 1,580 mg/m^3
Carbon monoxide	630-08-0	0.385[f]	1.35[g]	not classified	none found	OSHA-PEL: 55 mg/m^3 ACGIH-TLV: 29 mg/m^3 NIOSH-REL: 40 mg/m^3, IDLH: 1,392 mg/m^3
Carbon tetrachloride	56-23-5	$7x10^{-4}$[e]	$2.45x10^{-3}$[g]	EPA Group B2[e]	0.13 (oral) 0.053 (inhal)[j]	OSHA-PEL: 63.9 mg/m^3, 160 mg/m^3 (ceiling) ACGIH-TLV: 31 mg/m^3 (skin) NIOSH-STEL: 12.6 mg/m^3 IDLH: 1,278 mg/m^3
Chloride (Sodium chloride)	77647-14-5	0.12[l]	0.42[g]	not classified	none found	LD50: 3,000 mg/m^3[i] PEL: 17.1 mg/m^3[m]
Chlorine	7782-50-5	0.1[e]	0.35[g]	EPA Group D[k]	none found	OSHA-PEL: 3 mg/m^3 (ceiling) ACGIH-TLV: 1.5 mg/m^3, STEL: 2.9 mg/m^3 NIOSH-REL: 1.45 mg/m^3 (ceiling, 15 min.), IDLH: 29.5 mg/m^3
Chlorobenzene	108-90-7	0.02[e]	0.07[g]	EPA Group D[e]	none found	OSHA-PEL: 350 mg/m^3 ACGIH-TLV: 46 mg/m^3 NIOSH-REL: 4,680 mg/m^3
Chloroform	67-66-3	0.01[e]	0.035[g]	EPA Group B2[e]	$6.1x10^{-3}$ (oral)[e] 0.081 (inhal)[j]	OSHA-PEL: 240 mg/m^3 (ceiling) ACGIH-TLV: 49 mg/m^3 NIOSH-REL: 9.78 mg/m^3 (60 min), IDLH: 2,480 mg/m^3
bis-Chloromethyl ether	542-88-1	$3.29x10^{-5}$[r]	$1.15x10^{-4}$[g]	EPA Group A[e]	220[j]	PEL: 0.0047 mg/m^3[m] ACGIH-TLV: 0.0047 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Chromium (Hexavalent)	18540-29-9	$5x10^{-3}$	0.0175[g]	EPA Group A	41 (inhal)[j]	OSHA-PEL: 1 mg/m^3[i] ACGIH-TLV: 0.05 mg/m^3 (water soluble)
Chromium (Trivalent)	16065-83-1	1[e]	3.5[g]	not classified	none found	OSHA-PEL: 0.5 mg/m^3 ACGIH-TLV: 0.5 mg/m^3 NIOSH-REL: 0.5 mg/m IDLH: 25 mg/m^3
Cobalt (metal dust and fume)	7440-48-4	$7x10^{-4}$[f]	$2.45x10^{-3}$[g]	not classified	none found	OSHA-PEL: 0.1 mg/m^3 ACGIH-TLV: 0.05 mg/m^3 NIOSH-REL: 0.05 mg/m^3, IDLH: 20 mg/m^3
Copper (dusts and mists)	7440-50-8	0.007[f]	0.0245[g]	EPA Group D[e]	none found	OSHA-PEL: 1 mg/m^3 ACGIH-TLV: 1 mg/m^3 NIOSH-REL: 1 mg/m^3, IDLH: 100 mg/m^3
Cresol (m-cresol, cresylic acid)[p]	108-39-4	0.154[f]	0.539[g]	not classified	none found	OSHA-PEL: 22 mg/m^3 (skin) ACGIH-TLV: 22 mg/m^3 (skin, all isomers) NIOSH-REL: 10 mg/m^3, IDLH: 1,125 mg/m^3
Cyclohexane	110-82-7	7.35[f]	25.725[g]	not classified	none found	OSHA-PEL: 1,050 mg/m^3 ACGIH-TLV: 1,030 mg/m^3 NIOSH-REL: 1,050 mg/m^3, IDLH: 4,550 mg/m^3
Cyclohexanone	108-94-1	5[e]	17.5[g]	not classified	none found	OSHA-PEL: 200 mg/m^3 ACGIH-TLV: 100 mg/m^3 (skin) NIOSH-REL: 100 mg/m^3 (skin)
Cyclopentane	287-92-3	12.05[f]	42.18[g]	not classified	none found	OSHA-PEL: 1,721 mg/m^3[i] ACGIH-TLV: 1,720 mg/m^3 NIOSH-REL: 1,720 mg/m^3
Dibenzofuran	132-64-9	none found	none found	EPA Group D[e]	none found	none found

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Dibutyl phosphate	107-66-4	0.035[f]	0.1225[g]	not classified	none found	OSHA-PEL: 5 mg/m^3[i] ACGIH-TLV: 8.6 mg/m^3, STEL: 17 mg/m^3 NIOSH-REL: 5 mg/m^3 STEL: 10 mg/m^3
o-Dichlorobenzene (1,2-Dichlorobenzene)	95-50-1	0.09[e]	0.315[g]	EPA Group D	none found	OSHA-PEL: 300 mg/m^3 (ceiling) ACGIH-TLV: 150 mg/m^3, STEL: 301 mg/m^3 NIOSH-REL: 300 mg/m^3, IDLH: 1,222 mg/m^3
3,3-Dichlorobenzidine (and salts)	91-94-1	none found	none found	B2[o]	o.45[e]	none found
Dichlorodifluoromethane	75-71-8	0.2[e]	0.7[g]	EPA Group D[k]	none found	OSHA-PEL: 4,950 mg/m^3 ACGIH-TLV: 4,950 mg/m^3 NIOSH-REL: 4,950 mg/m^3 IDLH: 75,450 mg/m^3
Dichloromethane (Methylene chloride)	75-09-2	0.06[e]	3.0[g]	EPA Group B2[e]	$7.5x10^{-3}$ (oral)[e]	OSHA-PEL: 1,765 mg/m^3, 3,530 mg/m^3 (ceiling) ACGIH-TLV: 174 mg/m^3 NIOSH-REL: 8,119 mg/m^3
Dimethylformamide (DMF)	68-12-2	$8.58x10^{-3}$[d]	0.03[e]	not classified	none found	OSHA-PEL: 30 mg/m^3 (skin) ACGIH-TLV: 30 mg/m^3 (skin) NIOSH-REL: 30 mg/m^3 (skin), IDLH: 1,520 mg/m^3
2,4,-Dinitrotoluene	25321-14-6	0.002[e]	0.007[g]	not classified	none found	OSHA-PEL: 1.5 mg/m^3 (skin) ACGIH-TLV: 0.15 mg/m^3 (skin) NIOSH-REL: 1.5 mg/m^3 (skin), IDLH: 50 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Di-sec octyl phthalate	117-81-7	0.02[q]	0.07[g]	not classified	none	OSHA-PEL: 5 mg/m^3 ACGIH-TLV: 5 mg/m^3, STEL: 10 mg/m^3 NIOSH-REL: 5 mg/m^3, STEL: 10 mg/m^3 IDLH: 5,000 mg/m^3
1,4-Dioxane	123-91-1	2.52[f]	8.82[g]	EPA Group B2	0.011[e]	OSHA-PEL: 360 mg/m^3 (skin) ACGIH-TLV: 90 mg/m^3 (skin) NIOSH-REL: 3.6 mg/m^3 (ceiling, 30-min), IDLH: 1,830 mg/m^3
Dodecane	112-40-3	none found	none found	not classified	none found	none found
Ethane	74-84-0	none found	none found	not classified	none found	none found
Ethyl acetate	141-78-6	0.9[e]	3.15[g]	not classified	none found	OSHA-PEL: 1,400 mg/m^3 ACGIH-TLV: 1,440 mg/m^3 NIOSH-REL: 1,400 mg/m^3, IDLH: 7,320 mg/m^3
Ethyl alcohol	64-17-5	13.3[f]	46.55[g]	not classified	none found	OSHA-PEL: 1,900 mg/m^3 ACGIH-TLV: 1,880 mg/m^3 NIOSH-REL 1,900 mg/m^3 IDLH: 6,336 mg/m^3
Ethyl benzene	100-41-4	0.1[e]	1.0[e]	EPA Group D[e]	none found	OSHA-PEL: 435 mg/m^3 ACGIH-TLV: 434 mg/m^3, STEL: 543 mg/m^3 NIOSH-REL: 435 mg/m^3, STEL: 545 mg/m^3 IDLH: 3,528 mg/m^3
Ethyl ether	60-29-7	0.2[e]	0.7[g]	not classified	none found	OSHA-PEL: 1,200 mg/m^3 ACGIH-TLV: 1,210 mg/m^3, STEL: 1,520 mg/m^3 IDLH: 5,852 mg/m^3
Ethylene	74-85-1	none found	none found	not classified	none found	none found

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Ethylene dichloride (1,2-Dichloroethane)	107-06-2	1.44[f]	5.03[g]	EPA Group B2[e]	0.091 (oral)[e] 0.091 (inhal)[j]	OSHA-PEL: 205.5 mg/m^3, 411 mg/m^3 (ceiling) 822 mg/m^3 (5-min max peak any 3 hrs) ACGIH-TLV: 40 mg/m^3, NIOSH-REL: 4 mg/m^3, STEL: 8 mg/m^3 IDLH: 205.5 mg/m^3
Ethylene glycol	107-21-1	2.0[e]	7.0[g]	EPA Group D[k]	none found	ACGIH-TLV: 127 mg/m^3 (ceiling) PEL: 127 mg/m^{3m}
Ethylene glycol monoethyl ether (2-Ethoxyethanol)	110-80-5	5.18[f]	18.13[g]	not classified	none found	OSHA-PEL: 740 mg/m^3 (skin) ACGIH-TLV: 18 mg/m^3 (skin) NIOSH-REL: 1.8 mg/m^3 (skin), IDLH: 1,875 mg/m^3
Ethyltriacetyoxysilane	none	none	none	not classified	none found	none found
Fluoride	16984-48-8	0.0175[f]	0.061[g]	not classified	none found	OSHA-PEL: 2.5 mg/m^{3i} ACGIH-TLV: 2.5 mg/m^3
Formaldehyde	50-00-0	0.2[e]	0.7[g]	EPA Group B1[e]	0.045 (inhal)[j]	OSHA-PEL: 0.9375 mg/m^3, STEL: 2.5 mg/m^3 ACGIH-TLV: 0.37 mg/m^3 (ceiling) NIOSH-REL: 0.02 mg/m^3, 0.125 mg/m^3 (ceiling, 15 min.), IDLH: 25 mg/m^3
Formic Acid	64-18-6	0.063[f]	0.221[g]	not classified	none found	OSHA-PEL: 9 mg/m^3 ACGIH-TLV: 9.4 mg/m^3, STEL: 19 mg/m^3 NIOSH-REL: 9 mg/m^3, IDLH: 57.3 mg/m^3
n-Heptane	142-82-5	14[e]	49[g]	EPA Group D	none found	OSHA-PEL: 2,000 mg/m^3 ACGIH-TLV: 1,640 mg/m^3 STEL: 2,050 mg/m^3 NIOSH-REL: 350 mg/m^3 CEILING (15 min): 1,800 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
n-Hexane	110-54-3	0.06[d]	0.2[e]	EPA Group D[k]	none found	OSHA-PEL: 1800 mg/m^3 ACGIH-TLV: 176 mg/m^3 NIOSH-REL: 180 mg/m^3, IDLH: 3,938 mg/m^3
Hydrazine	302-01-2	$9.31x10^{-3}$[f]	$3.26x10^{-2}$[g]	EPA Group B2[e]	3.0 (oral)[e] 17 (inhal)[j]	OSHA-PEL: 1.33 mg/m^3 (skin) ACGIH-TLV: 0.13 mg/m^3 (skin) NIOSH-REL: 0.04 mg/m^3 (ceiling, 2 hr.), IDLH: 66.5 mg/m^3
Hydrochloric acid	7647-01-0	$2x10^{-3}$[d]	$7x10^{-3}$[e]	not classified	none found	OSHA-PEL: 7 mg/m^3 ACGIH-TLV: 7.5 mg/m^3 (ceiling) NIOSH-REL: 7 mg/m^3 IDLH: 76 mg/m^3
Hydrogen chloride	7647-01-0	$2x10^{-3}$[d]	$7x10^{-3}$[e]	not classified	none found	OSHA-PEL: 7 mg/m^3 ACGIH-TLV: 7.5 mg/m^3 (ceiling) NIOSH-REL: 7 mg/m^3 IDLH: 76 mg/m^3
Hydrogen cyanide	74-90-8	0.02[e]	0.07[g]	not classified	none found	OSHA-PEL: 11 mg/m^3 (skin) ACGIH-TLV: 11 mg/m^3 (skin, ceiling) NIOSH-REL: 5 mg/m^3 (skin), IDLH: 56 mg/m^3
Hydrogen fluoride	7664-39-3	0.06[q]	0.21[g]	not classified	none found	OSHA-PEL: 2.49 mg/m^3 ACGIH-TLV: 2.6 mg/m^3 (ceiling) NIOSH-REL: 2.5 mg/m^3, 5 mg/m^3 (ceiling, 15 min), IDLH: 24.9 mg/m^3
Hydrogen peroxide	7722-84-1	0.0098[f]	0.0343[g]	not classified	none found	OSHA-PEL: 1.4 mg/m^3 ACGIH-TLV: 1.4 mg/m^3 NIOSH-REL 1.4 mg/m^3 IDLH: 105.75 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Hydrogen sulfide	7783-06-4	$3x10^{-3}$[e]	$9x10^{-4}$[e]	not classified	none found	OSHA-PEL: 28.4 mg/m^3 (ceiling) ACGIH-TLV: 14 mg/m^3, STEL: 21 mg/m^3 NIOSH-REL: 15 mg/m^3 (ceiling, 10 min), IDLH: 142 mg/m^3
Iron (salts)	none found	0.007[r]	0.0245[g]	not classified	none found	PEL: 1 mg/m^{3m} ACGIH-TLV: 1 mg/m^3 NIOSH-REL: 1 mg/m^3
Isobutane	75-28-5	13.3[h]	46.55[g]	not classified	none found	PEL: 1900 mg/m^{3m} NIOSH-REL: 1900 mg/m^3
Isobutyl acetate	110-19-0	4.9[f]	17.15[g]	not classified	none found	OSHA-PEL: 700 mg/m^3 ACGIH-TLV: 713 mg/m^3 NIOSH-REL: 700 mg/m^3 IDLH: 6,279 mg/m^3
Isobutyl alcohol (isobutanol)	78-83-1	0.3[e]	1.05[g]	not classified	none found	OSHA-PEL: 300 mg/m^3 ACGIH-TLV: 152 mg/m^3 NIOSH-REL: 150 mg/m^3, IDLH: 4,928 mg/m^3
Isopropyl alcohol	67-63-0	6.9[q]	24.15[g]	not classified	none found	OSHA-PEL: 980 mg/m^3 ACGIH-TLV: 983 mg/m^3 STEL: 1,230 mg/m^3 NIOSH-REL: 980 mg/m^3 STEL: 1,225 mg/m^3 IDLH: 5,000 mg/m^3
Kerosene	8008-20-6	0.7[h]	2.45[g]	IARC Group 2A[i] (suspect carcinogen)	none found	NIOSH-REL: 100 mg/m^3
Lead	7439-92-1	$3.5x10^{-4}$[f]	$1.225x10^{-3}$[g]	EPA Group B2[e]	none found	OSHA-PEL: 0.05 mg/m^3 ACGIH-TLV: 0.15 mg/m^3 NIOSH-REL: 0.1 mg/m^3, IDLH: 100 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Lead chromate	7758-97-6	0.00035[r]	0.001225[g]	ACGIH Group A2[i] (suspect human carcinogen)	none found	OSHA-PEL: 0.05 mg/m^3[i] ACGIH-TLV (as Pb): 0.05 mg/m^3
Lithium	7439-93-2	none found	none found	not classified	none found	none found
Lithium hydride	7580-67-8	1.75×10^{-4}[f]	6.125×10^{-4}[g]	not classified	none found	OSHA-PEL: 0.025 mg/m^3 ACGIH-TLV: 0.025 mg/m^3 NIOSH-REL: 0.025 mg/m^3, IDLH: 0.5 mg/m^3
Magnesium (oxide fume)	1309-48-4	0.105[f]	0.368[g]	not classified	none found	OSHA-PEL: 15 mg/m^3 ACGIH-TLV: 10 mg/m^3 NIOSH-REL: 750 mg/m^3
Manganese	7439-96-5	1.43×10^{-5}[d]	5×10^{-5}[e]	EPA Group D[e]	none found	OSHA-PEL: 5 mg/m^3 (ceiling) ACGIH-TLV: 5 mg/m^3 (dust and compounds) NIOSH-REL: 1 mg/m^3, STEL: 3 mg/m^3, IDLH: 500 mg/m^3
Mercury (vapor)	7439-97-6	3×10^{-4} (inorganic, chronic)[j]	3×10^{-4}[q]	EPA Group D[e]	none found	OSHA-PEL: 0.1 mg/m^3 (ceiling) ACGIH-TLV: 0.05 mg/m^3 NIOSH-REL: 0.05 mg/m^3 (skin), IDLH: 10 mg/m^3
Methanol (methyl alcohol)	67-56-1	0.5[e]	1.75[g]	not classified	none found	OSHA-PEL: 260 mg/m^3 ACGIH-TLV: 262 mg/m^3 (skin), STEL: 328 mg/m^3 NIOSH-REL: 260 mg/m^3, STEL: 325 mg/m^3 (skin), IDLH: 7,980 mg/m^3
Methyl chloride	74-87-3	1.47[f]	5.145[g]	not classified	none found	OSHA-PEL: 210 mg/m^3 ACGIH-TLV: 103 mg/m^3 STEL: 207 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Methylene chloride (dichloromethane)	75-09-2	0.06[e]	3.0[q]	EPA Group B2[e]	$7.5x10^{-3}$ (oral)[e]	OSHA-PEL: 1,765 mg/m^3, 3,530 (ceiling) ACGIH-TLV: 174 mg/m^3 NIOSH-IDLH: 8,119 mg/m^3
Methyl ethyl ketone (MEK; 2-Butanone)	78-93-3	1.0[e]	1.0[e]	EPA Group D[e]	none found	OSHA-PEL: 590 mg/m^3 ACGIH-TLV: 590 mg/m^3, STEL: 885 mg/m^3 NIOSH-REL: 590 mg/m^3, STEL: 885 mg/m^3, IDLH: 9,000 mg/m^3
Methyl isobutyl ketone (hexone)	108-10-1	0.08 (chronic)[j]	0.28[g]	not classified	none found	OSHA-PEL: 410 mg/m^3 ACGIH-TLV: 205 mg/m^3, STEL: 307 mg/m^3 NIOSH-REL: 205 mg/m^3, STEL: 300 mg/m^3, IDLH: 2,085 mg/m^3
Naphthalene (napthene)	91-20-3	0.35[f]	1.225[g]	EPA Group D[e]	none found	OSHA-PEL: 50 mg/m^3 ACGIH-TLV: 52 mg/m^3, STEL: 79 mg/m^3 NIOSH-REL: 50 mg/m^3, STEL: 75 mg/m^3, IDLH: 1,333 mg/m^3
Nickel (refinery dust)	7440-02-0	0.007[f]	0.0245[g]	EPA Group A[e]	0.84 (inhal)[j]	OSHA-PEL: 1.0 mg/m^3 (metal and other compds.) ACGIH-TLV: 1 mg/m^3 NIOSH-REL: 0.015 mg/m^3
Nitric acid	7697-37-2	0.035[q]	0.1225[g]	not classified	none found	OSHA-PEL: 5 mg/m^3 ACGIH-TLV: 5.2 mg/m^3, STEL: 10 mg/m^3 NIOSH-REL: 5 mg/m^3, STEL: 10 mg/m^3, IDLH: 65.5 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Nitrobenzene	98-95-3	$5x10^{-4}$[e]	$1.75x10^{-3}$[g]	EPA Group D[e]	none found	OSHA-PEL: 5 mg/m^3 (skin) ACGIH-TLV: 5 mg/m^3 (skin) NIOSH-REL: 5.0 mg/m^3 (skin), IDLH: 1,024 mg/m^3
2-Nitropropane	79-46-9	$5.72x10^{-3}$[d]	0.02[e]	EPA Group B2[e]	9.4[j]	OSHA-PEL: 90 mg/m^3 ACGIH-TLV: 36 mg/m^3 IDLH: 370 mg/m^3
Octanol	111-87-5	0.72[l]	2.52[g]	not classified	none found	PEL: 102.8 LD50 (oral-rat) 18,000 mg/kg[i]
Oxalic acid	144-62-7	0.007[f]	0.0245[g]	not classified	none found	OSHA-PEL: 1 mg/m^3 ACGIH-TLV: 1 mg/m^3, STEL: 2 mg/m^3 NIOSH-REL: 1 mg/m^3, STEL: 2 mg/m^3, IDLH: 500 mg/m^3
Ozone	10028-15-6	$1.4x10^{-4}$[f]	$4.9x10^{-4}$[g]	not classified	none found	OSHA-PEL: 0.2 mg/m^3 ACGIH-TLV: 0.2 mg/m^3 NIOSH-REL: 0.2 mg/m^3 IDLH: 10 mg/m^3
Phenol	108-95-2	0.6[k]	2.1[g]	EPA Group D[e]	none found	OSHA-PEL: 19 mg/m^3 (skin) NIOSH-REL: 19 mg/m^3 (skin, ceiling, 15 min.)
Phosphoric acid	7664-38-2	0.007[f]	0.0245[g]	not classified	none found	OSHA-PEL: 1 mg/m^3 ACGIH-TLV: 1 mg/m^3, STEL: 3 mg/m^3 NIOSH-REL: 1 mg/m^3, STEL: 3 mg/m^3, IDLH: 1,000 mg/m^3
Phosphorus (yellow)	7723-14-0	$7x10^{-4}$[f]	$2.45x10^{-3}$[g]	not classified	none found	OSHA-PEL: 0.1 mg/m^3 ACGIH-TLV: 0.1 mg/m^3 NIOSH-REL: 0.1 mg/m^3, IDLH: 5 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Phosgene	75-44-5	$2.8x10^{-3}$[f]	$9.8x10^{-3}$[g]	not classified	none found	OSHA-PEL: 0.4 mg/m^3 ACGIH-TLV: 0.4 mg/m^3 NIOSH-REL: 0.4 mg/m^3, 0.8 mg/m^3 (ceiling, 15 min.) IDLH: 8.22 mg/m^3
Plutonium oxide (plutonium cmpds)	none found	none found	none found	not classified	none found	none found
Potassium chromate (VI)	7789-00-6	0.007[f]	0.0245[g]	not classified	none found	OSHA-PEL: 1.0 mg/m^3[i] NIOSH-REL: 0.05 mg/m^3
Potassium hydroxide	1310-58-03	0.014[f]	0.049[g]	not classified	none found	OSHA-PEL: 2 mg/m^3[i] ACGIH-TLV: 2 mg/m^3 (ceiling) NIOSH-REL: 2 mg/m^3
Propane	74-98-6	12.6[f]	44.1[g]	not classified	none found	OSHA-PEL: 1,800 mg/m^3 NIOSH-REL: 1,800 mg/m^3, IDLH: 3,843 mg/m^3
Propene	115-07-1	none found	none found	not classified	none found	none found
Propionaldehyde	123-38-6	0.056[l]	0.197[g]	not classified	none found	LD50 (oral, rat): 1,410 mg/kg[i] PEL: 8.06 mg/m^3[m]
Propylene oxide	75-56-9	1.68[f]	0.03[e]	EPA Group B2[e]	0.24[e]	OSHA-PEL: 240 mg/m^3 ACGIH-TLV: 48 mg/m^3
Pyrene	129-00-0	0.03[e]	0.105[g]	EPA Group D[e]	none found	OSHA-PEL: 0.2 mg/m^3[i]
Pyridine	110-86-1	0.001[e]	0.0035[g]	not classified	none found	OSHA-PEL: 15 mg/m^3 ACGIH-TLV: 16 mg/m^3 NIOSH-REL: 15 mg/m^3, IDLH: 3,290 mg/m^3
Selenium	7782-49-2	$5x10^{-3}$[e]	0.0175[g]	EPA Group D[e]	none found	OSHA-PEL: 0.2 mg/m^3 ACGIH-TLV: 0.2 mg/m^3 NIOSH-REL: 0.2 mg/m^3, IDLH: 1 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Silicon	7440-21-3	0.035[f]	0.1225[g]	not classified	none found	OSHA-PEL: 15 mg/m^3 (total), 5 mg/m^3 (resp) ACGIH-TLV: 10 mg/m^3 NIOSH-REL: 10 mg/m^3 (total), 5 mg/m^3 (resp)
Silver	7440-22-4	$5x10^{-3}$[e]	0.0175[g]	EPA Group D[e]	none found	OSHA-PEL: 0.01 mg/m^3 ACGIH-TLV: 0.1 mg/m^3 NIOSH-REL: 0.01 mg/m^3, IDLH: 10 mg/m^3
Stoddard solvent	8052-41-3	20.3[d]	71.05[f]	not classified	none found	OSHA-PEL: 2,900 mg/m^3 ACGIH-TLV: 525 mg/m^3 NIOSH-REL: 1,800 mg/m^3 (ceiling, 15-min) IDLH: 20,000 mg/m^3
Styrene	100-42-5	0.2[e]	1[e]	EPA Group C[k]	none found	OSHA-PEL: 433 mg/m^3, 866 mg/m^3 (ceiling) ACGIH-TLV: 213 mg/m^3 (skin), STEL: 426 mg/m^3 (skin) NIOSH-REL: 215 mg/m^3, STEL: 425 mg/m^3, IDLH: 3,031 mg/m^3
Sulfuric acid	7664-93-9	0.007[f]	0.0245[g]	not classified	none found	OSHA-PEL: 1 mg/m^3 ACGIH-TLV: 1 mg/m^3, STEL: 3 mg/m^3 NIOSH-REL: 1 mg/m^3, IDLH: 15 mg/m^3
Tetrachloroethylene	127-18-4	0.01[e]	0.035[g]	EPA Group C-B2[j]	0.002[j]	OSHA-PEL: 689 mg/m^3, 1,378 mg/m^3 (ceiling) ACGIH-TLV: 339 mg/m^3, STEL: 1,357 mg/m^3 NIOSH-STEL: 1,034 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Tetrahydrofuran (THF)	109-99-9	4.13[f]	14.455[g]	not classified	none found	OSHA-PEL: 590 mg/m^3 ACGIH-TLV: 590 mg/m^3, STEL: 737 mg/m^3 NIOSH-REL: 590 mg/m^3, STEL: 735 mg/m^3, IDLH: 6,000 mg/m^3
Titanium	7440-32-6	none found	none found	not classified	none found	none found
Toluene	108-88-3	0.2[e]	0.4[e]	EPA Group D[e]	none found	OSHA-PEL: 766 mg/m^3, 1,149 mg/m^3 (ceiling) ACGIH-TLV: 188 mg/m^3 (skin) NIOSH-REL: 375 mg/m^3, STEL: 560 mg/m^3, IDLH: 1,915 mg/m^3
Tributyl phosphate	126-73-8	0.035[d]	0.1225[g]	not classified	none found	OSHA-PEL: 5 mg/m^3 ACGIH-TLV: 2.2 mg/m^3 NIOSH-REL: 2.5 mg/m^3 IDLH: 332.1 mg/m^3
1,1,1-Trichloroethane (TCA; methyl chloroform)	71-55-6	0.035[k]	1.0	EPA Group D[e]	none found	OSHA-PEL: 1,900 mg/m^3 ACGIH-TLV: 1,910 mg/m^3, STEL: 2,460 mg/m^3 NIOSH-REL: 1,900 mg/m^3 (ceiling, 15 min.), IDLH: 3,885 mg/m^3
1,1,2-Trichloroethane	79-00-5	0.004[e]	0.014[g]	EPA Group C[e]	0.057 (oral)[e] 0.057 (inhal)[j]	OSHA-PEL: 45 mg/m^3 (skin) ACGIH-TLV: 55 mg/m^3 NIOSH-REL: 375 mg/m^3 (skin), IDLH: 555 mg/m^3
Trichloroethylene (TCE)	79-01-6	3.82[f]	13.377[g]	EPA Group B2[k]	$6.0x10^{-3}$ (inhal)[j]	OSHA-PEL: 546 mg/m^3, 1,092 mg/m^3 (ceiling) ACGIH-TLV: 269 mg/m^3, STEL: 1,070 mg/m^3 NIOSH-IDLH: 5,460 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Trichlorotrifluoroethane (Freon 113)	76-13-1	30.0[e]	105.0[g]	not classified	none found	OSHA-PEL: 7,600 mg/m^3 ACGIH-TLV: 7,670 mg/m^3, STEL: 9,590 mg/m^3 NIOSH-REL: 7,600 mg/m^3, STEL: 9,500 mg/m^3, IDLH: 15,580 mg/m^3
1,2,4-Trimethylbenzene	95-63-6	0.875[h]	3.06[g]	not classified	none found	PEL: 125 mg/m^{3m} NIOSH-REL: 125 mg/m^3
Tungsten (insoluble compds)	7440-33-7	0.035[h]	0.1225[g]	not classified	none found	ACGIH-TLV: 5 mg/m^3 STEL: 10 mg/m^3 NIOSH-REL: 5 mg/m^3 STEL: 10 mg/m^3
VM&P naphtha	8032-32-4	2.45[h]	8.575[g]	not classified	none found	PEL: 245 mg/m^{3m} ACGIH-TLV: 1,370 mg/m^3 NIOSH-REL: 350 mg/m^3, 1,800 mg/m^3 (ceiling, 15 min)
Welding fumes	ZC2550000	0.035[r]	0.1225[g]	not classified	none found	TLV[i]: 5 mg/m^3

Table M.3.3–1. Table of Exposure Limits—Continued

Compound	Chemical Abstracts Service No.	Reference Dose (oral) (mg/kg/day)	Reference Concentration (inhalation) (mg/m^3)	Cancer Class[a]	Slope Factor $(mg/kg/day)^{-1}$	Occupational Exposure Levels[b,c]
Xylene (mixture)	1330-20-7	2.0[e]	7.0[g]	EPA Group D[e]	none found	OSHA-PEL: 435 mg/m^3 ACGIH-TLV: 435 mg/m^3, STEL: 651 mg/m^3 NIOSH-REL: 435 mg/m^3, STEL: 655 mg/m^3, IDLH: 3,969 mg/m^3
Zinc	7440-66-6	0.3[e]	1.05[g]	EPA Group D[e]	none found	PEL: 42.9 mg/m^{3m}

[a] EPA Groups for carcinogenicity are classified as follows[j]:
EPA Group A: Human Carcinogen;
EPA Group B1: Probable Human Carcinogen - limited evidence in human studies;
EPA Group B2: Probable Human Carcinogen - sufficient evidence from animal studies, inadequate evidence or no data from human studies;
EPA Group C: Possible Human Carcinogen;
EPA Group D: Not Classifiable as to Human Carcinogenicity

[b] OSHA and NIOSH exposure levels were taken from NIOSH 1994a.

[c] ACGIH exposure levels were taken from ACGIH nda.

[d] RfD calculated from RfC, formula from the Center for Risk Management, ORNL (ORNL 1992d).

[e] ORNL 1994a.

[f] RfD calculated from OSHA-PEL, formula from the Center for Risk Management, ORNL (ORNL 1992d).

[g] RfC calculated from RfD, formula from the Center for Risk Management, ORNL (ORNL 1992d).

[h] RfD calculated from NIOSH-REL.

[i] Lewis 1992a.

[j] EPA 1994b.

[k] EPA 1993a.

[l] RfD calculated from LD50 (RfD = LD50 x $4x10^{-5}$).

[m] PEL calculated from RfD.

[n] EPA 1993c.

[o] Slope Factor=Unit Risk $(\mu g/m^3)^{-1}$ x 70 kg x 10^3 $(\mu g/mg)/20(m^3/day)$ where: 70 kg is the average weight of an adult, 10^3 $(\mu g/mg)$ converts ug to mg, and 20 (m^3/day) is the estimated volume of air inhaled by an average adult.

[p] Mixture of three isomers (m, o, and p) in which the m-isomer predominates (Merck 1976a).

[q] PNL 1995a.

[r] RfD calculated from ACGIH-TWA, formula from the Center for Risk Management, Oak Ridge National Laboratories (ORNL 1992d).

M.3.4 HAZARDOUS CHEMICAL RISK/EFFECTS CALCULATIONS

Tables M.3.4–1 through M.3.4–79 show the human health risk increment from exposure to hazardous chemicals associated with the various alternative activities. The terms associated with calculations are given in the footnotes for each table so that each calculated value can be verified.

Table M.3.4–1. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site—No Action

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Ammonia	0.10	35	f	$1.27x10^{-8}$	$4.22x10^{-5}$	$1.27x10^{-7}$	$1.20 x10^{-6}$	0	0
Carbon monoxide	1.35	55	f	$6.58 x10^{-5}$	$2.18 x10^{-1}$	$4.87x10^{-5}$	$3.96x10^{-3}$	0	0
VOC (toluene)	0.40	766	f	$5.23 x10^{-6}$	$1.73 x10^{-2}$	$1.30 x10^{-5}$	$2.26x10^{-5}$	0	0
Health Risk									
HI[g]						$6.20x10^{-5}$	$3.99x10^{-3}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: HF 1995a:2.

Table M.3.4–2. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site—Upgrade Plutonium Storage Facility (Both Options)

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	2.92×10^{-7}	9.69×10^{-4}	2.17×10^{-7}	1.76×10^{-5}	0	0
VOC (toluene)	0.4	766	[f]	2.87×10^{-7}	9.52×10^{-4}	7.18×10^{-7}	1.24×10^{-6}	0	0
Health Risk									
HI[g]						9.35×10^{-7}	1.89×10^{-5}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: HF DOE 1996a.

Table M.3.4–3. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site— Consolidate Plutonium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	$2.93x10^{-6}$	$9.72x10^{-3}$	$2.17x10^{-6}$	$1.76x10^{-4}$	0	0
Chlorine	0.35	3	f	$2.82x10^{-8}$	$9.35x10^{-5}$	$8.06x10^{-8}$	$3.11x10^{-5}$	0	0
Hydrazine	0.0326	1.33	17	$5.64 x10^{-9}$	$1.87x10^{-5}$	$1.73x10^{-7}$	$1.43x10^{-5}$	$2.74x10^{-8}$	$1.23x10^{-5}$
Nitric acid	0.1225	5	f	$3.38x10^{-8}$	$1.12x10^{-4}$	$2.76x10^{-7}$	$2.24x10^{-5}$	0	0
Phosphoric acid	0.0245	1	f	$5.64x10^{-9}$	$1.87x10^{-5}$	$2.30x10^{-7}$	$1.87x10^{-5}$	0	0
Sulfuric acid	0.0245	1	f	$5.64x10^{-9}$	$1.87x10^{-5}$	$2.30x10^{-7}$	$1.87x10^{-5}$	0	0
VOC (toluene)	0.4	766	f	$3.27x10^{-7}$	$1.08x10^{-3}$	$8.18x10^{-7}$	$1.41x10^{-6}$	0	0
Health Risk									
HI[g]						$3.98x10^{-6}$	$2.84x10^{-4}$		
Cancer risk[h]								$2.74x10^{-8}$	$1.23x10^{-5}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996e.

Table M.3.4–4. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site—Collocate Plutonium and Highly Enriched Uranium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	2.93×10^{-6}	9.72×10^{-3}	2.17×10^{-6}	1.76×10^{-4}	0	0
Chlorine	0.35	3	[f]	3.38×10^{-8}	1.12×10^{-4}	9.67×10^{-8}	3.74×10^{-5}	0	0
Hydrazine	0.0326	1.3	17	5.64×10^{-9}	1.87×10^{-5}	1.73×10^{-7}	1.43×10^{-5}	2.74×10^{-8}	1.23×10^{-5}
Hydrogen chloride	0.007	7	[f]	5.07×10^{-8}	1.68×10^{-4}	7.25×10^{-6}	2.40×10^{-5}	0	0
Hydrogen fluoride	0.21	2.49	[f]	5.07×10^{-8}	1.68×10^{-4}	2.41×10^{-7}	6.75×10^{-5}	0	0
Nitric acid	0.1225	5	[f]	5.36×10^{-7}	1.77×10^{-3}	4.37×10^{-6}	3.55×10^{-4}	0	0
Phosphoric acid	0.0245	1	[f]	5.64×10^{-9}	1.87×10^{-5}	2.30×10^{-7}	1.87×10^{-5}	0	0
Sulfuric acid	0.0245	1	[f]	5.64×10^{-9}	1.87×10^{-5}	2.30×10^{-7}	1.87×10^{-5}	0	0
VOC (toluene)	0.4	766	[f]	3.27×10^{-7}	1.08×10^{-3}	8.18×10^{-7}	1.41×10^{-6}	0	0
Health Risk									
HI[g]						1.56×10^{-5}	7.14×10^{-4}		
Cancer risk[h]								2.74×10^{-8}	1.23×10^{-5}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996f.

Table M.3.4–5. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site—No Action

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
No chemical emissions	–	–	–	–	–	0	0	0	0
[Text deleted.]									

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[Text deleted.]

Source: NTS 1993a:4.

Table M.3.4–6. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site—Consolidate Plutonium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	1.93×10^{-6}	2.23×10^{-2}	1.43×10^{-6}	4.05×10^{-4}	0	0
Chlorine	0.35	3	f	4.20×10^{-9}	4.85×10^{-5}	1.20×10^{-8}	1.61×10^{-5}	0	0
Hydrazine	0.0326	1.33	17	8.40×10^{-10}	9.70×10^{-6}	2.57×10^{-8}	7.46×10^{-6}	4.09×10^{-9}	6.38×10^{-6}
Nitric acid	0.1225	5	f	5.04×10^{-9}	5.82×10^{-5}	4.11×10^{-8}	1.16×10^{-5}	0	0
Phosphoric acid	0.0245	1	f	8.40×10^{-10}	9.70×10^{-6}	3.43×10^{-8}	9.70×10^{-6}	0	0
Sulfuric acid	0.0245	1	f	8.40×10^{-10}	9.70×10^{-6}	3.43×10^{-8}	9.70×10^{-6}	0	0
VOC (toluene)	0.4	766	f	2.77×10^{-7}	3.20×10^{-3}	6.93×10^{-7}	4.18×10^{-6}	0	0
Health Risk									
HI[g]						2.27×10^{-6}	4.65×10^{-4}		
Cancer risk[h]								4.09×10^{-9}	6.38×10^{-6}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996e.

Table M.3.4–7. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site— Consolidate Plutonium Storage Facility at P-Tunnel

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	2.10×10^{-6}	2.42×10^{-2}	1.55×10^{-6}	4.41×10^{-4}	0	0
Chlorine	0.35	3	[f]	6.72×10^{-9}	7.76×10^{-5}	1.92×10^{-8}	2.58×10^{-5}	0	0
Hydrazine	0.0326	1.3	17	8.40×10^{-10}	9.70×10^{-6}	2.57×10^{-8}	7.46×10^{-6}	4.09×10^{-9}	6.38×10^{-6}
Nitric acid	0.1225	5	[f]	4.20×10^{-9}	4.85×10^{-5}	3.43×10^{-8}	9.70×10^{-6}	0	0
Phosphoric acid	0.0245	1	[f]	8.40×10^{-10}	9.70×10^{-6}	3.43×10^{-8}	9.70×10^{-6}	0	0
Sulfuric acid	0.0245	1	[f]	8.40×10^{-10}	9.70×10^{-6}	3.43×10^{-8}	9.70×10^{-6}	0	0
VOC (toluene)	0.4	766	[f]	3.10×10^{-7}	3.59×10^{-3}	7.77×10^{-7}	4.68×10^{-6}	0	0
Health Risk									
HI[g]						2.48×10^{-6}	5.08×10^{-4}		
Cancer risk[h]								4.09×10^{-9}	6.38×10^{-6}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: NT DOE 1996a.

Table M.3.4–8. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site—Collocate Plutonium and Highly Enriched Uranium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	2.10×10^{-6}	2.42×10^{-2}	1.55×10^{-6}	4.41×10^{-4}	0	0
Chlorine	0.35	3	f	5.04×10^{-9}	5.82×10^{-5}	1.44×10^{-8}	1.94×10^{-5}	0	0
Hydrazine	0.0326	1.3	17	8.40×10^{-10}	9.70×10^{-6}	2.57×10^{-8}	7.46×10^{-6}	4.09×10^{-9}	6.38×10^{-6}
Hydrogen chloride	0.007	7	f	7.56×10^{-9}	8.73×10^{-5}	1.08×10^{-6}	1.24×10^{-5}	0	0
Hydrogen fluoride	0.21	2.49	f	7.56×10^{-9}	8.73×10^{-5}	3.60×10^{-8}	3.50×10^{-5}	0	0
Nitric acid	0.1225	5	f	7.98×10^{-8}	9.21×10^{-4}	6.51×10^{-7}	1.84×10^{-4}	0	0
Phosphoric acid	0.0245	1	f	8.40×10^{-10}	9.70×10^{-6}	3.43×10^{-8}	9.70×10^{-6}	0	0
Sulfuric acid	0.0245	1	f	8.40×10^{-10}	9.70×10^{-6}	3.43×10^{-8}	9.70×10^{-6}	0	0
VOC (toluene)	0.4	766	f	3.10×10^{-7}	3.59×10^{-3}	7.77×10^{-7}	4.68×10^{-6}	0	0
Health Risk									
HI[g]						4.21×10^{-6}	7.24×10^{-4}		
Cancer risk[h]								4.09×10^{-9}	6.38×10^{-6}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996f.

Table M.3.4–9. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site— Collocate Plutonium and Highly Enriched Uranium Storage Facility at P-Tunnel

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	2.35×10^{-6}	2.71×10^{-2}	1.74×10^{-6}	4.93×10^{-4}	0	0
Chlorine	0.35	3	f	6.72×10^{-9}	7.76×10^{-5}	1.92×10^{-8}	2.58×10^{-5}	0	0
Hydrazine	0.0326	1.3	17	8.40×10^{-10}	9.70×10^{-6}	2.57×10^{-8}	7.46×10^{-6}	4.09×10^{-9}	6.38×10^{-6}
Nitric acid	0.1225	5	f	4.20×10^{-9}	4.85×10^{-5}	3.43×10^{-8}	9.70×10^{-6}	0	0
Phosphoric acid	0.0245	1	f	8.40×10^{-10}	9.70×10^{-6}	3.43×10^{-8}	9.70×10^{-6}	0	0
Sulfuric acid	0.0245	1	f	8.40×10^{-10}	9.70×10^{-6}	3.43×10^{-8}	9.70×10^{-6}	0	0
VOC (toluene)	0.4	766	f	3.53×10^{-7}	4.07×10^{-3}	8.82×10^{-7}	5.32×10^{-6}	0	0
Health Risk									
HI[g]						2.77×10^{-6}	5.62×10^{-4}		
Cancer risk[h]								4.09×10^{-9}	6.38×10^{-6}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: NT DOE 1996a.

Table M.3.4–10. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—No Action

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
1,2,4-Trimethylbenzene	3.06	125	f	1.05×10^{-6}	1.64×10^{-3}	3.43×10^{-7}	1.31×10^{-5}	0	0
1,3-Butadiene	53.9	2200	1.8	2.66×10^{-6}	4.15×10^{-3}	4.93×10^{-8}	1.88×10^{-6}	1.37×10^{-6}	2.89×10^{-4}
Acetaldehyde	0.009	360	f	3.74×10^{-7}	5.85×10^{-4}	4.16×10^{-5}	1.62×10^{-6}	0	0
Ammonium hydroxide	0.0499	2	f	1.93×10^{-5}	3.02×10^{-2}	3.87×10^{-4}	1.51×10^{-2}	0	0
Arsenic	0.00105	0.01	50	5.08×10^{-8}	7.93×10^{-5}	4.83×10^{-5}	7.93×10^{-3}	7.26×10^{-7}	1.53×10^{-4}
Benzene	0.0796	3.25	0.029	4.47×10^{-6}	6.98×10^{-3}	5.62×10^{-5}	2.14×10^{-3}	3.71×10^{-8}	7.84×10^{-6}
Carbon monoxide	1.35	55	f	3.64×10^{-3}	5.68	2.69×10^{-3}	1.03×10^{-1}	0	0
Carbon tetrachloride	0.00245	63.9	0.053	3.38×10^{-7}	5.28×10^{-4}	1.38×10^{-4}	8.27×10^{-6}	5.13×10^{-9}	1.08×10^{-6}
Chloroform	0.035	240	0.081	2.29×10^{-8}	3.58×10^{-5}	6.56×10^{-7}	1.49×10^{-7}	5.32×10^{-10}	1.12×10^{-7}
Chromium-hexavalent	0.0175	1	41	4.83×10^{-9}	7.55×10^{-6}	2.76×10^{-7}	7.5537×10^{-6}	5.67×10^{-8}	1.20×10^{-5}
Chromium-trivalent	3.5	0.5	f	3.74×10^{-8}	5.85×10^{-5}	1.07×10^{-8}	1.17×10^{-4}	0	0
Cyclopentane	42.18	1,720	f	4.23×10^{-6}	6.60×10^{-3}	1.00×10^{-7}	3.84×10^{-6}	0	0
Dichloromethane	3.0	1,765	0.0075	7.49×10^{-6}	1.17×10^{-2}	2.49×10^{-6}	6.63×10^{-6}	1.61×10^{-8}	3.40×10^{-6}
Formaldehyde	0.7	0.9375	0.045	1.16×10^{-5}	1.81×10^{-2}	1.65×10^{-5}	1.93×10^{-2}	1.49×10^{-7}	3.16×10^{-5}
Hydrazine	0.0326	1.33	17	1.00×10^{-7}	1.56×10^{-4}	3.07×10^{-6}	1.17×10^{-4}	4.88×10^{-7}	1.03×10^{-4}
Hydrochloric acid	0.007	7	f	1.81×10^{-5}	2.83×10^{-2}	2.59×10^{-3}	4.04×10^{-3}	0	0
Lead	0.001225	0.05	f	5.08×10^{-8}	7.93×10^{-5}	4.14×10^{-5}	1.58×10^{-3}	0	0
Mercury	0.0003	0.1	f	2.41×10^{-6}	3.77×10^{-3}	8.06×10^{-3}	3.77×10^{-2}	0	0
Naphthalene	1.225	50	f	1.93×10^{-7}	3.02×10^{-4}	1.57×10^{-7}	6.04×10^{-6}	0	0
Nickel	0.0245	1	0.84	3.27×10^{-6}	5.10×10^{-3}	1.33×10^{-4}	5.10×10^{-3}	7.86×10^{-7}	1.66×10^{-4}

Table M.3.4–10. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—No Action—Continued

Chemical	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Nitric acid	0.1225	5	[f]	$1.81x10^{-5}$	$2.83x10^{-2}$	$1.48x10^{-4}$	$5.66x10^{-3}$	0	0
Phosphorus	0.00245	0.1	[f]	$6.77x10^{-7}$	$1.05x10^{-3}$	$2.76x10^{-4}$	$1.05x10^{-2}$	0	0
Potassium hydroxide	0.049	2	[f]	$1.19x10^{-5}$	$1.86x10^{-2}$	$2.44x10^{-4}$	$9.34x10^{-3}$	0	0
Propionaldehyde	0.197	8.06	[f]	$7.49x10^{-7}$	$1.17x10^{-3}$	$3.80x10^{-6}$	$1.45x10^{-4}$	0	0
Styrene	1	433	[f]	$5.68x10^{-8}$	$8.87x10^{-5}$	$5.68x10^{-8}$	$2.04x10^{-7}$	0	0
Tetrachloroethylene	0.035	689	0.002	$1.18x10^{-5}$	$1.85x10^{-2}$	$3.38x10^{-4}$	$2.68x10^{-5}$	$6.78x10^{-9}$	$1.43x10^{-6}$
Toluene	0.4	766	[f]	$7.01x10^{-6}$	$1.09x10^{-2}$	$1.75x10^{-5}$	$1.42x10^{-5}$	0	0
Trichloroethylene	13.377	546	0.006	$5.66x10^{-8}$	$8.83x10^{-5}$	$4.23x10^{-9}$	$1.61x10^{-7}$	$9.71x10^{-11}$	$2.05x10^{-8}$
Health Risk									
HI[g]						$1.53x10^{-2}$	$2.23x10^{-1}$		
Cancer risk[h]								$3.64x10^{-6}$	$7.70x10^{-4}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: INEL 1995a:1.

Table M.3.4–11. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Upgrade Plutonium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	1.08×10^{-5}	1.68×10^{-2}	7.97×10^{-6}	3.06×10^{-4}	0	0
Chlorine	0.35	3	f	1.21×10^{-8}	1.89×10^{-5}	3.46×10^{-8}	6.29×10^{-6}	0	0
Hydrazine	0.0326	1.33	17	1.21×10^{-8}	1.89×10^{-5}	3.71×10^{-7}	1.45×10^{-5}	5.88×10^{-8}	1.24×10^{-5}
Phosphoric acid	0.0245	1	f	1.21×10^{-8}	1.89×10^{-5}	4.94×10^{-7}	1.89×10^{-5}	0	0
Sulfuric acid	0.0245	1	f	1.21×10^{-8}	1.89×10^{-5}	4.94×10^{-7}	1.89×10^{-5}	0	0
VOCs (toluene)	0.4	766	f	1.00×10^{-6}	1.57×10^{-3}	2.51×10^{-6}	2.05×10^{-6}	0	0
Health Risk									
HI[g]						1.19×10^{-5}	3.66×10^{-4}		
Cancer risk[h]								5.88×10^{-8}	1.24×10^{-5}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: IN DOE 1996a.

Table M.3.4–12. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Consolidate Plutonium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	4.11×10^{-5}	6.42×10^{-2}	3.04×10^{-5}	1.16×10^{-3}	0	0
Chlorine	0.35	3	f	3.62×10^{-8}	5.66×10^{-5}	1.03×10^{-7}	1.88×10^{-5}	0	0
Hydrazine	0.0326	1.33	17	1.21×10^{-8}	1.88×10^{-5}	3.71×10^{-7}	1.45×10^{-5}	5.88×10^{-8}	1.24×10^{-5}
Nitric acid	0.1225	5	f	7.25×10^{-8}	1.13×10^{-4}	5.92×10^{-7}	2.26×10^{-5}	0	0
Phosphoric acid	0.0245	1	f	1.21×10^{-8}	1.88×10^{-5}	4.93×10^{-7}	1.88×10^{-5}	0	0
Sulfuric acid	0.0245	1	f	1.21×10^{-8}	1.88×10^{-5}	4.93×10^{-7}	1.88×10^{-5}	0	0
VOC (toluene)	0.4	766	f	4.83×10^{-6}	7.55×10^{-3}	1.21×10^{-5}	9.86×10^{-6}	0	0
Health Risk									
HI[g]						4.46×10^{-5}	1.27×10^{-3}		
Cancer risk[h]								5.88×10^{-8}	1.24×10^{-5}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for ME =(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions Concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286[converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996e.

Table M.3.4–13. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Collocate Plutonium and Highly Enriched Uranium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	4.83×10^{-5}	7.55×10^{-2}	3.58×10^{-5}	1.37×10^{-3}	0	0
Chlorine	0.35	3	f	4.83×10^{-8}	7.55×10^{-5}	1.38×10^{-7}	2.51×10^{-5}	0	0
Hydrazine	0.0326	1.3	17	1.21×10^{-8}	1.88×10^{-5}	3.71×10^{-7}	1.45×10^{-5}	5.88×10^{-8}	1.24×10^{-5}
Hydrogen chloride	0.007	7	f	1.08×10^{-7}	1.70×10^{-4}	1.55×10^{-5}	2.42×10^{-5}	0	0
Hydrogen fluoride	0.21	2.49	f	1.08×10^{-7}	1.70×10^{-4}	5.18×10^{-7}	6.82×10^{-5}	0	0
Nitric acid	0.1225	5	f	1.14×10^{-6}	1.79×10^{-3}	9.38×10^{-6}	3.58×10^{-4}	0	0
Phosphoric acid	0.0245	1	f	1.21×10^{-8}	1.88×10^{-5}	4.93×10^{-7}	1.88×10^{-5}	0	0
Sulfuric acid	0.0245	1	f	1.21×10^{-8}	1.88×10^{-5}	4.93×10^{-7}	1.88×10^{-5}	0	0
VOC (toluene)	0.4	766	f	5.68×10^{-6}	8.87×10^{-3}	1.42×10^{-5}	1.15×10^{-5}	0	0
Health Risk									
HI[g]						7.70×10^{-5}	1.91×10^{-3}		
Cancer risk[h]								5.88×10^{-8}	1.24×10^{-5}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996f.

Table M.3.4–14. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—No Action

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
1,1,1-Trichloroethane (TCA)	1.0	1,900	f	$7.17x10^{-7}$	$2.15x10^{-5}$	$7.17x10^{-6}$	$1.13x10^{-8}$	0	0
Carbon disulfide	0.35	63.2	f	$8.53x10^{-7}$	$2.56x10^{-5}$	$2.44x10^{-7}$	$4.05x10^{-7}$	0	0
Carbon tetrachloride	0.00245	63.9	0.53	$4.91x10^{-7}$	$1.48x10^{-4}$	$2.01x10^{-4}$	$2.31x10^{-6}$	$7.45x10^{-9}$	$3.03x10^{-7}$
Chlorobenzene	0.07	350	f	$5.63x10^{-8}$	$1.69x10^{-5}$	$8.05x10^{-7}$	$4.83x10^{-9}$	0	0
Cresol	0.539	22	f	$1.57x10^{-9}$	$4.72x10^{-7}$	$2.92x10^{-9}$	$2.15x10^{-8}$	0	0
Cresylic acid	0.539	22	f	$1.57x10^{-9}$	$4.72x10^{-7}$	$2.92x10^{-9}$	$2.15x10^{-8}$	0	0
Dibenzofuran			f	$2.29x10^{-9}$	$6.87x10^{-7}$			0	0
Ester glycol ethers (2-Ethoxyethanol)	0.2	740	f	$2.70x10^{-8}$	$8.12x10^{-6}$	$1.35x10^{-7}$	$1.10x10^{-8}$	0	0
Ethene, Trichloro	13.377	546	0.006	$4.98x10^{-8}$	$1.49x10^{-5}$	$3.72x10^{-9}$	$2.74x10^{-8}$	$8.54x10^{-11}$	$3.47x10^{-9}$
Ethyl benzene	1	435	f	$4.78x10^{-8}$	$1.43x10^{-5}$	$4.76x10^{-8}$	$3.29x10^{-8}$	0	0
Ethylene dichloride	5.03	411	0.091	$4.19x10^{-8}$	$1.26x10^{-5}$	$8.33x10^{-9}$	$6.12x10^{-8}$	$1.09x10^{-9}$	$4.43x10^{-8}$
Hydrogen chloride	0.007	7	f	$3.49x10^{-5}$	$1.05x10^{-2}$	$4.98x10^{-3}$	$1.50x10^{-3}$	0	0
Hydrogen fluoride	0.21	2.49	f	$3.71x10^{-5}$	$1.11x10^{-2}$	$1.77x10^{-4}$	$4.47x10^{-3}$	0	0
Ketones (acetone)	0.35	2,400	f	$8.72x10^{-9}$	$2.62x10^{-6}$	$2.49x10^{-8}$	$1.09x10^{-9}$	0	0
Methyl alcohol	1.75	260	f	$3.45x10^{-5}$	$1.04x10^{-2}$	$1.97x10^{-5}$	$3.98x10^{-5}$	0	0
Methyl ethyl ketone (MEK)	1	590	f	$2.23x10^{-4}$	$6.69x10^{-2}$	$2.23x10^{-4}$	$1.13x10^{-4}$	0	0
Methyl isobutyl ketone (MIBK)	0.28	410	f	$1.94x10^{-8}$	$5.84x10^{-6}$	$6.94x10^{-8}$	$1.42x10^{-8}$	0	0
Naphtalene	0.014	50	f	$1.29x10^{-8}$	$3.87x10^{-6}$	$9.19x10^{-7}$	$7.73x10^{-8}$	0	0
Nickel	0.0245	1	0.84	$5.15x10^{-9}$	$1.55x10^{-6}$	$2.10x10^{-7}$	$1.55x10^{-6}$	$1.24x10^{-9}$	$5.03x10^{-8}$
Nitrobenzene	0.00175	5	f	$1.57x10^{-9}$	$4.72x10^{-7}$	$8.99x10^{-7}$	$9.45x10^{-8}$	0	0
Phenol	2.1	19	f	$7.03x10^{-8}$	$2.11x10^{-5}$	$3.35x10^{-8}$	$1.11x10^{-6}$	0	0
Tetrachloroethylene	0.035	689	0.002	$2.03x10^{-7}$	$6.09x10^{-5}$	$5.80x10^{-6}$	$8.85x10^{-8}$	$1.16x10^{-10}$	$4.72x10^{-9}$
Toluene	0.4	766	f	$1.47x10^{-5}$	$4.41x10^{-3}$	$3.67x10^{-5}$	$5.76x10^{-6}$	0	0
Trichloroethene	13.377	546	0.006	$6.15x10^{-7}$	$1.85x10^{-4}$	$4.60x10^{-8}$	$3.38x10^{-7}$	$1.06x10^{-9}$	$4.29x10^{-8}$
Xylene	7	435	f	$7.00x10^{-6}$	$2.10x10^{-3}$	$1.00x10^{-6}$	$4.84x10^{-6}$	0	0

Table M.3.4–14. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—No Action—Continued

Chemical	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Health Risk									
HI[g]						$5.65x10^{-3}$	$6.14x10^{-3}$		
Cancer risk[h]								$1.10x10^{-8}$	$4.48x10^{-7}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions Concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286[converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: Chemicals deleted from the emissions list per memorandum are 1,1,2-Trichloroethane, 2-Nitropropane, Benzene, Chromium (VI), Formaldehyde, and Methylene chloride.

Source: PX 1995a:4; PX DOE 1996b.

Table M.3.4–15. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—Upgrade Plutonium Storage Facility[a]

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical[b]	RfC (mg/m^3)	PEL[c] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]	Boundary MEI[f]	Worker 100 Meters 8 Hours[g]
Health Risk									
HI[h]						i	i		
Cancer risk[j]								i	i

[a] Chemical impacts are the same for all three upgrade subalternatives.

[b] No hazardous chemical emissions are associated with the Upgrade Alternative at Pantex.

[c] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[d] HQ for MEI=boundary annual emissions/RfC.

[e] HQ for workers=100-m, 8-hr emissions/PEL.

[f] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[g] Cancer risk for workers=(emissions Concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[h] HI=sum of individual HQs.

[i] Health risks at Pantex are the same for both the Upgrade With RFETS Pits Subalternative and the Upgrade Without RFETS Pu and LANL Subalternative. The health risks for the Upgrade With RFETS Pu and LANL Pu Subaltemative are bounded by the results presented in Table M.3.4-16 for the Consolidated Pu Storage Facility Alternative.

[j] Total cancer risk=sum of individual cancer risks.

Source: PX MH 1994a.

Table M.3.4–16. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—Consolidate Plutonium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	1.16×10^{-4}	3.49×10^{-2}	8.62×10^{-5}	6.35×10^{-4}	0	0
Chlorine	0.35	3	f	1.57×10^{-7}	4.72×10^{-5}	4.49×10^{-7}	1.57×10^{-5}	0	0
Hydrazine	0.0326	1.33	17	3.14×10^{-8}	9.44×10^{-6}	9.64×10^{-7}	7.26×10^{-6}	1.53×10^{-7}	6.22×10^{-6}
Nitric acid	0.1225	5	f	1.88×10^{-7}	5.66×10^{-5}	1.54×10^{-6}	1.13×10^{-5}	0	0
Phosphoric acid	0.0245	1	f	3.14×10^{-8}	9.44×10^{-6}	1.28×10^{-6}	9.44×10^{-6}	0	0
Sulfuric acid	0.0245	1	f	3.14×10^{-8}	9.44×10^{-6}	1.28×10^{-6}	9.44×10^{-6}	0	0
VOC (toluene)	0.4	766	f	1.73×10^{-5}	5.19×10^{-3}	4.32×10^{-5}	6.78×10^{-6}	0	0
Health Risk									
HI[g]						1.35×10^{-4}	6.96×10^{-4}		
Cancer risk[h]								1.53×10^{-7}	6.22×10^{-6}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996e.

Table M.3.4–17. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—Collocate Plutonium and Highly Enriched Uranium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	$1.19x10^{-4}$	$3.59x10^{-2}$	$8.85x10^{-5}$	$6.52x10^{-4}$	0	0
Chlorine	0.35	3	f	$1.57x10^{-7}$	$4.72x10^{-5}$	$4.49x10^{-7}$	$1.57x10^{-5}$	0	0
Hydrazine	0.0326	1.33	17	$3.14x10^{-8}$	$9.44x10^{-6}$	$9.64x10^{-7}$	$7.26x10^{-6}$	$1.53x10^{-7}$	$6.22x10^{-6}$
Hydrogen chloride	0.007	7	f	$2.83x10^{-7}$	$8.50x10^{-5}$	$4.04x10^{-5}$	$1.21x10^{-5}$	0	0
Hydrogen fluoride	0.21	2.49	f	$2.83x10^{-7}$	$8.50x10^{-5}$	$1.34x10^{-6}$	$3.41x10^{-5}$	0	0
Nitric acid	0.1225	5	f	$2.98x10^{-6}$	$8.97x10^{-4}$	$2.43x10^{-5}$	$1.79x10^{-4}$	0	0
Phosphoric acid	0.0245	1	f	$3.14x10^{-8}$	$9.44x10^{-6}$	$1.28x10^{-6}$	$9.44x10^{-6}$	0	0
Sulfuric acid	0.0245	1	f	$3.14x10^{-8}$	$9.44x10^{-6}$	$1.28x10^{-6}$	$9.44x10^{-6}$	0	0
VOC (toluene)	0.4	766	f	$1.79x10^{-5}$	$5.38x10^{-3}$	$4.48x10^{-5}$	$7.03x10^{-6}$	0	0
Health Risk									
HI[g]						$2.04x10^{-4}$	$9.28x10^{-4}$		
Cancer risk[h]								$1.53x10^{-7}$	$6.22x10^{-6}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions Concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286[converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996f.

Table M.3.4–18. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—No Action

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
1,1,1-Trichloroethane (TCA)	1.0	1,900	[f]	$7.26x10^{-6}$	$4.36x10^{-3}$	$7.26x10^{-6}$	$2.29x10^{-6}$	0	0
Acetic acid	0.6125	25	[f]	$3.30x10^{-8}$	$1.98x10^{-5}$	$5.39x10^{-8}$	$7.93x10^{-7}$	0	0
Carbon monoxide	1.35	55	[f]	$3.14x10^{-3}$	$1.88x10^{0}$	$2.32x10^{-3}$	$3.42x10^{-2}$	0	0
Chlorine	0.35	3	[f]	$5.78x10^{-5}$	$3.47x10^{-2}$	$1.65x10^{-4}$	$1.16x10^{-2}$	0	0
Hydrogen chloride	0.007	7.0	[f]	$2.12x10^{-4}$	$1.27x10^{-1}$	$3.03x10^{-2}$	$1.82x10^{-2}$	0	0
Hydrogen fluoride	0.21	2.49	[f]	$2.31x10^{-6}$	$1.39x10^{-3}$	$1.10x10^{-5}$	$5.57x10^{-4}$	0	0
Methyl alcohol	1.75	260	[f]	$8.72x10^{-4}$	$5.23x10^{-1}$	$4.98x10^{-4}$	$2.01x10^{-3}$	0	0
Nitric acid	0.1225	5	[f]	$3.14x10^{-4}$	$1.88x10^{-1}$	$2.56x10^{-3}$	$3.76x10^{-2}$	0	0
Sulfuric acid	0.0245	1	[f]	$8.25x10^{-5}$	$4.95x10^{-2}$	$3.37x10^{-3}$	$4.95x10^{-2}$	0	0
VOC (toluene)	0.4	766	[f]	$1.22x10^{-4}$	$7.33x10^{-2}$	$3.05x10^{-4}$	$9.57x10^{-5}$	0	0
Health Risk									
HI[g]						$3.95x10^{-2}$	$1.54x10^{-1}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-h Concentrations)x(0.237[fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: OR LMES 1996i.

Table M.3.4–19. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—Upgrade Highly Enriched Uranium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Hydrogen chloride	0.007	7.0	f	$3.75x10^{-7}$	$2.25x10^{-4}$	$5.36x10^{-5}$	$3.22x10^{-5}$	0	0
Hydrogen fluoride	0.21	2.49	f	$3.75x10^{-7}$	$2.25x10^{-4}$	$1.79x10^{-6}$	$9.04x10^{-5}$	0	0
Nitric acid	0.1225	5	f	$3.75x10^{-6}$	$2.25x10^{-3}$	$3.06x10^{-5}$	$4.50x10^{-4}$	0	0
Health Risk									
HI[g]						$8.60x10^{-5}$	$5.73x10^{-4}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286[converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Source: OR MMES 1996a.

Table M.3.4–20. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—Collocate Plutonium Storage Facilities; Maintain Highly Enriched Uranium Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	6.27×10^{-5}	3.76×10^{-2}	4.64×10^{-5}	6.84×10^{-4}	0	0
Chlorine	0.35	3	f	1.98×10^{-7}	1.18×10^{-4}	5.66×10^{-7}	3.96×10^{-5}	0	0
Hydrazine	0.0326	1.33	17	3.30×10^{-8}	1.98×10^{-5}	1.01×10^{-6}	1.52×10^{-5}	1.61×10^{-7}	1.30×10^{-5}
Nitric acid	0.1225	5	f	1.98×10^{-7}	1.18×10^{-4}	1.61×10^{-6}	2.37×10^{-5}	0	0
Phosphoric acid	0.0245	1	f	3.30×10^{-8}	1.98×10^{-5}	1.34×10^{-6}	1.98×10^{-5}	0	0
Sulfuric acid	0.0245	1	f	3.30×10^{-8}	1.98×10^{-5}	1.34×10^{-6}	1.98×10^{-5}	0	0
VOC (toluene)	0.4	766	f	7.26×10^{-6}	4.35×10^{-3}	1.81×10^{-5}	5.69×10^{-6}	0	0
Health Risk									
HI[g]						7.05×10^{-5}	8.08×10^{-4}		
Cancer risk[h]								1.61×10^{-7}	1.30×10^{-5}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286[converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996e.

Table M.3.4–21. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—Collocate Plutonium and Highly Enriched Uranium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	$6.93x10^{-5}$	$4.16x10^{-2}$	$5.13x10^{-5}$	$7.56x10^{-4}$	0	0
Chlorine	0.35	3	f	$2.64x10^{-7}$	$1.58x10^{-4}$	$7.54x10^{-7}$	$5.28x10^{-5}$	0	0
Hydrazine	0.0326	1.33	17	$3.30x10^{-8}$	$1.98x10^{-5}$	$1.01x10^{-6}$	$1.52x10^{-5}$	$1.61x10^{-7}$	$1.30x10^{-5}$
Hydrogen chloride	0.007	7	f	$2.97x10^{-7}$	$1.78x10^{-4}$	$4.24x10^{-5}$	$2.54x10^{-5}$	0	0
Hydrogen fluoride	0.21	2.49	f	$2.97x10^{-7}$	$1.78x10^{-4}$	$1.41x10^{-6}$	$7.16x10^{-5}$	0	0
Nitric acid	0.1225	5	f	$3.13x10^{-6}$	$1.88x10^{-3}$	$2.56x10^{-5}$	$3.76x10^{-4}$	0	0
Phosphoric acid	0.0245	1	f	$3.30x10^{-8}$	$1.98x10^{-5}$	$1.34x10^{-6}$	$1.98x10^{-5}$	0	0
Sulfuric acid	0.0245	1	f	$3.30x10^{-8}$	$1.98x10^{-5}$	$1.34x10^{-6}$	$1.98x10^{-5}$	0	0
VOC (toluene)	0.4	766	f	$8.25x10^{-6}$	$4.95x10^{-3}$	$2.06x10^{-5}$	$6.46x10^{-6}$	0	0
Health Risk									
HI[g]						$1.46x10^{-4}$	$1.34x10^{-3}$		
Cancer risk[h]								$1.61x10^{-7}$	$1.30x10^{-5}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286[converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996f.

Table M.3.4–22. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—No Action

Chemical	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Benzene	0.0796	3.25	0.029	$1.25x10^{-5}$	$1.37x10^{-2}$	$1.57x10^{-5}$	$4.20x10^{-3}$	$1.04x10^{-8}$	$1.53x10^{-5}$
Benzene (DWPF)[f]	0.0796	3.25	0.029	$1.23x10^{-6}$	$1.35x10^{-1}$	$1.55x10^{-4}$	$4.15x10^{-2}$	$1.02x10^{-7}$	$1.51x10^{-4}$
Carbon monoxide	1.35	55	[g]	$5.41x10^{-3}$	59.1	$4.01x10^{-3}$	1.07	0	0
Chlorine	0.35	3	[g]	$9.27x10^{-9}$	$1.01x10^{-4}$	$2.65x10^{-8}$	$3.37x10^{-5}$	0	0
Chloroform	0.035	240	0.0061	$4.79x10^{-6}$	$5.24x10^{-2}$	$1.37x10^{-4}$	$2.18x10^{-4}$	$8.36x10^{-9}$	$1.24x10^{-5}$
Cobalt	0.00245	0.1	[g]	$7.46x10^{-9}$	$8.15x10^{-5}$	$3.05x10^{-6}$	$8.15x10^{-4}$	0	0
Hydrogen flouride	0.21	2.49	[g]	$4.29x10^{-8}$	$4.69x10^{-4}$	$2.04x10^{-7}$	$1.88x10^{-4}$	0	0
Hydrogen fluoride (DWPF)[f]	0.21	2.49	[g]	$8.39x10^{-12}$	$9.16x10^{-8}$	$3.99x10^{-11}$	$3.68x10^{-8}$	0	0
Mercury (vapor)	0.0003	0.1	[g]	$1.89x10^{-7}$	$2.06x10^{-3}$	$6.29x10^{-4}$	$2.06x10^{-2}$	0	0
Mercury (DWPF)[f]	0.0003	0.1	[g]	$5.17x10^{-8}$	$5.65x10^{-4}$	$1.72x10^{-4}$	$5.65x10^{-3}$	0	0
Mercury oxide (DWPF)[f]	0.0003	0.1	[g]	$6.36x10^{-18}$	$6.95x10^{-14}$	$2.12x10^{-14}$	$6.95x10^{-13}$	0	0
Nickel (vapor and compounds)	0.0245	1	0.84	$4.31x10^{-8}$	$4.70x10^{-4}$	$1.76x10^{-6}$	$4.70x10^{-4}$	$1.03x10^{-3}$	$1.53x10^{-5}$
Nickel compounds (DWPF)[f]	0.0245	1	0.84	$3.16x10^{-16}$	$3.45x10^{-12}$	$1.29x10^{-14}$	$3.45x10^{-12}$	$7.60x10^{-17}$	$1.12x10^{-13}$
Nitric acid	0.1225	5	[g]	$3.73x10^{-6}$	$4.07x10^{-2}$	$3.04x10^{-5}$	$8.15x10^{-3}$	0	0
Phosphoric acid	0.0245	1	[g]	$1.50x10^{-7}$	$1.63x10^{-3}$	$6.11x10^{-6}$	$1.63x10^{-3}$	0	0
Health Risk									
HI[h]						$5.16x10^{-3}$	1.16		
Cancer risk[i]								$1.31x10^{-7}$	$1.94x10^{-4}$

[a] See Table M.3.3–1 for the OSHA-PEL, ACGIH-TLV, NIOSH-REL, and other exposure limit values.

[b] HQ for MEI=Boundary Annual Emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] The Defense Waste Process Facility (DWPF), In-Tank Precipitation (ITP) facility, and Consolidation Incineration Facility (CIF) were not in operation during 1994, but potential emissions from DWPF based on limited trials were used to generate DWPF potential emissions. The ITP and CIF data were not included because only the inventory of chemicals to be processed through these facilities was available.

[g] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[h] HI=sum of individual HQs.

[i] Total cancer risk=sum of individual cancer risks.

Source: SRS 1995a:2; SRS 1996a:1.

Table M.3.4–23. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—Upgrade Plutonium Storage Facility

Chemical	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
With All or Some RFETS and LANL Material									
Carbon dioxide	211	9,000	f	$8.39x10^{-6}$	$9.16x10^{-2}$	$3.98x10^{-8}$	$1.02x10^{-5}$	0	0
Carbon monoxide	1.35	55	f	$1.06x10^{-6}$	$1.15x10^{-2}$	$7.82x10^{-7}$	$2.10x10^{-4}$	0	0
VOC (toluene)	0.4	766	f	$2.92x10^{-7}$	$3.19x10^{-3}$	$7.30x10^{-7}$	$4.17x10^{-6}$	0	0
Health Risk									
HI[g]						$1.6x10^{-6}$	$2.24x10^{-4}$		
Cancer risk[h]								0	0
With RFETS Non-Pit Pu Material									
Carbon monoxide	1.35	55	f	$1.06x10^{-6}$	$1.15x10^{-2}$	$7.82x10^{-7}$	$2.10x10^{-4}$	0	0
VOC (toluene)	0.4	766	f	$2.80x10^{-7}$	$3.05x10^{-3}$	$6.99x10^{-7}$	$3.99x10^{-6}$	0	0
Health Risk									
HI[g]						$1.48x10^{-6}$	$2.14x10^{-4}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions concentrations)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286[converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: SR DOE 1994e; WSRC 1995e.

Table M.3.4–24. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—Consolidate Plutonium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	$2.46x10^{-6}$	$2.68x10^{-2}$	$1.82x10^{-6}$	$4.88x10^{-4}$	0	0
Chlorine	0.35	3	f	$1.23x10^{-8}$	$1.34x10^{-4}$	$3.51x10^{-8}$	$4.48x10^{-5}$	0	0
Hydrazine	0.0326	1.3	17	$1.53x10^{-9}$	$1.68x10^{-5}$	$4.71x10^{-8}$	$1.29x10^{-5}$	$7.48x10^{-9}$	$1.11x10^{-5}$
Nitric acid	0.1225	5	f	$9.22x10^{-9}$	$1.00x10^{-4}$	$7.53x10^{-8}$	$2.01x10^{-5}$	0	0
Phosphoric acid	0.0245	1	f	$1.53x10^{-9}$	$1.68x10^{-5}$	$6.27x10^{-8}$	$1.68x10^{-5}$	0	0.
Sulfuric acid	0.0245	1	f	$1.53x10^{-9}$	$1.68x10^{-5}$	$6.27x10^{-8}$	$1.68x10^{-5}$	0	0
VOC (toluene)	0.4	766	f	$2.92x10^{-7}$	$3.19x10^{-3}$	$7.30x10^{-7}$	$4.16x10^{-6}$	0	0
Health Risk									
HI[g]						$2.84x10^{-6}$	$6.04x10^{-4}$		
Cancer risk[h]								$7.48x10^{-9}$	$1.11x10^{-5}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996e.

Table M.3.4–25. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—Collocate Plutonium and Highly Enriched Uranium Storage Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	2.61×10^{-6}	2.85×10^{-2}	1.93×10^{-6}	5.19×10^{-4}	0	0
Chlorine	0.35	3	[f]	1.53×10^{-8}	1.68×10^{-4}	4.39×10^{-8}	5.60×10^{-5}	0	0
Hydrazine	0.0326	1.33	17	1.53×10^{-9}	1.68×10^{-5}	4.71×10^{-8}	1.29×10^{-5}	7.48×10^{-9}	1.11×10^{-5}
Hydrogen chloride	0.007	7	[f]	1.38×10^{-8}	1.51×10^{-4}	1.99×10^{-6}	2.16×10^{-5}	0	0
Hydrogen fluoride	0.21	2.49	[f]	1.38×10^{-8}	1.51×10^{-4}	6.59×10^{-8}	6.07×10^{-5}	0	0
Nitric acid	0.1225	5	[f]	1.46×10^{-7}	1.59×10^{-3}	1.19×10^{-6}	3.19×10^{-4}	0	0
Phosphoric acid	0.0245	1	[f]	1.53×10^{-9}	1.68×10^{-5}	6.27×10^{-8}	1.68×10^{-5}	0	0
Sulfuric acid	0.0245	1	[f]	1.53×10^{-9}	1.68×10^{-5}	6.27×10^{-8}	1.68×10^{-5}	0	0
VOC (toluene)	0.4	766	[f]	3.07×10^{-7}	3.36×10^{-3}	7.68×10^{-7}	4.38×10^{-6}	0	0
Health Risk									
HI[g]						6.16×10^{-6}	1.03×10^{-3}		
Cancer risk[h]								7.48×10^{-9}	1.11×10^{-5}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: DOE 1996f.

Table M.3.4–26. Risk Assessments From Exposure to Hazardous Chemicals at Rocky Flats Environmental Technology Site—No Action

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Beryllium	0.0175	0.002	8.4	$1.04x10^{-12}$	$8.61x10^{-10}$	$5.97x10^{-11}$	$4.30x10^{-7}$	$2.51x10^{-12}$	$2.80x10^{-10}$
Carbon monoxide	1.35	55	[f]	$8.85x10^{-4}$	$7.20x10^{-1}$	$6.562x10^{-4}$	$1.32x10^{-2}$	0	0
Carbon tetrachloride	0.00245	63.9	0.053	$1.21x10^{-6}$	$9.96x10^{-4}$	$4.93x10^{-4}$	$1.55x10^{-5}$	$1.83x10^{-8}$	$2.04x10^{-6}$
Dioctyl phthalate	0.07	5	[f]	$1.43x10^{-7}$	$1.18x10^{-4}$	$2.05x10^{-6}$	$2.36x10^{-5}$	0	0
Freon 113	105	7,600	[f]	$2.46x10^{-6}$	$2.02x10^{-3}$	$2.34x10^{-8}$	$2.66x10^{-7}$	0	0
Hydrogen sulfide	0.0009	28.4	[f]	$1.05x10^{-8}$	$8.69x10^{-6}$	$1.17x10^{-5}$	$3.06x1^{-7}$	0	0
Lead	0.001225	0.05	[f]	$1.74x10^{-20}$	$1.43x10^{-17}$	$1.42x10^{-17}$	$2.87x10^{-16}$	0	0
Methylene chloride	3	1,765	0.0075	$1.25x10^{-6}$	$1.03x10^{-3}$	$4.17x10^{-7}$	$5.83x10^{-7}$	$2.68x10^{-9}$	$2.99x10^{-7}$
Nitric acid	0.1225	5	[f]	$1.38x10^{-10}$	$1.13x10^{-7}$	$1.13x10^{-9}$	$2.27x10^{-8}$	0	0
Trichloroethane	1	1,900	[f]	$3.07x10^{-6}$	$2.53x10^{-3}$	$3.07x10^{-6}$	$1.33x10^{-6}$	0	0
Health Risk									
HI[g]						$1.17x10^{-3}$	$1.33x10^{-2}$		
Cancer risk[h]								$2.10x10^{-8}$	$2.34x10^{-6}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Source: RFETS 1995a:1.

Table M.3.4–27. Risk Assessments From Exposure to Hazardous Chemicals at Los Alamos National Laboratory—No Action

Chemical	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
1, 1, 2-Trichloroethane	0.014	45	0.057	$1.03x10^{-4}$	$2.27x10^{-2}$	$7.33x10^{-3}$	$5.04x10^{-4}$	$1.67x10^{-6}$	$5.01x10^{-5}$
2-Butoxyethanol	5.88	240	f	$1.36x10^{-5}$	$3.01x10^{-3}$	$2.32x10^{-6}$	$1.25x10^{-5}$	0	0
Acetic acid	0.6125	25	f	$5.95x10^{-5}$	$1.31x10^{-2}$	$9.71x10^{-5}$	$5.26x10^{-4}$	0	0
Aluminum (metal & oxide)	0.368	15	f	$4.43x10^{-6}$	$9.79x10^{-4}$	$1.20x10^{-5}$	$6.53x10^{-5}$	0	0
Aluminum welding fumes	0.1225	5	f	$1.36x10^{-5}$	$3.01x10^{-3}$	$1.11x10^{-4}$	$6.02x10^{-4}$	0	0
Ammonia	0.1	35	f	$8.85x10^{-5}$	$1.96x10^{-2}$	$8.85x10^{-4}$	$5.59x10^{-4}$	0	0
Carbon monoxide	1.35	55	f	$2.39x10^{-3}$	$5.28x10^{-1}$	$1.77x10^{-3}$	$9.61x10^{-3}$	0	0
Chlorine	0.35	3	f	$1.44x10^{-6}$	$3.18x10^{-4}$	$4.11x10^{-6}$	$1.06x10^{-4}$	0	0
Chloroform	0.035	240	0.081	$5.90x10^{-5}$	$1.31x10^{-2}$	$1.69x10^{-3}$	$5.44x10^{-5}$	$1.37x10^{-6}$	$4.09x10^{-5}$
Cyclohexane	25.725	1050	f	$3.10x10^{-6}$	$6.86x10^{-4}$	$1.21x10^{-7}$	$6.53x10^{-7}$	0	0
Dichlorodifluoromethane (Freon 12)	0.7	4950	f	$1.88x10^{-6}$	$4.16x10^{-4}$	$2.69x10^{-6}$	$8.41x10^{-8}$	0	0
Ethyl acetate	3.15	1400	f	$9.85x10^{-6}$	$2.18x10^{-3}$	$3.13x10^{-6}$	$1.56x10^{-6}$	0	0
Ethylene glycol	7	127	f	$7.97x10^{-6}$	$1.76x10^{-3}$	$1.14x10^{-6}$	$1.39x10^{-5}$	0	0
Ethyl ether	0.7	1200	f	$1.88x10^{-6}$	$4.16x10^{-4}$	$2.69x10^{-6}$	$3.47x10^{-7}$	0	0
Formaldehyde	0.7	0.9375	0.045	$5.43x10^{-6}$	$1.20x10^{-3}$	$7.75x10^{-6}$	$1.28x10^{-3}$	$6.98x10^{-8}$	$2.09x10^{-6}$
Heavy metals (zinc)	1.05	42.9	f	$1.26x10^{-5}$	$2.79x10^{-3}$	$1.20x10^{-5}$	$6.51x10^{-5}$	0	0
Heptane	49	2000	f	$2.05x10^{-4}$	$4.53x10^{-2}$	$4.18x10^{-6}$	$2.26x10^{-5}$	0	0
Hexane	0.2	1800	f	$8.53x10^{-6}$	$1.89x10^{-3}$	$4.26x10^{-5}$	$1.05x10^{-6}$	0	0
Hexane (other isomers)	0.2	1800	f	$1.33x10^{-6}$	$2.94x10^{-4}$	$6.64x10^{-6}$	$1.63x10^{-7}$	0	0
Hydrocarbons (hexane)	0.2	1800	f	$3.20x10^{-4}$	$7.08x10^{-2}$	$1.60x10^{-3}$	$3.94x10^{-5}$	0	0
Hydrogen chloride	0.007	7	f	$7.06x10^{-5}$	$1.56x10^{-2}$	$1.01x10^{-2}$	$2.23x10^{-3}$	0	0
Hydrogen fluoride	0.21	2.49	f	$2.68x10^{-5}$	$5.93x10^{-3}$	$1.28x10^{-4}$	$2.38x10^{-3}$	0	0
Hydrogen peroxide	0.0343	1.4	f	$2.21x10^{-6}$	$4.90x10^{-4}$	$6.46x10^{-5}$	$3.50x10^{-4}$	0	0
Isobutyl acetate	17.15	700	f	$1.99x10^{-6}$	$4.41x10^{-4}$	$1.16x10^{-7}$	$6.30x10^{-7}$	0	0
Isopropyl alcohol	24.15	980	f	$5.97x10^{-5}$	$1.32x10^{-2}$	$2.47x10^{-6}$	$1.35x10^{-5}$	0	0
Kerosene	2.45	100	f	$2.88x10^{-5}$	$6.37x10^{-3}$	$1.18x10^{-5}$	$6.37x10^{-5}$	0	0
Lead	0.001225	0.05	f	$2.88x10^{-6}$	$6.37x10^{-4}$	$2.35x10^{-3}$	$1.27x10^{-2}$	0	0

Table M.3.4–27. Risk Assessments From Exposure to Hazardous Chemicals at Los Alamos National Laboratory—No Action—Continued

Chemical	Regulated Exposure Limits/Risk Factors: RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Emissions Inventory: Boundary MEI (mg/m^3)	Emissions Inventory: Worker 100 Meters 8 Hours (mg/m^3)	HQ: Boundary MEI[b]	HQ: Worker 100 Meters 8 Hours[c]	Cancer Risk: Boundary MEI[d]	Cancer Risk: Worker 100 Meters 8 Hours[e]
Lead chromate	0.001225	0.05	[f]	$1.77x10^{-6}$	$3.92x10^{-4}$	$1.45x10^{-3}$	$7.84x10^{-3}$	0	0
Methanol	1.75	260	[f]	$6.52x10^{-5}$	$1.44x10^{-2}$	$3.73x10^{-5}$	$5.55x10^{-5}$	0	0
Methyl chloride	5.145	210	[f]	$2.88x10^{-6}$	$6.37x10^{-4}$	$5.60x10^{-7}$	$3.03x10^{-6}$	0	0
Methyl ethyl ketone (MEK)	1	590	[f]	$2.06x10^{-4}$	$4.56x10^{-2}$	$2.06x10^{-4}$	$7.74x10^{-5}$	0	0
Methylene chloride	3	1765	0.0075	$1.22x10^{-4}$	$2.70x10^{-2}$	$4.07x10^{-5}$	$1.53x10^{-5}$	$2.62x10^{-7}$	$7.85x10^{-6}$
Nickel (metal)	0.0245	1	0.84	$6.09x10^{-6}$	$1.35x10^{-3}$	$2.49x10^{-4}$	$1.35x10^{-3}$	$1.46x10^{-6}$	$4.38x10^{-5}$
Nitric acid	0.1225	5	[f]	$7.32x10^{-5}$	$1.62x10^{-2}$	$5.97x10^{-4}$	$3.24x10^{-3}$	0	0
Phosgene	0.0098	0.4	[f]	$2.55x10^{-6}$	$5.63x10^{-4}$	$2.60x10^{-4}$	$1.41x10^{-3}$	0	0
Propylene oxide	0.03	240	0.24	$3.99x10^{-6}$	$8.81x10^{-4}$	$1.33x10^{-4}$	$3.67x10^{-6}$	$2.74x10^{-7}$	$8.19x10^{-6}$
Stoddard solvent	71.05	2900	[f]	$2.92x10^{-5}$	$6.46x10^{-3}$	$4.11x10^{-7}$	$2.23x10^{-6}$	0	0
Sulfuric acid	0.0245	1	[f]	$2.44x10^{-6}$	$5.39x10^{-4}$	$9.94x10^{-5}$	$5.39x10^{-4}$	0	0
Tetrahydrofuran (THF)	14.455	590	[f]	$1.88x10^{-6}$	$4.16x10^{-4}$	$1.30x10^{-7}$	$7.06x10^{-7}$	0	0
Toluene	0.4	766	[f]	$2.75x10^{-4}$	$6.08x10^{-2}$	$6.87x10^{-4}$	$7.94x10^{-5}$	0	0
Tricloroethylene (TCE)	13.377	546	0.006	$2.33x10^{-5}$	$5.14x10^{-3}$	$1.74x10^{-6}$	$9.42x10^{-6}$	$3.99x10^{-8}$	$1.19x10^{-6}$
Tungsten	0.1225	5	[f]	$1.21x10^{-5}$	$2.67x10^{-3}$	$9.85x10^{-5}$	$5.34x10^{-4}$	0	0
VM&P Naphtha	8.575	245	[f]	$6.79x10^{-5}$	$1.50x10^{-2}$	$7.92x10^{-6}$	$6.13x10^{-5}$	0	0
Welding fumes (acetylene)	65.219	2662	[f]	$5.66x10^{-5}$	$1.25x10^{-2}$	$8.68x10^{-7}$	$4.70x10^{-6}$	0	0
Xylene	7	435	[f]	$1.95x10^{-4}$	$4.31x10^{-2}$	$2.79x10^{-5}$	$9.92x10^{-5}$	0	0
Health Risk									
HI[g]						$3.01x10^{-2}$	$4.65x10^{-2}$		
Cancer risk[h]								$5.15x10^{-6}$	$1.54x10^{-4}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Source: LANL1994a.

Table M.3.4–28. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site—Pit Disassembly/Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	f	$4.23x10^{-6}$	$1.40x10^{-2}$	$5.72x10^{-6}$	$4.67x10^{-4}$	0	0
VOC (toluene)	0.40	766	f	$8.46x10^{-6}$	$2.80x10^{-2}$	$2.12x10^{-5}$	$3.66x10^{-5}$	0	0
Health Risk									
HI[g]						$2.69x10^{-5}$	$5.04x10^{-4}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.
[b] HQ for MEI=boundary annual emissions/RfC.
[c] HQ for workers=100-m, 8-hr emissions/PEL.
[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).
[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).
[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.
[g] HI=sum of individual HQs.
[h] Total cancer risk=sum of individual cancer risks.
Note: VOC=volatile organic compounds.
Source: LANL 1996d.

Table M.3.4–29. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site—Pit Disassembly/Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	[f]	6.30×10^{-7}	7.28×10^{-3}	8.52×10^{-7}	2.43×10^{-4}	0	0
VOC (toluene)	0.40	766	[f]	1.26×10^{-6}	1.46×10^{-2}	3.15×10^{-6}	1.90×10^{-5}	0	0
Health Risk									
HI[g]						4.00×10^{-6}	2.62×10^{-4}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LANL 1996d.

Table M.3.4–30. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Pit Disassembly/Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	f	9.07×10^{-6}	1.42×10^{-2}	1.23×10^{-5}	4.72×10^{-4}	0	0
VOC (toluene)	0.40	766	f	1.81×10^{-5}	2.83×10^{-2}	2.54×10^{-5}	3.70×10^{-5}	0	0
Health Risk									
HI[g]						5.76×10^{-5}	5.09×10^{-4}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.
[b] HQ for MEI=boundary annual emissions/RfC.
[c] HQ for workers=100-m, 8-hr emissions/PEL.
[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).
[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).
[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.
[g] HI=sum of individual HQs.
[h] Total cancer risk=sum of individual cancer risks.
Note: VOC=volatile organic compounds.
Source: LANL 1996d.

Table M.3.4–31. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—Pit Disassembly/Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	[f]	2.36×10^{-5}	7.09×10^{-3}	3.19×10^{-5}	2.36×10^{-4}	0	0
VOC (toluene)	0.40	766	[f]	4.72×10^{-5}	1.42×10^{-2}	1.18×10^{-4}	1.85×10^{-5}	0	0
Health Risk									
HI[g]						1.50×10^{-4}	2.55×10^{-4}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)*(0.286 [converts concentration to dose])*(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)*(0.237 [fraction of year exposed])*(0.571 [fraction of lifetime working])*(0.286 [converts concentration to dose])*(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LANL 1996d.

Table M.3.4–32. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—Pit Disassembly/Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	f	$2.48x10^{-5}$	$1.49x10^{-2}$	$3.35x10^{-5}$	$4.95x10^{-4}$	0	0
VOC (toluene)	0.40	766	f	$4.95x10^{-5}$	$2.97x10^{-2}$	$1.24x10^{-4}$	$3.88x10^{-5}$	0	0
Health Risk									
HI[g]						$1.57x10^{-4}$	$5.34x10^{-4}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.
[b] HQ for MEI=boundary annual emissions/RfC.
[c] HQ for workers=100-m, 8-hr emissions/PEL.
[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).
[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).
[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.
[g] HI=sum of individual HQs.
[h] Total cancer risk=sum of individual cancer risks.
Note: VOC=volatile organic compounds.
Source: LANL 1996d.

Table M.3.4–33. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—Pit Disassembly/Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	[f]	$1.15x10^{-6}$	$1.26x10^{-2}$	$1.56x10^{-6}$	$4.20x10^{-4}$	0	0
VOC (toluene)	0.40	766	[f]	$2.31x10^{-6}$	$2.52x10^{-2}$	$5.77x10^{-6}$	$3.29x10^{-5}$	0	0
Health Risk									
HI[g]						$7.33x10^{-6}$	$4.53x10^{-4}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LANL 1996d.

Table M.3.4–34. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site—Plutonium Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Ammonia	0.1	35	f	$5.64x10^{-8}$	$1.87x10^{-4}$	$5.64x10^{-7}$	$5.3x10^{-6}$	0	0
Carbon monoxide	1.35	55	f	$2.25x10^{-5}$	$7.48x10^{-2}$	$1.67x10^{-5}$	$1.3x10^{-3}$	0	0
Chlorine	0.35	3	f	$4.23x10^{-8}$	$1.40x10^{-4}$	$1.20x10^{-7}$	$4.67x10^{-5}$	0	0
Cleaning solvent (butyl lactate)	0.74	30	f	$5.64x10^{-7}$	$1.87x10^{-3}$	$7.62x10^{-7}$	$6.23x10^{-5}$	0	0
Ethanol	46.55	1,900	f	$1.12x10^{-7}$	$3.74x10^{-4}$	$2.42x10^{-9}$	$1.96x10^{-7}$	0	0
Hydrazine	0.0326	1.3	17	$5.64x10^{-9}$	$1.87x10^{-5}$	$1.73x10^{-7}$	$1.43x10^{-5}$	$2.74x10^{-8}$	$1.23x10^{-5}$
Hydrogen chloride	0.007	7	f	$6.77x10^{-8}$	$2.24x10^{-4}$	$9.67x10^{-6}$	$3.20x10^{-5}$	0	0
Hydrogen fluoride	0.21	2.49	f	$4.51x10^{-9}$	$1.49x10^{-5}$	$2.15x10^{-8}$	$6.00x10^{-6}$	0	0
Nitric acid	0.1225	5	f	$1.69x10^{-8}$	$5.61x10^{-5}$	$1.38x10^{-7}$	$1.12x10^{-5}$	0	0
Octanol	2.52	102.8	f	$6.32x10^{-10}$	$2.09x10^{-6}$	$2.51x10^{-10}$	$2.03x10^{-8}$	0	0
Phosphoric acid	0.0245	1	f	$5.64x10^{-9}$	$1.87x10^{-5}$	$2.30x10^{-7}$	$1.87x10^{-5}$	0	0
Sulfuric acid	0.0245	1	f	$5.64x10^{-9}$	$1.87x10^{-5}$	$2.30x10^{-7}$	$1.87x10^{-5}$	0	0
Tributyl phosphate	0.1225	5	f	$5.64x10^{-10}$	$1.87x10^{-6}$	$4.60x10^{-9}$	$3.74x10^{-7}$	0	0
Trichloroethylene	13.377	546	0.006	$2.53x10^{-6}$	$8.41x10^{-3}$	$1.89x10^{-7}$	$1.54x10^{-5}$	$4.36x10^{-9}$	$1.95x10^{-6}$
Health Risk									
HI[g]						$2.88x10^{-5}$	$1.59x10^{-3}$		
Cancer risk[h]								$3.18x10^{-8}$	$1.43x10^{-5}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Source: LANL 1996c.

Table M.3.4–35. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site—Plutonium Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Ammonia	0.1	35	f	$8.40x10^{-9}$	$9.70x10^{-5}$	$8.40x10^{-9}$	$2.77x10^{-6}$	0	0
Carbon monoxide	1.35	55	f	$3.36x10^{-6}$	$3.88x10^{-2}$	$2.49x10^{-6}$	$7.05x10^{-4}$	0	0
Chlorine	0.35	3	f	$6.30x10^{-9}$	$7.27x10^{-5}$	$1.80x10^{-8}$	$2.42x10^{-5}$	0	0
Cleaning solvent (butyl lactate)	0.74	30	f	$8.40x10^{-8}$	$9.70x10^{-4}$	$1.13x10^{-7}$	$3.2x10^{-5}$	0	0
[Text deleted.]									
Ethanol	46.55	1,900	f	$1.68x10^{-8}$	$1.94x10^{-4}$	$3.61x10^{-10}$	$1.02x10^{-7}$	0	0
Hydrazine	0.0326	1.3	17	$8.40x10^{-10}$	$9.70x10^{-6}$	$2.57x10^{-8}$	$7.46x10^{-6}$	$4.09x10^{-9}$	$6.38x10^{-6}$
Hydrogen chloride	0.007	7	f	$1.00x10^{-8}$	$1.16x10^{-4}$	$1.44x10^{-6}$	$1.66x10^{-5}$	0	0
Hydrogen fluoride	0.21	2.49	f	$6.72x10^{-10}$	$7.76x10^{-5}$	$3.20x10^{-9}$	$3.11x10^{-6}$	0	0
Nitric acid	0.1225	5	f	$2.52x10^{-9}$	$2.91x10^{-5}$	$2.05x10^{-8}$	$5.82x10^{-6}$	0	0
Octanol	2.52	102.8	f	$9.42x10^{-11}$	$1.08x10^{-6}$	$3.73x10^{-11}$	$1.05x10^{-8}$	0	0
Phosphoric acid	0.0245	1	f	$8.40x10^{-10}$	$9.70x10^{-6}$	$3.43x10^{-8}$	$9.70x10^{-6}$	0	0
Sulfuric acid	0.0245	1	f	$8.40x10^{-10}$	$9.70x10^{-6}$	$3.43x10^{-8}$	$9.70x10^{-6}$	0	0
Tributyl phosphate	0.1225	5	f	$8.40x10^{-11}$	$9.70x10^{-7}$	$6.86x10^{-10}$	$1.94x10^{-7}$	0	0
Trichloroethylene	13.377	546	0.006	$3.78x10^{-7}$	$4.36x10^{-3}$	$2.82x10^{-8}$	$7.99x10^{-6}$	$6.49x10^{-10}$	$1.01x10^{-6}$
Health Risk									
HI[g]						$4.29x10^{-6}$	$8.26x10^{-4}$		
Cancer risk[h]								$4.73x10^{-9}$	$7.40x10^{-6}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Source: LANL 1996c.

Table M.3.4–36. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Plutonium Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Ammonia	0.1	35	f	1.21×10^{-7}	1.88×10^{-4}	1.21×10^{-6}	5.39×10^{-6}	0	0
Carbon monoxide	1.35	55	f	4.83×10^{-5}	7.55×10^{-2}	3.58×10^{-5}	1.37×10^{-3}	0	0
Chlorine	0.35	3	f	9.07×10^{-8}	1.41×10^{-4}	2.59×10^{-7}	4.72×10^{-5}	0	0
Cleaning solvent (butyl lactate)	0.74	30	f	1.21×10^{-6}	1.88×10^{-3}	1.63×10^{-6}	6.29×10^{-5}	0	0
[Text deleted.]									
Ethanol	46.55	1,900	f	2.41×10^{-7}	3.77×10^{-4}	5.19×10^{-9}	1.98×10^{-7}	0	0
Hydrazine	0.0326	1.3	17	1.21×10^{-8}	1.88×10^{-5}	3.71×10^{-7}	1.45×10^{-5}	5.88×10^{-8}	1.24×10^{-5}
Hydrogen chloride	0.007	7	f	1.45×10^{-7}	2.26×10^{-4}	2.07×10^{-5}	3.23×10^{-5}	0	0
Hydrogen fluoride	0.21	2.49	f	9.67×10^{-9}	1.51×10^{-5}	4.60×10^{-8}	6.06×10^{-6}	0	0
Nitric acid	0.1225	5	f	3.62×10^{-8}	5.66×10^{-5}	2.96×10^{-7}	1.13×10^{-5}	0	0
Octanol	2.52	102.8	f	1.35×10^{-9}	2.11×10^{-6}	5.38×10^{-10}	2.05×10^{-8}	0	0
Phosphoric acid	0.0245	1	f	1.21×10^{-8}	1.88×10^{-5}	4.93×10^{-7}	1.88×10^{-5}	0	0
Sulfuric acid	0.0245	1	f	1.21×10^{-8}	1.88×10^{-5}	4.93×10^{-7}	1.88×10^{-5}	0	0
Tributyl phosphate	0.1225	5	f	1.21×10^{-9}	1.88×10^{-6}	9.87×10^{-9}	3.77×10^{-7}	0	0
Trichloroethylene	13.377	546	0.006	5.44×10^{-6}	8.49×10^{-3}	4.06×10^{-7}	1.55×10^{-5}	9.34×10^{-9}	1.97×10^{-6}
Health Risk									
HI[g]						6.18×10^{-5}	1.61×10^{-3}		
Cancer risk[h]								6.81×10^{-8}	1.44×10^{-5}

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Source: LANL 1996c.

Table M.3.4–37. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—Plutonium Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Ammonia	0.1	35	[f]	$3.14x10^{-7}$	$9.44x10^{-5}$	$3.14x10^{-6}$	$2.70x10^{-6}$	0	0
Carbon monoxide	1.35	55	[f]	$1.25x10^{-4}$	$3.78x10^{-2}$	$9.35x10^{-5}$	$6.87x10^{-4}$	0	0
Chlorine	0.35	3	[f]	$2.35x10^{-7}$	$7.08x10^{-5}$	$6.74x10^{-7}$	$2.36x10^{-5}$	0	0
Cleaning solvent (butyl lactate)	0.74	30	[f]	$3.14x10^{-6}$	$9.44x10^{-4}$	$4.25x10^{-6}$	$3.15x10^{-5}$	0	0
[Text deleted.]									
Ethanol	46.55	1,900	[f]	$6.29x10^{-7}$	$1.89x10^{-4}$	$1.35x10^{-8}$	$9.94x10^{-8}$	0	0
Hydrazine	0.0326	1.33	17	$3.14x10^{-8}$	$9.44x10^{-6}$	$9.64x10^{-7}$	$7.26x10^{-6}$	$1.53x10^{-7}$	$6.22x10^{-6}$
Hydrogen chloride	0.007	7	[f]	$3.77x10^{-7}$	$1.13x10^{-4}$	$5.39x10^{-5}$	$1.62x10^{-5}$	0	0
Hydrogen fluoride	0.21	2.49	[f]	$2.51x10^{-8}$	$7.55x10^{-6}$	$1.19x10^{-7}$	$3.03x10^{-6}$	0	0
Nitric acid	0.1225	5	[f]	$9.43x10^{-8}$	$2.83x10^{-5}$	$7.70x10^{-7}$	$5.66x10^{-6}$	0	0
Octanol	2.52	102.8	[f]	$3.52x10^{-9}$	$1.05x10^{-6}$	$1.39x10^{-9}$	$1.03x10^{-8}$	0	0
Phosphoric acid	0.0245	1	[f]	$3.14x10^{-8}$	$9.44x10^{-6}$	$1.28x10^{-6}$	$9.44x10^{-6}$	0	0
Sulfuric acid	0.0245	1	[f]	$3.14x10^{-8}$	$9.44x10^{-6}$	$1.28x10^{-6}$	$9.44x10^{-6}$	0	0
Tributyl phosphate	0.1225	5	[f]	$3.14x10^{-9}$	$9.44x10^{-7}$	$2.56x10^{-8}$	$1.89x10^{-7}$	0	0
Trichloroethylene	13.377	546	0.006	$1.41x10^{-5}$	$4.25x10^{-3}$	$1.05x10^{-6}$	$7.78x10^{-6}$	$2.43x10^{-8}$	$9.87x10^{-7}$
Health Risk									
HI[g]						$1.61x10^{-4}$	$8.01x10^{-4}$		
Cancer risk[h]								$1.77x10^{-7}$	$7.20x10^{-6}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Source: LANL 1996c.

Table M.3.4–38. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—Plutonium Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Ammonia	0.1	35	f	$3.30x10^{-7}$	$1.98x10^{-4}$	$3.30x10^{-6}$	$5.66x10^{-6}$	0	0
Carbon monoxide	1.35	55	f	$1.32x10^{-4}$	$7.92x10^{-2}$	$9.78x10^{-5}$	$1.44x10^{-3}$	0	0
Chlorine	0.35	3	f	$2.47x10^{-7}$	$1.48x10^{-4}$	$7.07x10^{-7}$	$4.95x10^{-5}$	0	0
Cleaning solvent (butyl lactate)	0.74	30	f	$3.30x10^{-6}$	$1.98x10^{-3}$	$4.46x10^{-6}$	$6.60x10^{-5}$	0	0
[Text deleted.]									
Ethanol	46.55	1,900	f	$6.06x10^{-7}$	$3.96x10^{-4}$	$1.41x10^{-8}$	$2.08x10^{-7}$	0	0
Hydrazine	0.0326	1.33	17	$3.30x10^{-8}$	$1.98x10^{-5}$	$1.01x10^{-6}$	$1.52x10^{-5}$	$1.61x10^{-7}$	$1.30x10^{-5}$
Hydrogen chloride	0.007	7	f	$3.96x10^{-7}$	$2.37x10^{-4}$	$5.66x10^{-5}$	$3.39x10^{-5}$	0	0
Hydrogen fluoride	0.21	2.49	f	$2.64x10^{-8}$	$1.58x10^{-5}$	$1.25x10^{-7}$	$6.36x10^{-6}$	0	0
Nitric acid	0.1225	5	f	$9.90x10^{-8}$	$5.94x10^{-5}$	$8.08x10^{-7}$	$1.18x10^{-5}$	0	0
Octanol	2.52	102.8	f	$3.70x10^{-9}$	$2.22x10^{-6}$	$1.46x10^{-9}$	$2.16x10^{-8}$	0	0
Phosphoric acid	0.0245	1	f	$3.30x10^{-8}$	$1.98x10^{-5}$	$1.34x10^{-6}$	$1.98x10^{-5}$	0	0
Sulfuric acid	0.0245	1	f	$3.30x10^{-8}$	$1.98x10^{-5}$	$1.34x10^{-6}$	$1.98x10^{-5}$	0	0
Tributyl phosphate	0.1225	5	f	$3.30x10^{-9}$	$1.98x10^{-6}$	$2.69x10^{-8}$	$3.96x10^{-7}$	0	0
Trichloroethylene	13.377	546	0.006	$1.48x10^{-5}$	$8.91x10^{-3}$	$1.11x10^{-6}$	$1.63x10^{-5}$	$2.55x10^{-8}$	$2.07x10^{-6}$
Health Risk									
HI[g]						$1.69x10^{-4}$	$1.69x10^{-3}$		
Cancer risk[h]								$1.86x10^{-7}$	$1.51x10^{-5}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Source: LANL 1996c.

Table M.3.4–39. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—Plutonium Conversion Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Ammonia	0.1	35	f	$1.53x10^{-8}$	$1.68x10^{-4}$	$1.53x10^{-7}$	$4.80x10^{-6}$	0	0
Carbon monoxide	1.35	55	f	$6.15x10^{-6}$	$6.7x10^{-2}$	$4.55x10^{-6}$	$1.22x10^{-3}$	0	0
Chlorine	0.35	3	f	$1.15x10^{-8}$	$1.26x10^{-4}$	$3.29x10^{-8}$	$4.20x10^{-5}$	0	0
Cleaning solvent (butyl lactate)	0.74	30	f	$1.53x10^{-7}$	$1.68x10^{-3}$	$2.07x10^{-7}$	$5.60x10^{-5}$	0	0
[Text deleted.]									
Ethanol	46.55	1,900	f	$3.07x10^{-8}$	$3.36x10^{-4}$	$6.60x10^{-10}$	$1.76x10^{-7}$	0	0
Hydrazine	0.0326	1.33	17	$1.53x10^{-9}$	$1.68x10^{-5}$	$4.71x10^{-8}$	$1.29x10^{-5}$	$7.48x10^{-9}$	$1.11x10^{-5}$
Hydrogen chloride	0.007	7	f	$1.84x10^{-8}$	$2.01x10^{-4}$	$2.63x10^{-6}$	$2.88x10^{-5}$	0	0
Hydrogen fluoride	0.21	2.49	f	$1.23x10^{-9}$	$1.34x10^{-5}$	$5.85x10^{-9}$	$5.39x10^{-6}$	0	0
Nitric acid	0.1225	5	f	$4.61x10^{-9}$	$5.04x10^{-5}$	$3.76x10^{-8}$	$1.00x10^{-5}$	0	0
Octanol	2.52	102.8	f	$1.72x10^{-10}$	$1.88x10^{-6}$	$6.84x10^{-11}$	$1.83x10^{-8}$	0	0
Phosphoric acid	0.0245	1	f	$1.53x10^{-9}$	$1.68x10^{-5}$	$6.27x10^{-8}$	$1.00x10^{-5}$	0	0
Sulfuric acid	0.0245	1	f	$1.53x10^{-9}$	$1.68x10^{-5}$	$6.27x10^{-8}$	$1.68x10^{-5}$	0	0
Tributyl phospate	0.1225	5	f	$1.53x10^{-10}$	$1.68x10^{-6}$	$1.25x10^{-9}$	$3.36x10^{-7}$	0	0
Trichloroethylene	13.377	546	0.006	$6.92x10^{-7}$	$7.56x10^{-3}$	$5.17x10^{-8}$	$1.38x10^{-5}$	$1.19x10^{-9}$	$1.76x10^{-6}$
Health Risk									
HI[g]						$7.86x10^{-6}$	$1.43x10^{-3}$		
Cancer risk[h]								$8.66x10^{-9}$	$1.28x10^{-5}$

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Source: LANL 1996c.

Table M.3.4–40. Risk Assessments From Exposure to Hazardous Chemicals at the Deep Borehole Complex—Direct Disposition Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	3.71×10^{-4}	2.23×10^{-1}	2.75×10^{-4}	4.05×10^{-3}	0	0
Hydrocarbons (pyrene)	0.105	0.2	f	9.34×10^{-5}	5.60×10^{-2}	8.90×10^{-4}	2.80×10^{-1}	0	0
Health Risk									
HI[g]						1.17×10^{-3}	2.85×10^{-1}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HQ=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: Emissions in the source document are for 10 years; therefore, emissions are divided by 10 for the annual emissions used in the HI and cancer risk calculations.

Source: LLNL 1996a.

Table M.3.4–41. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site—Ceramic Immobilization Facility for the Immobilized Disposition Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	$5.13x10^{-2}$	$1.70x10^{2}$	$2.32x10^{-4}$	$1.89x10^{-2}$	0	0
Carbon monoxide	1.35	55	f	$1.80x10^{-4}$	$5.95x10^{-1}$	$1.33x10^{-4}$	$1.08x10^{-2}$	0	0
Chloride (HCI)	0.007	7	f	$6.16x10^{-6}$	$2.04x10^{-2}$	$8.79x10^{-4}$	$2.91x10^{-3}$	0	0
Fluoride (HF)	0.21	2.49	f	$7.70x10^{-8}$	$2.55x10^{-4}$	$3.66x10^{-7}$	$1.02x10^{-4}$	0	0
Hydrocarbons (pyrene)	0.105	0.2	f	$5.39x10^{-6}$	$1.78x10^{-2}$	$5.13x10^{-5}$	$8.92x10^{-2}$	0	0
Iron (salts)	0.0245	1	f	$7.70x10^{-8}$	$2.55x10^{-4}$	$3.14x10^{-6}$	$2.55x10^{-4}$	0	0
Magnesium (oxide fume)	0.368	15	f	$7.70x10^{-6}$	$2.55x10^{-2}$	$2.09x10^{-5}$	$1.70x10^{-3}$	0	0
Phosphates (phosphoric acid)	0.0245	1	f	$3.85x10^{-6}$	$1.27x10^{-2}$	$1.57x10^{-4}$	$1.27x10^{-2}$	0	0
Phosphonates (phosgene)	0.0098	0.4	f	$7.70x10^{-7}$	$2.55x10^{-3}$	$7.85x10^{-5}$	$6.37x10^{-3}$	0	0
[Text deleted.]									
Silver	0.0175	0.01	f	$2.57x10^{-15}$	$8.50x10^{-12}$	$1.47x10^{-13}$	$8.50x10^{-10}$	0	0
VOC (toluene)	0.4	766	f	$5.39x10^{-7}$	$1.78x10^{-3}$	$1.35x10^{-6}$	$2.33x10^{-6}$	0	0
Health Risk									
HI[g]						$1.56x10^{-3}$	$1.43x10^{-1}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996e.

Table M.3.4–42. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site—Ceramic Immobilization Facility for the Immobilized Disposition Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	$7.64x10^{-3}$	$8.82x10^{1}$	$3.46x10^{-5}$	$9.80x10^{-3}$	0	0
Carbon monoxide	1.35	55	f	$2.67x10^{-5}$	$3.09x10^{-1}$	$1.98x10^{-5}$	$5.61x10^{-3}$	0	0
Chloride (HCl)	0.007	7	f	$9.17x10^{-7}$	$1.06x10^{-2}$	$1.31x10^{-4}$	$1.51x10^{-3}$	0	0
Fluoride (HF)	0.21	2.49	f	$1.15x10^{-8}$	$1.32x10^{-4}$	$5.46x10^{-8}$	$5.31x10^{-5}$	0	0
Hydrocarbons (pyrene)	0.105	0.2	f	$8.02x10^{-7}$	$9.26x10^{-3}$	$7.64x10^{-6}$	$4.63x10^{-2}$	0	0
Iron (salts)	0.0245	1	f	$1.15x10^{-8}$	$1.32x10^{-4}$	$4.68x10^{-7}$	$1.32x10^{-4}$	0	0
Magnesium (oxide fume)	0.368	15	f	$1.15x10^{-6}$	$1.32x10^{-2}$	$3.11x10^{-6}$	$8.82x10^{-4}$	0	0
Phosphates (phosphoric acid)	0.0245	1	f	$5.73x10^{-7}$	$6.61x10^{-3}$	$2.34x10^{-5}$	$6.61x10^{-3}$	0	0
Phosphonates (phosgene)	0.0098	0.4	f	$1.15x10^{-7}$	$1.32x10^{-3}$	$1.17x10^{-5}$	$3.31x10^{-3}$	0	0
[Text deleted.]									
Silver	0.0175	0.01	f	$3.82x10^{-16}$	$4.41x10^{-12}$	$2.18x10^{-14}$	$4.41x10^{-10}$	0	0
VOC (toluene)	0.4	766	f	$8.02x10^{-8}$	$9.26x10^{-4}$	$2.01x10^{-7}$	$1.21x10^{-6}$	0	0
Health Risk									
HI[g]						$2.32x10^{-4}$	$7.42x10^{-2}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996e.

Table M.3.4–43. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Ceramic Immobilization Facility for the Immobilized Disposition Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	1.10×10^{-1}	1.72×10^{2}	4.98×10^{-4}	1.91×10^{-2}	0	0
Carbon monoxide	1.35	55	f	3.85×10^{-4}	6.01×10^{-1}	2.85×10^{-4}	1.09×10^{-2}	0	0
Chloride (HCl)	0.007	7	f	1.32×10^{-5}	2.06×10^{-2}	1.89×10^{-3}	2.94×10^{-3}	0	0
Fluoride (HF)	0.21	2.49	f	1.65×10^{-7}	2.58×10^{-4}	7.85×10^{-7}	1.03×10^{-4}	0	0
Hydrocarbons (pyrene)	0.105	0.2	f	1.15×10^{-5}	1.80×10^{-2}	1.10×10^{-4}	9.01×10^{-2}	0	0
Iron (salts)	0.0245	1	f	1.65×10^{-7}	2.58×10^{-4}	6.73×10^{-6}	2.58×10^{-4}	0	0
Magnesium (oxide fume)	0.368	15	f	1.65×10^{-5}	2.58×10^{-2}	4.48×10^{-5}	1.72×10^{-3}	0	0
Phosphates (phosphoric acid)	0.0245	1	f	8.25×10^{-6}	1.29×10^{-2}	3.37×10^{-4}	1.29×10^{-2}	0	0
Phosphonates (phosgene)	0.0098	0.4	f	1.65×10^{-6}	2.58×10^{-3}	1.68×10^{-4}	6.44×10^{-3}	0	0
[Text deleted.]									
Silver	0.0175	0.01	f	5.50×10^{-15}	8.58×10^{-12}	3.14×10^{-13}	8.58×10^{-10}	0	0
VOC (toluene)	0.4	766	f	1.15×10^{-6}	1.80×10^{-3}	2.89×10^{-6}	2.35×10^{-6}	0	0
Health Risk									
HI[g]						3.34×10^{-3}	1.44×10^{-1}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996e.

Table M.3.4–44. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—Ceramic Immobilization Facility for the Immobilized Disposition Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	$2.86x10^{-1}$	$8.59x10^{1}$	$1.29x10^{-3}$	$9.54x10^{-3}$	0	0
Carbon monoxide	1.35	55	f	$1.00x10^{-3}$	$3.01x10^{-1}$	$7.41x10^{-4}$	$5.47x10^{-3}$	0	0
Chloride (HCl)	0.007	7	f	$3.43x10^{-5}$	$1.03x10^{-2}$	$4.90x10^{-3}$	$1.47x10^{-3}$	0	0
Fluoride (HF)	0.21	2.49	f	$4.29x10^{-7}$	$1.29x10^{-4}$	$2.04x10^{-6}$	$5.17x10^{-5}$	0	0
Hydrocarbons (pyrene)	0.105	0.2	f	$3.00x10^{-5}$	$9.02x10^{-3}$	$2.86x10^{-4}$	$4.51x10^{-2}$	0	0
Iron (salts)	0.0245	1	f	$4.29x10^{-7}$	$1.29x10^{-4}$	$1.75x10^{-5}$	$1.29x10^{-4}$	0	0
Magnesium (oxide fume)	0.368	15	f	$4.29x10^{-5}$	$1.29x10^{-2}$	$1.17x10^{-4}$	$8.59x10^{-4}$	0	0
Phosphates (phosphoric acid)	0.0245	1	f	$2.14x10^{-5}$	$6.44x10^{-3}$	$8.75x10^{-4}$	$6.44x10^{-3}$	0	0
Phosphonates (phosgene)	0.0098	0.4	f	$4.29x10^{-6}$	$1.29x10^{-3}$	$4.38x10^{-4}$	$3.22x10^{-3}$	0	0
[Text deleted.]									
Silver	0.0175	0.01	f	$1.43x10^{-14}$	$4.29x10^{-12}$	$8.17x10^{-13}$	$4.29x10^{-10}$	0	0
VOC (toluene)	0.4	766	f	$3.00x10^{-6}$	$9.02x10^{-4}$	$7.51x10^{-6}$	$1.18x10^{-6}$	0	0
Health Risk									
HI[g]						$8.68x10^{-3}$	$7.23x10^{-2}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996e.

Table M.3.4–45. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—Ceramic Immobilization Facility for the Immobilized Disposition Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	[f]	3.00×10^{-1}	1.80×10^{2}	1.36×10^{-3}	2.00×10^{-2}	0	0
Carbon monoxide	1.35	55	[f]	1.05×10^{-3}	6.30×10^{-1}	7.78×10^{-4}	1.15×10^{-2}	0	0
Chloride (HCl)	0.007	7	[f]	3.60×10^{-5}	2.16×10^{-2}	5.15×10^{-3}	3.09×10^{-3}	0	0
Fluoride (HF)	0.21	2.49	[f]	4.50×10^{-7}	2.70×10^{-4}	2.14×10^{-6}	1.09×10^{-4}	0	0
Hydrocarbons (pyrene)	0.105	0.2	[f]	3.15×10^{-5}	1.89×10^{-2}	3.00×10^{-4}	9.46×10^{-2}	0	0
Iron (salts)	0.0245	1	[f]	4.50×10^{-7}	2.70×10^{-4}	1.84×10^{-5}	2.70×10^{-4}	0	0
Magnesium (oxide fume)	0.368	15	[f]	4.50×10^{-5}	2.70×10^{-2}	1.22×10^{-4}	1.80×10^{-3}	0	0
Phosphates (phosphoric acid)	0.0245	1	[f]	2.25×10^{-5}	1.35×10^{-2}	9.19×10^{-4}	1.35×10^{-2}	0	0
Phosphonates (phosgene)	0.0098	0.4	[f]	4.50×10^{-6}	2.70×10^{-3}	4.59×10^{-4}	6.75×10^{-3}	0	0
[Text deleted.]									
Silver	0.0175	0.01	[f]	1.50×10^{-14}	9.01×10^{-12}	8.58×10^{-13}	9.01×10^{-10}	0	0
VOC (toluene)	0.4	766	[f]	3.15×10^{-6}	1.89×10^{-3}	7.88×10^{-6}	2.47×10^{-6}	0	0
Health Risk									
HI[g]						9.11×10^{-3}	1.52×10^{-1}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996e.

Table M.3.4–46. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—Ceramic Immobilization Facility for the Immobilized Disposition Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	$1.40x10^{-2}$	$1.53x10^{2}$	$6.33x10^{-5}$	$1.70x10^{-2}$	0	0
Carbon monoxide	1.35	55	f	$4.89x10^{-5}$	$5.35x10^{-1}$	$3.62x10^{-5}$	$9.72x10^{-3}$	0	0
Chloride (HCl)	0.007	7	f	$1.68x10^{-6}$	$1.83x10^{-2}$	$2.40x10^{-4}$	$2.62x10^{-3}$	0	0
Fluoride (HF)	0.21	2.49	f	$2.10x10^{-8}$	$2.29x10^{-4}$	$9.99x10^{-8}$	$9.20x10^{-5}$	0	0
Hydrocarbons (pyrene)	0.105	0.2	f	$1.47x10^{-6}$	$1.60x10^{-2}$	$1.40x10^{-5}$	$8.02x10^{-2}$	0	0
Iron (salts)	0.0245	1	f	$2.10x10^{-8}$	$2.29x10^{-4}$	$8.56x10^{-7}$	$2.29x10^{-4}$	0	0
Magnesium (oxide fume)	0.368	15	f	$2.10x10^{-6}$	$2.29x10^{-2}$	$5.70x10^{-6}$	$1.53x10^{-3}$	0	0
Phosphates (phosphoric acid)	0.0245	1	f	$1.05x10^{-6}$	$1.15x10^{-2}$	$4.28x10^{-5}$	$1.15x10^{-2}$	0	0
Phosphonates (phosgene)	0.0098	0.4	f	$2.10x10^{-7}$	$2.29x10^{-3}$	$2.14x10^{-5}$	$5.73x10^{-3}$	0	0
[Text deleted.]									
Silver	0.0175	0.01	f	$6.99x10^{-16}$	$7.64x10^{-12}$	$3.99x10^{-14}$	$7.64x10^{-10}$	0	0
VOC (toluene)	0.4	766	f	$1.47x10^{-7}$	$1.60x10^{-3}$	$3.67x10^{-7}$	$2.09x10^{-6}$	0	0
Health Risk									
HI[g]						$4.24x10^{-4}$	$1.29x10^{-1}$		
Cancer risk[h]								0	0

[a] See Table M.3.3.1–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996e.

Table M.3.4–47. Risk Assessments From Exposure to Hazardous Chemicals at the Deep Borehole Complex—Immobilized Disposition Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b] (mg/m^3)	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	$3.71x10^{-4}$	$2.23x10^{-1}$	$2.75x10^{-4}$	$4.05x10^{-3}$	0	0
Hydrocarbons (pyrene)	0.105	0.2	f	$9.264x10^{-5}$	$5.56x10^{-2}$	$8.82x10^{-4}$	$2.78x10^{-1}$	0	0
Health Risk									
HI[g]						$1.16x10^{-3}$	$2.82x10^{-1}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Source: LLNL 1996h.

Table M.3.4–48. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site—Vitrification Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9000	f	$2.57x10^{-3}$	8.5	$1.16x10^{-5}$	$9.44x10^{-4}$	0	0
Carbon monoxide	1.35	55	f	$4.10x10^{-4}$	1.36	$3.04x10^{-4}$	$2.47x10^{-2}$	0	0
Chloride (sodium chloride)	0.42	17.1	f	$4.62x10^{-6}$	$1.53x10^{-2}$	$1.1x10^{-5}$	$8.95x10^{-4}$	0	0
Fluoride (HF)	0.061	2.5	f	$1.13x10^{-7}$	$3.74x10^{-4}$	$1.85x10^{-6}$	$1.50x10^{-4}$	0	0
[Text deleted.]									
Iron (salts)	0.0245	1	f	$5.64x10^{-8}$	$1.87x10^{-4}$	$2.30x10^{-6}$	$1.87x10^{-4}$	0	0
Magnesium (oxide fume)	0.368	15	f	$6.16x10^{-6}$	$2.04x10^{-2}$	$1.67x10^{-5}$	$1.36x10^{-3}$	0	0
Phosphates (phosphoric acid)	0.0245	1	f	$2.82x10^{-6}$	$9.35x10^{-3}$	$1.15x10^{-4}$	$9.35x10^{-3}$	0	0
VOC (toluene)	0.4	766	f	$8.21x10^{-5}$	$2.72x10^{-1}$	$2.05x10^{-4}$	$3.55x10^{-4}$	0	0
Health Risk									
HI[g]						$6.68x10^{-4}$	$3.80x10^{-2}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996c.

Table M.3.4–49. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site—Vitrification Alternative

Chemical	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9000	[f]	$3.82x10^{-4}$	4.41	$1.73x10^{-6}$	$4.90x10^{-4}$	0	0
Carbon monoxide	1.35	55	[f]	$6.11x10^{-5}$	$7.06x10^{-1}$	$4.53x10^{-5}$	$1.28x10^{-2}$	0	0
Chloride (sodium chloride)	0.42	17.1	[f]	$6.88x10^{-7}$	$7.94x10^{-3}$	$1.64x10^{-6}$	$4.64x10^{-4}$	0	0
Fluoride (HF)	0.061	2.5	[f]	$1.68x10^{-8}$	$1.94x10^{-4}$	$2.76x10^{-7}$	$7.76x10^{-5}$	0	0
[Text deleted.]									
Iron (salts)	0.0245	1	[f]	$8.4x10^{-9}$	$9.7x10^{-5}$	$3.43x10^{-7}$	$9.7x10^{-5}$	0	0
Magnesium (oxide fume)	0.368	15	[f]	$9.17x10^{-7}$	$1.06x10^{-2}$	$2.49x10^{-6}$	$7.06x10^{-4}$	0	0
Phosphates (phosphoric acid)	0.0245	1	[f]	$4.2x10^{-7}$	$4.85x10^{-3}$	$1.72x10^{-5}$	$4.85x10^{-3}$	0	0
VOC (toluene)	0.4	766	[f]	$1.22x10^{-5}$	$1.41x10^{-1}$	$3.06x10^{-5}$	$1.84x10^{-4}$	0	0
Health Risk									
HI[g]						$9.95x10^{-5}$	$1.97x10^{-2}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996c.

Table M.3.4–50. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Vitrification Alternative

Chemical	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	$5.50x10^{-3}$	8.58	$2.49x10^{-5}$	$9.54x10^{-4}$	0	0
Carbon monoxide	1.35	55	f	$8.80x10^{-4}$	1.37	$6.52x10^{-4}$	$2.50x10^{-2}$	0	0
Chloride (sodium chloride)	0.42	17.1	f	$9.90x10^{-6}$	$1.55x10^{-2}$	$2.36x10^{-5}$	$9.04x10^{-4}$	0	0
Fluoride	0.061	2.5	f	$2.42x10^{-7}$	$3.78x10^{-4}$	$3.97x10^{-6}$	$1.51x10^{-4}$	0	0
[Text deleted.]									
Iron (salts)	0.0245	1	f	$1.21x10^{-7}$	$1.89x10^{-4}$	$4.94x10^{-6}$	$1.89x10^{-4}$	0	0
Magnesium (oxide fume)	0.368	15	f	$1.32x10^{-5}$	$2.06x10^{-2}$	$3.59x10^{-5}$	$1.37x10^{-3}$	0	0
Phosphates (phosphoric acid)	0.0245	1	f	$6.05x10^{-6}$	$9.44x10^{-3}$	$2.47x10^{-4}$	$9.44x10^{-3}$	0	0
VOC (toluene)	0.4	766	f	$1.76x10^{-4}$	$2.75x10^{-1}$	$4.40x10^{-4}$	$3.59x10^{-4}$	0	0
Health Risk									
HI[g]						$1.43x10^{-3}$	$3.83x10^{-2}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996c.

Table M.3.4–51. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—Vitrification Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	[f]	$1.43x10^{-2}$	4.29	$6.47x10^{-5}$	$4.77x10^{-4}$	0	0
Carbon monoxide	1.35	55	[f]	$2.29x10^{-3}$	$6.87x10^{-1}$	$1.69x10^{-3}$	$1.25x10^{-2}$	0	0
Chloride (sodium chloride)	0.42	17.1	[f]	$2.57x10^{-5}$	$7.73x10^{-3}$	$6.13x10^{-5}$	$4.52x10^{-4}$	0	0
Fluoride	0.061	2.5	[f]	$6.29x10^{-7}$	$1.89x10^{-4}$	$1.03x10^{-5}$	$7.56x10^{-5}$	0	0
[Text deleted.]									
Iron (salts)	0.0245	1	[f]	$3.15x10^{-6}$	$9.45x10^{-5}$	$1.28x10^{-5}$	$9.45x10^{-5}$	0	0
Magnesium (oxide fume)	0.368	15	[f]	$3.43x10^{-5}$	$1.03x10^{-2}$	$9.32x10^{-5}$	$6.87x10^{-4}$	0	0
Phosphates (phosphoric acid)	0.0245	1	[f]	$1.57x10^{-5}$	$4.72x10^{-3}$	$6.42x10^{-4}$	$4.72x10^{-3}$	0	0
VOC (toluene)	0.4	766	[f]	$4.58x10^{-4}$	$1.37x10^{-1}$	$1.14x10^{-3}$	$1.79x10^{-4}$	0	0
Health Risk									
HI[g]						$3.72x10^{-3}$	$1.92x10^{-2}$		
Cancer risk[h]								0	0

[a] See Table M.3.3.1–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996c.

Table M.3.4–52. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—Vitrification Alternative

Chemical	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	1.50×10^{-2}	9.01	6.79×10^{-5}	1.0×10^{-3}	0	0
Carbon monoxide	1.35	55	f	2.40×10^{-3}	1.44	1.78×10^{-3}	2.62×10^{-2}	0	0
Chloride (sodium chloride)	0.42	17.1	f	2.70×10^{-5}	1.62×10^{-2}	6.43×10^{-5}	9.48×10^{-4}	0	0
Fluoride	0.061	2.5	f	6.60×10^{-7}	3.96×10^{-4}	1.08×10^{-5}	1.59×10^{-4}	0	0
[Text deleted.]									
Iron (salts)	0.0245	1	f	3.30×10^{-7}	1.98×10^{-4}	1.35×10^{-5}	1.98×10^{-4}	0	0
Magnesium (oxide fume)	0.368	15	f	3.60×10^{-5}	2.16×10^{-2}	9.79×10^{-5}	1.44×10^{-3}	0	0
Phosphates (phosphoric acid)	0.0245	1	f	1.65×10^{-5}	9.91×10^{-3}	6.74×10^{-4}	9.91×10^{-3}	0	0
VOC (toluene)	0.4	766	f	4.80×10^{-4}	2.88×10^{-1}	1.20×10^{-3}	3.76×10^{-4}	0	0
Health Risk									
HI[g]						3.91×10^{-3}	4.02×10^{-2}		
Cancer risk[h]								0	0

[a] See Table M.3.3.1–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996c.

Table M.3.4–53. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—Vitrification Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	$6.99x10^{-4}$	7.64	$3.16x10^{-6}$	$8.48x10^{-4}$	0	0
Carbon monoxide	1.35	55	f	$1.12x10^{-4}$	1.22	$8.28x10^{-5}$	$2.22x10^{-2}$	0	0
Chloride (sodium chloride)	0.42	17.1	f	$1.26x10^{-6}$	$1.37x10^{-2}$	$3.00x10^{-6}$	$8.04x10^{-4}$	0	0
Fluoride	0.061	2.5	f	$3.08x10^{-8}$	$3.36x10^{-4}$	$5.04x10^{-7}$	$1.34x10^{-4}$	0	0
[Text deleted.]									
Iron (salts)	0.0245	1	f	$1.54x10^{-8}$	$1.68x10^{-4}$	$6.28x10^{-7}$	$1.68x10^{-4}$	0	0
Magnesium (oxide fume)	0.368	15	f	$1.68x10^{-6}$	$1.83x10^{-2}$	$4.56x10^{-6}$	$1.22x10^{-3}$	0	0
Phosphates (phosphoric acid)	0.0245	1	f	$7.69x10^{-7}$	$8.40x10^{-3}$	$3.14x10^{-5}$	$8.40x10^{-3}$	0	0
VOC (toluene)	0.4	766	f	$2.24x10^{-5}$	$2.44x10^{-1}$	$5.59x10^{-5}$	$3.19x10^{-4}$	0	0
Health Risk									
HI[g]						$1.82x10^{-4}$	$3.41x10^{-2}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996c.

Table M.3.4–54. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site—Ceramic Immobilization Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	[f]	4.10×10^{-2}	1.36×10^{2}	1.86×10^{-4}	1.51×10^{-2}	0	0
Carbon monoxide	1.35	55	[f]	1.41×10^{-3}	4.67	1.05×10^{-3}	8.50×10^{-2}	0	0
Chloride (HCl)	0.007	7	[f]	4.62×10^{-6}	1.53×10^{-2}	6.60×10^{-4}	2.19×10^{-3}	0	0
Fluoride (HF)	0.21	2.49	[f]	6.16×10^{-8}	2.04×10^{-4}	2.93×10^{-7}	8.19×10^{-5}	0	0
Iron (salts)	0.0245	1	[f]	5.64×10^{-8}	1.87×10^{-4}	2.30×10^{-6}	1.87×10^{-4}	0	0
Magnesium (oxide fume)	0.368	15	[f]	6.16×10^{-6}	2.04×10^{-2}	1.67×10^{-5}	1.36×10^{-3}	0	0
Phosphates (phosphoric acid)	0.0245	1	[f]	2.82×10^{-6}	9.35×10^{-3}	1.15×10^{-4}	9.35×10^{-3}	0	0
Phosphonates (phosgene)	0.0098	0.4	[f]	5.64×10^{-6}	1.87×10^{-2}	5.76×10^{-4}	4.67×10^{-2}	0	0
[Text deleted.]									
Silver	0.0175	0.01	[f]	2.57×10^{-15}	8.50×10^{-12}	1.47×10^{-13}	8.50×10^{-10}	0	0
VOC (toluene)	0.4	766	[f]	4.62×10^{-7}	1.53×10^{-3}	1.15×10^{-6}	2.00×10^{-6}	0	0
Health Risk									
HI[g]						2.60×10^{-3}	1.60×10^{-1}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996d.

Table M.3.4–55. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site—Ceramic Immobilization Alternative

Chemical	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary Annual MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	6.11×10^{-3}	7.06×10^{1}	2.77×10^{-5}	7.84×10^{-3}	0	0
Carbon monoxide	1.35	55	f	2.10×10^{-4}	2.43	1.56×10^{-4}	4.41×10^{-2}	0	0
Chloride (HCl)	0.007	7	f	6.88×10^{-7}	7.94×10^{-3}	9.82×10^{-5}	1.13×10^{-3}	0	0
Fluoride (HF)	0.21	2.49	f	9.17×10^{-9}	1.06×10^{-4}	4.37×10^{-8}	4.25×10^{-5}	0	0
Iron (salts)	0.0245	1	f	8.40×10^{-9}	9.70×10^{-5}	3.43×10^{-7}	9.70×10^{-5}	0	0
Magnesium (oxide fume)	0.368	15	f	9.17×10^{-7}	1.06×10^{-2}	2.49×10^{-6}	7.06×10^{-4}	0	0
Phosphates (phosphoric acid)	0.0245	1	f	4.20×10^{-7}	4.85×10^{-3}	1.72×10^{-5}	4.85×10^{-3}	0	0
Phosphonates (phosgene)	0.0098	0.4	f	8.40×10^{-7}	9.70×10^{-3}	8.58×10^{-5}	2.43×10^{-2}	0	0
[Text deleted.]									
Silver	0.0175	0.01	f	3.82×10^{-16}	4.41×10^{-12}	2.18×10^{-14}	4.41×10^{-10}	0	0
VOC (toluene)	0.4	766	f	6.88×10^{-8}	7.94×10^{-4}	1.72×10^{-7}	1.04×10^{-6}	0	0
Health Risk									
HI[g]						3.87×10^{-4}	8.30×10^{-2}		
Cancer risk[h]								0	0

[a] See Table M.3.3.1–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(Emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996d.

Table M.3.4–56. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Ceramic Immobilization Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	[f]	$8.80x10^{-2}$	$1.37x10^{2}$	$3.98x10^{-2}$	$1.53x10^{-3}$	0	0
Carbon monoxide	1.35	55	[f]	$3.02x10^{-3}$	4.72	$2.24x10^{-2}$	$8.58x10^{-2}$	0	0
Chloride (HCl)	0.007	7	[f]	$9.90x10^{-6}$	$1.55x10^{-2}$	$1.41x10^{-3}$	$2.21x10^{-3}$	0	0
Fluoride (HF)	0.21	2.49	[f]	$1.32x10^{-7}$	$2.06x10^{-4}$	$6.28x10^{-5}$	$8.27x10^{-5}$	0	0
Iron (salts)	0.0245	1	[f]	$1.21x10^{-7}$	$1.89x10^{-4}$	$4.94x10^{-4}$	$1.89x10^{-5}$	0	0
Magnesium (oxide fume)	0.368	15	[f]	$1.32x10^{-5}$	$2.06x10^{-2}$	$3.59x10^{-6}$	$1.37x10^{-4}$	0	0
Phosphates (phosphoric acid)	0.0245	1	[f]	$6.05x10^{-6}$	$9.44x10^{-3}$	$2.47x10^{-3}$	$9.44x10^{-3}$	0	0
Phosphonates (phosgene)	0.0098	0.4	[f]	$1.21x10^{-5}$	$1.89x10^{-2}$	$1.23x10^{-2}$	$4.72x10^{-2}$	0	0
[Text deleted.]									
Silver	0.0175	0.01	[f]	$5.50x10^{-15}$	$8.58x10^{-12}$	$3.14x10^{-10}$	$8.58x10^{-10}$	0	0
VOC (toluene)	0.4	766	[f]	$9.90x10^{-7}$	$1.55x10^{-3}$	$2.47x10^{-6}$	$2.02x10^{-6}$	0	0
Health Risk									
HI[g]						$5.58x10^{-3}$	$1.62x10^{-1}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996d.

Table M.3.4–57. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—Ceramic Immobilization Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	$2.29x10^{-1}$	$6.87x10^{-1}$	$1.04x10^{-2}$	$7.64x10^{-3}$	0	0
Carbon monoxide	1.35	55	f	$7.86x10^{-3}$	2.36	$5.83x10^{-2}$	$4.29x10^{-2}$	0	0
Chloride (HCl)	0.007	7	f	$2.57x10^{-5}$	$7.73x10^{-3}$	$3.68x10^{-3}$	$1.10x10^{-3}$	0	0
Fluoride (HF)	0.21	2.49	f	$3.43x10^{-7}$	$1.03x10^{-4}$	$1.63x10^{-6}$	$4.14x10^{-5}$	0	0
Iron (salts)	0.0245	1	f	$3.15x10^{-7}$	$9.45x10^{-5}$	$1.28x10^{-4}$	$9.45x10^{-5}$	0	0
Magnesium (oxide fume)	0.368	15	f	$3.43x10^{-5}$	$1.03x10^{-2}$	$9.32x10^{-6}$	$6.87x10^{-4}$	0	0
Phosphates (phosphoric acid)	0.0245	1	f	$1.57x10^{-5}$	$4.72x10^{-3}$	$6.42x10^{-3}$	$4.72x10^{-3}$	0	0
Phosphonates (phosgene)	0.0098	0.4	f	$3.15x10^{-5}$	$9.45x10^{-3}$	$3.21x10^{-2}$	$2.36x10^{-2}$	0	0
[Text deleted.]									
Silver	0.0175	0.01	f	$1.43x10^{-14}$	$4.29x10^{-12}$	$8.17x10^{-10}$	$4.29x10^{-10}$	0	0
VOC (toluene)	0.4	766	f	$2.57x10^{-6}$	$7.73x10^{-4}$	$6.43x10^{-6}$	$1.01x10^{-6}$	0	0
Health Risk									
HI[g]						$1.45x10^{-2}$	$8.09x10^{-2}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996d.

Table M.3.4–58. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—Ceramic Immobilization Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	$2.40x10^{-1}$	$1.44x10^{2}$	$1.09x10^{-3}$	$1.60x10^{-2}$	0	0
Carbon monoxide	1.35	55	f	$8.25x10^{-3}$	4.95	$6.11x10^{-3}$	$9.01x10^{-2}$	0	0
Chloride (HCl)	0.007	7	f	$2.70x10^{-5}$	$1.62x10^{-2}$	$3.86x10^{-3}$	$2.32x10^{-3}$	0	0
Fluoride (HF)	0.21	2.49	f	$3.60x10^{-7}$	$2.16x10^{-4}$	$1.72x10^{-6}$	$8.68x10^{-5}$	0	0
Iron (salts)	0.0245	1	f	$3.30x10^{-7}$	$1.98x10^{-4}$	$1.35x10^{-5}$	$1.98x10^{-4}$	0	0
Magnesium (oxide fume)	0.368	15	f	$3.60x10^{-5}$	$2.16x10^{-2}$	$9.79x10^{-5}$	$1.44x10^{-3}$	0	0
Phosphates (phosphoric acid)	0.0245	1	f	$1.65x10^{-5}$	$9.91x10^{-3}$	$6.74x10^{-4}$	$9.91x10^{-3}$	0	0
Phosphonates (phosgene)	0.0098	0.4	f	$3.30x10^{-5}$	$1.98x10^{-2}$	$3.37x10^{-3}$	$4.95x10^{-2}$	0	0
[Text deleted.]									
Silver	0.0175	0.01	f	$1.50x10^{-14}$	$9.01x10^{-12}$	$8.58x10^{-13}$	$9.01x10^{-10}$	0	0
VOC*(toluene)	0.4	766	f	$2.70x10^{-6}$	$1.62x10^{-3}$	$6.75x10^{-6}$	$2.12x10^{-6}$	0	0
Health Risk									
HI[g]						$1.52x10^{-2}$	$1.70x10^{-1}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996d.

Table M.3.4–59. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—Ceramic Immobilization Alternative

Chemical	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[a,b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[a,d]	Worker 100 Meters 8 Hours[e]
[Text deleted.]									
Carbon dioxide	221	9,000	f	1.12×10^{-2}	1.22×10^{2}	5.06×10^{-5}	1.36×10^{-2}	0	0
Carbon monoxide	1.35	55	f	3.84×10^{-4}	4.20	2.85×10^{-4}	7.64×10^{-2}	0	0
Chloride (HCl)	0.007	7	f	1.26×10^{-6}	1.37×10^{-2}	1.80×10^{-4}	1.96×10^{-3}	0	0
Fluoride (HF)	0.21	2.49	f	1.68×10^{-8}	1.83×10^{-4}	7.99×10^{-8}	7.36×10^{-5}	0	0
Iron (salts)	0.0245	1	f	1.54×10^{-8}	1.68×10^{-4}	6.28×10^{-7}	1.68×10^{-4}	0	0
Magnesium (oxide fume)	0.368	15	f	1.68×10^{-6}	1.83×10^{-2}	4.56×10^{-6}	1.22×10^{-3}	0	0
Phosphates (phosphoric acid)	0.0245	1	f	7.69×10^{-7}	8.40×10^{-3}	3.14×10^{-5}	8.40×10^{-3}	0	0
Phosphonates (phosgene)	0.0098	0.4	f	1.54×10^{-6}	1.68×10^{-2}	1.57×10^{-4}	4.20×10^{-2}	0	0
[Text deleted.]									
Silver	0.0175	0.01	f	6.99×10^{-16}	7.64×10^{-12}	3.99×10^{-14}	7.64×10^{-10}	0	0
VOC (toluene)	0.4	766	f	1.26×10^{-7}	1.37×10^{-3}	3.15×10^{-7}	1.79×10^{-6}	0	0
Health Risk									
HI[g]						7.09×10^{-4}	1.44×10^{-1}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996d.

Table M.3.4–60. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Electrometallurgical Treatment Alternative

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	f	5.06×10^{-7}	7.90×10^{-4}	3.75×10^{-7}	1.44×10^{-5}	0	0
VOCs (toluene)	0.4	766	f	5.50	8.58×10^{-4}	1.37×10^{-6}	1.12×10^{-6}	0	0
Health Risk									
HI[g]						1.75×10^{-6}	1.55×10^{-5}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LLNL 1996b.

Table M.3.4–61. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site—Mixed Oxide Fuel Fabrication Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	[f]	$1.41x10^{-5}$	$4.67x10^{-2}$	$1.91x10^{-5}$	$1.56x10^{-3}$	0	0
[Text deleted.]									
VOC (toluene)	0.40	766	[f]	$5.64x10^{-6}$	$1.87x10^{-2}$	$1.41x10^{-5}$	$2.44x10^{-5}$	0	0
Health Risk									
HI[g]						$3.32x10^{-5}$	$1.58x10^{-3}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LANL 1996b.

Table M.3.4–62. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site—Mixed Oxide Fuel Fabrication Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	f	$2.1x10^{-6}$	$2.43x10^{-2}$	$2.84x10^{-6}$	$8.08x10^{-4}$	0	0
[Text deleted.]									
VOC (toluene)	0.40	766	f	$8.40x10^{-7}$	$9.70x10^{-3}$	$2.10x10^{-6}$	$1.27x10^{-5}$	0	0
Health Risk									
HI[g]						$4.94x10^{-6}$	$8.21x10^{-4}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LANL 1996b.

Table M.3.4–63. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Mixed Oxide Fuel Fabrication Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	[f]	$3.02x10^{-5}$	$4.72x10^{-2}$	$4.09x10^{-5}$	$1.57x10^{-3}$	0	0
[Text deleted.]									
VOC (toluene)	0.40	766	[f]	$1.21x10^{-5}$	$1.89x10^{-2}$	$3.02x10^{-5}$	$2.47x10^{-5}$	0	0
Health Risk									
HI[g]						$7.11x10^{-5}$	$1.60x10^{-3}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LANL 1996b.

Table M.3.4–64. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—Mixed Oxide Fuel Fabrication Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor (mg/kg/day)	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	f	$7.86x10^{-5}$	$2.36x10^{-2}$	$1.06x10^{-4}$	$7.87x10^{-4}$	0	0
[Text deleted.]									
VOC (toluene)	0.40	766	f	$3.15x10^{-5}$	$9.45x10^{-3}$	$7.86x10^{-5}$	$1.23x10^{-5}$	0	0
Health Risk									
HI[g]						$1.85x10^{-4}$	$8.00x10^{-4}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor (SF)).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LANL 1996b.

Table M.3.4–65. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—Mixed Oxide Fuel Fabrication Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl latate) [Text deleted.]	0.74	30	f	$8.25x10^{-5}$	$4.95x10^{-2}$	$1.12x10^{-4}$	$1.65x10^{-3}$	0	0
VOC (toluene)	0.40	766	f	$3.30x10^{-5}$	$1.98x10^{-2}$	$8.25x10^{-5}$	$2.59x10^{-5}$	0	0
Health Risk									
HI[g]						$1.94x10^{-4}$	$1.68x10^{-3}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions Concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hrs)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LANL 1996b.

Table M.3.4–66. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—Mixed Oxide Fuel Fabrication Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	[f]	$3.84x10^{-6}$	$4.20x10^{-2}$	$5.20x10^{-6}$	$1.40x10^{-3}$	0	0
[Text deleted.]									
VOC (toluene)	0.40	766	[f]	$1.54x10^{-6}$	$1.68x10^{-2}$	$3.84x10^{-6}$	$2.19x10^{-5}$	0	0
Health Risk									
HI[g]						$9.04x10^{-6}$	$1.42x10^{-3}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hrs)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds.

Source: LANL 1996b.

Table M.3.4–67. Risk Assessments From Exposure to Hazardous Chemicals at Generic Site—Mixed Oxide Fuel Fabrication Facility

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Cleaning solvent (butyl lactate)	0.74	30	[f]	$8.25x10^{-5}$	$4.95x10^{-2}$	$1.12x10^{-4}$	$1.65x10^{-3}$	0	0
[Text deleted.]									
VOC (toluene)	0.40	766	[f]	$3.30x10^{-5}$	$1.98x10^{-2}$	$8.25x10^{-5}$	$2.59x10^{-5}$	0	0
Health Risk									
HI[g]						$1.94x10^{-4}$	$1.68x10^{-3}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hrs)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: VOC=volatile organic compounds. Incremental HIs and cancer risks calculated with ORR dispersion factors. Total HIs and cancer risks calculated with 0 No Action.

Source: LANL 1996b.

Table M.3.4–68. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site—Large Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	$2.57x10^{-7}$	$8.50x10^{-4}$	$1.90x10^{-7}$	$1.55x10^{-5}$	0	0
Health Risk									
HI[g]						$1.90x10^{-7}$	$1.55x10^{-5}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hrs)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

Table M.3.4–69. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site—Large Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	$3.82x10^{-8}$	$4.41x10^{-4}$	$2.83x10^{-8}$	$8.02x10^{-6}$	0	0
Health Risk									
HI[g]						$2.83x10^{-8}$	$8.02x10^{-6}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hrs)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

Table M.3.4–70. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Large Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	$5.50x10^{-7}$	$8.58x10^{-4}$	$4.07x10^{-7}$	$1.56x10^{-5}$	0	0
Health Risk									
HI[g]						$4.07x10^{-7}$	$1.56x10^{-5}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-PEL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hrs)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

Table M.3.4–71. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—Large Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	1.43×10^{-6}	4.29×10^{-4}	1.06×10^{-6}	7.81×10^{-6}	0	0
Health Risk									
HI[g]						1.06×10^{-6}	7.81×10^{-6}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hrs)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

Table M.3.4–72. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—Large Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	1.50×10^{-6}	9.01×10^{-4}	1.11×10^{-6}	1.64×10^{-5}	0	0
Health Risk									
HI[g]						1.11×10^{-6}	1.64×10^{-5}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hrs)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

Table M.3.4–73. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—Large Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	$6.99x10^{-8}$	$7.64x10^{-4}$	$5.18x10^{-8}$	$1.39x10^{-5}$	0	0
Health Risk									
HI[g]						$5.18x10^{-8}$	$1.39x10^{-5}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hrs)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

Table M.3.4–74. Risk Assessments From Exposure to Hazardous Chemicals at Hanford Site—Small Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	2.57×10^{-7}	8.50×10^{-4}	1.90×10^{-7}	1.55×10^{-5}	0	0
Health Risk									
HI[g]						1.90×10^{-7}	1.55×10^{-5}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hrs)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

Table M.3.4–75. Risk Assessments From Exposure to Hazardous Chemicals at Nevada Test Site—Small Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	$3.82x10^{-8}$	$4.41x10^{-4}$	$2.83x10^{-8}$	$8.02x10^{-6}$	0	0
Health Risk									
HI[g]						$2.83x10^{-8}$	$8.02x10^{-6}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

Table M.3.4–76. Risk Assessments From Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory—Small Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	$5.50x10^{-7}$	$8.58x10^{-4}$	$4.07x10^{-7}$	$1.56x10^{-5}$	0	0
Health Risk									
HI[g]						$4.07x10^{-7}$	$1.56x10^{-5}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

Table M.3.4–77. Risk Assessments From Exposure to Hazardous Chemicals at Pantex Plant—Small Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	1.43×10^{-6}	4.29×10^{-4}	1.06×10^{-6}	7.81×10^{-6}	0	0
Health Risk									
HI[g]						1.06×10^{-6}	7.81×10^{-6}		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

Table M.3.4–78. Risk Assessments From Exposure to Hazardous Chemicals at Oak Ridge Reservation—Small Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary ME (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	$1.50x10^{-6}$	$9.01x10^{-4}$	$1.11x10^{-6}$	$1.64x10^{-5}$	0	0
Health Risk									
HI[g]						$1.11x10^{-6}$	$1.64x10^{-5}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

Table M.3.4–79. Risk Assessments From Exposure to Hazardous Chemicals at Savannah River Site—Small Evolutionary Light Water Reactor

	Regulated Exposure Limits/Risk Factors			Emissions Inventory		HQ		Cancer Risk	
Chemical	RfC (mg/m^3)	PEL[a] (mg/m^3)	Slope Factor $(mg/kg/day)^{-1}$	Boundary MEI (mg/m^3)	Worker 100 Meters 8 Hours (mg/m^3)	Boundary MEI[b]	Worker 100 Meters 8 Hours[c]	Boundary MEI[d]	Worker 100 Meters 8 Hours[e]
Carbon monoxide	1.35	55	[f]	$6.99x10^{-8}$	$7.64x10^{-4}$	$5.18x10^{-8}$	$1.39x10^{-5}$	0	0
Health Risk									
HI[g]						$5.18x10^{-8}$	$1.39x10^{-5}$		
Cancer risk[h]								0	0

[a] See Table M.3.3–1 for the OSHA-PEL, NIOSH-REL, ACGIH-TLV, and other exposure limit values.

[b] HQ for MEI=boundary annual emissions/RfC.

[c] HQ for workers=100-m, 8-hr emissions/PEL.

[d] Cancer risk for MEI=(emissions concentrations)x(0.286 [converts concentration to dose])x(slope factor [SF]).

[e] Cancer risk for workers=(emissions for 8-hr)x(0.237 [fraction of year exposed])x(0.571 [fraction of lifetime working])x(0.286 [converts concentration to dose])x(SF).

[f] There is no slope factor when the data show the chemical is not a carcinogen, or alternatively when there are either no data or insufficient data to suggest the chemical is a carcinogen.

[g] HI=sum of individual HQs.

[h] Total cancer risk=sum of individual cancer risks.

Note: HIs and cancer risks are based on air emissions of the criteria pollutant, carbon monoxide. Other pollutants, potential hazardous chemicals, are water releases.

Source: LLNL 1996g.

M.4 HUMAN HEALTH STUDIES: EPIDEMIOLOGY

Various epidemiologic studies have been conducted at some of the sites evaluated in this PEIS because of the concern for potential health effects (that is, premature fatalities) associated with the manufacture and testing of nuclear weapons. These studies focus on the DOE workforce and residents of communities, surrounding DOE sites.

M.4.1 BACKGROUND

The health effects associated with ionizing radiation exposure were first published about 60 years ago. Studies published in the 1930s first documented cancer among painters who used radium to paint watch dials back in 1910-1920. Radiation therapy for disease was used since the 1930s, and studies have shown that the risk of cancer was related to the amounts of radiation received. Nuclear weapons research and manufacture and consequent exposure to radiation occurred beginning in the late 1930's. Exposure to radionuclides has changed over time with higher levels occurring in the early days of research and production. Numerous epidemiologic studies have been conducted among workers who manufactured and tested nuclear weapons due to the concern with potential adverse health effects. More recently, concerns about radiologic contaminants off-site have resulted in health studies among communities that surround DOE facilities. The following section briefly gives an overview of epidemiology followed by a review of epidemiologic studies of sites evaluated in the PEIS.

Epidemiology is the study of the distribution and determinants of disease in human populations. The distribution of disease is considered in relation to time, place, and person. Relevant population characteristics should include the age, race and sex distribution of a population, as well as other characteristics related to health, such as social characteristics (for example, income and education), occupation, susceptibility to disease, and exposure to specific agents. Determinants of disease include the causes of disease, as well as factors that influence the risk of disease.

M.4.1.1 Study Designs

Ecologic Studies. Ecologic studies compare the frequency of a disease in groups of people in conjunction with simple descriptive studies of geographical information in, an attempt to determine how health events among populations vary with levels of exposure. These groups may be identified as the residents of a neighborhood, a city, or a county where demographic information and disease or mortality data are available. Exposure to specific agents may be defined in terms of residential location or proximity to a particular area, such as distance from a waste disposal site. An example of an ecologic study is a comparison of the rate of heart disease among community residents by drinking water quality.

The major disadvantage of ecologic studies is that the measure of exposure is based on the average level of exposure in the community, when we are really interested in the individual's exposure. Ecologic studies do not take into account other factors, such as age and race that may also be related to disease. These types of studies may lead to incorrect conclusions, an "ecologic fallacy." For the above example, it would be incorrect to assume that the level of water hardness influences the risk of getting heart disease. Despite the obvious problems with ecologic studies, they can be a useful first step in identifying possible associations between risk of disease and environmental exposures. However, because of their potential for bias they should never be considered more than an initial step in investigation of disease causation.

Cohort Studies. The cohort study design is a type of epidemiologic study frequently used to examine occupational exposures within a defined workforce. A cohort study requires a defined population that can be classified as being exposed or not exposed to an agent of interest, such as radiation or chemicals that influence the probability of occurrence of a given disease. Characterization of the exposure may be qualitative (for example, high, low, or no exposure) or very quantitative (for example, radiation measured in Sieverts [Sv] and

chemicals in parts per million). Surrogates for exposure, such as job titles, are frequently used in the absence of quantitative exposure data.

Individuals enumerated in the study population are followed for a period of time to observe who died. In general overall rates of death and cause-specific rates of death have been assessed for workers at the PEIS sites. Death rates for the exposed worker population are compared with death rates of workers who did not have the exposure (internal comparison), or compared with expected death rates based on the U.S. population or State death rates (external comparison). If the rates of death differ from what is expected, an association is said to exist between the disease and exposure. In cohorts where the exposure has not been characterized, excess mortality can be identified, but these deaths cannot be attributed to a specific exposure, and additional studies may be warranted. More recent studies have looked at other disease endpoints, such as overall and cause-specific cancer incidence (newly diagnosed) rates.

Most cohort studies at PEIS sites have been historical cohort studies, that is, the exposure occurred some time in the distant past. These studies rely on past records to document exposure. This type of study can be problematic if exposure records are incomplete or were destroyed. Cohort studies require extremely large populations that have been followed for many (20-30) years. They are generally difficult to conduct and are very expensive. These studies are not well suited to studying diseases that are rare. Cohort studies do, however, provide a direct estimate of the risk of death from a specific disease, and allow an investigator to look at many disease endpoints.

Case-Control Studies. The case-control study design starts with the identification of persons with the disease of interest (case) and a suitable comparison (control population of persons without the disease). Controls must be persons who are at risk for the disease and are representative of the population that generated the cases. The selection of an appropriate control group is often quite problematic. Cases and controls are then compared with respect to the proportion of individuals exposed to the agent of interest. Case-control studies require fewer persons than cohort studies, and therefore, are usually less costly and less time consuming, but are limited to the study of one disease (or cause of death). These types of studies are well suited for the study of rare diseases and are generally used to examine the relationship between a specific disease and exposure.

M.4.1.2 Definitions

Unfamiliar terms frequently used in epidemiologic studies, including those used in this document, are defined below.

Age, gender, and cigarette smoking are the principal determinants of mortality. Standardization is a statistical method used to control for the effects of age, gender, or other characteristics so that death may be compare among different population groups. There are two ways to standardize rates, the indirect or direct methods. In general the indirect method of standardization is most frequently used.

Indirect standardization: The disease rates in the reference (comparison) population are multiplied by the number of individuals in the same age and gender group in the study population to obtain the expected rate of disease for the study population.

Direct standardization: The disease rates in the study population are multiplied by the number of individuals in the same age and gender group in the reference (comparison) population. This gives the expected rates of disease for the reference population if these rates had prevailed in that group.

Standardized mortality ratio (SMR): The SMR is the ratio of the number of deaths observed in the study population to the number of expected deaths. The expected number of deaths is based on a reference (or comparison population). Death rates for the U.S. population (or State) are most frequently used as the comparison to obtain expected rates. An SMR of 1 indicates a similar risk of disease in the study population

compared with the reference population. An SMR greater than 1 indicates excess risk of disease in the study population compared with the reference group, and an SMR less than 1 indicates a deficit of disease.

[Text deleted.]

Relative risk: The ratio of the risk of disease among the exposed population to the risk of disease in the unexposed population. Relative risks are estimated from cohort studies.

Odds ratio: The ratio of the odds of disease if exposed, to the odds of disease if not exposed. Under certain conditions, the odds ratio approaches the relative risk. Odds ratios are estimated from case-control studies.

Excess Relative Risk (ERR): Per SV is based on a regression model in which the relative risk is assumed to be of the form $1 + \beta Z$, where Z is the cumulative dose in SV.

Standardized Rate Ratio (SRR): A rate ratio in which the numerator and the denominator have been standardized to the same (standard) population distribution.

[Text deleted.]

Healthy Worker Effect: A phenomenon observed in studies of occupational diseases. Workers usually exhibit lower overall death or disease rates compared to the general population, due to the fact that the severely ill and disabled are excluded from employment. Rates from the general population may be inappropriate for comparison if this effect is not taken into consideration.

Confidence Interval (CI): A range of values for a variable of interest, for example, a rate, constructed so that this range has a specified probability of including the true value of the variable. The specified probability is called the confidence level, and the end points of the confidence interval are called the confidence limits.

P, P (Probability) Value: The probability that a test statistic would be as extreme as or more extreme than observed if the null hypothesis were true. The letter P, followed by the abbreviation n.s. (not significant) or by the symbol < (less than) and a decimal notation such as 0.01, 0.05, is a statement of the probability that the difference observed could have occurred by chance, if the groups are really alike, that is, under the *Null Hypothesis*. Investigators may arbitrarily set their own significance levels, but in most biomedical and epidemiologic work, a study result whose probability value is less than 5 percent ($P < 0.05$) or 1 percent ($P < 0.01$) is considered sufficiently unlikely to have occurred by chance to justify the designation "statistically significant."

Multivariate Analysis: A set of techniques used when the variation in several variables has to be studied simultaneously. In statistics, any analytic method that allows the simultaneous study of two or more *Dependent Variables*.

Incidence: (*Syn:incident number*) The number of instances of illness commencing, or of persons falling ill, during a given period in a specified population. More generally, the number of new cases of a disease in a defined population, within a specified period of time. The term incidence is sometimes used to denote *Incidence Rate*.

Incidence Rate: The rate at which new events occur in a population. The numerator is the number of new events that occur in a defined period; the denominator if the population at risk of experiencing the event during this period, sometimes expressed as person-time. The incidence rate most often used in public health practice is calculated by the formula

$$\frac{\text{Number of new events in specified period}}{\text{Number of persons exposed to risk during this period}} \times 10^n$$

In a dynamic population, the denominator is the average size of the population, often the estimated population at the mid-period. If the period is a year, this is the annual incidence rate. This rate is an estimate of the person-time incidence rate, that is, the rate per 10^n person-years. If the rate is low, as with many chronic diseases, it is also a good estimate of the cumulative incidence rate. In follow-up studies with no censoring, the incidence rate is calculated by dividing the number of new cases in a specified period by the initial size of the cohort of persons being followed; this is equivalent to the cumulative incidence rate during the period. If the number of new cases during a specified period is divided by the sum of the person-time units at risk for all persons during the period, the result is the person-time incidence rate.

[Text deleted.]

M.4.2 HANFORD SITE

Surrounding Community

Sever et al. published two studies in 1988 of birth defects in Benton and Franklin Counties in which Hanford is located (AJE 1988a:226-242, 243-254). The prevalence of births of congenital malformed infants for the study period from 1968 to 1980 was the focus of one of the two studies (AJE 1988a:243-254). The congenital malformation rate in the newborn population of 19.6/1000 was not elevated compared with the rates for the States of Washington, Idaho, and Oregon (12.2 / 1000). Neural tube defects were more common than expected in the comparison area (Prevalence=1.72; 95% CI=1.22-2.34). The companion case-control study investigated whether there was any association of parental occupational exposure to external radiation and the risk of congenital malformations among births occurring from 1957 to 1980 (AJE 1988a:226-242). Two defects, congenital dislocation of the hip (12 observed, 7.1 expected, $p<0.025$) and tracheoesophageal fistula (4 observed, 1.4 expected, $p<0.05$), showed statistically significant association with parental employment at Hanford but not with parental radiation exposure.

Neural tube defects showed a significant association with parental preconception external radiation exposure. Other defects studied, including Down's Syndrome, showed no evidence of such an association with parental external radiation exposure.

Jablon et al. examined cancer mortality in populations living near nuclear facilities in the U.S., including Hanford (JAMA 1991a:1403-1408). The study compared cancer mortality in 107 counties with or near 62 nuclear facilities to those in comparison counties with similar demographic characteristics but without nuclear facilities. For Hanford, Benton, Franklin, and Grant Counties were studied. The authors concluded that no general association was detected between residents in a county with a nuclear facility and death attributable to leukemia or any other form of cancer. The authors also noted that interpretation of the study results is limited by the study's ecological approach in which the exposures of individuals are not known.

Worker Studies

Mancuso and Sanders Era

Studies of the Hanford workers began in 1969. Initially, the study of Hanford workers conducted by the University of Pittsburgh was designed to evaluate longevity and disability in workers (HP 1978a:521-538). Hanford workers were compared with their brothers or sisters and to a national sample of employed people from the Social Security Administration continuous work history files. The study included 17,600 males and 3,900

females hired from 1944 through 1971, and considered deaths that occurred from 1944 to October 1972. Workers were categorized as "radiation exposed workers" and "nonexposed workers." In general, the longevity for both males and females within each category were similar, with the largest difference for exposed men who had a nonsignificantly reduced longevity relative to their sibling controls. A second analysis included about 1,800 Hanford workers; 1,800 matched Social Security Administration continuous work history controls; and 3,055 "identified siblings." The disability claim rate for all Hanford workers was significantly lower than the matched Social Security Administration continuous work history controls, as was the rate for radiation-exposed workers.

Analyses were expanded to examine specific causes of death (HP 1977a:369-385). In these analyses, the average cumulative radiation dose for workers dying of a site specific cancer, or group of cancers, was compared with the average radiation dose for all workers dying from all causes.

For deaths from 1944-1972, the following cancer types were reported with higher radiation doses: multiple myeloma, pancreas, brain, kidney, lung, colon, myeloid leukemia, and lymphomas. When the comparison was made against the average dose for all noncancer deaths rather than for all deaths, excess deaths were attributed to radiation for all cancers combined, multiple myeloma, myeloid leukemia, pancreas, and lung.

The authors examined the amount of radiation necessary to double the risk of death for specific cancers. Five cancer categories were concluded to have significant doubling doses: bone marrow cancers, pancreatic cancer, lung cancer, reticuloendothelial neoplasms, and all cancers combined. Next, the authors explored whether the doses received at some specific ages were more important than at other ages, and they concluded that sensitivity to radiation carcinogenesis was high before age 25 years and after age 45 years.

As the analytic methods used in the study were controversial, the Hanford data were re-analyzed by other investigators in 1979, and the analytic methods were reassessed. Hutchinson et al. concluded that analyses of the Hanford data, adjusted for age and calendar year of death, reduced the number of cancer sites for which a radiation dose relationship could be suggested to two: cancer of the pancreas ($p=0.011$ for trend test) and multiple myeloma ($p=0.009$ for trend test) (HP 1979a:207-220). For both of these sites, more deaths were observed than expected only among those with doses exceeding 10 rad. The authors also considered the issue of sensitive ages for radiation exposure and concluded such ages could not be identified without considering lifetime patterns of exposure ages.

In a separate independent analysis, Gofman et al. considered these issues using a different methodological approach (HP 1979a:617-639). The authors reported, consistent with the finding of Hutchinson et al., that differences in radiation dose between those dying of cancer compared with other diseases are found primarily in those receiving 10 rad or more exposure. The authors estimated that radiation caused a 3.5 percent increment in cancer deaths. The doubling dose for cancers overall was estimated at 43.5 rad, consistent with the Mancuso estimate previously reported. The authors did not concur with Mancuso et al. on the suggestion of variation in sensitivity to radiation by age at exposure.

Other methodological problems in the original analyses were identified by Anderson who concluded that the estimate of excess deaths was "implausible," but did agree that the analyses were consistent with some excess deaths from multiple myeloma, cancer of the pancreas, and possibly lung cancer (HP 1978b:743-750). A deficit in leukemia deaths was noted. The Mancuso study was also reviewed by the National Radiological Protection Board (NRPB) in the United Kingdom. This report concluded that the only excess fatal malignancies at Hanford that may be associated with radiation are cancer of the pancreas and multiple myeloma (NRPB 1978a). The report indicated that further investigation was necessary, as the effect could have been due to other carcinogens.

In 1978, Kneale, Stewart, and Mancuso updated the Hanford study with death information to 1977 (IAEA 1978a:387-412). The authors concluded that approximately 5 percent of the cancer deaths at Hanford were

radiation- induced and that these extra deaths were probably concentrated among cancers of the bone marrow, lung, and pancreas.

In 1981, Kneale et al. again reported on the Hanford data, using a different analytic technique (BJIM 1981a:156-166). The cohort included radiation-monitored employees up to 1975 and deaths through 1977. The authors estimated a linear model doubling dose at 15 rads, estimated the latency to be 25 years, and rejected the hypothesis that all age at exposure groups are equally sensitive to radiation.

In 1993, Kneale and Stewart published a re-analysis of the Hanford data (AJIM 1993a:371-389). The study included 27,395 male and 8,473 female workers who worked between 1944 and 1978 and had been monitored for radiation. Deaths were determined through 1986. In this analysis, all cancers listed on the death certificate were included in the study. The authors concluded that the Hanford data supported a doubling dose from 8.6 to 44.8 mSv, with a nonlinear dose response, in contrast to the prior study. The estimated proportion of radiation-caused cancers ranged from 12.5 percent to 50.9 percent, the cancer latency period was estimated to be 14-17 years, and the most radiosensitive ages for exposure were over 58 years of age.

In 1996, Stewart and Kneale again investigated the relationship between age at exposure and cancer risk in the Hanford data using monitored workers described in the 1993 analysis (OEM 1996a:225-230). The data were adjusted to account for the effects of date of birth and date of death. The workers were grouped by average doses into intervals of when dose was received to allow for cancer latency and age groups to isolate the most sensitive age at exposure.

The authors concluded that sensitivity to carcinogenic effects of radiation increase progressively with age during adult life and providing that the dose is too small to produce many cell deaths, the ratio of leukemias to solid tumors is no different for radiogenic and idiopathic tumors in contrast with the atomic bomb survivor data, which found a strong association with leukemia.

Simultaneously, other researchers were reporting the results of studies of the Hanford workers. In 1979, Gilbert and Marks reported the results of analyses of the mortality experience of Hanford workers from the time the plant was built through April 1974 (RR 1979a:122-148). The cohort consisted of 20,842 white males hired before 1966 with a focus on 13,075 employed at least 2 years. Mortality rates were not higher than expected among workers for all causes of death, all malignant neoplasms, diseases of the circulatory system, accidents, or other causes. When individual cancer sites were considered, only malignant neoplasm of the pancreas (SMR=130, $p<0.05$) among individuals who had worked less than 2 years at Hanford was significantly elevated.

To determine if there was an association with external radiation exposure, the mortality experience of workers who had been monitored for radiation was compared with all workers in the study. Among white males monitored for radiation, there was a statistically significant trend between mortality and increasing radiation dose for pancreatic cancer (4 observed, 2.5 expected; $p=0.07$ for trend test) and multiple myeloma (12.4 observed, 3.6 expected; $p=0.006$ for trend test) when lagged 2 years for cancer development. When exposures were lagged for 10 years, only deaths due to multiple myeloma (6.2 observed, 1.5 expected; $p=0.006$ for trend test) showed a trend with cumulative occupational exposure to ionizing radiation.

The mortality experience of the Hanford cohort was updated the following year (RR 1980a:740-741). Three hundred and ninety additional deaths among white males, occurring to May 1977, were included in the study. Results were similar to those previously reported.

The cohort was again updated in 1983 (RR 1983a:211-213). This analysis was expanded to include workers hired during and after 1965 and employed 2 or more years. In this analysis, the significant positive trend between increasing dose and pancreatic cancer disappeared. The significant trend for multiple myeloma remained.

The next update of the cohort mortality study for Hanford was published in 1989 (HP 1989a:11-25). The cohort consisted of 31,500 males and 12,600 females first employed through 1978. Deaths from 1944-1981 were analyzed for the entire cohort. Death certificates for radiation-monitored workers who died in the State of Washington between 1982-1985 were also obtained.

Overall, Hanford workers continued to have death rates substantially below the general U.S. population. Among female workers not monitored for external radiation, there were significantly more deaths for the category of accidents, poisonings, and violence than expected (SMR=1.38, p=0.05). Monitored females had a higher rate of death from diseases of the musculoskeletal system and connective tissues than expected (SMR=2.33, p=0.05). When individual cancer sites were considered, males not monitored for radiation were observed to have significantly higher rates of death from pancreatic cancer (SMR=1.69, p=0.01) and solid tumors (SMR=1.56, p=0.05) than expected.

The risk analyses for trends by radiation dose were lagged for 2- and 10-year induction periods, and included deaths from 1947 through 1981. No correlation between mortality and dose was seen when the analyses were lagged for 2 years. When dose was lagged 10 years, there was a suggestive trend between dose and deaths from all cancers, genital cancer among females, and multiple myeloma.

Although the number of workers at Hanford with Pu deposition was limited, data on these workers were analyzed separately to examine major cause of death categories by exposure categories. No trends between increasing death rates and increasing deposition Pu were detected. As cause of death information was available through 1985 for those dying in the State of Washington, additional analyses were conducted. Four additional deaths from multiple myeloma were observed, but the trend with dose was not statistically significant.

The Hanford cohort was once again updated by Gilbert et al. in 1993 (HP 1993a:577-590). This analysis included workers who were employed 6 months or more and were first employed through 1978. Deaths among the entire cohort that occurred from 1944 through 1986, and through 1989 for monitored workers who died in the State of Washington, were analyzed. This data set included 456 workers not previously studied and eliminated 265 individuals who never actually worked at the site. Radiation dose records from construction worker files were also added to the data set.

When the death rates for Hanford workers were compared with the general U.S. population, monitored females continued to have an elevated rate of deaths from musculoskeletal system and connective tissue conditions (SMR=2.06, p=0.05) noted in the 1989 paper. As previously reported, unmonitored males continued to have higher death rates for pancreatic cancer (SMR=1.57, p=0.05) and the category noted as miscellaneous solid tumors (SMR=1.47, p=0.05).

As in previous papers, the data were then analyzed to examine trends between the risk of death and external radiation dose lagged for 2 and 10 years. Statistically significant trends were seen when the dose was lagged 10 years for deaths due to pancreatic cancer (SMR=1.59, p=0.065), Hodgkin's disease (SMR=1.80, p=0.038), and multiple myeloma (SMR=1.54, p=0.10). Deaths due to liver cancer (SMR=1.93, p=0.065) were detected when the exposures were lagged for 2 years. Additional analyses were conducted, which included "all" cancers noted on the death certificate, in addition to those reported on the death certificate as the "underlying cause of death." The investigators concluded that there were no additional cancers that showed significant correlations with dose as compared with the previous analysis that used the underlying cause of death.

Hanford workers have been included in several studies that have examined occupational risks across the nuclear complex, both in the U.S. and internationally. These combined studies have been undertaken in an attempt to increase the statistical power of the studies to detect the effects of low-level chronic radiation exposure.

A combined site mortality study included workers from Hanford, Oak Ridge, and Rocky Flats (RR 1993a:408-421). Earlier analyses of these cohorts indicated that risk estimates calculated through

extrapolation from high-dose data to low-dose data did not seriously underestimate risks of exposure to low-dose radiation (AJE 1990a:917-927; RR 1989a:19-35). The updated analyses were performed in order to determine whether the extrapolated risks represented an over-estimation of the true risk at low doses. The study population consisted of white males employed at one of the three facilities for at least 6 months and monitored for external radiation. The Hanford population also included females and nonwhite workers. The total population dose was 1237 Sv. Analyses included trend tests for site-specific cancer deaths and several broad noncancer categories. Statistically significant trends were noted for cancer of the esophagus (p=0.015 for trend test), cancer of the larynx (p=0.019 for trend test), and Hodgkin's disease (p=0.048 for trend test). These cancers were not related to radiation exposure levels in previously published studies. Excess relative risk models were calculated for the combined DOE populations and for each DOE site separately. Without exception, all risk estimates included the possibility of zero risk (that is, the confidence interval for the risk coefficient went from below zero to above zero). There was evidence of an increase in the excess relative risk for cancer with increasing age in the Hanford and Oak Ridge populations; both populations showed significant correlations of all cancer with radiation dose among those 75 years and older.

Multiple myeloma (p=0.103 for trend test) was the only cancer found to exhibit a statistically significant correlation with radiation exposure that was based on the excess previously reported among Hanford workers.

An international effort to pool data from populations exposed to external radiation included Hanford workers, as well as workers at Rocky Flats and Oak Ridge in the U.S. and other radiation worker populations in Canada and Britain (RR 1995a:117-132). The cohort compared 95,673 workers employed 6 months or longer and the population dose was 3,543.2 Sv. There was no evidence of an association between radiation dose and mortality from all causes or from all cancers. There was a significant dose-response relationship with leukemia, excluding chronic lymphocytic leukemia (ERR=2.18 per Sv; 90 percent CI 0.1-5.7) and multiple myeloma (ERR not computed; 44 observed; p=0.037 for trend test). The study results do not suggest that current radiation risk estimates for cancer at low levels of exposure are appreciable in error.

Epidemiologic Studies

DOE's Office of Epidemiologic Studies has implemented an epidemiologic surveillance program at Hanford to monitor the health of current workers. This program will evaluate the occurrence of illness and injury in the workforce on a continuing basis and the results will be issued in annual reports. The implementation of this program will facilitate an ongoing assessment of the health and safety of Hanford's workforce and will help identify emerging health issues.

Currently operational at a number of DOE sites, including production sites and research and development (R&D) facilities, epidemiologic surveillance uses routinely collected health data including descriptions of illness resulting in absences lasting 5 or more consecutive workdays, disabilities, and OSHA recordable injuries and illnesses abstracted from the OSHA 200 log. These health event data, coupled with demographic data about the active workforce at participating sites, are analyzed to evaluate whether particular occupational groups are at increased risk of disease or injury when compared with other workers at a site. As the program continues and data for an extended period of time become available, time trend analysis will become an increasingly important part of the evaluation of worker health. Monitoring the health of the workforce provides a baseline determination of the illness and injury experience of workers and a tool for monitoring the effects of changes made to improve the safety and health of workers. Noteworthy changes in the health of the workforce may indicate the need for more detailed study or increased health and safety measures to ensure adequate protection for workers.

Memorandum of Understanding

The Hanford Environmental Dose Reconstruction (Hanford Environmental Dose Reconstruction) Project was undertaken by DOE to estimate the radiation dose that people may have received from nuclear operations at

Hanford (WA Ecology 1994a). In 1990, DOE entered into a Memorandum of Understanding with the Department of Health and Human Services to conduct health studies at DOE sites. The Centers for Disease Control and Prevention's National Center for Environmental Health is responsible for dose reconstruction studies and has managed the Hanford Environmental Dose Reconstruction Project since that time.

The study determined that the largest doses to offsite populations were from iodine-131 released into the air in large quantities between December 1944 and December 1947. The most important radiation exposure pathway for iodine-131 was the consumption of milk produced by cows grazing on pasture downwind of Hanford. The doses to the thyroid gland of individuals near Hanford were larger than those farther from the site, and depended on the iodine-131 deposition and quantity of milk consumed at each location.

A second pathway of potential importance was the Columbia River. Releases to the river from Hanford were highest in the years 1956-1965, which was the height of reactor operations at Hanford. The most important means of exposure from the river pathway was the consumption of fish by local residents. However, maximum doses for the heaviest consumption of fish were estimated to be about half the dose an individual normally receives each year from all sources of radioactive materials in the U.S. environment. This study is in its final stages and will be completed shortly.

A study in the United Kingdom linked a father's exposure to ionizing radiation in the workplace with the subsequent risk of leukemia in his children (RR=6.42; 95 percent CI=1.57-26.3) (BMJ 1990a:423-434). A study was undertaken to replicate this study in other similar populations. Hanford was one of three sites selected for study by NIOSH. The population under study consists of residents of Benton and Franklin Counties. The study includes leukemia, non-Hodgkin's lymphoma, and central nervous system tumors diagnosed from 1957-1991 in children under the age of 15. The study is expected to be completed in 1996.

A number of studies of the Hanford workforce are underway, directed by NIOSH, under the Memorandum of Understanding.

Researchers at the University of Texas Medical Branch are conducting a cohort mortality study of female nuclear weapons workers exposed to low levels of ionizing radiation and other workplace physical and chemical agents at 12 DOE facilities, including Hanford. The study will be completed in 1997.

A study of multiple myeloma among workers exposed to ionizing radiation and other physical and chemical agents is being conducted by the University of North Carolina at various DOE sites, including Hanford. The study is expected to be completed in 1996-1997.

An epidemiologic evaluation of childhood leukemia and paternal exposure to ionizing radiation is being conducted by Battelle Columbus. The study will collect information of selected childhood cancers, residential history, and the father's exposure to ionizing radiation. Completion of the study is expected in 1996-1997.

An epidemiologic study of leukemia at four DOE sites is being conducted by NIOSH. Sites selected for the study include Hanford.

Boston University is conducting a health-effects-of-job-stress study associated with the redesign and reconfiguration of the nuclear weapons industry. This study will identify how specific practices for managing change affect individual health and work performance and to recommend ways to minimize health effects in the future. Hanford is one of seven DOE facilities included in this multisite study. The study will begin in 1996 and is scheduled for completion in 1999.

A comprehensive occupational health surveillance project at Hanford will design and implement a health surveillance system at the site. The University of Washington and the Hanford Environmental Health Foundation will conduct the study. Completion is expected in 1998.

A study of heat stress among carpenters at Hanford will assess the real effects of heat stress on physiologic functions in a real work situation. The study is being conducted by Michigan State University and the United Brotherhood of Carpenters' Health and Safety Fund. The study is scheduled for completion in 1999.

Other Related Studies

The Hanford Thyroid Disease Study began in 1988 under the management of Centers for Disease Control and will be completed in 1998 (HF FHCRC 1995a). It was initiated based on preliminary information from the Hanford Environmental Dose Reconstruction Project indicating that releases of radioactive iodine-131 from Hanford in its early years may have produced exposures to human thyroids large enough to have affected the gland's functioning. About 3,200 people living at various distances from Hanford have been located and are now being examined for thyroid disease and thyroid function. These people were selected because as infants during the years of peak releases of iodine-131 they were the most sensitive population group. Information gathered from the individuals in the study about their diet, milk consumption, age, sex, and place of residence will be used to calculate individual doses received by the thyroid gland using the models developed in the Hanford Environmental Dose Reconstruction Project. The study results are expected in 1998.

M.4.3 NEVADA TEST SITE

Surrounding Communities. Above ground testing of nuclear weapons at the NTS Test Range Complex in southern Nevada between 1951 and 1958 resulted in the dissemination of radioactive fallout over southeastern Nevada and southwestern Utah through wind dispersion. Several epidemiologic studies have been conducted to investigate possible health effects of low-level radiative fallout on residents of these States. These studies focused on leukemia and thyroid disease in children downwind of NTS.

A series of ecologic studies showed equivocal results in potentially exposed children. A cross sectional review of thyroid modularity among teenage children reported by Weiss et al. found no significant difference in the frequency of nodules among "potentially exposed" and "not exposed" children (AJPH 1971a:241-249). Exposure was defined in terms county of residence. Rallison et al. reported no significant difference in any type of thyroid disease between Utah children exposed to fallout radiation in the 1950s and control groups drawn from Utah and Arizona (AJM 1974a:457-463; JAMA 1975a:1069-1072).

To investigate the possible relationship between childhood leukemia and radioactive fallout, Lyon et al. conducted a mortality study of Utah-children under 15 years old who died in Utah between 1944 and 1975 (NEJM 1979a:397-402). Lyon et al. selected this age group because of the reported increased susceptibility of children to the neoplastic effects of radiation and the lack of a comparison group over 14 years of age with suitable low exposures. Lyon et al. obtained death certificates from the Utah vital statistics registrar and based on year of death, categorized decedents into either high (fallout years of 1951-1958) or low exposure periods (combined pre-fallout years of 1944-1950 and post-fallout years of 1959-1975). From estimated fallout patterns contained in maps of 26 tests, Lyon et al. categorized 17 southern rural counties high fallout area and the remaining northern urban counties as low fallout areas. Age-specific mortality rates derived for deaths which occurred in the combined low exposure periods were compared with those in the high exposure period. For reasons unknown, leukemia mortality during the low exposure periods in high fallout counties was half that of the United States and Utah. A significant excess of leukemia occurred among children statewide who died during the high fallout period compared to those who died during the low fallout periods (SMR=1.40, 95 percent CI=1.08-1.82, $p<0.01$). This excess was more pronounced among those who resided in the high fallout area (SMR=2.44, 95 percent CI=1.18-5.03). No pattern was found for other childhood cancers in relation to fallout exposure. A radiation dosage was not available, and the effect of migration were not determined for this study.

Beck and Krey reconstructed exposure of Utah residents studied by Lyon et al. (Science 1983a:18-24) to external gamma-radiation from NTS fallout through measurements of residual cesium-137 and Pu in soil

(NEJM 1979a:397-402). Beck and Krey found that residents in southwest Utah closest to NTS received the highest exposures, but noted that residents of urban northern areas received a higher mean dose and a significantly greater population dose than did residents of most counties closer to the test site. Northern Utah residents received higher average bone doses than southern Utah residents; therefore, the distance from NTS should not be the sole criteria for dividing the State into geographic subgroups for the purpose of conducting epidemiologic studies. Beck and Krey concluded that bone doses to southern Utah residents were too low to account for the excess leukemia deaths identified by Lyon et al. They also determined that bone and whole body doses from NTS fallout were small relative to lifetime doses most Utah residents receive from background radiation, and that it was unlikely that these exposures would have resulted in any observed health effects.

Land et al. attempted to confirm the association between leukemia and fallout reported by Lyon et al. using cancer mortality data from the National Center for Health Statistics for the period 1950 through 1978 (NEJM 1979a:397-402); (Science 1984a:139-144). No statistically significant differences in mortality from leukemia or other childhood malignancies between northern (SRR=1.52, 90 percent CI=1.24-1.87) and southern Utah (SRR=1.49, 90 percent CI=0.88-2.51) were observed. The observed difference in leukemia mortality between the border and interior counties was opposite in direction to that reported by Lyon et al. Results indicated a downward trend in childhood leukemia mortality over time. Eastern Oregon and the State of Iowa also were selected for comparison with Utah. The leukemia mortality rate for eastern Oregon was higher (SRR=1.81, 90 percent CI=1.07-3.07), and Iowa lower (SRR=1.16, 90 percent CI=1.02-1.31) than the rate for Utah (SRR=1.49, 90 percent CI=0.88-2.51. Land et al. concluded that these results suggest that the association reported by Lyon et al. merely reflects an unexplained low leukemia rate in southern Utah for the period 1944 to 1949.

Another study that assessed the development of cancer among individuals potentially exposed to radioactive fallout has been reported by Rallison et al. (HP 1990c:739-746). This study examined the thyroid neoplasia risk in a cohort of children born between 1947 and 1954 in two counties near nuclear test sites, one in Utah and one in Nevada. A comparison group of Arizona children presumed to have no fallout exposure was also evaluated. The children (11 to 18 years of age) were examined between 1965 and 1968 for thyroid abnormalities and were reexamined in 1985 and 1986. Children living in the nuclear testing (Utah/Nevada) area had a higher rate of thyroid neoplasia (5.6/1000 for phase 1 and 24.6/1000 for phase 2) than the comparison children in Arizona (3.3/1000 for phase and 20.2/1000 for phase 2), but the differences were not statistically significant (RR=1.2, p=0.65 for phase 2). The authors concluded that living near the NTS in the 1950s has not resulted in a statistically significant increase in thyroid neoplasms.

A study by Johnson examined cancer incidence in a cohort of families that were members of the Church of Jesus Christ of Latter-Day Saints in southwest Utah near the NTS (JAMA 1984b:230-236). The study compared cancer incidence among all Utah members of the Church of Jesus Christ of Latter-Day Saints during the period 1967-1975 with cancer incidence among two exposed populations: persons residing in a "high fallout area"' and an "exposure effects group" residing in a broader area that received less intense exposure from radioactive fallout. Limitations of the study include: the inability to locate 40 percent of the defined population; the lack of verifying the reported diagnosis of cancer; and the inability to interview a comparable control group.

Cancer incidence for both exposed groups was compared with that of all Utah members of the Church of Jesus Christ of Latter-Day Saints for two time periods, 1958-1966 and 1972-1980. Johnson found an apparent increased incidence of leukemia (19 cases, 3.6 expected, p=0.01) and cancers of the thyroid (6 observed, 1.4 expected, p=0.01) and bone (3 observed, 0.3 expected, p=0.01) for residents of the high fallout area for both time periods. Additional analyses suggested that a higher proportion of the cancers among exposed groups were in radiosensitive tissues and the proportional excess increased with time compared with all Utah members of the Church of Jesus Christ of Latter-Day Saints. The ratio of radiosensitive cancers to all other cancers from 1959-1966 was 24 percent higher among the "high fallout area" group and 29.6 percent higher among those in the "fallout effects" group. For 1972-1980, the ratio was 53.3 percent higher in the "high fallout area" group and 300 percent higher in the "fallout effects" group.

Machado examined cancer mortality rates of a three-county region in southwestern Utah in comparison to the remainder of Utah (AJE 1987c:44-61). There was no excess risk of cancer mortality in southwest Utah, with the exception of leukemia (OR=1.45, 90 percent CI=1.18-1.79 with Utah controls), which showed a statistically significant excess for all ages combined, and for children age 0-14. In fact, mortality from all cancer sites combined was lower in southwest Utah than the remainder of the State. The authors noted that their findings, including those for leukemia, were inconsistent with the cancer incidence study conducted by Johnson (JAMA 1984b:230-236).

Archer measured soil, milk, and bone strontium-90 levels to identify states with high-, intermediate and low-fallout contamination (AEH 1987a:263-271). He then correlated the deaths from radiogenic and nonradioactive leukemias with the time periods of above ground nuclear testing both in the United States and Asia. The results show that leukemia deaths in children were higher in States with high exposure and lower in States with less exposure. He showed that leukemia deaths in children peaked approximately 5.5 years following nuclear testing peaks. The last leukemia peak in the United States occurred in 1968 to 1969, 5.5 years after the last year of a 3-year period of intensive testing in Asia. The increases were seen in the radiogenic leukemias (myeloid and acute leukemias), and not with "all other leukemias."

Kerber et al. updated a previously identified cohort of children living in portions of Utah, Nevada, and Arizona, to estimate individual radiation doses and determine thyroid disease status through 1985-1986 (JAMA 1993a:2076-2082). Of the 4,818 children originally examined between 1965-1970, 2,473 were included in the followup exam. Outcomes of interest included thyroid cancers, neoplasms, and nodules based on physical examinations of the thyroid. Exposure of the thyroid to radioiodines was based on radionuclide deposition rates provided by DOE and surveys of milk producers. Children with questionable findings were referred to a panel of endocrinologists for further examination. The authors reported an excess number of thyroid neoplasms (combined benign and malignant) and a positive dose-response trend for neoplasms, both of which were statistically significant. The authors also reported a positive dose-response trend for thyroid nodules, not statistically significant, and a positive dose-response trend for thyroid carcinomas with marginal statistical significance. The authors estimated that an excess of between 1 and 12 neoplasms (between 0 to 6 excess malignancies was probably caused by exposure to radioiodines from the nuclear weapons testing. A letter to the editor criticized Kerber et al. for relying on food histories obtained 22 years after the fact to depict radioiodine intake, and for the untested modeling approach-for determining dose to the thyroid (JAMA 1994a:825-826). These concerns were addressed by Kerber et al., which acknowledged the uncertainties in the dose estimates, but concluded that their estimates were conservative (JAMA 1994a:826).

Till et al. estimated doses to the thyroid of 3,545 subjects who were exposed to radioiodine fallout from NTS (HP 1995a:472-483). The U.S. Public Health Service first examined this cohort for thyroid disease between 1965-70 and later in 1985-86. Till et al. assigned individual doses based on age, residence histories, dietary histories, and lifestyle. Individualized dose and uncertainty was combined with the results of clinical examinations to determine the relationship between dose from NTS fallout and thyroid disease incidence.

Workers. Military personnel and civilian employees of the Department of Defense observed and participated in maneuvers at the NTS Test Range Complex during above ground tests. An excess number of leukemia cases was reported (9 cases, 3.5 expected) among the 3,224 men who participated in military maneuvers in August 1957 at the time of the nuclear test explosion "Smoky" (JAMA 1980a:1575-1578). The participants were located and queried on their health status, diseases, or hospitalizations as of December 1981. Various Federal records systems were linked, including clinical files, and next of kin was queried about cause of death for those participants who were deceased. Exposure information was available from film badged records, and the mean gamma dose for the entire cohort was 466.2 mrem. In a later report of the same cohort, the number of incident cases of leukemia had increased to 10 with 4 expected (O/E=2.5, 95 percent CI=1.2-4.6) (JAMA 1983a:620-624). No excess in "total cancers" was observed, however. In addition, four cases of polycythemia vera were reported where 0.2 was expected (JAMA 1984a:662-664). The excess in leukemia cancer incidence and mortality appear to be limited to the soldiers who participated in "Smoky."

The leukemia excess was not observed in a National Research Council mortality study of soldiers exposed to five series of tests at two sites: Nevada Test Site (PLUMBBOB) and the Pacific Proving Ground (DOE 1985b). The National Research Council reported that the number of leukemia cases in "Smoky" was greater, but the increase was considered nonsignificant when analyzed with the data from the other four tests. In 1989, however, it was discovered that the roster of the atomic veterans cohort on which the National Research Council based its 1985 study contained misclassification errors. As a result, this study is being reanalyzed, and the National Research Council anticipates publishing the new results by 1997.

M.4.4 IDAHO NATIONAL ENGINEERING LABORATORY

Surrounding Communities

Jablon et al. examined cancer mortality in populations living near nuclear facilities in the U.S., including INEL in Idaho (JAMA 1991a:1403-1408). The study compared cancer mortality from 1950-1984 in 107 counties with or near 62 nuclear facilities with cancer mortality in control counties without nuclear facilities. Cancer mortality for Bingham, Butte, and Jefferson Counties, where INEL is located, was compared with nine control counties in the same region, with similar demographic characteristics. The authors concluded that no general association was detected between residents in a county with a nuclear facility and death attributable to leukemia or any other form of cancer. The authors noted that interpretation of the study results is limited by the study's ecological approach in which the exposures of individuals are not known.

Cancer morbidity and mortality data in two additional counties near INEL, Clark and Minidoka, were reviewed by the Idaho Department of Health and Welfare (ID DHW 1991a; ID DHW 1991b). Clark County lies northeast of INEL and Minidoka County southwest of INEL. Cancer death rates were examined for the years 1950-1989 and cancer incidence rates for the years 1978-1987 to determine if any significant trends in cancer morbidity and mortality could be observed in these counties compared with the entire State. No statistically significant differences in age- and sex-adjusted death rates were observed in either county.

When cancer incidence data were considered, the overall cancer incidence rate in Clark County was higher than expected based on the State of Idaho's experience. When the Clark County data were examined by primary site, only two sites were found to be significantly higher than expected—female breast cancer (8 cases observed vs. 3.2 expected, p=0.05) and lip cancer (3 cases observed vs. 0.4 expected, p=0.05). In Minidoka County, there was no increase in overall cancer incidence rate compared with the entire State. Examination by primary sites in Minidoka County, however, showed three cancer sites were found to be increased—cancer of the stomach (20 cases observed vs. 11.6 expected, p=0.05), lip (23 cases observed vs. 8 expected, p=0.01), and uterus (40 cases observed vs. 24.2 expected, p=0.01). These studies also suffered from the limitations inherent in ecological studies. In addition, the authors noted that too many comparisons were made for "significant" results and that the data for Clark County, with an estimated population of 800, were too small to make meaningful analyses.

State Health Agreement Program

In 1991, INEL completed a historical dose reconstruction study to examine the impact of radioactive materials released to the environment during INEL's past operations. Subsequently, under the State Health Agreement program managed by the DOE Office of Epidemiologic Studies, a grant was awarded to the State of Idaho to convene an expert panel to review the final dose reconstruction report. The State panel evaluated the environmental transport and dose assessment models used for the dose reconstruction and recommended that additional work, involving public participation, be done to more fully examine offsite consequences (ID DHW 1993a).

Workers

No occupational epidemiologic studies have been completed at INEL to date.

Memorandum of Understanding

DOE entered into a Memorandum of Understanding with the Department of Health and Human Services to conduct health studies at DOE sites, and the Centers for Disease Control and Prevention became responsible for conducting dose reconstructions in several host States, including Idaho. Under the Memorandum of Understanding, Centers for Disease Control began a phased approach to determine the need for an expansion of the dose reconstruction work initiated earlier and reviewed by the State of Idaho. The first part, data identification retrieval, was completed in 1995. No decision about the need for additional phases of a dose reconstruction for INEL has yet been reached. NIOSH is responsible for worker studies and is currently conducting a cohort mortality study of the workforce with a projected completion date of September 1997 (IN DOE 1995e).

Epidemiologic Studies

DOE's Office of Epidemiologic Studies has implemented an epidemiologic surveillance program at INEL to monitor the health of current workers. This program will evaluate the occurrence of illness and injury in the workforce on a continuing basis and the results will be issued in annual reports. The implementation of this program will facilitate an ongoing assessment of the health and safety of INEL's workforce and will help identify emerging health issues.

Currently operational at a number of DOE sites, including production sites and R&D facilities, epidemiologic surveillance uses routinely collected health data including descriptions of illness resulting in absences lasting 5 or more consecutive workdays, disabilities, and OSHA recordable injuries and illnesses abstracted from the OSHA 200 log. These health event data, coupled with demographic data about the active workforce at the participating sites, are analyzed to evaluate whether particular occupational groups are at increased risk of disease or injury when compared with other workers at a site. As the program continues and data for an extended period of time become available, time trend analysis will become an increasingly important part of the evaluation of worker health. Monitoring the health of the workforce provides a baseline determination of the illness and injury experience of workers and a tool for monitoring the effects of changes made to improve the safety and health of workers. Noteworthy changes in the health of the workforce may indicate the need for more detailed study or increased health and safety measures to ensure adequate protection for workers.

M.4.5 PANTEX PLANT

Surrounding Communities. A June 1994 study by the Texas Cancer Registry, Texas Department of Health, showed significant increases in prostate cancer mortality among Potter County and Randall County males, and leukemia mortality among Carson County males during the period 1981-1992 (TX DOH 1994a). There were no statistically significant increases observed in site-specific cancer mortality among females during this period. For cancer incidence during the period 1986-1992, no statistically significant excesses in males were seen; however, cancer of the prostate was slightly elevated in Potter/Randall County males. Analysis of the four major cell-specific types of leukemia, showed a significant excess in the incidence of chronic lymphocytic leukemia among Potter/Randall County females. This study was conducted in Carson, Potter, and Randall Counties, which are located near Pantex. This study focused only on cancers of the breast, prostate, brain, thyroid, and leukemia, which were of specific concern to citizens in the area. Other radiation-associated cancers such as bone and lung, were not included in this study. Although prostate cancer and chronic lymphocytic leukemia have not been linked to radiation exposure, further follow-up to this study was recommended.

Workers. An epidemiologic study of Pantex workers was published by Acquavella (HP 1985a:735-746). This study compared total and cause-specific mortality for Pantex workers employed between 1951 and December 31, 1978, with expected cause-specific mortalities based on U.S. death rates. Significantly fewer deaths were observed in the workforce than would be expected based on U.S. death rates for the following causes of death: all cancers (SMR=0.72; 95 percent CI=0.64 0.81),arteriosclerotic heart disease (SMR=0.75; 95 percent CI=0.61-0.91), and digestive diseases (SMR=0.46; 95 percent CI=0.22-0.85). No specific causes of death occurred significantly more frequently than expected. Slightly elevated mortality ratios were observed for brain cancer (SMR=1.36; 95 percent CI=0.37-3.47) and leukemia (SMR=1.28; 95 percent CI=0.35-3.27); neither excess was statistically significant. The four deaths from brain cancer all occurred among those who had worked at the plant less than 5 years. The four deaths from leukemia occurred with equal frequency among those who had worked at the plant a short time and those who had worked more than 15 years.

Memorandum of Understanding. A follow-up of the 1985 mortality study of the Pantex workforce is planned. The update will be conducted by NIOSH as part of a research program funded by DOE under a Memorandum of Understanding with the Department of Health and Human Services. The followup study is scheduled to commence either in late 1996 or early 1997. In addition, female workers at Pantex will be included in a NIOSH funded multisite study of mortality among female nuclear weapons workers.

Epidemiologic Surveillance. DOE's Office of Epidemiologic Studies' Epidemiologic Surveillance Program was implemented at Pantex in 1993 in order to monitor the health of current workers. This program evaluates the occurrence of illness and injury in the workforce on a continuing basis and issues the results of the ongoing surveillance in annual reports. The program facilitates an ongoing assessment of the health and safety of the site's workforce and helps to identify any emerging health issues in a timely manner. Monthly data collection began on January 1, 1994, and the results of the first complete year of epidemiologic surveillance will be presented to workers and other site stakeholder groups in spring 1996.

Currently operational at a number of DOE sites, including production sites and R&D laboratories, epidemiologic surveillance makes use of routinely collected health data including descriptions of illness resulting in absences lasting five or more consecutive workdays, disabilities, and OSHA recordable injuries and illnesses abstracted from the OSHA 200 log. These health event data coupled with demographic data about the active workforce at the participating sites, are analyzed to evaluate whether particular occupational groups are at increased risk of disease or injury when compared with other workers at a site. As the program continues and data become available for an extended period of time, trend analysis will become an increasingly important part of the evaluation of workers health. Monitoring for changes in the health of the work force provides both a baseline determination of the illness and injury experience of workers and a tool for monitoring the effects of changes made to improve the safety and health of workers. Noteworthy changes in the health of the workforce may indicate areas in need of more detailed study or increased health and safety measures to ensure adequate protection for workers.

M.4.6 OAK RIDGE RESERVATION

Surrounding Communities. The population-based National Cancer Institute mortality survey for selected nuclear facilities (NIH Publication No. 90-874; JAMA 1991a:1403–1408) examined the cancer mortality in communities near several nuclear facilities, including Anderson and Roane counties. No excess cancer mortality was observed in the population living in the exposed counties when compared to the U.S. white male population nor when compared to the population of the control counties (Blount, Bradley, Coffee, Jefferson, Hamblen, TN, and Henderson, NC), nor when time trends were assessed.

Tennessee Medical Management, Inc. used data from the Tennessee Cancer Reporting System to compare mortality and incidence data for counties near Oak Ridge, Tennessee, for the 3-year period 1988-1990 to the U.S. population (TMM 1993a). For Oak Ridge, total deaths from all causes was significantly lower than expected. For Anderson County, the observed number of deaths from uterine cancer and from cancer of

respiratory and intrathoracic organs was statistically greater than expected and the number of deaths from brain cancer, breast cancer, and all the other sites category were lower than expected for Anderson County. For Roane County, the number of deaths from cancer of the respiratory and intrathoracic organs was statistically greater than expected; the number of deaths from cancer of the digestive organs and the peritoneum, and from uterine, lip, oral cavity, and pharynx cancer was lower than expected.

Tennessee Medical Management, Inc. examined new (incident) cancer cases and identified the following statistically significant: for Anderson County, the observed numbers of cases of cancer of the prostate and of cancer of the lung and bronchus were greater than expected. Leukemia, stomach and small intestine cancers, and cancers of the colon and intestinal tract were lower than expected. For Roane County, the number of cases of cancer of the lung and bronchus was greater than expected. Non-Hodgkin's lymphoma, female breast cancer, esophageal cancer, cancer of the pancreas, and cancer in all sites were lower than expected. The only consistent excess reported for both cancer mortality and cancer incidence was for cancer of respiratory and intrathoracic organs.

Because of a concern for possible contamination of the population by mercury, the Tennessee Department of Health and Environment conducted a pilot study in 1984 (TN DHE 1984a). The study showed no difference in urine or hair mercury exposures (residence or activity in contaminated areas) compared to those with little potential exposure. Mercury levels in some soils measured as high as 2,000 parts per million. Analysis of a few soil samples showed that most of the mercury in the soil however, was inorganic, thereby lowering the probability of bioaccumulation and health effects. Examination of the long-term effects of exposure to mercury and other chemicals continues.

State Health Agreement Program. Under the State Health Agreement program managed by the DOE's Office of Epidemiologic Studies, a grant was awarded to the Tennessee Department of Health and Environment. The purpose of the grant was to determine the extent of exposure to contaminants among workers and residents of the surrounding community as a result of ORR operations and to assess the current status of health outcomes and determine their potential association with these exposures.

A dose reconstruction feasibility study began in 1992 with the contract awarded by the State of Tennessee to Chemrisk. The contractor performed extensive review of Oak Ridge documents and issued a report which concluded that sufficient information exists to reconstruct past releases and offsite doses caused by radioactive and hazardous materials. The report also concluded that doses from mercury, polychlorinated biphenyls, radioactive iodine, and radioactive cesium may have been great enough to cause harmful health effects in offsite population. Based on this information, a full dose reconstruction study was initiated in August 1994.

Other activities supported under the grant include: development of a birth defects registry; a quality improvement program for the Tennessee cancer registry; a review and evaluation of the DOE occupational medical program; and the implementation of a community participation/public information program.

Technical support to the State health department is provided by a 12 member Oak Ridge Health Agreement Steering Panel. The Health Advisory Panel provides direction and oversight to those working on health studies, ensures public input, and informs the public of activities related to the health studies. A representative of the Centers for Disease Control and Prevention's National Center for Environmental Health is a member of the advisory panel. A representative from DOE serves as an "ex-officio" member.

Workers. Between 1943 and 1985, there were 118,588 male and female individuals of all races who were ever employed in any of the Oak Ridge facilities. These included ORNL for nuclear research (also called the X-10 Facility), Y–12 under management of the Tennessee-Eastman Corporation (1943 to 1947) which produced enriched uranium by the electromagnetic separation process, Y–12 under management of Union Carbide (1948 to 1984) which fabricated and certified nuclear weapons parts, and K–25 (Oak Ridge Gaseous Diffusion Plant) which produced enriched uranium through the gaseous process. Analyses at the Oak Ridge facilities have been

carried out mostly for white males, and for specific cohorts talking into consideration time-related exposure risks.

Oak Ridge National Laboratory. The mortality experience of 8,375 white males employed at least a month between 1943 and 1972 at ORNL was compared with the U.S. white male population using SMR analyses in a 1985 paper by Checkoway, et al. (BJIM 1985a:525-533). Increases in deaths from leukemia (SMR=1.49, .16 observed; 95 percent Confidence Interval=0.31-4.38), cancer of the prostate (SMR=1.16, 14 observed, 11.9 expected), and Hodgkin's disease (SMR=1.10, 5 observed, 3.7 expected) were observed, although none were statistically significant. Dose response analyses were performed for all causes of death combined, all cancers combined, leukemia, and prostate cancer comparing exposed worker death rates with non-exposed worker death rates. Dosimetry data were available for the entire period of the study with the total population external radiation dose measuring 135 Sv. No dose response gradients were observed. Death rates were calculated for 11 different job categories by length of time in each job in an attempt to determine whether specific work environments were related to cancer and leukemia. Leukemia mortality was observed to be related to length of employment in engineering and maintenance jobs.

Follow-up of this cohort was extended through 1984 in an updated study by Wing et al. (JAMA 1991a:1397-1402). Again, death rates in the worker population were compared with those in the U.S. population. Non-statistically significant increases were noted for cancers of the pancreas (SMR=1.09, 25 observed, 95 percent CI=0.71-1.61), prostate (SMR=1.05, 26 observed, 95 percent CI=0.68-1.53), brain (SMR=1.04, 15 observed, 95 percent CI=0.58-1.72), and lymphosarcoma and/or reticulosarcoma (SMR=1.05, 9 observed, 95 percent CI=0.48-1.99). There was a significant increase in deaths from leukemia (SMR=1.63, 28 observed, 95 percent confidence, interval 1.08-2.35). The total population external radiation dose was 144 Sv. Dose response analyses performed for all causes except cancer, lung cancer, and leukemia did not demonstrate a relationship between level of external radiation and increased risk of death from these outcomes. There was a significant dose response relationship (4.94 percent per 10 milliSieverts) between cancer deaths and level of external radiation dose using models with a 20-year lag. A subgroup of workers who were monitored for internal contamination had non-statistically elevated SMRs for cancer of the prostate (SMR=1.12 10-observed), 95 percent CI=0.53-2.05 and lymphosarcoma and/or reticulosarcoma (SMR=1.65, 6 observed, 95 percent CI=0.60-3.59). The workers monitored for internal contamination had a statistically significant elevated SMR for leukemia (SMR=2.23, 16 observed, 95 percent CI=1.27-3.62).

A second publication on the above data set (Wing, et al), examined the effect of controlling for a number of possible selection and confounding factors on the risk coefficient for all cancer dose responses (AJIM 1993a:265-279). Models were adjusted for the following variables with little change in the previously reported risk coefficient: employment during the World War II era, short-term employment job category, and exposure to beryllium lead, and mercury. The authors concluded that the previously calculated dose response estimate was fairly stable when adjustments were made for a wide range of potential confounders that were not explored in the earlier study.

Y–12 Plant. Y–12 is a nuclear weapons metals fabrication plant where the radiologic exposure of greatest concern is internal exposure from the inhalation of uranium compounds. The Tennessee Eastman Corporation managed the plant from 1943 to 1947. Polednak and Frome reported a follow-up through 1974 of all 18,869 white male workers employed at Y–12 from 1943 to 1947 (JOM 1981a:169-178). The workers included those exposed to internal ("alpha") and external ("beta") radiation through the inhalation of uranium dusts, electrical workers who performed maintenance in the exposed areas, and other non-exposed workers. Individual measures of exposure were not available for any members of this cohort so exposure levels were inferred from plant areas of work and jobs. High average air levels of uranium dust were documented in departments employing chemical workers. Elevated SMRs were observed for mental, psychoneurotic, personality disorders (SMR=1.36, 33 observed, 24.2 expected), emphysema (SMR 1.16, 100 observed, 85.9 expected), diseases of the bones and organs of movement (SMR=1.22, 11 observed, 8.5 expected), lung cancer (SMR=1.09, 324 observed, 296.5 expected), and external causes of death (SMR=1.09, 623 observed, 571.8 expected). The lung cancer SMR was

greater among workers employed for 1 year or more compared with workers employed less than 1 year and was more pronounced in workers hired at the age of 45 or older (SMR=1.51;95 percent CI 1.01-2.31). Of the workers employed after the age of 44, the SMR for lung cancer was greatest for electrical workers (SMR=1.55, 7 observed, D=1.11), alpha chemistry workers (SMR=3.02, 7 observed, D=2.27) and beta process workers (SMR=1.5, 11 observed, D=1.3).

During the early operation of Y–12, from 1942-1947, a group of male workers was exposed to phosgene gas on a chronic basis (N=694) and a smaller group of males received acute exposures (N=106) along with a small group of females (N=91) (ER 1980a:357-367; TIH 1985a:137-147). A control group of 9,280 workers who also worked at Y–12 during the same era, but who did not have phosgene exposure, was also described. All groups were followed through the end of 1978. The SMRs for the chronically-exposed group and the control group, were similar for all causes examined. There was no evidence for increased mortality from respiratory diseases in this group and the SMR for lung cancer, while elevated, was similar to the lung cancer SMR for workers in the rest of the plant. Among those with acute exposures, the SMR for respiratory diseases was elevated (SMR=2.66, 5 observed). This elevation may be related to residual lung damage from the acute phosgene exposure. It was difficult to trace the vital status of the 91 women; therefore, description of these highly exposed workers was limited to listing the frequency of their initial symptoms after exposure. As expected, nausea, vomiting and cough were the most frequently reported symptoms. Unexpectedly, the women experienced a lower frequency of pneumonitis than their male counterparts.

The portion of the Y–12 cohort employed between 1947 and 1974 was described by Checkoway et al. (AJE 1988a:255-266). This study included 6,781 white male workers first employed at Y–12 between 1947 and 1974 who were employed for at least 30 days. Mortality data were collected for the cohort through the end of 1979 and were used to perform SMR and cause specific dose-response analyses. Non-statistically significant increases were observed for all cancers (SMR=1.01, 196 observed, 95 percent CI=0.88-1.17), diseases of the blood-forming organs (SMR=1.48, 3 observed, 95 percent CI=0.31-4.38), kidney cancer (SMR=I.22, 6 observed, 95 percent CI=0.45-2.66), brain cancer (SMR=1.80, 14 observed, 95 percent CI=0.98 - 3.02), and other lymphatic cancers (SMR=1.86, 9 observed, 95 percent CI=0.85-3.53). A statistically significant increase in deaths from lung cancer (SMR=1.36, 89 observed; 95 percent CI=1.09-1.67) was observed compared with the U.S. lung cancer rates, but not with Tennessee lung cancer rates (SMR=1.18, 95 percent CI=0.95-1.45). Dose-response analyses for lung cancer and internal alpha radiation dose and external gamma radiation dose did not reveal a positive relationship for a 0-year or 10-year lag. Examination of lung cancer rates distributed across both internal and external dose categories suggested a dose-response with external radiation dose among individuals who had 5 or more rems of internal dose. Brain cancer was not related to the level of internal or external radiation dose.

The Y–12 cohort studied by Checkoway was updated through the end of 1990 by Loomis and Wolf and included African-American and white female workers (AJIM 1996a:131-141). The dose-response analyses were not included in the update; therefore, only SMR analyses are reported. For all workers examined as a group, non-statistically significant elevations were observed for cancer of the pancreas (SMR=1.36, 34 observed, 95 percent CI=0.94-1.90), skin cancer (SMR)=1.07, 11 observed, 95 percent CI=0.54-1.92), breast cancer (females only, SMR=1.21, 11 observed, 95 percent CI=0.60-2.17), prostate cancer (SMR)=1.31, 36 observed, 95 percent CI=0.91-1.81), kidney cancer (SMR=1.30, 16 observed, 95 percent CI=0.74-2.11), brain cancer (SMR=1.29, 20 observed 95 percent CI=0.79-2.00), cancers of other lymphatic tissues (SMR=1.32, 22 observed, 95 percent CI=0.82-1.99) and diseases of the blood forming organs (SMR=1.23, 6 observed, 95 percent CI=0.45-2.68). The SMR for lung cancer was statistically significant (SMR=1.17, 202 observed; 95 percent CI 1.01-1.34), particularly in the white male segment of the population (SMR=1.20, 194 observed 95 percent CI=1.04-1.38). Examination of the lung cancer mortality by year of hire, latency, duration of employment and calendar year at risk indicated the excess was confined to those who were first hired before 1954 (SMR=1.27, 161 observed), and was greatest in persons employed 5 to 20 years with 10 to 30 years of follow-up. Elevated lung cancer deaths rates were first evident between 1955 and 1964 and continued to increase from 1975 to 1979, followed by a decrease in lung cancer death rates.

Between 1953 and 1963, Y–12 used mercury in a process to produce large quantities of enriched lithium. Cragle et al. studied all workers employed at Y–12 at least 5 months between January 1, 1953 and April 30, 1958 (N=5,663) (JOM 1984a:817-821). This group was categorized into workers exposed to mercury and workers not exposed to mercury based on results of urinalysis data supplied by the plant. Vital status follow-up was complete through the end of 1978, and SMRs were calculated. Compared with non-exposed workers, there were no differences in the mortality patterns for mercury exposed workers as a whole, workers with the highest mercury exposures, and workers employed more than a year in a mercury process. The authors acknowledge that mortality is not the optimal end point to assess health effects related to mercury exposure.

The mercury workers were involved in a clinical study by Albers et al. who examined 502 Y–12 workers, 247 of whom worked in the mercury process 20 to 35 years prior to the examination (AN 1988a:651-659). Correlations between declining neurological function and increasing exposure were identified. An exposure assessment was determined for each mercury worker during the time of employment in the mercury process. Study subjects who had at least one urinalysis equal or greater than 0.6 mg/L of mercury showed decreased strength, coordination and sensations along with increased tremor, and prevalence of Babinski and snout reflexes when compared with the 255 unexposed workers. Clinical polyneuropathy was associated with the level, of the highest exposure, but not with the duration of exposure.

K–25 Site. The K–25 Site enriched uranium beginning in 1945 using a gaseous diffusion process. There was potential exposure to uranium dust, oxidized uranium compounds, uranium hexafluoride, and a number of chemical compounds used in the process. In later years of operation, the gas centrifuge process was used to enrich uranium. No analyses of death rates for this population have been published; however, health effects have been studied.

Powdered nickel was used at K–25 in the production of the barrier material used to separate and enrich uranium. Workers who fabricated the barrier material were exposed to nickel powder through inhalation. Cragle et al. updated an earlier study by Godbold et al. of 814 workers who were employed in the manufacture of barrier material between 1948 and 1953 (JOM 1979a:799-806); (IARC 1984a:57-63). A comparison group of white males employed at K–25 sometime between 1948 and 1953 (N=7,552) was also selected. The SMRs in the barrier group were similar to those in the non-barrier worker group for most non-cancer outcomes. The nickel workers were noted to have a higher rate of death from cancers of the buccal cavity and pharynx (SMR=2.92, 3 observed, 95 percent CI=0.59-8.54) than the non-nickel workers (SMR=0.23, 3 observed, 95 percent CI=0.05-0.67). When the standardized rates were directly compared, the rate of buccal cavity and pharynx cancer in the nickel workers was approximately 19 times higher than the rate in the non-nickel workers. The authors acknowledge that the number of cases is quite small and recommended additional follow-up to determine if this trend continued. There were no nasal sinus cancers observed in the worker population exposed to metallic nickel in contrast to the results of studies of workers in nickel refineries where the rates of sinus cancer related to nickel compounds are quite high.

K–25 workers employed in the gas centrifuge process were the focus of an interview study by Cragle et al. (AOEH 1992a:826-834). The study was conducted in order to determine the incidence rate for cancer and illness symptoms among workers exposed to epoxy resin and solvents prevalent in the process. A total of 263 workers determined to have worked closest and longest to the process were compared with 271 employees employed at the plant during the same time, but did not work in the centrifuge process. The centrifuge workers and the non-centrifuge workers had similar overall cancer incidence rates. However, the centrifuge workers reported five incident bladder cancers versus none reported by the non-centrifuge group. The centrifuge workers also reported significantly more rashes, dizziness, and numb or tingling limbs during employment, which are symptoms associated with high solvent exposure. One of the epoxy resins used in the early years of the process was a potential bladder carcinogen, but none of the workers with bladder cancer had jobs that required routine, hands-on work with that material. A specific causative agent for the increase in bladder cancer was not identified.

Combined-Oak Ridge Reservation Facilities. Frome et al. reported on the mortality experience of World War II workers employed at three ORR facilities between 1943 and 1947 (RR 1990a:138-152). Poisson regression analyses were used to control for potential confounders such as facility of employment, socioeconomic status, period of follow-up, and birth year. The cohort included white males employed at any ORR facility at least 30 days between the start of the operation and 1947 and were never employed at an ORR facility after 1947 (N=28,008). Elevated mortality was statistically significant for all causes (SMR=1.11, 11,671 observed, 10,537 expected; standard deviation (sd)=1), tuberculosis (SMR=1.37, 108 observed, 78 expected; sd=10.2), mental, psychoneurotic, and personality disorders (SMR=1.60, 81 observed, 50 expected; sd=10.2), cerebrovascular disease (SMR 1.11, 833 observed, 753 expected; sd=3.9), diseases of the respiratory system (SMR=1.25, 792 observed, 634 expected; sd=4.4), emphysema (SMR=1.24, 209 observed, 168 expected; sd=8.4), all accidents (SMR=1.28, 694 observed, 542 expected, sd=3.8), and motor vehicle accidents (SMR=1.44, 339 observed, 235 expected; sd=5.5). The only elevated site specific cancer that was statistically significant was lung cancer (SMR=1.27, 850 observed, 667 expected, sd=4.4, $p<0.01$). A surrogate for radiation exposure based on a workers job and department was used to indicate the probability of exposure. This surrogate for actual radiation exposure was not associated with increased rates of cancer.

Carpenter investigated earlier reports of an association between brain cancer and employment at Y–12 by conducting a case-control study of workers employed between 1943 and 1977 at ORNL or Y–12 (JOM 1987a:601-604). Cases consisted of 72 white males and 17 white females with brain cancer. Four controls were selected for each case matched on age, sex, cohort, year of birth, and year of hire. Analyses with respect to internal and external radiation exposures indicated no association with brain cancer. Two companion papers were also published from this case-control study, one examined relationships between brain cancer and chemical exposures, and the other examined non-occupational risk factors (AJIM 1988a:351-362); (AJPH 1987a:1180-1182). No statistically significant association between the use of 26 chemicals evaluated and the risk of brain cancer was observed. The chemicals evaluated included those encountered in welding fumes, beryllium, mercury, 4,4-methylene is 2-chloroaniline or MOCA, cutting oils, thorium, methylene chloride, and other solvents. Excess brain cancer was observed among individuals employed for more than 20 years (odds ratio=7.0, 9 cases; 95 percent CI 1.2-41.1). Analysis of 82 cases with complete medical records revealed an association with a previous diagnosis of epilepsy (odds ratio=5.7, 4 cases; 95 percent. CI=1.0-32.1) recorded for pre-employment and health status follow-up.

Causes of death among white male welders (N=1,059) employed between 1943 and 1973 at Y–12, the K–25 Site, and ORNL were studied by Polednak (AEH 198la:235-242). Based on deaths reported through 1974, mortality from all causes for welders was slightly lower than that expected based on death rates for U.S. white males (SMR=0.87, 173 observed, 199 expected, 95 percent CI=0.75-1.01). Non-statistically significant decreases in mortality were also observed for all cancers (SMR=0.88, 32 observed, 36.57 expected, 95 percent CI=0.60-1.23), especially digestive cancer (SMR=0.49, 5 observed, 10.3 expected, 95 percent CI=0.16-1.14); diseases of the circulatory system (SMR=0.74, 72 observed, 97.51 expected, 95 percent CI=0.58-0.94); diseases of the digestive system (SMR=0.76, 9 observed, 11.86 expected 95 percent, CI=0.35-1.4), and accidents (SMR=0.89, 16 observed, 17.86 expected, 95 percent CI=0.51-1.44). Non-statistically significant increases were noted for lung cancer (SMR=1.50, 17 observed, 11.37 expected, 95 percent CI=0.87-2.40); diseases of the respiratory system (SMR=1.33, 13 observed, 9.77 expected, 95 percent CI=0.71-2.27), especially emphysema (SMR=2.21, 6 observed, 2.71 expected, 95 percent CI=0.81-4.82); and suicide (SMR=1.64, 10 observed, 6.09 expected; 95 percent CI=0.79 - 3.02). A subgroup of welders (N=536) exposed to nickel oxides (possible respiratory carcinogens) at K-25 were compared with welders at the other two facilities (N=523). The risk of lung cancer and other respiratory diseases did not differ between the two groups.

Combined Nuclear Sites. ORR workers have been included in several studies that have examined occupational risks across the nuclear complex, both in the United States and internationally. These combined studies have been undertaken in an attempt to increase the statistical power of the studies to detect the effects of low-level chronic radiation exposure.

Y–12 workers were included in a lung cancer case-control study of workers from the Fernald Feed Materials and Production Center cohort and the Mallinckrodt Chemical Works cohort. Dupree et al. conducted a nested case-control study of lung cancer (N=787) to investigate the relationship between lung cancer and uranium dust exposure (Epidemiology 1995a:370-375). Eligible cases were employed at least 183 days in any of the facilities and died before January 1, 1983, with lung cancer listed anywhere on the death certificate. Inclusion of deaths through 1982 allowed over 30 years of observation at each facility. One control was matched to each case on facility, race, gender, and birth and hire dates within three years. Data collected on all study members included smoking history, first pay code (a surrogate for socioeconomic status), complete work histories and occupational radiation monitoring records. Annual radiation lung dose from deposited uranium was estimated for each study member. Annual external whole body doses from gamma radiation were determined for workers who had personal monitoring data available. Potential confounders considered in the analysis were smoking (ever/never used tobacco) and pay code (monthly/non-monthly). With a 10-year lag, cumulative lung doses ranged from 1 to 137 centigays (cGy) for cases and from 0 to.80 cGy for controls. The odds ratios for lung cancer mortality for seven cumulative internal dose groups did not demonstrate increasing risk with increasing dose. An odds ratio of 2.0 was estimated for those exposed to 25 cGy or more, but the 95 percent confidence interval of 0.20 to 20 showed great uncertainty in the estimate. There was a suggestion of an exposure effect for workers hired at age 45 years or older.

A combined site mortality study included workers from ORNL, the Hanford Site and the Rocky Flats Plant (RR 1993a:408-421). Earlier analyses of these cohorts by Gilbert et al. indicated that risk estimates calculated through extrapolation from high-dose data to low-dose data did not seriously underestimate risks of exposure to low-dose radiation (AJE 1990a:917-927; RR 1989a:19-35). The updated analyses were performed in order to determine whether the extrapolated risks represented an over-estimation of the true risk at low doses. The study population consisted of white males employed at one of the three facilities for at least six months and monitored for external radiation. The Hanford population also included females and non-white workers. The total population dose was 1,237 Sv. Analyses included trend tests for site specific cancer deaths and several broad non-cancer categories. Statistically significant trends were noted for cancer of the esophagus, cancer of the larynx, and Hodgkin's disease. These cancers were not related to radiation exposure levels in previously published studies. Excess relative risk models were calculated for the combined DOE populations and for each DOE site separately. Without exception, all risk estimates included the possibility of zero risk (that is, the confidence interval for the risk coefficient went from below zero to above zero). There was evidence of an increase in the excess relative risk for cancer with increasing age in the Hanford and ORNL population; both populations showed significant correlations of all cancer with radiation dose among those 75 years and older.

An international effort to pool data from populations exposed to external radiation included the ORNL population in addition to other radiation worker populations in the United States, Canada, and Britain (RR 1995a:117-132). The cohort comprised 95,673 workers (85.4 percent men) employed 6 months or longer and the population dose was 3,843.2 Sv. There was no evidence of an association between radiation dose and mortality from all causes or from all cancers. There was a significant dose-response relationship with leukemia, excluding chronic lymphocytic leukemia (excess relative risk=2.18 per SV, 90 percent CI=0.1-5.7) and multiple melanoma (excess relative risk not computed; 44 observed). The study results do not suggest that current radiation risk estimates for cancer at low levels of exposure are appreciable in error.

Memorandum of Understanding. The Department entered into a Memorandum of Understanding with the Department of Health and Human Services to conduct health studies at DOE sites. NIOSH is responsible for the conduct or management of worker studies.

The following studies at the ORR are managed by NIOSH with funding from DOE: a study of multiple myeloma among workers at the K-25 Plant at Oak Ridge (expected completion date 1996); a multisite study to assess the potential association between paternal exposure to ionizing radiation and the risk of leukemia in offspring of exposed male workers; a study of neurologic health outcomes in workers exposed to high levels of mercury between 1953 and 1963; studies of mortality among Oak Ridge workers; a multisite study of mortality

among female nuclear workers; a multi-site exposure assessment of hazardous waste/cleanup workers; a chronic beryllium disease study; and a multi-site study of heat stress and performance among carpenters.

M.4.7 SAVANNAH RIVER SITE

The Savannah River Site, established in 1953 in Aiken, SC, produced Pu, tritium, and other nuclear materials. There are reports that millions of curies of tritium have been released over the years both in plant exhaust plumes and in surface and groundwater streams (ED 1982a:135-152).

Surrounding Communities. In 1984, Sauer and Associates examined mortality rates in Georgia and South Carolina by distance from the Savannah River Plant (now known as the SRS) (SR duPont 1984b). Rates for areas near the plant were compared with U.S. rates and with rates for counties located more than 50 miles away. Breast cancer, respiratory cancer, leukemia, thyroid cancer, bone cancer, malignant melanoma of the skin, non-respiratory cancer, congenital anomalies or birth defects, early infancy death rates, stroke, or cardiovascular disease in the populations living near the plant did not show any excess risk compared with the reference populations.

State Health Agreement Program. Under the State Health Agreement program managed by the DOE Office of Epidemiologic Studies, a grant was awarded to the Medical University of South Carolina in 1991 to develop the Savannah River Region Health Information System. The purpose of the Savannah River Region Health Information System database was to assess the health of populations surrounding SRS by tracking cancer rates and, birth defect rates in the area. Information from the registry is available to public and private health care providers for use in evaluating cancer control efforts. A steering committee provides advice to the Savannah River Region Health Information System and communicates public concerns to Savannah River Region Health Information System. It consists of 12-community members and persons with technical expertise representing South Carolina and Georgia. The meetings are open to the public.

Workers. A descriptive mortality study was conducted that included 9,860 white male workers who had been employed at least 90 days at the Savannah River Plant between 1952 and the end of 1974 (AJIM 1988b:370-401). Vital status was followed through the end of 1980 and mortality was compared with the U.S. population. SMRs were computed separately for hourly and salaried employees. For hourly employees non-statistically significant increases were seen for cancer of the rectum (SMR=1.09, 5 observed, 95 percent CI=0.35-2.54), cancer of the pancreas (SMR=1.08, 10 observed, 95 percent CI=0.59-2.18), leukemia and aleukemia (SMR=1.63, 13 observed, 95 percent CI=0.87-2.80), other lymphatic tissue (SMR=1.06, 5 observed, 95 percent CI=0.34-2.48), benign neoplasms (SMR=1.33, 4 observed, 95 percent CI=0.36-3.40), and motor vehicle accidents (SMR=1.10, 63 observed, 95 percent CI=0.84-1.4). Salaried employees exhibited non-statistically significant increases in cancer of the liver (SMR=1.84, 3 observed, 95 percent CI=0.38-5.38), cancer of the prostate (SMR=1.35, 5 observed, 95 percent CI=0.44-3.16), cancer of the bladder-(SMR=1.87, 4 observed, 95 percent CI=0.51 4.79), brain cancer (SMR=1.06, 4,observed, 95 percent CI=0.29-2.72), leukemia and aleukemia (SMR=1.05, 4 observed, 95 percent CI=0.29-2.69), and other lymphatic tissue (SMR=1.23, 3 observed, 95 percent CI=0.26-3.61). No trends between increasing duration of employment and SMRs were observed. A statistically significant excess of leukemia deaths was observed for hourly workers employed at least 5, but less than 15 years (SMR=2.75, 6 observed, 95 percent CI=1.01-5.99). Review of the plant records and job duties of the workers who died from leukemia indicated that two of the cases had potential routine exposure to solvents, four had potential occasional exposure to solvents and one had potential for minimal exposure. Benzene, a known carcinogen was reportedly not used at the plant.

Epidemiologic Studies. The Department's Office of Epidemiologic Studies has implemented an Epidemiologic Surveillance Program at SRS to monitor the health of current workers. This program will evaluate the occurrence of illness and injury in the workforce on a continuing basis and the results will be issued in annual reports. The implementation of this program will facilitate an ongoing assessment of the health and safety of SRS's workforce and will help identify emerging health issues.

Currently operational at a number of DOE sites, including production sites and R&D facilities, epidemiologic surveillance uses routinely collected health data including descriptions of illness resulting in absences lasting 5 or more consecutive workdays, disabilities, and OSHA recordable injuries and illnesses abstracted from the OSHA 200 log. These health event data, coupled with demographic data about the active workforce at the participating sites, are analyzed to evaluate whether particular occupational groups are at increased risk of disease or injury when compared with other workers at a site. As the program continues and data for an extended period of time become available, time trend analysis will become an increasingly important part of the evaluation of worker health. Monitoring the health of the workforce provides a baseline determination of the illness and injury experience of workers and a tool for monitoring the effects of changes made to improve the safety and health of workers. Noteworthy changes in the health of the workforce may indicate the need for more detailed study or increased health and safety measures to ensure adequate protection for workers.

Memorandum of Understanding. The Department entered into a Memorandum of Understanding with the Department of Health and Human Services to conduct health studies at DOE sites. The Centers for Disease Control and Prevention's National Center for Environmental Health is responsible for dose reconstruction studies and NIOSH is responsible for worker studies. These activities are funded by DOE.

A study of mortality among SRS workers employed from 1952 to 1974 to examine whether risks of death due to selected causes may be related to occupational exposures at SRS is being conducted by NIOSH. SRS is also included in several multisite studies managed by NIOSH. The first study is to assess the potential association between paternal work-related exposure to ionizing radiation and the risk of leukemia in offspring of exposed male workers. The second study is to examine causes of death among female workers at nuclear weapons facilities to develop risk estimates based on exposures to external and internal ionizing radiation and to hazardous chemicals. A third multi-site project is a case-control study of multiple myeloma; a type of blood cell cancer.

A dose reconstruction project around SRS is being conducted by the National Center for Environmental Health to determine the type and amount of contaminants to which people living around the site may have been exposed, to identify exposure pathways of concern and to quantify the doses people may have received as a result of SRS operations. The estimated completion date is 1999 or 2000.

M.4.8 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Surrounding Communities

Johnson examined cancer incidence from 1969 to 1971 among non-Hispanic whites in the Denver area to determine if exposure to a small concentration of Pu and other radionuclides had increased the incidence of cancer (Ambio ~~1981a:176~~-182). The authors categorized census tracts into four areas based on Pu isotope concentrations in soil from a 1970 Atomic Energy Commission survey. The highest concentrations of Pu were closest to the Rocky Flats Plant (Area I) and decreased with distance from the plant (Areas II & III). Area IV was considered unexposed. The study calculated cancer incidence rates for each of the four areas. To account for confounding factors, median income and education levels of the study and control populations derived from 1970 census data also were considered.

Cancer incidence appeared to be inversely proportional to the distance from Rocky Flats. Among males, total cancer incidence for 1969-1971 was significantly elevated by 24 percent in Area I and by 15 percent in Area II compared with Area IV. Among women, total cancer incidence was 10 percent higher in Area I than Area IV. When specific cancer sites for each area were compared with Area IV, cancer of the lung and bronchus was significantly elevated in men by 33 percent in Area I and by 46 percent in Area II. Cancers of the colon and rectum were significantly elevated in men by 47 percent and in women by 37 percent in Area I. Leukemia was significantly elevated in women in Area III by 58 percent. There were 18 percent fewer leukemia cases than expected among women in Area I. Cancer of the tongue, pharynx, and esophagus was significantly elevated in

men by 139 percent and in women by 257 percent in Area II. Men in Area II also had significant elevations in liver, gallbladder, and testicular cancers. The author concluded that over the study period, cancer incidence increased with increasing Pu soil concentrations and that exposure of the public to low concentrations of Pu and other radionuclides may effect the incidence of total and radiation-related cancer.

To further investigate these reported geographic correlations between Rocky Flats and cancer incidence patterns, Crump et al. re-examined cancer incidence data for the 3-year period studied by Johnson, 1969 to 1971, and also analyzed data from a later period, 1979-1981 (AJE 1987b:127-135). Crump et al. used the same concentration contours for soil Pu contamination as the Johnson study and computed gender- and age-specific cancer rates for each of the four exposure areas. As in the previous study, Area I, with the highest exposure, was closest to Rocky Flats; Area IV was most distant.

The authors' findings paralleled the earlier results of Johnson for 1969-1971. For 1979-1981, significant positive trends were observed in males for total cancer, "radiosensitive cancer," as defined by BEIR III, and respiratory cancer; and in females for total cancer, radiosensitive cancer, and digestive cancer. Whereas cancer incidence tended to decrease with increasing distance from the Rocky Flats Plant for the 1969-1971 study period, cancer incidence in the 1979-1981 time period was lower in Area I, closer to Rocky Flats, than for Area II in six of the cancer sites studied.

To examine the possible effects of urbanization on cancer incidence, census tracts were then grouped by distance from the State Capitol Building. Total cancer incidence was higher nearer to downtown Denver and the State Capitol for males in the earlier period, and for both sexes in the later period. Cancer incidence rates were found to decrease in all directions as one moved away from the State Capitol, including the direction of Rocky Flats. After controlling for distance from the Capitol, the statistically significant association of increases in various cancers among those living near Rocky Flats disappeared.

The authors then compared that part of Area I closest to Rocky Flats (within 16 km) to the whole Denver metropolitan area. No excess was seen for either males or females during either study period for total cancer, radiosensitive cancer, or respiratory cancer.

Crump et al. concluded that this study did not support a correlation between environmental exposure to Pu from Rocky Flats and cancer incidence; correlations of cancer incidence with proximity to Rocky Flats disappeared for both time periods when analyses took into account the levels of urbanization.

Jablon et al. analyzed cause, gender, race, and age-specific cancer mortality from 1950 through 1984 in residents who lived near 62 nuclear facilities throughout the United States (JAMA 1991a:1403-1408). Each of 107 counties with or near nuclear installations, including Jefferson County, where Rocky Flats is located, was matched to three control counties in the same region, without nuclear facilities. The matching criteria included population size, age, race, urban/rural differences, manufacturing, education, income, migration, and infant death rates. The authors concluded that the survey did not detect any general association between residence in a county with a nuclear facility and death attributable to leukemia or any other form of cancer. The authors noted that interpretation of the study results is limited by its ecologic approach in which the exposures of individuals are not known.

State Health Agreement Program

Under the State Health Agreement program managed by the DOE Office of Epidemiologic Studies, a grant was awarded to the Colorado Department of Public Health and Environment for the performance of an offsite historical dose reconstruction. Due to be completed by 1998, this study includes a thorough examination of major fires and other events releasing Pu from Rocky Flats, estimates of resulting risks due to exposure to Pu and other environmental releases, as well as extensive support of cancer and birth defects registries and public involvement activities.

Workers

Voelz et al. conducted a historical cohort mortality study of 7,112 white male workers ever employed at Rocky Flats between 1952 and 1979 (HP 1983b:493-503).

Cause specific death rates in workers were compared with those in the U.S. white male population adjusted for age and calendar year. Statistically significant fewer deaths were observed than expected based on rates in the U.S. population from all causes (SMR=0.54, 95 percent CI=0.49-0.60), all cancers (SMR=0.64, 95 percent CI=0.52 0.77), digestive organs/peritoneal cancer (SMR=0.66, 95 percent CI=0.44-0.95), and respiratory cancer (SMR=0.58, 95 percent CI=0.40-0.80). Benign and unspecified neoplasms were the only cause of death significantly elevated in these workers with eight cases observed, (SMR=3.32, 95 percent CI=1.43-6.53). All eight tumors were intracranial. The cohort was then stratified by exposure to Pu. Among Pu exposed workers, significantly fewer deaths than expected were observed from all causes of death (SMR=0.38, 95 percent CI=0.31-0.46), all malignant neoplasms (SMR=0.41, 95 percent CI=0.23-0.59), and respiratory cancer (SMR=0.20, 95 percent CI=0.05-0.52). No cases of bone cancer were observed. Workers not exposed to Pu also showed significantly fewer deaths from all causes and all cancers.

Workers exposed to external radiation had significantly fewer deaths from all causes (SMR=0.49, 95 percent CI=0.43-0.54), all cancers (SMR=0.58, 95 percent CI=0.46-0.73), and respiratory cancer (SMR=0.57, 95 percent CI=0.37-0.83) than expected when compared with U.S. white males. Six of the total eight cases of benign and unspecified neoplasms occurred in workers exposed to external radiation. Two occurred in those exposed to Pu.

To investigate whether brain tumor mortality was associated with exposure to internally deposited Pu or external radiation, Reyes et al. conducted a case-control study of all primary brain tumor deaths that occurred among white males who had been employed at Rocky Flats between 1952 and 1977, and died between 1952 and 1980 (JOM 1984b:721-725). Sixteen cases were identified. Four controls were matched to each case on year of birth and period of employment. Demographic data and detailed work histories were obtained from employment records. Exposure data for internally deposited Pu and external radiation data were obtained from Rocky Flats Plant health physics records.

No statistically significant association was found between brain tumor mortality and exposure to Pu or cumulative external radiation exposure. No significant dose response trends were observed for any job or work area. The authors noted that the study was limited by the small number of cases in the study and the small proportion (10 percent) of the cohort who had died.

Tietjen presented mortality data on all causes of death, all cancer deaths, and lung cancer deaths for Rocky Flats workers with exposures greater than 74 Bq (2.0 nanocuries [nCi]) (HP 1987a:625-628). No excess mortality was observed, with fewer deaths from all causes (SMR=0.70, 95 percent CI=0.54-0.89) and lung cancer (SMR=0.14, 95 percent CI=0.0-0.76) than expected compared with U.S. rates. When compared to an internal comparison group, the Risk Ratio (RR) for mortality from all causes was 1.16 (95 percent CI=0.89-1.52) and for lung cancer it was 0.21 (95 percent CI=0.03-1.26).

To further elucidate the risks from exposure to low levels of Pu and external radiation, Wilkinson et al. studied the cohort of workers employed at Rocky Flats between 1952 and 1979 (AJE 1987d:231-250). The analyses were limited to 5,413 white males who were employed for at least 2 years at Rocky Flats. Workers with cumulative exposures >1 rem were considered exposed to external radiation; those with body burdens ≥2 nCi were considered exposed to Pu.

Compared with death rates among white males in the United States, significantly fewer deaths were observed than expected from all causes (SMR=0.62, 90 percent CI=0.57-0.68), all cancers (SMR=0.71, 90 percent CI=0.59-0.84), diseases of the circulatory system (SMR=0.61, 90 percent CI=0.54-0.69), accidents, poisonings,

and violence (SMR=0.65, 90 percent CI=0.51-0.81). As reported earlier by Voelz et al., benign and unspecified neoplasms were the only cause of death significantly elevated (SMR=3.16, 90 percent CI=1.77-7.07). Workers with Pu body burdens of ≥2 nCi were then compared with workers with less exposure. As cancers take varying times to develop, analyses were conducted considering induction periods of 2, 5, and 10 years. No significant excesses were seen for a 2-year induction period. After a 5-year induction period, significant increases from all causes (RR=1.33, 90 percent CI=1.05-1.68) and lymphopoietic cancer (RR=9.86, 90 percent CI=1.26-94.03) were observed. After 10 years, the excess in death from leukemia was no longer statistically significant (RR=5.22, 90 percent CI=0.57-38.8).

Similar analyses were conducted for workers who received 1 rem or more of external radiation compared with workers less exposed. Workers with ≥1 rem had statistically significant fewer deaths from all cancers, when compared with those with <1 rem. No dose-response relationships for Pu or external radiation were found. The authors noted nonstatistically significant increases in myeloid leukemia, lymphosarcoma and reticulum cell sarcoma, liver neoplasms, and unspecified brain tumors in workers with ≥1 rem of external radiation compared with workers with <1 rem.

Gilbert et al. conducted a combined cohort mortality analysis of white male workers employed at Hanford, Oak Ridge, or Rocky Flats for at least 6 months and monitored for exposure to external radiation (RR 1989a:19-35). Analyses for Rocky Flats were based on the same vital status and cause of death information reported by Wilkinson et al. To eliminate overlap, those who worked at multiple facilities were included in the analysis for the facility where they first met eligibility requirements; doses accumulated at other facilities were excluded. To allow for minimum latency (the time between exposure and the diagnosis of cancer), cumulative dose was lagged 2 years for leukemia and 10 years for other cancers. Expected death rates were derived from age and calendar specific death rates for U.S. white males.

In Rocky Flats workers monitored for external radiation, significantly fewer deaths were observed than expected from all causes, lung cancer, circulatory diseases, respiratory diseases excluding pneumonia, cirrhosis, and external causes. Consistent with previous studies of this cohort, benign and unspecified neoplasms of the brain were the only cause of death significantly elevated (SMR=3.84, 95 percent CI=1.5, 7.9). Unmonitored workers had a borderline statistically significant excess mortality from all cancers (SMR=1.6, 90 percent CI=1.0-2.5) but did not differ from monitored workers with respect to site-specific cancer mortality.

Analyses of mortality by cumulative radiation dose found no indication of increased cancer deaths with increased radiation dose, but a significant positive association was observed between noncancer mortality and radiation exposure. The authors indicated that mortality from circulatory diseases and external causes were contributors to this correlation with noncancer mortality. The authors concluded that there was no evidence of a correlation between chronic low-dose radiation exposure and mortality from all cancer or from leukemia.

In 1993, Gilbert et al. published an update of their previous analyses of data from Hanford, Oak Ridge, and Rocky Flats (RR 1993a:408-421). Four additional years of mortality data for the Rocky Flats cohort were included in this later analysis. As in the previous analysis, the study was limited to white males employed for at least 6 months and monitored for external radiation. All analyses were based on internal comparisons of death rates by level of radiation dose, as internal comparisons were considered by the authors to be less subject to bias and more likely to detect risks resulting from radiation exposure than were comparisons to external populations. Workers were included in the analyses beginning with the year after initial employment plus 5 years, or the first year of monitoring, whichever occurred later.

The previously observed correlation between noncancer mortality and external radiation exposure in Rocky Flats workers was no longer statistically significant, and external causes of death were now negatively correlated with radiation dose. Benign and unspecified neoplasms of the brain, which had been shown to be elevated in previous papers by Voelz and Wilkinson, remained elevated and showed no evidence of any dose

response relationship with external radiation. Deaths from leukemia indicated a positive correlation with external radiation exposure at Rocky Flats, but not at two other facilities considered in the analyses.

An international effort to pool data from populations exposed to external radiation included Rocky Flats workers, as well as workers at Hanford and Oak Ridge in the United States and other radiation worker populations in Canada and Britain (RR 1995a:117-132). The cohort was comprised of 95,673 workers employed 6 months or longer and the population dose was 3,543.2 Sv. There was no evidence of an association between radiation dose and mortality from all causes or from all cancers. There was a significant dose-response relationship with leukemia, excluding chronic lymphocytic leukemia (ERR=2.18 per Sv; 90 percent CI 0.1-5.7) and multiple myeloma (excess relative risk not computed; 44 observed). The authors concluded that the study results did not suggest that current radiation risk estimates for cancer at low levels of exposure are appreciable in error.

Epidemiologic Studies

The Department's Office of Epidemiologic Studies has implemented an epidemiologic surveillance program at Rocky Flats to monitor the health of current workers. This program will evaluate the occurrence of illness and injury in the workforce on a continuing basis and the results will be issued in annual reports. The implementation of this program will facilitate an ongoing assessment of the health and safety of Rocky Flats' workforce and will help identify emerging health issues.

Currently operational at a number of DOE sites, including production sites and R&D facilities, epidemiologic surveillance uses routinely collected health data including descriptions of illness resulting in absences lasting 5 or more consecutive workdays, disabilities, and OSHA recordable injuries and illnesses abstracted from the OSHA 200 log. These health event data, coupled with demographic data about the active workforce at the participating sites, are analyzed to evaluate whether particular occupational groups are at increased risk of disease or injury when compared with other workers at a site. As the program continues and data for an extended period of time become available, time trend analysis will become an increasingly important part of the evaluation of worker health. Monitoring the health of the workforce provides a baseline determination of the illness and injury experience of workers and a tool for monitoring the effects of changes made to improve the safety and health of workers. Noteworthy changes in the health of the workforce may indicate the need for more detailed study or increased health and safety measures to ensure adequate protection for workers.

Memorandum of Understanding

The Department entered into a Memorandum of Understanding with the Department of Health and Human Services to conduct health studies at DOE sites, and the Centers for Disease Control and Prevention became responsible for conducting dose reconstructions in several host States, including Idaho. NIOSH is responsible for worker studies. These activities are funded by DOE. A number of studies of the Rocky Flats' workforce are ongoing under the Memorandum of Understanding.

A study is currently underway by NIOSH, under a cooperative agreement with the State of Colorado, to update the Rocky Flats cohort mortality and cancer incidence among Rocky Flats workers. This study should be completed in 1997.

The University of Colorado is conducting a sentinel exposure event surveillance/evaluation at DOE sites. This study will develop a sentinel exposure event surveillance and evaluation system for exposures to chemicals and both ionizing and non-ionizing radiation in the defense nuclear industry. The pilot will start at Rocky Flats in 1997.

The National Jewish Center for Immunology and Respiratory Medicine is conducting a study of lung fibrosis in Pu workers at Rocky Flats. The goal of the study is to confirm that Pu workers are at increased risk for

developing radiographic abnormalities consistent with fibrosis; to determine the relationship between Pu-239 and other radionuclide and chemical exposures and the development of lung fibrosis; and to determine the frequency of fibrosis on lung biopsies of Rocky Flats workers compared to biopsies from nonexposed individuals and to relate the clinical, physiologic, and pathologic severity to radionuclide dose.

Under a cooperative agreement with the State of Colorado, a study is being conducted of the relationship between the different types of leukemia commonly diagnosed in children and parental exposure to ionizing radiation used in medical procedures and received through occupational exposure.

M.4.9 LOS ALAMOS NATIONAL LABORATORY

Los Alamos and adjacent counties comprise a unique setting and history. The LANL for much of its existence was a closed community where most of the residents had direct economic ties to the Laboratory. Nearly all male residents and some of the female residents are employed at LANL. Medical care in Los Alamos County had been centralized at the Laboratory and a single community hospital. This is a unique, highly educated community situated adjacent to lands populated by Native Americans.

Surrounding Communities. Selected cancer mortality and incidence (newly diagnosed cancer) rates between 1950-1969, for eleven selected cancers among white males in Los Alamos County were compared with rates for the State of New Mexico, the United States five "socioeconomic and occupational" control counties, and five high education Western counties," based on U.S. Bureau of the Census information (ER 1981a:86-105). The comparisons were made to identify cancer types that were greater than expected while taking into account important factors, such as income and education, associated with cancer patterns. Six cancer types were identified that had rates greater than cancer rates for one or more of the four comparison groups; they are: cancer of the bile ducts and liver; bladder; prostate; brain and nervous system; lympho- and reticulo-sarcoma; and leukemia. Cancer rates of the prostate, bladder, and leukemia were also greater than expected.

Compared with New Mexico white males, Los Alamos County Anglo-white males show non-statistically significant excesses in cancer incidence from 1969-1974 for the stomach colon, rectum, pancreas, lung, and bladder (ER 1981a:86-105). All cancers combined show a 35 percent statistically significant excess. Los Alamos County white females show non-statistically significant excesses for cancer of the stomach, large intestine, lymphosarcoma and reticulosarcoma, and leukemia. All cancers combined show a statistically significant 40 percent excess.

In 1991, the New Mexico Department of Health initiated epidemiologic studies in response to citizen concerns about an apparent excess of brain tumors among residents of the western area neighborhood of Los Alamos County as a result of historical LANL nuclear operations. The New Mexico Department of Health conducted a descriptive study of brain cancer incidence in Los Alamos County and for 22 other sites (NM DOH 1993a). The study showed that during the mid- to late- 1980s an approximate 80 percent excess of brain cancer had occurred in Los Alamos County compared with a New Mexico reference population and national statistics. The excess incidence had disproportionately occurred among persons who were residents of the western area at the time of diagnosis or death; however, there were only three cases and they were confined to the 2-year time period, 1986 and 1987. Additional descriptive studies showed that the brain cancer rates for Los Alamos County were within the range of rates observed across New Mexico counties from 1983-1987 and 1988-1991. A review of mortality statistics for benign or unspecified neoplasms of the brain and nervous system showed no deaths from these causes in Western Area residents during 1984-1990.

Los Alamos County breast cancer incidence rates remained level but higher than New Mexico rates from 1970-1990. Reproductive and demographic factors associated with the risk of breast cancer were thought to account for the higher rates. A special study was conducted to examine the recent increase in breast cancer since 1988 (NM DOH 1994a). The New Mexico Tumor Registry concluded that the increase seen in 1988-1992 was primarily due to increased detection of early stage disease.

The incidence of ovarian cancer in Los Alamos County women was elevated from the mid- 1970s to 1990. From 1986 through 1990, ovarian cancer incidence in Los Alamos County was roughly two-fold higher compared with New Mexico reference population rates. The excess ovarian cancer rate was confined to a census tract corresponding to two neighborhoods and was four to six-fold higher than that observed in the remaining Los Alamos County census tracts.

The incidence rates for melanoma (cancer of the skin) in Los Alamos County workers elevated from 1970 through 1990, with peak elevations occurring from the mid- to late-1980's. There was approximately a two-fold excess risk compared with a New Mexico State reference population. The excess melanoma incidence observed in Los Alamos County was thought to be related to the high ambient solar ultraviolet radiation intensity due to its high altitude.

A four-fold increase in thyroid cancer incidence during the late 1980s was noted in a study by Athas (NM DOH 1996a). A case-series records review was initiated to examine data relating to the detection, diagnosis, and known risk factors for thyroid cancer. All cases of thyroid cancer diagnosed among Los Alamos County residents between 1970 and 1995 were identified through the New Mexico Tumor Registry. The incidence rate for thyroid cancer in Los Alamos County was slightly higher than New Mexico rates between 1970 and the mid-1980's. There was a statistically-significant four-fold increase during the late-1980s and early 1990s compared with the State, but the rate began to decline in 1994 and 1995.

The higher than expected number of thyroid cancer cases could not be explained by changes in diagnosis of thyroid cancer among Los Alamos County residents. Additional analyses suggested that increased medical surveillance and greater access-to medical care were responsible for the recent excess in Los Alamos County. Potential risk factors for thyroid cancer including therapeutic irradiation, genetic susceptibility, occupational radiation exposure, and weight were also examined. However, the investigation did not identify a specific cause for the elevated rate of thyroid cancer in Los Alamos County.

Male Workers. A mortality study of 224 white males with the highest internal depositions of Pu 239 (10 nanocuries or more) at LANL were examined by Voelz, et al. (LANL 1985a). Followup was through April 1980; SMRs were low for all cause of death (SNM=0.56, 95 percent CI=0.40-0.75), all malignant neoplasms (SMR=0.54, 95 percent CI=0.23-1.06), compared with U.S. white males and lung cancer (SMR=20, 95 percent CI=0-110).

A cohort mortality study by Wiggs et al. examined the causes of death among 15,727 white males hired at LANL between 1943 and 1977 (HP 1994a:577-588). The purpose of the study was to determine if Pu deposition and external ionizing radiation were related to worker mortality. After nearly 30 years of followup, the LANL workforce experienced 37 percent fewer deaths from all causes, and 36 percent fewer deaths due to cancer than expected when compared with death rates for the U.S. population.

The researchers identified a subset of 3,775 workers who had been monitored for Pu exposure; of these, 303 workers were categorized as "exposed" based on a urine bioassay for Pu; the remainder were "non-exposed." One case of rare bone cancer, osteogenic sarcoma, a type of cancer related to Pu exposure in animal studies, was noted among the Pu exposed group. The overall mortality and site-specific rates of cancer did not differ significantly between the two groups of workers. A non-statistically significant increase in lung cancer among the exposed group was noted, but there was no information on cigarette use among the workers.

When researchers examined data for the 10,182 workers who were monitored for exposure to external ionizing radiation (including 245 workers exposed to Pu) they observed a dose-response relationship for cancers of the brain/central nervous system, cancer of the esophagus, and Hodgkin's disease. When the 225 Pu-exposed workers were excluded from the analysis, there was a statistically significant dose response between external ionizing radiation and kidney cancer and lymphocytic leukemia.

A special lifetime medical study was conducted on 26 of the workers who have the largest internal depositions of Pu at LANL. Voelz and Lawrence reported on the 42-year follow-up of the 26 white males who designed and built the first atomic bomb and were determined to have had a significant deposition of Pu-239 sometime in 1944 or 1945 based on job assignment, working conditions, and urine levels of Pu (HP 1991a:181-190). Their mortality experience was compared to U.S. white males adjusted for age and calendar time. The mortality rates were also compared with rates for a cohort of Los Alamos workers hired at the same time and born between the same years; no significant differences were observed for all cause mortality and all cancer mortality. One of the seven reported deaths was due to bone sarcoma, the most frequent radiation-induced cancer observed in persons with radium depositions.

Wiggs reported on 6,970 women employed at LANL at least 6 months from 1943 through 1979, with deaths determined through 1981 (LA Wiggs 1987a). The mortality rates for all causes of death combined and all cancers combined were 24 percent and 22 percent below the rate for the U.S. population. Although the overall rates are low, women occupationally exposed to ionizing radiation have elevated rates for cancer of the ovary and of the pancreas relative to those not exposed. An unusual finding was that female radiation workers experienced a statistically significant excess of death from suicide. In a special in-depth study, the suicides were compared to two control groups, deaths from other injuries and deaths from non-injuries. History of employment as a radiation worker was significantly associated with death from suicide for both comparison groups. No significant associations for duration of employment, Pu exposure, or marital status were seen (APHA 1988a).

As a result of a reported three-fold excess of malignant melanoma among laboratory workers at LLNL in California and similarities between occupational exposures and prevailing sunshine conditions at LANL and LLNL, an investigation was undertaken to assess the risk of melanoma at LANL (Lancet 198la:712-716). Incidence data were obtained from the New Mexico Tumor Registry. No excess risk for melanoma was detected at LANL among 11,308 laboratory workers between 1969 and 1978. Six cases were identified where about 5.7 were expected (Lancet 1982a:883-884). The rate for the total cohort, Hispanic males and females, non-Hispanic males and females were not significantly different from the corresponding New Mexico rates.

A special in-depth, study of fifteen cases diagnosed through 1982 did not detect an association between melanoma and exposure to any type of external radiation as measured by film badges, neutron exposures, Pu body burden based on urine samples, or employment as a chemist or physicist (HP 1983c:587-592). However, the melanoma cases were more educated than the comparison group using the college and graduate degree as a measure of education; a finding consistent with other reports of malignant melanoma according to the authors. The numbers in this study are too small to detect any but large excesses.

Memorandum of Understanding. The Department entered into a Memorandum of Understanding with the Department of Health and Human Services to conduct health studies at DOE sites. NIOSH is responsible for managing or conducting the worker studies. The following multi-site studies that include LANL are currently underway: a study of mortality among female nuclear weapons workers; a case-control study of multiple myeloma; a leukemia study; and an exposure assessment of hazardous waste/cleanup workers.

M.5 FACILITY ACCIDENTS

M.5.1 EVALUATION METHODOLOGIES AND ASSUMPTIONS

M.5.1.1 Introduction

The potential for facility accidents and the magnitudes of their consequences are important factors in the evaluation of the storage and disposition alternatives addressed in the PEIS. The health risk issues are twofold:

- Whether accidents at any of the individual storage and disposition facilities (or reasonable combinations thereof) pose unacceptable health risks to workers or the general public.

- Whether alternative locations for storage and disposition facilities (or reasonable combinations thereof) can provide lesser public or worker health risks. These lesser risks may arise either from a greater isolation of the site from the public, or from a reduced frequency of such external accident initiators as seismic events, aircraft crashes, and so forth.

Guidance for implementation of Council on Environmental Quality regulation 40 CFR 1502.22, as amended (51 FR 15618) requires the evaluation of impacts which have low probability of occurrence but high consequences if they do occur; thus facility accidents must be addressed to the extent feasible in the PEIS. Further, public comments received during the scoping process clearly indicated the public concern with facility safety and consequent health risks, and the need to address these concerns in the decisionmaking process.

For the No Action case, potential accidents are defined in existing facility documentation, such as safety analysis reports, hazards assessment documents, NEPA documents and probabilistic risk assessments. The accidents include radiological and chemical accidents that produce high consequences but have a low likelihood of occurrence, and a spectrum of other accidents that have a higher likelihood of occurrence and lesser consequences than the high consequence accidents. The data in these documents includes accident scenarios, materials at risk, source terms (quantities of hazardous materials released to the environment) and consequences.

For new storage and disposition facilities, the identification of accident scenarios and associated data would normally be a product of safety analysis reports performed on completed facility designs. However, the conceptual design information available during the PEIS preparation is not useful for quantitative safety analyses. Accordingly, for each of the storage and disposition facilities, the accident information developed for similar existing facilities is used as a surrogate and the likelihood and consequences (which are site dependent) are recomputed for each of the storage and disposition proposed sites where a facility may be located. This calculation reflects the effects of such site parameters as population size and distribution, meteorology and distance to the site boundary.

This analysis also acknowledges, semi-quantitatively, the differences in likelihood of accident initiators at specific sites (for example, aircraft impacts, beyond evaluation basis seismic events) as well as qualitatively discussing the opportunities for risk reduction afforded by the potential incorporation of new technologies, processes or protective features in the storage and disposition facilities that will enhance public health and safety over the existing facilities. Subsequent to the PEIS, evaluation of the specific benefits achieved by such measures would be presented in the tiered, project-specific environmental impact statement for each facility. Also, for each facility, a *Hazards Analysis Document* that identifies and estimates the effects of all major hazards that have the potential to affect the environment, workers and the public would be issued in conjunction with the Conceptual Design Package. Additional accident analyses for identified major hazards would be provided in a *Preliminary Safety Analysis Report* to be issued during the period of Definitive Design (Title II) Review. A *Final Safety Analysis Report* would be prepared during the construction period and issued before testing begins

as final documented evidence that the new facility can be operated in a manner that does not present any undo risk to the health and safety of workers and the public.

In determining the potential for facility accidents and the magnitudes of their consequences, this PEIS incorporates two important concepts to the presentation of results: risk and uncertainties and conservatism.

M.5.1.1.1 *Risk*

Risk is most important when presenting accident analysis results. The chance that an accident might occur during the conduct of an operation is called the probability of occurrence. An event that is certain to occur has a probability of 1 (as in 100 percent certainty). The probability of occurrence of an accident is less than one because accidents, by definition, are not certain to occur. If an accident is expected to happen once every 5 years, the frequency (and probability) of occurrence is 0.2/yr (1 occurrence ÷ 5 years = 0.2 occurrences/yr).

Once the frequency (occurrences per year) and the consequences (for radiation effects, measured in terms of the number of latent cancer fatalities caused by the radiation exposure) of an accident are known, the risk can be determined. The risk of latent cancer fatalities per year is the product of the annual frequency of occurrence times the number of latent cancer fatalities that would result if the accident occurred. This annual risk expresses the expected number of latent cancer fatalities per year, taking account of both the annual chance that an accident might occur and the estimated consequences if it does occur.

For example, if the frequency of an accident were 0.2 occurrences/yr and the number of latent cancer fatalities resulting from the accident were 0.05, the risk would be 0.01 latent cancer fatalities/yr (0.2 occurrences/yr x 0.05 latent cancer fatalities per occurrence = 0.01 latent cancer fatalities/yr). Another way to express this risk (0.01 latent cancer fatalities/yr) is to note that if the operation subject to the accident continued for 100 years, one latent cancer fatality would be likely to occur because of accidents during that period. This is equivalent to 1 chance in 100 that a single latent cancer fatality would be caused by the accident source for each year of operation.

A frame of reference for the risks from accidents associated with storage and disposition alternatives can be developed in the same way. As an example, the risk of a latent cancer fatality from a beyond evaluation basis earthquake (the maximum radiation exposure consequence) for a hypothetical individual at the INEL site boundary from the consolidation of Pu would be approximately 2.7×10^{-11} ($1.0 \times 10^{-7} \times 2.7 \times 10^{-4}$)/yr (Table M.5.2.1.2–3). This risk can be compared with the lifetime risks of death from other accidental causes to gain a perspective. For example, the risk of dying from a motor vehicle accident is about 1 in 80. Similarly, the risk of death for the average American from fires is approximately 1 in 500, and for death from accidental poisoning, the risk is about 1 in 1,000. These comparisons are not meant to imply that risks of a latent cancer fatality caused by DOE operations are trivial, only to show how they compare with other, more common risks. Radiological risks to the general public from DOE operations are considered to be involuntary risks, as opposed to voluntary risks such as operating a motor vehicle.

M.5.1.1.2 *Uncertainties and Conservatism*

[Text deleted.] For routine operations, the results of monitoring actual operations provide realistic estimates of source terms, which when combined with conservative estimates of the effects of radiation, produce estimates of risk that are very unlikely to be exceeded. The effects for all alternatives have been calculated using uniform source terms and other factors, so this PEIS provides an appropriate means of comparing potential impacts on human health and the environment.

The analyses of hypothetical accidents are based on calculations that in turn are based on sequences of events and models of effects that have not occurred. The models provide estimates of the probabilities, source terms, pathways for dispersion and exposure, and the effects on human health and the environment that are as realistic

as possible. In many cases, the probability of the accidents postulated is very low and little experience is available; thus, the consequences are uncertain. This has required the use of models or values for input that produce estimates of consequences and risks that are higher than would actually occur in order to provide conservative results. All the alternatives have been evaluated using uniform methods and data, allowing a fair comparison of all the alternatives on the same basis. [Text deleted.]

M.5.1.2 Safety Design Process

One of the major design goals for storage and disposition facilities is to achieve a reduced risk to worker and public health and safety relative to that associated with similar operations at the existing nuclear weapons complex. Significant changes exist between storage and disposition facilities and the current facilities design criteria and safety standards, which would reduce total risk to the public. These changes include: design to current DOE structural and safety criteria; smaller throughput, batch size and inventories of certain hazardous materials; and elimination of the same hazardous materials. This would reduce potential offsite health effects if a significant accidental release were to occur.

Storage and disposition facilities would be designed to comply with current Federal, State and local laws, DOE Orders, and industrial codes and standards. This would provide a plant that is highly resistant to the effects of natural phenomena, including earthquake, flood, tornado, high wind, as well as credible events as appropriate to the site, such as fire and explosions, and man-made threats to its continuing structural integrity for containing hazardous materials. The facilities would be designed to maintain their continuing structural integrity in the event of any credible accident or event, including an aircraft crash.

The design process for the storage and disposition facilities would comply with the requirements for safety analysis and evaluation in DOE O 430.1 and Order 5480.23. These require that the safety assessment be an integral part of the design process to ensure compliance with all DOE safety criteria by the time that the facilities are constructed and in operation.

The safety analysis process begins early in conceptual design with identification of hazards having potential to produce unacceptable safety consequences to workers or the public. As the design develops, failure mode and effects analyses are performed to identify events which have the potential to release hazardous material. The kinds of events considered include equipment failure, spills, human error, fire, explosions, criticality, earthquake, electrical storms, tornado, flood, and aircraft crash. These postulated events become focal points for design changes or improvements to prevent unacceptable accidents. These analyses continue as the design progresses to assess the need for safety equipment and to assess the performance of this equipment in accident mitigation. Eventually, the safety analyses are formally documented in a safety analysis report (SAR) and, if appropriate, in a probabilistic risk assessment (PRA). The PRA documents the estimated frequency and consequence for a complete spectrum of accidents and helps to identify where design improvements could make meaningful safety improvements.

The first SAR is completed at the conclusion of conceptual design and includes identification of hazards and some limited assessment of a few enveloping evaluation basis accidents. This analysis includes deterministic safety analysis and failure modes and effects analysis of major systems. A detailed comprehensive preliminary SAR is completed by the completion of preliminary design and provides a broad assessment of the range of evaluation basis accident scenarios and the performance of equipment provided in the facility specifically for accident consequence mitigation. A limited PRA may be included in that analysis.

The SAR continues to be developed during detailed design. The safety review of this report and any supporting PRA is completed and safety issues resolved before initiation of construction of the facility. There is also a final SAR produced that includes documentation of safety-related design changes during construction and the impact of those changes on the safety assessment. It also includes the results of any safety-related research and

development that has been performed to support the safety assessment of the facility. Final approval of the final SAR is required before the facility is allowed to commence operation.

M.5.1.3 Analysis Methodology

M.5.1.3.1 *Introduction*

The MELCOR Accident Consequence Code System (MACCS) was used to estimate the consequences of all storage and disposition facilities for all accidents. A discussion of the MACCS computer code is provided in Section M.5.1.3.2. A detailed description of the MACCS model is available in NUREG/CR-6059, SAND92-2146. The MACCS computer code has been used for the analysis of accidents for many environmental impact statements and other safety documentations and is considered applicable for analyzing potential accidents associated with the storage and disposition of Pu and HEU.

M.5.1.3.2 *MACCS Overview*

MACCS models the offsite consequences of an accident that releases a plume of radioactive materials to the atmosphere. Should such an accidental release occur, the radioactive gases and aerosols in the plume would be transported by the prevailing wind while dispersing in the atmosphere. The environment would be contaminated by radioactive materials deposited from the plume and the population would be exposed to radiation. An estimation of the range and probability of the health effects induced by the radiation exposures not avoided by protective actions and the economic costs and losses that would result from the contamination of the environment are the objectives of a MACCS calculation.

There are two fundamental aspects of the organization of MACCS which are basic to its understanding: the time scale after the accident is divided into various "phases;" and the region surrounding the reactor is divided into a polar-coordinate grid.

The time scale after the accident is divided into three phases: emergency phase, intermediate phase, and long-term phase. The emergency phase begins immediately after the accident and could last up to seven days following the accident. In this period, the exposure of population to both radioactive clouds and contaminated ground is modeled. Various protective measures can be specified for this phase, including evacuation, sheltering, and dose-dependent relocation.

The intermediate phase can be used to represent a period in which evaluations are performed and decisions are made regarding the type of protective measure actions which need to be taken. In this period, the radioactive clouds are assumed to be gone and the only exposure pathways are those from the contaminated ground. The protective measure which can be taken during this period is temporary relocation.

The long-term phase represents all time subsequent to the intermediate phase. The only exposure pathways considered here are those resulting from the contaminated ground. A variety of protective measures can be taken in the long-term phase in order to reduce doses to acceptable levels: decontamination, interdiction, and condemnation of property.

The spatial grid used to represent the region is centered on the facility itself. The user specifies the number of radial divisions as well as their endpoint distances. Up to 35 of these divisions may be defined, extending out to a maximum distance of 9,999 km (6,213 mi). The angular divisions used to define the spatial grid correspond to the sixteen directions of the compass.

Since the emergency phase calculations utilize dose-response models for early fatality and early injury which are highly non-linear, it is necessary for those calculations to be performed on a finer grid than the calculations

of the intermediate and long-term phases. For this reason, the sixteen compass sectors are divided into three, five, or seven user-specified subdivisions in the calculations of the emergency phase.

The dose-to-risk conversion factors (0.0005 latent cancer fatalities/person-rem for the public and 0.0004 for the worker) used in this PEIS to relate radiation exposures to latent cancer fatalities are based on the *1990 Recommendations of the International Commission on Radiation Protection* (ICRP Publication 60). These conversion factors are consistent with those used by the U.S. NRC in its rulemaking "Standards for Protection Against Radiation" (10 CFR 20). In developing these conversion factors, the International Commission on Radiological Protection reviewed many studies, including *Health Effects of Exposure to Low Levels of Ionizing Radiation (BEIR V)* and *Sources, Effects and Risks of Ionizing Radiation*. These conversion factors represent the best-available estimates for relating a dose to its effect; most other conversion factors fall within the range of uncertainty associated with the conversion factors that are discussed in the National Academy of Sciences NAS/NRC (1990). The conversion factors apply where the dose to an individual is less than 20 rem (20,000 millirem [mrem]) and the dose rate is less than 10 rem (10,000 mrem) per hour. At doses greater than 20 rem (20,000 mrem), the conversion factors used to relate radiation doses to latent cancer fatalities are doubled. At much higher doses, prompt effects, rather than latent cancer fatalities, may be the primary concern. Unusual accident situations that may result in high radiation doses to individuals are considered special cases.

The MACCS code was applied in a probabilistic manner using a weather bin sampling technique. Centerline doses as a function of distance were calculated for each of 150 meteorological sequence samples; the mean value of these doses and increased likelihoods of cancer fatality for the distance corresponding to the location of the maximum offsite individual (sometimes referred to as the "maximum exposed individual") at each site were reported for that individual. Doses to an uninvolved worker were calculated similarly, except that the worker would experience an increased likelihood of cancer fatality of 4.0×10^{-4} times the dose in rem for doses less than 20 rem or exposure rates less than 10 rem/hr. For larger doses, when the rate of exposure is greater than 10 rem/hr, the increased likelihood of latent cancer fatality is doubled. The estimated dose to a worker was based on a location 1,000 m (3,280 ft) from the release point.

Offsite population doses and latent cancer fatalities are calculated by MACCS using a similar methodology to that described for the maximum offsite individual. In the case of the population, each of the sampled meteorological sequences was applied to each of the 16 sectors (accounting for the frequency of occurrence of the wind blowing in that direction). Population doses are the sum of the individual doses in each sector. Once again, the mean value of the calculated population doses and latent cancer fatalities for each of these trials is reported.

M.5.1.3.3 *Methodology and Techniques*

The relative consequences of postulated accidents in the evaluation of each alternative are assessed in the Public and Occupational Health and Safety Sections of Section 4.2 for the storage alternatives and Section 4.3 for the disposition alternatives. The accident analysis involves less detail than a formal probabilistic risk assessment and facility safety analysis by addressing bounding accidents (relatively low probability of occurrence and high consequence) and a representative spectrum of possible operational accidents (relatively high probability of occurrence and low consequence). The technical approach for the selection of accidents is consistent with the DOE Office of NEPA Oversight *Recommendation for the Preparation of Environmental Assessments and Environmental Impact Statement* guidance, which recommends consideration of two major categories of accidents: within design basis accidents and beyond design basis accidents.

The preliminary accident analyses (conducted during the feasibility design) were performed primarily to identify those systems and structures which should be categorized as "safety class." This determination, for a particular system or structure, involves assessing whether the consequence of an accident in which that system

or structure fails exceeds some threshold exposure value. In general, the consequence assessments are very conservative to ensure that cost estimates which result from the feasibility design have a conservative basis.

In developing a range of accidents to consider, it is common to consider only those accidents that have a probability of occurrence equal to or greater than 10^{-7} per year. The accidents evaluated were selected to represent a spectrum of accident probabilities and consequences ranging from low-probability/high-consequence to high-probability/low-consequence events. However, because of the preliminary nature of the designs under consideration here, it has not been possible to assess quantitatively the probability of occurrence of all of the events addressed. The information provided does not indicate the total risk of operating the facility but does provide information identifying high risk events that could be used to differentiate safety risks among alternatives if an accident were to occur. The probabilities for the accidents described have been estimated by considering qualitatively accident probabilities from other facilities and locations. It is possible that the beyond design basis accidents included for consideration here will later be shown in tiered NEPA documentation to have probabilities of occurrence much less than 10^{-7}.

For each potential accident, information is provided on the risk and consequences to three types of receptors: (1) a worker, (2) a maximally exposed individual member of the public, and (3) the offsite population. The first receptor, a worker, is a hypothetical individual working on the site but not involved in the proposed action. This worker is assumed to be located at a point 1,000 m (3,280 ft)from the location of the accident. Although other distances closer to the accident could have been assumed, the results would be less accurate because of limitations of the MACCS computer code in modeling the effects of building and local terrain on the dispersion of the released radioactive substances. A worker that is closer than 1,000 m (3,280 ft) from the accident will generally receive a higher dose, while a worker further away would generally receive a lower dose. At some sites where the distance from the accident to the nearest site boundary is less than 1,000 m (3,280 ft), the worker is assumed to be located at the site boundary. The second receptor, a member of the public, is a hypothetical individual who is assumed to be located at the nearest site boundary. Exposures received by this individual are intended to represent the highest risks to a member of the public. The third receptor, the offsite population, represents all members of the public located within 80 km (50 mi) of the location of the accident. The choice of 80 km (50 mi) is a common practice, although other distances could have been used.

The consequences of an accident for a worker or individual at the site boundary are expressed in terms of dose (rem) and probability of a cancer fatality if the individual is exposed to the dose. The risk of cancer fatality to the individual is the mathematical product of the probability of the accident and the consequence (probability of a cancer fatality). The consequences for the offsite population are expressed in terms of population dose (person-rem) and the number of cancer fatalities in the population within 80 km (50 mi) of the site boundary. The risk of the estimated number of cancer fatalities is the mathematical product of the number of cancer fatalities and the probability of the accident. The estimated risks are expressed either on an annual basis or on the basis of the operational campaign proposed or assumed for a storage or disposition facility, depending on the context of the information.

The MACCS model is one of a number of models that could be used for accident evaluations. The models will generally differ in their results because of the many differences in their assumptions and techniques. The MACCS model was selected because it is commonly used for SAR and EIS accident analyses, particularly for severe accident analyses. For each of the accidents selected for evaluation of an alternative, information is provided on the accident probability, dose, cancer fatalities, and risk.

M.5.1.3.4 *Isotopic Spectra Used in the Storage and Disposition Accident Analyses*

For each of the accidents selected for evaluation of an alternative, source term information (radionuclide release) is generated based on the total Pu release using the pertinent radionuclide spectrum for that alternative. A mixed Pu spectrum presented in Table M.5.1.3.4–1 is used for Pu storage and disposition alternatives. A

weapons grade Pu spectrum presented in Table M.5.1.3.4–2 is used for Pit Disassembly and Conversion operations. The Pu spectrum presented in Table M.5.1.3.4–3 is used for Pu conversion process operations.

Table M.5.1.3.4–1. Isotopic Distribution for a Mixed Plutonium Release[a]

Isotope	Isotopic Content (g/g Pu)	Specific Activity of Isotope (Ci/g Isotope)	Specific Activity (Ci/g Pu)
Pu-238	9.21×10^{-5}	17.1	1.58×10^{-3}
Pu-239	0.921	0.0621	0.0572
Pu-240	0.0666	0.228	0.0152
Pu-241	5.23×10^{-4}	103	0.0539
Pu-242	5.69×10^{-4}	3.93×10^{-3}	2.23×10^{-6}
Am-241	8.28×10^{-5}	3.43	2.84×10^{-4}

[a] Isotopic distribution for mixed Pu aged for 60 years. Used for calculating the source terms for the accidents evaluated for Pu storage and disposition alternatives.

Note: Am=Americium.

Source: HNUS 1996a.

Table M.5.1.3.4–2. Isotopic Distribution for a Weapons-Grade Plutonium Release[a]

Isotope	Isotopic Content (g/g Pu)	Specific Activity of Isotope (Ci/g Isotope)	Specific Activity (Ci/g Pu)
Pu-238	3.29×10^{-5}	17.1	5.63×10^{-4}
Pu-239	0.930	0.0621	0.0578
Pu-240	0.0596	0.228	0.0136
Pu-241	4.19×10^{-4}	103	0.0430
Pu-242	1.0×10^{-4}	3.93×10^{-3}	3.93×10^{-7}
Am-241	6.63×10^{-3}	3.43	0.0227

[a] Isotopic distribution for weapons-grade Pu aged for 60 years. Used for calculating the source terms for the potential accidents evaluated for pit disassembly process operations.

Note: Am=Americium.

Source: HNUS 1996a.

Table M.5.1.3.4–3. Isotopic Distribution for a Non-Pit (Pu Conversion) Plutonium Release[a]

Isotope	Isotopic Content (g/g Pu)	Specific Activity of Isotope (Ci/g Isotope)	Specific Activity (Ci/g Pu)
Pu-238	2.12×10^{-4}	17.1	3.62×10^{-3}
Pu-239	0.902	0.0621	0.0560
Pu-240	0.0807	0.228	0.0184
Pu-241	7.35×10^{-4}	103	0.0757
Pu-242	1.51×10^{-3}	3.93×10^{-3}	5.94×10^{-6}
Am-241	1.16×10^{-4}	3.43	3.99×10^{-4}

[a] Isotopic distribution for non-pit (Pu conversion) Pu aged for 60 years. Used for calculating the source terms for the potential accidents evaluated for Pu conversion process operations.

Note: Am=Americium.

Source: HNUS 1996a.

M.5.2 LONG-TERM STORAGE ALTERNATIVES

M.5.2.1 Consolidation of Plutonium Alternative

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for the consolidated Pu storage facility in the *Beyond Design Basis Accident Analysis*. The studies postulated a set of accident scenarios that were representative of the risks and consequences for workers and the public that can be expected if the facility were constructed and operated. Although not all potential accidents were addressed, those that were postulated have consequences and risks that are expected to envelop the consequences and risks of an operating facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than 1.0×10^{-7}/yr are anticipated that will have consequences and risks larger than those described in this section. [Text deleted.] This includes the potential impacts of an aircraft crash which has been considered and dismissed because the probability of crashing into a single facility and causing sufficient damage to release Pu is much lower than 10^{-7}/yr.

M.5.2.1.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the facility. Through a screening process, three evaluation basis accidents and seven beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.2.1.1–1 and M.5.2.1.1–2. Accident scenario descriptions are provided in Table M.5.2.1.1–3. Accident source term information is provided in Tables M.5.2.1.1–4 and M.5.2.1.1–5.

[Text deleted.]

Table M.5.2.1.1–1. Evaluation Basis Accident Scenarios for Consolidation Alternative

Accident Scenario	Accident Frequency (per year)	Source Term at Risk[a] (PCV)	Source Term Released to Environment (g Pu)
PCV puncture by forklift	6.0×10^{-4}	2	0.0387
PCV breach by firearms discharge	3.5×10^{-4}	1	3.87×10^{-3}
PCV penetration by corrosion	0.064	1	0.158

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.
Source: DOE 1995mm.

Table M.5.2.1.1–2. Beyond Evaluation Basis Accident Scenarios for Consolidation Alternative

Accident Scenario	Accident Frequency (per year)	Source Term at Risk[a] (PCV)	Source Term Released to Environment
Vault fire	1.0×10^{-7}	120	81.3 g Pu
Truck bay fire	1.0×10^{-7}	12	5.40 g Pu
Spontaneous combustion	7.0×10^{-7}	2	7.75×10^{-3} g Pu
Explosion in the vault	1.0×10^{-7}	45	12.7 g Pu
Explosion outside of vault	1.0×10^{-7}	1	0.058 g Pu
Nuclear criticality	1.0×10^{-7}	[b]	1.0×10^{19} fissions[b]
Beyond evaluation basis earthquake	1.0×10^{-7}	194	146 g Pu

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.
[b] See Table M.5.2.1.1–5.
Source: DOE 1995mm.

Table M.5.2.1.1–3. Accident Scenario Descriptions for Consolidation and Collocation Facilities

Accident Scenario	Accident Description
Evaluation Basis Accidents	
PCV puncture by forklift	A forklift driver attempting to pick up a pallet containing PCVs in the shipping/receiving area encounters a situation in which the fork is incorrectly positioned such that it contacts the PCVs. Before the operator responds to the contact, the forward motion of the forklift punctures two PCVs with the tines of the fork. The operator backs the forklift away from the structure, and the PCVs fall off the fork, spilling some of the contents on the floor.
PCV breach by firearms discharge	Because of the armed security guard force at the storage facility, it is necessary to consider possible breach of a PCV caused by a bullet from accidental discharge of the guard's firearm. The PCV is not designed to withstand such an impact, and its effect would be to potentially penetrate the container and cause some dispersal of the contents. This can occur only where the PCVs are above the operating floor, and would be most likely in the shipping/receiving area and possibly some material handling areas.
PCV penetration by corrosion	The PCV is presumed to fail because of long-term corrosion, gradual buildup of internal pressure, or other causes generally internal to the PCV itself, and probably related to its contents. These events would generally be the result of errors in packaging the contents or in sealing the PCV. The failure would take place over an extended period, and the initial progress of the failure would be undetectable through casual external observation. Eventually, the PCV closure seal would be breached and a small slit or crack would develop. The opening would be enlarged through continuation of the driving force and eventually some PCV contents would be expelled into the storage area or into one of the handling/inspection areas.
Beyond Evaluation Basis Accidents	
Vault fire	A large amount of jet fuel, gasoline, or some high energy density fuel is introduced into the vault through a ventilation duct and ignited.
Truck bay fire	A fire occurs following the rupture of the a truck's fuel tank and ignition of the spilled fuel. A single trailer is engulfed by flames and is heated to at least the ignition point of Pu.
Spontaneous combustion	Due to improper packaging, the contents of two PCVs ignite spontaneously after being punctured by a forklift accident.
Explosion in the vault	An explosion of undefined origin is assumed to occur below grade in the vault. The detonation is assumed to deform some storage tubes, which in turn crush and open some PCVs. There is no fire and other systems remain intact.
Explosion outside of vault	An explosion of undefined origin is assumed to occur in the repackaging area. The blast has sufficient force to breach the glovebox, exposing the contents to the room atmosphere and bypassing two levels of filtration material.
Nuclear criticality	The only way a criticality event could occur would be in the case of multiple operational errors or an accident scenario that breaches PCVs and the fissile material somehow collects in a criticality favorable geometry.
Beyond evaluation basis earthquake	The building collapses and some PCVs are crushed.

Note: PCV=primary containment vessel.

Source: DOE 1995mm.

Table M.5.2.1.1–4. Consolidation Alternative Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario		
	PCV Puncture by Forklift	PCV Breach by Firearms Discharge	PCV Penetration by Corrosion
Frequency of occurrence (per year)	6.0×10^{-4}	3.5×10^{-4}	6.4×10^{-2}
Pu released to environment (g)	0.0387	3.87×10^{-3}	0.158
Isotope Released to Environment (Ci)			
Pu-238	6.11×10^{-5}	6.11×10^{-6}	2.50×10^{-4}
Pu-239	2.21×10^{-3}	2.21×10^{-4}	9.04×10^{-3}
Pu-240	5.88×10^{-4}	5.88×10^{-5}	2.40×10^{-3}
Pu-241	2.09×10^{-3}	2.09×10^{-4}	8.52×10^{-3}
Pu-242	8.63×10^{-8}	8.63×10^{-9}	3.52×10^{-7}
Am-241	1.10×10^{-5}	1.10×10^{-6}	4.49×10^{-5}

Note: Am=Americium; PCV=primary containment vessel.
Source: Derived from Tables M.5.1.3.4–1 and M.5.2.1.1–1.

Table M.5.2.1.1–5. Consolidation Alternative Beyond Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario						
	Vault Fire	Truck Bay Fire	Spontaneous Combustion	Explosion in the Vault	Explosion Outside of Vault	Nuclear Criticality	Beyond Evaluation Basis Earthquake
Frequency of occurrence (per year)	1.0×10^{-7}	1.0×10^{-7}	7.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}
Pu released to environment (g)	81.3	5.40	7.75×10^{-3}	12.69	0.058	NA	146.39
Fission	NA	NA	NA	NA	NA	1.0×10^{19}	NA
Isotope Released to Environment (Ci)							
Pu-238	0.128	8.53×10^{-3}	1.22×10^{-5}	0.020	9.16×10^{-5}	0	0.231
Pu-239	4.65	0.309	4.43×10^{-4}	0.726	3.32×10^{-3}	0	8.37
Pu-240	1.24	0.082	1.18×10^{-4}	0.193	8.82×10^{-4}	0	2.23
Pu-241	4.38	0.291	4.18×10^{-4}	0.684	3.13×10^{-3}	0	7.89
Pu-242	1.81×10^{-4}	1.20×10^{-5}	1.73×10^{-8}	2.83×10^{-5}	1.29×10^{-7}	0	3.26×10^{-4}
Am-241	0.023	1.53×10^{-3}	2.20×10^{-6}	3.60×10^{-3}	1.65×10^{-5}	0	4.16×10^{-2}
Kr-83m	0	0	0	0	0	55.0	0
Kr-85m	0	0	0	0	0	35.5	0
Kr-85	0	0	0	0	0	4.05×10^{-3}	0
Kr-87	0	0	0	0	0	215	0
Kr-88	0	0	0	0	0	115	0
Kr-89	0	0	0	0	0	6.5×10^{3}	0
Xe-131	0	0	0	0	0	0.05	0
Xe-133m	0	0	0	0	0	1.10	0
Xe-133	0	0	0	0	0	13.5	0
Xe-135m	0	0	0	0	0	1.65×10^{3}	0
Xe-135	0	0	0	0	0	205	0
Xe-137	0	0	0	0	0	2.45×10^{4}	0
Xe-138	0	0	0	0	0	5.5×10^{3}	0
I-131	0	0	0	0	0	0.55	0
I-132	0	0	0	0	0	60.0	0
I-133	0	0	0	0	0	8.0	0
I-134	0	0	0	0	0	215	0
I-135	0	0	0	0	0	22.5	0

[Text deleted.]

Note: NA=not applicable.

Source: Derived from Tables M.5.1.3.4–1 and M.5.2.1.1–2

M.5.2.1.2 *Accident Impacts*

The estimated impacts of the postulated accidents at each site are provided in Tables M.5.2.1.2–1 through M.5.2.1.2–5. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.2.1.1–4 and M.5.2.1.1–5 using the MACCS computer code. [Text deleted].

Table M.5.2.1.2–1. Consolidation Alternative Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	0.011	4.4×10^{-6}	8.8×10^{-5}	4.4×10^{-8}	0.64	3.2×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	1.1×10^{-3}	4.4×10^{-7}	8.8×10^{-6}	4.4×10^{-9}	0.064	3.2×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.045	1.8×10^{-5}	3.6×10^{-4}	1.8×10^{-7}	2.6	1.3×10^{-3}	6.4×10^{-2}
Vault fire	23.1	0.012	0.18	9.2×10^{-5}	1,340	0.67	1.0×10^{-7}
Truck bay fire	1.5	6.1×10^{-4}	0.012	6.1×10^{-6}	89	0.045	1.0×10^{-7}
Spontaneous combustion	2.2×10^{-3}	8.8×10^{-7}	1.8×10^{-5}	8.8×10^{-9}	0.13	6.4×10^{-5}	7.0×10^{-7}
Explosion in the vault	3.6	1.4×10^{-3}	0.029	1.4×10^{-5}	209	0.11	1.0×10^{-7}
Explosion outside of vault	0.016	6.6×10^{-6}	1.3×10^{-4}	6.6×10^{-8}	0.96	4.8×10^{-4}	1.0×10^{-7}
Nuclear criticality	0.010	4.2×10^{-6}	6.5×10^{-5}	3.3×10^{-8}	0.07	3.5×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	41.6	0.022	0.33	1.7×10^{-4}	2,410	1.2	1.0×10^{-7}
[Text deleted]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.1.1–4 and M.5.2.1.1–5 and the MACCS computer code.

Table M.5.2.1.2–2. Consolidation Alternative Accident Impacts at Nevada Test Site

Accident Scenario	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	7.5×10^{-3}	3.0×10^{-6}	1.4×10^{-4}	7.0×10^{-8}	0.014	7.2×10^{-6}	6.0×10^{-4}
PCV breach by firearms discharge	7.5×10^{-4}	3.0×10^{-7}	1.4×10^{-5}	7.0×10^{-9}	1.4×10^{-3}	7.2×10^{-7}	3.5×10^{-4}
PCV penetration by corrosion	0.031	1.2×10^{-5}	5.7×10^{-4}	2.9×10^{-7}	0.059	3.0×10^{-5}	6.4×10^{-2}
Vault fire	15.8	7.6×10^{-3}	0.29	1.5×10^{-4}	30.3	0.015	1.0×10^{-7}
Truck bay fire	1.0	4.2×10^{-4}	0.019	9.7×10^{-5}	2.0	1.0×10^{-3}	1.0×10^{-7}
Spontaneous combustion	1.5×10^{-3}	6.0×10^{-7}	2.8×10^{-5}	1.4×10^{-8}	2.9×10^{-3}	1.5×10^{-6}	7.0×10^{-7}
Explosion in the vault	2.5	9.9×10^{-4}	0.046	2.3×10^{-5}	4.7	2.4×10^{-3}	1.0×10^{-7}
Explosion outside of vault	0.011	4.5×10^{-6}	2.1×10^{-4}	1.0×10^{-7}	0.021	1.1×10^{-5}	1.0×10^{-7}
Nuclear criticality	7.7×10^{-3}	3.1×10^{-6}	1.3×10^{-4}	6.5×10^{-8}	1.4×10^{-3}	6.9×10^{-7}	1.0×10^{-7}
Beyond evaluation basis earthquake	28.4	0.015	0.53	2.6×10^{-4}	55	0.027	1.0×10^{-7}
[Text deleted]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.1.1–4 and M.5.2.1.1–5 and the MACCS computer code.

Table M.5.2.1.2–3. Consolidation Alternative Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	0.010	4.1×10^{-6}	8.8×10^{-5}	4.4×10^{-8}	0.19	9.6×10^{-5}	6.0×10^{-4}
PCV breach by firearms discharge	1.0×10^{-3}	4.1×10^{-7}	8.8×10^{-6}	4.4×10^{-9}	0.19	9.6×10^{-6}	3.5×10^{-4}
PCV penetration by corrosion	0.042	1.7×10^{-5}	3.6×10^{-4}	1.8×10^{-7}	0.78	3.9×10^{-4}	6.4×10^{-2}
Vault fire	21.6	0.011	0.19	9.3×10^{-5}	402	0.20	1.0×10^{-7}
Truck bay fire	1.4	5.7×10^{-4}	0.012	6.2×10^{-6}	26.7	0.013	1.0×10^{-7}
Spontaneous combustion	2.1×10^{-3}	8.2×10^{-7}	1.8×10^{-5}	8.9×10^{-9}	0.038	1.9×10^{-5}	7.0×10^{-7}
Explosion in the vault	3.4	1.3×10^{-3}	0.029	1.5×10^{-5}	62.7	0.031	1.0×10^{-7}
Explosion outside of vault	0.015	6.2×10^{-6}	1.3×10^{-4}	6.7×10^{-8}	0.29	1.4×10^{-4}	1.0×10^{-7}
Nuclear criticality	0.010	4.0×10^{-6}	7.7×10^{-5}	3.9×10^{-8}	0.018	9.0×10^{-6}	1.0×10^{-7}
Beyond evaluation basis earthquake	38.9	0.021	0.34	1.7×10^{-4}	723	0.36	1.0×10^{-7}
[Text deleted]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.1.1–4 and M.5.2.1.1–5 and the MACCS computer code.

Table M.5.2.1.2–4. Consolidation Alternative Accident Impacts at Pantex Plant

Accident Scenario	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	4.4×10^{-3}	1.8×10^{-6}	1.4×10^{-3}	7.1×10^{-7}	0.22	1.1×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	4.4×10^{-4}	1.8×10^{-7}	1.4×10^{-4}	7.1×10^{-8}	0.022	1.1×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.018	7.2×10^{-6}	5.8×10^{-3}	2.9×10^{-6}	0.89	4.4×10^{-4}	6.4×10^{-2}
Vault fire	9.3	3.8×10^{-3}	3.0	1.5×10^{-3}	456	0.23	1.0×10^{-7}
Truck bay fire	0.62	2.5×10^{-4}	0.20	9.9×10^{-5}	303	0.015	1.0×10^{-7}
Spontaneous combustion	8.9×10^{-4}	3.5×10^{-7}	2.8×10^{-4}	1.4×10^{-7}	0.044	2.2×10^{-5}	7.0×10^{-7}
Explosion in the vault	1.5	5.8×10^{-4}	0.46	2.3×10^{-4}	71.2	0.036	1.0×10^{-7}
Explosion outside of vault	6.6×10^{-3}	2.7×10^{-6}	2.1×10^{-3}	1.1×10^{-6}	0.33	1.6×10^{-4}	1.0×10^{-7}
Nuclear criticality	4.8×10^{-3}	1.9×10^{-6}	1.9×10^{-3}	9.3×10^{-7}	0.046	2.3×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	16.7	7.5×10^{-3}	5.34	2.7×10^{-3}	821	0.41	1.0×10^{-7}
[Text deleted]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.1.1–4 and M.5.2.1.1–5 and the MACCS computer code.

Table M.5.2.1.2–5. Consolidation Alternative Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	7.2×10^{-3}	2.9×10^{-6}	1.4×10^{-4}	7.1×10^{-8}	0.068	3.4×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	7.2×10^{-4}	2.9×10^{-7}	1.4×10^{-5}	7.1×10^{-9}	0.068	3.4×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.029	1.2×10^{-5}	5.8×10^{-4}	2.9×10^{-7}	2.8	1.4×10^{-3}	6.4×10^{-2}
Vault fire	15.2	6.9×10^{-3}	0.3	1.5×10^{-4}	1,440	0.72	1.0×10^{-7}
Truck bay fire	1.0	4.0×10^{-4}	0.020	9.9×10^{-6}	95.5	0.048	1.0×10^{-7}
Spontaneous combustion	1.4×10^{-3}	5.8×10^{-7}	2.8×10^{-5}	1.4×10^{-8}	0.14	6.9×10^{-5}	7.0×10^{-7}
Explosion in the vault	2.4	9.4×10^{-4}	0.046	2.3×10^{-5}	224	0.11	1.0×10^{-7}
Explosion outside of vault	0.011	4.3×10^{-6}	2.1×10^{-4}	1.1×10^{-7}	1.0	5.1×10^{-4}	1.0×10^{-7}
Nuclear criticality	6.9×10^{-2}	2.8×10^{-6}	1.1×10^{-4}	5.7×10^{-8}	0.094	4.7×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	27.3	0.013	0.53	2.7×10^{-4}	2,590	1.3	1.0×10^{-7}
[Text deleted]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.1.1–4 and M.5.2.1.1–5 and the MACCS computer code.

M.5.2.2 Collocation of Plutonium and Highly Enriched Uranium Alternatives

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for the consolidated special nuclear storage plant in the *Beyond Design Basis Accident Analysis*. The study results are directly applicable for the evaluation of the collocation of Pu and HEU storage facilities because consequences of Pu-based accidents bound the consequences of similar uranium-based accidents. The consolidated special nuclear storage plant studies postulated a set of Pu-based accident scenarios that were representative of the risks and consequences for workers and the public that can be expected if the consolidation of Pu and collocation with HEU storage facility were constructed and operated. Although not all potential accidents were addressed, those that were postulated have consequences and risks that are expected to envelop the consequences and risks of an operating facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than 1.0×10^{-7}/yr are anticipated that will have consequences and risks larger than those described in this section.

M.5.2.2.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the facility. Through a screening process, three evaluation basis accidents and seven beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.2.2.1–1 and M.5.2.2.1–2. Accident source term information is provided in Tables M.5.2.2.1–3 and M.5.2.2.1–4.

Table M.5.2.2.1–1. Evaluation Basis Accident Scenarios for Collocation Alternative

Accident Scenario	Accident Frequency (per year)	Source Term at Risk (PCV)[a]	Source Term Released to Environment
PCV puncture by forklift	6.0×10^{-4}	2	0.0387 g Pu
PCV breach by firearms discharge	3.5×10^{-4}	1	3.87×10^{-3} g Pu
PCV penetration by corrosion	0.064	1	0.158 g Pu

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.

Source: DOE 1995mm.

Table M.5.2.2.1–2. Beyond Evaluation Basis Accident Scenarios for Collocation Alternative

Accident Scenario	Accident Frequency (per yr)	Source Term at Risk (PCV)[a]	Source Term Released to Environment
Vault fire	$1.0x10^{-7}$	120	81.3 g Pu
Truck bay fire	$1.0x10^{-7}$	12	5.40 g Pu
Spontaneous combustion	$7.0x10^{-7}$	2	$7.75x10^{-3}$ g Pu
Explosion in the vault	$1.0x10^{-7}$	45	12.7 g Pu
Explosion outside of vault	$1.0x10^{-7}$	1	0.058 g Pu
Nuclear criticality	$1.0x10^{-7}$	[b]	$1.0x10^{19}$ fissions[b]
Beyond evaluation basis earthquake	$1.0x10^{-7}$	194	146

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.

[b] See Table M.5.2.1.1–5.

Source: DOE 1995mm.

Table M.5.2.2.1–3. Collocation Alternative Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario		
	PCV Puncture by Forklift	PCV Breach by Firearms Discharge	PCV Penetration by Corrosion
Frequency of occurrence (per yr)	$6.0x10^{-4}$	$3.5x10^{-4}$	0.064
Pu released to environment (g)	0.0387	$3.87x10^{-3}$	0.158
Isotope released to environment (Ci)			
Pu-238	$6.11x10^{-5}$	$6.11x10^{-6}$	$2.50x10^{-4}$
Pu-239	$2.21x10^{-3}$	$2.21x10^{-4}$	$9.04x10^{-3}$
Pu-240	$5.88x10^{-4}$	$5.88x10^{-5}$	$2.40x10^{-3}$
Pu-241	$2.09x10^{-3}$	$2.09x10^{-4}$	$8.52x10^{-3}$
Pu-242	$8.63x10^{-8}$	$8.63x10^{-9}$	$3.52x10^{-7}$
Am-241	$1.10x10^{-5}$	$1.10x10^{-6}$	$4.49x10^{-5}$

Note: PCV=primary containment vessel.

Source: Derived from Tables M.5.1.3.4–1 and M.5.2.2.1–1.

Table M.5.2.2.1–4. Collocation Alternative Beyond Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario						
	Vault Fire	Truck Bay Fire	Spontaneous Combustion	Explosion in the Vault	Explosion Outside of Vault	Nuclear Criticality	Beyond Evaluation Basis Earthquake
Frequency of occurrence[a] (per year)	1.0×10^{-7}	1.0×10^{-7}	7.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}
Pu Released to environment (g)	81.3	5.40	7.75×10^{-3}	12.69	0.058	NA	146
Fissions	NA	NA	NA	NA	NA	1.0×10^{19}	NA
Isotope released to environment (Ci)							
Pu-238	0.128	8.53×10^{-3}	1.22×10^{-5}	0.0201	9.16×10^{-5}	0	0.231
Pu-239	4.65	0.309	4.43×10^{-4}	0.726	3.32×10^{-3}	0	8.37
Pu-240	1.24	0.082	1.18×10^{-4}	0.193	8.82×10^{-4}	0	2.23
Pu-241	4.38	0.291	4.18×10^{-4}	0.684	3.13×10^{-3}	0	7.89
Pu-242	1.81×10^{-4}	1.20×10^{-5}	1.73×10^{-8}	2.83×10^{-5}	1.29×10^{-7}	0	3.26×10^{-4}
Am-241	0.023	1.53×10^{-3}	2.20×10^{-6}	3.60×10^{-3}	1.65×10^{-5}	0	4.16×10^{-2}
Kr-83m	0	0	0	0	0	55.0	0
Kr-85m	0	0	0	0	0	35.5	0
Kr-85	0	0	0	0	0	4.05×10^{-3}	0
Kr-87	0	0	0	0	0	215	0
Kr-88	0	0	0	0	0	115	0
Kr-89	0	0	0	0	0	6.5×10^{3}	0
Xe-131m	0	0	0	0	0	0.05	0
Xe-133m	0	0	0	0	0	1.10	0
Xe-133	0	0	0	0	0	13.5	0
Xe-135m	0	0	0	0	0	1.65×10^{3}	0
Xe-135	0	0	0	0	0	205	0
Xe-137	0	0	0	0	0	2.45×10^{4}	0
Xe-138	0	0	0	0	0	5.5×10^{3}	0
I-131	0	0	0	0	0	0.55	0
I-132	0	0	0	0	0	60.0	0
I-133	0	0	0	0	0	8.0	0
I-134	0	0	0	0	0	215	0
I-135	0	0	0	0	0	22.5	0

[a] Midpoint of the estimated frequency range.

Note: NA=not applicable.

Source: Derived from Tables M.5.1.3.4–1 and M.5.2.2.1–1.

M.5.2.2.2 *Accident Impacts*

The estimated impacts of the postulated accidents at each site are provided in Tables M.5.2.2.2–1 through M.5.2.2.2–6. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 using the MACCS computer code. [Text deleted.]

Table M.5.2.2.2–1. Collocation Alternative Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	0.011	4.4×10^{-6}	8.8×10^{-5}	4.4×10^{-8}	0.64	3.2×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	1.1×10^{-3}	4.4×10^{-7}	8.8×10^{-6}	4.4×10^{-9}	0.064	3.2×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.045	1.8×10^{-5}	3.6×10^{-4}	1.8×10^{-7}	2.6	1.3×10^{-3}	0.064
Vault fire	23.1	0.012	0.18	9.2×10^{-5}	1,340	0.67	1.0×10^{-7}
Truck bay fire	1.5	6.1×10^{-4}	0.012	6.1×10^{-6}	89	0.045	1.0×10^{-7}
Spontaneous combustion	2.2×10^{-3}	8.8×10^{-7}	1.8×10^{-5}	8.8×10^{-9}	0.13	6.4×10^{-5}	7.0×10^{-7}
Explosion in the vault	3.6	1.4×10^{-3}	0.029	1.4×10^{-5}	209	0.11	1.0×10^{-7}
Explosion outside the vault	0.016	6.6×10^{-6}	1.3×10^{-4}	6.6×10^{-8}	0.96	4.8×10^{-4}	1.0×10^{-7}
Nuclear criticality	0.010	4.2×10^{-6}	6.5×10^{-5}	3.3×10^{-8}	0.07	3.5×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	41.6	0.022	0.33	1.7×10^{-4}	2,410	1.2	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code.

Table M.5.2.2.2–2. Collocation Alternative Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	7.5×10^{-3}	3.0×10^{-6}	1.4×10^{-4}	7.0×10^{-8}	0.014	7.2×10^{-6}	6.0×10^{-4}
PCV breach by firearms discharge	7.5×10^{-4}	3.0×10^{-7}	1.4×10^{-5}	7.0×10^{-9}	1.4×10^{-3}	7.2×10^{-7}	3.5×10^{-4}
PCV penetration by corrosion	0.031	1.2×10^{-5}	5.7×10^{-4}	2.9×10^{-7}	0.059	3.0×10^{-5}	0.064
Vault fire	15.8	7.6×10^{-3}	0.29	1.5×10^{-4}	30.3	0.015	1.0×10^{-7}
Truck bay fire	1.0	4.2×10^{-4}	0.019	9.7×10^{-6}	2.0	1.0×10^{-3}	1.0×10^{-7}
Spontaneous combustion	1.5×10^{-3}	6.0×10^{-7}	2.8×10^{-5}	1.4×10^{-8}	2.9×10^{-3}	1.5×10^{-6}	7.0×10^{-7}
Explosion in the vault	2.5	9.9×10^{-4}	0.046	2.3×10^{-5}	4.7	2.4×10^{-3}	1.0×10^{-7}
Explosion outside the vault	0.011	4.5×10^{-6}	2.1×10^{-4}	1.0×10^{-7}	0.022	1.1×10^{-5}	1.0×10^{-7}
Nuclear criticality	7.7×10^{-3}	3.1×10^{-6}	1.3×10^{-4}	6.5×10^{-8}	1.4×10^{-3}	6.9×10^{-7}	1.0×10^{-7}
Beyond evaluation basis earthquake	28.4	0.015	0.53	2.6×10^{-4}	55	0.027	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code.

Table M.5.2.2.2–3. Collocation Alternative Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	0.010	4.1×10^{-6}	8.8×10^{-5}	4.4×10^{-8}	0.19	9.6×10^{-5}	6.0×10^{-4}
PCV breach by firearms discharge	1.0×10^{-3}	4.1×10^{-7}	8.8×10^{-6}	4.4×10^{-9}	0.019	9.6×10^{-6}	3.5×10^{-4}
PCV penetration by corrosion	0.042	1.7×10^{-5}	3.6×10^{-4}	1.8×10^{-7}	0.78	3.9×10^{-4}	0.064
Vault fire	21.6	0.011	0.19	9.3×10^{-5}	402	0.20	1.0×10^{-7}
Truck bay fire	1.4	5.7×10^{-4}	0.012	6.2×10^{-6}	26.7	0.013	1.0×10^{-7}
Spontaneous combustion	2.1×10^{-3}	8.2×10^{-7}	1.8×10^{-5}	8.9×10^{-9}	0.038	1.9×10^{-5}	7.0×10^{-7}
Explosion in the vault	3.4	1.3×10^{-3}	0.029	1.5×10^{-5}	62.7	0.031	1.0×10^{-7}
Explosion outside the vault	0.015	6.2×10^{-6}	1.3×10^{-4}	6.7×10^{-8}	0.29	1.4×10^{-4}	1.0×10^{-7}
Nuclear criticality	0.010	4.0×10^{-6}	7.7×10^{-5}	3.9×10^{-8}	0.018	9.0×10^{-6}	1.0×10^{-7}
Beyond evaluation basis earthquake	38.9	0.021	0.34	1.7×10^{-4}	723	0.36	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code.

Table M.5.2.2.2–4. Collocation Alternative Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	4.4×10^{-3}	1.8×10^{-6}	1.4×10^{-3}	7.1×10^{-7}	0.22	1.1×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	4.4×10^{-4}	1.8×10^{-7}	1.4×10^{-4}	7.1×10^{-8}	0.022	1.1×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.018	7.2×10^{-6}	5.8×10^{-3}	2.9×10^{-6}	0.89	4.4×10^{-4}	0.064
Vault fire	9.3	3.8×10^{-3}	3.0	1.5×10^{-3}	456	0.23	1.0×10^{-7}
Truck bay fire	0.62	2.5×10^{-4}	0.20	9.9×10^{-5}	30.3	0.015	1.0×10^{-7}
Spontaneous combustion	8.9×10^{-4}	3.5×10^{-7}	2.8×10^{-4}	1.4×10^{-7}	0.044	2.2×10^{-5}	7.0×10^{-7}
Explosion in the vault	1.5	5.8×10^{-4}	0.46	2.3×10^{-4}	71.2	0.036	1.0×10^{-7}
Explosion outside the vault	6.6×10^{-3}	2.7×10^{-6}	2.1×10^{-3}	1.1×10^{-6}	0.33	1.6×10^{-4}	1.0×10^{-7}
Nuclear criticality	4.8×10^{-3}	1.9×10^{-6}	1.9×10^{-3}	9.3×10^{-7}	0.046	2.3×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	16.7	7.5×10^{-3}	5.3	2.7×10^{-3}	821	0.41	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code.

Table M.5.2.2.2–5. Collocation Alternative Accident Impacts at Oak Ridge Reservation

Accident Scenario	Worker at 619 m		Maximum Offsite Individual		Population to 80 km		
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	0.015	6.0×10^{-6}	0.015	7.5×10^{-6}	2.6	1.3×10^{-3}	6.0×10^{-4}
PCV breach by firearms discharge	1.5×10^{-3}	6.0×10^{-7}	1.5×10^{-3}	7.5×10^{-7}	0.26	1.3×10^{-4}	3.5×10^{-4}
PCV penetration by corrosion	0.061	2.5×10^{-5}	0.061	3.1×10^{-5}	10.6	5.3×10^{-3}	0.064
Vault fire	31.6	0.016	31.6	0.019	5,480	2.7	1.0×10^{-7}
Truck bay fire	2.1	8.4×10^{-4}	2.1	1.1×10^{-3}	364	0.18	1.0×10^{-7}
Spontaneous combustion	3.0×10^{-3}	1.2×10^{-6}	3.0×10^{-3}	1.5×10^{-6}	0.52	2.6×10^{-4}	7.0×10^{-7}
Explosion in the vault	4.9	2.0×10^{-3}	4.9	2.5×10^{-3}	856	0.43	1.0×10^{-7}
Explosion outside the vault	0.023	9.0×10^{-6}	0.023	1.1×10^{-5}	3.9	2.0×10^{-3}	1.0×10^{-7}
Nuclear criticality	0.014	5.5×10^{-6}	0.014	6.9×10^{-6}	0.83	4.1×10^{-4}	1.0×10^{-7}
Beyond evaluation basis earthquake	57	0.032	57	0.041	9,870	4.9	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [619 m for this facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code.

Table M.5.2.2.2–6. Collocation Alternative Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	7.2×10^{-3}	2.9×10^{-6}	9.7×10^{-5}	4.8×10^{-8}	0.70	3.5×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	7.2×10^{-4}	2.9×10^{-7}	9.7×10^{-5}	4.8×10^{-9}	0.070	3.5×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.029	1.2×10^{-5}	3.9×10^{-4}	2.0×10^{-7}	2.9	1.4×10^{-3}	0.064
Vault fire	15.2	6.9×10^{-3}	0.20	1.0×10^{-4}	1,470	0.73	1.0×10^{-7}
Truck bay fire	1.0	4.0×10^{-4}	0.013	6.7×10^{-6}	97.5	0.049	1.0×10^{-7}
Spontaneous combustion	1.4×10^{-3}	5.8×10^{-7}	1.9×10^{-5}	9.7×10^{-9}	0.14	7.0×10^{-5}	7.0×10^{-7}
Explosion in the vault	2.4	9.4×10^{-4}	0.032	1.6×10^{-5}	229	0.12	1.0×10^{-7}
Explosion outside the vault	0.011	4.3×10^{-6}	1.5×10^{-4}	7.3×10^{-8}	1.1	5.2×10^{-4}	1.0×10^{-7}
Nuclear criticality	6.9×10^{-3}	2.8×10^{-6}	7.0×10^{-5}	3.5×10^{-8}	0.088	4.4×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	27.2	0.013	0.37	1.8×10^{-4}	2,640	1.3	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code

M.5.2.3 Upgrade of Existing Interim Storage Facilities at Hanford Site

The Fuels Materials Examination Facility (FMEF) at Hanford is partially completed and can be upgraded for the long-term storage of Pu that is presently on the site. The FMEF has never operated and therefore safety documentation pertaining to the storage of Pu is not available. Under the Upgrade Alternative, the FMEF will be modified and improved to meet the requirements for long-term storage of Pu. A second option is a new long-term storage facility which could be constructed in the 200 Area West at Hanford.

The impacts associated with upgraded storage of Pu that already exists at Hanford are shown in Table M.5.2.3–1. The impacts apply to either the FMEF upgrade or a new storage facility in the 200 West Area. The impacts are derived from the impacts for consolidated storage at Hanford with an adjustment for smaller amounts of materials at risk for certain accident scenarios for which the amount of Pu available is a factor.

Table M.5.2.3–1. Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	0.011	4.4×10^{-6}	8.8×10^{-5}	4.4×10^{-8}	0.64	3.2×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	1.1×10^{-3}	4.4×10^{-7}	8.8×10^{-6}	4.4×10^{-9}	0.064	3.2×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.045	1.8×10^{-5}	3.6×10^{-4}	1.8×10^{-7}	2.6	1.3×10^{-3}	6.4×10^{-3}
Vault fire	2.3	1.2×10^{-3}	0.018	9.2×10^{-6}	134	0.067	1.0×10^{-7}
Truck bay fire	1.5	6.1×10^{-4}	0.012	6.1×10^{-6}	89	0.045	1.0×10^{-7}
Spontaneous combustion	2.2×10^{-3}	8.8×10^{-7}	1.8×10^{-5}	8.8×10^{-9}	0.13	6.4×10^{-5}	7.0×10^{-7}
Explosion in the vault	0.36	1.4×10^{-4}	2.9×10^{-3}	1.4×10^{-6}	20.9	0.011	1.0×10^{-7}
Explosion outside of vault	0.016	6.6×10^{-6}	1.3×10^{-4}	6.6×10^{-8}	0.96	4.8×10^{-4}	1.0×10^{-7}
Nuclear criticality	0.010	4.2×10^{-6}	6.5×10^{-5}	3.3×10^{-8}	0.07	3.5×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	4.2	2.2×10^{-3}	0.033	1.7×10^{-5}	241	0.12	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using Table M.5.2.1.2–1 and adjustments for smaller amounts of Pu to be stored.

The impacts associated with the upgraded storage of only the Pu from RFETS and LANL are shown in Table M.5.2.3–2. The impacts apply to either the FMEF or a new storage facility in the 200 West Area. The impacts are derived from the impacts for consolidated storage at Hanford with an adjustment for smaller amounts of materials at risk for certain accident scenarios for which the amount of Pu available is a factor.

[Text deleted.]

Table M.5.2.3–2. Upgrade With Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	0.011	4.4×10^{-6}	8.8×10^{-5}	4.4×10^{-8}	0.64	3.2×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	1.1×10^{-3}	4.4×10^{-7}	8.8×10^{-6}	4.4×10^{-9}	0.064	3.2×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.045	1.8×10^{-5}	3.6×10^{-4}	1.8×10^{-7}	2.6	1.3×10^{-3}	6.6×10^{-3}
Vault fire	2.4	1.2×10^{-3}	0.018	9.4×10^{-6}	137	0.069	1.0×10^{-7}
Truck bay fire	1.5	6.1×10^{-4}	0.012	6.1×10^{-6}	89	0.045	1.0×10^{-7}
Spontaneous combustion	2.2×10^{-3}	8.8×10^{-7}	1.8×10^{-5}	8.8×10^{-9}	0.13	6.4×10^{-5}	7.0×10^{-7}
Explosion in the vault	0.37	1.4×10^{-4}	3.0×10^{-3}	1.4×10^{-6}	21.4	0.011	1.0×10^{-7}
Explosion outside of vault	0.016	6.6×10^{-6}	1.3×10^{-4}	6.6×10^{-8}	0.96	4.8×10^{-4}	1.0×10^{-7}
Nuclear criticality	0.010	4.2×10^{-6}	6.5×10^{-5}	3.3×10^{-8}	0.07	3.5×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	4.3	2.3×10^{-3}	0.034	1.7×10^{-5}	247	0.12	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using Table M.5.2.1.2–1 and adjustments for smaller amounts of Pu to be stored.

M.5.2.4 Upgrade of Existing Interim Storage Facilities at Idaho National Engineering Laboratory

The Pu storage facilities at ANL-W at INEL are presently used for Pu storage and can be upgraded for the long-term storage of Pu that is presently on the site. Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed in the *Beyond Design Basis Accident Analysis*. The studies postulated a set of accident scenarios that were representative of the risks and consequences for workers. Although not all potential accidents were addressed, those that were postulated have consequences and risks that are expected to envelop the consequences and risks of the facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than 1.0×10^{-7}/yr are anticipated that will have consequences and risks larger than those described in this section.

The impacts associated with the upgraded storage of only the Pu from RFETS and LANL are shown in Table M.5.2.4–1. The impacts are derived from the impacts for consolidated storage at INEL with an adjustment for smaller amounts of material at risk for certain accident scenarios for which the amount of Pu available is a factor.

M.5.2.4.1 *Accident Scenarios and Source Terms*

A range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the upgraded Pu storage facility at ANL-W. Through a screening process,

Table M.5.2.4–1. Upgrade With Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative Accident Impacts at Idaho National Engineering Laboratory

Accident Scenario	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per year)
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	
PCV puncture by forklift	0.010	4.1×10^{-7}	8.8×10^{-5}	4.4×10^{-8}	0.19	9.6×10^{-5}	6.0×10^{-4}
PCV breach by firearms discharge	1.0×10^{-3}	4.1×10^{-7}	8.8×10^{-6}	4.4×10^{-9}	0.19	9.6×10^{-6}	3.5×10^{-4}
PCV penetration by corrosion	0.042	1.7×10^{-5}	3.6×10^{-4}	1.8×10^{-7}	0.78	3.9×10^{-4}	6.6×10^{-3}
Vault fire	2.21	1.1×10^{-3}	0.019	9.5×10^{-5}	41.2	0.021	1.0×10^{-7}
Truck bay fire	1.4	5.7×10^{-4}	0.012	6.2×10^{-6}	26.7	0.013	1.0×10^{-7}
Spontaneous combustion	2.1×10^{-3}	8.2×10^{-7}	1.8×10^{-5}	8.9×10^{-9}	0.038	1.9×10^{-5}	1.0×10^{-7}
Explosion in the vault	0.35	1.3×10^{-4}	3.0×10^{-3}	1.5×10^{-6}	6.4	3.2×10^{-3}	1.0×10^{-7}
Explosion outside of vault	0.015	6.2×10^{-6}	1.3×10^{-4}	6.7×10^{-8}	0.29	1.4×10^{-4}	1.0×10^{-7}
Nuclear criticality	0.010	4.0×10^{-6}	7.7×10^{-5}	3.9×10^{-8}	0.018	9.0×10^{-6}	1.0×10^{-7}
Beyond evaluation basis earthquake	4.0	2.2×10^{-3}	0.035	1.7×10^{-5}	74.1	0.037	1.0×10^{-7}

[Text deleted.]

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using Table M.5.2.1.2–3 and adjustments for smaller amounts of Pu to be stored.

three evaluation basis accidents and seven beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.2.4.1–1 and M.5.2.4.1–2. Accident source term information is provided in Tables M.5.2.4.1–3 and M.5.2.4.1–4. Accident scenario descriptions are provided in Table M.5.2.4.1–5.

Table M.5.2.4.1–1. Evaluation Basis Accident Scenarios for Upgrade of Interim Storage Facilities at Idaho National Engineering Laboratory

Accident Scenario	Accident Frequency (per year)	Source Term at Risk (PCV)[a]	Source Term Released to Environment
PCV puncture by forklift	6.0×10^{-4}	2	0.038 g Pu
PCV breach by firearms discharge	3.5×10^{-4}	1	3.8×10^{-3} g Pu
PCV penetration by corrosion	0.064	1	0.157 g Pu

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.

Source: DOE 1995mm.

Table M.5.2.4.1–2. Beyond Evaluation Basis Accident Scenarios for Upgrade of Interim Storage Facilities at Idaho National Engineering Laboratory

Accident Scenario	Accident Frequency (per year)	Source Term at Risk (PCV)[a]	Source Term Released to Environment
Vault fire	1.0×10^{-7}	264	66.3 g Pu
Truck bay fire	1.0×10^{-7}	12	5.42 g Pu
Spontaneous combustion	1.4×10^{-7}	2	7.6×10^{-3} g Pu
Explosion in the vault	1.0×10^{-7}	66	49.8 g Pu
Explosion outside of vault	1.0×10^{-7}	1	0.0542 g Pu
Nuclear criticality	1.0×10^{-7}	[b]	1.0×10^{19} fissions[b]
Beyond evaluation basis earthquake	1.0×10^{-7}	132	99.5 g Pu

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.

[b] See Table M.5.2.1.1–5.

Source: DOE 1995mm.

Table M.5.2.4.1–3. Evaluation Basis Accident Source Terms for Upgrade of Interim Storage Facilities at Idaho National Engineering Laboratory

Accident Parameter	Accident Scenario		
	PCV Puncture by Forklift	PCV Breach by Firearms Discharge	PCV Penetration by Corrosion
Frequency of occurrence (per year)	6.0×10^{-4}	3.5×10^{-4}	0.064
Pu released to environment (g)	0.038	3.8×10^{-3}	0.157
Isotope released to environment (Ci)			
Pu-238	4.75×10^{-5}	4.75×10^{-6}	1.96×10^{-4}
Pu-239	2.20×10^{-3}	2.20×10^{-4}	9.09×10^{-3}
Pu-240	5.21×10^{-4}	5.21×10^{-5}	2.15×10^{-3}
Pu-241	4.29×10^{-3}	4.29×10^{-4}	0.0177
Pu-242	1.49×10^{-8}	1.49×10^{-9}	6.17×10^{-8}
Am-241	8.02×10^{-4}	8.02×10^{-5}	3.31×10^{-3}

Note: Am=Americium; PCV=primary containment vessel.

Source: Derived from Tables M.5.1.3.4–1 and M.5.2.4.1–1.

Table M.5.2.4.1–4. Beyond Evaluation Basis Accident Source Terms for Upgrade of Interim Storage Facilities at Idaho National Engineering Laboratory

	Accident Scenario						
Accident Parameter	**Vault Fire**	**Truck Bay Fire**	**Spontaneous Combustion**	**Explosion in the Vault**	**Explosion Outside of Vault**	**Nuclear Criticality**	**Beyond Evaluation Basis Earthquake**
Frequency of occurrence (per year)	1.0×10^{-7}	1.0×10^{-7}	1.40×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}
Pu released to environment (g)	66.3	5.42	7.6×10^{-3}	49.77	0.0542	NA	99.5
Fissions	NA	NA	NA	NA	NA	1.0×10^{19}	NA
Isotope released to environment (Ci)							
Pu-238	0.0829	6.78×10^{-3}	9.50×10^{-6}	0.0622	6.78×10^{-5}	0	0.124
Pu-239	3.84	0.314	4.40×10^{-4}	2.88	3.14×10^{-3}	0	5.76
Pu-240	0.908	0.0743	1.04×10^{-4}	0.682	7.43×10^{-4}	0	1.36
Pu-241	7.49	0.612	8.59×10^{-4}	5.62	6.12×10^{-3}	0	11.2
Pu-242	2.61×10^{-5}	2.13×10^{-6}	2.99×10^{-9}	1.96×10^{-5}	2.13×10^{-8}	0	3.91×10^{-5}
Am-241	1.4	0.114	1.60×10^{4}	1.05	1.14×10^{-3}	0	2.10
Kr-83m	0	0	0	0	0	55.0	0
Kr-85m	0	0	0	0	0	35.5	0
Kr-85	0	0	0	0	0	4.05×10^{-3}	0
Kr-87	0	0	0	0	0	215	0
Kr-88	0	0	0	0	0	115	0
Kr-89	0	0	0	0	0	6.5×10^{3}	0
Xe-131m	0	0	0	0	0	0.05	0
Xe-133m	0	0	0	0	0	1.10	0
Xe-133	0	0	0	0	0	13.5	0
Xe-135m	0	0	0	0	0	1.65×10^{3}	0
Xe-135	0	0	0	0	0	205	0
Xe-137	0	0	0	0	0	2.45×10^{4}	0
Xe-138	0	0	0	0	0	5.5×10^{3}	0
I-131	0	0	0	0	0	0.55	0
I-132	0	0	0	0	0	60.0	0
I-133	0	0	0	0	0	8.0	0
I-134	0	0	0	0	0	215	0
I-135	0	0	0	0	0	22.5	0

Note: NA=not applicable.
Source: Derived from Tables M.5.1.3.4–1, M.5.2.1.1–5, and M.5.2.4.1–2.

Table M.5.2.4.1–5. Accident Scenario Descriptions for Storage Facilities at Idaho National Engineering Laboratory

Accident Scenario	Accident Description
Evaluation Basis Accident	
PCV puncture by forklift	A forklift driver attempting to pick up a pallet containing PCVs in the shipping/receiving area encounters a situation in which the fork is positioned such that it contacts the PCVs. Before the operator responds to the contact, the forward motion of the forklift punctures two PCVs with the tines of the fork. The operator backs the forklift away from the structure, and the PCVs fall off the fork, spilling some of the contents on the floor.
PCV breach by firearms discharge	Because of the armed security guard force at the storage facility, it is necessary to consider possible breach of a PCV caused by a bullet from accidental discharge of the guard's firearm. The PCV is not designed to withstand such an impact, and its effect would be to potentially penetrate the container and cause some dispersal of the contents. This can occur only where the PCVs are above the operating floor, and would be most likely in the shipping/receiving area and possibly some material handling areas.
PCV penetration by corrosion	The PCV is presumed to fail because of long-term corrosion, gradual buildup of internal pressure, or other causes generally internal to the PCV itself, and probably related to its contents. These events would generally be the result of errors in packaging the contents or in sealing the PCV. The failure would take place over an extended period, and the initial progress of the failure would be undetectable through casual external observation. Eventually, the PCV closure seal would be breached and a small slit or crack would develop. The opening would be enlarged through continuation of the driving force and eventually some PCV contents would be expelled into the storage area or into one of the handling/inspection areas.
Beyond Evaluation Basis Accident	
Vault fire	A large amount of jet fuel, gasoline, or some other high energy density fuel is introduced into the vault through a ventilation duct and ignited.
Truck bay fire	A fire occurs following the rupture of a truck's fuel tank and ignition of the spilled fuel. A single trailer is engulfed by flames and is heated to at least the ignition point of Pu.
Spontaneous combustion	Due to improper packaging, the contents of two PCVs ignite spontaneously after being punctured by a forklift accident.
Explosion in the vault	An explosion of undefined origin is assumed to occur below grade in the vault. The detonation is assumed to deform some storage tubes, which in turn crush and open some PCVs. There is no fire, and other systems remain intact.
Explosion in the vault	An explosion of undefined origin is assumed to occur below grade in the vault. Portions of the ceiling spall or collapse. Falling debris punctures Beverly cans and the quart product can contained within.
Explosion outside of vault	An explosion of undefined origin is assumed to occur in the repackaging area. The blast has sufficient force to breach the glovebox, exposing the contents to the room atmosphere and bypassing two levels of filtration provided by the glovebox.
Nuclear criticality	The only way a criticality event could occur would be in the case of multiple operational errors or an accident scenario that breaches PCVs and the fissile material somehow collects in a criticality favorable geometry.

Table M.5.2.4.1–5. Accident Scenario Descriptions for Storage Facilities at Idaho National Engineering Laboratory—Continued

Accident Scenario	Accident Description
Beyond evaluation basis earthquake	The building collapses. The strength of the operating floor is such that it could withstand the weight and the impact. Differential motion between the operating floor and the vault floor could cause some of the storage tubes to buckle enough to crush some PCVs. Significant building damage occurs. Spalling of the roof and/or collapse of the Beverly can walls. Falling debris punctures Beverly cans and the quart product can contained within.

Note: PCV=primary containment vessel.
Source: DOE 1995mm.

M.5.2.4.2 *Accident Impacts*

The estimated impacts of the postulated accidents at INEL are provided in Table M.5.2.4.2–1. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.2.4.1–3 and M.5.2.4.1–4 using the MACCS computer code. [Text deleted.]

Table M.5.2.4.2–1. Accident Impacts for Upgrade of Existing Storage Facilities at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	0.014	5.6×10^{-6}	7.5×10^{-4}	3.8×10^{-7}	0.25	1.2×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	1.4×10^{-3}	5.6×10^{-7}	7.5×10^{-5}	3.8×10^{-8}	0.025	1.2×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.058	2.3×10^{-5}	3.1×10^{-3}	1.6×10^{-6}	1.0	5.1×10^{-4}	0.064
Vault fire	24.6	0.013	1.3	6.6×10^{-4}	433	0.22	1.0×10^{-7}
Truck bay fire	2.0	8.0×10^{-4}	0.11	5.4×10^{-5}	35.4	0.018	1.0×10^{-7}
Spontaneous combustion	2.8×10^{-3}	1.1×10^{-6}	1.5×10^{-4}	7.5×10^{-8}	0.05	2.5×10^{-5}	7.0×10^{-7}
Explosion in the vault	18.5	9.1×10^{-3}	0.98	4.9×10^{-4}	325	0.16	1.0×10^{-7}
Explosion outside the vault	0.020	8.0×10^{-6}	1.1×10^{-3}	5.4×10^{-7}	0.35	1.8×10^{-4}	1.0×10^{-7}
Nuclear criticality	0.010	4.0×10^{-6}	5.9×10^{-4}	3.0×10^{-7}	0.019	9.6×10^{-6}	1.0×10^{-7}
Beyond evaluation basis earthquake	36.9	0.020	2.0	9.8×10^{-4}	650	0.33	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.4.1–3 and M.5.2.4.1–4 and the MACCS computer code.

M.5.2.5 Upgrade or Consolidation of Existing Interim Storage Facilities at Pantex Plant

The accident analysis of the upgrade or consolidation of existing facilities at Pantex consists of two buildings: a Surplus Materials Storage Building (SM Building) and a Strategic Reserves Storage Building (SR Building). Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed in the *Beyond Design Basis Accident Analysis*. The studies postulated a set of accident scenarios that were representative of the risks and consequences for workers. Although not all potential accidents were addressed, those that were postulated have consequences and risks that are expected to envelop the consequences and risks of the facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than 1.0×10^{-7}/yr are anticipated that will have consequences and risks larger than those described in this section. [Text deleted.]

M.5.2.5.1 *Accident Scenarios and Source Terms*

A range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the modified Pu storage facilities at Pantex. Through a screening process, three evaluation basis accidents and seven beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.2.5.1–1 and M.5.2.5.1–2 for the SM Building and in Tables M.5.2.5.1–3 and M.5.2.5.1–4 for the SR Building. Accident source term information is provided in Tables M.5.2.5.1–5 and M.5.2.5.1–6 for the SM Building and in Tables M.5.2.5.1–7 and M.5.2.5.1–8 for the SR Building. Accident scenario descriptions are provided in Table M.5.2.5.1–9.

Table M.5.2.5.1–1. Evaluation Basis Accident Scenarios for Upgrade or Consolidation at Pantex Plant—Surplus Materials Storage Building

Accident Scenario	Accident Frequency (per year)	Source Term at Risk (PCV)[a]	Source Term Release to Environment
PCV puncture by forklift	6.0×10^{-4}	2	0.038 g Pu
PCV breach by firearms discharge	3.5×10^{-4}	1	3.8×10^{-3} g Pu
PCV penetration by corrosion	6.4×10^{-2}	1	0.157 g Pu

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.

Source: DOE 1995mm.

Table M.5.2.5.1–2. Beyond Evaluation Basis Accident Scenarios for Upgrade or Consolidation at Pantex Plant—Surplus Materials Storage Building

Accident Scenario	Accident Frequency (per year)	Source Term at Risk (PCV)[a]	Source Term Release to Environment
Vault fire	$1.0x10^{-7}$	120	81 g Pu
Truck bay fire	$1.0x10^{-7}$	12	5.42 g Pu
Spontaneous combustion	$7.0x10^{-7}$	2	$7.6x10^{-3}$ g Pu
Explosion in the vault	$1.0x10^{-7}$	45	12.6 g Pu
Explosion outside of vault	$1.0x10^{-7}$	1	0.054 g Pu
Nuclear criticality	$1.0x10^{-7}$	[b]	$1.0x10^{19}$ fissions[b]
Beyond evaluation basis earthquake	$1.0x10^{-7}$	194	54.76 g Pu

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.
[b] See Table M.5.2.5.1–6.
Source: DOE 1995mm.

Table M.5.2.5.1–3. Evaluation Basis Accident Scenarios for Upgrade or Consolidation at Pantex Plant—Strategic Reserves Storage Building

Accident Scenario	Accident Frequency (per year)	Source Term at Risk (PCV)[a]	Source Term Release to Environment
PCV puncture by forklift	$6.0x10^{-4}$	2	0.038 g Pu
PCV breach by firearms discharge	$3.5x10^{-4}$	1	$3.8x10^{-3}$ g Pu
PCV penetration by corrosion	0.064	1	0.157 g Pu

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.
Source: DOE 1995mm.

Table M.5.2.5.1–4. Beyond Evaluation Basis Accident Scenarios for Upgrade or Consolidation at Pantex Plant—Strategic Reserves Storage Building

Accident Scenario	Accident Frequency (per year)	Source Term at Risk (PCV)[a]	Source Term Release to Environment
Vault fire	$1.0x10^{-7}$	406	483 g Pu
Truck bay fire	$1.0x10^{-7}$	12	5.42 g Pu
Spontaneous combustion	$7.0x10^{-7}$	2	$7.6x10^{-3}$ g Pu
Explosion in the vault	$1.0x10^{-7}$	120	16.3 g Pu
Explosion outside of vault	$1.0x10^{-7}$	1	0.054 g Pu
Nuclear criticality	$1.0x10^{-7}$	[b]	$1.0x10^{19}$ fissions[b]
Beyond evaluation basis earthquake	$1.0x10^{-7}$	194	111.1 g Pu

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.
[b] See Table M.5.2.5.1–6.
Source: DOE 1995mm.

Table M.5.2.5.1–5. Evaluation Basis Accident Source Terms for Upgrade or Consolidation at Pantex Plant—Surplus Materials Storage Building

Accident Parameter	Accident Scenario		
	PCV Puncture by Forklift	PCV Breach by Firearms Discharge	PCV Penetration by Corrosion
Frequency of occurrence (per year)	6.0×10^{-4}	3.5×10^{-4}	0.064
Pu released to environment (g)	0.038	3.8×10^{-3}	0.157
Isotope Released to Environment (Ci)			
Pu-238	2.14×10^{-5}	2.14×10^{-6}	8.84×10^{-4}
Pu-239	2.20×10^{-3}	2.20×10^{-4}	9.07×10^{-3}
Pu-240	5.17×10^{-4}	5.17×10^{-5}	2.14×10^{-3}
Pu-241	1.63×10^{-3}	1.63×10^{-4}	6.75×10^{-3}
Pu-242	1.49×10^{-8}	1.49×10^{-9}	6.15×10^{-8}
Am-241	8.63×10^{-4}	8.63×10^{-5}	3.56×10^{-3}

Note: PCV=primary containment vessel.
Source: Derived from Tables M.5.1.3.4–2 and M.5.2.5.1–1.

Table M.5.2.5.1–6. Beyond Evaluation Basis Accident Source Terms for Upgrade or Consolidation at Pantex Plant—Surplus Materials Storage Building

	Accident Scenario						
Accident Parameter	**Vault Fire**	**Truck Bay Fire**	**Spontaneous Combustion**	**Explosion in the Vault**	**Explosion Outside of Vault**	**Nuclear Criticality**	**Beyond Evaluation Basis Earthquake**
Frequency of occurrence (per year)	$1.0x10^{-7}$	$1.0x10^{-7}$	$1.40x10^{-7}$	$1.0x10^{-7}$	$1.0x10^{-7}$	$1.0x10^{-7}$	$1.0x10^{-7}$
Pu released to environment (g)	81	5.42	$7.6x10^{-3}$	12.6	0.054	NA	54.76
Fissions	NA	NA	NA	NA	NA	$1.0x10^{19}$	NA
Isotope Released to Environment (Ci)							
Pu-238	0.0456	$3.05x10^{-3}$	$4.28x10^{-6}$	$7.09x10^{-3}$	$3.04x10^{-5}$	0	0.0308
Pu-239	4.68	0.313	$4.39x10^{-4}$	0.728	$3.12x10^{-3}$	0	3.17
Pu-240	1.10	0.0737	$1.03x10^{-4}$	0.171	$7.34x10^{-4}$	0	0.745
Pu-241	3.48	0.233	$3.27x10^{-4}$	0.542	$2.32x10^{-3}$	0	2.35
Pu-242	$3.18x10^{-5}$	$2.12x10^{-6}$	$2.98x10^{-9}$	$4.94x10^{-6}$	$2.12x10^{-8}$	0	$2.15x10^{-5}$
Am-241	1.84	0.123	$1.73x10^{-4}$	0.286	$1.23x10^{-3}$	0	1.24
Kr-83m	0	0	0	0	0	55.0	0
Kr-85m	0	0	0	0	0	35.5	0
Kr-85	0	0	0	0	0	$4.05x10^{-3}$	0
Kr-87	0	0	0	0	0	215	0
Kr-88	0	0	0	0	0	115	0
Kr-89	0	0	0	0	0	$6.5x10^{3}$	0
Xe-131m	0	0	0	0	0	0.05	0
Xe-133m	0	0	0	0	0	1.10	0
Xe-133	0	0	0	0	0	13.5	0
Xe-135m	0	0	0	0	0	$1.65x10^{3}$	0
Xe-135	0	0	0	0	0	205	0
Xe-137	0	0	0	0	0	$2.45x10^{4}$	0
Xe-138	0	0	0	0	0	$5.5x10^{3}$	0
I-131	0	0	0	0	0	0.55	0
I-132	0	0	0	0	0	60.0	0
I-133	0	0	0	0	0	8.0	0
I-134	0	0	0	0	0	215	0
I-135	0	0	0	0	0	22.5	0

Note: NA=not applicable.

Source: Derived from Tables M.5.1.3.4–2, M.5.2.1.1–3, and M.5.2.5.1–2.

Table M.5.2.5.1–7. Evaluation Basis Accident Source Terms for Upgrade or Consolidation at Pantex Plant—Strategic Reserves Storage Building

Accident Parameter	Accident Scenario		
	PCV Puncture by Forklift	PCV Breach by Firearms Discharge	PCV Penetration by Corrosion
Frequency of occurrence (per year)	6.0×10^{-4}	3.5×10^{-4}	0.064
Pu released to environment (g)	0.038	3.8×10^{-3}	0.157
Isotope Released to Environment (Ci)			
Pu-238	2.14×10^{-5}	2.14×10^{-6}	8.84×10^{-4}
Pu-239	2.20×10^{-3}	2.20×10^{-4}	9.07×10^{-3}
Pu-240	5.17×10^{-4}	5.17×10^{-5}	2.14×10^{-3}
Pu-241	1.63×10^{-3}	1.63×10^{-4}	6.75×10^{-3}
Pu-242	1.49×10^{-8}	1.49×10^{-9}	6.15×10^{-8}
Am-241	8.63×10^{-4}	8.63×10^{-5}	3.56×10^{-3}

Note: PCV=primary containment vessel.
Source: Derived from Tables M.5.1.3.4–2 and M.5.2.5.1–3.

Table M.5.2.5.1–8. Beyond Evaluation Basis Accident Source Terms for Upgrade or Consolidation at Pantex Plant—Strategic Reserves Storage Building

	Accident Scenario						
Accident Parameter	**Vault Fire**	**Truck Bay Fire**	**Spontaneous Combustion**	**Explosion in the Vault**	**Explosion Outside of Vault**	**Nuclear Criticality**	**Beyond Evaluation Basis Earthquake**
Frequency of occurrence (per year)	$1.0x10^{-7}$	$1.0x10^{-7}$	$1.40x10^{-7}$/yr	$1.0x10^{-7}$	$1.0x10^{-7}$	$1.0x10^{-7}$	$1.0x10^{-7}$
Pu released to environment (g)	482.5	5.42	$7.6x10^{-3}$	16.27	0.054	NA	111.1
Fissions	NA	NA	NA	NA	NA	$1.0x10^{19}$	NA
Isotope Released to Environment (Ci)							
Pu-238	0.272	$3.05x10^{-3}$	$428x10^{-6}$	9.16x10-3	$3.04x10^{-5}$	0	0.0625
Pu-239	27.9	0.313	$4.39x10^{-4}$	0.940	$3.12x10^{-3}$	0	6.42
Pu-240	6.56	0.0737	$1.04x10^{-4}$	0.221	$7.34x10^{-4}$	0	1.51
Pu-241	20.7	0.233	$3.27x10^{-4}$	0.700	$2.32x10^{-3}$	0	4.78
Pu-242	$1.89x10^{-4}$	$2.12x10^{-6}$	$2.98x10^{-9}$	$6.38x10^{-6}$	$2.12x10^{-8}$	0	$4.36x10^{-5}$
Am-241	11.0	0.114	$1.73x10^{-4}$	0.369	$1.23x10^{-3}$	0	2.52
Kr-83m	0	0	0	0	0	55.0	0
Kr-85m	0	0	0	0	0	35.5	0
Kr-85	0	0	0	0	0	$4.05x10^{-3}$	0
Kr-87	0	0	0	0	0	215	0
Kr-88	0	0	0	0	0	115	0
Kr-89	0	0	0	0	0	$6.5x10^{3}$	0
Xe-131m	0	0	0	0	0	0.05	0
Xe-133m	0	0	0	0	0	1.10	0
Xe-133	0	0	0	0	0	13.5	0
Xe-135m	0	0	0	0	0	$1.65x10^{3}$	0
Xe-135	0	0	0	0	0	205	0
Xe-137	0	0	0	0	0	$2.45x10^{4}$	0
Xe-138	0	0	0	0	0	$5.5x10^{3}$	0
I-131	0	0	0	0	0	0.55	0
I-132	0	0	0	0	0	60.0	0
I-133	0	0	0	0	0	8.0	0
I-134	0	0	0	0	0	215	0
I-135	0	0	0	0	0	22.5	0

Note: NA=not applicable.

Source: Derived from Tables M.5.1.3.4–2 and M.5.2.5.1–4.

Table M.5.2.5.1–9. Accident Scenario Descriptions for Storage Facilities at Pantex Plant

Accident Scenario	Accident Description
Evaluation Basis Accident	
PCV puncture by forklift	A forklift driver attempting to pick up a pallet containing PCVs in the shipping/receiving area encounters a situation in which the fork is positioned such that it contacts the PCVs. Before the operator responds to the contact, the forward motion of the forklift punctures two PCVs with the tines of the fork. The operator backs the forklift away from the structure, and the PCVs fall off the fork, spilling some of the contents on the floor.
PCV breach by firearms discharge	Because of the armed security guard force at the storage facility, it is necessary to consider possible breach of a PCV caused by a bullet from accidental discharge of the guard's firearm. The PCV is not designed to withstand such an impact, and its effect would be to potentially penetrate the container and cause some dispersal of the contents. This can occur only where the PCVs are above the operating floor, and would be most likely in the shipping/receiving area and possibly some material handling areas.
PCV penetration by corrosion	The PCV is presumed to fail because of long-term corrosion, gradual buildup of internal pressure, or other causes generally internal to the PCV itself, and probably related to its contents. These events would generally be the result of errors in packaging the contents or in sealing the PCV. The failure would take place over an extended period, and the initial progress of the failure would be undetectable through casual external observation. Eventually, the PCV closure seal would be breached and a small slit or crack would develop. The opening would be enlarged through continuation of the driving force, and eventually some PCV contents would be expelled into the storage area or into one of the handling/inspection areas.
Beyond Evaluation Basis Accident	
Vault fire	A large amount of jet fuel, gasoline, or some other high energy density fuel is introduced into the vault through a ventilation duct and ignited.
Truck bay fire	A fire occurs following the rupture of a truck's fuel tank and ignition of the spilled fuel. A single trailer is engulfed by flames and is heated to at least the ignition point of Pu.
Spontaneous combustion	Due to improper packaging, the contents of two PCVs ignite spontaneously after being punctured by a forklift accident.
Explosion in the vault	An explosion of undefined origin is assumed to occur below grade in the vault. The detonation is assumed to deform some storage tubes, which in turn crush and open some PCVs. There is no fire, and other systems remain intact.
Explosion in the vault	An explosion of undefined origin is assumed to occur below grade in the vault. The explosion is confined to a single compartment. The effect will be to damage some of the racks and some of the PCVs. PCVs within 20 ft of the blast may be damaged and breached.
Explosion outside of vault	An explosion of undefined origin is assumed to occur in the repackaging area. The blast has sufficient force to breach the glovebox, exposing the contents to the room atmosphere and bypassing two levels of filtration provided by the glovebox.
Nuclear criticality	The only way a criticality event could occur would be in the case of multiple operational errors or an accident scenario that breaches PCVs and the fissile material somehow collects in a criticality favorable geometry.

Table M.5.2.5.1–9. Accident Scenario Descriptions for Storage Facilities at Pantex Plant—Continued

Accident Scenario	Accident Description
Beyond evaluation basis earthquake	The building collapses. The strength of the operating floor is such that it could withstand the weight and the impact. Differential motion between the operating floor and the vault floor could cause some of the storage tubes to buckle enough to crush some PCVs. The PCVs will fall onto the storage compartment floor. Some of the PCVs may be damaged by falling debris and breached.

Note: PCV=primary containment vessel.
Source: DOE 1995mm.

M.5.2.5.2 *Accident Impacts*

The estimated impacts of the postulated accidents for the interim storage facilities in the SM Building and SR Building are provided in Tables M.5.2.5.2–1 and M.5.2.5.2–2. [Text deleted.] The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.2.5.1–5 through M.5.2.5.1–8 using the MACCS computer code. Accident impacts for the Upgrade With RFETS Pu Pits Subalternative (Preferred Alternative) are shown in Table M.5.2.5.2–3. The impacts are based on the impacts estimated for the Consolidation Alternative in Table M.5.2.1.2–4 and adjustments to certain accidents to reflect upgrade storage of 25,000 positions instead of 40,000 positions as in consolidation.

M.5.2.5.3 *Aircraft Crash*

Pantex is located approximately 13.6 km (8.5 mi) from the northeast-southwest runway at Amarillo International Airport. Potential accident scenarios in which an aircraft crashes into one or more facilities at Pantex have been developed for the Pantex EIS. A discussion of aircraft accidents for this PEIS is contained in Appendix R.

Table M.5.2.5.2–1. Accident Impacts for Consolidation in the Surplus Materials Storage Building at Pantex Plant

Accident Scenario	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per year)
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	
PCV puncture by forklift	6.1×10^{-3}	2.4×10^{-6}	1.9×10^{-3}	9.7×10^{-7}	0.28	1.4×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	6.1×10^{-4}	2.4×10^{-7}	1.9×10^{-4}	9.7×10^{-8}	0.028	1.4×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.025	1.0×10^{-5}	8.0×10^{-3}	4.0×10^{-6}	1.1	5.7×10^{-4}	0.064
Vault fire	13	5.7×10^{-3}	4.1	2.1×10^{-3}	588	10.29	1.0×10^{-7}
Truck bay fire	0.87	3.5×10^{-4}	0.28	1.4×10^{-4}	39.3	0.020	1.0×10^{-7}
Spontaneous combustion	1.2×10^{-3}	4.9×10^{-7}	3.9×10^{-4}	1.9×10^{-7}	0.055	2.8×10^{-5}	7.0×10^{-7}
Explosion in the vault	2.0	8.1×10^{-4}	0.64	3.2×10^{-4}	91.5	0.046	1.0×10^{-7}
Explosion outside of vault	8.7×10^{-3}	3.5×10^{-6}	2.8×10^{-3}	1.4×10^{-6}	0.39	2.0×10^{-4}	1.0×10^{-7}
Nuclear criticality	4.8×10^{-3}	1.9×10^{-6}	1.9×10^{-3}	9.3×10^{-7}	0.041	2.1×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	8.8	3.6×10^{-3}	2.8	1.4×10^{-3}	398	0.20	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.5.1–5 and M.5.2.5.1–6 and the MACCS computer code.

Table M.5.2.5.2–2. Accident Impacts for Consolidation in the Strategic Reserves Storage Building at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	6.1×10^{-3}	2.4×10^{-6}	2.0×10^{-3}	9.9×10^{-7}	0.28	1.4×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	6.1×10^{-4}	2.4×10^{-7}	2.0×10^{-4}	9.9×10^{-8}	0.028	1.4×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.025	1.0×10^{-5}	8.1×10^{-3}	4.1×10^{-6}	1.2	5.7×10^{-4}	0.064
Vault fire	78	0.043	25	0.015	3,500	1.8	1.0×10^{-7}
Truck bay fire	0.87	3.5×10^{-4}	0.28	1.4×10^{-4}	39.5	0.020	1.0×10^{-7}
Spontaneous combustion	1.2×10^{-3}	4.9×10^{-7}	4.0×10^{-4}	2.0×10^{-7}	0.056	2.8×10^{-5}	7.0×10^{-7}
Explosion in the vault	2.6	1.0×10^{-3}	0.84	4.2×10^{-4}	119	0.059	1.0×10^{-7}
Explosion outside of vault	8.7×10^{-3}	3.5×10^{-6}	2.8×10^{-3}	1.4×10^{-6}	0.39	2.0×10^{-4}	1.0×10^{-7}
Nuclear criticality	4.8×10^{-3}	1.9×10^{-6}	1.9×10^{-3}	9.4×10^{-7}	0.042	2.1×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	17.8	8.0×10^{-3}	5.8	3.0×10^{-3}	810	0.44	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.5.1–7 and M.5.2.5.1–8 and the MACCS computer code.

Table M.5.2.5.2–3. Upgrade With Rocky Flats Environmental Technology Site Plutonium Pits Subalternative (Preferred Alternative) Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	4.4×10^{-3}	1.8×10^{-6}	1.4×10^{-3}	7.1×10^{-7}	0.22	1.1×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	4.4×10^{-4}	1.8×10^{-7}	1.4×10^{-4}	7.1×10^{-8}	0.022	1.1×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.018	7.2×10^{-6}	5.8×10^{-3}	2.9×10^{-6}	0.89	4.4×10^{-4}	0.04
Vault fire	5.8	2.4×10^{-3}	1.9	9.4×10^{-4}	285	0.14	1.0×10^{-7}
Truck bay fire	0.62	2.5×10^{-4}	0.20	1.0×10^{-4}	303	0.015	1.0×10^{-7}
Spontaneous combustion	8.9×10^{-4}	3.5×10^{-7}	2.8×10^{-4}	1.4×10^{-7}	0.044	2.2×10^{-5}	7.0×10^{-7}
Explosion in the vault	0.94	3.6×10^{-4}	0.29	1.4×10^{-4}	44.5	0.023	1.0×10^{-7}
Explosion outside of vault	6.6×10^{-3}	2.7×10^{-6}	2.1×10^{-3}	1.1×10^{-6}	0.33	1.6×10^{-4}	1.0×10^{-7}
Nuclear criticality	4.8×10^{-3}	1.9×10^{-6}	1.9×10^{-3}	9.3×10^{-7}	0.046	2.3×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	10.4	4.7×10^{-3}	3.34	1.7×10^{-3}	513	0.26	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using M.5.2.1.2–4 and adjustments for smaller amounts of Pu to be stored.

M.5.2.6 Upgrade of Existing Storage Facilities at Oak Ridge Reservation

The HEU storage facilities at ORR are presently used for HEU storage and would be upgraded for the purpose of long-term storage of HEU that is presently on the site. Under the Upgrade Alternative, existing facilities at the Y–12 site would be modified and improved to meet the requirements for long-term storage of HEU. For upgraded conditions, potential accidents and their consequences have previously been addressed and documented according to requirements in DOE Orders.

Under the Preferred Alternative at ORR, nonsurplus HEU and surplus HEU pending disposition would remain in storage at Y–12 in existing and upgraded storage facilities. Upgrades for HEU storage in Building 9212, the building used in the Y–12 EA accident analysis, would include structural modifications to numerous columns, knee braces, and cross braces to provide proper stiffness and load distribution as documented in *Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities* (Y/EN-5080, 1994). Appendix G of the Y–12 EA contains a list of buildings and the modifications required to bring the buildings into conformance with the target performance goal that is equivalent to the structural response of new facilities. The modifications made to these facilities are expected to result in a reduction in risk of accidents to workers and the public for equivalent quantities of stored HEU. Modification to these facilities would ensure that long-term storage would be in accordance with DOE Orders, and that the risks to the public of prompt fatalities due to accidents and of latent cancer fatalities due to normal operations would be minimized. These structural modifications would reduce the risk from seismic initiators such as a beyond design basis earthquake scenario.

Buildings included in the upgrade for long-term storage at Y–12, as described in Section 2.3.1, would be evaluated by analyses employing methodologies outlined in DOE Order 5480.21, Unreviewed Safety Questions; DOE Order 5480.22, Technical Safety Requirements; and DOE Order 5480.23, Nuclear Safety Analysis Reports. Facilities and buildings within Y–12 that contain substantial quantities of enriched uranium have DOE-approved SARs that are currently undergoing review in an SAR Update Program to meet requirements of new DOE Orders (OR DOE 1994:E-3). The SAR Update Program would reflect the long-term storage upgrade at Y–12 in a Conceptual Design Report for these structural modifications as part of the Stockpile Management Restructuring Initiative that DOE is pursuing.

One of the natural phenomena initiators of accident scenarios analyzed (nuclear criticality, fire, and mechanical upset) in the Y–12 EA included a design basis accident earthquake. For the earthquake scenario, the present evaluation criterion for the design basis earthquake corresponds to a hazard exceedance frequency of 5×10^{-4} per year. The Y–12 long-term storage buildings would be upgraded to meet the performance goal for a moderate hazard facility of Performance Category 3 in DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*. The structures, systems, and components in a Performance Category 3 facility pose a potential hazard to worker and public health and safety and to the environment because radioactive or toxic materials are present in significant quantities. Design considerations for this category are to limit facility damage so that hazardous materials can be controlled and confined, occupants are protected, and functioning of the facility is not interrupted. A performance goal for Performance Category 3 is a hazard exceedance frequency of 1×10^{-4} per year (DOE Order 5480.28). Meeting this performance goal would reduce the expected risk for the design basis accidents analyzed in the Y–12 EA for Building 9212 by approximately 80 percent, resulting in a latent cancer fatality risk of 5.1×10^{-7} to the MEI and 5.7×10^{-8} to a noninvolved worker, and potential latent cancer fatalities of 7.4×10^{-6} for the 80-km (50-mi) offsite population.

The HEU EIS describes the disposition of surplus HEU currently stored at ORR. As surplus HEU is removed for disposition, the quantity of material in storage would be reduced, and therefore fewer buildings would be needed for storage. As this is a reduction in the storage footprint, the risk would be reduced accordingly. The combination of upgrading the buildings with structural modifications (as discussed above) and reducing the storage footprint as surplus HEU disposition continues are expected to result in overall reduction in the risk to the public and workers from facility accidents.

M.5.2.7 Upgrade of Existing Storage Facilities at Savannah River Site

Under the Upgrade at SRS alternative, the Actinide Packaging and Storage Facility at SRS would be upgraded to accommodate additional RFETS and LANL material. For No Action conditions, potential accidents and their consequences have previously been addressed and documented according to requirements in DOE Orders. The estimated impacts of potential accidents are shown in Table M.5.2.7–1. The estimates are based on the impacts shown in Table M.5.2.1.2–5 for a new consolidated storage facility with adjustments for the reduced quantities of plutonium that would be stored for the upgraded case. The adjustments are based on data supplied by Westinghouse Savannah River Company (SRS 1996a:6).

Table M.5.2.7–1. Upgrade With Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	7.2×10^{-3}	2.9×10^{-6}	1.4×10^{-4}	7.1×10^{-8}	0.068	3.4×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	7.2×10^{-4}	2.9×10^{-7}	1.4×10^{-5}	7.1×10^{-9}	0.068	3.4×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.029	1.2×10^{-5}	5.8×10^{-4}	2.9×10^{-7}	2.8	1.4×10^{-3}	6.6×10^{-3}
Vault fire	1.6	7.1×10^{-4}	0.031	1.5×10^{-5}	148	0.072	1.0×10^{-7}
Truck bay fire	1.0	4.0×10^{-4}	0.020	9.9×10^{-6}	95.5	0.048	1.0×10^{-7}
Spontaneous combustion	1.4×10^{-3}	5.8×10^{-7}	2.8×10^{-5}	1.4×10^{-8}	0.14	6.9×10^{-5}	7.0×10^{-7}
Explosion in the vault	2.5	9.6×10^{-5}	4.7×10^{-3}	2.4×10^{-6}	23.0	0.011	1.0×10^{-7}
Explosion outside of vault	0.011	4.3×10^{-6}	2.1×10^{-4}	1.1×10^{-7}	1.0	5.1×10^{-4}	1.0×10^{-7}
Nuclear criticality	6.9×10^{-2}	2.8×10^{-6}	1.1×10^{-4}	5.7×10^{-8}	0.094	4.7×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	2.8	1.3×10^{-3}	0.054	2.8×10^{-5}	265	0.13	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred. Impacts not dependent on the quantity of Pu would be the same as those for the new consolidated storage facility.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the impacts in Table M.5.2.1.2–5 with adjustments to reflect smaller quantities of Pu for upgraded storage.

Under the Preferred Alternative, the Actinide Packaging and Storage Facility at SRS would be upgraded to accommodate additional RFETS non-pit Pu material for the Preferred Alternative. The estimated impacts of potential accidents are shown in Table M.5.2.7–2. The estimates are based on the impacts shown in Table M.5.2.1.2–5 for a new consolidated storage facility with adjustments for the reduced quantities of Pu that would be stored for the upgraded case. The adjustments are based on data supplied by Westinghouse Savannah River Company (SRS 1996a:6).

M.5.2.8 Nevada Test Site Storage Facility

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for the NTS Storage Facility in the *Beyond Design Basis Accident Analysis*. The studies postulated a set of accident scenarios

Table M.5.2.7–2. Upgrade With Rocky Flats Environmental Technology Site Non-Pit Plutonium Subalternative (Preferred Alternative) Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	7.2×10^{-3}	2.9×10^{-6}	1.4×10^{-4}	7.1×10^{-8}	0.068	3.4×10^{-4}	6.0×10^{-4}
PCV breach by firearms discharge	7.2×10^{-4}	2.9×10^{-7}	1.4×10^{-5}	7.1×10^{-9}	0.068	3.4×10^{-5}	3.5×10^{-4}
PCV penetration by corrosion	0.029	1.2×10^{-5}	5.8×10^{-4}	2.9×10^{-7}	2.8	1.4×10^{-3}	4.8×10^{-3}
Vault fire	1.1	5.2×10^{-4}	0.023	1.1×10^{-5}	108	0.054	1.0×10^{-7}
Truck bay fire	1.0	4.0×10^{-4}	0.020	9.9×10^{-6}	95.5	0.048	1.0×10^{-7}
Spontaneous combustion	1.4×10^{-3}	5.8×10^{-7}	2.8×10^{-5}	1.4×10^{-8}	0.14	6.9×10^{-5}	7.0×10^{-7}
Explosion in the vault	0.18	7.1×10^{-5}	3.5×10^{-3}	1.7×10^{-6}	16.8	8.3×10^{-3}	1.0×10^{-7}
Explosion outside of vault	0.011	4.3×10^{-6}	2.1×10^{-4}	1.1×10^{-7}	1.0	5.1×10^{-4}	1.0×10^{-7}
Nuclear criticality	6.9×10^{-2}	2.8×10^{-6}	1.1×10^{-4}	5.7×10^{-8}	0.094	4.7×10^{-5}	1.0×10^{-7}
Beyond evaluation basis earthquake	2.0	9.8×10^{-4}	0.040	2.0×10^{-5}	194	0.098	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred. Impacts not dependent on the quantity of Pu would be the same as those for the new consolidated storage facility.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the impacts in Table M.5.2.1.2–5 with adjustments to reflect smaller quantities of Pu for upgraded storage.

that were representative of the risks and consequences for workers and the public that can be expected if the facility were constructed and operated. Although not all potential accidents were addressed, those that were postulated have consequences and risks that are expected to envelop the consequences and risks of an operating facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than 1.0×10^{-7} per year are anticipated that will have consequences and risks larger than those described in this section.

M.5.2.8.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the facility. Through a screening process, three evaluation basis accidents and four beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.2.8.1–1 and M.5.2.8.1–2. As discussed in Section M.5.1.2, Pu-based accidents bound the consequences of similar uranium-based accidents when both functions are performed at a collocated facility. Therefore, only Pu-based accidents are provided in Tables M.5.2.8.1–1 and M.5.2.8.1–2. Accident source term information is provided in Tables M.5.2.8.1–3 and M.5.2.8.1–4. Descriptions of the accident scenarios provided in Table M.5.2.8.1–5.

Table M.5.2.8.1–1. Evaluation Basis Accident Scenarios at Nevada Test Site for Plutonium Storage Facility—P-Tunnel

Accident Scenario	Accident Frequency (per year)	Source Term at Risk (PCV)[a]	Source Term Released to Environment
PCV puncture by forklift	6.0×10^{-4}	2	0.038 g Pu
PCV breach by firearms discharge	3.5×10^{-4}	1	3.8×10^{-3} g Pu
PCV penetration by corrosion	6.4×10^{-2}	1	0.163 g Pu

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.
Source: DOE 1995mm.

Table M.5.2.8.1–2. Beyond Evaluation Basis Accident Scenarios at Nevada Test Site for Plutonium Storage Facility—P-Tunnel

Accident Scenario	Accident Frequency (per year)	Source Term at Risk (PCV)[a]	Source Term Released to Environment
Truck bay fire	1.0×10^{-7}	12	5.42 g Pu
Spontaneous combustion	7.0×10^{-7}	2	7.6×10^{-3} g Pu
Explosion outside of vault	1.0×10^{-7}	1	0.054 g Pu
Nuclear criticality	1.0×10^{-7}	[b]	1.0×10^{19} fissions[b]

[a] Primary containment vessel (PCV) is assumed to contain up to 4,500 g of weapons-grade Pu as a bounding case.
[b] See Table M.5.2.1.1–5.
Source: DOE 1995mm.

Table M.5.2.8.1–3. Evaluation Basis Accident Source Terms at Nevada Test Site for Plutonium and Highly Enriched Uranium Storage Facility—P-Tunnel

Accident Parameter	Accident Scenario: PCV Puncture by Forklift	PCV Breach by Firearms Discharge	PCV Penetration by Corrosion
Frequency of occurrence (per year)	6.0×10^{-4}	3.5×10^{-4}	6.4×10^{-2}
Pu released to environment (g)	0.038	3.8×10^{-3}	0.163
Isotope Released to Environment (Ci)			
Pu-238	6.00×10^{-5}	6.00×10^{-6}	2.58×10^{-4}
Pu-239	2.17×10^{-3}	2.17×10^{-4}	9.32×10^{-3}
Pu-240	5.78×10^{-4}	5.78×10^{-5}	2.48×10^{-3}
Pu-241	2.05×10^{-3}	2.05×10^{-4}	8.79×10^{-3}
Pu-242	8.47×10^{-8}	8.47×10^{-9}	3.63×10^{-7}
Am-241	1.08×10^{-5}	1.08×10^{-6}	4.63×10^{-5}

Note: PCV=primary containment vessel.
Source: Derived from Table M.5.1.3.4–1 and M.5.2.8.1–1.

Table M.5.2.8.1–4. Beyond Evaluation Basis Accident Source Terms at Nevada Test Site for Plutonium and Highly Enriched Uranium Storage Facility—P-Tunnel

Accident Parameter	Accident Scenario			
	Truck Bay Fire	Spontaneous Combustion	Explosion Outside of Vault	Nuclear Criticality
Frequency of occurrence (per year)	1.0×10^{-7}	7.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}
Pu released to environment (g)	5.42	7.6×10^{-3}	0.054	NA
Fissions	NA	NA	NA	1.0×10^{19}
Isotope Released to Environment (Ci)				
Pu-238	8.56×10^{-3}	1.20×10^{-5}	1.53×10^{-5}	0
Pu-239	0.310	4.35×10^{-4}	3.09×10^{-3}	0
Pu-240	0.0824	1.16×10^{-4}	8.21×10^{-4}	0
Pu-241	0.292	4.10×10^{-4}	2.91×10^{-3}	0
Pu-242	1.21×10^{-5}	1.69×10^{-8}	1.20×10^{-7}	0
Am-241	1.54×10^{-3}	2.16×10^{-6}	1.53×10^{-5}	0
Kr-83m	0	0	0	55.0
Kr-85m	0	0	0	35.5
Kr-85	0	0	0	4.05×10^{-3}
Kr-87	0	0	0	215
Kr-88	0	0	0	115
Kr-89	0	0	0	6.5×10^{3}
Xe-131m	0	0	0	0.05
Xe-133m	0	0	0	1.10
Xe-133	0	0	0	13.5
Xe-135m	0	0	0	1.65×10^{3}
Xe-135	0	0	0	205
Xe-137	0	0	0	2.45×10^{4}
Xe-138	0	0	0	5.5×10^{3}
I-131	0	0	0	0.55
I-132	0	0	0	60.0
I-133	0	0	0	8.0
I-134	0	0	0	215
I-135	0	0	0	22.5

Note: NA=not applicable.
Source: Derived from Tables M.5.1.3.4–1 and M.5.2.8.1–2.

Table M.5.2.8.1–5. Accident Scenario Descriptions for Nevada Test Site Plutonium Storage Facility—P-Tunnel

Accident Scenario	Accident Description
Evaluation Basis Accident	
PCV puncture by forklift	A forklift driver attempting to pick up a pallet containing PCVs in the shipping/receiving area encounters a situation in which the fork is positioned such that it contacts the PCVs. Before the operator responds to the contact, the forward motion of the forklift punctures two PCVs with the tines of the fork. The operator backs the forklift away from the structure, and the PCVs fall off the fork, spilling some of the contents on the floor.
PCV breach by firearms discharge	Because of the armed security guard force at the storage facility, it is necessary to consider possible breach of a PCV caused by a bullet from accidental discharge of the guard's firearm. The PCV is not designed to withstand such an impact, and its effect would be to potentially penetrate the container and cause some dispersal of the contents. This can occur only where the PCVs are above the operating floor, and would be most likely in the shipping/receiving area and possibly some material handling areas.
PCV penetration by corrosion	The PCV is presumed to fail because of long-term corrosion, gradual buildup of internal pressure, or other causes generally internal to the PCV itself, and probably related to its contents. These events would generally be the result of errors in packaging the contents or in sealing the PCV. The failure would take place over an extended period, and the initial progress of the failure would be undetectable through casual external observation. Eventually, the PCV closure seal would be breached, and a small slit or crack would develop. The opening would be enlarged through continuation of the driving force and eventually some PCV contents would be expelled into the storage area or into the storage area or into one of the handling/inspection areas.
Beyond Evaluation Basis Accident	
Truck bay fire	A fire occurs following the rupture of a truck's fuel tank and ignition of the spilled fuel. A single trailer is engulfed by flames and is heated to at least the ignition point of Pu.
Spontaneous combustion	Due to improper packaging, the contents of two PCVs ignite spontaneously after being punctured by a forklift accident.
Explosion outside of vault	An explosion of undefined origin is assumed to occur in the repackaging area. The blast has sufficient force to breach the glovebox, exposing the contents to the room atmosphere and bypassing two levels of filtration provided by the glovebox.
Nuclear criticality	The only way a criticality event could occur would be in the case of multiple operational errors or an accident scenario that breaches PCVs and the fissile material somehow collects in a criticality favorable geometry.

Note: PCV=primary containment vessel.
Source: DOE 1995mm.

M.5.2.8.2 *Accident Impacts*

The estimated impacts of the postulated accidents at NTS are provided in Table M.5.2.8.2–1. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.2.8.1–3 and M.5.2.8.1–4 using the MACCS computer code. [Text deleted.]

Table M.5.2.8.2–1. Plutonium and Highly Enriched Uranium Storage Facility Accident Impacts at Nevada Test Site—P-Tunnel

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
PCV puncture by forklift	7.4×10^{-3}	2.9×10^{-6}	1.0×10^{-3}	5.0×10^{-7}	7.4×10^{-3}	3.7×10^{-6}	6.0×10^{-4}
PCV breach by firearms discharge	7.4×10^{-4}	2.9×10^{-7}	1.0×10^{-4}	5.0×10^{-8}	7.4×10^{-4}	3.7×10^{-7}	3.5×10^{-4}
PCV penetration by corrosion	0.032	1.3×10^{-5}	4.3×10^{-3}	2.2×10^{-6}	0.032	1.6×10^{-5}	0.064
Truck bay fire	1.1	4.2×10^{-4}	0.14	7.2×10^{-5}	1.1	5.3×10^{-4}	1.0×10^{-7}
Spontaneous combustion	1.5×10^{-3}	5.9×10^{-7}	2.0×10^{-4}	1.0×10^{-7}	1.5×10^{-3}	7.5×10^{-7}	1.0×10^{-7}
Explosion outside of vault	0.011	4.2×10^{-6}	1.4×10^{-3}	7.2×10^{-7}	0.011	5.3×10^{-6}	1.0×10^{-7}
Nuclear criticality	7.7×10^{-3}	3.1×10^{-6}	1.2×10^{-3}	6.1×10^{-7}	1.3×10^{-3}	6.4×10^{-7}	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the incident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values; PCV=primary containment vessel.

Source: Calculated using the source terms in Tables M.5.2.8.1–3 and M.5.2.8.1–4 and the MACCS computer code.

M.5.3 DISPOSITION ALTERNATIVES

M.5.3.1 Pit Disassembly/Conversion Facility

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for a pit disassembly/conversion facility in the *Fissile Material Disposition Program PEIS Data Call Input Report: Pit Disassembly and Conversion Facility.* The studies postulated a set of accident scenarios that were representative of the risks and consequences for workers and the public that can be expected if the facility were constructed and operated. Although not all potential accidents were addressed, those that were postulated have consequences and risks that are expected to envelop the consequences and risks of an operating facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than 1.0×10^{-7}/yr are anticipated that will have consequences and risks larger than those described in this section. [Text deleted.]

M.5.3.1.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the facility. Through a screening process, four evaluation basis accidents and four beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.3.1.1–1 and M.5.3.1.1–2. Accident source term information is provided in Tables M.5.3.1.1–3 through M.5.3.1.1–5. Descriptions of the accident scenarios are provided in Table M.5.3.1.1–6.

Table M.5.3.1.1–1. Evaluation Basis Accident Scenarios for the Pit Disassembly/Conversion Facility

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Fire on the loading dock	1.0×10^{-4} to 1.0×10^{-3}	18 g Pu	0.8 g Pu
Fire in a process cell	1.0×10^{-5} to 1.0×10^{-3}	24 g Pu	4.8×10^{-6} g Pu
Deflagration inside a glovebox	1.0×10^{-5} to 1.0×10^{-3}	10 kg Pu	1.0×10^{-3} g Pu
Impact induced spill	4.5×10^{-5}	4 kg PuO_2	1.7×10^{-9} g Pu

Source: LANL 1996d.

Table M.5.3.1.1–2. Beyond Evaluation Basis Accident Scenarios for the Pit Disassembly/Conversion Facility

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Nuclear criticality	$<1.0 \times 10^{-7}$	5.0×10^{17} fissions; gaseous by-products released[a]	[a]
Beyond design basis fire in a process cell	$<1.0 \times 10^{-7}$	24 g Pu	0.034 g Pu
Oxyacetylene explosion in a process cell	$<1.0 \times 10^{-7}$	10 kg Pu	50 g Pu
Beyond evaluation basis earthquake	$<1.0 \times 10^{-7}$	10 kg Pu	25 g Pu

[a] See Table M.5.3.1.1–3.
Source: LANL 1996d.

Table M.5.3.1.1–3. Pit Disassembly/Conversion Facility Criticality Source Terms

Nuclide	Produced (Ci)	Released (Ci)
Kr-83m	5.5	5.5
Kr-85m	3.55	3.55
Kr-85	4.05×10^{-4}	4.05×10^{-4}
Kr-87	21.5	21.5
Kr-88	11.5	11.5
Kr-89	650	650
Xe-131m	5.0×10^{-3}	5.0×10^{-3}
Xe-133m	0.11	0.11
Xe-133	1.35	1.35
Xe-135m	165	165
Xe-135	20.5	20.5
Xe-137	2,450	2,450
Xe-138	550	550
I-131	0.55	0.138
I-132	60	15
I-133	8	2.0
I-134	215	53.8
I-135	22.5	5.36

Source: LANL 1996d.

Table M.5.3.1.1–4. Pit Disassembly/Conversion Facility Evaluation Basis Accident Source Terms

	Accident Scenario			
Accident Parameter	Fire on Loading Dock	Beyond Design Basis Fire in Process Cell	Deflagration Inside a Glovebox	Impact Induced Spill
Frequency of occurrence (per year)	5.0×10^{-4}[a]	1.0×10^{-4}[a]	1.0×10^{-4}[a]	4.5×10^{-5}
Pu released to environment (g)	0.8	4.8×10^{-6}	1.0×10^{-3}	1.7×10^{-9}
Isotope Released to Environment (Ci)				
Pu-238	4.50×10^{-4}	2.70×10^{-9}	5.63×10^{-7}	9.57×10^{-13}
Pu-239	0.0462	2.77×10^{-7}	5.78×10^{-5}	9.83×10^{-11}
Pu-240	0.0109	6.53×10^{-8}	1.36×10^{-5}	2.31×10^{-11}
Pu-241	0.0344	2.06×10^{-7}	4.30×10^{-5}	7.31×10^{-11}
Pu-242	3.14×10^{-7}	1.88×10^{-12}	3.92×10^{-10}	6.66×10^{-16}
Am-241	0.0182	1.09×10^{-7}	2.27×10^{-5}	3.86×10^{-11}

[a] Midpoint of the estimated frequency range.

Source: Derived from Tables M.5.1.3.4–2 and M.5.3.1.1–1.

Table M.5.3.1.1–5. Pit Disassembly/Conversion Facility Beyond Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario			
	Nuclear Criticality	Beyond Design Basis Fire in a Process Cell	Oxyacetylene Explosion in a Process Cell	Beyond Design Basis Earthquake
Frequency of occurrence (per year)[a]	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}
Pu released to environment (g)	NA	0.034	50	25
Fissions	5.0×10^{17}	NA	NA	NA
Isotope Released to Environment (Ci)				
Pu-238	0	1.91×10^{-5}	0.0281	0.0141
Pu-239	0	1.97×10^{-3}	2.89	1.44
Pu-240	0	4.62×10^{-4}	0.680	0.340
Pu-241	0	1.46×10^{-3}	2.15	1.08
Pu-242	0	1.34×10^{-8}	1.96×10^{-5}	9.80×10^{-6}
Am-241	0	7.72×10^{-4}	1.13	0.567
Kr-83m	5.5	0	0	0
Kr-85m	3.55	0	0	0
Kr-85	4.05×10^{-4}	0	0	0
Kr-87	21.5	0	0	0
Kr-88	11.5	0	0	0
Kr-89	650	0	0	0
Xe-131m	5.0×10^{-3}	0	0	0
Xe-133m	0.11	0	0	0
Xe-133	1.35	0	0	0
Xe-135m	165	0	0	0
Xe-135	20.5	0	0	0
Xe-137	2.45×10^{3}	0	0	0
Xe-138	550	0	0	0
I-131	0.138	0	0	0
I-132	15	0	0	0
I-133	2.0	0	0	0
I-134	53.8	0	0	0
I-135	5.36	0	0	0

[a] Maximum value of the estimated frequency range.

Note: NA=not applicable.

Source: Derived from Tables M.5.1.3.4–2, M.5.3.1.1–2, and M.5.3.1.1–3.

Table M.5.3.1.1–6. Accident Scenario Descriptions for the Pit Disassembly/Conversion Facility

Accident Scenario	Accident Description
Evaluation Basis Accidents	
Fire on the loading dock	The fire is caused by welding, cleaning solvents, electrical shorts, or other miscellaneous causes. The scenario assumes an open garage door and that a single drum of combustible waste is involved in the fire.
Fire in a process cell	It is assumed that a process cell contains a glovebox used for final processing of plutonium oxide powder. The gloves, stowed outside the glovebox, are coated with a layer of Pu dust. A flammable cleaning liquid such as acetone or isopropyl alcohol is brought into the process cell in violation of operating procedures, spills, and ignites. The initial extent and intensity of the fire are sufficient to completely incinerate the gloves. The sprinkler system activates and protects the glovebox from further damage. The ventilation system with HEPA filters continues to function throughout the accident.
Deflagration inside a glovebox	The bounding evaluation basis explosion is a deflagration of a flammable gas mixture inside a glovebox. It is assumed that through some unforeseen set of failures, a combustible gas mixture accumulates inside a glovebox and is ignited, possibly by an electrical spark from an operating electrical device. The deflagration blows out the HEPA filter from the glovebox ventilation system exit. Gloves may also be blown out. The room volumes are sufficient to attenuate the pressure wave to levels below that needed to damage building ventilation system HEPA filters.
Impact induced spill	The most catastrophic case of leak or spill of nuclear material would result from a forklift or other large vehicle running over a package of nuclear material, breaching the containment, and causing airborne release to the room. Three stage HEPA filtration is available for the facility exhaust to limit the release to the environment.
Beyond Evaluation Basis Accidents	
Nuclear criticality	The postulated criticality accident was caused by improper stacking or handling of bulk nuclear material. Multiple operational errors in the material spacing, packing density, manner, and type of containment, and maximum quantities of fissile material permitted in the area would be required for postulated criticality accident to occur.
Beyond evaluation basis fire in a process cell	A typical fire with coincident failures of two or more major safety systems constitutes a beyond evaluation basis fire. The evaluation postulated the fire in a process cell, discussed above, with the sprinkler system and ventilation system with HEPA filtration inoperative during the accident.
Oxyacetylene explosion in a process cell	The evaluation postulated the explosion of a welding rig oxyacetylene bottle in a process cell. The explosion is sufficient to blow out the HEPA filters and cause significant damage to the ventilation system and nearby equipment.
Beyond evaluation basis earthquake	The following assumptions were used in the evaluation: (1) the earthquake disables the ventilation system; (2) there is sufficient structural damage to the building and it does not totally collapse; (3) a ceiling slab falls on the glovebox with the most material at risk and severely damages the glovebox; (4) the process cell with the most material at risk is located on an outside wall; (5) the outside wall cracks; and (6) the wind is blowing and the cracks are located on the lee side of the building.

Source: LANL 1996d.

M.5.3.1.2 *Accident Impacts*

The estimated impacts of the postulated accidents at each site are provided in Tables M.5.3.1.2–1 through M.5.3.1.2–6. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.3.1.1–4 and M.5.3.1.1–5 using the MACCS code. [Text deleted.]

Table M.5.3.1.2–1. Pit Disassembly/Conversion Facility Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Fire on the loading dock	0.32	1.3×10^{-4}	0.010	5.1×10^{-6}	18.5	9.3×10^{-3}	5.0×10^{-5}
Fire in a process cell	1.9×10^{-6}	7.6×10^{-10}	6.1×10^{-8}	3.0×10^{-11}	1.1×10^{-4}	5.5×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	4.0×10^{-4}	1.6×10^{-7}	1.3×10^{-5}	6.4×10^{-9}	0.023	1.2×10^{-5}	1.0×10^{-4}
Impact induced spill	6.8×10^{-10}	2.7×10^{-13}	2.2×10^{-11}	1.1×10^{-14}	3.9×10^{-8}	2.0×10^{-11}	4.5×10^{-5}
Nuclear criticality	1.7×10^{-3}	6.9×10^{-7}	5.7×10^{-5}	2.9×10^{-8}	0.016	7.8×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	0.014	5.4×10^{-6}	4.3×10^{-4}	2.2×10^{-7}	0.79	3.9×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	19.9	9.4×10^{-3}	0.63	3.2×10^{-4}	1150	0.58	1.0×10^{-7}
Beyond evaluation basis earthquake	9.9	4.1×10^{-3}	0.32	1.6×10^{-4}	576	0.29	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1–4 and M.5.3.1.1–5 and the MACCS computer code.

Table M.5.3.1.2–2. Pit Disassembly/Conversion Facility Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Fire on the loading dock	0.22	8.7×10^{-5}	4.0×10^{-3}	2.0×10^{-6}	0.42	2.1×10^{-4}	5.0×10^{-5}
Fire in a process cell	1.3×10^{-6}	5.2×10^{-10}	2.4×10^{-8}	1.2×10^{-11}	2.5×10^{-6}	1.3×10^{-9}	1.0×10^{-4}
Deflagration inside a glovebox	2.7×10^{-4}	1.1×10^{-7}	5.1×10^{-6}	2.5×10^{-9}	5.2×10^{-4}	2.6×10^{-7}	1.0×10^{-4}
Impact induced spill	4.6×10^{-10}	1.9×10^{-13}	8.6×10^{-12}	4.3×10^{-15}	8.9×10^{-10}	4.5×10^{-13}	4.5×10^{-5}
Nuclear criticality	1.3×10^{-3}	5.0×10^{-7}	2.2×10^{-5}	1.1×10^{-8}	3.2×10^{-4}	1.6×10^{-7}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	9.3×10^{-3}	3.7×10^{-6}	1.7×10^{-4}	8.6×10^{-8}	0.018	8.9×10^{-6}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	13.6	6.3×10^{-3}	0.25	1.3×10^{-4}	26.1	1.3×10^{-2}	1.0×10^{-7}
Beyond evaluation basis earthquake	6.8	2.7×10^{-3}	0.13	6.3×10^{-5}	13.0	6.5×10^{-3}	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1–4 and M.5.3.1.1–5 and the MACCS computer code.

Table M.5.3.1.2–3. Pit Disassembly/Conversion Facility Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Fire on the loading dock	0.30	1.2×10^{-4}	2.6×10^{-3}	1.3×10^{-6}	5.5	2.8×10^{-3}	5.0×10^{-5}
Fire in a process cell	1.8×10^{-6}	7.1×10^{-10}	1.5×10^{-8}	7.7×10^{-12}	3.3×10^{-5}	1.7×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	3.7×10^{-4}	1.5×10^{-7}	3.2×10^{-6}	1.6×10^{-9}	6.9×10^{-3}	3.5×10^{-6}	1.0×10^{-4}
Impact induced spill	6.3×10^{-10}	2.5×10^{-13}	5.5×10^{-12}	2.7×10^{-15}	1.2×10^{-8}	5.9×10^{-12}	4.5×10^{-5}
Nuclear criticality	1.7×10^{-3}	6.7×10^{-7}	1.3×10^{-5}	6.7×10^{-9}	4.2×10^{-3}	2.1×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	0.013	5.1×10^{-6}	1.1×10^{-4}	5.5×10^{-8}	0.24	1.2×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	18.6	9.2×10^{-3}	0.16	8.0×10^{-5}	346	0.17	1.0×10^{-7}
Beyond evaluation basis earthquake	9.3	3.7×10^{-3}	0.080	4.0×10^{-5}	173	0.086	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1–4 and M.5.3.1.1–5 and the MACCS computer code.

Table M.5.3.1.2–4. Pit Disassembly/Conversion Facility Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Fire on the loading dock	0.13	5.1×10^{-5}	0.041	2.0×10^{-5}	6.3	3.2×10^{-3}	5.0×10^{-5}
Fire in a process cell	7.7×10^{-7}	3.1×10^{-10}	2.5×10^{-7}	1.2×10^{-10}	3.8×10^{-5}	1.9×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	1.6×10^{-4}	6.4×10^{-8}	5.1×10^{-5}	2.6×10^{-8}	7.9×10^{-3}	3.9×10^{-6}	1.0×10^{-4}
Impact induced spill	2.7×10^{-10}	1.1×10^{-13}	8.7×10^{-11}	4.3×10^{-14}	1.3×10^{-8}	6.7×10^{-12}	4.5×10^{-5}
Nuclear criticality	7.7×10^{-4}	3.1×10^{-7}	2.9×10^{-4}	1.4×10^{-7}	9.5×10^{-3}	4.8×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	5.5×10^{-3}	2.2×10^{-6}	1.7×10^{-3}	8.7×10^{-7}	0.27	1.3×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	8.0	3.3×10^{-3}	2.6	1.3×10^{-3}	393	0.20	1.0×10^{-7}
Beyond evaluation basis earthquake	4.0	1.6×10^{-3}	1.3	6.4×10^{-4}	196	0.098	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1–4 and M.5.3.1.1–5 and the MACCS computer code.

Table M.5.3.1.2–5. Pit Disassembly/Conversion Facility Accident Impacts at Oak Ridge Reservation

	Worker at 772 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Fire on the loading dock	0.37	1.5×10^{-4}	0.37	1.9×10^{-4}	69.3	0.035	5.0×10^{-5}
Fire in a process cell	2.2×10^{-6}	8.9×10^{-10}	2.2×10^{-6}	1.1×10^{-9}	4.2×10^{-4}	2.1×10^{-7}	1.0×10^{-4}
Deflagration inside a glovebox	4.7×10^{-4}	1.9×10^{-7}	4.7×10^{-4}	2.3×10^{-7}	0.087	4.3×10^{-5}	1.0×10^{-4}
Impact induced spill	7.9×10^{-10}	3.2×10^{-13}	7.9×10^{-10}	4.0×10^{-13}	1.5×10^{-7}	7.4×10^{-11}	4.5×10^{-5}
Nuclear criticality	2.0×10^{-3}	7.8×10^{-7}	2.0×10^{-3}	9.8×10^{-7}	0.13	6.6×10^{-5}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	0.016	6.3×10^{-6}	0.016	7.9×10^{-6}	3.0	1.5×10^{-3}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	23.3	1.1×10^{-2}	23.3	0.014	4,320	2.2	1.0×10^{-7}
Beyond evaluation basis earthquake	11.6	4.6×10^{-3}	11.6	5.8×10^{-3}	2,160	1.1	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [772 m for this facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1–4 and M.5.3.1.1–5 and the MACCS computer code.

Table M.5.3.1.2–6. Pit Disassembly/Conversion Facility Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Fire on the loading dock	0.21	8.4×10^{-5}	4.1×10^{-3}	2.0×10^{-6}	19.8	9.9×10^{-3}	5.0×10^{-5}
Fire in a process cell	1.3×10^{-6}	5.0×10^{-10}	2.5×10^{-8}	1.2×10^{-11}	1.2×10^{-4}	5.9×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	2.6×10^{-4}	1.0×10^{-7}	5.1×10^{-6}	2.6×10^{-9}	0.025	1.2×10^{-5}	1.0×10^{-4}
Impact induced spill	4.4×10^{-10}	1.8×10^{-13}	8.7×10^{-12}	4.4×10^{-15}	4.2×10^{-8}	2.1×10^{-11}	4.5×10^{-5}
Nuclear criticality	1.1×10^{-3}	4.5×10^{-7}	2.0×10^{-5}	1.0×10^{-8}	0.020	1.0×10^{-5}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	8.9×10^{-3}	3.6×10^{-6}	1.7×10^{-4}	8.7×10^{-8}	0.84	4.2×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	13.0	5.8×10^{-3}	0.26	1.3×10^{-4}	1,240	0.62	1.0×10^{-7}
Beyond evaluation basis earthquake	6.5	2.8×10^{-3}	0.13	6.4×10^{-5}	618	0.31	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1–4 and M.5.3.1.1–5 and the MACCS computer code.

M.5.3.2 Mixed Oxide Fuel Fabrication Facility

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for a MOX fuel fabrication at DOE sites and a generic site in the *Fissile Material Disposition Program PEIS Data Call Input Report: Mixed Oxide Fuel Fabrication.* The studies postulated a set of accident scenarios that were representative of the risks and consequences for workers and the public that can be expected if the facility were constructed and operated. Although not all potential accidents were addressed, those that were postulated have consequences and risks that are expected to envelop the consequences and risks of an operating facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than 1.0×10^{-7}/yr are anticipated that will have consequences and risks larger than those described in this section. [Text deleted.]

M.5.3.2.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the facility. Through a screening process, four evaluation basis accidents and four beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.3.2.1–1 and M.5.3.2.1–2. Accident source term information is provided in Tables M.5.3.2.1–3 through M.5.3.2.1–5. Description of accident scenarios are provided in Table M.5.3.2.1–6.

Table M.5.3.2.1–1. Evaluation Basis Accident Scenarios for the Mixed Oxide Fuel Fabrication Facility

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Fire on open loading dock	1.0×10^{-4} to 1.0×10^{-3}	18 g Pu	0.8 g Pu
Fire in process cell	1.0×10^{-5} to 1.0×10^{-3}	24 g Pu	4.8×10^{-6} g Pu
Leaks or spills from breach of containment	4.5×10^{-5}	4 kg Pu	1.7×10^{-9} g Pu
Explosion inside a glovebox	1.0×10^{-5} to 1.0×10^{-3}	10 kg Pu	1.0×10^{-3} g Pu

Source: LANL 1996b.

Table M.5.3.2.1–2. Beyond Evaluation Basis Accident Scenarios for the Mixed Oxide Fuel Fabrication Facility

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Nuclear criticality	1.0×10^{-7}	5.0×10^{17} fissions; gaseous by-products released[a]	[a]
Beyond evaluation basis fire	1.0×10^{-7}	24 g Pu	0.034 g Pu
Beyond evaluation basis explosion	1.0×10^{-7}	10 kg Pu	50 g Pu
Beyond evaluation basis earthquake	1.0×10^{-7}	10 kg Pu	25 g Pu

[a] See Table M.5.3.2.1–3.
Source: LANL 1996b.

Table M.5.3.2.1–3. Mixed Oxide Fuel Fabrication Facility Criticality Source Terms

Nuclide	Produced (Ci)	Released (Ci)
Kr-83m	5.5	2.75
Kr-85m	3.5	1.75
Kr-85	4.0×10^{-4}	2.0×10^{-4}
Kr-87	21.5	11
Kr-88	11.5	6
Kr-89	650	325
Xe-131m	5.0×10^{-3}	2.5×10^{-3}
Xe-133m	0.1	0.05
Xe-133	1.5	0.75
Xe-135m	165	85
Xe-135	20.5	10
Xe-137	2,450	1,225
Xe-138	550	275
I-131	0.5	0.025
I-132	60	3
I-133	8	0.4
I-134	215	11
I-135	22.5	1.0

Source: LANL 1996b.

Table M.5.3.2.1–4. Mixed Oxide Fuel Fabrication Facility Evaluation Basis Accident Source Terms

	Accident Scenario			
Accident Parameter	Fire on Loading Dock	Fire in Process Cell	Leaks or Spills from Breach of Containment	Explosion Inside Glovebox
Frequency of occurrence (per year)	5.0×10^{-4}[a]	1.0×10^{-4}[a]	4.5×10^{-5}	1.0×10^{-4}[a]
Pu released to environment (g)	0.8	4.8×10^{-6}	1.7×10^{-9}	1.0×10^{-3}
Isotope Released to Environment (curies)				
Pu-238	4.50×10^{-4}	2.70×10^{-9}	9.57×10^{-13}	5.63×10^{-7}
Pu-239	0.0462	2.77×10^{-7}	9.83×10^{-11}	5.78×10^{-5}
Pu-240	0.0109	6.53×10^{-8}	2.31×10^{-11}	1.36×10^{-5}
Pu-241	0.0344	2.06×10^{-7}	7.31×10^{-11}	4.30×10^{-5}
Pu-242	3.14×10^{-7}	1.88×10^{-12}	6.66×10^{-16}	3.92×10^{-10}
Am-241	0.0182	1.09×10^{-7}	3.86×10^{-11}	2.27×10^{-5}

[a] Midpoint of the estimated frequency range.

Note: Am=Americium.

Source: Derived from Tables M.5.1.3.4–2 and M.5.3.2.1–1.

Table M.5.3.2.1–5. Mixed Oxide Fuel Fabrication Facility Beyond Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario			
	Nuclear Criticality	Beyond Evaluation Basis Fire	Beyond Evaluation Basis Explosion	Beyond Evaluation Basis Earthquake
Frequency of occurrence (per year)	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}
Pu released to environment (g)	NA	0.034	50	25
Fissions	5.0×10^{17}	NA	NA	NA
Isotope Released to Environment (Ci)				
Pu-238	0	1.91×10^{-5}	0.0281	0.0141
Pu-239	0	1.97×10^{-3}	2.89	1.44
Pu-240	0	4.62×10^{-4}	0.680	0.340
Pu-241	0	1.46×10^{-3}	2.15	1.08
Pu-242	0	1.33×10^{-8}	1.96×10^{-5}	9.80×10^{-6}
Am-241	0	7.72×10^{-4}	1.13	0.567
Kr-83m	2.75	0	0	0
Kr-85m	1.75	0	0	0
Kr-85	2.0×10^{-4}	0	0	0
Kr-87	11	0	0	0
Kr-88	6	0	0	0
Kr-89	325	0	0	0
Xe-131m	2.5×10^{-3}	0	0	0
Xe-133m	0.05	0	0	0
Xe-133	0.75	0	0	0
Xe-135m	85	0	0	0
Xe-135	10	0	0	0
Xe-137	1,225	0	0	0
Xe-138	275	0	0	0
I-131	0.025	0	0	0
I-132	3	0	0	0
I-133	0.4	0	0	0
I-134	11	0	0	0
I-135	1.0	0	0	0

Note: NA=not applicable.
Source: Derived from Tables M.5.1.3.4–2, M.5.3.2.1–2, and M.5.3.2.1–3.

Table M.5.3.2.1–6. Accident Scenario Descriptions for the Mixed Oxide Fuel Fabrication Facility

Accident Scenario	Accident Description
Evaluation Basis Accidents	
Fire on the loading dock	The fire is caused by welding, cleaning solvents, electrical shorts, or other miscellaneous causes. The scenario assumes an open garage door and that a single drum of combustible waste is involved in the fire.
Fire in a process cell	It is assumed that a process cell contains a glovebox used for final processing of plutonium oxide powder. The gloves, stowed outside the glovebox, are coated with a layer of Pu dust. A flammable cleaning liquid such as acetone or isopropyl alcohol is brought into the process cell in violation of operating procedures, spills, and ignites. The initial extent and intensity of the fire are sufficient to completely incinerate the gloves. The sprinkler system activates and protects the glovebox from further damage. The ventilation system with HEPA filters continues to function throughout the accident.
Deflagration inside a glovebox	The bounding evaluation basis explosion is a deflagration of a flammable gas mixture inside a glovebox. It is assumed that through some unforeseen set of failures, a combustible gas mixture accumulates inside a glovebox and is ignited, possibly by an electrical spark from an operating electrical device. The deflagration blows out the HEPA filter from the glovebox ventilation system exit. Gloves may also be blown out. The room volumes are sufficient to attenuate the pressure wave to levels below that needed to damage the building ventilation system HEPA filters.
Impact-induced spill	The most catastrophic case of leak or spill of nuclear material would result from a forklift or other large vehicle running over a package of nuclear material, breaching the containment, and causing an airborne release to the room. Three-stage HEPA filtration is available for the facility exhaust to limit the release to the environment.
Beyond Evaluation Basis Accidents	
Nuclear criticality	There will not be sufficient quantities of plutonium solutions at the facility to cause a criticality accident. The most likely cause of a criticality event involving Pu oxides would be improper stacking or handling of bulk nuclear material. Multiple operational errors in the material spacing, packing density, manner, and type of containment, and maximum quantities of fissile material permitted in the area would be required for the postulated criticality accident to occur.
Beyond evaluation basis fire in a process cell	A typical fire with coincident failures of two or more major safety systems constitutes a beyond evaluation basis fire. The evaluation postulated the fire in a process cell, discussed above, with the sprinkler system and ventilation system with HEPA filtration inoperative during the accident.
Oxyacetylene explosion in a process cell	The evaluation postulated the explosion of a welding rig oxyacetylene bottle in a process cell. The explosion is sufficient to blow out the HEPA filters and cause significant damage to the ventilation system and nearby equipment.
Beyond evaluation basis earthquake	The following assumptions were used in the evaluation: (1) the earthquake disables the ventilation system; (2) there is significant structural damage to the building but it does not totally collapse; (3) a ceiling slab fall on the glovebox with the most material at risk and severely damages the glovebox; (4) the process cell with the most material at risk is located on an outside wall; (5) the outside wall cracks and the cracks; and (6) the wind is blowing and the cracks are located on the lee side of the building.

Source: LANL 1996b.

M.5.3.2.2 *Accident Impacts*

The estimated impacts of the postulated accidents at each site are provided in Tables M.5.3.2.2–1 through M.5.3.2.2–6. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.3.2.1–4 and M.5.3.2.1–5 using the MACCS computer code. [Text deleted.]

Table M.5.3.2.2–1. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Evaluation basis fire on open loading dock	0.32	1.3×10^{-4}	0.010	5.1×10^{-6}	18.5	9.3×10^{-3}	5.0×10^{-4}
Evaluation basis fire in process cell	1.9×10^{-6}	7.6×10^{-10}	6.1×10^{-8}	3.0×10^{-11}	1.1×10^{-4}	5.5×10^{-8}	1.0×10^{-4}
Leaks or spills from breach of containment	6.8×10^{-10}	2.7×10^{-13}	2.2×10^{-11}	1.1×10^{-14}	3.9×10^{-8}	2.0×10^{-11}	4.5×10^{-5}
Evaluation basis explosion inside a glovebox	4.0×10^{-4}	1.6×10^{-7}	1.3×10^{-5}	6.4×10^{-9}	0.023	1.2×10^{-5}	1.0×10^{-4}
Nuclear criticality	5.2×10^{-4}	2.1×10^{-7}	1.7×10^{-5}	8.4×10^{-9}	3.4×10^{-3}	1.7×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire	0.014	5.4×10^{-6}	4.3×10^{-4}	2.2×10^{-7}	0.79	3.9×10^{-4}	1.0×10^{-7}
Beyond evaluation basis explosion	19.9	9.4×10^{-3}	0.63	3.2×10^{-4}	1150	0.58	1.0×10^{-7}
Beyond evaluation basis earthquake	9.9	4.1×10^{-3}	0.32	1.6×10^{-4}	576	0.29	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table M.5.3.2.2–2. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Nevada Test Site

Accident Scenario	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per year)
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	
Evaluation basis fire on open loading dock	0.22	8.7×10^{-5}	4.0×10^{-3}	2.0×10^{-6}	0.42	2.1×10^{-4}	5.0×10^{-4}
Evaluation basis fire in process cell	1.3×10^{-6}	5.2×10^{-10}	2.4×10^{-8}	1.2×10^{-11}	2.5×10^{-6}	1.3×10^{-9}	1.0×10^{-4}
Leaks or spills from breach of containment	4.6×10^{-10}	1.8×10^{-13}	8.6×10^{-12}	4.3×10^{-15}	8.9×10^{-10}	4.5×10^{-13}	4.5×10^{-5}
Evaluation basis explosion inside a glovebox	2.7×10^{-4}	1.1×10^{-7}	5.1×10^{-6}	2.5×10^{-9}	5.2×10^{-4}	2.6×10^{-7}	1.0×10^{-4}
Nuclear criticality	3.9×10^{-4}	1.5×10^{-7}	6.5×10^{-6}	3.3×10^{-9}	6.6×10^{-5}	3.3×10^{-8}	1.0×10^{-7}
Beyond evaluation basis fire	9.3×10^{-3}	3.7×10^{-6}	1.7×10^{-4}	8.6×10^{-8}	0.018	8.9×10^{-6}	1.0×10^{-7}
Beyond evaluation basis explosion	13.6	6.3×10^{-3}	0.25	1.3×10^{-4}	26.1	0.013	1.0×10^{-7}
Beyond evaluation basis earthquake	6.8	2.7×10^{-3}	0.13	6.3×10^{-5}	13.0	6.5×10^{-3}	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table M.5.3.2.2–3. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Evaluation basis fire on open loading dock	0.30	1.2×10^{-4}	2.6×10^{-3}	1.3×10^{-6}	5.5	2.8×10^{-3}	5.0×10^{-4}
Evaluation basis fire in process cell	1.8×10^{-6}	7.1×10^{-10}	1.5×10^{-8}	7.7×10^{-12}	3.3×10^{-5}	1.7×10^{-8}	1.0×10^{-4}
Leaks or spills from breach of containment	6.3×10^{-10}	2.5×10^{-13}	5.5×10^{-12}	2.7×10^{-15}	1.2×10^{-10}	5.9×10^{-12}	4.5×10^{-5}
Evaluation basis explosion inside a glovebox	3.7×10^{-4}	1.5×10^{-7}	3.2×10^{-6}	1.6×10^{-9}	6.9×10^{-3}	3.5×10^{-6}	1.0×10^{-4}
Nuclear criticality	5.0×10^{-4}	2.0×10^{-7}	3.9×10^{-6}	1.9×10^{-9}	8.5×10^{-4}	4.3×10^{-7}	1.0×10^{-7}
Beyond evaluation basis fire	0.013	5.1×10^{-6}	1.1×10^{-4}	5.5×10^{-8}	0.24	1.2×10^{-4}	1.0×10^{-7}
Beyond evaluation basis explosion	18.6	9.2×10^{-3}	0.16	8.0×10^{-5}	346	0.17	1.0×10^{-7}
Beyond evaluation basis earthquake	9.3	3.7×10^{-3}	0.080	4.0×10^{-5}	173	0.086	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table M.5.3.2.2–4. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Evaluation basis fire on open loading dock	0.13	5.1×10^{-5}	0.041	2.0×10^{-5}	6.3	3.2×10^{-3}	5.0×10^{-4}
Evaluation basis fire in process cell	7.7×10^{-7}	3.1×10^{-10}	2.4×10^{-7}	1.2×10^{-10}	3.8×10^{-5}	1.9×10^{-8}	1.0×10^{-4}
Leaks or spills from breach of containment	2.7×10^{-10}	1.1×10^{-13}	8.7×10^{-11}	4.3×10^{-14}	1.3×10^{-8}	6.7×10^{-12}	4.5×10^{-5}
Evaluation basis explosion inside a glovebox	1.6×10^{-4}	6.4×10^{-8}	5.1×10^{-5}	2.6×10^{-8}	7.9×10^{-3}	3.9×10^{-6}	1.0×10^{-4}
Nuclear criticality	2.4×10^{-4}	9.7×10^{-8}	9.3×10^{-5}	4.6×10^{-8}	2.3×10^{-3}	1.1×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire	5.5×10^{-3}	2.2×10^{-6}	1.7×10^{-3}	8.7×10^{-7}	0.27	1.3×10^{-4}	1.0×10^{-7}
Beyond evaluation basis explosion	8.0	3.3×10^{-3}	2.6	1.3×10^{-3}	393	0.20	1.0×10^{-7}
Beyond evaluation basis earthquake	4.0	1.6×10^{-3}	1.3	6.4×10^{-4}	196	9.8×10^{-2}	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table M.5.3.2.2–5. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Oak Ridge Reservation

	Worker at 801[a]m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Evaluation basis fire on open loading dock	0.36	1.4×10^{-4}	0.36	1.8×10^{-4}	74	0.037	5.0×10^{-4}
Evaluation basis fire in process cell	2.2×10^{-6}	8.7×10^{-10}	2.2×10^{-6}	1.1×10^{-9}	4.4×10^{-4}	2.2×10^{-7}	1.0×10^{-4}
Leaks or spills from breach of containment	7.7×10^{-10}	3.1×10^{-13}	7.7×10^{-10}	3.8×10^{-13}	1.6×10^{-7}	7.9×10^{-1}	4.5×10^{-5}
Evaluation basis explosion inside a glovebox	4.5×10^{-4}	1.8×10^{-7}	4.5×10^{-4}	2.3×10^{-7}	0.092	4.6×10^{-5}	1.0×10^{-4}
Nuclear criticality	5.8×10^{-4}	2.3×10^{-7}	5.8×10^{-4}	2.9×10^{-7}	0.040	2.0×10^{-5}	1.0×10^{-7}
Beyond evaluation basis fire	0.015	6.2×10^{-6}	0.015	7.7×10^{-6}	3.2	1.6×10^{-3}	1.0×10^{-7}
Beyond evaluation basis explosion	22.6	0.011	22.6	0.013	4,620	2.3	1.0×10^{-7}
Beyond evaluation basis earthquake	11.3	4.5×10^{-3}	11.3	5.6×10^{-3}	2,310	1.2	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [801 m for this facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table M.5.3.2.2–6. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Savannah River Site

Accident Scenario	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Evaluation basis fire on open loading dock	0.21	8.4×10^{-5}	5.9×10^{-3}	2.9×10^{-6}	19.8	9.9×10^{-3}	5.0×10^{-4}
Evaluation basis fire in process cell	1.3×10^{-6}	5.0×10^{-10}	3.5×10^{-8}	1.8×10^{-11}	1.2×10^{-4}	5.9×10^{-8}	1.0×10^{-4}
Leaks or spills from breach of containment	4.4×10^{-10}	1.8×10^{-13}	1.2×10^{-11}	6.2×10^{-15}	4.2×10^{-8}	2.1×10^{-11}	4.5×10^{-5}
Evaluation basis explosion inside a glovebox	2.6×10^{-4}	1.0×10^{-7}	7.3×10^{-6}	3.7×10^{-9}	0.025	1.2×10^{-5}	1.0×10^{-4}
Nuclear criticality	3.5×10^{-4}	1.4×10^{-7}	9.0×10^{-6}	4.5×10^{-9}	4.6×10^{-3}	2.3×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire	8.9×10^{-3}	3.6×10^{-6}	2.5×10^{-4}	1.2×10^{-7}	0.84	4.2×10^{-4}	1.0×10^{-7}
Beyond evaluation basis explosion	13.0	5.8×10^{-3}	0.36	1.8×10^{-4}	1,240	0.62	1.0×10^{-7}
Beyond evaluation basis earthquake	6.5	2.8×10^{-3}	0.18	9.1×10^{-5}	618	0.31	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

M.5.3.3 Direct Disposition Alternative for a Deep Borehole Complex

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for a deep borehole disposal facility and the direct emplacement of Pu and Plutonium Dioxide in the *Fissile Material Disposition Program Deep Borehole Disposal Facility PEIS Data Input Report for Direct Disposal–Direct Disposal of Plutonium/Plutonium Dioxide in Compound Canisters*. The studies postulated a set of accident scenarios that were representative of the risks and consequences for workers and the public that can be expected if the facility were constructed and operated. Although not all potential accidents were addressed, those that were postulated have consequences and risks that are expected to envelop the consequences and risks of an operating facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than 1.0×10^{-7}/yr are anticipated that will have consequences and risks larger than those described in this section.

M.5.3.3.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the facility. Through a screening process, seven evaluation basis accidents with release to the environment and three beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.3.3.1–1 and M.5.3.3.1–2. Accident source term information is provided in Tables M.5.3.3.1–3 and M.5.3.3.1–4. Descriptions of accident scenarios are provided in Table M.5.3.3.1–5.

Table M.5.3.3.1–1. Evaluation Basis Accident Scenarios for Direct Disposition at the Deep Borehole Complex

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Evaluation basis earthquake	$1.0x10^{-6}$ to $1.0x10^{-4}$	NA	No release
Evaluation basis tornado	$1.0x10^{-6}$ to $1.0x10^{-4}$	NA	No release
Evaluation basis flood	$1.0x10^{-6}$ to $1.0x10^{-4}$	NA	No release
Pu storage container breakage during storage	$1.0x10^{-4}$ to 0.01	4.5 kg Pu	$4.5x10^{-10}$ g Pu
Pu storage container breakage during handling	$1.0x10^{-4}$ to 0.01	4.5 kg Pu	$4.5x10^{-8}$ g Pu
Emplacement canister dropped during handling	$1.0x10^{-4}$ to 0.01	40.5 kg Pu	No release
Onsite emplacement canister transportation accident	$1.0x10^{-4}$ to 0.01	40.5 kg Pu	No release
Nuclear Criticality during emplacement canister filling	$1.0x10^{-6}$ to $1.0x10^{-4}$	$1.0x10^{19}$ prompt fissions in 8 hrs; noble gas and halogen fission products release. Release factors: 1.0 noble gas, 0.25 halogen.	[a]
Nuclear Criticality during Pu storage container spill	$1.0x10^{-6}$ to $1.0x10^{-4}$	$1.0x10^{19}$ prompt fissions in 8 hrs; noble gas and halogen fission products release. Release factors: 1.0 noble gas, 0.25 halogen.	[a]
Fire in facility process areas	$1.0x10^{-6}$ to $1.0x10^{-4}$	40.5 kg Pu	$4.05x10^{-5}$ g Pu
Failure of ventilation filter	0.01 to 0.1	NA	No release
Failure of ventilation blower	0.5	NA	No release
Loss of electrical power	1.0	NA	No release
Canister string dropped during emplacement—ruptured in emplacement zone	$1.0x10^{-6}$ to $1.0x10^{-4}$	1,012 kg Pu	$4.05x10^{-4}$ g Pu
Canister string dropped during emplacement—ruptured and stuck in isolation zone	$1.0x10^{-6}$ to $1.0x10^{-4}$	1,012 kg Pu	$2.43x10^{-7}$ g Pu
Canister string struck in emplacement zone	$1.0x10^{-6}$ to $1.0x10^{-4}$	1,012 kg Pu	No release
Canister string struck in isolation zone	$1.0x10^{-6}$ to $1.0x10^{-4}$	1,012 kg Pu	No release
Emplacement facility fire - electrical	$1.0x10^{-6}$ to $1.0x10^{-4}$	1,012 kg Pu	No release

[a] See Table M.5.3.3.1–3.

Note: NA=not applicable.

Source: LLNL 1996a.

Table M.5.3.3.1–2. Beyond Evaluation Basis Accident Scenarios for Direct Disposition at the Deep Borehole Complex

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Uncontrolled chemical reaction	$<1.0 \times 10^{-6}$	NA	No release
Pu container nuclear criticality in storage	$<1.0 \times 10^{-6}$	1.0×10^{19} prompt fissions in 8 hr; noble gas and halogen fission products release. Release factors: 1.0 noble gas, 0.25 halogen.	[a]
Emplacement canister nuclear criticality in storage	$<1.0 \times 10^{-6}$	1.0×10^{19} prompt fissions in 8 hr; noble gas and halogen fission products release. Release factors: 1.0 noble gas, 0.25 halogen.	[a]
Nuclear criticality of canister contents at bottom of emplacement zone upon rupture of dropped canister string	$<1.0 \times 10^{-6}$	1.0×10^{19} prompt fissions in 8 hr; noble gas and halogen fission products release. Release factors: 1.0 noble gas, 0.25 halogen.	[a]

[a] See Table M.5.3.3.1–4.

Note: NA=not applicable.

Source: LLNL 1996a.

Table M.5.3.3.1–3. Direct Disposition at the Deep Borehole Complex Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario						
	Pu Storage Container Breakage During Storage	Pu Storage Container Breakage During Handling	Nuclear Criticality During Emplacement Canister Filling[a]	Nuclear Criticality During Pu Storage Container Spill[b]	Fire in Facility Process Area	Canister String Dropped During Emplacement—Ruptured in Emplacement Zone	Canister String Dropped During Emplacement—Ruptured and Stuck in Isolation Zone
Frequency of occurrence[b] (per year)	1.0×10^{-3}	1.0×10^{-3}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}
Pu released to environment (g)	4.5×10^{-10}	4.5×10^{-8}	–	–	4.05×10^{-5}	4.05×10^{-4}	2.43×10^{-7}
Fissions	–	–	1.0×10^{19}	1.0×10^{19}	–	–	–
Isotope Released to Environment (Ci)							
Pu-238	7.11×10^{-13}	7.11×10^{-11}	0	0	6.40×10^{-8}	6.40×10^{-7}	3.84×10^{-10}
Pu-239	2.57×10^{-11}	2.57×10^{-9}	0	0	2.32×10^{-6}	2.32×10^{-5}	1.39×10^{-8}
Pu-240	6.84×10^{-12}	6.84×10^{-10}	0	0	6.16×10^{-7}	6.16×10^{-6}	3.69×10^{-9}
Pu-241	2.43×10^{-11}	2.43×10^{-9}	0	0	2.18×10^{-6}	2.18×10^{-5}	1.31×10^{-8}
Pu-242	1.00×10^{-15}	1.00×10^{-13}	0	0	9.03×10^{-11}	9.03×10^{-10}	5.42×10^{-13}
Am-241	1.28×10^{-13}	1.28×10^{-11}	0	0	1.15×10^{-8}	1.15×10^{-7}	6.90×10^{-11}
Kr-83m	0	0	110	110	0	0	0
Kr-85m	0	0	71	71	0	0	0
Kr-85	0	0	8.1×10^{-4}	8.1×10^{-4}	0	0	0
Kr-87	0	0	430	430	0	0	0
Kr-88	0	0	230	230	0	0	0
Kr-89	0	0	1.3×10^{-4}	1.3×10^{-4}	0	0	0
Xe-131m	0	0	0.1	0.1	0	0	0
Xe-133m	0	0	2.2	2.2	0	0	0
Xe-133	0	0	27	27	0	0	0
Xe-135m	0	0	3.3×10^{3}	3.3×10^{3}	0	0	0
Xe-135	0	0	410	410	0	0	0
Xe-137	0	0	4.9×10^{4}	4.9×10^{4}	0	0	0
Xe-138	0	0	1.1×10^{4}	1.1×10^{4}	0	0	0
I-131	0	0	2.75	2.75	0	0	0
I-132	0	0	300	300	0	0	0
I-133	0	0	40	40	0	0	0
I-134	0	0	1.08×10^{3}	1.08×10^{3}	0	0	0
I-135	0	0	113	113	0	0	0

[a] Curies produced (by isotope) for the 1.0×10^{19} fission criticality were scaled from Table M.5.3.1.1–3.

[b] Midpoint of the estimated frequency range.

Source: Derived from Tables M.5.1.3.4–1, M.5.3.1.1–3, and M.5.3.3.1–1.

Table M.5.3.3.1–4. Direct Disposition at the Deep Borehole Complex Beyond Evaluation Basis Accident Source Terms

	Accident Scenario		
Accident Parameter	**Pu Container Nuclear Criticality in Storage[a]**	**Emplacement Canister Nuclear Criticality in Storage[a]**	**Nuclear Criticality of Canister Contents at Bottom of Emplacement Zone Upon Rupture of Dropped Canister String[a]**
Frequency of occurrence (per year)	$1.0x10^{-6}$	$1.0x10^{-6}$	$1.0x10^{-6}$
Pu released to environment	NA	NA	NA
Fissions	$1.0x10^{19}$	$1.0x10^{19}$	$1.0x10^{19}$
Isotope Released to Environment (Ci)			
[Text deleted.]			
Kr-83m	110	110	110
Kr-85m	71	71	71
Kr-85	$8.1x10^{-4}$	$8.1x10^{-4}$	$8.1x10^{-4}$
Kr-87	430	430	430
Kr-88	230	230	230
Kr-89	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$
Xe-131m	0.1	0.1	0.1
Xe-133m	2.2	2.2	2.2
Xe-133	27	27	27
Xe-135m	$3.3x10^{3}$	$3.3x10^{3}$	$3.3x10^{3}$
Xe-135	410	410	410
Xe-137	$4.9x10^{4}$	$4.9x10^{4}$	$4.9x10^{4}$
Xe-138	$1.1x10^{4}$	$1.1x10^{4}$	$1.1x10^{4}$
I-131	2.75	2.75	2.75
I-132	300	300	300
I-133	40	40	40
I-134	$1.08x10^{3}$	$1.08x10^{3}$	$1.08x10^{3}$
I-135	113	113	113

[a] Curies produced (by isotope) for the $1.0x10^{19}$ fission criticality were scaled from Table M.5.3.1.1–3.

Note: NA=not applicable.

Source: Derived from Tables M.5.1.3.4–1, M.5.3.1.1–3, and M.5.3.3.1–2.

Table M.5.3.3.1–5. Accident Scenario Descriptions for Direct Disposition at the Deep Borehole Complex

Accident Scenario	Accident Description
Evaluation Basis Accidents	
Pu storage container breakage during storage	It is postulated that a Pu storage container is ruptured due to overpressurization of the container. The overpressurization could occur as a result of volume expansion caused by either complete oxidation of Pu metal buttons stored in cans or pressure buildup due to radiolysis of residual moisture in Pu oxide and helium gas from the alpha decay of Pu and daughter products. Respirable Pu fines are released to the storage area.
Pu storage container breakage during handling	It is postulated that a 2R Pu container is dropped and breaches in container handling operations. The force of the drop ruptures the container and respirable oxide fines are released to the process area.
Nuclear criticality during emplacement canister filling	Mishandling of the Pu containers during handling operations could lead to a criticality accident. At least three independent and concurrent equipment failures or operation errors must occur before a criticality accident could occur. It is postulated that additional Pu containers are introduced into the emplacement canister filling process area in violation of procedural controls and a criticality occurs as a result of the containers being spaced too closely.
Nuclear criticality during Pu storage canister spill	A nuclear criticality could occur if Pu containers were damaged in handling and the mass of the spilled Pu oxide containers exceeds the critical mass. Because each 2R primary container contains a limited amount of Pu, a criticality accident would require successively damaging several containers.
Fire in process area	The combustible loading in the process area is very low because the process does not involve any combustible materials. However, it is postulated that a large fire occurs in the process area for emplacement canister filling, the containers are breached by the fire, and the contents are exposed to the fire. The ventilation system two-stage HEPA filters are operational during the fire.
Canister string dropped during emplacement, ruptured in emplacement zone	A canister string could be dropped into the borehole as a result of either a structural failure in the crane and associated hoisting and securing equipment or as a result of operator error. A free-falling canister string could rupture upon impact at the bottom of the borehole.
Canister string dropped during emplacement, ruptured and stuck in isolation zone	A canister string could be dropped into the borehole as a result of either a structural failure in the crane and associated hoisting and securing equipment or as a result of operator error. The canister string impacts a projecting ledge at a change in the diameter of the well casings, ruptures, and remains stuck in the isolation zone instead of falling to the bottom of the borehole.
Beyond Evaluation Basis Accidents	
Pu container nuclear criticality in storage	The Pu storage facility is designed to ensure that an accidental criticality during dry or flood conditions is not credible. The assumed criticality accident severity is based on guidance provided in NRC Regulatory Guide 3.35.
Emplacement canister nuclear criticality in storage	The storage racks are designed to maintain the geometry of the array under all postulated accident and natural conditions. The assumed criticality accident severity is based on guidance provided in NRC Regulatory Guide 3.35.
Nuclear criticality of canister contents at bottom of emplacement zone upon rupture of dropped canister string	A canister string could be dropped into the borehole as a result of either a structural failure in the crane and associated hoisting and securing equipment or as a result of operator error. A free-falling canister string could rupture upon impact at the bottom of the borehole. The evaluation assumed that Pu released from the ruptured string would collect in a critical mass at the bottom of the borehole. The assumed criticality accident severity is based on guidance provided in NRC Regulatory Guide 3.35.

Source: LLNL 1996a.

M.5.3.3.2 *Accident Impacts*

The estimated range of impacts of the postulated accidents at reference sites is provided in Table M.5.3.3.2–1. The estimated range of environmental data (wet to dry site) and the general public population density data (low to high density) for the reference sites envelope the site characteristics expected for the direct disposition site. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.3.3.1–3 and M.5.3.3.1–4 using the MACCS computer code. [Text deleted.]

[Text deleted.]

Table M.5.3.3.2–1. Direct Disposition at the Deep Borehole Complex Accident Impacts Ranges at Generic Sites

Accident Scenario	Worker at 1,000 m				Maximum Offsite Individual				Population to 80 km				Accident Frequency (per year)
	Dose (rem)		Probability of Cancer Fatality[a]		Dose (rem)		Probability of Cancer Fatality[a]		Dose (person-rem)		Number of Cancer Fatalities[b]		
	High	Low	High	Low	High	Low	High	Low	High	High	Low	Low	
Pu storage container breakage during storage	1.3×10^{-10}	5.3×10^{-11}	5.1×10^{-14}	2.1×10^{-14}	2.1×10^{-11}	9.4×10^{-13}	1.0×10^{-14}	4.7×10^{-16}	1.8×10^{-8}	1.7×10^{-10}	9×10^{-12}	8.4×10^{-14}	1.0×10^{-3}
Pu storage container breakage during handling	1.3×10^{-8}	5.3×10^{-9}	5.1×10^{-12}	2.1×10^{-12}	2.1×10^{-9}	9.4×10^{-11}	1.0×10^{-12}	4.7×10^{-14}	1.8×10^{-6}	1.7×10^{-8}	9.0×10^{-10}	8.4×10^{-12}	1.0×10^{-3}
Nuclear criticality during emplacement canister filling	3.5×10^{-2}	1.6×10^{-2}	1.4×10^{-5}	6.2×10^{-6}	5.8×10^{-3}	2.0×10^{-4}	2.9×10^{-6}	1.0×10^{-7}	1.3	4.6×10^{-2}	6.3×10^{-4}	2.3×10^{-5}	1.0×10^{-5}
Nuclear criticality during Pu storage canister spill	3.5×10^{-2}	1.6×10^{-2}	1.4×10^{-5}	6.2×10^{-6}	5.8×10^{-3}	2.0×10^{-4}	2.9×10^{-6}	1.0×10^{-7}	1.2	6.6×10^{-3}	6.0×10^{-4}	3.3×10^{-6}	1.0×10^{-5}
Fire in process area	1.2×10^{-5}	4.7×10^{-6}	4.6×10^{-9}	1.9×10^{-9}	1.9×10^{-6}	8.4×10^{-8}	9.3×10^{-10}	4.2×10^{-11}	1.6×10^{-3}	6.6×10^{-3}	8.1×10^{-7}	3.3×10^{-6}	1.0×10^{-5}
Canister string dropped during emplacement, ruptured in emplacement zone	1.2×10^{-4}	4.7×10^{-5}	4.6×10^{-8}	1.9×10^{-8}	1.9×10^{-5}	8.5×10^{-7}	9.3×10^{-9}	4.2×10^{-12}	1.6×10^{-2}	1.5×10^{-4}	8.1×10^{-6}	7.6×10^{-8}	1.0×10^{-5}
Canister string dropped during emplacement, ruptured in isolation zone	6.9×10^{-8}	2.8×10^{-8}	2.8×10^{-11}	1.1×10^{-11}	1.1×10^{-8}	5.0×10^{-10}	5.6×10^{-12}	2.5×10^{-13}	9.7×10^{-6}	9.0×10^{-8}	4.9×10^{-9}	4.5×10^{-11}	1.0×10^{-5}
Pu container nuclear criticality in storage	3.5×10^{-2}	1.6×10^{-2}	1.4×10^{-5}	6.2×10^{-6}	5.8×10^{-3}	2.0×10^{-4}	2.9×10^{-6}	1.0×10^{-7}	1.3	6.6×10^{-3}	6.3×10^{-4}	3.3×10^{-6}	1.0×10^{-6}
Emplacement canister nuclear criticality in storage	3.5×10^{-2}	1.6×10^{-2}	1.4×10^{-5}	6.2×10^{-6}	5.8×10^{-3}	2.0×10^{-4}	2.9×10^{-6}	1.0×10^{-7}	1.3	6.6×10^{-3}	6.3×10^{-4}	3.3×10^{-6}	1.0×10^{-6}
Nuclear criticality of canister contents at bottom of emplacement zone upon rupture of dropped canister string	3.5×10^{-2}	1.6×10^{-2}	1.4×10^{-5}	6.2×10^{-6}	5.8×10^{-3}	2.0×10^{-4}	2.9×10^{-6}	1.0×10^{-7}	1.3	6.6×10^{-3}	6.3×10^{-4}	3.3×10^{-6}	1.0×10^{-6}

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Source: Calculated using the source terms in Tables M.5.3.3.1–3 and M.5.3.3.1–4 and the MACCS computer code.

M.5.3.4 Immobilized Disposition Alternative for a Deep Borehole Complex

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for a deep borehole immobilized disposal facility in the *Fissile Material Disposition Program: Deep Borehole Disposal Facility PEIS Data Input Report for Immobilized Disposal—Immobilized Disposal of Plutonium in Coated Ceramic Pellets in Grout Without Canisters*. The studies postulated a set of accidents scenarios that were representative of the risks and consequences for workers and the public that can be expected if the facility were constructed and operated. Although not all potential accidents were addressed, those that were postulated have consequences and risk that are expected to envelop the consequences and risks of an operating facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than 1.0×10^{-7}/yr are anticipated that will have consequences and risks larger than those described in this section.

M.5.3.4.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the facility. Through a screening process, 14 evaluation basis accidents and 4 beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.3.4.1–1 and M.5.3.4.1–2. Accident source term information is provided in Tables M.5.3.4.1–3 and M.5.3.4.1–4. Descriptions of accident scenarios are provided in Table M.5.3.4.1–5.

Table M.5.3.4.1–1. Evaluation Basis Accident Scenarios for Immobilized Disposition at the Deep Borehole Complex

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Earthquake	1.0×10^{-6} to 1.0×10^{-4}	5 kg Pu	5.0×10^{-10} g Pu
Tornado	1.0×10^{-6} to 1.0×10^{-4}	NA	No release
Flood	1.0×10^{-6} to 1.0×10^{-4}	NA	No release
Pu storage container breakage	1.0×10^{-4} to 0.01	5 kg Pu	5.0×10^{-12} g Pu
Pu storage container breach	1.0×10^{-4} to 0.01	5 kg Pu	5.0×10^{-12} g Pu
Onsite pellet transporter accident	1.0×10^{-4} to 0.01	5 kg Pu	No release
Pellet-grout mixing process facility fire	1.0×10^{-6} to 1.0×10^{-4}	5 kg Pu	5.0×10^{-10} g Pu
Ceramic pellet spill	1.0×10^{-4} to 0.01	0.5 kg Pu	5.0×10^{-13} g Pu
Pellet-grout mix spill	0.01 to 0.1	0.5 kg Pu	3.0×10^{-11} g Pu
Failure of ventilation blower	0.01 to 0.1	NA	No release
Loss of electrical power	0.01 to 0.1	NA	No release
Bucket Emplacement			
Bucket dropped during emplacement	1.0×10^{-6} to 1.0×10^{-4}	834 kg Pu	5.0×10^{-7} g Pu
Bucket stuck in the isolation zone	1.0×10^{-6} to 1.0×10^{-4}	834 kg Pu	No release
Bucket stuck in emplacement zone	1.0×10^{-6} to 1.0×10^{-4}	834 kg Pu	No release
Failure of release—fails to open	1.0×10^{-6} to 1.0×10^{-4}	834 kg Pu	No release
Failure of release—opens early during bucket emplacement	1.0×10^{-6} to 1.0×10^{-4}	834 kg Pu	2.5×10^{-6} g Pu
Pellet-grout sets in bucket	1.0×10^{-6} to 1.0×10^{-4}	834 kg Pu	No release
Mixing system breaks pellets during bucket emplacement	1.0×10^{-4} to 0.01	834 kg Pu	5.0×10^{-8} g Pu
Pellets break during bucket emplacement release	1.0×10^{-4} to 0.01	834 kg Pu	5.0×10^{-8} g Pu
Emplacement facility fire - combustibles	1.0×10^{-6} to 1.0×10^{-4}	834 kg Pu	No release
Emplacement facility fire - electrical	1.0×10^{-6} to 1.0×10^{-4}	834 kg Pu	No release
Loss of electrical power	0.01 to 0.1	NA	No release
Pumped Emplacement			
Rupture of delivery pipe during pumped emplacement	1.0×10^{-6} to 1.0×10^{-4}	100 kg Pu	3.0×10^{-7} g Pu
Pellet-grout solidifies in delivery pipe	1.0×10^{-4} to 0.01	100 kg Pu	No release
Delivery pipe dropped during pumped emplacement	1.0×10^{-6} to 1.0×10^{-4}	100 kg Pu	6.0×10^{-8} g Pu
Delivery pipe stuck in the borehole	$<1.0\times10^{-6}$	100 kg Pu	No release
Mixing system breaks pellets during pumped emplacement	1.0×10^{-4} to 0.01	100 kg Pu	6.0×10^{-9} g Pu
Pellets break during release during pumped emplacement	1.0×10^{-4} to 0.01	100 kg Pu	6.0×10^{-9} g Pu

Table M.5.3.4.1–1. Evaluation Basis Accident Scenarios for Immobilized Disposition at the Deep Borehole Complex—Continued

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Emplacement facility fire—combustibles	$1.0x10^{-6}$ to $1.0x10^{-4}$	100 kg Pu	No release
Emplacement facility fire—electrical	$1.0x10^{-6}$ to $1.0x10^{-4}$	100 kg Pu	No release
Loss of electrical power	0.01 to 0.1	NA	No release

Note: NA=not applicable.

Source: LLNL 1996b.

Table M.5.3.4.1–2. Beyond Evaluation Basis Accident Scenarios for Immobilized Disposition at the Deep Borehole Complex

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Failure of ventilation filter	$<1.0x10^{-6}$	0.5 kg Pu	$3.0x10^{-9}$ g Pu
Uncontrolled chemical reaction	$<1.0x10^{-6}$	5 kg Pu	$5.0x10^{-9}$ g Pu
Pellet storage nuclear criticality	$<1.0x10^{-6}$	$1.0x10^{19}$ prompt fissions in 8 hrs; noble gas and halogen fission products release. Release factors: 1.0 noble gas, 0.25 halogen	[a]
Pellet-grout mixing nuclear criticality	$<1.0x10^{-6}$	$1.0x10^{19}$ prompt fissions in 8 hrs; noble gas and halogen fission products release. Release factors: 1.0 noble gas, 0.25 halogen.	[a]

[a] See Table M.5.3.4.1–4.

Source: LLNL 1996b.

Table M.5.3.4.1–3. Immobilized Disposition at the Deep Borehole Complex Evaluation Basis Accident Source Terms

	Accident Scenario						
Accident Parameter	**Earthquake**	**Pu Storage Container Breakage**	**Pu Storage Container Breach**	**Pellet-Grout Mixing Process Facility Fire**	**Ceramic Pellet Spill**	**Pellet-Grout Mix Spill**	**Dropped Bucket During Emplacement**
Frequency of occurrence (per year)	1.0×10^{-5}	1.0×10^{-3}	1.0×10^{-3}	1.0×10^{-5}	1.0×10^{-3}	0.05	1.0×10^{-5}
Pu released to environment (g)	5.0×10^{-10}	5.0×10^{-12}	5.0×10^{-12}	5.0×10^{-10}	5.0×10^{-13}	3.0×10^{-11}	5.0×10^{-7}
Isotope Released to Environment (Ci)							
Pu-238	7.90×10^{-13}	7.90×10^{-15}	7.90×10^{-15}	7.90×10^{-13}	7.90×10^{-16}	4.74×10^{-14}	7.90×10^{-10}
Pu-239	2.86×10^{-11}	2.86×10^{-13}	2.86×10^{-13}	2.86×10^{-11}	2.86×10^{-14}	1.72×10^{-12}	2.86×10^{-8}
Pu-240	7.60×10^{-12}	7.60×10^{-14}	7.60×10^{-14}	7.60×10^{-12}	7.60×10^{-15}	4.56×10^{-13}	7.60×10^{-9}
Pu-241	2.69×10^{-11}	2.69×10^{-13}	2.69×10^{-13}	2.69×10^{-11}	2.69×10^{-14}	1.62×10^{-12}	2.69×10^{-8}
Pu-242	1.11×10^{-15}	1.12×10^{-17}	1.12×10^{-17}	1.11×10^{-15}	1.12×10^{-18}	6.69×10^{-17}	1.12×10^{-12}
Am-241	1.42×10^{-13}	1.42×10^{-15}	1.42×10^{-15}	1.42×10^{-13}	1.42×10^{-16}	8.52×10^{-15}	1.42×10^{-10}

Table M.5.3.4.1–3. Immobilized Disposition at the Deep Borehole Complex Evaluation Basis Accident Source Terms—Continued

Accident Parameter	Accident Scenario						
	Failure of Release - Opens Early During Bucket Emplacement	Mixing System Breaks Pellets During Bucket Emplacement	Pellets Break During Bucket Emplacement Release	Rupture of Delivery Pipe During Pumped Emplacement	Delivery Pipe Dropped During Pumped Emplacement	Mixing System Breaks Pellets During Pumped Emplacement	Pellets Break During Pumped Emplacement Release
Frequency of occurrence[a] (per year)	1.0×10^{-5}	1.0×10^{-3}	1.0×10^{-3}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-3}	1.0×10^{-3}
Pu released to environment (g)	2.5×10^{-6}	5.0×10^{-8}	5.0×10^{-8}	3.0×10^{-7}	6.0×10^{-8}	6.0×10^{-9}	6.0×10^{-9}
Isotope Released to Environment (Ci)							
Pu-238	3.95×10^{-9}	7.90×10^{-11}	7.90×10^{-11}	4.74×10^{-10}	9.48×10^{-11}	9.48×10^{-12}	9.48×10^{-12}
Pu-239	1.43×10^{-7}	2.86×10^{-9}	2.86×10^{-9}	1.72×10^{-8}	3.43×10^{-9}	3.43×10^{-10}	3.43×10^{-10}
Pu-240	3.80×10^{-8}	7.60×10^{-10}	7.60×10^{-10}	4.56×10^{-9}	9.12×10^{-10}	9.12×10^{-11}	9.12×10^{-11}
Pu-241	1.35×10^{-7}	2.70×10^{-9}	2.70×10^{-9}	1.62×10^{-8}	3.23×10^{-9}	3.23×10^{-10}	3.23×10^{-10}
Pu-242	5.58×10^{-12}	1.12×10^{-13}	1.12×10^{-13}	6.69×10^{-13}	1.34×10^{-13}	1.34×10^{-14}	1.34×10^{-15}
Am-241	7.10×10^{-10}	1.42×10^{-11}	1.42×10^{-11}	8.52×10^{-11}	1.70×10^{-11}	1.70×10^{-12}	1.70×10^{-12}

[a]Midpoint of the estimated frequency range.

Note: Am=Americium.

Source: Derived from Tables M.5.1.3.4–1 and M.5.3.4.1–1.

Table M.5.3.4.1–4. Immobilized Disposition at the Deep Borehole Complex Beyond Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario			
	Failure of Ventilation Filter	Uncontrolled Chemical Reaction	Pellet Storage Nuclear Criticality[a]	Pellet-Grout Mixing Process Nuclear Criticality
Frequency of occurrence (per year)	1.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}
Pu released to environment (g)	3.0×10^{-9}	5.0×10^{-9}	NA	NA
Fissions	NA	NA	1.0×10^{19}	1.0×10^{19}
Isotope Released to Environment (Ci)				
Pu-238	4.74×10^{-12}	7.90×10^{-12}	0	0
Pu-239	1.72×10^{-10}	2.86×10^{-10}	0	0
Pu-240	4.56×10^{-11}	7.60×10^{-11}	0	0
Pu-241	1.62×10^{-10}	2.70×10^{-10}	0	0
Pu-242	6.69×10^{-15}	1.12×10^{-14}	0	0
Am-241	8.52×10^{-13}	1.42×10^{-12}	0	0
Kr-83m	0	0	110	110
Kr-85m	0	0	71	71
Kr-85	0	0	8.1×10^{-4}	8.1×10^{-4}
Kr-87	0	0	430	430
Kr-88	0	0	230	230
Kr-89	0	0	1.3×10^{-4}	1.3×10^{-4}
Xe-131m	0	0	0.1	0.1
Xe-133m	0	0	2.2	2.2
Xe-133	0	0	27	27
Xe-135m	0	0	3.3×10^{3}	3.3×10^{3}
Xe-135	0	0	410	410
Xe-137	0	0	4.9×10^{4}	4.9×10^{4}
Xe-138	0	0	1.1×10^{4}	1.1×10^{4}
I-131	0	0	2.75	2.75
I-132	0	0	300	300
I-133	0	0	40	40
I-134	0	0	1.08×10^{3}	1.08×10^{3}
I-135	0	0	113	113

[a] Curies produced (by isotope) for the 1.0×10^{19} fission criticality were scaled from Table M.5.3.1.1–3.

Note: NA=not applicable.

Source: Derived from Tables M.5.1.3.4–1, M.5.3.1.1–3, and M.5.3.4.1–2.

Table M.5.3.4.1–5. Accident Scenario Descriptions for Immobilized Disposition at the Deep Borehole Complex

Accident Scenario	Accident Description
Evaluation Basis Accidents	
Earthquake	It was postulated that the evaluation basis earthquake would rupture the ceramic pellet grouting vessel and lines. The Pu-containing particulate would be removed from the grouting area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.
Pu storage container breakage	It is postulated that a container breakage could occur in ceramic pellet storage. Respirable fines of ceramic are released to the storage area and collected by the ventilation system. The airborne fines pass through the ventilation HEPA filters and are released to the environment.
Pu storage container breach	It is postulated that a container breach could occur in ceramic pellet container handling operations. A container is punctured during handling and ceramic pellets spill from the punctured container. Respirable fines of ceramic are released to the process area and collected by the ventilation system. The airborne fines pass through the ventilation HEPA filters and are released to the environment.
Pellet-grout mixing process facility fire	It is postulated that an unimpeded fire begins in the process area which houses the grouting vessel. The fire breaches the vessel enclosure that contains the Pu-loaded ceramic pellets. The Pu-containing particulate would be removed from the process area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.
Ceramic pellet spill	It is postulated that the ceramic pellets overflow the grouting feed bin and spill onto the floor. The spill spreads out in a safe geometry. The spill is cleaned up in two hours but some of the spill material converts to an aerosol and becomes airborne as respirable particles. The Pu-containing particulate would be removed from the process area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.
Pellet-grout mix spill	It is postulated that the grouting vessel or the bucket overflows and spills onto the floor. The spill spreads out in a safe geometry. The spill is cleaned up in 2 hours but some of the spill material converts to an aerosol and becomes airborne as respirable particles. The Pu-containing particulate would be removed from the process area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.
Dropped bucket during emplacement	A bucket could be dropped into the borehole as a result of either a structural failure in the crane, the associated hoisting and securing equipment, or as a result of operator error. A free-falling bucket could rupture upon impact at the bottom of the borehole.
Failure of release—opens early during bucket emplacement	The valve at the bottom of the bucket opens prematurely and the pellets and the cement free fall to the bottom of the borehole. This would probably result in some broken or fractured pellets.
Mixing system breaks pellets during emplacement	The pellets are mixed with cement and pushed with water, air pressure, or gravity into the bucket. It is postulated that some of the pellets may break or crack due to unforeseen events in the emplacement process.
Pellets break during bucket emplacement release	Upon release, the pellets and cement will flow out into the borehole. The weight of the column in the bucket and the pressure that will likely be needed to push out the mix could cause some of the pellets to break due to some unforeseen events in the emplacement process.
Rupture of delivery pipe during pumped emplacement	If the delivery pipe were to rupture, the pellets and cement would free fall to the bottom of the borehole. This would probably result in some broken or fractured pellets.

Table M.5.3.4.1–5. Accident Scenario Descriptions for Immobilized Disposition at the Deep Borehole Complex—Continued

Accident Scenario	Accident Description
Delivery pipe dropped during pumped emplacement	A delivery pipe could be dropped into the borehole as a result of either a structural failure in the crane or drill rig, or as a result to operator error. Substantial quantities of ceramic pellets could be broken or cracked upon impact at the bottom of the borehole.
Mixing system breaks pellets during pumped emplacement	The pellets are mixed with cement and pushed with water, air pressure, or gravity into the delivery pipe. It is postulated that some of the pellets may break or crack due to unforeseen events in the process.
Pellets break during pumped emplacement release	Upon release from the end of the delivery pipe, the pellets and cement will flow out into the borehole. The weight of the column in the pipe and the pressure that will likely be needed to push out the mix could cause some of the pellets to break due to some unforeseen events in the emplacement process.
Beyond Evaluation Basis Accidents	
Failure of ventilation filter	A HEPA filter could fail due to moisture collection on the filter, excessive pressure loading from exhaust blower, excessive heat from a fire, or mechanical shock. It is postulated that the HEPA filter servicing the grout mixing process fails concurrently with a grouting process spill accident. Some of the spill material converts to an aerosol and becomes airborne as respirable particles. The Pu-containing particulate would be removed from the process area by the ventilation system, pass through the failed HEPA filters and be released to the environment.
Uncontrolled chemical reaction	It is postulated that hydrogen produced in the battery of the uninterruptible power system detonates in the grout mix vessel area, fractures pellets in the process, and some of the fractured pellets becomes airborne as respirable particles. The Pu-containing particulate would be removed from the process area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.
Pellet storage nuclear criticality	The designed Pu concentration in the ceramic pellet is sufficiently low to maintain criticality safe under all postulated accidents and natural conditions. The facility is designed to preclude flooding in the storage area. A nuclear criticality accident in the pellet storage vault area is not credible. However, a criticality accident was postulated, and the assumed criticality accident severity is based on guidance provided in NRC Regulatory Guide 3.35.
Pellet-grout mixing process nuclear criticality	The designed Pu concentration in the ceramic pellet is sufficiently low to maintain criticality safe under all postulated accidents during grout mixing process conditions. A nuclear criticality accident in the pellet storage vault area is not credible. However, a criticality accident was postulated, and the assumed criticality accident severity is based on guidance provided in NRC Regulatory Guide 3.35.

Source: LLNL 1996a.

M.5.3.4.2 *Accident Impacts*

The estimated range of impacts of the postulated accidents at reference sites are provided in Table M.5.3.4.2–1. The estimated range of environmental data (wet to dry site) and the general public population density data (low to high density) for the reference sites envelop the site characteristics expected for the emplacement site. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.3.4.1–3 and M.5.3.4.1–4 using the MACCS computer code.

[Text deleted.]

Table M.5.3.4.2–1. Immobilized Disposition at the Deep Borehole Complex Accident Impacts Ranges at Generic Site

	Worker at 1,000 m				Maximum Offsite Individual				Population to 80 km				
	Dose (rem)		Probability of Cancer Fatality[a]		Dose (rem)		Probability of Cancer Fatality[a]		Dose (person-rem)		Number of Cancer Fatalities[b]		Accident Frequency (per year)
Accident Scenario	High	Low	High	Low	High	Low	High	Low	High	High	Low	Low	
Earthquake	1.4×10^{-10}	5.8×10^{-11}	5.7×10^{-14}	2.3×10^{-14}	2.3×10^{-11}	1.0×10^{-12}	1.2×10^{-14}	$5./2\times10^{-16}$	2.0×10^{-8}	1.9×10^{-10}	1.0×10^{-11}	9.3×10^{-14}	1.0×10^{-5}
Pu storage container breakage	1.4×10^{-12}	5.8×10^{-13}	5.7×10^{-16}	2.3×10^{-16}	2.3×10^{-13}	1.0×10^{-14}	1.2×10^{-16}	5.2×10^{-18}	2.0×10^{-10}	1.9×10^{-12}	1.0×10^{-13}	9.3×10^{-16}	1.0×10^{-3}
Pu storage container breach	1.4×10^{-12}	5.8×10^{-13}	5.7×10^{-16}	2.3×10^{-16}	2.3×10^{-13}	1.0×10^{-14}	1.2×10^{-16}	5.2×10^{-18}	2.0×10^{-10}	1.9×10^{-12}	1.0×10^{-13}	9.3×10^{-16}	1.0×10^{-3}
Pellet-grout mixing process facility fire	1.4×10^{-10}	5.8×10^{-11}	5.7×10^{-14}	2.3×10^{-14}	2.3×10^{-11}	1.0×10^{-12}	1.2×10^{-14}	5.2×10^{-16}	2.0×10^{-8}	1.9×10^{-10}	1.0×10^{-11}	9.3×10^{-14}	1.0×10^{-5}
Ceramic pellet spill	1.4×10^{-13}	5.8×10^{-14}	5.7×10^{-17}	2.3×10^{-17}	2.3×10^{-14}	1.0×10^{-15}	1.2×10^{-17}	5.2×10^{-19}	2.0×10^{-11}	1.9×10^{-13}	1.0×10^{-14}	9.3×10^{-17}	1.0×10^{-3}
Pellet grout mix spill	8.5×10^{-12}	3.4×10^{-12}	3.4×10^{-15}	1.4×10^{-15}	1.4×10^{-12}	6.2×10^{-14}	6.9×10^{-16}	3.1×10^{-17}	1.2×10^{-9}	1.1×10^{-11}	6.0×10^{-13}	5.5×10^{-15}	5.0×10^{-2}
Bucket dropped during emplacement	1.4×10^{-7}	5.8×10^{-8}	5.7×10^{-11}	2.3×10^{-11}	2.3×10^{-8}	1.0×10^{-9}	1.2×10^{-11}	5.2×10^{-13}	2.0×10^{-5}	1.9×10^{-7}	1.0×10^{-8}	9.3×10^{-11}	1.0×10^{-5}
Failure of release - opens early during bucket emplacement	7.1×10^{-7}	2.8×10^{-7}	2.8×10^{-10}	1.1×10^{-10}	1.2×10^{-7}	5.1×10^{-9}	5.8×10^{-11}	2.6×10^{-12}	1.0×10^{-4}	$9.1\times10x^{-7}$	5.0×10^{-8}	4.6×10^{-10}	1.0×10^{-5}
Mixing system breaks pellets during emplacement	1.4×10^{-8}	5.8×10^{-9}	5.7×10^{-12}	2.3×10^{-12}	2.3×10^{-9}	1.0×10^{-10}	1.2×10^{-12}	5.2×10^{-14}	2.0×10^{-6}	1.9×10^{-8}	1.0×10^{-9}	9.3×10^{-12}	1.0×10^{-3}
Pellets break during bucket emplacement release	1.4×10^{-8}	5.8×10^{-9}	5.7×10^{-12}	2.3×10^{-12}	2.3×10^{-9}	1.0×10^{-10}	1.2×10^{-12}	5.2×10^{-14}	2.0×10^{-6}	1.9×10^{-8}	1.0×10^{-9}	9.3×10^{-12}	1.0×10^{-3}

Table M.5.3.4.2–1. Immobilized Disposition at the Deep Borehole Complex Accident Impacts Ranges at Generic Site—Continued

	Worker at 1,000 m				Maximum Offsite Individual				Population to 80 km				
	Dose (rem)		Probability of Cancer Fatality[a]		Dose (rem)		Probability of Cancer Fatality[a]		Dose (person-rem)		Number of Cancer Fatalities[b]		Accident Frequency (per year)
Accident Scenario	High	Low	High	Low	High	Low	High	Low	High	High	Low	Low	
Rupture of delivering pipe during pumped emplacement	8.5×10^{-8}	3.4×10^{-8}	3.4×10^{-11}	1.4×10^{-11}	1.4×10^{-8}	6.2×10^{-10}	7.2×10^{-12}	3.1×10^{-13}	1.2×10^{-5}	1.1×10^{-7}	6.0×10^{-9}	5.5×10^{-11}	1.0×10^{-5}
Delivering pipe dropped during pumped emplacement	1.7×10^{-8}	6.9×10^{-9}	6.8×10^{-12}	2.7×10^{-12}	2.8×10^{-9}	1.2×10^{-10}	1.4×10^{-12}	6.2×10^{-14}	2.4×10^{-6}	2.2×10^{-8}	1.2×10^{-9}	1.1×10^{-11}	1.0×10^{-5}
Mixing system breaks pellets during pumped emplacement	1.7×10^{-9}	6.9×10^{-10}	6.8×10^{-13}	2.7×10^{-13}	2.8×10^{-10}	1.2×10^{-11}	1.4×10^{-13}	6.2×10^{-15}	2.4×10^{-7}	2.2×10^{-9}	1.2×10^{-10}	1.1×10^{-12}	1.0×10^{-3}
Pellets break during pumped emplacement release	1.7×10^{-9}	6.9×10^{-10}	6.8×10^{-13}	2.7×10^{-13}	2.8×10^{-10}	1.2×10^{-11}	1.4×10^{-13}	6.2×10^{-15}	2.4×10^{-7}	2.2×10^{-9}	1.2×10^{-10}	1.1×10^{-12}	1.0×10^{-3}
Failure of ventilation filter	8.5×10^{-10}	3.4×10^{-10}	3.4×10^{-13}	1.4×10^{-13}	1.4×10^{-10}	6.2×10^{-12}	6.9×10^{-14}	3.1×10^{-15}	1.2×10^{-7}	1.1×10^{-9}	6.0×10^{-11}	5.5×10^{-13}	1.0×10^{-6}
Uncontrolled chemical reaction	1.4×10^{-9}	5.8×10^{-10}	5.7×10^{-13}	2.3×10^{-13}	2.3×10^{-10}	1.0×10^{-11}	1.2×10^{-13}	5.2×10^{-15}	2.0×10^{-7}	1.9×10^{-9}	1.0×10^{-10}	9.3×10^{-13}	1.0×10^{-6}
Pellet storage nuclear criticality	3.5×10^{-2}	1.6×10^{-2}	1.4×10^{-5}	6.2×10^{-6}	5.8×10^{-3}	2.0×10^{-4}	2.9×10^{-6}	1.0×10^{-7}	1.3	6.6×10^{-3}	6.3×10^{-4}	3.3×10^{-6}	1.0×10^{-6}
Pellet-grout mixing nuclear criticality	3.5×10^{-2}	1.6×10^{-2}	1.4×10^{-5}	6.2×10^{-6}	5.8×10^{-3}	2.0×10^{-4}	2.9×10^{-6}	1.0×10^{-7}	1.3	6.6×10^{-3}	6.3×10^{-4}	3.3×10^{-6}	1.0×10^{-6}

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Source: Calculated using the source terms in Tables M.5.3.3.1–3 and M.5.3.3.1–4 and the MACCS computer code.

M.5.3.5 Vitrification Alternative

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for a vitrification facility in the *Fissile Material Disposition Program PEIS Data Call Input Report: New Glass Vitrification Facility.* The studies postulated a set of accident scenarios that were representative of the risks and consequences for workers and the public that can be expected if the facility were constructed and operated. Although not all potential accidents were addressed, those that were postulated have consequences and risk that are expected to envelope the consequences and risks of an operating facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than 1.0×10^{-7}/yr are anticipated that will have consequences and risks larger than those described in this section. The potential for an aircraft crash has been considered and dismissed because the probability of a crash into a facility and causing sufficient damage to release Pu is much less than 10^{-7}/yr.

M.5.3.5.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the facility. Through a screening process, seven evaluation basis accidents and three beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.3.5.1–1 and M.5.3.5.1–2. Accident source term information is provided in Tables M.5.3.5.1–3 and M.5.3.5.1–4. Descriptions of accident scenarios are provided in Table M.5.3.5.1–5.

Table M.5.3.5.1–1. Evaluation Basis Accident Scenarios for the Vitrification Alternative

Accident Scenario	Accident Frequency (per year)	Source Term	
		At Risk	Released to Environment
Blender spill	0.01 to 0.1	82.5 kg Pu 9.23×10^{4} Ci Cs	1.24×10^{-5} g Pu 1.38×10^{-5} Ci Cs
Loss of offsite power	0.01 to 0.1	No release	No release
Melter spill	1.0×10^{-4} to 0.01	82.5 kg Pu 9.23×10^{4} Ci Cs	6.2×10^{-7} g Pu 6.9×10^{-7} Ci Cs
Cs capsule drop	1.0×10^{-4} to 0.01	70 kCi Cs	1.75×10^{-5} Ci Cs
Canister drop	1.0×10^{-4} to 0.01	82.5 kg Pu 9.23×10^{4} Ci Cs	6.1×10^{-6} g Pu 6.83×10^{-6} Ci Cs
CPC ion column fire	1.0×10^{-4} to 0.01	9.23×10^{4} Ci Cs	0.23 Ci Cs
Pu oxide solids fire oven	1.0×10^{-4} to 0.01	5 kg Pu	1.5×10^{-8} g Pu
Earthquake	1.0×10^{-6} to 1.0×10^{-4}	170 kg Pu 347 Ci Cs	3.86×10^{-4} g Pu 6.59×10^{-7} Ci Cs
Tornado	1.0×10^{-6} to 1.0×10^{-4}	No release	No release
Flood	1.0×10^{-6} to 1.0×10^{-4}	No release	No release

Source: LLNL 1996c.

Table M.5.3.5.1–2. Beyond Evaluation Basis Accident Scenarios for the Vitrification Alternative

Accident Scenario	Accident Frequency (per year)	Source Term	
		At Risk	Released to Environment
Cs fire	$<1.0\times10^{-6}$	1.3×10^{6} Ci Cs	1.3 Ci Cs
Blender fire	$<1.0\times10^{-6}$	82.5 kg Pu 9.23×10^{4} Ci Cs	5.16×10^{-5} g Pu 0.231 Ci Cs
Nuclear criticality in Pu oxide oven	$<1.0\times10^{-6}$	1.0×10^{18} fissions. Release fractions: 0.5 noble gases, 0.05 iodine.	[a]

[a] See Table M.5.3.5.1–4.

Source: LLNL 1996c.

Table M.5.3.5.1–3. Vitrification Alternative Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario						
	Blender Spill	Melter Spill	Cs Capsule Drop	Canister Drop	CPC Ion Column Fire	Pu Oxide Oven Solids Fire	Earthquake
Frequency of occurrence[a](per year)	0.05	1.0×10^{-3}/yr	1.0×10^{-3}/yr	1.0×10^{-3}/yr	1.0×10^{-3}/yr	1.0×10^{-3}/yr	1.0×10^{-5}/yr
Pu released to environment (g)	1.24×10^{-5}	6.2×10^{-7}	NA	6.1×10^{-6}	NA	1.5×10^{-8}	3.86×10^{-4}
Cs released to environment (Ci)	1.38×10^{-5}	6.9×10^{-7}	1.75×10^{-5}	6.83×10^{-6}	0.23	NA	6.59×10^{-7}
Isotope Released to Environment (Ci)							
Pu-238	1.96×10^{-8}	9.80×10^{-10}	0	9.64×10^{-9}	0	2.37×10^{-11}	6.10×10^{-7}
Pu-239	7.09×10^{-7}	3.55×10^{-8}	0	3.49×10^{-7}	0	8.58×10^{-10}	2.21×10^{-5}
Pu-240	1.88×10^{-7}	9.42×10^{-9}	0	9.27×10^{-8}	0	2.28×10^{-10}	5.87×10^{-6}
Pu-241	6.68×10^{-7}	3.34×10^{-8}	0	3.29×10^{-7}	0	8.08×10^{-10}	2.08×10^{-5}
Pu-242	2.77×10^{-11}	1.38×10^{-12}	0	1.36×10^{-11}	0	3.34×10^{-14}	8.61×10^{-10}
Am-241	3.52×10^{-9}	1.76×10^{-10}	0	1.73×10^{-9}	0	4.26×10^{-12}	1.10×10^{-7}
Cs-137	1.38×10^{-5}	6.9×10^{-7}	1.75×10^{-5}	6.83×10^{-6}	0.23	0	6.59×10^{-7}

[a] Midpoint of the estimated frequency range.

Note: Am=Americium; NA=not applicable.

Source: Derived from Tables M.5.1.3.4–1 and M.5.3.5.1–1.

Table M.5.3.5.1–4. Vitrification Alternative Beyond Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario		
	Cs Fire	Blender Fire	Nuclear Criticality in Pu Oxide Furnace[a]
Frequency of occurrence (per year)	1.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}
Pu released to environment (g)	NA	5.16×10^{-5}	NA
Cs released to environment (Ci)	1.3	0.231	NA
Fissions	NA	NA	1.0×10^{18}
Isotope Released to Environment (Ci)			
Pu-238	0	8.15×10^{-8}	0
Pu-239	0	2.95×10^{-6}	0
Pu-240	0	7.84×10^{-7}	0
Pu-241	0	2.78×10^{-6}	0
Pu-242	0	1.15×10^{-10}	0
Am-241	0	1.47×10^{-8}	0
Cs-137	1.3	0.231	0
Kr-83m	0	0	5.5
Kr-85m	0	0	3.55
Kr-85	0	0	4.05×10^{-5}
Kr-87	0	0	21.5
Kr-88	0	0	11.5
Kr-89	0	0	650
Xe-131m	0	0	5.0×10^{-3}
Xe-133m	0	0	0.11
Xe-133	0	0	1.35
Xe-135m	0	0	165
Xe-135	0	0	20.5
Xe-137	0	0	2.45×10^{3}
Xe-138	0	0	550
I-131	0	0	0.055
I-132	0	0	6
I-133	0	0	0.8
I-134	0	0	21.5
I-135	0	0	2.25

[a] Curies produced (by isotope) or the 1.0×10^{18} fission criticality were scaled from Table M.5.3.1.1–3.

Note: NA=not applicable.

Source: Derived from Tables M.5.1.3.4–1, M.5.3.1.1–3, and M.5.3.5.1–2.

Table M.5.3.5.1–5. Accident Scenario Descriptions for the Vitrification Alternative

Accident Scenario	Accident Description
Evaluation Basis Accidents	
Blender spill	The spill occurs as material is transferred from the blender to the melter. Fine particulate materials that became airborne during the spill would be removed from the area by the ventilation system and passed through HEPA filters before release to the environment.
Melter spill	The source document provided summary data in a tabular format for this accident scenario. This accident scenario was not described in the source document.
Cs capsule drop	The source document provided summary data in a tabular format for this accident scenario. This accident scenario was not described in the source document.
Canister drop	It was postulated that the impact shatters the glass and disperses the fragments into the cell atmosphere. Fine particulate materials that became airborne would be removed from the area by the ventilation system and passed through HEPA filters before release to the environment.
CPC ion column fire	The source document provided summary data in a tabular format for this accident scenario. This accident scenario was not described in the source document.
Pu oxide oven solids fire	The source document provided summary data in a tabular format for this accident scenario. This accident scenario was not described in the source document.
Earthquake	Contents of the blender, melter, Pu oxide oven the Cs preparation cell would be spilled. Fine particulate materials that became airborne during the spills would be removed from the area by the ventilation system and passed through HEPA filters before release to the environment.
Beyond Evaluation Basis Accidents	
Cs fire	The combustible load for the processes involving Cs is very low. The Cs is in the form of CsCl which is not flammable. A large fire was postulated in the process area and all Cs effected by the fire was released to the area ventilation system and passed through HEPA filters before release to the environment.
Blender fire	The combustible load in the process is very low. The process involves no flammable material. A large fire was postulated in the process cell. It is assumed that the fire ruptures the blender and the blender contents are exposed to the fire. The resultant airborne material is removed by the area ventilation system and passed through HEPA filters before release to the environment.
Nuclear criticality in Pu oxide furnace	A criticality event was assumed to occur in the Pu oxide oven process area and the assumed criticality accident severity is based on guidance provided in NRC Regulatory Guide 3.35.

Source: LLNL 1996c.

M.5.3.5.2 *Accident Impacts*

The estimated impacts of the postulated accidents at each site are provided in Tables M.5.3.5.2–1 through M.5.3.5.2–6. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 using the MACCS computer code. [Text deleted.]

Table M.5.3.5.2–1. Vitrification Alternative Accident Impacts at Hanford Site

Accident Scenario	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per year)
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	
Blender spill	4.6×10^{-6}	1.8×10^{-9}	3.4×10^{-8}	1.7×10^{-11}	3.1×10^{-4}	1.5×10^{-7}	0.05
Melter spill	2.3×10^{-7}	9.1×10^{-11}	1.7×10^{-9}	8.6×10^{-13}	1.5×10^{-5}	7.6×10^{-9}	1.0×10^{-3}
Cs capsule drop	1.3×10^{-6}	5.3×10^{-10}	8.0×10^{-9}	4.0×10^{-12}	1.3×10^{-4}	6.4×10^{-8}	1.0×10^{-3}
Canister drop	2.2×10^{-6}	9.0×10^{-10}	1.7×10^{-8}	8.5×10^{-12}	1.5×10^{-4}	7.5×10^{-8}	1.0×10^{-3}
Cs ion processing fire	0.017	6.9×10^{-6}	1.1×10^{-4}	5.3×10^{-8}	1.7	8.4×10^{-4}	1.0×10^{-3}
Pu oxide oven solids fire	4.3×10^{-9}	1.7×10^{-12}	3.4×10^{-11}	1.7×10^{-14}	2.5×10^{-7}	1.2×10^{-10}	1.0×10^{-3}
Earthquake	1.1×10^{-4}	4.4×10^{-8}	8.8×10^{-7}	4.4×10^{-10}	6.4×10^{-3}	3.2×10^{-6}	1.0×10^{-5}
Cs fire	0.098	3.9×10^{-5}	6.0×10^{-4}	3.0×10^{-7}	9.5	4.7×10^{-3}	1.0×10^{-6}
Blender fire	0.017	7.0×10^{-6}	1.1×10^{-4}	5.3×10^{-8}	1.7	8.4×10^{-4}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	1.0×10^{-3}	4.2×10^{-7}	6.5×10^{-6}	3.3×10^{-9}	7.0×10^{-3}	3.5×10^{-6}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table M.5.3.5.2–2. Vitrification Alternative Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Blender spill	3.1×10^{-6}	1.2×10^{-9}	5.5×10^{-8}	2.8×10^{-11}	7.0×10^{-6}	3.5×10^{-9}	0.05
Melter spill	1.6×10^{-7}	6.2×10^{-11}	2.7×10^{-9}	1.4×10^{-12}	3.5×10^{-7}	1.7×10^{-10}	1.0×10^{-3}
Cs capsule drop	8.9×10^{-7}	3.6×10^{-10}	1.3×10^{-8}	6.6×10^{-12}	3.0×10^{-6}	1.5×10^{-9}	1.0×10^{-3}
Canister drop	1.5×10^{-6}	6.1×10^{-10}	2.7×10^{-8}	1.4×10^{-11}	3.4×10^{-6}	1.7×10^{-9}	1.0×10^{-3}
Cs ion processing fire	0.012	4.7×10^{-6}	1.7×10^{-4}	8.7×10^{-8}	0.039	1.9×10^{-5}	1.0×10^{-3}
Pu oxide oven solids fire	2.9×10^{-9}	1.2×10^{-12}	5.4×10^{-11}	2.7×10^{-14}	5.6×10^{-9}	2.8×10^{-12}	1.0×10^{-3}
Earthquake	7.5×10^{-5}	3.0×10^{-8}	1.4×10^{-6}	9.0×10^{-10}	1.4×10^{-4}	7.2×10^{-8}	1.0×10^{-5}
Cs fire	0.066	2.6×10^{-5}	9.8×10^{-4}	4.9×10^{-7}	0.22	1.1×10^{-4}	1.0×10^{-6}
Blender fire	0.012	4.7×10^{-6}	1.8×10^{-4}	8.7×10^{-8}	0.039	2.0×10^{-5}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	7.7×10^{-4}	3.1×10^{-7}	1.3×10^{-5}	6.5×10^{-9}	1.4×10^{-4}	6.9×10^{-8}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table M.5.3.5.2–3. Vitrification Alternative Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Blender spill	4.2×10^{-6}	1.7×10^{-9}	3.5×10^{-8}	1.7×10^{-11}	9.3×10^{-5}	4.7×10^{-8}	0.05
Melter spill	2.1×10^{-7}	8.4×10^{-11}	1.7×10^{-9}	8.7×10^{-13}	4.7×10^{-6}	2.3×10^{-9}	1.0×10^{-3}
Cs capsule drop	1.2×10^{-6}	4.6×10^{-10}	7.7×10^{-9}	3.8×10^{-12}	4.0×10^{-5}	2.0×10^{-8}	1.0×10^{-3}
Canister drop	2.1×10^{-6}	8.3×10^{-10}	1.7×10^{-8}	8.5×10^{-12}	4.6×10^{-5}	2.3×10^{-8}	1.0×10^{-3}
Cs ion processing fire	0.015	6.1×10^{-6}	1.0×10^{-4}	5.0×10^{-8}	0.53	2.6×10^{-4}	1.0×10^{-3}
Pu oxide oven solids fire	4.0×10^{-9}	1.6×10^{-12}	3.4×10^{-11}	1.7×10^{-14}	7.4×10^{-8}	3.7×10^{-11}	1.0×10^{-3}
Earthquake	1.0×10^{-4}	4.1×10^{-8}	8.8×10^{-7}	4.4×10^{-10}	1.9×10^{-3}	9.6×10^{-7}	1.0×10^{-5}
Cs fire	0.086	3.4×10^{-5}	5.7×10^{-4}	2.9×10^{-7}	3.0	1.5×10^{-3}	1.0×10^{-6}
Blender fire	0.015	6.1×10^{-6}	1.0×10^{-4}	5.1×10^{-8}	0.53	2.7×10^{-4}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	1.0×10^{-3}	4.0×10^{-7}	7.7×10^{-6}	3.9×10^{-9}	1.8×10^{-3}	9.0×10^{-7}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table M.5.3.5.2–4. Vitrification Alternative Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Blender spill	1.9×10^{-6}	7.5×10^{-10}	4.2×10^{-7}	2.1×10^{-10}	1.0×10^{-4}	5.0×10^{-8}	0.05
Melter spill	9.3×10^{-8}	3.7×10^{-11}	2.1×10^{-8}	1.0×10^{-11}	5.0×10^{-6}	2.5×10^{-9}	1.0×10^{-3}
Cs capsule drop	5.6×10^{-7}	2.2×10^{-10}	1.2×10^{-7}	5.9×10^{-11}	3.8×10^{-5}	1.9×10^{-8}	1.0×10^{-3}
Canister drop	9.2×10^{-7}	3.7×10^{-10}	2.1×10^{-7}	1.0×10^{-10}	4.9×10^{-5}	2.5×10^{-8}	1.0×10^{-3}
Cs ion processing fire	7.4×10^{-3}	3.0×10^{-6}	1.5×10^{-3}	7.7×10^{-7}	0.51	2.5×10^{-4}	1.0×10^{-3}
Pu oxide oven solids fire	1.7×10^{-9}	6.9×10^{-13}	4.0×10^{-10}	2.0×10^{-13}	8.4×10^{-8}	4.2×10^{-11}	1.0×10^{-3}
Earthquake	4.4×10^{-5}	1.8×10^{-8}	1.0×10^{-5}	5.1×10^{-9}	2.2×10^{-3}	1.1×10^{-6}	1.0×10^{-5}
Cs fire	0.042	1.7×10^{-5}	8.7×10^{-3}	4.4×10^{-6}	2.9	1.4×10^{-3}	1.0×10^{-6}
Blender fire	7.4×10^{-3}	3.0×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	0.51	2.5×10^{-4}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	4.8×10^{-4}	1.9×10^{-7}	1.4×10^{-4}	7.0×10^{-8}	4.5×10^{-3}	2.2×10^{-6}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table M.5.3.5.2–5. Vitrification Alternative Accident Impacts at Oak Ridge Reservation

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Blender spill	4.3×10^{-6}	1.7×10^{-9}	7.3×10^{-7}	3.7×10^{-10}	7.1×10^{-4}	3.5×10^{-7}	0.05
Melter spill	2.1×10^{-7}	8.6×10^{-11}	3.7×10^{-8}	1.8×10^{-11}	3.5×10^{-5}	1.8×10^{-8}	1.0×10^{-3}
Cs capsule drop	1.3×10^{-6}	5.2×10^{-10}	2.1×10^{-7}	1.0×10^{-10}	2.7×10^{-4}	1.3×10^{-7}	1.0×10^{-3}
Canister drop	2.1×10^{-6}	8.4×10^{-10}	3.6×10^{-7}	1.8×10^{-10}	3.5×10^{-4}	1.7×10^{-7}	1.0×10^{-3}
Cs ion processing fire	0.017	6.8×10^{-6}	2.7×10^{-3}	1.4×10^{-6}	3.5	1.8×10^{-3}	1.0×10^{-3}
Pu oxide oven solids fire	3.9×10^{-9}	1.6×10^{-12}	6.9×10^{-10}	3.5×10^{-13}	6.0×10^{-7}	3.0×10^{-10}	1.0×10^{-3}
Earthquake	1.0×10^{-4}	4.1×10^{-8}	1.8×10^{-5}	8.9×10^{-9}	0.015	7.7×10^{-6}	1.0×10^{-5}
Cs fire	0.095	3.8×10^{-5}	0.015	7.7×10^{-6}	19.8	9.9×10^{-3}	1.0×10^{-6}
Blender fire	0.017	6.8×10^{-6}	2.7×10^{-3}	1.4×10^{-6}	3.5	1.8×10^{-3}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	9.5×10^{-4}	3.8×10^{-7}	1.7×10^{-4}	8.5×10^{-8}	0.031	1.6×10^{-5}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [1,000 m for this facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table M.5.3.5.2–6. Vitrification Alternative Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Blender spill	3.0×10^{-6}	1.2×10^{-9}	5.8×10^{-8}	2.9×10^{-11}	3.2×10^{-4}	1.6×10^{-7}	0.05
Melter spill	1.5×10^{-7}	6.1×10^{-11}	2.9×10^{-9}	1.5×10^{-12}	1.6×10^{-5}	8.0×10^{-9}	1.0×10^{-3}
Cs capsule drop	9.2×10^{-7}	3.7×10^{-10}	1.6×10^{-8}	8.2×10^{-12}	1.3×10^{-4}	6.4×10^{-8}	1.0×10^{-3}
Canister drop	1.5×10^{-6}	6.0×10^{-10}	2.9×10^{-8}	1.4×10^{-11}	1.6×10^{-4}	7.9×10^{-8}	1.0×10^{-3}
Cs ion processing fire	0.012	4.8×10^{-6}	2.2×10^{-4}	1.1×10^{-7}	1.7	8.4×10^{-4}	1.0×10^{-3}
Pu oxide oven solids fire	2.8×10^{-9}	1.1×10^{-12}	5.5×10^{-11}	2.7×10^{-12}	2.7×10^{-7}	1.3×10^{-10}	1.0×10^{-3}
Earthquake	7.2×10^{-5}	2.9×10^{-8}	1.4×10^{-6}	7.1×10^{-10}	6.8×10^{-3}	3.4×10^{-8}	1.0×10^{-5}
Cs fire	0.068	2.7×10^{-5}	1.2×10^{-3}	6.1×10^{-7}	9.5	4.7×10^{-3}	1.0×10^{-6}
Blender fire	0.012	4.8×10^{-6}	2.2×10^{-4}	1.1×10^{-7}	1.7	8.4×10^{-4}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	6.9×10^{-4}	2.8×10^{-7}	1.1×10^{-5}	5.7×10^{-9}	9.4×10^{-3}	4.7×10^{-6}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

M.5.3.6 Ceramic Immobilization Alternative

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for a ceramic immobilized facility in the *Fissile Material Disposition Program PEIS Data Call Input Report: Ceramic Immobilization Facility with Radionuclides*. The studies postulated a set of accidents scenarios that were representative of the risks and consequences for workers and the public that can be expected if the facility were constructed and operated. Although not all potential accidents were addressed, those that were postulated have consequences and risk that are expected to envelop the consequences and risks of an operating facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than 1.0×10^{-7} per year are anticipated that will have consequences and risks larger than those described in this section. The potential for an aircraft crash has been considered and dismissed because the probability of a crash into a facility and causing sufficient damage to release Pu is much less than 10^{-7}/yr.

M.5.3.6.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the facility. Through a screening process, nine evaluation basis accidents and four beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.3.6.1–1 and M.5.3.6.1–2. Accident source term information is provided in Tables M.5.3.6.1–3 and M.5.3.6.1–4. Descriptions of accident scenarios are provided in Table M.5.3.6.1–5.

Table M.5.3.6.1–1. Evaluation Basis Accident Scenarios for the Ceramic Immobilization Alternative

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Earthquake	1.0×10^{-6} to 1.0×10^{-4}	7 kg Pu	7.0×10^{-6} g Pu
Tornado	1.0×10^{-6} to 1.0×10^{-4}	No Release	No Release
Flood	1.0×10^{-6} to 1.0×10^{-4}	No Release	No Release
Glovebox fire	1.0×10^{-6} to 1.0×10^{-4}	7 kg Pu	7.0×10^{-6} g Pu
Glovebox nuclear criticality	1.0×10^{-6} to 1.0×10^{-4}	10^{18} fissions. Release fractions: 1.0 noble gases, 0.25 halogens.	[a]
Mixing tank nuclear criticality	1.0×10^{-6} to 1.0×10^{-4}	1.0×10^{19} fissions total. 1.0×10^{18} fissions initial, 47 pulses of 1.0×10^{17} fissions at 10 minute intervals. Release fractions: 1.0 noble gases, 0.25 halogens.	[a]
Bellows drop	1.0×10^{-4} to 0.01	4 kg Pu 4,330 Ci Cs	4.0×10^{-9} g Pu 4.3×10^{-9} Ci Cs
Canister drop	1.0×10^{-4} to 0.01	No Release	No Release
Cs capsule drop	1.0×10^{-4} to 0.01	4.0×10^{7} Ci Cs	4.0×10^{-5} Ci Cs
Plutonyl nitrate dissolver spill	0.01 to 0.1	0.4 kg Pu	2.4×10^{-11} g Pu
Calciner feed spill	0.01 to 0.1	2.5 kg Pu 2,740 Ci Cs	1.25×10^{-10} g Pu 1.37×10^{-10} Ci Cs
Calciner product spill	0.01 to 0.1	5 kg Pu 5,480 Ci Cs	3.5×10^{-8} g Pu 3.8×10^{-8} Ci Cs
Loss of off-site power	0.01 to 0.1	No Release	No Release

[a] See Table M.5.3.6.1–3.

Source: LLNL 1996d; NRC 1979a.

Table M.5.3.6.1–2. Beyond Evaluation Basis Accident Scenarios for the Ceramic Immobilization Alternative

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Cs fire	$<1.0\times10^{-6}$	1.3×10^{6} Ci Cs	1.3×10^{-5} Ci Cs
Process cell fire	$<1.0\times10^{-6}$	50 kg Pu	5.0×10^{-7} g Pu
Nuclear criticality	$<1.0\times10^{-6}$	3.0×10^{20} fissions total. 5.0×10^{19} fissions initial, 47 pulses of 5.0×10^{18} fissions at 10 minute intervals. Release fractions: 1.0 noble gases, 0.25 halogens.	[a]
Uncontrolled chemical reaction	$<1.0\times10^{-6}$	25 kg Pu 27,400 Ci Cs	2.5×10^{-7} g Pu 2.74×10^{-7} Ci Cs

[a] See Table M.5.3.6.1–4.

Source: LLNL 1996d; NRC 1979a.

Table M.5.3.6.1–3. Ceramic Immobilization Alternative Evaluation Basis Accident Source Terms

	Accident Scenario								
Accident Parameter	**Earthquake**	**Glovebox Fire**	**Glovebox Nuclear Criticality[a]**	**Mixing Tank Nuclear Criticality[a]**	**Bellows Drop**	**Cs Capsule Drop**	**Plutonyl Nitrate Dissolver Spill**	**Calciner Feed Spill**	**Calciner Product Spill**
Frequency of occurrence[b] (per year)	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-3}	1.0×10^{-3}	0.05	0.05	0.05
Pu released to environment (g)	7.0×10^{-6}	7.0×10^{-6}	NA	NA	4.0×10^{-9}	NA	2.4×10^{-11}	1.25×10^{-10}	3.5×10^{-8}
Cs released to environment (Ci)	NA	NA	NA	NA	4.3×10^{-9}	4.0×10^{-5}	NA	1.37×10^{-10}	3.8×10^{-8}
Fissions	NA	NA	1.0×10^{18}	1.0×10^{19}	NA	NA	NA	NA	NA
Isotope Released to Environment (Ci)									
Pu-238	1.11×10^{-8}	1.11×10^{-8}	0	0	6.32×10^{-12}	0	3.79×10^{-14}	1.98×10^{-13}	5.53×10^{-11}
Pu-239	4.00×10^{-7}	4.06×10^{-7}	0	0	2.79×10^{-10}	0	1.37×10^{-12}	7.15×10^{-12}	2.00×10^{-9}
Pu-240	1.06×10^{-7}	1.06×10^{-7}	0	0	6.08×10^{-11}	0	3.65×10^{-13}	1.90×10^{-12}	5.32×10^{-10}
Pu-241	3.77×10^{-7}	3.77×10^{-7}	0	0	2.16×10^{-10}	0	1.29×10^{-12}	6.74×10^{-12}	1.89×10^{-9}
Pu-242	1.56×10^{-11}	1.56×10^{-11}	0	0	8.92×10^{-15}	0	5.35×10^{-17}	2.79×10^{-16}	7.81×10^{-14}
Am-241	1.99×10^{-9}	1.99×10^{-9}	0	0	1.14×10^{-12}	0	6.82×10^{-15}	3.55×10^{-14}	9.94×10^{-12}
Cs-137	0	0	0	0	4.3×10^{-9}	4.0×10^{-5}	0	1.37×10^{-10}	3.8×10^{-8}
Kr-83m	0	0	11	110	0	0	0	0	0
Kr-85m	0	0	7.1	71	0	0	0	0	0
Kr-85	0	0	8.1×10^{-5}	8.1×10^{-4}	0	0	0	0	0
Kr-87	0	0	43	430	0	0	0	0	0
Kr-88	0	0	23	230	0	0	0	0	0
Kr-89	0	0	1.3×10^{3}	1.3×10^{4}	0	0	0	0	0

Table M.5.3.6.1–3. Ceramic Immobilization Alternative Evaluation Basis Accident Source Terms—Continued

	Accident Scenario								
Accident Parameter	Earthquake	Glovebox Fire	Glovebox Nuclear Criticality[a]	Mixing Tank Nuclear Criticality[a]	Bellows Drop	Cs Capsule Drop	Plutonyl Nitrate Dissolver Spill	Calciner Feed Spill	Calciner Product Spill
Xe-131m	0	0	0.01	0.1	0	0	0	0	0
Xe-133m	0	0	0.22	2.2	0	0	0	0	0
Xe-133	0	0	2.7	27	0	0	0	0	0
Xe-135m	0	0	330	3.3×10^3	0	0	0	0	0
Xe-135	0	0	41	410	0	0	0	0	0
Xe-137	0	0	4.9×10^3	4.9×10^4	0	0	0	0	0
Xe-138	0	0	1.1×10^3	1.1×10^4	0	0	0	0	0
I-131	0	0	0.28	2.75	0	0	0	0	0
I-132	0	0	30	300	0	0	0	0	0
I-133	0	0	4	40	0	0	0	0	0
I-134	0	0	108	1.08×10^3	0	0	0	0	0
I-135	0	0	11.3	113	0	0	0	0	0

[a] Curies produced (by isotope) for the 1.0×10^{18} and 1.0×10^{19} fission criticalities were scaled from Table M.5.3.1.1–3.

[b] Midpoint of estimated frequency range.

Note: NA=not applicable.

Source: Derived from Tables M.5.1.3.4–1, M.5.3.1.1–3, and M.5.3.6.1–1.

Table M.5.3.6.1–4. Ceramic Immobilization Alternative Beyond Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario			
	Cs Fire	Process Cell Fire	Nuclear Criticality[a]	Uncontrolled Chemical Reaction
Frequency of occurrence (per year)[b]	1.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}
Pu released to environment (g)	NA	5.0×10^{-7}	NA	2.5×10^{-7}g
Cs released to environment (Ci)	1.3×10^{-5}	NA	NA	2.74×10^{-7}
Fissions	NA	NA	3.0×10^{20}	NA
Isotope Released to Environment (Ci)				
Pu-238	0	7.9×10^{-10}	0	3.95×10^{-10}
Pu-239	0	2.86×10^{-8}	0	1.43×10^{-8}
Pu-240	0	7.60×10^{-9}	0	3.80×10^{-9}
Pu-241	0	2.69×10^{-8}	0	1.35×10^{-8}
Pu-242	0	1.12×10^{-12}	0	5.58×10^{-13}
Am-241	0	1.42×10^{-10}	0	7.10×10^{-11}
Cs-137	1.3×10^{-5}	0	0	2.74×10^{-7}
Kr-83m	0	0	3.3×10^{3}	0
Kr-85m	0	0	2.13×10^{3}	0
Kr-85	0	0	0.0243	0
Kr-87	0	0	1.29×10^{4}	0
Kr-88	0	0	6.90×10^{3}	0
Kr-89	0	0	3.90×10^{5}	0
Xe-131m	0	0	3.0	0
Xe-133m	0	0	66	0
Xe-133	0	0	810	0
Xe-135m	0	0	9.9×10^{4}	0
Xe-135	0	0	1.23×10^{4}	0
Xe-137	0	0	1.47×10^{6}	0
Xe-138	0	0	3.3×10^{5}	0
I-131	0	0	82.5	0
I-132	0	0	9.0×10^{3}	0
I-133	0	0	1.2×10^{3}	0
I-134	0	0	3.23×10^{4}	0
I-135	0	0	3.38×10^{3}	0

[a] Curies produced (by isotope) for the 3.0×10^{20} fission criticality was scaled from Table M.5.3.1.1–3.

[b] Midpoint of estimated frequency range.

Note: NA=not applicable.

Source: Derived from Tables M.5.1.3.4–1, M.5.3.1.1–3, and M.5.3.6.1–2.

Table M.5.3.6.1–5. Accident Scenario Descriptions for Ceramic Immobilization Alternative

Accident Scenario	Accident Description
Evaluation Basis Accidents	
Earthquake	It is assumed that the earthquake starts a fire in the room housing the Pu metal glovebox line. The fire is unimpeded and breaches a glovebox containing Pu. The glovebox inert atmosphere is lost and the Pu ignites. The ventilation system removes the Pu-containing gases from the area. The gasses pass through HEPA filters and are then released to the environment.
Glovebox fire	It is assumed that an unimpeded fire begins in the room housing the Pu metal glovebox line and breaches a glovebox containing Pu. The glovebox inert atmosphere is lost and the Pu ignites. The ventilation system removes the Pu-containing gases from the area. The gases pass through HEPA filters and are then released to the environment.
Glovebox nuclear criticality	It is assumed that controls are violated so that additional fissile material is introduced into a double batched glovebox. This results in a criticality.
Mixing tank nuclear criticality	It is assumed that controls are violated so that limits on fissile materials and poison controls are violated. A pulsed criticality event results.
Bellows drop	A bellows is dropped 6 m during handling. The force of the drop factures the ceramic material and ruptures the bellows. Respirable fines of ceramic are released to the cell and collected by the ventilation system. The airborne fines pass through HEPA filters and are released to the environment.
Cs capsule drop	A capsule is dropped 6 m during handling. The force of the drop fractures the CsCl material and ruptures the capsule. Respirable fines of CsCl are released to the cell and collected by the ventilation system. The airborne fines pass through HEPA filters and are released to the environment.
Plutonyl nitrate dissolver spill	It is postulated that the dissolver overflows the spills onto the floor. The spill spreads out in a safe geometry. The spill is cleaned up in two hours but some of the spill material is aerosolized and becomes airborne as respirable particles. The Pu-containing particulate would be removed from the process area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.
Calciner feed spill	It is postulated that the calciner feed make-up tank overflows and spills onto the floor. The spill spreads out in a safe geometry. The spill is cleaned up in two hours but some of the spill material is aerosolized and becomes airborne as respirable particles. The Pu-containing particulate would be removed from the process area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.
Calciner product spill	It is postulated that the calciner product bin overflow and spills powder onto the floor. The spill spreads out in a safe geometry. The spill is cleaned up in two hours but some of the spill becomes airborne as respirable particles. The Pu-containing particulate would be removed from the process area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.
Beyond Evaluation Basis Accidents	
Cs fire	The combustible load for the processes involving Cs is very low. The Cs is in the form of CsCl which is not flammable. A large fire was postulated in the process area and all Cs effected by the fire was released to the area ventilation system and passes through HEPA filters before release to the environment.
Process cell fire	The combustible load in the remote process cells is very low. The process involves no flammable material. A large fire was postulated in the process cell. It is assumed that the fire ruptures the calciner product bins and the contents are exposed to the fire. The resultant airborne material is removed by the area ventilation system and passed through HEPA filters before release to the environment.

Table M.5.3.6.1–5. Accident Scenario Descriptions for Ceramic Immobilization Alternative—Continued

Accident Scenario	Accident Description
Nuclear criticality	A criticality event was assumed to occur in the facility and the assumed criticality accident severity is based on guidance provided in NRC Regulatory Guide 3.35.
Uncontrolled chemical reaction	Radiolytic hydrogen will be produced in the solutions in the facility. It was assumed that hydrogen accumulated within tanks because the tanks were isolated from the gas treatment system from a considerable period of time. It was postulated that hydrogen detonated in the calciner feed tank and some of the tank contents became airborne. The resultant airborne material is removed by the area ventilation system and passed through HEPA filters before release to the environment.

Source: LLNL 1996d.

M.5.3.6.2 *Accident Impacts*

The estimated impacts of the postulated accidents at each site are provided in Tables M.5.3.6.2–1 through M.5.3.6.2–6. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.3.6.1–3 and M.5.3.6.1–4 using the MACCS computer code. [Text deleted.]

Table M.5.3.6.2–1. Ceramic Immobilization Alternative Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	2.0×10^{-6}	7.9×10^{-10}	1.6×10^{-8}	7.9×10^{-12}	1.2×10^{-4}	5.8×10^{-8}	1.0×10^{-5}
Glovebox fire	2.0×10^{-6}	7.9×10^{-10}	1.6×10^{-8}	7.9×10^{-12}	1.2×10^{-4}	5.8×10^{-8}	1.0×10^{-5}
Glovebox criticality	3.5×10^{-3}	1.4×10^{-6}	2.3×10^{-5}	1.2×10^{-8}	0.032	1.6×10^{-5}	1.0×10^{-5}
Mixing tank criticality	0.035	1.4×10^{-5}	2.3×10^{-4}	1.2×10^{-7}	0.32	1.6×10^{-4}	1.0×10^{-5}
Bellows drop	1.5×10^{-9}	5.8×10^{-13}	1.1×10^{-11}	5.5×10^{-15}	9.7×10^{-8}	4.9×10^{-11}	1.0×10^{-3}
Cesium capsule drop	3.0×10^{-6}	1.2×10^{-9}	1.8×10^{-8}	9.2×10^{-12}	2.9×10^{-4}	1.5×10^{-7}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	6.8×10^{-12}	2.7×10^{-15}	5.4×10^{-14}	2.7×10^{-17}	4.0×10^{-10}	2.0×10^{-13}	0.05
Calciner feed spill	4.6×10^{-11}	1.8×10^{-14}	3.5×10^{-13}	1.7×10^{-16}	3.1×10^{-9}	1.5×10^{-12}	0.05
Calciner product spill	1.3×10^{-8}	5.1×10^{-12}	9.7×10^{-11}	4.8×10^{-14}	8.5×10^{-7}	4.3×10^{-10}	0.05
Cesium fire	9.8×10^{-7}	3.9×10^{-10}	6.0×10^{-9}	3.0×10^{-12}	9.5×10^{-5}	4.7×10^{-8}	1.0×10^{-6}
Process cell fire	1.4×10^{-7}	5.7×10^{-11}	1.1×10^{-9}	5.7×10^{-13}	8.2×10^{-6}	4.1×10^{-9}	1.0×10^{-6}
Criticality	1.0	4.2×10^{-4}	6.9×10^{-3}	3.5×10^{-6}	9.5	4.8×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	9.1×10^{-8}	3.7×10^{-11}	7.0×10^{-10}	3.5×10^{-13}	6.1×10^{-6}	3.1×10^{-9}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.6.1–3 and M.5.3.6.1–4 and the MACCS computer code.

Table M.5.3.6.2–2. Ceramic Immobilization Alternative Accident Impacts at Nevada Test Site

Accident Scenario	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	1.4×10^{-6}	5.4×10^{-10}	2.5×10^{-8}	1.3×10^{-11}	2.6×10^{-6}	1.3×10^{-9}	1.0×10^{-5}
Glovebox fire	1.4×10^{-6}	5.4×10^{-10}	2.5×10^{-8}	1.3×10^{-11}	2.6×10^{-6}	1.3×10^{-9}	1.0×10^{-5}
Glovebox criticality	2.5×10^{-3}	1.0×10^{-6}	4.5×10^{-5}	2.3×10^{-8}	6.5×10^{-4}	3.3×10^{-7}	1.0×10^{-5}
Mixing tank criticality	0.025	1.0×10^{-5}	4.5×10^{-4}	2.3×10^{-7}	6.5×10^{-3}	3.3×10^{-6}	1.0×10^{-5}
Bellows drop	9.9×10^{-10}	4.0×10^{-13}	1.8×10^{-11}	8.8×10^{-15}	2.2×10^{-9}	1.1×10^{-12}	1.0×10^{-3}
Cesium capsule drop	2.0×10^{-6}	8.1×10^{-10}	3.0×10^{-8}	1.5×10^{-11}	6.7×10^{-6}	3.4×10^{-9}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	4.7×10^{-12}	1.9×10^{-15}	8.6×10^{-14}	4.3×10^{-17}	8.9×10^{-12}	4.5×10^{-15}	0.05
Calciner feed spill	3.1×10^{-11}	1.2×10^{-14}	5.5×10^{-13}	2.8×10^{-16}	7.0×10^{-11}	3.5×10^{-14}	0.05
Calciner product spill	8.7×10^{-9}	3.5×10^{-12}	1.5×10^{-10}	7.7×10^{-14}	2.0×10^{-8}	9.7×10^{-12}	0.05
Cesium fire	6.6×10^{-7}	2.6×10^{-10}	9.8×10^{-9}	4.9×10^{-12}	2.2×10^{-6}	1.1×10^{-9}	1.0×10^{-6}
Process cell fire	9.7×10^{-8}	3.9×10^{-11}	1.8×10^{-9}	9.0×10^{-13}	1.9×10^{-7}	9.3×10^{-11}	1.0×10^{-6}
Criticality	0.76	3.0×10^{-4}	0.014	6.8×10^{-6}	0.20	9.7×10^{-5}	1.0×10^{-6}
Uncontrolled chemical reaction	6.2×10^{-8}	2.5×10^{-11}	1.1×10^{-9}	5.5×10^{-13}	1.4×10^{-7}	7.0×10^{-11}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.6.1–3 and M.5.3.6.1–4 and the MACCS computer code.

Table M.5.3.6.2–3. Ceramic Immobilization Alternative Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	1.9×10^{-6}	7.4×10^{-10}	1.6×10^{-8}	8.0×10^{-12}	3.5×10^{-5}	1.7×10^{-8}	1.0×10^{-5}
Glovebox fire	1.9×10^{-6}	7.4×10^{-10}	1.6×10^{-8}	8.0×10^{-12}	3.5×10^{-5}	1.7×10^{-8}	1.0×10^{-5}
Glovebox nuclear criticality	3.4×10^{-3}	1.4×10^{-6}	2.7×10^{-5}	1.3×10^{-8}	8.7×10^{-3}	4.3×10^{-6}	1.0×10^{-5}
Mixing tank nuclear criticality	0.034	1.4×10^{-5}	2.7×10^{-4}	1.3×10^{-7}	0.086	4.3×10^{-5}	1.0×10^{-5}
Bellows drop	1.3×10^{-9}	5.4×10^{-13}	1.1×10^{-11}	5.5×10^{-15}	3.0×10^{-8}	1.5×10^{-11}	1.0×10^{-3}
Cesium capsule drop	2.6×10^{-6}	1.1×10^{-9}	1.8×10^{-8}	8.8×10^{-12}	9.2×10^{-5}	4.6×10^{-8}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	6.4×10^{-12}	2.5×10^{-15}	5.5×10^{-14}	2.8×10^{-17}	1.2×10^{-10}	5.9×10^{-14}	0.05
Calciner feed spill	4.2×10^{-11}	1.7×10^{-14}	3.5×10^{-13}	1.7×10^{-16}	9.3×10^{-10}	4.7×10^{-13}	0.05
Calciner product spill	1.2×10^{-8}	4.7×10^{-12}	9.7×10^{-11}	4.8×10^{-14}	2.6×10^{-7}	1.3×10^{-10}	0.05
Cesium fire	8.6×10^{-7}	3.4×10^{-10}	5.7×10^{-9}	2.9×10^{-12}	3.0×10^{-5}	1.5×10^{-8}	1.0×10^{-6}
Process cell fire	1.3×10^{-7}	5.3×10^{-11}	1.1×10^{-9}	5.7×10^{-13}	2.5×10^{-6}	1.2×10^{-9}	1.0×10^{-6}
Nuclear criticality	1.0	4.0×10^{-4}	8.1×10^{-3}	4.0×10^{-6}	2.6	1.3×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	8.4×10^{-8}	3.4×10^{-11}	6.9×10^{-10}	3.5×10^{-13}	1.9×10^{-6}	9.3×10^{-10}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

All values are mean values.

Calculated using the source terms in Tables M.5.3.6.1–3 and M.5.3.6.1–4 and the MACCS computer code.

Table M.5.3.6.2–4. Ceramic Immobilization Alternative Accident Impacts at Pantex Plant

Accident Scenario	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	8.0×10^{-7}	3.2×10^{-10}	1.8×10^{-7}	9.2×10^{-11}	3.9×10^{-5}	2.0×10^{-8}	1.0×10^{-5}
Glovebox fire	8.0×10^{-7}	3.2×10^{-10}	1.8×10^{-7}	9.2×10^{-11}	3.9×10^{-5}	2.0×10^{-8}	1.0×10^{-5}
Glovebox nuclear criticality	1.5×10^{-3}	6.2×10^{-7}	4.4×10^{-4}	2.2×10^{-7}	0.019	9.5×10^{-6}	1.0×10^{-5}
Mixing tank nuclear criticality	0.015	6.2×10^{-6}	4.4×10^{-3}	2.2×10^{-6}	0.19	9.5×10^{-5}	1.0×10^{-5}
Bellows drop	6.0×10^{-10}	2.4×10^{-13}	1.3×10^{-10}	6.7×10^{-14}	3.2×10^{-8}	1.6×10^{-11}	1.0×10^{-3}
Cesium capsule drop	1.3×10^{-6}	5.1×10^{-10}	2.7×10^{-7}	1.3×10^{-10}	8.8×10^{-5}	4.4×10^{-8}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	2.7×10^{-12}	1.1×10^{-15}	6.3×10^{-13}	3.2×10^{-16}	1.4×10^{-10}	6.7×10^{-14}	0.05
Calciner feed spill	1.9×10^{-11}	7.5×10^{-15}	4.2×10^{-12}	2.1×10^{-15}	1.0×10^{-9}	5.0×10^{-13}	0.05
Calciner product spill	5.2×10^{-9}	2.1×10^{-12}	1.2×10^{-9}	5.9×10^{-13}	2.8×10^{-7}	1.4×10^{-10}	0.05
Cesium fire	4.2×10^{-7}	1.7×10^{-10}	8.7×10^{-8}	4.4×10^{-11}	2.9×10^{-5}	1.4×10^{-8}	1.0×10^{-6}
Process cell fire	5.7×10^{-8}	2.3×10^{-11}	1.3×10^{-8}	6.6×10^{-12}	2.8×10^{-6}	1.4×10^{-9}	1.0×10^{-6}
Nuclear criticality	0.46	1.9×10^{-4}	0.13	6.5×10^{-5}	5.7	2.8×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	3.7×10^{-8}	1.5×10^{-11}	8.5×10^{-9}	4.2×10^{-12}	2.0×10^{-6}	1.0×10^{-9}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

All values are mean values.

Calculated using the source terms in Tables M.5.3.6.1–3 and M.5.3.6.1–4 and the MACCS computer code.

Table M.5.3.6.2–5. Ceramic Immobilization Alternative Accident Impacts at Oak Ridge Reservation

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	1.8×10^{-6}	7.3×10^{-10}	3.2×10^{-7}	1.6×10^{-10}	2.8×10^{-4}	1.4×10^{-7}	1.0×10^{-5}
Glovebox fire	1.8×10^{-6}	7.3×10^{-10}	3.2×10^{-7}	1.6×10^{-10}	2.8×10^{-4}	1.4×10^{-7}	1.0×10^{-5}
Glovebox nuclear criticality	3.2×10^{-3}	1.3×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	0.13	6.3×10^{-5}	1.0×10^{-5}
Mixing tank nuclear criticality	0.032	1.3×10^{-5}	5.8×10^{-3}	2.9×10^{-6}	1.3	6.3×10^{-4}	1.0×10^{-5}
Bellows drop	1.4×10^{-9}	5.5×10^{-13}	2.4×10^{-10}	1.2×10^{-13}	2.3×10^{-7}	1.1×10^{-10}	1.0×10^{-3}
Cesium capsule drop	2.9×10^{-6}	1.2×10^{-9}	4.7×10^{-7}	2.4×10^{-10}	6.1×10^{-4}	3.1×10^{7}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	6.3×10^{-12}	2.5×10^{-15}	1.1×10^{-12}	5.5×10^{-16}	9.6×10^{-10}	4.8×10^{-13}	0.05
Calciner feed spill	4.3×10^{-11}	1.7×10^{-14}	7.4×10^{-12}	3.7×10^{-15}	7.1×10^{-9}	3.5×10^{-12}	0.05
Calciner product spill	1.2×10^{-8}	4.8×10^{-12}	2.1×10^{-9}	1.0×10^{-12}	2.0×10^{-6}	9.9×10^{-10}	0.05
Cesium fire	9.5×10^{-7}	3.8×10^{-10}	1.5×10^{-7}	7.7×10^{-11}	2.0×10^{-4}	9.9×10^{-8}	1.0×10^{-6}
Process cell fire	1.3×10^{-7}	5.3×10^{-11}	2.3×10^{-8}	1.2×10^{-11}	2.0×10^{-5}	1.0×10^{-8}	1.0×10^{-6}
Nuclear criticality	0.94	3.8×10^{-4}	0.17	8.6×10^{-5}	37.4	0.019	1.0×10^{-6}
Uncontrolled chemical reaction	8.6×10^{-8}	3.4×10^{-11}	1.5×10^{-8}	7.3×10^{-12}	0.14×10^{-5}	7.1×10^{-9}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [1,000 m for this facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.6.1–3 and M.5.3.6.1–4 and the MACCS computer code.

Table M.5.3.6.2–6. Ceramic Immobilization Alternative Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	1.3×10^{-6}	5.2×10^{-10}	2.6×10^{-8}	1.3×10^{-11}	1.2×10^{-4}	6.2×10^{-8}	1.0×10^{-5}
Glovebox fire	1.3×10^{-6}	5.2×10^{-10}	2.6×10^{-8}	1.3×10^{-11}	1.2×10^{-4}	6.2×10^{-8}	1.0×10^{-5}
Glovebox nuclear criticality	2.3×10^{-3}	9.1×10^{-7}	4.0×10^{-5}	2.0×10^{-8}	0.041	2.0×10^{-5}	1.0×10^{-5}
Mixing tank nuclear criticality	0.023	9.1×10^{-6}	4.0×10^{-4}	2.0×10^{-7}	0.41	2.0×10^{-4}	1.0×10^{-5}
Bellows drop	9.7×10^{-10}	3.9×10^{-13}	1.9×10^{-11}	9.3×10^{-15}	1.0×10^{-7}	5.1×10^{-11}	1.0×10^{-3}
Cesium capsule drop	2.1×10^{-6}	8.4×10^{-10}	3.8×10^{-8}	1.9×10^{-11}	2.9×10^{-4}	1.5×10^{-7}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	4.5×10^{-12}	1.8×10^{-15}	8.8×10^{-14}	4.4×10^{-17}	4.2×10^{-10}	2.1×10^{-13}	0.05
Calciner feed spill	3.0×10^{-11}	1.2×10^{-14}	5.9×10^{-13}	2.9×10^{-16}	3.2×10^{-9}	1.6×10^{-12}	0.05
Calciner product spill	8.5×10^{-9}	3.4×10^{-12}	1.6×10^{-10}	8.2×10^{-12}	9.0×10^{-7}	4.5×10^{-10}	0.05
Cesium fire	6.8×10^{-7}	2.7×10^{-10}	1.2×10^{-8}	6.1×10^{-12}	9.5×10^{-5}	4.7×10^{-8}	1.0×10^{-6}
Process cell fire	9.3×10^{-8}	3.7×10^{-11}	1.8×10^{-9}	9.1×10^{-13}	8.8×10^{-6}	4.4×10^{-9}	1.0×10^{-6}
Nuclear criticality	0.68	2.7×10^{-4}	0.012	6.0×10^{-6}	12.2	6.1×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	6.1×10^{-8}	2.4×10^{-11}	1.2×10^{-9}	5.9×10^{-13}	6.4×10^{-6}	3.2×10^{-9}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.6.1–3 and M.5.3.6.1–4 and the MACCS computer code.

M.5.3.7 Ceramic Immobilization Facility for Immobilized Disposition Alternative

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for a ceramic immobilization facility in the *Fissile Material Disposition Program PEIS Data Call Input Report: Ceramic Immobilization Facility Using Coated Pellets Without Radionuclides*. The studies postulated a set of accident scenarios that represented the risks and consequences for workers and the public that can be expected if the facility were constructed and operated. Although not all potential accidents were addressed, those that were postulated have consequences and risks that are expected to envelop the consequences and risks of an operating facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than $1.0x10^{-7}$ per year are anticipated that will have consequences and risks larger than those described in this section. The potential for an aircraft crash has been considered and dismissed because the probability of a crash into a facility and causing sufficient damage to release Pu is much less than 10^{-7}/yr.

M.5.3.7.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public operating the facility. Through a screening process, nine evaluation basis accidents and three beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.3.7.1–1 and M.5.3.7.1–2. Accident source term information is provided in Tables M.5.3.7.1–3 and M.5.3.7.1–4. Descriptions of accident scenarios are provided in Table M.5.3.7.1–5.

Table M.5.3.7.1–1. Evaluation Basis Accident Scenarios for Immobilized Disposition at the Ceramic Immobilization Facility

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Earthquake	$1.0x10^{-6}$ to $1.0x10^{-4}$	20 kg Pu	$2.0x10^{-5}$ g Pu
Tornado	$1.0x10^{-6}$ to $1.0x10^{-4}$	No Release	No Release
Flood	$1.0x10^{-6}$ to $1.0x10^{-4}$	No Release	No Release
Glovebox fire	$1.0x10^{-6}$ to $1.0x10^{-4}$	20 kg Pu	$2.0x10^{-5}$ g Pu
Glovebox nuclear criticality	$1.0x10^{-6}$ to $1.0x10^{-4}$	$1.0x10^{18}$ fissions. Release fractions: 1.0 noble gases, 0.25 halogens.	[a]
Calciner feed tank nuclear criticality	$1.0x10^{-6}$ to $1.0x10^{-4}$	$1.0x10^{19}$ fissions total, $1.0x10^{18}$ fissions initial, 47 pulses of $1.0x10^{17}$ fissions at 10 minute intervals. Release fractions: 1.0 noble gases, 0.25 halogens.	[a]
Ceramic can drop	$1.0x10^{-4}$ to 0.01	0.5 kg Pu	$5.0x10^{-10}$ g Pu
Pellet container breakage	$1.0x10^{-4}$ to 0.01	5 kg Pu	$5.0x10^{-12}$ g Pu
Dissolver spill	0.01 to 0.1	0.4 kg Pu	$2.4x10^{-11}$ g Pu
Calciner feed spill	0.01 to 0.1	1.4 kg Pu	$7.0x10^{-11}$ g Pu
Calciner product spill	0.01 to 0.1	2.5 kg Pu	$1.75x10^{-8}$ g Pu
Loss of offsite power	0.01 to 0.1	No Release	No Release

[a] See Table M.5.3.7.1–3.

Source: LLNL 1996e.

Table M.5.3.7.1–2. Beyond Evaluation Basis Accident Scenarios for Immobilized Disposition at the Ceramic Immobilization Facility

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Sintering furnace explosion	$<1.0 \times 10^{-6}$	3 kg Pu	3.0×10^{-4} g Pu
Uncontrolled chemical reaction	$<1.0 \times 10^{-6}$	14 kg Pu	1.4×10^{-5} g Pu
Pu storage nuclear criticality	$<1.0 \times 10^{-6}$	10^{18} fissions. Release fractions: 1.0 noble gases, 0.25 halogens.	[a]

[a] See Table M.5.3.7.1–4.

Source: LLNL 1996e.

Table M.5.3.7.1–3. Immobilized Disposition at the Ceramic Immobilization Facility Evaluation Basis Accident Source Terms

	Accident Scenario								
Accident Parameter	**Earthquake**	**Glovebox Fire**	**Glovebox Nuclear Criticality[a]**	**Calciner Feed Nuclear Criticality[a]**	**Ceramic Can Drop**	**Pellet Container Breakage**	**Plutonyl Nitrate Dissolver Spill**	**Calciner Feed Spill**	**Calciner Product Spill**
Frequency of occurrence (per year)[b]	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-3}	1.0×10^{-3}	0.05	0.05	0.05
Pu released to environment (g)	2.0×10^{-5}	2.0×10^{-5}	NA	NA	5.0×10^{-10}	5.0×10^{-12}	2.4×10^{-11}	7.0×10^{-11}	1.75×10^{-8}
Fissions	NA	NA	1.0×10^{18}	1.0×10^{19}	NA	NA	NA	NA	NA
Isotope released to environment (Ci)									
Pu-238	3.16×10^{-8}	3.16×10^{-8}	0	0	7.90×10^{-13}	7.90×10^{-15}	3.79×10^{-14}	1.11×10^{-13}	2.77×10^{-11}
Pu-239	1.14×10^{-6}	1.14×10^{-6}	0	0	2.86×10^{-11}	2.86×10^{-13}	1.37×10^{-12}	4.00×10^{-12}	1.00×10^{-9}
Pu-240	3.04×10^{-7}	3.04×10^{-7}	0	0	7.60×10^{-12}	7.60×10^{-14}	3.65×10^{-13}	1.06×10^{-12}	2.66×10^{-10}
Pu-241	1.08×10^{-6}	1.08×10^{-6}	0	0	2.69×10^{-11}	2.69×10^{-13}	1.20×10^{-12}	3.77×10^{-12}	9.43×10^{-10}
Pu-242	4.46×10^{-11}	4.46×10^{-11}	0	0	1.11×10^{-15}	1.16×10^{-17}	5.35×10^{-17}	1.56×10^{-16}	3.90×10^{-14}
Am-241	5.68×10^{-9}	5.68×10^{-9}	0	0	1.42×10^{-13}	1.42×10^{-15}	6.82×10^{-15}	1.99×10^{-14}	4.97×10^{-12}
Cs-137	0	0	0	0	0	0	0	0	0
Kr-83m	0	0	11	110	0	0	0	0	0
Kr-85m	0	0	7.1	71	0	0	0	0	0
Kr-85	0	0	8.1×10^{-5}	8.1×10^{-4}	0	0	0	0	0
Kr-87	0	0	43	430	0	0	0	0	0
Kr-88	0	0	23	230	0	0	0	0	0
Kr-89	0	0	1.3×10^{3}	1.3×10^{4}	0	0	0	0	0
Xe-131m	0	0	0.01	0.1	0	0	0	0	0
Xe-133m	0	0	0.22	2.2	0	0	0	0	0
Xe-133	0	0	2.7	27	0	0	0	0	0
Xe-135m	0	0	330	3.3×10^{3}	0	0	0	0	0
Xe-135	0	0	41	410	0	0	0	0	0

Table M.5.3.7.1–3. Immobilized Disposition at the Ceramic Immobilization Facility Evaluation Basis Accident Source Terms—Continued

Accident Parameter	Accident Scenario								
	Earthquake	Glovebox Fire	Glovebox Nuclear Criticality[a]	Calciner Feed Nuclear Criticality[a]	Ceramic Can Drop	Pellet Container Breakage	Plutonyl Nitrate Dissolver Spill	Calciner Feed Spill	Calciner Product Spill
Xe-137	0	0	4.9×10^{3}	4.9×10^{4}	0	0	0	0	0
Xe-138	0	0	1.1×10^{3}	1.1×10^{4}	0	0	0	0	0
I-131	0	0	0.28	2.75	0	0	0	0	0
I-132	0	0	30	300	0	0	0	0	0
I-133	0	0	4	40	0	0	0	0	0
I-134	0	0	108	1.08×10^{3}	0	0	0	0	0
I-135	0	0	11.3	113	0	0	0	0	0

[a] Curies produced (by isotope) for the 1.0×10^{18} and 1.0×10^{19} fission criticalities were scaled from Table M.5.3.1.1–3.

[b] Midpoint of the estimated frequency range.

Note: All values are mean values.

Source: Derived from Tables M.5.1.3.4–1, M.5.3.1.1–3, and M.5.3.7.1–1.

Table M.5.3.7.1–4. Immobilized Disposition at the Ceramic Immobilization Facility Beyond Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario		
	Sintering Furnace Explosion	Uncontrolled Chemical Reaction	Nuclear Criticality[a]
Frequency of occurrence (per year)[b]	1.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}
Pu released to environment (g)	3.0×10^{-4}	1.4×10^{-5}	NA
Fissions	NA	NA	1.0×10^{18}
Isotope Released to Environment (Ci)			
Pu-238	4.74×10^{-7}	2.21×10^{-8}	0
Pu-239	1.72×10^{-5}	8.01×10^{-7}	0
Pu-240	4.56×10^{-6}	2.13×10^{-7}	0
Pu-241	1.62×10^{-5}	7.55×10^{-7}	0
Pu-242	6.69×10^{-10}	3.12×10^{-11}	0
Am-241	8.52×10^{-8}	3.98×10^{-9}	0
Kr-83m	0	0	11
Kr-85m	0	0	7.1
Kr-85	0	0	8.1×10^{-5}
Kr-87	0	0	43
Kr-88	0	0	23
Kr-89	0	0	1.3×10^{3}
Xe-131m	0	0	0.01
Xe-133m	0	0	0.22
Xe-133	0	0	2.7
Xe-135m	0	0	330
Xe-135	0	0	41
Xe-137	0	0	4.9×10^{3}
Xe-138	0	0	1.1×10^{3}
I-131	0	0	0.28
I-132	0	0	30
I-133	0	0	4
I-134	0	0	108
I-135	0	0	11.3

[a] Curies produced (by isotope) for the 1.0×10^{18} fission criticality were scaled from Table M.5.3.1.1–3.

[b] Maximum of the estimated frequency range.

Note: All values are mean values.

Source: Derived from Tables M.5.1.3.4–1, M.5.3.1.1–3, and M.5.3.7.1–1.

Table M.5.3.7.1–5. Accident Scenario Descriptions for Immobilized Disposition at the Ceramic Immobilization Facility

Accident Scenario	Accident Description
Evaluation Basis Accidents	
Earthquake	It is assumed that the earthquake starts a fire in the room housing the plutonium metal glovebox line. The fire is unimpeded and breaches a glovebox containing plutonium. The glovebox inert atmosphere is lost and the Pu ignites. The ventilation system removes the Pu-containing gasses from the area. The gasses pass through HEPA filters and are then released to the environment.
Glovebox fire	It is assumed that an unimpeded fire begins in the room housing the Pu metal glovebox line and breaches a glovebox containing plutonium. The glovebox inert atmosphere is lost and the Pu ignites. The ventilation system removes the Pu-containing gases from the area. The gasses pass through HEPA filters and are then released to the environment.
Glovebox nuclear criticality	It is assumed that controls are violated so that additional fissile material is introduced into a double batched glovebox. This results in a criticality.
Calciner feed tank nuclear criticality	Criticality safety of this tank depends on controlling the concentrations of the gadolinium and plutonyl nitrate solutions in the tank. It is assumed that controls are violated so that limits on fissile materials and poison controls are violated. A pulsed criticality event results.
Ceramic can drop	A can is dropped during handling. The ceramic powder spills from the overturned can. Respirable fines of ceramic are released to the process area and collected by the ventilation system. The airborne fines pass through HEPA filters and are released to the environment.
Pellet container breakage	Finished ceramic pellets are loaded in drum containers and stored in the product storage vault. It is postulated that a container breakage could occur in ceramic pellet storage. A ceramic pellet container develops leakage during storage. Respirable fines of ceramic are released to the process area and collected by the ventilation system. The airborne fines pass through HEPA filters and are released to the environment.
Dissolver spill	It is postulated that the dissolver overflows and spills onto the floor. The spill spreads out in a safe geometry. The spill is cleaned up in 2 hours, but some of the spill material converts to an aerosol and becomes airborne as respirable particles. The Pu-containing particulate would be removed from the process area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.
Calciner feed spill	It is postulated that the calciner feed make-up tank overflows and spills onto the floor. The spill spreads out in a safe geometry. The spill is cleaned up in 2 hours, but some of the spill material converts to an aerosol and becomes airborne as respirable particles. The Pu-containing particulate would be removed from the process area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.
Calciner product spill	It is postulated that the calciner product bin overflows and spills powder onto the floor. The spill spreads out in a safe geometry. The spill is cleaned up in 2 hours, but some of the spill becomes airborne as respirable particles. The Pu-containing particulate would be removed from the process area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.

Table M.5.3.7.1–5. Accident Scenario Descriptions for Immobilized Disposition at the Ceramic Immobilization Facility—Continued

Accident Scenario	Accident Description
Beyond Evaluation Basis Accidents	
Sintering furnace explosion	A pressure excursion in the sintering furnace of undefined origin could rupture the furnace vessel. It was postulated that the force from the explosion would blow ceramic pellets out of the ends and become airborne as respirable particles. The Pu-containing particulate would be removed from the process area by the ventilation system. The particulate then passes through a HEPA filtration system before it is released to the environment.
Uncontrolled chemical reaction	Radiolytic hydrogen will be produced in the solutions in the facility. It was assumed that hydrogen accumulated within tanks because the tanks were isolated from the gas treatment system for a considerable period of time. It was postulated that hydrogen detonated in the calciner feed tank and some of it became airborne. The resultant airborne material is removed by the area ventilation system and passed through HEPA filters before release to the environment.
Nuclear criticality	A criticality event was assumed to occur in the facility and the assumed criticality accident severity is based on guidance provided in NRC Regulatory Guide 3.35.

Source: LLNL 1996e.

M.5.3.7.2 *Accident Impacts*

The estimated impacts of the postulated accidents at each site are provided in Tables M.5.3.7.2–1 through M.5.3.7.2–6. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4, using the MACCS computer code. [Text deleted.]

Table M.5.3.7.2–1. Immobilized Disposition at the Ceramic Immobilization Facility Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	5.7×10^{-6}	2.3×10^{-9}	4.5×10^{-8}	2.3×10^{-11}	3.3×10^{-4}	1.6×10^{-7}	1.0×10^{-5}
Glovebox fire	5.7×10^{-6}	2.3×10^{-9}	4.5×10^{-8}	2.3×10^{-11}	3.3×10^{-4}	1.6×10^{-7}	1.0×10^{-5}
Glovebox nuclear criticality	3.5×10^{-3}	1.4×10^{-6}	2.3×10^{-5}	1.2×10^{-8}	0.032	1.6×10^{-5}	1.0×10^{-5}
Calciner feed nuclear criticality	0.035	1.4×10^{-5}	2.3×10^{-4}	1.2×10^{-7}	0.32	1.6×10^{-4}	1.0×10^{-5}
Ceramic can drop	1.4×10^{-10}	5.7×10^{-14}	1.1×10^{-12}	5.7×10^{-16}	8.2×10^{-9}	4.1×10^{-12}	1.0×10^{-3}
Pellet container drop	1.4×10^{-12}	5.7×10^{-16}	1.1×10^{-14}	5.7×10^{-18}	8.2×10^{-11}	4.1×10^{-14}	1.0×10^{-3}
Dissolver spill	6.8×10^{-12}	2.7×10^{-15}	5.4×10^{-14}	2.7×10^{-17}	4.0×10^{-10}	2.0×10^{-13}	0.05
Calciner feed spill	2.0×10^{-11}	7.9×10^{-15}	1.6×10^{-13}	7.9×10^{-17}	1.2×10^{-9}	5.8×10^{-13}	0.05
Calciner product spill	5.0×10^{-9}	2.0×10^{-12}	4.0×10^{-11}	2.0×10^{-14}	2.9×10^{-7}	1.4×10^{-10}	0.05
Sintering furnace explosion	8.5×10^{-5}	3.4×10^{-8}	6.8×10^{-7}	3.4×10^{-10}	5.0×10^{-3}	2.5×10^{-6}	1.0×10^{-6}
Uncontrolled chemical reaction	4.0×10^{-6}	1.6×10^{-9}	3.2×10^{-8}	1.6×10^{-11}	2.3×10^{-4}	1.2×10^{-7}	1.0×10^{-6}
Nuclear criticality	3.5×10^{-3}	1.4×10^{-6}	2.3×10^{-5}	1.2×10^{-8}	0.032	1.6×10^{-5}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table M.5.3.7.2–2. Immobilized Disposition at the Ceramic Immobilization Facility Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	3.9×10^{-6}	1.6×10^{-9}	7.2×10^{-8}	3.6×10^{-11}	7.4×10^{-6}	3.7×10^{-9}	1.0×10^{-5}
Glovebox fire	3.9×10^{-6}	1.6×10^{-9}	7.2×10^{-8}	3.6×10^{-11}	7.4×10^{-6}	3.7×10^{-9}	1.0×10^{-5}
Glovebox nuclear criticality	2.5×10^{-3}	1.0×10^{-6}	4.5×10^{-5}	2.3×10^{-8}	6.5×10^{-4}	3.3×10^{-7}	1.0×10^{-5}
Calciner feed nuclear criticality	0.025	1.0×10^{-5}	4.5×10^{-4}	2.3×10^{-7}	6.5×10^{-3}	3.3×10^{-6}	1.0×10^{-5}
Ceramic can drop	9.7×10^{-11}	3.9×10^{-14}	1.8×10^{-12}	9.0×10^{-16}	1.9×10^{-10}	9.3×10^{-14}	1.0×10^{-3}
Pellet container drop	9.7×10^{-13}	3.9×10^{-16}	1.8×10^{-14}	9.0×10^{-18}	1.9×10^{-12}	9.3×10^{-16}	1.0×10^{-3}
Dissolver spill	4.7×10^{-12}	1.9×10^{-15}	8.6×10^{-14}	4.3×10^{-17}	8.9×10^{-12}	4.5×10^{-15}	0.05
Calciner feed spill	1.4×10^{-11}	5.4×10^{-15}	2.5×10^{-13}	1.3×10^{-16}	2.6×10^{-11}	1.3×10^{-14}	0.05
Calciner product spill	3.4×10^{-9}	1.4×10^{-12}	6.3×10^{-11}	3.1×10^{-14}	6.5×10^{-9}	3.3×10^{-12}	0.05
Sintering furnace explosion	5.8×10^{-5}	2.3×10^{-8}	1.1×10^{-6}	5.4×10^{-10}	1.1×10^{-4}	5.6×10^{-8}	1.0×10^{-6}
Uncontrolled chemical reaction	2.7×10^{-6}	1.1×10^{-9}	5.0×10^{-8}	2.5×10^{-11}	5.2×10^{-6}	2.6×10^{-9}	1.0×10^{-6}
Nuclear criticality	2.5×10^{-3}	1.0×10^{-6}	4.5×10^{-5}	2.3×10^{-8}	6.5×10^{-4}	3.3×10^{-7}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table M.5.3.7.2–3. Immobilized Disposition at the Ceramic Immobilization Facility Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	5.3×10^{-6}	2.1×10^{-9}	4.6×10^{-8}	2.3×10^{-5}	9.9×10^{-5}	4.9×10^{-8}	1.0×10^{-5}
Glovebox fire	5.3×10^{-6}	2.1×10^{-9}	4.6×10^{-8}	2.3×10^{-5}	9.9×10^{-5}	4.9×10^{-8}	1.0×10^{-5}
Glovebox nuclear criticality	3.4×10^{-3}	1.4×10^{-6}	2.7×10^{-5}	2.4×10^{-8}	8.7×10^{-3}	4.3×10^{-6}	1.0×10^{-5}
Calciner feed nuclear criticality	0.034	1.4×10^{-5}	2.7×10^{-4}	1.3×10^{-7}	0.086	4.3×10^{-5}	1.0×10^{-5}
Ceramic can drop	1.3×10^{-10}	5.3×10^{-14}	1.1×10^{-12}	5.7×10^{-16}	2.5×10^{-9}	1.2×10^{-12}	1.0×10^{-3}
Pellet container drop	1.3×10^{-12}	5.3×10^{-16}	1.1×10^{-14}	5.7×10^{-18}	2.5×10^{-11}	1.2×10^{-14}	1.0×10^{-3}
Dissolver spill	6.4×10^{-12}	2.5×10^{-15}	5.5×10^{-14}	2.8×10^{-17}	1.2×10^{-10}	5.9×10^{-14}	0.05
Calciner feed spill	1.9×10^{-11}	7.4×10^{-15}	1.6×10^{-13}	8.0×10^{-17}	3.5×10^{-10}	1.7×10^{-13}	0.05
Calciner product spill	4.6×10^{-9}	1.9×10^{-12}	4.0×10^{-11}	2.0×10^{-14}	8.6×10^{-8}	4.3×10^{-11}	0.05
Sintering furnace explosion	8.0×10^{-5}	3.2×10^{-8}	6.9×10^{-7}	3.4×10^{-10}	1.5×10^{-3}	7.4×10^{-7}	1.0×10^{-6}
Uncontrolled chemical reaction	3.7×10^{-6}	1.5×10^{-9}	3.2×10^{-8}	1.6×10^{-11}	6.9×10^{-5}	3.5×10^{-8}	1.0×10^{-6}
Nuclear criticality	3.4×10^{-3}	1.4×10^{-6}	2.7×10^{-5}	1.3×10^{-8}	8.7×10^{-3}	4.3×10^{-6}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table M.5.3.7.2–4. Immobilized Disposition at the Ceramic Immobilization Facility Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	2.3×10^{-6}	9.1×10^{-10}	5.3×10^{-7}	2.6×10^{-10}	1.1×10^{-4}	5.6×10^{-8}	1.0×10^{-5}
Glovebox fire	2.3×10^{-6}	9.1×10^{-10}	5.3×10^{-7}	2.6×10^{-10}	1.1×10^{-4}	5.6×10^{-8}	1.0×10^{-5}
Glovebox nuclear criticality	1.5×10^{-3}	6.2×10^{-7}	4.4×10^{-4}	2.2×10^{-7}	0.019	9.5×10^{-6}	1.0×10^{-5}
Calciner feed nuclear criticality	0.015	6.2×10^{-6}	4.4×10^{-3}	2.2×10^{-6}	0.19	9.5×10^{-5}	1.0×10^{-5}
Ceramic can drop	5.7×10^{-11}	2.3×10^{-14}	1.3×10^{-11}	6.6×10^{-15}	2.8×10^{-9}	1.4×10^{-12}	1.0×10^{-3}
Pellet container drop	5.7×10^{-13}	2.3×10^{-16}	1.3×10^{-13}	6.6×10^{-17}	2.8×10^{-11}	1.4×10^{-14}	1.0×10^{-3}
Dissolver spill	2.7×10^{-12}	1.1×10^{-15}	6.3×10^{-13}	3.2×10^{-16}	1.4×10^{-10}	6.7×10^{-14}	0.05
Calciner feed spill	8.0×10^{-12}	3.2×10^{-15}	1.8×10^{-12}	9.2×10^{-16}	3.9×10^{-10}	2.0×10^{-13}	0.05
Calciner product spill	2.0×10^{-9}	8.0×10^{-13}	4.6×10^{-10}	2.3×10^{-13}	9.8×10^{-8}	4.9×10^{-11}	0.05
Sintering furnace explosion	3.4×10^{-5}	1.4×10^{-8}	8.0×10^{-6}	4.0×10^{-9}	1.7×10^{-3}	8.5×10^{-7}	1.0×10^{-6}
Uncontrolled chemical reaction	1.6×10^{-6}	6.4×10^{-10}	3.7×10^{-7}	1.9×10^{-10}	7.9×10^{-5}	3.9×10^{-8}	1.0×10^{-6}
Nuclear criticality	1.5×10^{-3}	6.2×10^{-7}	4.4×10^{-4}	2.2×10^{-7}	0.019	9.5×10^{-6}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table M.5.3.7.2–5. Immobilized Disposition at the Ceramic Immobilization Facility Accident Impacts at Oak Ridge Reservation

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	5.2×10^{-6}	2.1×10^{-9}	9.2×10^{-7}	4.6×10^{-10}	8.0×10^{-4}	4.0×10^{-7}	1.0×10^{-5}
Glovebox fire	5.2×10^{-6}	2.1×10^{-9}	9.2×10^{-7}	4.6×10^{-10}	8.0×10^{-4}	4.0×10^{-7}	1.0×10^{-5}
Glovebox nuclear criticality	3.2×10^{-3}	1.3×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	0.13	6.3×10^{-5}	1.0×10^{-5}
Calciner feed nuclear criticality	0.032	1.3×10^{-5}	5.8×10^{-3}	2.9×10^{-6}	1.3	6.3×10^{-4}	1.0×10^{-5}
Ceramic can drop	1.3×10^{-10}	5.3×10^{-14}	2.3×10^{-11}	1.2×10^{-14}	2.0×10^{-8}	1.0×10^{-11}	1.0×10^{-3}
Pellet container drop	1.3×10^{-12}	5.3×10^{-16}	2.3×10^{-13}	1.2×10^{-16}	2.0×10^{-10}	1.0×10^{-13}	1.0×10^{-3}
Dissolver spill	6.3×10^{-12}	2.5×10^{-15}	1.1×10^{-12}	5.5×10^{-16}	9.6×10^{-10}	4.8×10^{-13}	0.05
Calciner feed spill	1.8×10^{-11}	7.3×10^{-15}	3.2×10^{-12}	1.6×10^{-15}	2.8×10^{-9}	1.4×10^{-12}	0.05
Calciner product spill	4.6×10^{-9}	1.8×10^{-12}	8.1×10^{-10}	4.0×10^{-13}	7.0×10^{-7}	3.5×10^{-10}	0.05
Sintering furnace explosion	7.9×10^{-5}	3.2×10^{-8}	1.4×10^{-5}	6.9×10^{-9}	0.012	6.0×10^{-6}	1.0×10^{-6}
Uncontrolled chemical reaction	3.7×10^{-6}	1.5×10^{-9}	6.5×10^{-7}	3.2×10^{-10}	5.6×10^{-4}	2.8×10^{-7}	1.0×10^{-6}
Nuclear criticality	3.2×10^{-3}	1.3×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	0.13	6.3×10^{-5}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary (1,000 m for this facility at ORR), whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table M.5.3.7.2–6. Immobilized Disposition at the Ceramic Immobilization Facility Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Earthquake	3.7×10^{-6}	1.5×10^{-9}	7.3×10^{-8}	3.6×10^{-11}	3.5×10^{-4}	1.8×10^{-7}	1.0×10^{-5}
Glovebox fire	3.7×10^{-6}	1.5×10^{-9}	7.3×10^{-8}	3.6×10^{-11}	3.5×10^{-4}	1.8×10^{-7}	1.0×10^{-5}
Glovebox nuclear criticality	2.3×10^{-3}	9.1×10^{-7}	4.0×10^{-5}	2.0×10^{-8}	0.041	2.0×10^{-5}	1.0×10^{-5}
Calciner feed nuclear criticality	0.023	9.1×10^{-6}	4.0×10^{-4}	2.0×10^{-7}	0.41	2.0×10^{-4}	1.0×10^{-5}
Ceramic can drop	9.3×10^{-11}	3.7×10^{-14}	1.8×10^{-12}	9.1×10^{-16}	8.8×10^{-9}	4.4×10^{-12}	1.0×10^{-3}
Pellet container drop	9.3×10^{-13}	3.7×10^{-16}	1.8×10^{-14}	9.1×10^{-18}	8.8×10^{-11}	4.4×10^{-14}	1.0×10^{-3}
Dissolver spill	4.5×10^{-12}	1.8×10^{-15}	8.8×10^{-14}	4.4×10^{-17}	4.2×10^{-10}	2.1×10^{-13}	0.05
Calciner feed spill	1.3×10^{-11}	5.2×10^{-15}	2.6×10^{-13}	1.3×10^{-16}	1.2×10^{-9}	6.2×10^{-13}	0.05
Calciner product spill	3.3×10^{-9}	1.3×10^{-12}	6.4×10^{-11}	3.2×10^{-14}	3.1×10^{-7}	1.6×10^{-10}	0.05
Sintering furnace explosion	5.6×10^{-5}	2.2×10^{-8}	1.1×10^{-6}	5.5×10^{-10}	5.3×10^{-3}	2.7×10^{-6}	1.0×10^{-6}
Uncontrolled chemical reaction	2.6×10^{-6}	1.0×10^{-9}	5.1×10^{-8}	2.6×10^{-11}	2.5×10^{-4}	1.2×10^{-7}	1.0×10^{-6}
Nuclear criticality	2.3×10^{-3}	9.1×10^{-7}	4.0×10^{-5}	2.0×10^{-8}	0.041	2.0×10^{-5}	1.0×10^{-6}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

M.5.3.8 Evolutionary Light Water Reactor

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for an evolutionary LWR in the *Evolutionary/Advanced Light Water Reactor Data Report*. The studies postulated a set of accident scenarios that were representative of the risks and consequences for workers and the public that can be expected if the facility were constructed and operated. The advanced boiling reactor studies were selected as representative studies for the evolutionary LWRs.

M.5.3.8.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents from operating the facility were identified as candidates to represent the risks to workers and the public. Through a screening process, four evaluation basis accidents and two beyond evaluation basis accidents were selected for further definition and analysis. Supporting information for these accidents has been documented in *Assessment of Radioactive Releases to the Environment Due to the Incorporation of Tritium Targets into an Advanced Light Water Reactor to Produce Tritium*, October 1995.

Evaluation Basis Accidents

Failure of Small Primary Coolant Line Outside of Containment

This accident postulated the rupture of an instrument line outside the drywell but inside the reactor building. It is not possible to isolate the leak. The flow from the instrument line is limited by a 0.64-centimeter (0.25-inch) diameter flow-restricting orifice inside the drywell. The total integrated mass of fluid released into the reactor building is 5,442 kg (12,000 pounds [lb]), with approximately 2,270 kg (5,000 lb) flashed into steam. The accident sequence is terminated by the orderly shutdown and depressurization of the reactor. Table M.5.3.8.1–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence. It is expected that the postulated annual frequency of occurrence would range from 0.01/yr to 1.0×10^{-4}/yr. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be 1.0×10^{-3}/yr.

Steam System Piping Break Outside Containment

This accident postulated a large steam line break outside of containment downstream of the outermost isolation valve. The plant is designed to immediately detect the break and initiate isolation of the broken line. Table M.5.3.8.1–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence. It is expected that the postulated annual frequency of occurrence would range from 1.0×10^{-4}/yr to 1.0×10^{-6}/yr. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be 1.0×10^{-5}/yr.

Cleanup Water Line Break Outside Containment

This accident postulated a large cleanup water line break outside of containment. The analysis assumed that the non-filtered inventory in both the regenerative and non-regenerative heat exchangers is released through the break. The leak is automatically isolated approximately 75 seconds after the break. Table M.5.3.8.1–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence. It is expected that the postulated annual frequency of occurrence would range from 1.0×10^{-4}/yr to 1.0×10^{-6}/yr. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be 1.0×10^{-5}/yr.

Table M.5.3.8.1–1. Advanced Boiling Water Reactor Evaluation Basis Accident Source Terms

	Accident Scenario			
Accident Parameter	**Failure of Small Primary Coolant Line Outside Containment**	**Steam System Piping Break Outside Containment**	**Cleanup Water Line Break Outside Containment**	**Fuel Handling**
Frequency of occurrence[a]	1.0×10^{-3}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}
Isotope Released to Environment (Ci)				
I-131	4.2	43	2.4	130
I-132	34	410	5.5	160
I-133	25	260	5.9	120
I-134	49	720	8.3	6.0×10^{-6}
I-135	36	390	6.8	21
Xe-131m	0	2.9×10^{-4}	0	84
Xe-133m	0	5.5×10^{-3}	0	1.1×10^{3}
Xe-133	0	0.14	0	2.7×10^{4}
Xe-135m	0	0.47	0	220
Xe-135	0	1.3	0	1.9×10^{4}
Xe-137	0	2.0	0	2.1×10^{-10}
Xe-138	0	1.5	0	4.3×10^{-10}
Xe-139	0	0.70	0	0
Kr-83m	0	0.040	0	3.8
Kr-85m	0	0.078	0	55
Kr-85	0	1.9×10^{-4}	0	250
Kr-87	0	0.24	0	7.1×10^{-3}
Kr-88	0	0.23	0	14
Kr-89	0	1.6	0	8.1×10^{-11}
Kr-90	0	0.42	0	0

[a] Midpoint of the estimated frequency range.

Source: GE nda.

Fuel Handling Accident

This accident postulated a spent fuel assembly dropped into the reactor core. The analysis assumed that some rods in the dropped assembly and in the struck assembly fail. Table M.5.3.8.1–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence. It is expected that the postulated annual frequency of occurrence would range from 1.0×10^{-4}/yr to 1.0×10^{-6}/yr. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be 1.0×10^{-5}/yr.

Beyond Evaluation Basis Accidents

Chapter 19 of the *Advanced Boiling Water Reactor Standard Safety Analysis Report* evaluated beyond design basis accidents that were initiated by either internal events (for example, a sequence of equipment failures) or external events (for example, severe natural phenomena such as beyond design basis earthquakes). The evaluation of external event-initiated accidents did not present accident frequency data, release fractions, or source term data that could be used to analyze the accident consequences and risks for this class of accident in this document.

Numerous internal event-initiated accidents were evaluated in Chapter 19 of the Advanced Boiling Water Reactor (BWR) Standard SAR. The accidents that had a common source term were grouped together and evaluated as a single accident, and a single total annual frequency of occurrence was defined for the group. Release fractions and the annual frequency of occurrence were defined for two accidents. The annual frequency of occurrence for the ten accidents in Chapter 19 of the Advanced BWR Standard SAR ranged from 7.0×10^{-8}/yr to less than 1.0×10^{-10}/yr. Two of the ten accidents had an annual frequency of occurrence greater than 1.0×10^{-8}/yr. These two accidents were selected for evaluation.

Anticipated Transient Without Scram and Loss of Core Cooling

The postulated accident is an anticipated transient without scram with the loss of core cooling. Due to the loss of core cooling, core damage results, the vessel fails in approximately 1 hour, and the containment fails in approximately 19 hours. The source term is presented in Table M.5.3.8.1–2. The annual frequency of occurrence for this accident is1.3×10^{-7}/yr.

Large Break Loss of Coolant Accident and Loss of Core Cooling

The postulated accident is represented by a source term that is common for a group of accidents. The group of accidents includes the following:

- Loss of all core cooling, vessel failure at high pressure, firewater addition system switched to drywell spray mode, containment overpressure protection system rupture disk ruptures, and release negligible—less than 0.1 percent volatile fission products.
- Loss of all core cooling, vessel failure at high pressure, passive flooder and drywell spray available, containment overpressure protection system rupture disk ruptures, and release negligible—less than 0.1 percent volatile fission products.
- Large break loss of coolant accident, loss of all core cooling, firewater addition system switched to drywell spray mode, containment overpressure protection system rupture disk ruptures, and release negligible—less than 0.1 percent volatile fission products.
- Station blackout with reactor core isolation cooling operating for 8 hours, offsite power restored at 8 hours, firewater addition system switched to drywell spray mode, containment overpressure protection system rupture disk ruptures, and release negligible—less than 0.1 percent volatile fission products.
- Loss of all core cooling, vessel failure at low pressure, passive flooder available, containment overpressure protection system rupture disk ruptures, and release negligible—less than 0.1 percent volatile fission products.
- Loss of all core cooling, vessel failure at low pressure, firewater addition system switched to drywell spray mode, containment overpressure protection system rupture disk ruptures, and release negligible—less than 0.1 percent volatile fission products.

The source term is presented in Table M.5.3.8.1–2. The annual frequency of occurrence for the group of accidents is 2.1×10^{-8}/yr.

Table M.5.3.8.1–2. Advanced Boiling Water Reactor Beyond Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario	
	Anticipated Transient Without Scram and Loss of Core Cooling	Large Break Loss of Coolant Accident and Loss of Core Cooling[a]
Frequency of occurrence[b]	1.3×10^{-7}	2.1×10^{-8}
Isotope Released to Environment (Ci)		
Kr-85	2.3×10^{6}	5.2×10^{5}
Kr-85m	1.0×10^{6}	2.3×10^{7}
Kr-87	1.7×10^{6}	3.9×10^{7}
Kr-88	2.3×10^{6}	5.2×10^{7}
Rb-86	0.53	0.30
I-131	2.6×10^{3}	18
I-132	3.8×10^{3}	25
I-133	4.8×10^{3}	31
I-134	5.3×10^{3}	35
I-135	4.7×10^{3}	31
Xe-133	9.1×10^{6}	2.1×10^{8}
Xe-135	6.7×10^{6}	1.5×10^{8}
Cs-134	200	110
Cs-136	150	86
Cs-137	210	120

[a] Representative accident description for a group of accidents with the same source term.

[b] Total frequency for a group of accidents with same source term.

Source: Source term derived from accident release fractions (GE nda) and core inventory (TTI 1995b).

M.5.3.8.2 *Accident Impacts*

The estimated impacts of the postulated accidents at each site are provided in Tables M.5.3.8.2–1 through M.5.3.8.2–6. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 using the MACCS computer code. [Text deleted.]

Table M.5.3.8.2–1. Evolutionary Light Water Reactor Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (person-rem)	Number of Latent Cancer/Prompt Fatalities[b]	Accident Frequency (per year)
Failure of small primary coolant line outside containment	5.6×10^{-3}	2.2×10^{-6}/ 0	5.6×10^{-4}	2.8×10^{-7}/ 0	0.10	5.2×10^{-5}/ 0	1.0×10^{-3}
Scram system piping break outside containment	0.061	2.5×10^{-5}/ 0	6.2×10^{-3}	3.1×10^{-6}/ 0	1.11	5.5×10^{-4}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	1.7×10^{-3}	6.7×10^{-7}/ 0	1.7×10^{-4}	8.4×10^{-8}/ 0	0.036	1.8×10^{-5}/ 0	1.0×10^{-5}
Fuel handling	0.071	2.8×10^{-5}/ 0	8.6×10^{-3}	4.3×10^{-6}/ 0	2.0	1.0×10^{-3}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	40.4	0.021/ 0	5.4	2.7×10^{-3}/ 0	1,650	0.82/ 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	422	0.089/ 0.40	85.6	0.08/ 9.7×10^{-3}	11,700	5.9/ 0	2.1×10^{-8}
[Text deleted.]							

[a] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

Table M.5.3.8.2–2. Evolutionary Light Water Reactor Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (person-rem)	Number of Latent Cancer/Prompt Fatalities[b]	Accident Frequency (per year)
Failure of small primary coolant line outside containment	3.9×10^{-3}	1.5×10^{-6}/ 0	8.3×10^{-5}	4.1×10^{-8} 0	3.2×10^{-3}	1.6×10^{-6}/ 0	1.0×10^{-3}
Scram system piping break outside containment	0.043	1.7×10^{-5}/ 0	9.0×10^{-4}	4.5×10^{-7}/ 0	0.033	1.7×10^{-5}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	1.2×10^{-3}	4.7×10^{-7}/ 0	2.5×10^{-5}	1.2×10^{-8}/ 0	1.1×10^{-3}	5.6×10^{-7}/ 0	1.0×10^{-5}
Fuel handling	0.048	1.9×10^{-5}/ 0	1.5×10^{-3}	7.6×10^{-7}/ 0	0.051	2.6×10^{-5}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	27	0.014/ 0	1.0	5.0×10^{-4}/ 0	50.9	0.026/ 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	279	0.087/ 0.25	17.8	0.15/ 2.4×10^{-4}	118	0.059/ 0	2.1×10^{-8}
[Text deleted.]							

[a] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

Table M.5.3.8.2–3. Evolutionary Light Water Reactor Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (person-rem)	Number of Latent Cancer/ Prompt Fatalities[b]	Accident Frequency (per year)
Failure of small primary coolant line outside containment	5.5×10^{-3}	2.2×10^{-6}/ 0	5.0×10^{-5}	2.5×10^{-8}/ 0	0.043	2.2×10^{-5}/ 0	1.0×10^{-3}
Scram system piping break outside containment	0.061	2.4×10^{-5}/ 0	5.4×10^{-4}	2.7×10^{-7}/ 0	0.45	2.3×10^{-4}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	1.6×10^{-3}	6.6×10^{-7}/ 0	1.5×10^{-5}	7.6×10^{-9}/ 0	0.015	7.6×10^{-6}/ 0	1.0×10^{-5}
Fuel handling	0.068	2.7×10^{-5}/ 0	1.0×10^{-3}	5.1×10^{-7}/ 0	0.65	3.3×10^{-4}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	36.3	0.020/ 0	0.66	3.3×10^{-4}/ 0	689	0.35/ 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	385	0.071/ 0.36	12.4	0.010/ 0	1,150	0.57/ 0	2.1×10^{-8}
[Text deleted.]							

[a] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

Table M.5.3.8.2–4. Evolutionary Light Water Reactor Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (person-rem)	Number of Latent Cancer/Prompt Fatalities[b]	Accident Frequency (per year)
Failure of small primary coolant line outside containment	2.2×10^{-3}	8.8×10^{-7}/ 0	1.6×10^{-3}	7.9×10^{-7}/ 0	0.063	3.2×10^{-5}/ 0	1.0×10^{-3}
Scram system piping break outside containment	0.024	9.7×10^{-6}/ 0	0.017	8.7×10^{-6}/ 0	0.68	3.4×10^{-4}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	6.5×10^{-4}	2.6×10^{-7}/ 0	4.7×10^{-4}	2.3×10^{-7}/ 0	0.021	1.1×10^{-5}/ 0	1.0×10^{-5}
Fuel handling	0.027	1.1×10^{-5}/ 0	0.020	9.9×10^{-6}/ 0	0.97	4.9×10^{-4}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	16.4	7.2×10^{-3}/ 0	12.0	6.5×10^{-3}/ 0	813	0.41/ 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	162	0.095/ 0.080	129	0.10/ 0.047	4,660	2.3/ 0	2.1×10^{-8}
[Text deleted.]							

[a] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

Table M.5.3.8.2–5. Evolutionary Light Water Reactor Accident Impacts at Oak Ridge Reservation

	Worker at 665 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (person-rem)	Number of Latent Cancer/Prompt Fatalities[b]	Accident Frequency (per year)
Failure of small primary coolant line outside containment	6.9×10^{-3}	2.8×10^{-6}/ 0	6.9×10^{-3}	3.5×10^{-6}/ 0	0.43	2.2×10^{-4}/ 0	1.0×10^{-3}
Scram system piping break outside containment	0.076	3.0×10^{-5}/ 0	0.076	3.8×10^{-5}/ 0	4.6	2.3×10^{-3}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	2.1×10^{-3}	8.3×10^{-7}/ 0	2.1×10^{-3}	1.0×10^{-6}/ 0	0.15	7.4×10^{-5}/ 0	1.0×10^{-5}
Fuel handling	0.085	3.4×10^{-5}/ 0	0.085	4.3×10^{-5}/ 0	7.8	3.9×10^{-3}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	50.6	0.028/ 0	50.6	0.035/ 0	6,250	3.1/ 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	474	0.058/ 0.56	474	0.072/ 0.56	45,100	22.2/ 0	2.1×10^{-8}
[Text deleted.]							

[a] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [665 m for this facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

Table M.5.3.8.2–6. Evolutionary Light Water Reactor Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (rem)	Probability of Latent Cancer/ Prompt Fatality[a]	Dose (person-rem)	Number of Latent Cancer/Prompt Fatalities[b]	Accident Frequency (per year)
Failure of small primary coolant line outside containment	3.5×10^{-3}	1.4×10^{-6}/ 0	4.2×10^{-5}	2.1×10^{-8}/ 0	0.15	7.5×10^{-5}/ 0	1.0×10^{-3}
Scram system piping break outside containment	0.039	1.6×10^{-5}/ 0	4.5×10^{-4}	2.3×10^{-7}/ 0	1.6	7.9×10^{-4}/ 0	1.0×10^{-5}
Cleanup water line break outside containment	1.1×10^{-3}	4.2×10^{-7}/ 0	1.3×10^{-5}	6.3×10^{-9}/ 0	0.053	2.6×10^{-5}/ 0	1.0×10^{-5}
Fuel handling	0.045	1.8×10^{-5}/ 0	7.7×10^{-4}	3.9×10^{-7}/ 0	2.5	1.3×10^{-3}/ 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	27.2	0.013/ 0	0.52	2.6×10^{-4}/ 0	2,260	1.1/ 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	279	0.095/ 0.21	8.4	4.9×10^{-3}/ 0	8,640	4.3/ 0	2.1×10^{-8}
[Text deleted.]							

[a] Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

M.5.3.9 Plutonium Conversion

Studies of evaluation basis accidents and beyond evaluation basis accidents have been performed for a Pu conversion facility in the *Data Report for Plutonium Conversion Facility*. The studies postulated a set of accident scenarios that were representative of the risks and consequences for workers and the public that can be expected in the facility were constructed and operated. Although not all potential accidents were addressed, those that were postulated have consequences and risks that are expected to envelop the consequences and risks of an operating facility. In this manner, no other credible accidents with an expected frequency of occurrence larger than $1.0x10^{-7}$ per year are anticipated that will have consequences and risks larger than those described in this section.

M.5.3.9.1 *Accident Scenarios and Source Terms*

A wide range of hazardous conditions and potential accidents were identified as candidates to represent the risks to workers and the public of operating the facility. Through a screening process, four evaluation basis accidents and four beyond evaluation basis accidents were selected for further definition and analysis. Descriptive information on these accidents is provided in Tables M.5.3.9.1–1 and M.5.3.9.1–2. Accidents source term information is provided in Tables M.5.3.9.1–3 through M.5.3.9.1–5. Descriptions of accident scenarios are provided in Table M.5.3.9.1–6.

Table M.5.3.9.1–1. Evaluation Basis Accident Scenarios for the Plutonium Conversion Facility

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Fire on the loading dock	$1.0x10^{-4}$ to $1.0x10^{-3}$	18 g Pu	0.8 g Pu
Fire in a process cell	$1.0x10^{-5}$ to $1.0x10^{-3}$	24 g Pu	$4.8x10^{-6}$ g Pu
Deflagration inside a glovebox	$1.0x10^{-5}$ to $1.0x10^{-3}$	10 kg Pu	$1.0x10^{-3}$ g Pu
Forklift breach of containment	$4.5x10^{-5}$	4 kg PuO_2	$1.7x10^{-9}$ g Pu

Source: LANL 1996c.

Table M.5.3.9.1–2. Beyond Evaluation Basis Accident Scenarios for the Plutonium Conversion Facility

Accident Scenario	Accident Frequency (per year)	Source Term at Risk	Source Term Released to Environment
Nuclear criticality	$<1.0x10^{-7}$	$5.0x10^{17}$ fissions; gaseous by-products released	[a]
Beyond design basis fire in a process cell	$<1.0x10^{-7}$	24 g Pu	0.034 g Pu
Oxyacetylene explosion in a process cell	$<1.0x10^{-7}$	10 kg Pu	50 g Pu
Beyond evaluation basis earthquake	$<1.0x10^{-7}$	10 kg Pu	25 g Pu

[a] See Table M.5.3.9.1–3.

Source: LANL 1996c.

Table M.5.3.9.1–3. Plutonium Conversion Facility Criticality Source Terms

Nuclide	Produced (Ci)	Released (Ci)
Kr-83m	5.5	2.75
Kr-85m	3.55	1.75
Kr-85	4.05×10^{-4}	2.0×10^{-4}
Kr-87	21.5	11
Kr-88	11.5	6
Kr-89	650	325
Xe-131m	5.0×10^{-3}	2.5×10^{-3}
Xe-133m	0.11	0.05
Xe-133	1.35	0.75
Xe-135m	165	85
Xe-135	20.5	10
Xe-137	2,450	1,225
Xe-138	550	275
I-131	0.55	0.025
I-132	60	3
I-133	8	0.4
I-134	215	11
I-135	22.5	1.0

Source: LANL 1996c.

Table M.5.3.9.1–4. Plutonium Conversion Facility Evaluation Basis Source Terms

Accident Parameter	Accident Scenario: Fire on Loading Dock	Fire in Process Cell	Deflagration Inside a Glovebox	Forklift Breach of Containment
Frequency of occurrence (per year)	5.0×10^{-4}[a]	1.0×10^{-4}[a]	1.0×10^{-4}[a]	4.5×10^{-5}
Pu released to environment (g)	0.8	4.8×10^{-6}	1.0×10^{-3}	1.7×10^{-9}
Isotope Released to Environment (Ci)				
Pu-238	2.9×10^{-3}	1.74×10^{-8}	3.62×10^{-6}	6.15×10^{-12}
Pu-239	0.0448	2.69×10^{-7}	5.60×10^{-5}	9.57×10^{-11}
Pu-240	0.0147	8.83×10^{-8}	1.84×10^{-5}	3.13×10^{-11}
Pu-241	0.0606	3.63×10^{-7}	7.57×10^{-5}	1.29×10^{-10}
Pu-242	4.75×10^{-6}	2.85×10^{-11}	5.94×10^{-9}	1.01×10^{-14}
Am-241	3.19×10^{-4}	1.92×10^{-9}	3.99×10^{-7}	6.78×10^{-13}

[a] Midpoint of the estimated frequency range.

Source: Derived from Table M.5.1.3.4–3 and M.5.3.9.1–1.

Table M.5.3.9.1–5. Plutonium Conversion Facility Beyond Evaluation Basis Accident Source Terms

Accident Parameter	Accident Scenario			
	Nuclear Criticality	Beyond Evaluation Basis Fire in Process Cell	Oxyacetylene Explosion in Process Cell	Beyond Design Basis Earthquake
Frequency of occurrence (per year)	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}
Pu released to environment (g)	NA	0.034	50	25
Fissions	5.0×10^{17}	NA	NA	NA
Isotope Released to Environment (Ci)				
Pu-238	0	1.23×10^{-4}	0.181	0.0905
Pu-239	0	1.90×10^{-3}	2.80	1.40
Pu-240	0	6.26×10^{-4}	0.920	0.460
Pu-241	0	2.57×10^{-3}	3.79	1.89
Pu-242	0	2.02×10^{-7}	2.97×10^{-4}	1.49×10^{-4}
Am-241	0	1.36×10^{-5}	0.02	9.98×10^{-3}
Kr-83m	2.75	0	0	0
Kr-85m	1.75	0	0	0
Kr-85	2.0×10^{-4}	0	0	0
Kr-87	11	0	0	0
Kr-88	6	0	0	0
Kr-89	325	0	0	0
Xe-131m	2.5×10^{-3}	0	0	0
Xe-133m	0.05	0	0	0
Xe-133	0.75	0	0	0
Xe-135m	85	0	0	0
Xe-135	10	0	0	0
Xe-137	1,225	0	0	0
Xe-138	275	0	0	0
I-131	0.025	0	0	0
I-132	3	0	0	0
I-133	0.4	0	0	0
I-134	11	0	0	0
I-135	1.0	0	0	0

Note: NA=not applicable.

Source: Derived from Tables M.5.1.3.4–3, M.5.3.9.1–2, and M.5.3.9.1–3.

Table M.5.3.9.1–6. Accident Scenario Descriptions for the Plutonium Conversion Facility

Accident Scenario	Accident Description
Evaluation Basis Accidents	
Fire on the loading dock	The fire is caused by welding, cleaning solvents, electrical shorts, or other miscellaneous causes. The scenario assumes an open garage door and that a single drum of combustible waste is involved in the fire.
Fire in the process cell	It is assumed that a process cell contains a glovebox used for final processing of Pu oxide powder. The gloves, stowed outside the glovebox, are coated with a layer of Pu dust. A flammable cleaning liquid such as acetone or isopropyl alcohol is brought into the process cell in violation of operating procedures, spills and ignites. The initial extent and intensity of the fire are sufficient to completely incinerate the gloves. The sprinkler system activates and protects the glovebox from further damage. The ventilation system with HEPA filters continues to function throughout the accident.
Deflagration inside a glovebox	The bounding evaluation basis explosion is a deflagration of a flammable gas mixture inside a glovebox. It is assumed that through some unforeseen set of failures, a combustible gas mixture accumulates inside a glovebox and is ignited, possibly by an electrical spark from an operating electrical device. The deflagration blows out the HEPA filter from the glovebox ventilation system exit. Gloves may also be blown out. The room volumes are sufficient to attenuate the pressure wave to levels below that needed to damage the building ventilation system HEPA filters.
Forklift breach of containment	The most catastrophic case of leak or spill or nuclear material would result from a forklift or other large vehicle running over a package or nuclear material, breaching the containment, and causing an airborne release to the room. Three-stage HEPA filtration is available for the facility exhaust to limit the release to the environment.
Beyond Evaluation Basis Accidents	
Nuclear criticality	There will not be sufficient quantities of Pu solutions at the facility to cause a criticality accident. The most likely cause of a criticality event involving Pu oxides would be improper stacking or handling of bulk nuclear material. Multiple operational errors in the material spacing, packing density, manner and type of containment, and maximum quantities of fissile materials permitted in the area would be required for the postulated criticality accident to occur.
Beyond evaluation basis fire in a process cell	A typical fire with coincident failures of two or more major safety systems constitutes a beyond evaluation basis fire. The evaluation postulated the fire in a process cell, discussed above, with the sprinkler system and ventilation system with HEPA filtration inoperative during the accident.
Oxyacetylene explosion in a process cell	The evaluation postulated the explosion of a welding rig oxyacetylene bottle in a process cell. The explosion is sufficient to blow out the HEPA filters and cause significant damage to the ventilation system and nearby equipment.
Beyond evaluation basis earthquake	The following assumptions were used in the evaluation: (1) the earthquake disables the ventilation system; (2) there is significant structural damage to the building but it does not totally collapse; (3) a ceiling slab falls on the glovebox; (4) the process cell with the most material at risk is located on an outside wall; (5) the outside wall cracks; and (6) the wind is blowing and the cracks are located in the lee side of the building.

Source: LANL 1996c.

M.5.3.9.2 *Accident Impacts*

The estimated impacts of the postulated accidents at each site are provided in the Tables M.5.3.9.2–1 through M.5.3.9.2–6. The dose and cancer fatality estimates are based on the analysis of the accident source terms in Tables M.5.3.9.1–4 and M.5.3.9.1–5 using the MACCS computer code. [Text deleted.].

Table M.5.3.9.2–1. Plutonium Conversion Facility Accident Consequences at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Fire on the loading dock	0.24	9.7×10^{-5}	7.7×10^{-3}	3.8×10^{-6}	14.0	7.0×10^{-3}	5.0×10^{-4}
Fire in a process cell	1.4×10^{-6}	5.8×10^{-10}	4.6×10^{-8}	2.3×10^{-11}	8.4×10^{-5}	4.2×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	3.0×10^{-4}	1.2×10^{-7}	9.6×10^{-6}	4.8×10^{-9}	0.018	8.7×10^{6}	1.0×10^{-4}
Forklift breach of containment	5.1×10^{-10}	2.0×10^{-13}	1.6×10^{-11}	8.2×10^{-15}	3.0×10^{-8}	1.5×10^{-11}	4.5×10^{-5}
Nuclear criticality	5.2×10^{-4}	2.1×10^{-7}	1.7×10^{-5}	8.4×10^{-9}	3.4×10^{-3}	1.7×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	0.010	4.1×10^{-6}	3.3×10^{-4}	1.6×10^{-7}	0.59	3.0×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	15.0	6.8×10^{-3}	0.48	2.4×10^{-4}	873	0.44	1.0×10^{-7}
Beyond evaluation basis earthquake	7.5	3.1×10^{-3}	0.24	1.2×10^{-4}	436	0.22	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

Table M.5.3.9.2–2. Plutonium Conversion Facility Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Fire on the loading dock	0.16	6.6×10^{-5}	3.0×10^{-3}	1.5×10^{-6}	0.32	1.6×10^{-4}	5.0×10^{-4}
Fire in a process cell	9.9×10^{-7}	4.0×10^{-10}	1.8×10^{-8}	9.1×10^{-12}	1.9×10^{-6}	9.5×10^{-10}	1.0×10^{-4}
Deflagration inside a glovebox	2.1×10^{-4}	8.2×10^{-8}	3.8×10^{-6}	1.9×10^{-9}	4.0×10^{-4}	2.0×10^{-7}	1.0×10^{-4}
Forklift breach of containment	3.5×10^{-10}	1.4×10^{-13}	6.4×10^{-12}	3.2×10^{-15}	6.7×10^{-10}	3.4×10^{-13}	4.5×10^{-5}
Nuclear criticality	3.9×10^{-4}	1.5×10^{-7}	6.5×10^{-6}	3.2×10^{-9}	6.6×10^{-5}	3.3×10^{-8}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	7.0×10^{-3}	2.8×10^{-6}	1.3×10^{-4}	6.4×10^{-8}	0.013	6.7×10^{-6}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	10.3	4.5×10^{-3}	0.19	9.4×10^{-5}	19.8	9.9×10^{-3}	1.0×10^{-7}
Beyond evaluation basis earthquake	5.1	2.1×10^{-3}	0.094	4.7×10^{-5}	9.9	4.9×10^{-3}	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

Table M.5.3.9.2–3. Plutonium Conversion Facility Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Fire on the loading dock	0.22	9.0×10^{-5}	1.9×10^{-3}	9.7×10^{-7}	4.2	2.1×10^{-3}	5.0×10^{-4}
Fire in a process cell	1.3×10^{-6}	5.4×10^{-10}	1.2×10^{-8}	5.8×10^{-12}	2.5×10^{-5}	1.3×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	2.8×10^{-4}	1.1×10^{-7}	2.4×10^{-6}	1.2×10^{-9}	5.2×10^{-3}	2.6×10^{-6}	1.0×10^{-4}
Forklift breach of containment	4.8×10^{-10}	1.9×10^{-13}	4.1×10^{-12}	2.1×10^{-15}	8.9×10^{-9}	4.5×10^{-12}	4.5×10^{-5}
Nuclear criticality	5.0×10^{-4}	2.0×10^{-7}	3.9×10^{-6}	1.9×10^{-9}	8.5×10^{-4}	4.3×10^{-7}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	9.5×10^{-3}	3.8×10^{-6}	8.3×10^{-5}	4.1×10^{-8}	0.18	8.9×10^{-5}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	14.1	6.9×10^{-3}	0.12	6.1×10^{-5}	262	0.13	1.0×10^{-7}
Beyond evaluation basis earthquake	7.0	2.8×10^{-3}	0.061	3.0×10^{-5}	131	0.065	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

Table M.5.3.9.2–4. Plutonium Conversion Facility Accident Impacts at Pantex Plant

Accident Scenario	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per year)
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	
Fire on the loading dock	0.097	3.9×10^{-5}	0.031	1.5×10^{-5}	4.8	2.4×10^{-3}	5.0×10^{-4}
Fire in a process cell	5.8×10^{-7}	2.3×10^{-10}	1.9×10^{-7}	9.3×10^{-11}	2.8×10^{-5}	1.4×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	1.2×10^{-4}	4.8×10^{-8}	3.9×10^{-5}	1.9×10^{-8}	5.9×10^{-3}	3.0×10^{-6}	1.4×10^{-8}
Forklift breach of containment	2.1×10^{-10}	8.2×10^{-14}	6.6×10^{-11}	3.3×10^{-14}	1.0×10^{-8}	5.1×10^{-12}	4.5×10^{-5}
Nuclear criticality	2.4×10^{-4}	9.7×10^{-8}	9.3×10^{-5}	4.6×10^{-8}	2.3×10^{-3}	1.1×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	4.1×10^{-3}	1.6×10^{-6}	1.3×10^{-3}	6.6×10^{-7}	0.20	1.0×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	6.1	2.5×10^{-3}	1.9	9.7×10^{-4}	297	0.15	1.0×10^{-7}
Beyond evaluation basis earthquake	3.0	1.2×10^{-3}	0.97	4.8×10^{-4}	149	0.074	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

Table M.5.3.9.2–5. Plutonium Conversion Facility Accident Impacts at Oak Ridge Reservation

Accident Scenario	Worker at 772 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per year)
	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability of Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	
Fire on the loading dock	0.28	1.1×10^{-4}	0.28	1.4×10^{-4}	52.3	0.026	5.0×10^{-4}
Fire in a process cell	1.7×10^{-6}	6.8×10^{-10}	1.7×10^{-6}	8.4×10^{-10}	3.1×10^{-4}	1.6×10^{-7}	1.0×10^{-4}
Deflagration inside a glovebox	3.5×10^{-4}	1.4×10^{-7}	3.5×10^{-4}	1.8×10^{-7}	0.065	3.3×10^{-5}	1.0×10^{-4}
Forklift breach of containment	6.0×10^{-10}	2.4×10^{-13}	6.0×10^{-10}	3.0×10^{-13}	1.1×10^{-7}	5.6×10^{-11}	4.5×10^{-5}
Nuclear criticality	5.9×10^{-4}	2.4×10^{-7}	5.9×10^{-4}	3.0×10^{-7}	0.035	1.8×10^{-5}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	0.012	4.8×10^{-6}	0.012	6.0×10^{-6}	2.2	1.1×10^{-3}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	17.6	7.9×10^{-3}	17.6	9.8×10^{-3}	3,270	1.63	1.0×10^{-7}
Beyond evaluation basis earthquake	8.8	3.5×10^{-3}	8.8	4.4×10^{-3}	1,630	0.82	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary (772 m for this facility at ORR), whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

Table M.5.3.9.2–6. Plutonium Conversion Facility Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Scenario	Dose (rem)	Probability of Cancer Fatality[a]	Dose (rem)	Probability Cancer Fatality[a]	Dose (person-rem)	Number of Cancer Fatalities[b]	Accident Frequency (per year)
Fire on the loading dock	0.16	6.3×10^{-5}	3.1×10^{-3}	1.5×10^{-6}	15.0	7.5×10^{-3}	5.0×10^{-4}
Fire in a process cell	9.4×10^{-7}	3.8×10^{-10}	1.9×10^{-8}	9.3×10^{-10}	9.0×10^{-5}	4.5×10^{-8}	1.0×10^{-4}
Deflagration inside a glovebox	2.0×10^{-4}	7.9×10^{-6}	3.9×10^{-6}	1.9×10^{-9}	0.019	9.4×10^{-6}	1.0×10^{-4}
Forklift breach of containment	3.3×10^{-10}	1.3×10^{-13}	6.6×10^{-12}	3.3×10^{-15}	3.2×10^{-8}	1.6×10^{-11}	4.5×10^{-5}
Nuclear criticality	3.5×10^{-4}	1.4×10^{-7}	5.7×10^{-6}	2.8×10^{-9}	4.6×10^{-3}	2.3×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	6.7×10^{-3}	2.7×10^{-6}	1.3×10^{-4}	6.6×10^{-8}	0.64	3.2×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	9.9	4.4×10^{-3}	0.19	9.7×10^{-5}	936	0.47	1.0×10^{-7}
Beyond evaluation basis earthquake	4.9	2.1×10^{-3}	0.097	4.8×10^{-5}	468	0.23	1.0×10^{-7}
[Text deleted.]							

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.9.1–4 and M.5.3.9.1–5 and the MACCS computer code.

M.5.3.10 Existing Commercial and Partially Completed Light Water Reactors

The use of MOX in place of Uranium Dioxide (UO_2) fuel in existing commercial and partially completed LWRs is an alternative being considered for the disposition of surplus Pu. The risks and consequences of potential accidents for commercial LWRs that use UO_2 fuel have been studied in detail and documented in reports submitted by nuclear plant owners to the NRC. These reports do not address the potential accident impacts associated with the use of MOX fuels.

The risks associated with existing commercial LWRs has been studied by the operating organizations in accordance with NRC guidance. The safety of these reactors has been analyzed and reported by plant operators in such documents as SARs and probabilistic risk assessments. In addition, the NRC has conducted probabilistic risk assessments on five existing reactors and issued the report *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants* (NUREG-1150). According to this report, the estimated mean core damage frequencies would range from 4.0×10^{-6} to 3.4×10^{-4} caused by internal events (not including natural phenomena). Should such core damage occur, the potential consequences would range from 71 to 1,022 latent cancer fatalities for the offsite population according to this NRC report. The estimated risks to the offsite population from these accidents would range from 9.6×10^{-4} to 2.4×10^{-2}.

Reactor safety issues regarding the use of MOX fuel in existing LWRs are addressed in a recent report by the National Academy of Science (NAS). The report indicates that the potential influences on the safety of the use of MOX fuel in LWRs has been extensively studied in the United States in the 1970s. These influences on safety have also been extensively studied in Europe, Japan, and Russia. Regarding effects of MOX fuel on accident probabilities, the report states,"... no important overall adverse impact of MOX fuel use on the accident probabilities of the LWRs involved will occur; if there are adequate reactivity and thermal margins in the fuel, as licensing review should ensure, the main remaining determinants of accident probabilities that will involve factors not related to fuel composition and hence unaffected by the use of MOX fuel rather than LEU fuel" (NAS 1995a:352). Regarding the effects of MOX fuel on accident consequences, the report states, "... it seems unlikely that the switch from uranium-based fuel could worsen the consequences of a postulated (and very improbable) severe accident in an LWR by more than 10 to 20 percent. The influence on the consequence of less severe accidents, which probably dominate the spectrum value of population exposure per reactor-year of operation would be even smaller, because less severe accidents are unlikely to mobilize any significant quantity of plutonium at all" (NAS 1995a:355).

Analysis described has been performed using the MACCS code to determine the effects of the use of MOX fuel in an existing LWR. The assumed accident conditions include a large population distribution near the existing LWR and meteorology conditions for dispersal leading to large doses, and would not necessarily be reflective of actual site conditions. A sample of severe accident scenarios is illustrated in Table M.5.3.10–1. The data shown are derived from a range of severe accidents that make up the release scenarios. Some accidents have frequencies much less than 1×10^{-8} and large releases. These low frequency/high release accidents were included to reflect severe accident conditions leading to core damage and release of radioactive materials in order to obtain an estimate on the effects of using MOX fuel versus uranium fuel, as indicated by the ratios. To perform a comparison of existing commercial LWR impacts with other disposition alternatives, reactor accidents with frequencies less than 1×10^{-7}/yr would need to be done with site-specific meteorology, receptor, and population data.

Impacts are calculated in units of probability of cancer fatality for the MEI and the worker and the number of cancer fatalities for the offsite population. The fatality data shown does not reflect site conditions and would differ if site-specific meteorology and population were used. The ratios of accident fatalities for MOX and UO_2 fueled LWRs are given in Table M.5.3.10–2 only for the purpose of showing the relative impacts because the ratios would not be affected by meteorological or population data. Each scenario is based on releases taken from an existing commercial LWR probabilistic risk assessment of severe accidents. The releases were modeled using the MACCS code based on a large population distribution near a generic LWR and meteorological

Table M.5.3.10–1. Accident Impacts for Existing Light Water Reactor With Mixed Oxide Fuels

Accident Release Scenario[a]	Accident Scenario Frequency[b] (per year)	Worker at 1,000 m			Maximum Offsite Individual			Population Within 80 km		
		Probability of Latent Cancer Fatality	Risk of Latent Cancer Fatality (per year)	Risk of Latent Cancer Fatality per 17 yr (per 11 yr)	Probability of Latent Cancer Fatality	Risk of Latent Cancer Fatality (per year)	Risk of Latent Cancer Fatality per 17 yr (per 11 yr)	Number of Latent Cancer Fatalities	Risk of Latent Cancer Fatalities (per year)	Risk of Latent Cancer Fatalities[c] per 17 yr (per 11 yr)
Steam generator tube rupture	1.5×10^{-6}	1.0	1.5×10^{-6}	2.6×10^{-5} (1.7×10^{-5})	1.0	1.5×10^{-6}	2.6×10^{-5} (1.7×10^{-5})	5.9×10^{3}	0.0089	0.15 (0.098)
Large late containment failure-high RCS pressure	8.1×10^{-6}	0.79	6.4×10^{-6}	1.1×10^{-4} (7.2×10^{-5})	0.86	7.0×10^{-6}	1.2×10^{-4} (7.8×10^{-5})	1.3×10^{2}	0.0011	0.018 (0.012)
Large early containment failure-medium/low RCS pressure	7.0×10^{-7}	1.0	7.0×10^{-7}	1.2×10^{-5} (7.8×10^{-6})	1.0	7.0×10^{-7}	1.2×10^{-5} (7.8×10^{-6})	2.3×10^{3}	0.0016	0.027 (0.018)
Large early containment failure-high RCS pressure	8.7×10^{-7}	1.0	8.7×10^{-7}	1.5×10^{-5} (9.8×10^{-6})	1.0	8.7×10^{-7}	1.5×10^{-5} (9.8×10^{-6})	1.6×10^{3}	0.0014	0.024 (0.016)

Table M.5.3.10–1. Accident Impacts for Existing Light Water Reactor With Mixed Oxide Fuels—Continued

Accident Release Scenario[a]	Accident Scenario Frequency[b] (per year)	Worker at 1,000 m: Probability of Latent Cancer Fatality	Worker at 1,000 m: Risk of Latent Cancer Fatality (per year)	Worker at 1,000 m: Risk of Latent Cancer Fatality per 17 yr (per 11 yr)	Maximum Offsite Individual: Probability of Latent Cancer Fatality	Maximum Offsite Individual: Risk of Latent Cancer Fatality (per year)	Maximum Offsite Individual: Risk of Latent Cancer Fatality per 17 yr (per 11 yr)	Population Within 80 km: Number of Latent Cancer Fatalities	Population Within 80 km: Risk of Latent Cancer Fatalities (per year)	Population Within 80 km: Risk of Latent Cancer Fatalities[c] per 17 yr (per 11 yr)
Interfacing system loss of cooling accident	1.3×10^{-7}	1.0	1.3×10^{-7}	2.2×10^{-6} (1.4×10^{-6})	1.0	1.3×10^{-7}	2.2×10^{-6} (4.8×10^{-6})	7.3×10^{3}	0.00095	0.016 (0.010)
Small early containment failure	2.4×10^{-6}	1.0	2.4×10^{-6}	4.1×10^{-5} (2.7×10^{-5})	1.0	2.4×10^{-6}	4.1×10^{-5} (2.7×10^{-5})	1.2×10^{3}	0.0029	0.049 (0.032)

[a] Each release scenario is based on existing commercial LWR probabilistic risk assessment of severe accidents. The release scenarios were modeled using the MACCS code based on large population distribution near a generic site and meteorological conditions leading to large doses. The meteorological data used to estimate the fatalities are not for reactor sites, and therefore, the fatality data shown are not relevant to nor indicative of fatalities that would be calculated if site-specific meteorological and population data were used in the model.

[b] A release scenario typically will contain many accident sequences that have a common outcome (for example steam generator tube rupture). Each accident sequence has a frequency of occurrence that is derived from an event tree analysis and will include sequences with frequencies that are below those used in typical EISs.

[c] The population risk of latent cancer fatality, when compared with similar risk from the use of LEU reactor fuel, yields correct latent cancer fatality ratios of MOX-fuel relative to LEU-fuel. The accident conditions include a large population distribution near the existing LWR and meteorology conditions for dispersal leading to large doses and would not necessarily be reflective of actual site conditions. Further site-specific NEPA and safety documentation would be completed if the existing LWR alternative is selected.

Note: RCS=Reactor Coolant System. For the Preferred Alternative, for analysis purposes, approximately 70 percent of the Pu was assumed to be used for MOX fuel. The impacts projected for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced to those for an 11-year campaign; all values are mean values.

Source: HNUS 1996a.

Table M.5.3.10–2. Ratio of Accident Impacts for Mixed Oxide Fueled and Uranium Fueled Reactors for Typical Severe Accidents (Mixed Oxide Impacts/Uranium Impacts)[a]

Accident Release Scenarios[b]	Worker at 1,000 m	Maximum Offsite Individual	Population Within 80 km
Steam generator tube rupture	0.94	0.94	0.94
Large late containment failure-high RCS pressure	1.08	1.07	1.08
Large early containment failure-medium/ low RCS pressure	0.93	0.93	0.93
Large early containment failure-high RCS pressure	0.97	0.96	0.97
Interfacing system loss of cooling accident	0.93	0.92	0.93
Small early containment failure	0.96	0.95	0.96

[a] The ratio of accident fatalities for MOX-and UO_2-fueled LWRs are shown for the purposes of showing relative impacts. For example, 0.94 indicates that the impacts of the accident would be lower for a reactor with MOX fuel.

[b] Each release scenario is based on existing commercial LWR probabilistic risk assessment of severe accidents. The release scenarios were modeled using the MACCS code based on estimated population distribution near a generic site and meteorological conditions for dispersal leading to large doses. Therefore, the fatality data shown are not relevant to nor indicative of fatalities that would be calculated if site-specific meteorological and population data were used in the model.

Note: RCS=Reactor Coolant System.

Source: HNUS 1996a.

conditions for dispersal leading to large doses and would not necessarily be reflective of actual site conditions. Further site-specific NEPA and safety reviews would be performed should the Existing LWR Alternative be selected at the ROD.

The MACCS calculations for typical LWR reactors using a MOX core have shown that, for some risk measures, there is a reduction in risk. This must result from lower releases of some fission products, all else being equal. The main reasons for such lower releases are the following:

- The different spectrum of fission products resulting from Pu-239 fissions as compared to those from fissions of U-235.
- The lower flux level in a reactor with an increased loading of Pu-239 in place of U-235, both at the same power level.

The first effect will alter the amounts produced of individual radionuclides. The lower flux level will alter both the level at which saturating fission products will equilibrate and the rates of change of fission products with medium cross-sections.

Additional effects can result from different neutron flux spectrum shapes in MOX-fueled reactors, the effects of Pu-241 fission in MOX cores, and the change in U-238 fast fissions, as well as several other phenomena, but these are all of less importance.

Examination of typical core inventory isotopic ratios for MOX compared to UO_2 cores, reveals that the ratios are less than one for some risk-important radionuclides. In particular, these are the krypton, strontium, and tritium isotopes, and also cesium-134, iodine-134 and iodine-135. While there are others that are reduced, they all are not readily released to the environment (very small "release fraction") in a severe accident so that the change is not significant.

A series of sensitivity calculations has been performed to illustrate the effects of the changes is the isotopic core inventory ratios. These have been carried out using the MACCS code for one particular Pressurized Water Reactor reactor using as a basis the severe accident releases quoted in the Individual Plant Evaluation PRA submittal document to the NRC. Six risk calculations were performed: the base case (UO_2) for the Individual Plan and Evaluation submittal case, a MOX case using the isotopic factors, and four sensitivity cases in which some of the isotopic ratio factors were arbitrarily set to 1.0, while the remaining ratios were as for the MOX case. The sensitivity cases run were the following:

- Cs-134 ratio increased to 1.0 (from 0.65)
- All krypton (Kr) isotopes increased to 1.0 (from 0.57-0.62)
- All strontium (Sr) and yttrium (Y) isotopes increased to 1.0 (from 0.5-0.78)
- Iodine, I-134, and I-135 increased to 1.0 (from 0.96 and 0.92)

The results of these cases are shown in Table M.5.3.10–3. The column headed MOX is the percentage change in the risk factors in going to a MOX core from a UO_2 core.The columns headed Cs, Kr, Sr/Y, I-134/135 are the sensitivity cases listed immediately above, with the changes shown as percentage differences from the MOX case.

Table M.5.3.10–3. Accident Impact Sensitivity Analysis for Light Water Reactors Using Mixed Oxide Fuels

Risk Factor	MOX[a]	Cs -134[b]	Kr[b]	Sr/Y[b]	I-134/135[b]
Latent Cancer Fatalities to Regional Population					
Within 10 miles	-8%	11%	0%	0%	0%
Within 50 miles	4%	0%	0%	0%	0%
Within 500 miles	-6%	8%	0%	0%	0%
Population Dose					
Within 10 miles	-6%	9%	0%	0%	0%
Within 50 miles	4%	-1%	0%	0%	0%
Within 500 miles	-5%	8%	0%	0%	0%
Prompt Cancer Fatalities to Regional Population					
Within 10 miles	2%	1%	0%	0%	0%
Within 50 miles	2%	1%	0%	0%	0%
Within 500 miles	2%	1%	0%	0%	0%

[a] Values are the percent change in health impacts due to replacing UO_2 core with MOX core.

[b] Values are the percent change in health impacts due to changing the isotopes as described in the text.

Source: HNUS 1996a.

The MOX and Cs columns taken together show that the reduction in the latent fatalities and population exposures can be explained by the reduction in the amount of Cs-134 in the MOX core. For example, the MOX core substitution results in a 6-percent reduction (from the UO_2 base) in latent fatalities out to 800 km (500 mi). Arbitrarily increasing the Cs-134 core inventory back up to the UO_2 level results in an 8-percent increase in this risk factor (from the MOX base) back to the magnitude of the UO_2 case.

The other isotopes do not appear to have a significant effect. The strontium and tritium fission products have a very low release fraction in all of the accidents for this reactor. The two iodine isotopes would be expected to have the same effect as the cesium but do not appear to be significant as the relative change in isotopic ratio is small. The negative early fatality effect of the cesium, iodine and krypton isotope decreases appear to be outweighed by all the other fission products whose inventories are larger in the MOX core (relative to the UO_2 core).

It is not immediately obvious why, relative to the UO_2 case, the MOX latent fatalities decrease within both the 16-km (10-mi) and the 800-km (500-mi) radius but increase within the 80-km (50-mi) radius. These do appear to track with the cesium. It is postulated that this effect is due to the varying temporal relationships of the decay, the meteorology, the population distributions, the different paths, and other factors that have differing relative dose importances with distance and time.

These results are quantitatively applicable only to a typical set of accidents and environmental conditions. They should be qualitatively indicative for other reactor situations that are not too dissimilar.

M.5.3.11 Contribution of Americium, Curium, and Plutonium to Reactor Accident Consequences

The analysis of potential accidents and risks for an LWR that uses MOX fuel was performed using the MACCS computer program and the library of isotopes that was included with the program. The isotopes in the library are considered important contributors to accident risk and consequences by the program developers at Sandia National Laboratory. In addition to the analysis of potential reactor accident impacts discussed in this appendix, a study using the MACCS program has also been performed to provide information on the contribution to accident risks and consequences of radioisotopes associated with MOX fuel: (1) Americium (Am-241); (2) Curium (Cm-242 and Cm-244), and (3) Pu (Pu-238, Pu-239, Pu-240, and Pu-241). The study was based on several potential severe accidents for three operating commercial reactors. Using the MACCS program, the ratio of dose due only to Americium, Curium, and Pu to the total dose due to all isotopes in the MACCS library were estimated and are shown in Table M.5.3.11–1. The results indicate that the contribution of Americium, Curium, and Pu to accident risks and consequences in a MOX fueled LWR very low, less than 1 percent to 2 percent of the total. The only exception to this is the "large late containment failure high reactor coolant system" accident for which the contribution of Americium, Curium, and Pu is 10 percent of total.

Table M.5.3.11–1. Ratio of Accident Dose for Americium, Curium, and Plutonium in a Mixed Oxide Fuel Reactor to Total Dose for Uranium Fueled Reactor (Americium+Curium+Plutonium Dose/Total Dose)

	Offsite Population	Maximum Exposed Individual
Accident Release Category		
Steam generator tube rupture	1.7×10^{-4}	2.4×10^{-4}
Large late containment failure	1.0×10^{-1}	9.7×10^{-2}
Large early containment failure—low to medium RCS pressure	1.3×10^{-3}	1.8×10^{-3}
Large early containment failure—high RCS pressure	1.6×10^{-2}	2.1×10^{-2}
Interfacing system loss of cooling accident	2.1×10^{-3}	3.1×10^{-3}
Small early containment failure	1.4×10^{-2}	1.5×10^{-2}

Note: RCS=Reactor Coolant System.
Source: HNUS 1996a.

Appendix N
Multipurpose Reactor

A multipurpose reactor is a reactor that can produce tritium, use plutonium (Pu)-based fuel, and/or offset operating costs through revenues generated from the sale of electricity. In the past, Congress and commercial parties, including reactor vendors, have expressed interest in developing a multipurpose reactor that could both meet the nations tritium supply requirements and accommodate the disposition of surplus Pu. In the National Defense Authorization Act for Fiscal Year 1996, Congress directed that the Department of Energy (DOE) include a cost-benefit analysis in the *Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement* (Storage and Disposition PEIS) of the multipurpose reactor using the Advanced Light Water Reactor (ALWR) and Modular Helium Reactor (MHR) technologies. DOE has also received comments on the Storage and Disposition PEIS concerning certain types of multipurpose reactors including the Fast Flux Test Facility (FFTF) at Hanford Site (Hanford), which would actually be a dual purpose reactor than a multipurpose reactor as characterized above.

The purpose of this appendix is to provide information on the costs and benefits of carrying out two separate projects for the performance of the tritium production and Pu disposition missions, versus the costs and benefits of carrying out one multipurpose project for both missions. Information in the appendix is not a proposal for action by the Department, nor is it an analysis of the multi-purpose reactor technology that would allow it to be selected in the Storage and Disposition PEIS Record of Decision (ROD). This information is presented in the interest of more fully informing the decision-maker and the public regarding discussions about the potential utility of multi-purpose reactors for overlapping or simultaneous Departmental missions. The cost-effectiveness of using FFTF is not known, beyond the common-sense proposition that using an existing facility could be an advantage. Furthermore, neither the multipurpose reactor nor the FFTF in a dual-purpose mode has been proposed or subjected an independent system analysis by the Department.

N.1 BACKGROUND

An evaluation of multipurpose reactors was performed as part of DOE's *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (TSR PEIS) (DOE/EIS-0161, October 1995). This evaluation was a part of the TSR PEIS because the multipurpose reactor could potentially offer the capability of producing tritium at a reduced cost compared to other tritium production options through the sharing of costs with the Pu disposition mission. The TSR PEIS evaluated the potential environmental impacts for multipurpose reactors for ALWR, Modular High Temperature Gas-Cooled Reactor (MHTGR), and existing commercial light water reactor (LWR) designs. Although the TSR PEIS also mentioned a MHR, an emerging design variation of the MHTGR, no detailed analyses of the MHR as a reasonable option for the tritium production mission were included.

All of these reactor types normally utilize uranium as fuel. Uranium fuel could continue to be used if one of these technologies were selected for tritium production; however, an all Pu fuel or a mixed oxide (MOX) fuel of Pu and uranium could also be used for a tritium production reactor. Both the LWR and gas cooled reactor technologies have been used for electrical power production but not for tritium production. While the technology exists in other countries for operating LWRs with MOX fuel, the gas cooled reactor has no MOX fuel operating experience.

The Department's TSR Record of Decision (ROD) was to pursue a dual track for tritium supply based on the two most promising tritium supply alternatives. This dual track consists of (1) initiating the purchase of an existing commercial reactor (operating or partially complete) or irradiation services with an option to purchase the reactor for conversion to a defense facility and (2) designing, building, and testing critical components of an accelerator system for tritium production. Within a 3-year period, DOE expects to select one of the tracks to serve as the primary source of tritium. The TSR ROD concluded that the use of LWRs, especially existing

commercial reactors, has the highest potential for delivering new tritium gas by the required start date of 2011. The MHTGR and MHR were judged to have a lower probability of meeting this date because they have the potential for major technical or regulatory delays. They were also judged to have a lower probability than the other alternatives considered of being able to operate with sufficient reliability, to meet the annual tritium production requirements. Furthermore, total life cycle costs and operation and maintenance costs for gas reactors were high, especially for the MHTGR.

The TSR PEIS also considered tritium production in the FFTF, an existing liquid metal cooled reactor located at Hanford near Richland, Washington. It was dismissed in the TSR ROD as a long-term tritium supply option because its remaining life is substantially less than the long-term mission requirements for tritium production. The FFTF is also limited in the amount of tritium that it could produce, which is only a percentage of the tritium requirement. It was therefore not considered reasonable to rely on operating the facility as a long-term tritium supply option. Nevertheless, the TSR ROD indicated that DOE would conduct further evaluations to determine whether the operation of the FFTF might be able to play any role in meeting future tritium requirements. Although the FFTF produces no electricity and like the light water and gas cooled reactors has never been used for tritium production, it has been used in experimental capacities. Therefore, its utility as a multipurpose reactor is included in the discussion below.

The sizes of the multipurpose reactors considered for tritium production use based upon meeting specific tritium supply requirements and not on the disposition of a prescribed quantity of Pu within a reasonable (25-year) time period. These reactors would have to be capable of producing tritium at a steady state production mode and at an increased production mode should the need arise.

Plutonium disposition using a single multipurpose reactor would take longer than the disposition goal of 25 years from project authorization. This disposition goal could only be achieved by using more reactors (or an additional disposition option such as immobilization). This would be required for tritium production alone. Furthermore, if new reactor(s) were provided, the Pu disposition mission would be completed before the end of their useful design life for the reactors, thereby resulting in unneeded plutonium disposition capacity after approximately 15 years of operation (assuming 50 metric tons [t] (55 short tons) [tons] of Pu). Thus, while plutonium disposition would be possible in a multipurpose reactor, the primary purpose of the reactor would be tritium production.

N.2 NEW MULTIPURPOSE REACTORS

A new ALWR or MHR multipurpose reactor could potentially offer savings to the Government by combining the tritium production and Pu disposition missions into a single reactor program. Although it may be technically feasible for a multipurpose reactor to perform these combined missions, additional development, demonstration, and testing would be required to address a number of technical issues. These technical issues relate primarily to fuel and tritium target development and demonstration, and to related reactor modification and licensing requirements. These issues would be expected to have greater impact on the MHR than on an ALWR because of its extensive developmental requirements and lack of operating experience. Also issues related to the different capacity requirements (number of reactors) for each mission, and different refueling and re-targeting schedules would need to be addressed. The use of a single reactor for tritium production is not compatible with the Pu disposition objective of satisfying the Spent Fuel Standard in 25 years or less from the time of project authorization. Furthermore, a lower reliability would be expected for combined missions versus separate missions in separate reactors, because the problems and delays with one mission could impact the timely implementation of the other. For example, problems with MOX fuel performance (a disposition mission factor) or tritium target performance such as repeated leaks (a tritium production mission factor) could delay both missions. Whether this potentially lower reliability would impact the effective implementation of both these critically important missions is still an open question.

The Nuclear Regulatory Commission (NRC) evaluated MOX-burning LWRs in an environmental impact statement issued in 1976.[1] They included extensive information on the changes and impacts required for an LWR in order to allow it to utilize MOX fuel. This document was reviewed as part of DOE's analysis of the multipurpose ALWR.

N.3 ADVANCED LIGHT WATER REACTOR

The TSR PEIS considered four ALWR options: a large 1300-megawatt electric (MWe) pressurized water reactor (PWR) plant, a large 1,100-MWe boiling water reactor (BWR) plant, a small 600-MWe PWR plant, and a small 600-MWe BWR plant. All ALWR options would use light (regular) water as the reactor coolant and moderator, and a steam cycle to remove heat from the light water coolant to generate electricity.

The ALWR concepts considered for tritium production are based on advanced commercial reactor designs developed by U.S. reactor vendors in conjunction with DOE. These commercial designs have been reviewed or are undergoing review by the NRC with the goal of simplifying their licensing process. They incorporate passive safety features and other advancements that would be expected in any new LWRs that might be built in the United States in the future. Advanced BWRs, similar to some of the designs being developed in the United States, are being built in Japan.

Although no ALWRs have been built in the United States, they are considered to have the lowest risk of any new reactor option evaluated for tritium production or Pu disposition because they are based on the light water technology and extensive operating experience of the 110 commercial reactors operating in this country today. A single multipurpose large ALWR (1,256 MWe) with a typical commercial reactor fuel cycle (18 to 24 months) could meet both the steady state and increased tritium production requirements. The steady state requirement could be achieved without having to displace any of the reactor's fuel rods with tritium target rods. However, the disposition of 50 t (55 tons) of surplus Pu in a single multipurpose reactor would take approximately 44 years from project authorization (12 years of plant design and construction and 32 years of operation). For the increased tritium production requirement, Pu disposition would take even longer since some of the reactor's fuel may have to be displaced by tritium targets to accommodate the higher tritium requirement. In order to produce the required amount of tritium and disposition 50 t (55 tons) of Pu in approximately 25 years from project authorization, two multipurpose ALWRs would be required. If a hybrid approach were chosen for Pu disposition in which reactors and immobilization were used, less than the full 50 t (55 tons) of Pu would be identified for disposition in reactors, and the disposition times and number of reactors would therefore be reduced.

N.4 MODULAR HELIUM REACTOR AND MODULAR HIGH TEMPERATURE GAS-COOLED REACTOR

The TSR PEIS considered the use of three 350-megawatt thermal (MWt) MHTGR modules for the production of tritium. The MHTGR concept uses a steam cycle to remove heat from the helium reactor coolant and to generate electricity. There has been some limited experience (with mixed success) in the United States and abroad with gas reactors using a steam cycle. However, the use of MOX fuel in MHTGR reactors designed to produce tritium would significantly reduce tritium production capability. Combining tritium production and Pu disposition in multipurpose gas reactors would require an increase to six 350-MWt MHTGR reactor modules in order to meet the increased tritium production requirement. However, this number of modules would still be insufficient to meet the 25 year Pu disposition objective. Approximately twenty-four 350-MWt reactor modules would be required to satisfy the Pu mission goal using the MHTGR technology. This number of reactors would be economically unattractive.

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[1] *Final Environmental Statement on the Use of Recycled Plutonium Mixed Oxide Fuel in Light Water Cooled Reactors* (GESMO) (NUREG-0002), August 1976.

The MHR concept is economically more attractive than the MHTGR because it has the potential to achieve higher thermal efficiencies and its advanced design allows reactors to be packaged into larger modules (600-MWt) than the 350-MWt MHTGR. Fewer MHR modules would therefore be required to satisfy the same tritium or Pu mission, and the cost of reactor construction and operations would be less. Two MHR reactor modules would be required to meet the increased tritium production requirement alone, without Pu disposition. Eight multipurpose reactor modules using a 2-year reactor fuel cycle proposed by the MHR vendor, would be required to satisfy the increased tritium production requirement and disposition approximately 50 t (55 tons) of surplus Pu. With eight 600-MWt MHR reactor modules, the disposition of 50 t (55 tons) of surplus Pu would take approximately 26 years from project authorization (12 years of plant construction and 14 years of operation).

The MHR can achieve substantial cost savings when compared to the MHTGR because it uses the reactor's helium coolant in a high efficiency direct-cycle gas turbine to generate electricity rather than in a steam cycle like the MHTGR. While the direct cycle approach has cost advantages and higher plant efficiency, it also has a much larger risk associated with bringing it to a level of technical maturity that would allow the Government to proceed with confidence in the timeframe required to meet tritium production and Pu disposition objectives.

Since the direct-cycle turbine power conversion system is new and unproven, it must complete an extensive design, development, testing, and demonstration program. Further, the integration of the power conversion system with the reactor system has not been demonstrated, and will require extensive design and development. In addition to the direct cycle turbine, only very limited experience exists with Pu fuel for gas reactors. Both the fabrication process and operational performance of the fuel must be developed and demonstrated. The Pu fuel fabrication facility for the MHR would be a first-of-a-kind facility and therefore represents one of the highest risk items for maintaining the aggressive schedule that would be required for tritium production and Pu disposition. Direct cycle turbine and fuel development activities required for the MHR would therefore represent a major risk to meeting mission objectives in a timely, reliable, and cost-effective manner. It was for this reason that DOE did not consider the MHR to be a reasonable alternative for either tritium production or Pu disposition, or both missions combined in a multipurpose MHR reactor.

N.5 COST COMPARISONS

N.5.1 ADVANCED LIGHT WATER REACTOR COSTS

For purposes of cost analysis, reactors were assumed to be located at the Savannah River Site (SRS). Costs were calculated for separate tritium production and Pu disposition missions in separate reactors, as well as for combined missions in a multipurpose reactor.

The cost/benefit of the multipurpose ALWR reactor option was analyzed for two cases: Government ownership and private ownership. In the case of Government ownership, the front-end costs which include the reactor, tritium recovery facility, pit disassembly/conversion facility, MOX fuel fabrication facility, and all associated research and development, would all be paid for by the Government. In the case of private ownership, the reactor and MOX fuel fabrication plant would be financed, constructed, and operated by a private entity. All other front-end costs would be paid for by the Government. Cost comparisons, expressed in discounted 1996 dollars, are provided in Table N.5.1–1. Costs shown are for construction and operation of the reactor and common facilities (pit disassembly/conversion, MOX fuel fabrication, tritium target fabrication). An average revenue return of $.029 per kilowatt-hour is assumed for electricity production over the life of the reactor. This return reflects the potential effect of deregulation of the electric power industry. This value was also used in the *Reactor Alternative Summary Report Vol. 4—Evolutionary LWR Alternative* (ORNL/TM-13275/r4) and the *Technical Summary Report for Surplus Weapons—Usable Plutonium Disposition* (DOE/MD-0003).

The Government ownership cases highlight the potential cost advantages of a multipurpose reactor as compared to building new reactors for each mission separately. The front-end costs to the Government for deploying

Table N.5.1–1. Advanced Light Water Reactor Costs (1996 Dollars)

Mission	Reactor Size	Front-End Costs (Dollars in Billions)	Discounted Life Cycle Costs (Dollars in Billions)	Discounted Total Costs for Both Missions (Dollars in Billions)
Private[a]				
Pu disposition only	Two ALWRs 2,512 MWe	0.32	4.1	7.0[b]
Tritium production only	One ALWR 1,100 MWe	0.34	2.9	
Multipurpose	Two ALWRs 2,512 MWe	0.66	4.4	4.4
Government[c]				
Pu disposition only[d]	Two ALWRs 2,512 MWe	6.9	3.7	7.0[b]
Tritium production only	One ALWR 1,100 MWe	4.3	2.0	
Multipurpose	Two ALWRs 2,512 MWe	7.2	3.7	3.7

[a] Privately owned MOX fuel fabrication facilities and reactors. Government owned Pu processing and tritium facilities.
[b] Sum of Pu disposition and tritium production.
[c] All government owned facilities.
[d] Same case as Table 4.2 of October 1996 Technical Summary Report for Surplus Weapons Usable Plutonium Disposition (Rev 1).

separate reactors and associated facilities versus the costs for two multipurpose reactors and associated facilities are $11.2 billion and $7.2 billion, respectively. The front-end cost for the multipurpose reactor is therefore $4.0 billion less than that for separate new reactors. The discounted life-cycle costs are $2.6 billion less for the two multipurpose reactors compared to the three reactor separate projects case.

The private ownership option assumes a combination of industry-based financing for a substantial part of the undertaking, together with debt financing for the balance. However, the potential feasibility of private financing must be tempered with the recognition that for more than 15 years, the commercial nuclear power industry has not found it economically and politically feasible to build new nuclear power plants in the United States. It is unlikely that passive investors would be willing to "project finance" the construction phase of the project (that is, where the debt and equity investors take the project risk), for the following reasons: the size of the investment; the risks associated with completing the construction of such a facility; and the general anxiety within the investment community over nuclear projects. There is some possibility that passive investors might be willing to finance such a project once it is built and operating; after NRC approvals and associated risks are complete; and after technology issues, construction delays, cost overruns, permitting, and initial startup testing are behind the project. Government support of a privately owned reactor may overcome some of these concerns, as suggested by the interest expressed by some industry groups in both single purpose and multipurpose reactors for tritium production and Pu disposition.

The private ownership cases highlight the potential cost advantages of private ownership. The front-end costs to the Government are significantly reduced for the reactors in the Pu disposition only case ($6.6 billion reduction), the tritium production only case ($4.0 billion reduction), and the multipurpose reactor case ($6.6 billion reduction), when compared to Government ownership because the front-end costs of the reactor and MOX fuel fabrication facility would be financed by a private entity. For the multipurpose reactor, the discounted life-cycle cost is increased, however, by about $0.7 billion as a result of the higher financing costs for a private owner combined with tax effects and the desire by the private investor for a return on investment. These costs are

ultimately paid for by the Government as part of the irradiation service over the 40-year operating life of the reactor. Potential advantages of private ownership would be lower front-end costs and the fact that Government outlays could be spread over the life of the project.

The Department tasked a consultant (Putnam, Hayes & Bartlett, Inc. [PHB]) to provide an independent cost analysis of DOE's tritium production alternatives, including a preliminary assessment of the multipurpose ALWR option. For the multipurpose reactor option, the PHB report[2] analyzed the costs of a Government-owned multipurpose reactor and a privately financed and owned option for three cases: the purchase of an existing commercial LWR; the construction and operation of a new small ALWR; and the construction and operation of a new large ALWR.

The PHB analysis of cost impacts of privately financing the multipurpose reactor indicates that only the purchase of an existing reactor would result in a cost benefit to the Government. The PHB report shows that privatization of such a multipurpose reactor could provide savings to the Government of about $1 billion in discounted life-cycle cost compared to the cost of separate reactors for tritium production and Pu disposition. A privately financed and owned multipurpose reactor could cost the Government an additional $0.7 billion to $11.4 billion in discounted cost compared to the Government ownership option as a result of the higher financing cost for a private owner and the desire by the private investor for a return on investment. This result depends heavily on electricity unit revenues and the terms that private participants are willing to offer DOE. The PHB report concluded that private financing may provide benefits to the Government, but should be examined by DOE after a tritium supply option or strategy is chosen.

N.5.2 Modular Helium Reactor Costs

For purposes of MHR cost analysis, reactors were again assumed to be located at Savannah River Site. As in the case of the ALWR, costs were calculated for separate tritium production and Pu disposition missions in separate reactors, as well as for combined missions in a multipurpose MHR. The cost/benefit of the multipurpose MHR option was analyzed for two cases: Government ownership and private ownership. In the case of Government ownership, the front-end costs, which include the reactor, tritium recovery facility, pit disassembly/conversion facility, MOX fuel fabrication facility, and all associated research and development, would all be paid for by the Government. In the case of private ownership, the reactor and MOX fuel fabrication facility would be financed, constructed, and operated by a private entity. All other front-end costs would be paid for by the Government. Cost comparisons, expressed in discounted 1996 dollars, are provided in Table N.5.2–1. Costs shown are for construction and operation of the reactor and common facilities (pit disassembly/conversion, MOX fuel fabrication, tritium target fabrication). An average revenue return of $.029 per kilowatt-hour is assumed for electricity production over the life of the reactor.

For the Government ownership option, the Government's front-end costs for the multipurpose MHR plant and the sum of the costs for separate reactor plants for tritium production and Pu disposition, were calculated to be about $6.5 billion and $8.1 billion, respectively. The potential cost advantage of the multipurpose MHR would be about $1.6 billion in front-end costs.

With regard to private financing, the MHR would not be feasible until after a period of successful operation of a demonstration facility. Financing for a multipurpose MHR would be difficult in view of the poor operating history of the Fort Saint Vrain facility, a gas-cooled reactor plant in Colorado that experienced a multitude of operational problems. The revolutionary nature of its design, the development and demonstration requirements associated with the reactor fuel and direct cycle turbine, and the lack of NRC review would be further impediments to private financing.

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[2] DOE Tritium Production Options: Putnam, Hayes & Bartlett Final Report On Cost Analysis, September 1, 1995 (Text Revision October 15, 1995).

Table N.5.2–1. Modular Helium Reactor Costs (1996 Dollars)

Mission	Reactor Size[a]	Front-End Costs (Dollars in Billions)	Discounted Life Cycle Costs (Dollars in Billions)	Discounted Total Costs for Both Missions (Dollars in Billions)
Private[b]				
Pu disposition only	8 modules 2,288 MWe	0.32	3.5	5.0[c]
Tritium production only	2 modules 572 MWe	0.68	1.5	
Multipurpose	8 modules 2,288 MWe	1.0	4.1	4.1
Government[d]				
Pu disposition only	8 modules 2,288 MWe	5.8	3.1	5.0[c]
Tritium production only	2 modules 572 MWe	2.3	1.0	
Multipurpose	8 modules 2,288 MWe	6.5	3.7	3.7

[a] Each reactor module is designed to produce 286 MWe.
[b] Privately owned MOX fuel fabrication facilities and reactors. Government owned Pu Processing and tritium facilities.
[c] Sum of Pu disposition and tritium production.
[d] All government facilities.

For the privately owned multipurpose MHR, the front-end costs could be reduced by about $5.5 billion relative to the Government-owned multipurpose reactor option because the reactors and the fuel fabrication plant would be financed, constructed, and operated by private entities. The privately owned multipurpose reactor would cost the Government about $0.4 billion more in discounted life cycle costs compared to the Government-owned option. This increase, as in the case of the ALWR, is the result of higher financing costs for a private owner combined with tax effects and the desire of the private investor for a return on investment. These costs would ultimately be paid for by the Government as part of the irradiation service over the operating life of the reactor. Again, potential advantages of private ownership would be lower front-end costs and the fact that the Government outlays could be spread over the life of the project.

N.6 FAST FLUX TEST FACILITY

As part of the process of selecting Pu disposition technologies for evaluation in the Storage and Disposition PEIS, DOE considered the FFTF, a liquid metal reactor at Hanford, because it was an existing facility that would not require the large commitment of time and money that a new reactor would require for implementation of the Pu disposition mission. The FFTF, however, was eliminated because it was in a standby status awaiting shutdown and because it could not satisfy the Storage and Disposition PEIS criterion of completing the disposition mission within 25 years using the historic FFTF Pu fuel enrichment specifications.

It has been suggested by commentors in this PEIS and others that the use of the FFTF as an integral part of the nation's tritium production infrastructure might help ensure the tritium supply by 2005 and at the same time provide a way to begin the disposition of surplus weapons-usable Pu as well as provide a source of medical isotopes.

As noted in the DOE's December 5, 1995 ROD on Tritium Supply and Recycling, DOE is evaluating the operation of the FFTF to determine if it might have a role in meeting future tritium requirements. If DOE

proposes and subsequently decides to use the FFTF for tritium production, then, in order to accomplish this mission, a portion of the fuel-usable surplus Pu could be used to operate the FFTF.[3] Before the FFTF could begin to use this Pu for the production of tritium, 3 to 4 years would be required to develop and test a higher Pu enriched reactor fuel and to establish a MOX fuel fabrication capability. Under these conditions, it would take at least 35 years from a ROD to disposition the surplus weapons-grade Pu that is suitable for use in reactors, or a supplementary disposition approach (such as immobilization) would be needed for the unused balance.

At the time this Storage and Disposition PEIS went to print, DOE had not proposed to use FFTF for tritium production. If DOE proposes to consider the FFTF in detail for this purpose, appropriate *National Environmental Policy Act* review will be performed.

N.7 SUMMARY

A single multipurpose ALWR could perform the tritium mission at a steady state mode but it would not provide the capability to disposition surplus Pu in a timely manner. For a single new large multipurpose ALWR operating on a typical commercial fuel cycle, it would take approximately 12 years of design and construction and 32 years of operation (a total of 44 years) to disposition 50 t (55 tons) of Pu. The same reactor could meet an increased tritium production requirement, but Pu disposition would take longer since some of the reactor's fuel may have to be displaced by tritium targets to accommodate the higher production requirement. Two multipurpose ALWRs would be required to meet the increased tritium production requirement and complete Pu disposition within the goal of 25 years from project authorization.

Two MHR reactor modules would be required to meet the increased tritium production requirement alone, without Pu disposition. Eight MHR modules would be required to meet the same tritium production requirement and complete the Pu disposition mission in 26 years (12 years for construction and 14 years for operation).

The use of the FFTF, or new multipurpose reactors sized for tritium production alone, could provide cost advantages to the Government in front-end costs and overall life cycle costs relative to the use of separate new reactor facilities for tritium production and Pu disposition. However, these cost savings would need to be balanced against the impacts of the slower Pu disposition rate imposed by the limited reactor capacity of these options. The goal of completing the disposition mission within 25 years of project authorization could only be achieved if additional reactors were to be provided or other means of disposition employed, such as immobilization. In the case of multiple new reactors, the disposition mission would be completed before the end of the useful design life of the reactors, which would result in unneeded reactor capacity.

[3] The rate of utilization would be about one ton per year maximum. See Use of the Fast Flux Test Facility for Tritium Production (the "JASON Report"), S. Drell and D. Hoummer, Co-chairs, The MITRE Corporation, McLean, Virginia, September 11, 1996, page 22 (draft).

Appendix O
Can-in-Canister Variants

O.1 INTRODUCTION

This appendix presents descriptive information on variants to the vitrification and ceramic immobilization disposition alternatives described as "a can-in-canister approach at Savannah River Site (SRS)" in Table 2.4-1. Based upon comments from the public on the Draft Programmatic Environmental Impact Statement, there is substantial interest in the can-in-canister (CIC) concept for the disposition of surplus plutonium (Pu), and several requests have been made for the Department of Energy (DOE) to consider this concept in its decisionmaking process.

During the initial 12 scoping meetings held across the country from August to October 1994, there was public input on the potential reasonable alternatives and proposed screening process. One of the 37 disposition options under consideration at that time was Option I-2: Borosilicate Glass Immobilization using a Modified Defense Waste Processing Facility (DWPF). This option was eliminated as unreasonable because the DWPF was not designed for criticality control, and therefore would require extensive modifications and refitting of the facility and equipment during its present mission, potentially resulting in increased personnel radiation exposure, along with potential delays and cost escalation for its present mission (DOE 1995m:1-9).

The Department recognized that there could be potential cost savings for the immobilization category of disposition alternatives if the output product from the DWPF (that is, vitrified high-level waste [HLW]) could be used in the disposal of Pu. In response, SRS and the national laboratories developed a CIC concept, which was mentioned in the *Summary Report of the Screening Process* as a variant of Option I-3: Immobilization in Borosilicate Glass (DOE 1995m:4-6). This concept currently consists of two CIC variants that are included in the *Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition* (DOE/MD–0003) dated July 17, 1996.

The CIC concept at SRS is described as an example of a technology variant at an existing facility. However, the Record of Decision (ROD) for this PEIS will only select broader technology strategies for disposition. Site specific decisions and variant-specific decisions will be made pursuant to subsequent *National Environmental Policy Act* (NEPA) review tiered from this initial PEIS.

O.2 CAN-IN-CANISTER CONCEPT AT SAVANNAH RIVER SITE

The CIC concept includes variations to the two Pu disposition alternatives for vitrification and ceramic immobilization. CIC could utilize existing facilities at SRS to house the processes for pit disassembly/conversion, Pu conversion, and vitrification or ceramic immobilization. These existing facilities include the 221-F Facility in F-Area where Pu would be immobilized into a ceramic or glass form and loaded in a can and the DWPF in S-Area where the immobilized Pu would be loaded into a canister with vitrified HLW. For vitrification CIC, Pu would be immobilized in a borosilicate glass matrix in small cans and the cans placed in stainless steel canisters, which are then filled with molten borosilicate glass containing HLW to serve as the radiation barrier. For ceramic CIC, Pu would be immobilized in a ceramic matrix in small cans in lieu of the borosilicate glass, and the cans placed in stainless steel canisters, which are then filled with molten borosilicate glass containing HLW to serve as the radiation barrier. In both cases, the stainless steel canisters would be filled at the DWPF and placed in interim onsite storage at SRS until shipment to a HLW repository is possible.

The CIC concept at SRS could offer the following advantages over the base case immobilization category alternatives:

- Maximize use of existing SRS facilities
- Use vitrified HLW already slated for disposal in a HLW repository
- Provide a simple, yet effective, means to control criticality (that is, small cans of Pu)
- Eliminate unnecessary packaging between front-end operations and immobilization operations
- Require fewer additional canisters in a HLW repository
- Potentially reduce cost and worker radiation exposure

O.3 VITRIFICATION CAN-IN-CANISTER VARIANT

The vitrification CIC variant would process Pu forms to oxide, immobilize Pu oxide in borosilicate glass, and fill individual stainless steel cans. The filled cans would be loaded onto a frame and placed inside an empty stainless steel canister. The canister would have a cylindrical shape with a diameter of 0.6 meters (m) (2 feet [ft]) and length of 3 m (10 ft), and be identical to the stainless steel canister currently used in the DWPF to hold vitrified HLW, with the exception that the canister head would not be welded to the body until after the canister is loaded with cans of Pu glass. The loaded canister would be transferred to the DWPF facility, where molten HLW glass would be poured inside the canister and around the small cans and allowed to harden. The filled canisters would then be decontaminated, welded closed, and stored on-site in the Glass Waste Storage Building until a HLW repository is available for final disposal. A process schematic and material flow diagram for the vitrification CIC process are presented in Figures O.3–1 and O.3–2, respectively.

Facility Description. The vitrification CIC variant could use part of the existing 221-F Canyon building including the Pu Storage Facility and the New Special Recovery facilities, and part of the DWPF including the Vitrification and Service Buildings and the Glass Waste Storage Building. Table O.3–1 lists the location of each process area. Pit disassembly/conversion and other front-end processing, pretreatment operations, and first stage vitrification could be performed in the existing 221-F facility in areas specifically modified to vitrify Pu. The current F-Area facilities are designed and built to handle large quantities of Pu and have systems to maintain criticality control and safeguard systems to maintain accountability and security. The F-Area site layout is shown in Figure O.3–3. The floor area required for the front-end Pu processing and the vitrification functions

Table O.3–1. Locations for Proposed Vitrification Can-in-Canister Process Equipment

Process	Location
Receiving, shipping, storage, sampling	221-F Pu Storage Facility
Pit disassembly, dehydrate/hydride/oxidation	221-F New Special Recovery Facilities
Oralloy decontamination	221-F New Special Recovery Facilities
Special recovery	221-F Canyon 3rd Level
Fuel decladding, halide material processing	221-F Canyon 3rd Level
Feed preparation (dry variants)	221-F Canyon 3rd Level
Oxide lag storage (dry variants)	221-F Canyon 3rd Level
1st stage melter (dry variants)	221-F Canyon 3rd Level
Off-gas treatment (dry variants)	221-F Canyon 3rd Level
Feed preparation (wet variants)	221-F Canyon 3rd Level
Oxide lag storage (wet variants)	221-F Canyon 3rd Level

Table O.3–1. Locations for Proposed Vitrification Can-in-Canister Process Equipment—Continued

Process	Location
1st stage melter (wet variants)	221-F Canyon 2nd Level
Off-gas treatment (wet variants)	221-F Canyon 2nd Level
Can decon (dry variants)	221-F Canyon 3rd Level
Can decon (wet variants)	221-F Canyon 2nd Level
Can weld and test (dry variants)	221-F Canyon 3rd Level
Can weld and test (wet variants)	221-F Canyon 2nd Level
Interim can storage	221-F Canyon 3rd Level
Place in canister	221-F Canyon 1st Level
Weld and test	221-F Canyon 1st Level
Interim canister storage	221-F Canyon 1st Level/DWPF Service Building Interim Vault
Blend tank	DWPF Vitrification Building Hot Cell
2nd stage melter	DWPF Vitrification Building Hot Cell
Canister decontamination	DWPF Vitrification Building Hot Cell
Weld and test	DWPF Vitrification Building Hot Cell
Off-gas treatment	DWPF Vitrification Building Hot Cell
Interim product storage	DWPF Glass Waste Storage Building

Source: LLNL 1996j.

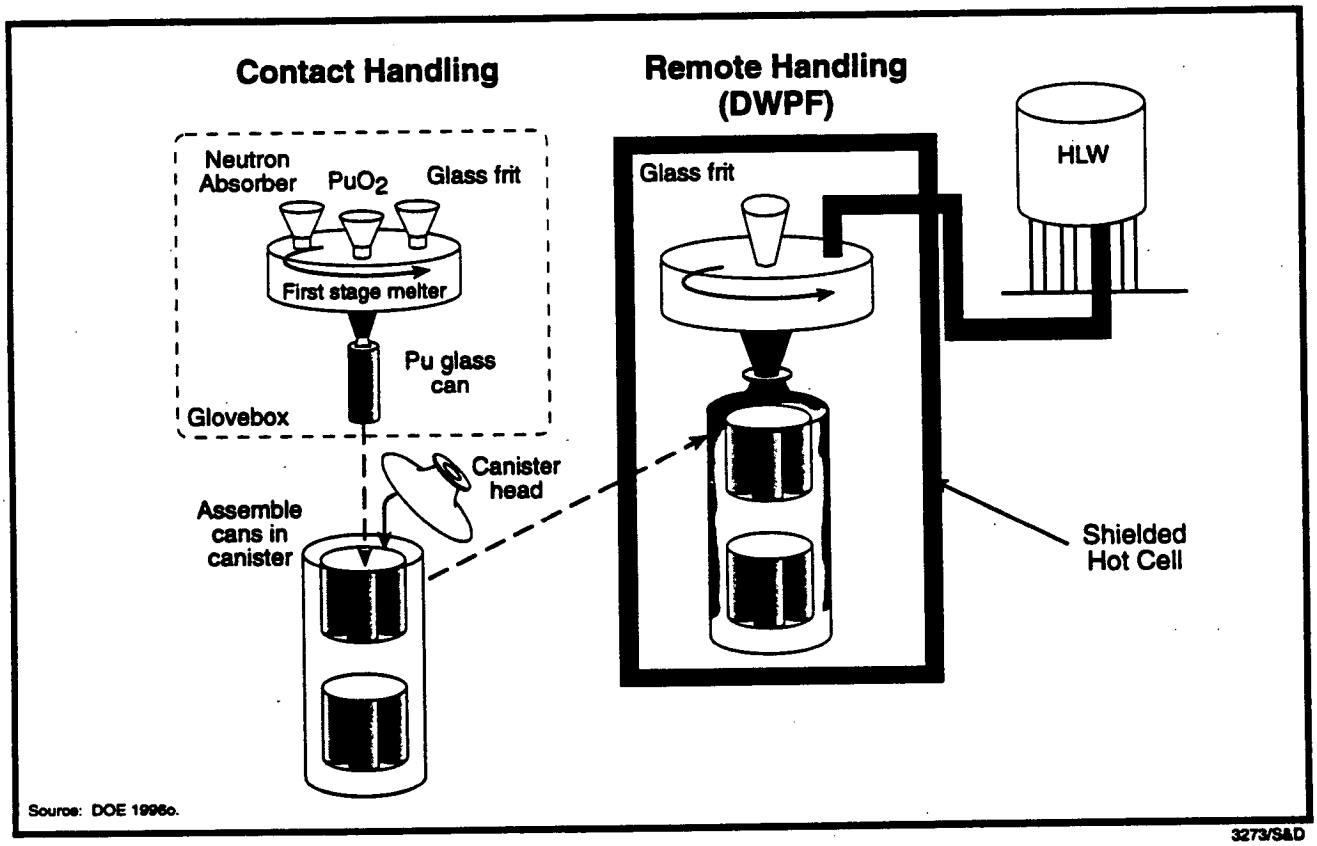
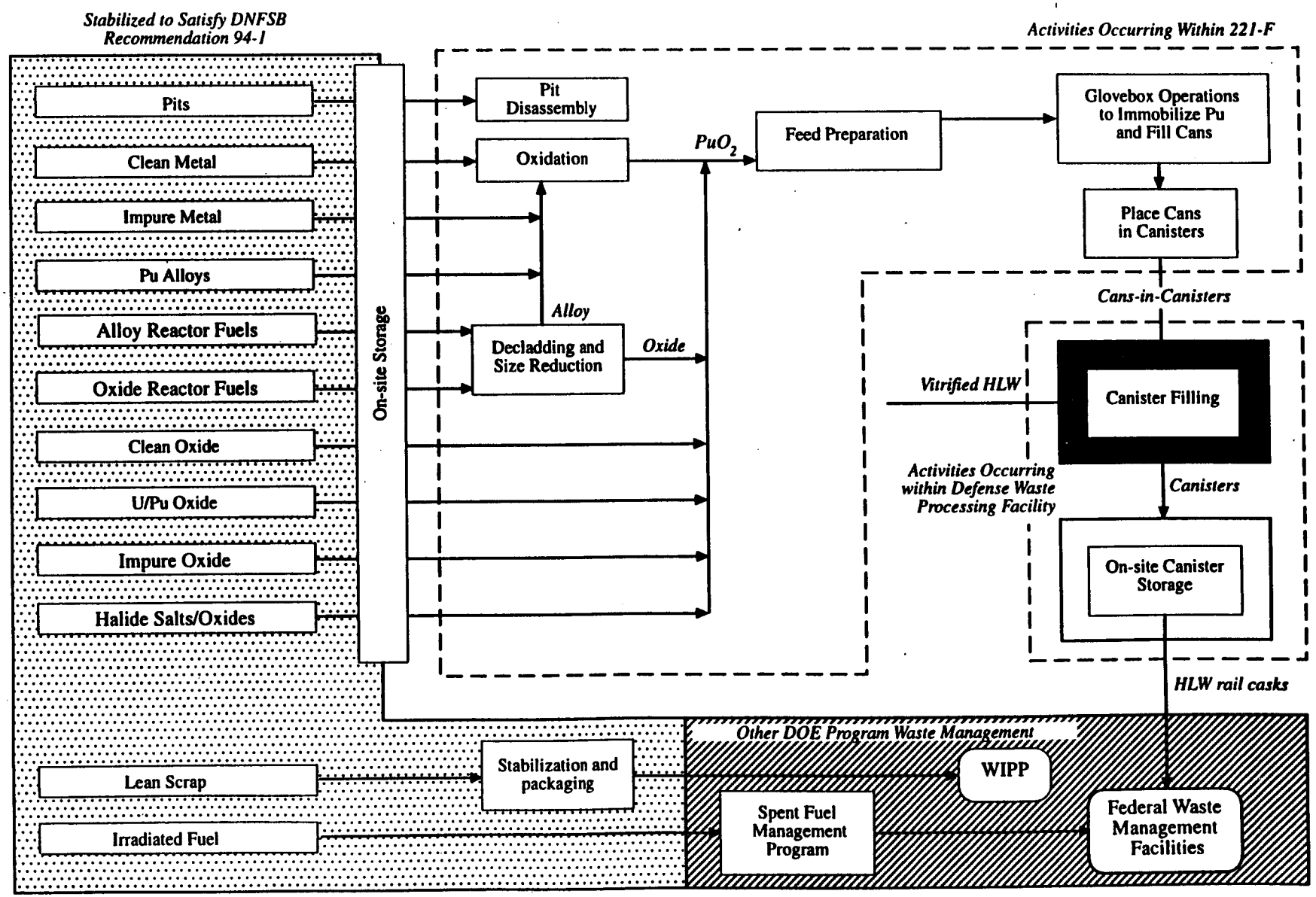


Figure O.3–1. Vitrification Can-in-Canister Variant Process.



Source: LLNL 1996j.

3277/S&D

Figure O.3–2. Can-in-Canister Material Flow Diagram for Operations at Savannah River Site.

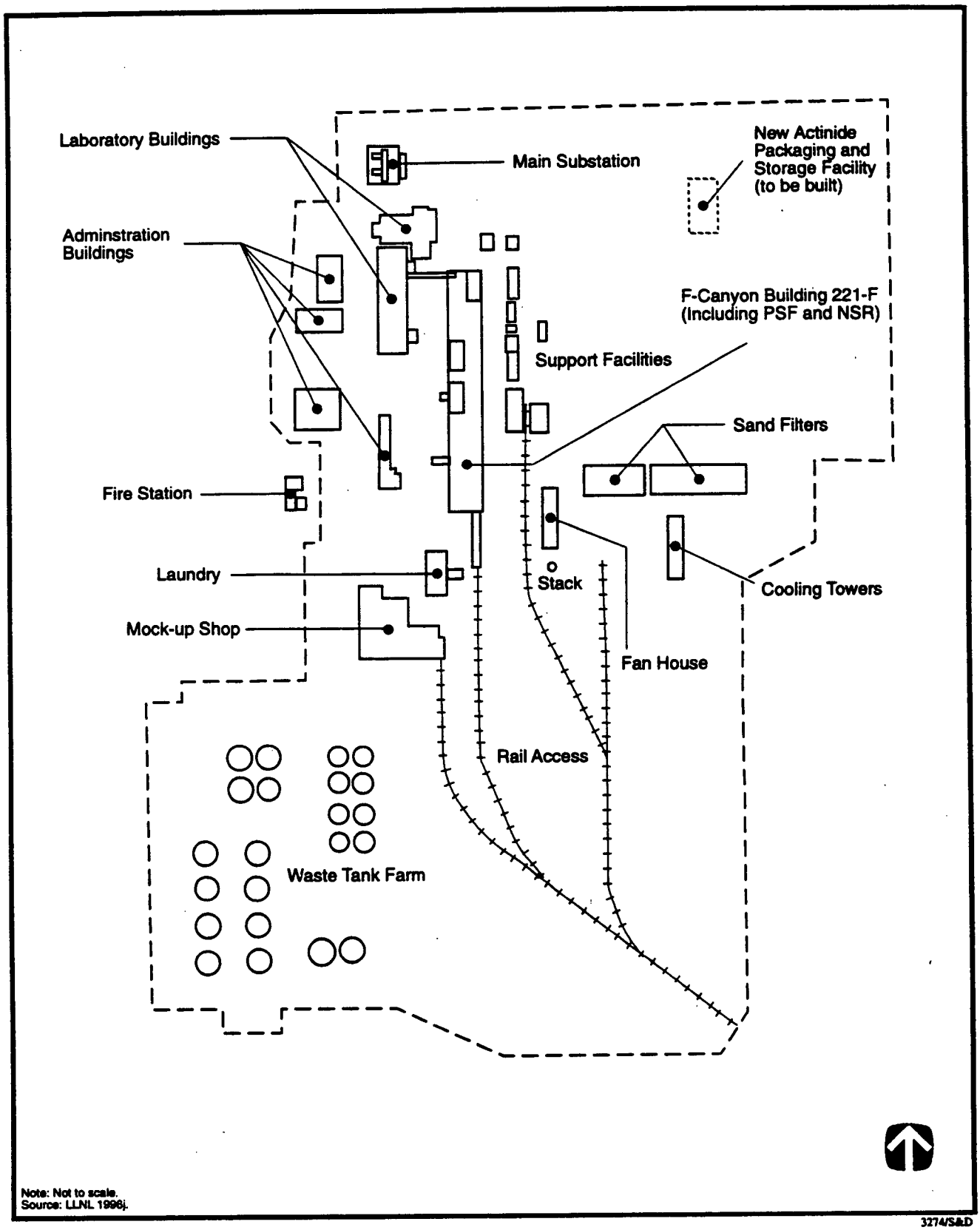


Figure O.3–3. Savannah River Site F-Area Layout Showing Building 221-F.

would be approximately 2,080 square meters (m^2) (22,390 square feet [ft^2]). Total support area (heating, ventilation, and air conditioning, ingress, egress) would be an additional 6,500 m^2 (70,000 ft^2), approximately. The addition of the molten HLW as a radiation barrier in the canister would take place in the DWPF located in the S-Area. The S-Area site layout is shown in Figure O.3–4. The existing DWPF would be upgraded to meet safeguards and security requirements for the handling of stainless steel canisters containing Pu-glass cans during the canister filling operations. Disruptions to current DWPF operations would be minimized since Pu would not be introduced into the DWPF in other than a vitrified, criticality safe manner. Safeguards and security provisions would be upgraded in selected portions of the DWPF buildings.

Facility Operations. In the vitrification CIC variant, the initial step in the immobilization process would be the transportation by safe secure trailer (SST) of Pu feed materials (such as pits, metal, oxides, and unirradiated reactor fuels) from storage site(s) to the receiving facilities in the Pu Storage Facility and New Special Recovery facilities on top of the 221-F Canyon building at SRS. The shipping containers would be unpacked, and accountability measurements conducted. Pu pits would be disassembled and converted to oxide.[1] Other forms would go through the minimum necessary processing to be converted to oxides. The oxide feed materials would then enter into specially modified portions of the 221-F Canyon and undergo first stage immobilization in glove boxes as depicted in Figure O.3–2.

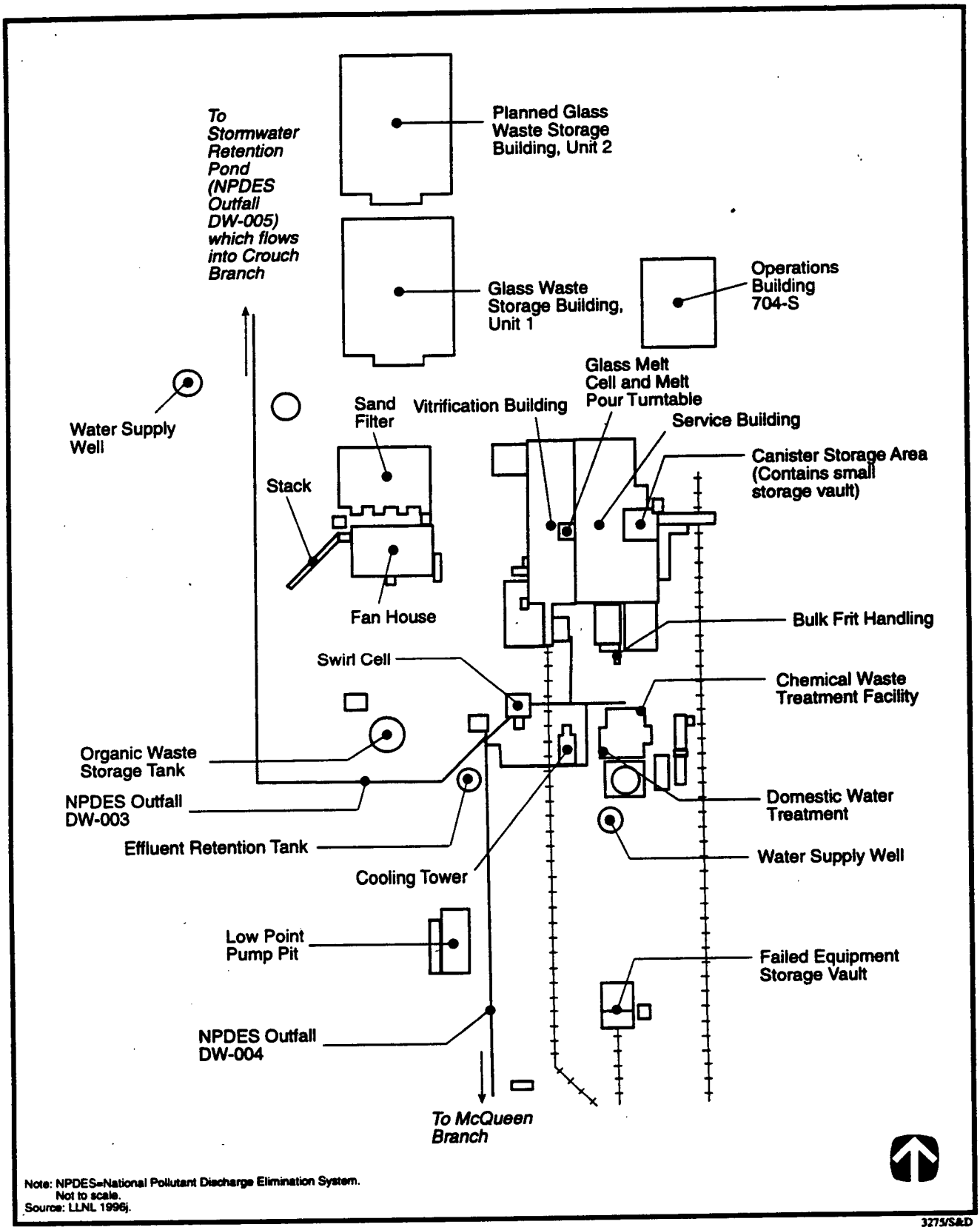
The feeds to this process would consist of glass formers, a neutron absorber, and the Pu oxide which would be combined in a melter to prepare a homogeneous borosilicate glass. This glass would be poured into small stainless steel cans with a Pu concentration of approximately 10 percent by weight. The outside dimensions of the can are a diameter of 13.4 centimeters (cm) (5.3 inches [in]), a length of 47.6 cm (18.7 in), and a shell thickness of 1 cm (0.4 in). After filling, the cans would then be capped, decontaminated, welded, tested, and transferred to lag storage in an onsite secured vault.

When Pu-glass cans are ready for processing, they will be decontaminated and transported to the canister loading area of the F-Canyon. The cans would be placed in a holding rack inside an open DWPF canister (head removed). After loading a canister with approximately 20 Pu-glass cans (5 cans in an array–4 arrays high), the head of the canister would be welded to the body and tested. Each canister would contain approximately 50 kilograms (kg) (110 pounds [lbs]) of Pu. The canisters may be placed in temporary storage in 221-F until they are shipped by rail or truck to the DWPF Service Building. A small storage vault, designed for special nuclear material and sized for about one week supply of canisters, would be provided in or adjacent to the DWPF Service Building to permit interim storage, if necessary, of canisters awaiting processing.

When a canister is ready to be filled, it would be transferred from the DWPF Service Building, via a controlled corridor, to the Melt Cell in the Vitrification Building. Utilizing a melt pour turntable, the HLW-borosilicate glass would be poured into the canister and around the Pu-glass cans. The cans would then become encapsulated in the HLW-glass within the stainless-steel canister. After filling, the canister would be decontaminated and sealed by plug welding and transported to the Glass Waste Storage Facility for interim onsite storage.

The Glass Waste Storage Building, Unit 1, was designed and constructed to hold HLW-glass canisters until a HLW repository is available. Since the capacity of Unit 1 is 2,286 canisters, a Unit 2 building is planned to be constructed as Unit 1 fills with HLW-glass canisters. Since Unit 2 is scheduled to be built in support of the DWPF mission, only upgrades to facility safeguards and security and increased capacity are necessary to accommodate additional canisters resulting from the Pu disposition mission. Alternatively, Unit 1 could be upgraded in the event Unit 2 was determined to be unnecessary. Because the Pu-glass cans displace volume that would normally contain HLW-glass in a separate DWPF operation, additional DWPF canisters would be needed to process all of the HLW in the SRS tank farm and all of the surplus Pu under scope of this PEIS. The number of additional DWPF canisters would be directly proportional to Pu loading in the Pu-glass. The total number of DWPF canisters containing Pu-glass cans would be about 1,000. Assuming 20 cans per canister, the volume of

[1] Based upon the Preferred Alternative, Pu pits would be converted to MOX fuel and would not be immobilized.



Note: NPDES=National Pollutant Discharge Elimination System.
Not to scale.
Source: LLNL 1996j.

3275/S&D

Figure O.3–4. Savannah River Site S-Area Layout Showing Defense Waste Processing Facility.

HLW-glass displaced would be approximately 20 percent, or about 200 additional canisters to those required for the SRS tank farm HLW program.

This variant would process 5,000 kg (11,000 lb) of surplus Pu annually. A normal operating year for the facility would be 200 days with a nominal throughput of 25 kg (55 lb) of Pu per operating day. This operating schedule assumes three shifts per day, 7 days per week. Remote maintenance, accountability, criticality control, and other functions would be performed during the 165 days per year the plant would not be expected to operate.

Construction. The vitrification CIC variant utilizes existing SRS facilities to house the pit disassembly/conversion, Pu conversion, and immobilization operations. For this variant, no major new construction would be required at SRS. However, some of the existing facilities would be modified and upgraded. Facilities in F-Area are designed and built to handle large quantities of Pu and have systems in place to maintain criticality control and safeguards systems to maintain accountability and security. However, the DWPF Vitrification Building, selected portions of the Service Building, and the Glass Waste Storage Building, Unit 1 or 2, would have to be upgraded to meet safeguards and security requirements to support storage and handling of vitrified Pu in accordance with DOE O 470.1 *Safeguards and Security Program.*

Radiological. With the CIC concept, the radiation source used to satisfy the spent fuel standard is the vitrified HLW outside the can. This eliminates the need for introducing radioactive cesium-137 (Cs-137) into the immobilization process, thereby reducing radiation shielding/hot cell requirements and the potential radiation exposures to operating personnel and the public. The dose to workers and the public would be smaller for the CIC variant than the dose to workers and the public for the new facility analyzed in Section 4.3.4.1.9.

Waste Management. Since the Pu conversion and immobilization processes would be similar to those otherwise described for the vitrification alternative, implementation of the vitrification CIC variant would result in similar waste streams. The wastes generated as a result of the operation of this variant would consist of transuranic (TRU), mixed TRU, low-level, mixed low-level, hazardous, nonhazardous (sanitary), and nonhazardous (other) materials. This variant could offer the potential for significant reductions in the quantity of pollutants emitted and wastes generated compared to the construction and operation of the separate disposition facilities as detailed in this PEIS. Significant emphasis would be placed on the minimization of both liquid and solid wastes. Vitrified HLW would be used to surround the cans and fill the canisters; however, no HLW would be generated as a result of the Pu disposition operations. In addition, any criteria pollutants, hazardous air pollutants, and other toxic compounds and gases that may be emitted as a result of the process would be within permit requirements.

Transportation. Fissile material located at various DOE facilities would be transported by SST, in compliance with applicable regulatory requirements, to SRS and placed in onsite temporary storage. Intrasite transport of radiological materials that are not immobilized would be limited to the secure movements within the 221-F Canyon building. Canisters containing the vitrified Pu in cans would be transported from 221-F to the DWPF Service Building via rail or truck. The filled canisters would be stored in the Glass Waste Storage Building until shipment to a HLW repository is possible.

The Department is developing a rail shipping cask for DWPF canisters. This rail shipping cask would hold five DWPF canisters. Based on the use of this transport cask, it is estimated that over the life of the project 40 additional shipments from SRS to a HLW repository would be required.

O.4 CERAMIC CAN-IN-CANISTER VARIANT

The ceramic CIC variant would be similar to the vitrification CIC variant in that both could use existing SRS facilities, produce cans of immobilized Pu, and fill DWPF canisters with Pu and vitrified HLW. The major difference between the two variants is that the Pu inside the stainless steel can would be immobilized in a titanate-based ceramic matrix, rather than a glass matrix. The ceramic product would be formed using a dry

feed, cold press, and sintering (heating) process without including Cs-137 in the ceramic matrix, rather than the wet feed, hot press process with the added Cs-137 radiation barrier as described for the ceramic immobilization alternative in Section 2.4.4.2. The advantages of using the cold press and sintering (heating) process would include increased throughput, simplicity, and proven production experience as used in the MOX fuel industry. Cold pressing would be an option for the ceramic CIC because the volatility of Cs-137 in the sintering process is not an issue with external radiation barrier variants. Using HLW as the radiation barrier, in lieu of the Cs-137 from cesium chloride capsules, would offer the advantages of process simplification and cost reduction, reduction in the potential for worker radiation exposure, and improvements in facility operations and maintenance requirements. If desired, the wet feed and cold press and sintering process could be used in the ceramic CIC variant.

A process schematic for the ceramic CIC process is presented in Figure O.4–1; the material flow diagram for this CIC process is the same as that shown in Figure O.3–2. As in the vitrification CIC variant, many of the feed materials require conversion to oxide form. Such treatment, conversion processing, and oxidation would take place in glove boxes. The resulting Pu oxide product would be fed to the ceramic process where Pu oxide would be blended with ceramic precursors and neutron absorbers. This mixture would be calcined, cold pressed, and sintered to produce densified pellets to be loaded into the small stainless steel cans. The cans of immobilized Pu in ceramic forms would be placed on a frame which would fit inside a DWPF canister and be transferred to the DWPF. These canisters would be filled with vitrified HLW at the DWPF to provide a radiation barrier for the final product.

Facility Description. The ceramic CIC variant could use part of the existing 221-F Canyon building including the Pu Storage Facility and New Special Recovery facilities, and part of the DWPF including the Vitrification and Service Buildings and the Glass Waste Storage Building. Table O.4–1 lists the location of each process area. Pit disassembly/conversion and other front-end processing, treatment operations, and immobilization (feed preparation, calcine and fill, press and package, and can filling) could be performed in the existing 221- F facility in areas specifically modified for Pu ceramic immobilization. The current F-Area facilities are designed and built to handle large quantities of Pu and have systems to maintain criticality control and safeguard systems to maintain accountability and security. The F-Area site layout was previously shown in Figure O.3–3. The floor area required for the front-end Pu processing and immobilization functions would be approximately 2,080 m^2 (22,390 ft^2). Total support area (heating, ventilation, and air conditioning, ingress, egress) would be an additional 6,500 m^2 (70,000 ft^2). The addition of the molten HLW as a radiation barrier in the canister would take place in the DWPF located in the S-Area. The S-Area site layout was previously shown in Figure O.3–4. The existing DWPF would be upgraded to satisfy the safeguards and security requirements for the handling of the stainless steel canisters containing Pu ceramic cans during the canister filling operations. Disruptions to current DWPF operations would be minimized since Pu would not be introduced into the DWPF in other than an immobilized, criticality safe manner. Safeguards and security provisions would be upgraded in selected portions of the DWPF buildings.

Facility Operations. In the ceramic CIC variant, the initial step in the immobilization process would be the transportation by SST, in Department of Transportation shipping containers, of Pu feed materials (such as pits, metal, oxides, and unirradiated reactor fuels) from storage site(s) to receiving facilities in the Pu Storage Facility and New Special Recovery facilities on top of the 221-F Canyon building at SRS. The shipping containers would be unpacked and accountability measurements conducted. Pu pits would be disassembled and converted to oxide.[2] Other forms would go through the minimum necessary processing to be converted to oxides. The oxide feed materials would then enter into specially modified portions of the 221-F Canyon and undergo ceramic immobilization in glove boxes as depicted in Figure O.3–2.

The feeds to this process would consist of ceramic precursors with a neutron absorber, dried titanate ion exchanger, and size-reduced Pu oxide powders which would be dry blended. Dry blending would be conducted

[2] Based upon the Preferred Alternative, Pu pits would be converted to MOX fuel and would not be immobilized.

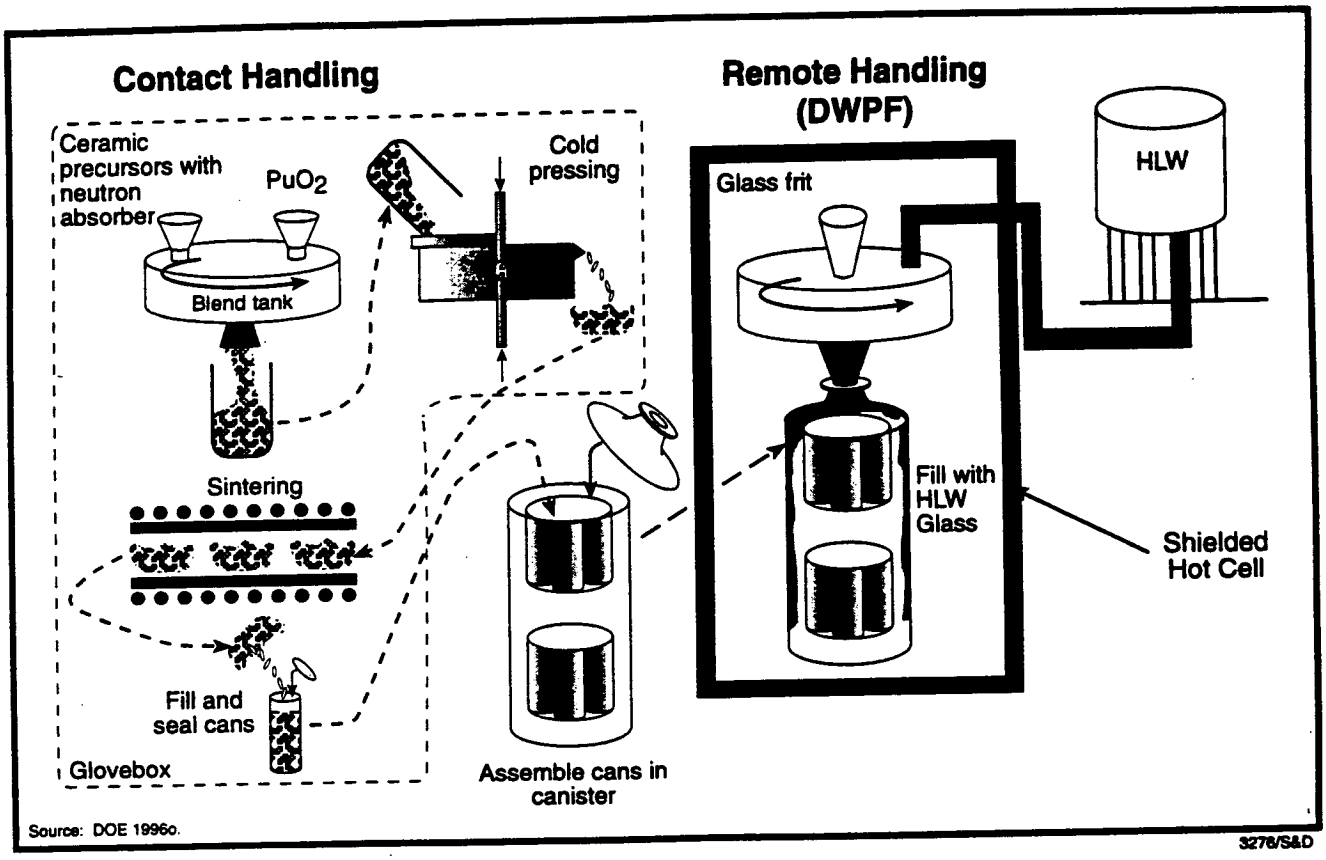


Figure O.4–1. Ceramic Can-in-Canister Variant Process.

Table O.4–1. Locations for Proposed Ceramic Can-in-Canister Process Equipment

Process	Location
Receiving, shipping, storage, sampling	221-F Pu Storage Facility
Pit disassembly, dehydride/hydride/oxidation	221-F New Special Recovery Facilities
Oralloy decontamination	221-F New Special Recovery Facilities
Special recovery	221-F Canyon 3rd Level
Fuel decladding	221-F Canyon 3rd Level
Feed preparation (dry feed)	221-F New Special Recovery Facilities
Oxide lag storage (dry feed)	221-F Canyon 3rd Level
Ceramic press and sinter (dry feed)	221-F Canyon 3rd Level
Off-gas treatment (dry feed)	221-F Canyon 3rd Level
Feed preparation (wet feed variant)	221-F Canyon 3rd Level
Oxide lag storage (wet feed variant)	221-F Canyon 3rd Level
Ceramic press and sinter (wet feed variant)	221-F Canyon 2nd Level
Off-gas treatment (wet feed variant)	221-F Canyon 2nd Level
Can decon (dry)	221-F Canyon 3rd Level
Can decon (wet feed variant)	221-F Canyon 2nd Level
Can weld and test (dry)	221-F Canyon 3rd Level
Can weld and test (wet feed variant)	221-F Canyon 2nd Level
Interim can storage	221-F Canyon 3rd Level
Place in canister	221-F Canyon 1st Level

Table O.4–1. Locations for Proposed Ceramic Can-in-Canister Process Equipment—Continued

Process	Location
Weld and test	221-F Canyon 1st Level
Interim canister storage	221-F Canyon 1st Level/DWPF Service Building Interim Vault
Blend tank	DWPF Vitrification Building Hot Cell
DWPF melter	DWPF Vitrification Building Hot Cell
Canister decontamination	DWPF Vitrification Building Hot Cell
Weld and test	DWPF Vitrification Building Hot Cell
Off-gas treatment	DWPF Vitrification Building Hot Cell
Interim product storage	DWPF Glass Waste Storage Building

Source: LLNL 1996k.

in a standard blending device such as a V-blender. The drying and calcining would be conducted in a rotary calciner that is a rotating tank inside a high temperature furnace. Following the drying and calcining process, the material would undergo milling and granulation to optimize size and morphology for the pressing and sintering operations. The dried and calcined ceramic precursor material loaded with Pu would then be poured into a feeder hopper which would deliver the oxide material into an automated pressing machine. The size of the pellets would be about 7 cm (2.75 in) in diameter by 2.8 cm (1.1 in) high. Pressed pellets would be transferred by a conveyer belt to the sintering oven and heated to 1,200 degrees Centigrade (°C) (2,200 degrees Fahrenheit [°F]) for several hours. After sintering, the pellets would be approximately 6.4 cm (2.5 in) in diameter by 2.5 cm (1 in) high. Any cracked or deformed pellets would be recycled. The Pu-ceramic pellets would then be loaded into 7.6 cm (3 in) diameter by 0.6 m (2 ft) high cans. The Pu loading in the ceramic form would not exceed 12 percent by weight. Cans loaded with the Pu-ceramic would be stored in storage racks in a vault on the third level of the 221-F Canyon building until ready to be placed in the DWPF canister.

When Pu-ceramic cans are ready for processing, they will be decontaminated and transported to the canister loading area of the F-Canyon. The cans would be placed in a holding rack inside an open DWPF canister (head removed). After loading a canister with approximately 20 Pu ceramic cans (5 cans in an array–4 arrays high), the head of the canister would be welded to the body and tested. Each canister would contain approximately 50 kg (110 lb) of Pu. The canisters may be placed in temporary storage in 221-F until shipped by rail or truck to the DWPF Service Building. A small storage vault, designed for special nuclear material and sized for about one week supply of canisters, would be provided in or adjacent to the DWPF Service Building to permit interim storage, if necessary, of canisters awaiting processing.

When a canister is ready to be filled, it would be transferred from the DWPF Service Building via a controlled corridor, to the Melt Cell in the Vitrification Building. Utilizing a melt pour turntable, the HLW-borosilicate glass would be poured into the canister and around the Pu-ceramic cans. The cans would then become encapsulated in the HLW-glass within the stainless-steel canister. After filing, the canister would be decontaminated and sealed by plug welding and transported to the Glass Waste Storage Facility for interim onsite storage.

The Glass Waste Storage Building, Unit 1, was designed and constructed to hold HLW-glass canisters until a HLW repository becomes available. Since the capacity of Unit 1 is 2,286 canisters, a Unit 2 building is planned to be constructed as Unit 1 fills with HLW-glass canisters. Since Unit 2 is scheduled to be built in support of the DWPF mission, only upgrades to facility safeguards and security and increased capacity would be necessary to accommodate the additional canisters resulting from the Pu disposition mission. Alternatively, Unit 1 could be upgraded in the event Unit 2 was determined to be unnecessary. Because the Pu-ceramic cans displace volume that would normally contain HLW-glass in a separate DWPF operation, additional DWPF canisters would be needed to process all of the HLW in the SRS tank farm and all of the surplus Pu. The number of additional

DWPF canisters would be directly proportional to Pu loading in the Pu-ceramic. The total number of DWPF canisters containing Pu-ceramic cans would be expected to be about 1,000. Assuming 20 cans per canister, the volume of HLW-glass displaced would be approximately 20 percent, or about 200 additional canisters to those required for the SRS tank farm HLW program.

This variant would process 5,000 kg (11,000 lb) of surplus Pu annually. A normal operating year for the facility would be 200 days with a nominal throughput of 25 kg (55 lb) of Pu per operating day. This operating schedule assumes 3 shifts per day, 7 days per week. Remote maintenance, accountability, criticality control, and other functions would be performed during the 165 days per year the facility would not be expected to operate.

Construction. The ceramic CIC variant utilizes existing SRS facilities to house the pit disassembly/conversion, Pu conversion, and immobilization operations. Under this variant, no major new construction would be required at SRS. However, some of the existing facilities would be modified and upgraded. Facilities in F-Area are designed and built to handle large quantities of Pu and have systems in place to maintain criticality control and safeguard systems to maintain accountability and security. However, the DWPF Vitrification Building, selected portions of the Service Building, and the Glass Waste Storage Building, Unit 1 or 2, would have to be upgraded to meet the safeguards and security requirements to support storage and handling of immobilized Pu, in accordance with DOE O 470.1, *Safeguards and Security Program*.

Radiological. With the CIC concept, the radiation source used to satisfy the spent fuel standard is the vitrified HLW outside the can. This eliminates the need for introducing radioactive Cs-137 into the immobilization process, thereby reducing radiation shielding/hot cell requirements and the potential radiation exposures to operating personnel and the public. The dose to workers and the public would be smaller for the CIC variant than the dose to workers and the public for the new facility analyzed in Section 4.3.4.2.9.

Waste Management. Since the Pu conversion and immobilization processes would be similar to those otherwise described for the ceramic immobilization alternative, implementation of the ceramic CIC variant would result in similar waste streams. The wastes generated as a result of the operation of this variant would consist of TRU, mixed TRU, low-level, mixed low-level, hazardous, nonhazardous (sanitary), and nonhazardous (other) materials. The ceramic CIC variant could offer the potential for significant reductions in the quantity of pollutants emitted and wastes generated when compared to the construction and operation of the other separate disposition facilities as detailed in this PEIS. Significant emphasis would be placed on the minimization of both liquid and solid wastes. Vitrified HLW would be used to surround the cans and fill the canisters; however, no HLW would be generated as a result of the Pu disposition operations. In addition, any criteria pollutants, hazardous air pollutants, and other toxic compounds and gases that may be emitted as a result of immobilization activities would be within permit requirements.

Transportation. Fissile material located at various DOE facilities would be transported by SST, in compliance with applicable regulatory requirements, to SRS and placed in onsite temporary storage. Intrasite transport of radiological materials that are not immobilized would be limited to the secure movements within the 221-F Canyon. Canisters containing the Pu-ceramic cans would be transported from 221-F to the DWPF Service Building via rail or truck. The filled canisters would be stored in the Glass Waste Storage Building, Unit 2, until shipment to a HLW repository is possible.

The Department is developing a rail shipping cask for DWPF canisters. This rail shipping cask would hold five DWPF canisters. Based on the use of this transport cask, it is estimated that, over the life of the project, 40 additional shipments from SRS to a HLW repository would be required.

O.5 REPOSITORY ACCEPTANCE

An analysis has been completed that examines the feasibility of introducing Pu-loaded glass into a HLW repository, using a CIC concept where the DWPF glass is poured into the space between the Pu glass cans and the DWPF canister (DOE 1996d:8-8). The DWPF glass acts as a radiation barrier to theft and diversion; gadolinium is added to the Pu glass cans as a neutron absorber. The analysis presented represents a case where the CIC concept for Pu disposition is a supplement to the disposition of the defense HLW already planned for the repository. The conclusions presented here for the vitrification variant are expected to apply to the ceramic CIC variant.

Regulatory. Any waste form that is accepted for disposal in a geologic repository must comply with the provisions of the *Nuclear Waste Policy Act* (NWPA), as amended. Under Section 2(12)B of the NWPA, the Nuclear Regulatory Commission (NRC) has the authority to certify this waste as eligible for the NWPA geologic repository. Such NRC action or legislative clarification in authorizing legislation will be necessary before this waste form can be considered for disposal in an NWPA repository. The final disposal of this waste form will have to conform to the licensing provisions of the NRC. Further, it is current DOE policy not to accept into the first HLW repository any wastes that include components regulated as hazardous under the *Resource Conservation and Recovery Act* (RCRA) (DOE 1995a:6). The absence of any RCRA-regulated hazardous materials in the final form would have to be demonstrated prior to acceptance into the HLW repository.

Criticality. The effective neutron multiplication factor (k_{eff}) for the intact glass form, assuming credit for the neutron absorbers during the post-closure period, is calculated to be 0.3 which is well below the 0.95 maximum value of k_{eff} allowed (10 CFR 60).

Thermal. The initial heat release from this CIC waste form is mostly from the HLW glass component. Temperatures peak between 30 and 60 years. By 100 years, the radiolytic heat generated by Pu will exceed the thermal output from the HLW. These predicted temperatures are far lower than, and therefore safely away from, the glass transition temperature of 400°C (750°F). The temperature and thermal output from these canisters are unlikely to materially affect the thermal balance of the repository.

Radiation. A comparison of the radiation exposure emanating from a repository waste package containing DWPF HLW glass canisters versus a package containing Pu cans and HLW glass shows that the radiation dose at the waste package surface is 81 roentgen equivalent man (rem)/hour (hr) for the package containing DWPF glass compared to the 30 rem/hr for one with the Pu cans with HLW glass. The radiation level for the package incorporating Pu CIC is below the threshold value for radiolytic corrosion, so no additional thickness of the copper-nickel alloy waste package outer barrier would be required to reduce the radiation to an acceptable level (100 radiation absorbed dose/hr) to protect the waste package from radiolysis-induced corrosion. However, additional shielding would be required to protect workers. Doses at a distance of 2 m (6.6 ft) from the waste package surface show values of 12.5 rem/hr for the DWPF glass and 4.7 rem/hr for the CIC. For emplacement in the repository, only 7 cm (2.75 in) of lead thickness must be added to the CIC waste package underground transporter to reduce the radiation doses to meet the standard allowable dose of 10 millirem/hr at 2 m (6.6 ft) from lateral outer surfaces (49 CFR 173.441) to ensure worker protection versus 10 cm of lead for repository waste package containing DWPF HLW glass canisters.

Releases. The calculated dose contribution to the accessible environment from all the CIC waste packages would be nearly 100 times lower than the calculated peak dose from a repository that contains only commercial spent fuel and HLW. This is to be expected because the repository release would be dominated by the greater quantity of commercial, uranium-based spent nuclear fuel.

O.6 TESTS AND DEMONSTRATIONS

The department has received comments on the Draft PEIS requesting that "pilot plant" studies of the CIC concept be performed. In this regard, DOE has initiated research, development, and testing of various aspects of the CIC concept for both the vitrification and ceramic immobilization alternatives. For example, in January 1996, a cold (without radionuclides) demonstration of the CIC variant was successfully conducted at the DWPF. Small cans containing a high temperature glass with a Pu surrogate were loaded into two full-size DWPF canisters (one canister contained 8 cans and the other 20 cans) which were subsequently filled with surrogate HLW-glass in the DWPF as part of the cold stratup qualification tests of that facility. Other tests are being conducted to demonstrate techniques that could enhance the nonproliferation properties of the final product. Ceramic waste forms have been under development for HLW for many years; however, the application of this technology to the immobilization of Pu is currently developmental.

The DOE plans to continue research to determine whether glass or ceramic is the preferred form for Pu disposition and to establish the optimum Pu concentration and chemical composition of a waste form that can be readily processed and satisfy nonproliferation concerns and perform well after the emplacement in a geologic repository. In addition, developmental efforts are underway to design acceptable processing equipment and controls and to demonstrate on a pilot scale the integration of the individual processing steps. As part of this effort, the Pacific Northwest National Laboratory, Argonne National Laboratory, Lawrence Livermore National Laboratory, and SRS are each contributing to a cooperative, integrated program of testing and evaluation of forms and processes.

Should DOE select either the vitrification or ceramic immobilization disposition alternative or the CIC variant, these activities will provide the information needed to demonstrate technical viability and practicality of the Preferred Alternative for disposition as well as provide information useful for DOE's tiered NEPA reviews (and RODs) regarding the selection of a specific technology variant, location, and/or facilities.

Appendix P
Manzano Storage Facility

The *Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (Pantex EIS) analyzed the storage of plutonium (Pu) in a pit form. Under the Pit Storage Relocation Alternative in the Pantex EIS, the pit storage function currently carried out at Pantex Plant (Pantex) would be transferred to another site. The Manzano Weapons Storage Area (WSA) at the Kirtland Air Force Base (KAFB) near Albuquerque, NM, is one of the candidate sites for the storage of pits. The WSA represented a reasonable alternative for this mission because the pits to be potentially relocated from Pantex exist in a sealed and stable metal form and will be packaged in specially designed containers that will ensure a very low probability of breach, metal oxidation, and dispersion of oxidation products. Therefore, the Manzano WSA was considered in the Draft Programmatic Environmental Impact Statement (PEIS) but eliminated as a reasonable alternative primarily because Manzano WSA could not accommodate storage of both pit and non-pit materials.

Since the issuance of the Draft PEIS, the Department of Energy (DOE) has developed a Preferred Alternative for storage that would separate storage of most Pu pits from storage of non-pit Pu material. Specifically, the Preferred Alternative would store Pu pits from Pantex and Rocky Flats Environmental Technology Site (RFETS) at Pantex, and would store non-pit Pu at Savannah River Site, Hanford Site, and Idaho National Engineering Laboratory. Since DOE's Preferred Alternative would separately locate storage of pits and non-pit Pu from RFETS, the option to store pits at Manzano WSA no longer appears unreasonable. Therefore, DOE has added this appendix to the Final PEIS, which discusses potential storage of Pantex and RFETS pits at Manzano WSA.

For a number of reasons, the Preferred Alternative would store the pits from Pantex and RFETS at Pantex, rather than Manzano WSA. Pantex is the proposed site for interim storage of pits under the Preferred Alternative in the Pantex EIS.[1] The majority of the pits that require storage are surplus to U.S. defense needs and are already located at Pantex. The number of pits that would be relocated from RFETS would be small by comparison. Since the majority of pits are already in storage at Pantex, it would be prudent for DOE to consolidate all pits there for storage. Assembly and disassembly operations would continue at Pantex even if pit storage did not occur there. Selecting Manzano WSA would require DOE to create another site where Pu would be located with the risk of contamination and the associated costs for site infrastructure and security. In addition, other missions that could be added to Pantex (for example, pit disassembly/conversion or mixed oxide fuel fabrication) could not be added to Manzano.

Storage at Manzano WSA would involve the transportation risk of moving these materials from Pantex to Manzano WSA. Furthermore, two shipment campaigns would be required for disposition for most of the pits (those already at Pantex) if Manzano WSA were chosen, whereas only one shipment campaign of those same pits would be required if the pits were stored at Pantex. For the Manzano case, pits at Pantex would require relocation to Manzano and then a second shipment campaign to a disposition site. Leaving the pits in storage at Pantex would result in only one shipment campaign from Pantex to the disposition site.[2] This appendix incorporates applicable information from the Pantex EIS.

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[1] The disposition of these surplus pits would begin within the next 10 years and would be completed within the next 25 years. The time period required for the storage of the pits is therefore close to that considered in the Pantex EIS for pit storage and the reasons for not using Manzano WSA are the same.

[2] Two shipment campaigns of pits would be required for those pits currently stored at RFETS for both Pantex and Manzano.

P.1 MANZANO WEAPONS STORAGE AREA

The KAFB is an Air Force Materiel Command base sharing base facilities and infrastructure with a number of major tenants, including DOE, Sandia National Laboratories (SNL), the Defense Special Weapons Agency, and Phillips Laboratory (Figure P.1–1). The base covers an area of 21,320 hectares (ha) (52,600 acres) on the southeast boundary of Albuquerque, New Mexico. Approximately 8,300 ha (20,500 acres) of this area is withdrawn public lands (USAF 1993a:1-3). Major Air Force units at KAFB include the 377th Air Base Wing, 58th Special Operations Wing (which performs helicopter crew training and pararescue training) and Phillips Laboratory (which performs research and development for space systems, ballistic missiles, geophysics, and directed energy systems). SNL conducts research and development for space systems, testing, stockpile surveillance, and the transportation of nuclear materials (USAF 1993a:3-2).

The Manzano WSA at KAFB consists of four plants inside Manzano Mountain (used primarily for research activities) and 122 magazines, of which 81 are earth covered and 41 are tunneled into the mountainside (KAFB 1993a:13) (Figure P.1–2). Construction began in June 1947, and the facility became operational in April 1950. In June 1992, the Manzano WSA was deactivated, and Phillips Laboratory assumed responsibility for its maintenance. SNL continues to provide minimum security, although the Perimeter Intrusion Detection and Alarm System was deactivated with the termination of the main mission in 1992. The Manzano WSA has enough magazine space to store the pits from Pantex and RFETS. The proposed location for the storage of pits is the set of 41 magazines that are tunneled into the mountainside. As many as 35 magazines have overburden greater than 9 meters (m) (30 feet [ft]) of earth and granite. The existing fence would be reactivated to the extent necessary, and no new fence or security systems would be required. If in the Pantex EIS, DOE chooses to do storage of pits in the Manzano WSA at KAFB, a pit placement, retrieval, and inventory system would have been implemented. The storage areas at the Manzano WSA are well suited for the Stage Right equipment and techniques successfully implemented at Pantex Plant.

P.2 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

The environmental resources discussed below have been assessed for KAFB. Analyses have shown that the impacts to some resources from the potential storage of pits at the Manzano WSA are small enough to warrant only limited discussion. Therefore, the resources are discussed commensurate with their impacts.

P.2.1 LAND RESOURCES

The Manzano WSA is currently being used in part for storage of a variety of items such as furniture and document boxes. These items would easily be removed and space made available for storage of surplus pits. The use of some storage magazines for the storage of pits would not change the array of potential storage materials for which these weapon storage magazines are designed. Additionally, no land disturbance is projected as it pertains to the Manzano WSA. Impacts to land use would not be expected.

P.2.2 SITE INFRASTRUCTURE

The KAFB infrastructure is managed by the 377th Air Base Wing and includes support to all tenants. As the Manzano WSA is not a DOE site, the exact breakdown of infrastructure support activities that would be performed by KAFB and DOE personnel has yet to be worked out in detail. Should this site be selected for pit storage, a Memorandum of Understanding between the Department of the Air Force and DOE would be developed detailing these duties. The infrastructure operations at KAFB that could be affected by or be expected to directly support pit storage operations include security, vehicle and building maintenance, safety and health protection, utilities, administration, and general support (for example, cafeteria, general stores).

The direct impacts from the implementation of pit storage would include a small increase in the site's security force. Electrical usage due to long-term pit storage (estimated to be 4,110 megawatt-hours per year [MWh/yr])

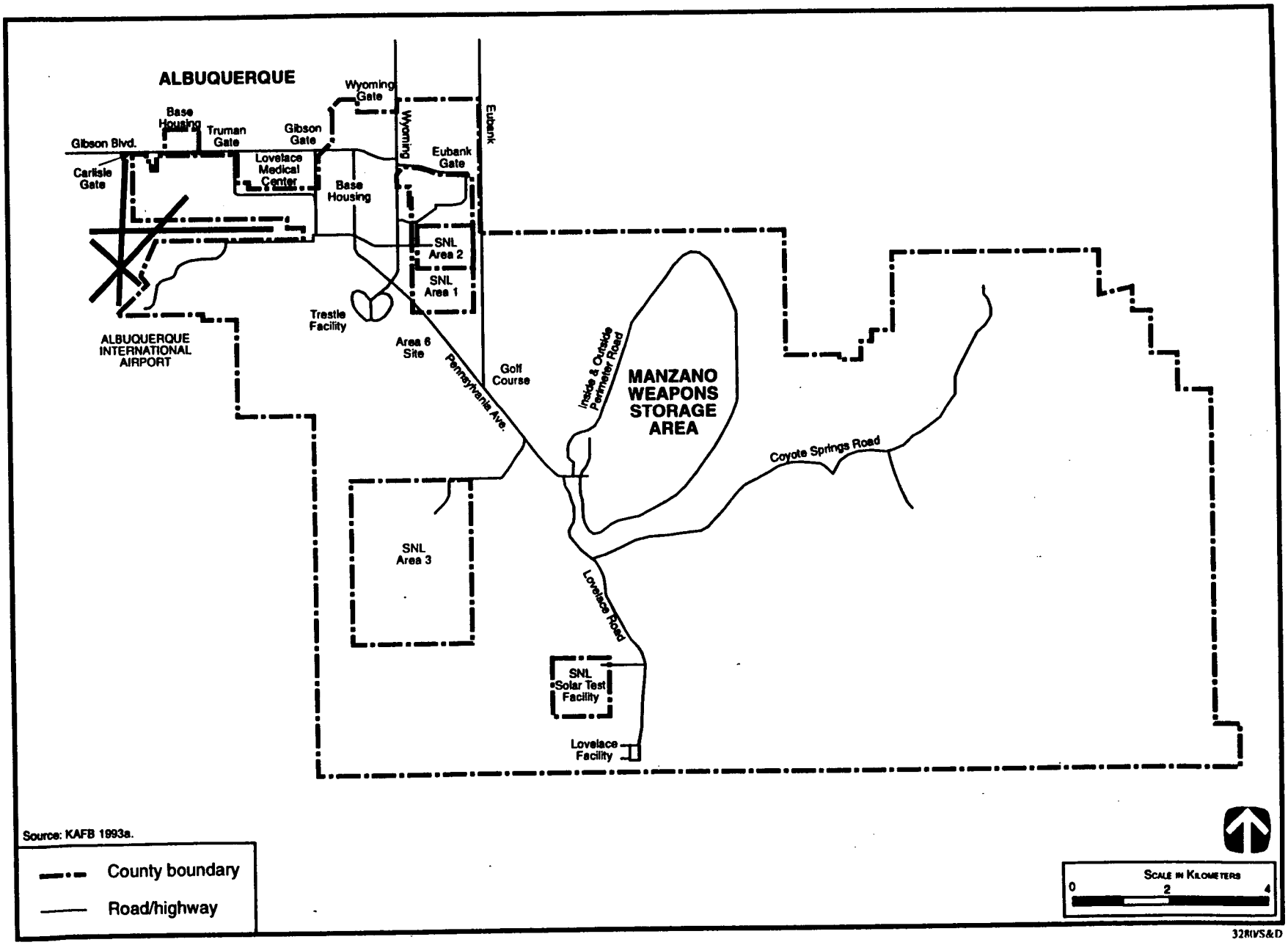

Figure P.1–1. The Manzano Weapons Storage Area at Kirtland Air Force Base, New Mexico.

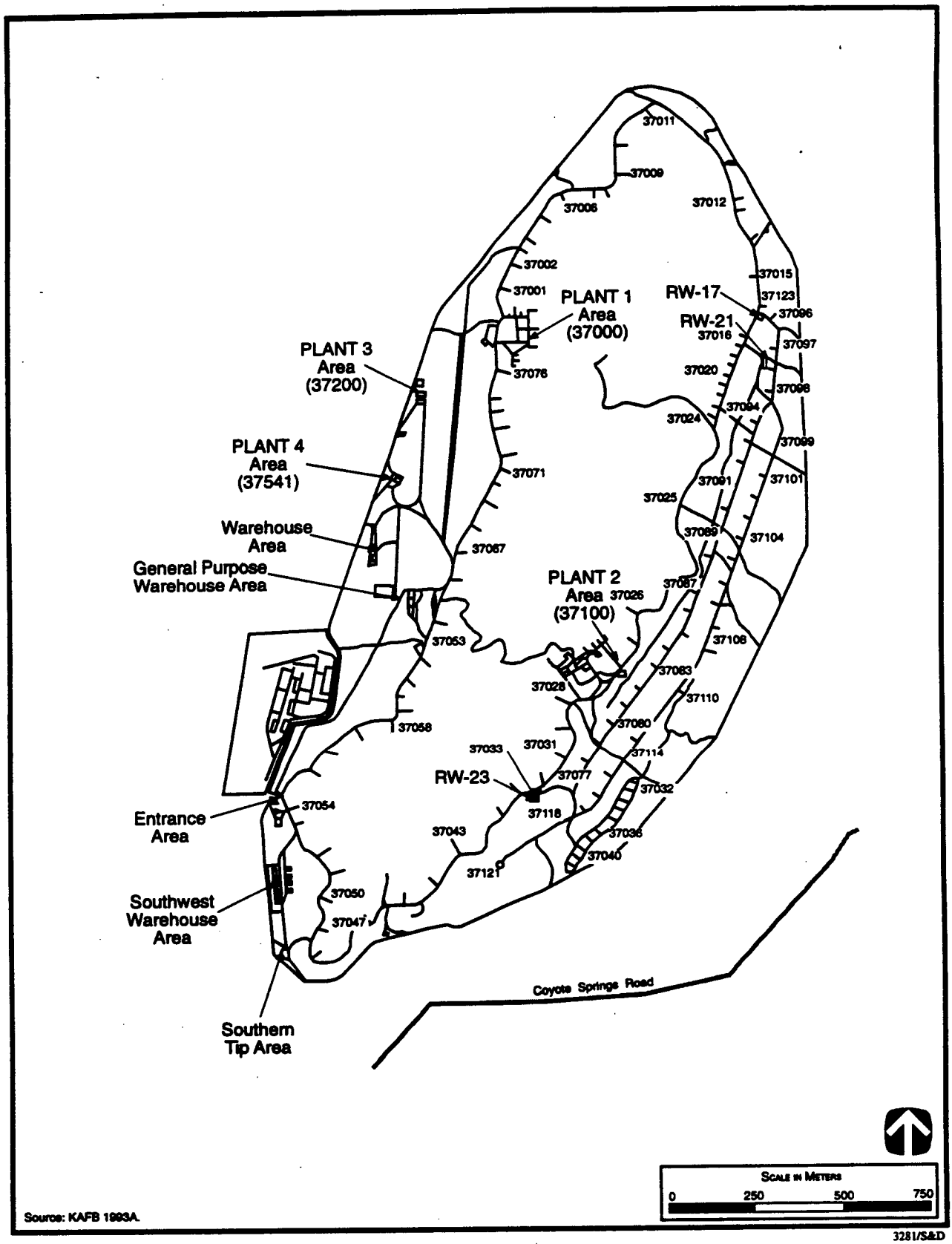

Figure P.1–2. Layout of the Manzano Weapons Storage Area at Kirtland Air Force Base.

represents a 0.8 percent increase over the site's fiscal year 1993 usage of 490,000 MWh/yr and 0.4 percent of the fiscal year 1993 system capacity of 1,095,000 MWh (USAF 1993a:3-17). Maintenance support and indirect impacts resulting from pit storage worker requirements (for example, water, wastewater treatment, and fuel) would increase minimally in comparison to the current and historical onsite infrastructure support levels and system capacities. The Manzano WSA is not currently being utilized at historical or design levels; therefore, the utility systems supporting this facility generally have excess capacity available to support pit storage activity.

P.2.3 AIR QUALITY AND NOISE

Since Manzano WSA is in a moderate nonattainment area for carbon monoxide (CO), air quality analysis is performed at a greater detail for this site. This section provides a more detailed analysis.

P.2.3.1 Air Quality Affected Environment

The Manzano WSA at KAFB is located in Bernalillo County, which is situated in the Albuquerque-Mid Rio Grande Intrastate Air Quality Control Region 152. The Manzano WSA lies outside the City of Albuquerque and is classified as better than national standards for sulfur dioxide, unclassifiable/attainment for ozone (O_3), unclassifiable for particulate matter less than or equal to 10 microns in diameter (PM_{10}), cannot be classified or better than national standards for nitrogen dioxide (NO_2), attainment for CO, and not designated for lead. For CO, Bernalillo County has not had a violation during the past 3 years. As of July 15, 1996, the Environmental Protection Agency (EPA) redesignated Bernalillo County from nonattainment to attainment for CO. The nearest Prevention of Significant Deterioration (PSD) Class I area to the Manzano WSA is the Bandelier Wilderness, approximately 80 kilometers (km) (50 miles [mi]) to the north. The Manzano WSA has no emission sources subject to PSD requirements.

P.2.3.2 Air Quality Environmental Impacts

There are no direct criteria pollutant emissions from the pits during storage. Indirect pollutant emissions would be produced from the exhausts of the vehicles used by employees used to commute to and from work. Also, exhaust emissions from the tractor-trailers used to transport the pits from Pantex to the Manzano WSA would contribute a small amount of pollution to the overall pollutant burden in Bernalillo County, NM.

The calculation of emission rates of exhaust pollutants from employee and pit delivery vehicles was made based on emission factors obtained from the EPA Mobile Source Emission Factor Model (MOBILE 5a). The following assumptions were used in calculating the exhaust pollutant emissions:

- 120 vehicles would be used by security employees (365 days/yr)
- 30 vehicles would be used by operations staff employees (255 days/yr)
- Average roundtrip commute distance: 48 km (30 mi)
- Pit delivery truck roundtrip distance from Pantex in Bernalillo County: 80 km (50 mi)

Table P.2.3.2–1 presents the estimated annual pollutant emissions from employee and pit delivery vehicles. A comparison of these emissions with those in Bernalillo County is also provided in the table. Table P.2.3.2–1 shows that the resulting increase in the CO emission due to storage of pits at the Manzano WSA would be 0.08 percent. Also, these emissions from mobile sources would be distributed over a relatively large area. The increases in the ambient concentrations would, therefore, probably not be detectable and would not cause an increase in the violations of the CO ambient air quality standard (Bernalillo County is currently an attainment area for CO). Nor would these negligible increases cause any violations of the National Ambient Air Quality Standards (NAAQS) for the other criteria pollutants. Also, these small emission increases would not slow

progress in attaining the CO standard. The air quality impacts resulting from the storage of pits at the Manzano WSA would therefore be negligible.

Table P.2.3.2–1. Pollutant Emission Rates Related to Storage of Pits at the Manzano Weapons Storage Area

Source	Pollutant Emission Rate		
	CO (kg)	NO_2 (kg)	VOC (kg)
Employee Vehicles	19,940	3620	2,080
Pit Delivery Vehicles	40	50	10
Total	19,980	3,670	2,090
Bernalillo County (1993)	26,303	NA	NA
Percent of County Emission	0.08	NA	NA

Note: NA=emission factors not available.
Source: PX DOE 1996b.

P.2.3.3 General Conformity Determination

The EPA published the General Conformity Rule 40 Code of Federal Regulations (CFR) parts 6, 51, and 93 on November 30, 1993, to implement section 176(c) of the *Clean Air Act* (CAA) as amended in 1990. This section requires that Federal action conform to the appropriate State Implementation Plan. Conformity, as defined in the CAA, is conformity to the State Implementation Plan's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards. A formal conformity determination is required for Federal actions occurring in nonattainment areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified annual de minimis (threshold) values. Because O_3 is a secondary pollutant, the conformity determination for O_3 uses the precursor emissions of volatile organic compounds and NO_2 as surrogate pollutants. The threshold values are presented in Table P.2.3.3–1. Since the Manzano WSA is in a maintenance for attainment area for CO, the threshold value for CO is 90.7 metric tons (100 short tons) per year (Table P.2.3.2–1). As shown in Table P.2.3.3–1, the emission rate for CO is well below the threshold value. Therefore, a general conformity analysis is not required for the Manzano WSA.

Table P.2.3.3–1. Threshold Values

Criteria Pollutant	Degree of Nonattainment	Emission Rate (kg)
Ozone (VOCs and NO_2)	Serious	45,400
	Severe	22,700
	Extreme	9,100
	Other ozone nonattainment areas (outside of ozone transport region)	90,700
VOCs	Marginal/moderate nonattainment (within ozone transport region)	45,400
NO_2	Marginal/moderate nonattainment (within ozone transport region)	90,700
CO	All	90,700
PM_{10}	Moderate	90,700
	Serious	63,500
SO_2/NO_2	All	90,700
Pb	All	22,700

Source: PX DOE 1996b.

P.2.3.4 Noise

The major sources of noise within KAFB include blasting and explosives testing, aircraft operations, and equipment and machine operations. The only additional sources of noise associated with pit storage operations would be from transportation vehicles. These impacts would be minimal.

P.2.4 WATER RESOURCES

Because of the nature of the pit storage activities, operations at the Manzano WSA would not affect surface water or groundwater. The pit storage activities would not use surface waters at the Manzano WSA. The Manzano WSA has several springs and seeps. Four springs are located on the mountains that make up the Manzano WSA (USCOE 1995b:22,23,27). Some magazines show evidence of water intrusion (KAFB 1993a:48). These magazines were designated as unsuitable for pit storage and would not be used. The sanitary sewer waste from the Manzano WSA would be discharged to approved septic systems. The wastewater would not have a measurable affect on groundwater quality because of the combined effects of a deep water table (15 to 30 m [50 to 100 ft]), low additional discharge volumes, high evaporation rates, and a composition and concentration consistent with treated and sanitary wastewater. The water demands of pit storage operations are solely due to use by storage personnel. The water demands would be less than historical usage at the Manzano WSA and negligible in comparison to the 6.4 billion liters (1.7 billion gallons) used annually at KAFB (USAF 1994a:3-20). The Manzano WSA is located outside of the 100-year and 500-year floodplains (USAF 1979a).

P.2.5 GEOLOGY AND SOILS

The only aspects of geology and soils resource area that could be affected by or have an effect on the implementation of long-term pit storage at the Manzano WSA are the risks associated with earthquakes. The earthquake risk was assessed and found to be bounded by other accidents, as discussed in Section P.2.9. The Manzano WSA is not anticipated to require upgrades that would involve land disturbance; therefore, impacts to soils are not anticipated.

P.2.6 BIOTIC RESOURCES

No Federally listed threatened or endangered plant and animal species have been reported from the Manzano WSA, although the peregrine falcon and the bald eagle may be occasional KAFB migrants (USAF 1994a:3-8, 3-9). However, three specimens of the grama grass cactus, a species of concern, were noted just west of the perimeter fence near the Manzano WSA administrative complex. The western burrowing owl, another species of concern, has been reported 1.6 km (1 mi) west of the Manzano WSA perimeter fence, but not within that facility's boundary. Additionally, two State endangered plants, the viznagita cactus and Wright's fishhook cactus, were found together on gravelly or rocky slopes at nine sites within the Manzano WSA (NM NHP 1995a:15,C-176,C-177). Further, four springs were identified within the perimeter of the Manzano WSA (USCOE 1995b:ES,15-27). However, the long-term storage of pits does not include any action that would disturb the animal or plant species noted above or any of the four springs. Therefore, no impacts to biotic resources would be expected.

P.2.7 CULTURAL RESOURCES

Twenty-seven historic and prehistoric archaeological sites have been found in the Manzano WSA. Of these sites, 8 have been recommended for inclusion in the National Register of Historic Places (NRHP) and 14 others are considered to be potentially eligible for inclusion (ANL 1995c:1-1,1-2,8-2–8-6). The storage of pits would not include any action that would disturb these resources. No storage facilities identified have been nominated to the NRHP. Therefore, no impacts to cultural and paleontological resources would be expected.

To identify areas of potential concern and locations, DOE has, in the past, sought consultations with Native American groups with traditional ties to the area. Two of these groups, the Sandia and Isleta Pueblos, expressed a general concern about the Manzano WSA. Isleta Pueblo considers the Four Hills area that comprises the Manzano WSA to be within their traditional area of cultural activities. They have requested that KAFB inform them of any archaeological finds at the Manzano WSA, specifically in regards to human remains and ritual objects (ANL 1995c:1-1,1-2). The long-term storage of pits is not expected to affect these concerns.

P.2.8 SOCIOECONOMIC RESOURCES

Approximately 150 additional personnel (including 120 security personnel) would be required to operate the storage magazines at the Manzano WSA if pit storage activities were moved to this facility. This number represents less than a 0.8-percent increase in the total Federal workforce at KAFB. Most of these workers could be hired locally; therefore, the increase to the KAFB workforce or the regional population would not be significant. According to the 1990 Census, 150 workers represent 0.06 percent of the of the workforce employed within the KAFB region of influence (ROI) (Census 1993m:202-205). No socioeconomic impacts would be anticipated.

P.2.9 OCCUPATIONAL AND PUBLIC HEALTH

The basic approach used in assessing human health concerns is to first identify the affected environments and establish a baseline that represents the risk from current operations. Changes in this baseline risk resulting from the long-term storage of pits are then examined for both normal operations and potential accidents.

In the Pantex EIS, the assessment of the human health risk impact from potential accidents that results from storing the pits in the Manzano WSA involved a risk screening process. The first step in this process was to identify a broad spectrum of potential accident scenarios. The second step in the process used screening techniques to identify the specific scenarios that dominate risk. Rigorous consequence evaluations are only performed for the identified risk-dominant scenarios.

Two types of accident consequences are examined:

- Worker and public exposure
- The probability of the accident causing fatal cancer in a worker or the public

If DOE chooses to relocate pits to KAFB, two aspects of this relocation contribute to a potential for environmental impacts. They are the impacts associated with the following:

- Transferring pits from the transporter to their storage location inside the facility
- Storage itself (for example, potential impacts resulting from having the pits reside inside the facility)

Each time pits are transferred from the transporter to their storage location inside the facility, there is a small probability that an accidental release could occur due to a handling accident. In addition, the transfer of pits from the transporter to their storage location would result in radiological exposures to involved workers.

P.2.9.1 Affected Environment

The release of radioactivity and toxic chemicals to the environment from a DOE facility is an important issue for onsite workers and the public. Since the human environment contains many sources of radioactivity and toxic chemicals, it is essential to understand the sources of these substances and how effectively they are controlled.

Table P.2.9.1–1 summarizes the major sources of radiation exposure in the vicinity of the Manzano WSA. The average annual probability of contracting a fatal cancer in the State of New Mexico is 1.4×10^{-3}. Using a nominal

Table P.2.9.1–1. Major Sources of Radiation Exposure in the Vicinity of the Manzano Weapons Storage Area at Kirtland Air Force Base

Source of Exposure	Dose to Average Individual (mrem/yr)	Percentage of Total Exposure
Natural Background Radiation		
Cosmic and external terrestrial	119	84.8
Internal terrestrial	39	
Radon in home	200	
Total natural	358	
Medical Radiation		
Diagnostic x rays	39	12.6
Nuclear medicine	14	
Total medical	53	
Other Sources		
Weapons test fallout	<1	2.6
Consumer and industrial products	10	
Air travel	1	
Nuclear facilities (other than transportation of radioactive materials)	<1	
Manzano/Sandia-environmental radioactivity	4×10^{-8}	
Total other	11	
Total (All Sources)	**422**	**100**

Source: NCRP 1987a.

fatal cancer risk factor of 5×10^{-4} cancer fatalities per person rem and the environmental radioactivity data for Manzano/Sandia in Table P.2.9.1–1, it is calculated that fatal cancers attributable to environmental radioactivity released in the vicinity of the Manzano WSA and SNL constitute an extremely small fraction (<0.01 percent) of the average yearly fatal cancer probability in the State of New Mexico (NM DOH 1995a:1).

Figure P.2.9.1–1 depicts the offsite population within an 80-km (50-mi) radius of the Manzano WSA. Windspeeds and directions in the Manzano WSA vicinity are presented in Figure P.2.9.1–2. Winds are predominantly southerly during the summer and northerly during the winter.

P.2.9.2 Environmental Impacts

Human health impacts from pit storage activities could potentially result from normal operations and accident scenarios. Impacts from normal operations would be confined to onsite workers. Normal operational impacts result from the unloading of pits from safe, secure trailers (SSTs) at the Manzano WSA. Unloading operations would result in radiological exposure to cargo handlers. Based on conservative calculations made for handling of pits at Pantex Plant, the worker doses from unloading of 2,000 pits per year are estimated to be 27 person-roentgen equivalent man (rem) per year or 270 person-rem for the unloading of pits. Once removed from the SSTs, pits would be transferred into the Manzano WSA for storage. Pit transfers within the Manzano WSA would result in radiological exposures to onsite workers handling the pits. The transfer of pits would result in worker doses of less than 2 person-rem per year for handling 2,000 pits and 13 person-rem for the placement of pits. The combined worker dose from unloading and storage of pits at the Manzano WSA would be 283 person-rem distributed over the 30 people directly involved in material movement. Over a period of

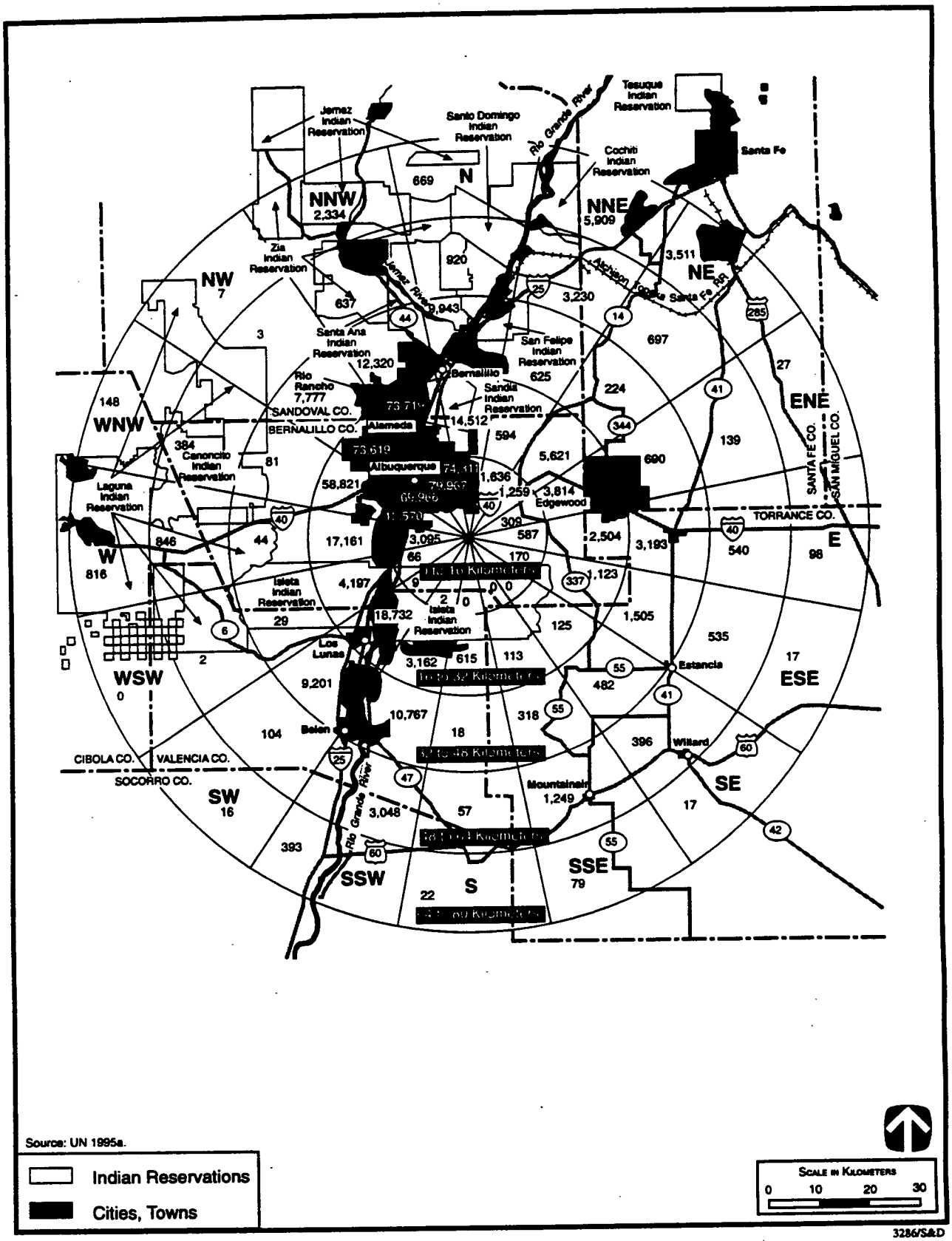

Figure P.2.9.1–1. Offsite Populations in the Vicinity of the Manzano Weapons Storage Area.

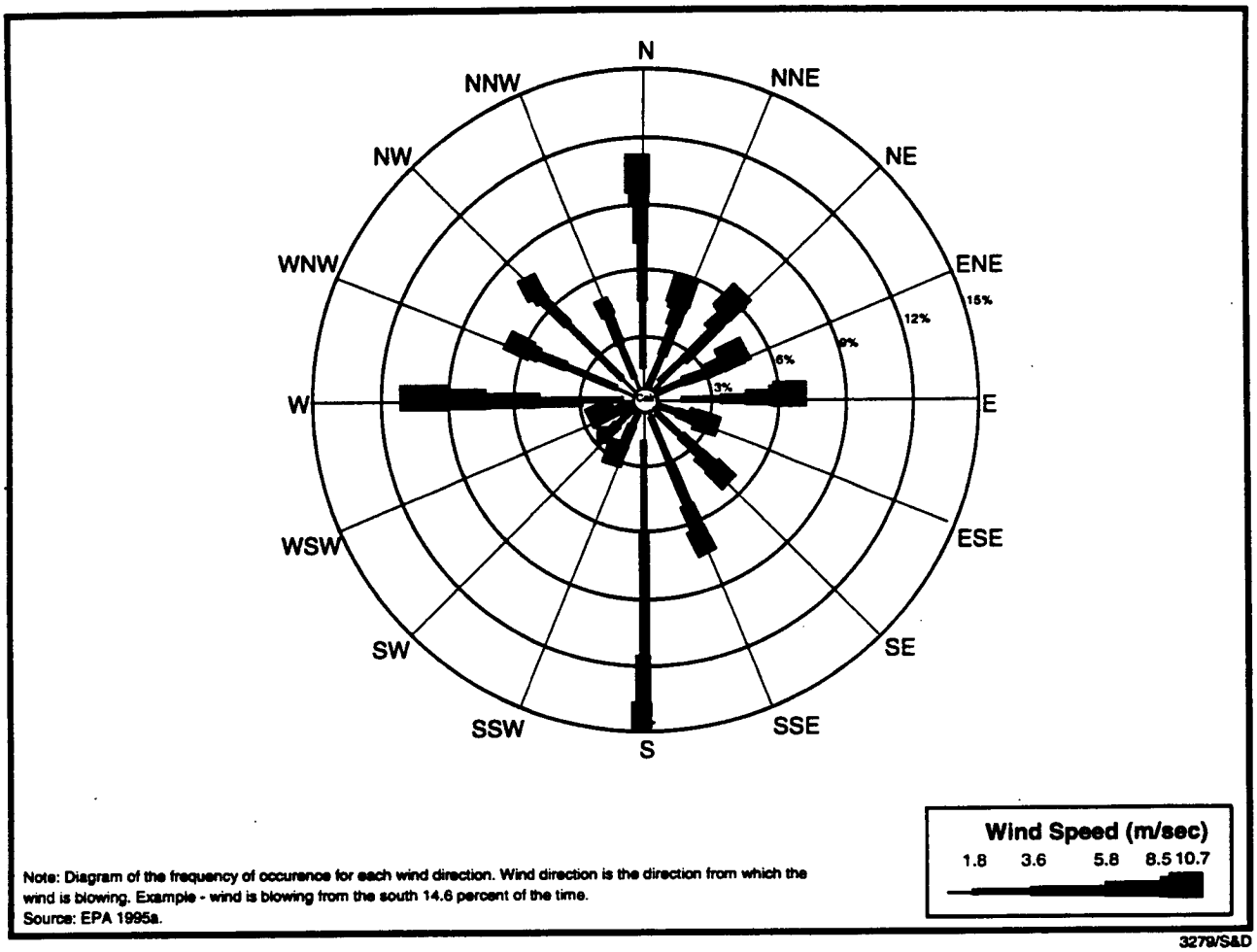

Figure P.2.9.1–2. Wind Direction and Speed at Albuquerque International Airport.

10 years and using a dose-to-risk conversion factor of 4×10^{-4} latent cancer fatality (LCF) per person-rem, there would be an additional 0.11 LCF experienced by this group due to radiological exposure from pit handling. For long-term storage, over a period of 50 years, assuming the handling of 2,000 pits per year and no movement to or from the WSA, there would be an addition 0.04 LCF experienced by the workers.[3]

Some operational accidents could result in impacts to both onsite workers and the offsite general population. Radiological exposures and the resultant risk of latent cancers have been evaluated. The probability of an onsite worker or an offsite member of the general public contracting a fatal cancer resulting from accidental radiological exposure was calculated using the Melcor Accident Consequence Code System (MACCS) computer code.

The radiological health risk from accidents associated with the storage of pits is dominated by handling accidents that could occur when the pits are being transferred from the transporter. A standard tine forklift is likely to be used to remove pit containers from an SST. The probability of a standard tine forklift causing a puncture during a single handling operation is in the range 10^{-4} to 10^{-6} (that is, extremely unlikely as defined by DOE orders). It is estimated that a forklift puncture of a pit container would release 9.2×10^{-5} curies of Pu.

[3] For the Preferred Alternative, surplus Pu material would not be stored for 50 years but until disposition occurs.

This is a conservative estimate of the respirable, airborne release caused by a puncture of one shipping container (PX DOE 1992f:7-39).

Given such a release, an involved worker (the forklift driver) would receive a dose of 6.6 rem, corresponding to an incremental increase in an LCF of 2.6×10^{-3}. In addition, a noninvolved worker 100 m (328 ft) downwind along the center line of the Pu dispersion plume would receive a 5.2×10^{-2} rem exposure, corresponding to an incremental increase in an LCF of 2.1×10^{-5}. The maximally exposed individual of the public would be expected to receive an exposure of 6.7×10^{-3} rem, corresponding to an incremental increase in an LCF of 3.4×10^{-6}.

This event would result in an exposure of 4.0×10^{-2} person-rem to the public within 50 km (80 mi). Considering the likelihood and consequence of this event, on the average, a member of the public will have an increased annual risk of developing a fatal cancer from this potential accident of 2.6×10^{-14} fatal cancers per year. The annual fatal cancer risk to a person in the State of New Mexico from all other causes is 1.4×10^{-3} fatal cancers per year.

Pit container inventories at the Manzano WSA are expected to be performed using either shielded or automated techniques and equipment. Consequently, these normal operations are not expected to result in any significant radiological exposure to workers.

P.2.9.3 Aircraft Accidents

The Manzano WSA is located in the foothills of the Manzano Mountains, approximately 6.5 km (4 mi) southeast of the main (east-west) runway of the Albuquerque International Airport. Figure P.1–1 shows the locations of the Manzano WSA relative to the two runways for the Albuquerque International Airport, one of three airports in the vicinity of the Manzano WSA. The Albuquerque International Airport is the major commercial airfield in the State of New Mexico; it is the only airport with regular commercial jet service. In addition to its role as a commercial airfield, the Albuquerque International Airport is utilized by military aircraft stationed at Kirtland Air Force Base. In 1994, the Albuquerque International Airport had 220,914 aircraft operations (takeoffs and landings) (FAA 1996a:1). Table P.2.9.3–1 summarizes the total number of airfield operations at the Albuquerque International Airport.

In addition to the Albuquerque International Airport, there are two other airports within the Albuquerque area. Coronado Airport is located approximately 19 km (12 mi) to the north-northwest, has two runways, and is used by general aviation aircraft. Similarly, Alameda Airport is located approximately 24 km (15 mi) to the northwest, has two runways, and is also used by general aviation aircraft. Both of these airports are outside the boundary for general aviation aircraft and were therefore not included in the aircraft crash analysis. Only the Albuquerque International Airport and nonairport (in-flight) aircraft were included in the analysis.

Table P.2.9.3–1. Albuquerque International Airport Operations for 1994

Aircraft Type	Number of Operations
Air Carrier	77,978
Air Taxi	41,349
Military	29,929
General Aviation	71,658
Total Airfield Operations	220,914

Source: FAA 1996a:1.

In the history of the Manzano WSA, there have been three aircraft crashes. One crash involved an F-100C; the crash site is located east of the Manzano administration area. Another crash involved a B-29 in the northern portion of the site. This aircraft departed from Kirtland Air Force Base and crashed after approximately

3 minutes in flight, killing the crew. The third crash also occurred in the northern portion of the site and involved an EC-135 (KAFB 1993a:69,73,74). None of these crashes affected the storage facilities.

If DOE chooses to relocate pits to the Manzano WSA, the pits would be stored in Type D magazines. Type D magazines (as shown in Figure P.2.9.3–1) have access tunnels that vary in length from 20 m to over 30 m (65 ft to over 100 ft). The main chambers are approximately 19 m (61 ft) long and have the capacity to store up to 800 pit containers each in a Stage Right configuration using a shielded forklift to stack containers. In addition, the main chambers are protected by two vaultlike steel doors at both ends of the access tunnel.

Type D facilities are tunneled into the mountainside, which provides significant earth overburden protection from penetrating aircraft. As many as 35 magazines have overburden greater than 9 m (30 ft) and are potentially available for pit storage. The frequency of an aircraft impacts at the Manzano WSA is relatively high compared with other potential storage sites. However, the earth overburden of Type D magazine provides complete protection against potential damage from aircraft impacts.

At Manzano, the potential exists for airplanes overflying the area to be carrying conventional bombs. An analysis was performed to determine whether expected bomb loads (one to four 909-kg [2,000-lb] bombs) could damage the Manzano storage magazines in the event of an airplane crash. With the minimum overburden cover of 9 m (30 ft) of granite and earth, the magazines cannot be damaged by any foreseeable aircraft events (Army 1986a: 3-19).

Using the Final DOE Standard for determining the probability of aircraft crashes and 1994 data from the FAA, the frequency of hitting one of the 25 Type D magazines was calculated as 8.8×10^{-5} for all types of aircraft (*DOE Standard, Accident Analysis for Aircraft Crash into Hazardous Facilities, SAFT-0030*). It should be noted that the frequency calculation represents a conservative upper bound. Since this frequency is greater than 1×10^{-7}, the Final DOE Standard stated that further analysis was needed. A structural analysis was done according to the Final DOE Standard for the facility with a 9-m (30-ft) overburden. The analysis was done for the maximum penetrator missile for each of the aircraft categories except for helicopters. None of the aircraft missiles penetrated the facility. Since this frequency is 0, the DOE Standard stated no further analysis was needed.

P.2.10 WASTE MANAGEMENT

For the purpose of this assessment, it is assumed that DOE's SNL would manage the wastes from pit storage at the Manzano WSA. Waste management figures from SNL are used for comparison. SNL manages mixed transuranic waste, transuranic waste, mixed waste, low-level waste, hazardous waste, and nonhazardous wastes in accordance with the requirements of a number of Federal and State regulations, permits obtained under these regulations (for example, New Mexico unilateral FCC order) and DOE Orders. These requirements are primarily under the authority of the EPA, DOE, and the New Mexico Environment Department. SNL generated an estimated 90 cubic meters (m^3) (110 cubic yards [yd^3]) of low-level waste and an estimated 1.7 m^3 (2 yd^3) of mixed waste in 1994. In addition, SNL currently stores approximately 70 m^3 (90 yd^3) of mixed waste onsite (DOE 1995cc:6-4; DOE 1993j:3-71). The new Radioactive Mixed Waste Management Facility for handling these wastes is due to become operational in the near future. SNL generated 751 m^3 (198,450 gal) of liquid and 127 m^3 (166 yd^3) of solid hazardous waste in 1991 (DOE 1993j:3-71). The pit storage operations would generate less than 1 m^3 (1.3 yd^3) of mixed, low-level, and hazardous wastes. Compared to the amounts of waste generated and stored at SNL, the wastes generated by the pit storage activities would be minimal and would not impact the current waste management at SNL.

P.2.11 INTRASITE TRANSPORTATION

Interstate 40 and Interstate 25 provide access to the Albuquerque metropolitan area. Access to KAFB from Interstate 40 is provided from either the Wyoming or Eubank gate entrances (Figure P.1–1). Access to KAFB from Interstate 25 is via Gibson Boulevard.

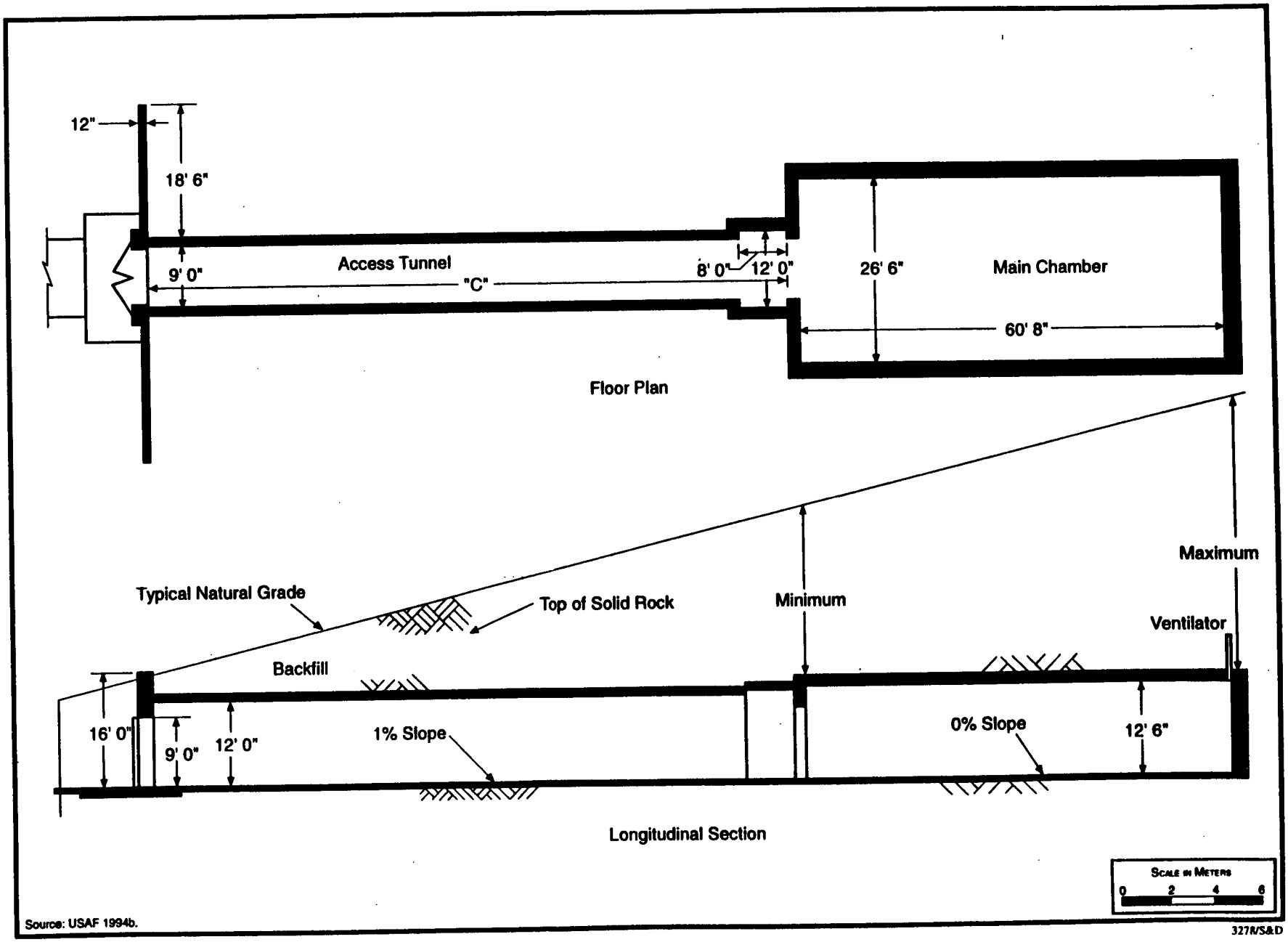

Figure P.2.9.3–1. Type D Storage Facility at the Manzano Weapons Storage Area.

The onsite road system at KAFB consists of paved streets and access roads. The Manzano WSA is located on the east side of KAFB. Access to the Manzano WSA is via Pennsylvania Avenue. The Manzano WSA is surrounded by fencing. Access to facilities within the area is provided via a ring road that encircles the mountain (Figure P.1–2). Traffic within the KAFB boundaries is strictly controlled, and the roads are not open to public traffic. Base personnel traffic would be controlled as SST convoys pass through the base roads. Because a release of Pu from an intersite pit shipment would require a severe accident (for example, an accident with a fuel tanker or a train), the controlled transportation environment at KAFB does not pose a significant threat to pit shipments. Consequently, the contribution to overall intersite transportation accident risk from onsite transport is negligible.

Two high speed transportation corridors (Gibson and Tijeras Arroyo corridors) that would traverse KAFB have been proposed. Of these, the Tijeras Arroyo Corridor would come in closest proximity to the Manzano WSA. Both transportation routes have been discussed for a number of years. However, *National Environmental Policy Act* documentation has not been completed on either project.

P.2.12 ENVIRONMENTAL JUSTICE

P.2.12.1 Affected Environment

The Manzano WSA is located on KAFB, which is adjacent to the southeastern city limits of Albuquerque, in central New Mexico. Besides the Air Force and other Department of Defense facilities, KAFB is also the location of various DOE operations, including SNL. Nearly 20,000 military and civilian personnel work on the base (KAFB 1995a:14). In order to identify the populations covered by Executive Order 12898, an 80-km (50-mi) radius circle centered on the Manzano WSA was overlaid on 1990 Census tract maps. The communities that lie within the 80-km (50-mi) ROI are shown in Figure P.2.12.1–1.

According to the 1990 Census, there were 606,446 persons within the Manzano ROI. White persons comprised 55 percent of the population, Hispanics were the second largest group with 37 percent, and Native Americans accounted for just over 4 percent of the total population. Native American reservations and trust lands belonging to 10 Native American tribes are located within the Manzano ROI, and approximately half of the Native Americans counted in the area in 1990 resided on Native American land. Blacks, Asians, Pacific Islanders and other racial groups totaled less than 4 percent of the total population in 1990 (UN 1995a).

Most of the population in the Manzano ROI resides in various cities, towns, and Census Designated Places. Albuquerque is the most populous community, with 384,736 persons or 63 percent of the total population within the Manzano ROI in 1990. An unincorporated area known as the South Valley, located immediately southwest of Albuquerque and due west of KAFB, is the second largest community in the area, with a 1990 population of 35,701. More than 70 percent of residents in the South Valley were Hispanic. Rio Rancho, northwest of Albuquerque in south-central Sandoval County, is third largest, with 32,505 persons in 1990. North and south of Albuquerque, along the Rio Grande River, are a number of towns and villages, most with primarily Hispanic populations: Belen (5,960 persons in 1990, 67 percent Hispanic), Bernalillo (5,960 persons, 75 percent Hispanic), Bosque Farms (3,791 persons, 25 percent Hispanic), Corrales (5,453 persons, 27 percent Hispanic), Los Chaves (3,872 persons, 49 percent Hispanic), Los Lunas (6,013 persons, 58 percent Hispanic), Tome-Adelino (1,695 persons, 65 percent Hispanic), and Valencia (3,917 persons, 47 percent Hispanic) (Census 1992b:11-21). Most of these communities are also characterized by fairly large low-income populations. For example, Belen had 28 percent of its population below the poverty level, Bernalillo had 24 percent below the poverty level, Los Chaves had 19 percent below the poverty level, Los Lunas had 25 percent below the poverty level, and Valencia had 15 percent below the poverty level (Census 1993m:516-520).

There are also nine primarily Native American communities in the Manzano ROI. A major portion of the northern boundary of the Isleta Indian Reservation borders the southern boundary of KAFB, but the Isleta people (2,699 in 1990) primarily live near the Rio Grande River, several miles from the KAFB boundary. In the

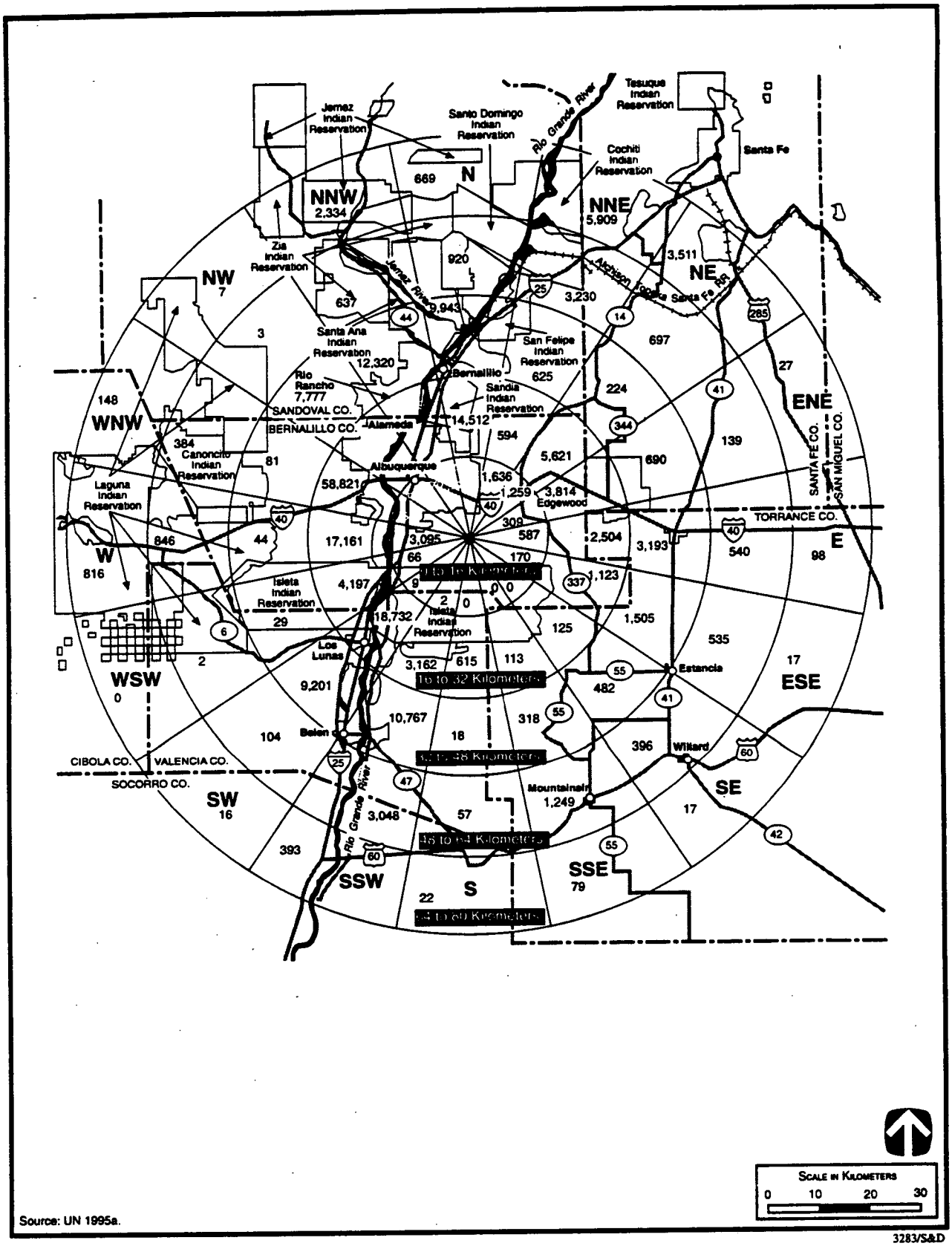

Figure P.2.12.1–1. The Manzano Weapons Storage Area Region of Influence.

Sandoval County portion of the Manzano ROI are seven additional Native American reservations with persons residing in dense settlements known as Pueblos: Sandia Pueblo with 358 Native American residents in 1990; Santa Ana Pueblo with 481 Native American residents; San Felipe Pueblo with 1,859 Native American residents; Santo Domingo Pueblo with 2,947 Native American residents; Cochiti Pueblo with 666 Native American residents; Zia Pueblo with 637 Native American residents; and Jemez Pueblo with 1,738 Native American residents. In the northwest corner of Bernalillo County is the Canoncito Navajo Reservation, a satellite of the main Navajo Reservation, with 1,060 Native American residents counted in 1990 (Census 1991h:60,61). The most notable socioeconomic characteristic of these communities is their large numbers of low-income persons. The percentage of persons below the poverty level based on 1989 incomes found on these reservations were: Isleta, 27 percent; Sandia, 19 percent; Santa Ana, 13 percent; San Felipe, 42 percent; Santo Domingo, 34 percent; Cochiti, 25 percent; Zia, 33 percent; Jemez, 37 percent; and Canoncito, 60 percent (Census 1993m:622-625).

Figure P.2.12.1–2 shows 1990 Census tracts within the Manzano ROI. The tracts are shaded if minority populations comprised 25 percent or more of the populations in 1990 or if 25 percent or more of the persons in a tract were below the poverty level based on their incomes in 1989. The 25 percent threshold levels for minority or low-income persons are based on the working definitions contained in the notice of the EPA's Office of Environmental Justice (59 FR 50757).

Virtually every tract in the Manzano ROI had a population in 1990 in which at least 25 percent of persons were minority or non-Whites. The major exceptions were the southernmost tract in Santa Fe County, 4 tracts in Rio Rancho in southcentral Sandoval County, and 25 tracts located primarily in the northeastern quadrant of Albuquerque, including the Four-Hills Tract located just north of the Manzano WSA.

Low-income persons were not nearly as prevalent in the Manzano ROI in 1990 as were minority persons. High levels of poverty found in Native American communities account for the shaded tracts in rural Sandoval County, eastern Cibola County, and western and southern Bernalillo County. The tracts shaded for low-income persons in rural Socorro, Valencia, Torrance and San Miguel Counties are also areas with largely Hispanic populations. In the Albuquerque area, high poverty levels were found primarily in the southern half of the city, with the greatest concentration of low-income persons situated in the southwest quadrant, in the unincorporated area known as the South Valley, with its 73-percent Hispanic population (Census 1992b:11-21).

P.2.12.2 Environmental Impacts

Because the long-term storage of pits at KAFB would not require any construction activities and because all facility modifications would take place inside existing facilities, impacts to the natural environment would be minimal. Under normal operating conditions, a minor increase in PM_{10} concentrations would be expected from the operation of forklifts that are used to move the pits from the unloading area to the storage area. These impacts are not likely to affect the surrounding population. Radiological releases from normal pit storage operations would have no measurable effect on an individual occupying a position near the KAFB boundary for an entire year. Levels at the site boundary would be indistinguishable from natural background radiation. No health effects would be expected among the general public, including minority and low-income populations, as a result of normal storage operations.

An abnormal event, such as accidental puncture of a storage container by a forklift, has the potential of exposing the general public to radiation. The analysis in Section P.2.9, indicates that the risk to the public from such an accident would be negligible. With no measurable impacts on the general population, the minority and low-income populations would not be disproportionately impacted.

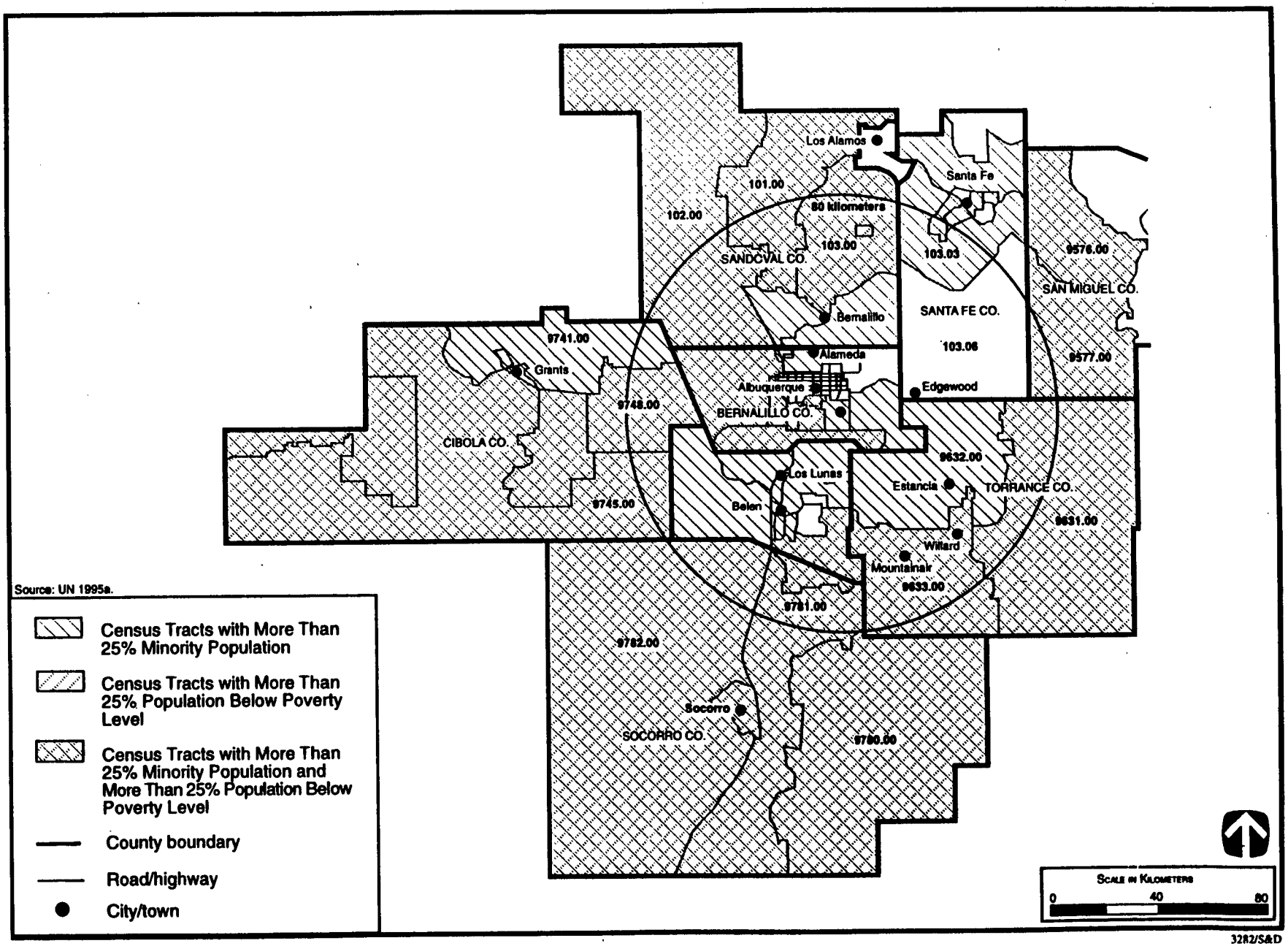

Figure P.2.12.1–2. Minority and Low-Income Populations in the Manzano Weapons Storage Area Region of Influence.

Appendix Q
Storage of Rocky Flats Environmental Technology Site Plutonium Pits at Pantex Plant

Q.1 INTRODUCTION

The Preferred Alternative for storage identified in this Programmatic Environmental Impact Statement (PEIS) calls for the transfer of plutonium (Pu) pits from Rocky Flats Environmental Technology Site (RFETS) (both strategic and surplus) to Pantex Plant (Pantex) with storage of surplus pits continuing until disposition. Pits to be transferred would be packaged in FL (Type B) containers at RFETS before shipment and, upon receipt at Pantex, would be repackaged into AL-R8 containers in Zone 12 South and placed into storage in Zone 4 West pending availability of AT-400A containers and relocation to upgraded storage facilities in Zone 12 South. The transportation of pits between Zone 4 and Zone 12 and the repackaging of the pits from AL-R8 to AT-400A containers is analyzed in the *Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (Pantex EIS). The environmental analysis of intersite transportation for shipment of the RFETS Pu to Pantex is given in Section 4.4 and Appendix G of this PEIS for both workers and the public. Storage of Pantex pits at Zone 4 West is analyzed in the Pantex EIS and incorporated into this appendix as follows.

There are a small number of pits at RFETS that are surplus to national security needs but are still needed for on-going, non-weapons-related research and development projects at Los Alamos National Laboratory (LANL) and Lawrence Livermore National Laboratory. Therefore, these pits will not come within the scope of this PEIS until the research and development projects are completed. It is expected that this work will result in the conversion of the Pu into metal or oxide and the return of the material to RFETS. At that point, the materials will come within the scope of this PEIS and be stored and dispositioned in accordance with the decisions reached on the storage and disposition of surplus Pu in metal or oxide form.

The majority of the surplus pits at RFETS are already in a shippable form. However, there are a small number of pits that are not currently in a shippable condition. If a decision is reached to store surplus pits to Pantex, actions will be taken at RFETS, in accordance with existing procedures and in accordance with decisions based on existing environmental analyses, to place them in a shippable condition prior to shipment to Pantex. All of these pits are types which are currently stored at Pantex or have been stored there in the past.

Q.2 PIT TRANSFER AND STORAGE

Currently at Pantex, pits removed from weapons are swipe-tested to ensure that there is no surface radioactive contamination. Pits are then placed in AL-R8 containers and sealed with a tamper-indicating device. A pit within a container presents an external radiological hazard that is weapons-system-specific. A typical dose rate is 3 millirem per hour at 1 meter (m) (3.3 feet [ft]) from the AL-R8 container.

All pits at Pantex are expected to be stored in Zone 4 West using Stage Right techniques and equipment by December 1996. Stage Right techniques and equipment would enable the stacking of pit containers in a safe configuration, simplify pit transfers, reduce the need for entrance into magazines by personnel, and limit their exposure to radiation. Pits being transferred to Zone 4 West for staging are placed at the disassembly point within a Stage Right pallet (either 4 or 6 containers per pallet) and, using an electric forklift, loaded into a pallet trailer or a hardened trailer, which can carry 24 pit containers. The pallet trailer is driven to Zone 4 West, and the pit pallets are then unloaded by the shielded Stage Right forklift into the storage magazine. Pits are retrieved from a storage magazine in a similar manner.

Q.3 ZONE 4 WEST STAGING OPERATIONS

The bulk of the storage activity associated with the Zone 4 West staging magazines involves material movements to and from the production areas in Zone 12, as discussed in Section 4.12.1.1 of the Pantex EIS.

The Department requires safeguards and security programs at facilities handling special nuclear material. At Pantex, this program requires the periodic inventory of the magazines containing nuclear explosives and nuclear explosive components. The frequency of inventory for pit-staging magazines is dictated by the staging class of the magazine. Pit-staging magazines are divided into two classes: normal and exempt magazines. Normal staging magazines contain reserve components for existing weapon systems. For these magazines, the maximum time between inventories would be 12 months and 1 week. Exempt magazines contain components that are not expected to be reused. For these magazines, the maximum time between inventories would be 21 months and 1 week.

When pit containers are placed in Stage Right configuration, inventories in the magazines are performed with automatic bar code readers and video cameras attached to an inventory pallet. No movement of the pit containers is required for the inventory.

Q.4 RADIOLOGICAL EXPOSURE FROM ZONE 4 STORAGE

Pits from both dismantlement and stockpile management activities are transported and handled within the Pantex boundary as part of the Pantex operations. The transfer of pits between Zone 4 and Zone 12 would require repackaging of pits from original containers (for example, the FL [Type B] containers for pits from the RFETS) into AL-R8 containers for storage in Zone 4. After the AT-400A containers are available, the pits would be repackaged into AT-400A containers for either long-term storage or transportation to a disposition site. Pantex's current schedule indicates a repackaging rate of approximately 2,000 pits /year(yr) starting in 1997. No public exposure to radiation would occur from onsite, incident-free transport of pits.

Under the Proposed Action described in the Pantex EIS, as many as 20,000 pits could be stored in Zone 4. From the repackaging of 2,000 pits per year, it is estimated that an additional worker exposure of less than 30 person-roentgen equivalent man (rem) will be incurred. Similarly, an additional worker exposure of less than 300 person-rem for the repackaging of 20,000 pits will be incurred. Using a normal operations dose-to-risk conversion factor of 4×10^{-4} cancer fatalities per rem, less than 0.12 cancer fatalities would be incurred in the workforce from repackaging 20,000 pits. Repackaging all of the RFETS pits would yield less than an additional 10^{-2} cancer fatalities.

Table Q.4–1 presents the estimated exposures to the 50 people (based on current operation levels) who are directly involved with transportation and staging operations at Pantex. Workers who are not directly involved are not allowed in the vicinity of material transfer operations. These exposures were estimated using historical dosimetry information on site. No public exposure to radiation occurs from nonincident onsite material transfers. Assuming a 2,000 weapons operations maximum activity level, and assuming that the same 50 people remain involved in material handling for the 10 years under evaluation of the Pantex EIS, there should be 0.024 additional latent cancer fatalities in this group due to this exposure.

Assuming that a maximum exposed worker receives less than 0.3 rem/yr over the timeframe evaluated in the Pantex EIS, the incremental increase in lifetime fatal cancer probability from the projected exposure period of 10 yr is approximately 1.2×10^{-3}.

Although the worker exposure will vary depending on the weapons-system-specific pit, the dose to workers from the movement of a single pit container between Zone 4 and Zone 12 or Zone 12 and Zone 4 is 6.5×10^{-4} person-rem, as analyzed in the Pantex EIS. Transferring all of the RFETS pit containers from storage in Zone 4 to Zone 12 for repackaging and returning them to Zone 4 for storage would yield less than 10^{-3} cancer fatalities.

Table Q.4–1. Estimated Transportation and Staging Worker Exposures for the Proposed Action

Number of Additional Weapons Operations	10-Year Worker Exposure[a] (person-rem)	Yearly Average Exposure[a] (person-rem)	Latent Cancer Risk For 10-Year Exposure[a]
2,000	61	6	0.024
1,000	48	5	0.019
500	41	4	0.016

[a] Includes a baseline of 2,000 Pantex pit repackaging operations per year.
Source: PX DOE 1996b.

Therefore, the total exposure to workers from both the transfer of pit containers and the repackaging of pits from FL (Type B) to AL-R8 containers would be less than 10^{-2} additional latent cancer fatalities to workers due to this exposure. No additional exposure to the public from these activities for normal operations would occur.

Potential consequences to the Ogallala Aquifer from an accidental plutonium release were investigated in conjunction with a Safety Analysis Report and an Environmental Assessment by LANL (LANL 1992e:1,2,10). The hypothetical accident leading to dispersal of Pu to the environment around Pantex was assumed to be a high-temperature fire caused by a jet plane impact into a Zone 4 storage magazine containing Pu pits, and subsequent ignition of jet fuel. LANL envisioned that the hypothetical jet fuel fire could disperse fine particulate plutonium downwind of Pantex for a maximum distance of 80 kilometers (50 miles). Prompt decontamination efforts could reduce radiation levels to 0.2 microcuries per square meter ($\mu Ci/m^2$), but surface runoff and wind transport could concentrate contamination at playa lakes, where surface soil radiation levels could be as high as 2.0 $\mu Ci/m^2$. Surface water infiltrating through this contaminated soil could carry plutonium and decay products down toward the Ogallala Aquifer. The model assumed an average recharge rate of 3 centimeters (1 inch)/yr (10 times the High Plains average), and that recharge water would reach the Ogallala Aquifer at a depth of 20 to 100 m (65 to 330 ft).

The analyses conclude that the hypothetical plutonium dispersal accident does not pose a significant threat to the Ogallala Aquifer. The assumptions of the analyses were conservative because the "worst-case" scenarios were based on a depth to the water table of 20 m (50 ft) whereas, at Pantex, the typical depth to the top of perched groundwater is approximately 82 m (270 ft), and the depth to the main Ogallala Aquifer rangers from 104 to 140 m (340 to 460 ft). For water table depths of 60 and 100 m (200 and 330 ft), LANL calculated plutonium travel times of 305,000 and 610,000 years, respectively. Interactions with both surficial materials and the unsaturated portion of the Ogallala Formation would be expected to retard the movement of Pu relative to the infiltrating water (that is Pu would move at a rate slower than the infiltrating water). During the transport time, radioactive decay would be expected to further reduce Pu concentrations (LANL 1992e:10,12). Where the perched aquifer is present, the downward movement of plutonium would be further reduced, because the low-permeability fine-grained zone would impede downward flow and potential contamination would be more likely to move horizontally and follow the course of buried channel sands and gravels.

The likelihood of an aircraft crashing into a critical area at Pantex is extremely unlikely. The likelihood of an aircraft crashing into a critical area at Pantex and affecting (by fire or direct hit) an intransit pit shipment is considered not reasonably foreseeable (frequency of occurrence is less than 10^{-6} /yr) and at least several orders of magnitude less likely than an aircraft impact to a Pantex facility (because of the limited target area of the trailer compared with facilities and the limited time that weapons are contained in a trailer). In terms of risk the potential environmental impacts from an airplane crash into a Zone 4 weapons magazine are much more significant than those associated with a crash into a trailer.

Other potential onsite transportation accidents are much more likely to occur but have less potential for environmental impacts. A characteristic high-probability/low-consequence accident involving radioactive

material is a forklift puncture causing a release of plutonium from a pit container in the onsite transportation environment.

An individual worker would be expected to receive no more than a 7-rem exposure from Scenario 6 (PX DOE 1994e:ES-9). This corresponds to an upper bound incremental increase in fatal cancer probability of 2.8×10^{-3}, given that the release occurs. The maximally exposed non-involved worker would be expected to receive an exposure of 4×10^{-3} rem. This corresponds to an incremental increase in fatal cancer probability of 1.6×10^{-6}.

Q.5 OTHER IMPACTS FROM ZONE 4 STORAGE

The storage of RFETS pits planned under the Preferred Alternative would use existing storage space in Zone 4. Therefore, no land resources, including floodplains and wetlands, would be affected. Currently, all existing Modified Richmond and Steel Arch Construction magazines have the necessary utility support and material access control, and are supported by existing plant facilities and infrastructure. Steel Arch Construction magazines are used to stage nuclear weapons and pits, and require similar levels of infrastructure support as the Modified Richmond magazines. No new construction of storage magazines is required as a result of increasing storage for the RFETS pits. Therefore, current levels of infrastructure and utility support are expected to continue.

Only indirect pollutant emissions would result from pit storage activities. Pollutant exhaust emissions from moving pits between Zone 4 and Zone 12 would be the principal source. Onsite pit transfers are accomplished with electric forklifts which do not emit any pollutants. Pollutant emissions from these indirect sources are a small fraction of the total emissions from Pantex. Therefore, air quality impacts resulting from pit storage activities would be negligible. The principal noise source from pit storage activities would be from the vehicles moving pits between Zone 4 and Zone 12. The number of vehicles would be a very small fraction of the total traffic generated by Pantex. Overall noise level increases resulting from pit storage activities would not be detectable by the human ear. Therefore, noise impacts from pit storage activities would be negligible.

Under the Preferred Alternative, the RFETS number of pits would be stored at Pantex. The increased number of pits would be within the capacity of Zone 4. Storage activities do not pose additional impacts to water quality or availability currently for the operations occurring. Impacts to pit storage activities due to potential erosion, subsidence, and seismic hazards are the same or less than those for other operations at Pantex. Storage activities do not pose additional impacts to soil and sediment quality under normal conditions because the pits would not come in contact with the soil or sediment. Accident release scenarios are discussed in Section Q.4.

The storage of RFETS pits would utilize existing facilities and would not pose impacts to biotic or cultural resources. Only 30 employees are directly involved in current pit storage activity at Pantex. The addition of RFETS pits would use only a portion of these employees. Since they are part of the total employment of 3,800 workers at Pantex, the socioeconomic effects would be minimal.

Pit storage activities generate low-level waste, mixed low-level waste, hazardous waste, and nonhazardous waste. The amount of waste generated (less than 1 cubic meter [1.3 cubic yards] /yr) for each waste category is small compared to the volume of waste routinely handled at the plant, and would not affect waste management activities. The activities generating waste include radiation safety operations (for example, labels, security seals, and personnel protective equipment) and minor maintenance.

Appendix R
Aircraft Crash Accident at Pantex Plant

Aircraft accidents are a concern at Pantex Plant (Pantex) because of the large volume of local air traffic, the proximity of Pantex to flight paths to and from the Amarillo International Airport, and overflights. Pantex is a unique Department of Energy (DOE) facility because the location of nuclear weapons and weapon components, Zone 4 West, is situated on a direct line off the centerline of Runway 04/22. The airport is used by commercial air carriers and air taxis, large and small military aircraft flying touch and go training exercises, and general aviation aircraft. Even though the likelihood of an aircraft crash at Pantex is small, a crash could have the potential of causing radioactive releases from Pantex facilities.

In the past, the aircraft crash analysis was done using the Solomon model, which is over 20 years old. However, this method has been determined to be obsolete because it does not consider aircraft altitude in the model, does not incorporate recent data for crashes that occur near airports in the United States, and does not account for recent changes for aircraft that do not fly on designated airways. DOE has created a new set of models that replace the Solomon model. This DOE standard, *Accident Analysis for Aircraft Crash Into Hazardous Facilities*, was used to estimate the aircraft impacts in the *Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (Pantex EIS).

The Pantex EIS analyzed the probability of hitting those nuclear facilities where plutonium (Pu), highly enriched uranium (HEU), and tritium are located. This analysis separated the 60 storage magazines in Zone 4 West from the nuclear facilities in Zone 12 South, where nuclear operations occur. The probability of an aircraft hitting a facility in Zone 4 or Zone 12 is 1.3×10^{-5} and 1.8×10^{-5}, respectively, for a total probability of 3.1×10^{-5}. The likelihood of an aircraft hitting a Zone 12 South nuclear facility is slightly greater than that of an aircraft hitting a Zone 4 West magazine, primarily because the total Zone 12 South target footprint is slightly larger than that of Zone 4 West.

After determining the probability of an aircraft crashing into a facility, the potential for sufficient building damage to cause a release was then determined. For an aircraft impact, building damage is defined as perforation (when a missile [flying object] generated by an aircraft penetrates into a facility) or scabbing (when an impact of an aircraft missile on a facility generates a secondary missile inside the facility). For magazines or building containing pits not in weapons, the only release mechanism possible is a perforation followed by a fire from spilled aircraft fuel. The Pantex EIS assumed that a perforation would lead to a release. This assumption is conservative for several reasons: 1) a fire may not occur, 2) the magazine contents may not be involved in the fire if the fuel material does not get into the facility, and 3) pits are currently stored in AL-R8 containers, which provide thermal and impact resistance. For Zone 4 and Zone 12 where Pu, HEU, and tritium are stored, the probability of facility perforation leading to a fire is 5.3×10^{-7} and 4.7×10^{-7}, respectively, for a total of 9.9×10^{-7}.

If any of the three storage alternatives (upgrade, consolidate, or collocate) of the *Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Impact Statement* (Storage and Disposition PEIS) were implemented, there would be a change in the aircraft crash probability. These alternatives would transport Pu material from other existing Pu storage sites, including Rocky Flats Environmental Technology Site (RFETS). Since the result of any of these alternatives would be the removal of all Pu pits not in weapons from Zone 4, aircraft crash and release probabilities would be reduced. If either the Preferred Alternative (Upgrade With RFETS Pu Pits Subalternative) or the Upgrade With All or Some RFETS Pu and Los Alamos National Laboratory Pu Subalternative is selected, all Pu would be moved to existing buildings in 12-66 and 12-82. This would reduce the aircraft crash and release probabilities almost proportionally to the number of Zone 4 West magazines no longer used. The aircraft crash and release probabilities in Zone 4 would only be for those magazines where nuclear weapons are staged. The impact of additional Pu in Zone 12 South buildings would

be minimal because Buildings 12-66 and 12-82 are existing and adjacent to where Pu is currently stored. Therefore, the aircraft crash probability would be approximately the same.

The Consolidation Alternative to the Storage and Disposition PEIS has two options at Pantex: 1) build a new facility and modify existing facilities in Zone 12 South or 2) build a new facility in Zone 12 South. Under the first option, there would be a reduction in the aircraft crash and release probabilities due to a reduction in target footprint in Zone 4 and a minimal increase in Zone 12 South as discussed for the Upgrade Alternative. The new facility in Zone 12 South would have a smaller target footprint compared to the Zone 4 West pit storage magazines no longer used. There would be an increase in the aircraft crash and release probabilities because of the addition of a new facility in Zone 12 South and a decrease because of the closing of some magazines in Zone 4 West. Because the overall Pantex footprint would decrease, the overall aircraft accident probabilities for all of Pantex would be reduced. The impacts from the second consolidation option, building a new facility, or the Collocation Alternative, would be similar to the first consolidation option since material would be moved from Zone 4 West to Zone 12 South.

Pantex is a potential site for locating two disposition facilities - pit disassembly/conversion and mixed oxide (MOX) fuel fabrication. Should new facilities be built at Pantex, there would be an increase in the aircraft crash and release probabilities depending on locations. If existing buildings where Pu operations are currently occurring were used, there would be no increase in the aircraft crash and release probabilities. The aircraft crash and release probabilities are highly dependent on the size of the building (target footprint) and the location of the building (whether or not it is shielded by other buildings). Based on the current size and location of the buildings, for the Preferred Alternative, if either the pit disassembly/conversion facility or MOX fuel fabrication facility were built at Pantex, either building would increase by no more than 10 percent of the current Zone 12 crash probability, 1.8×10^{-5}, or release probability, 4.7×10^{-7}. The crash and release probabilities for either building would be assessed in subsequent, tiered *National Environmental Policy Act* review.

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Volume IV - Part A

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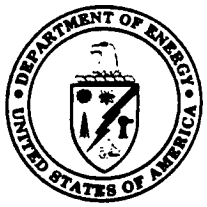
ABSTRACT: This document analyzes the potential environmental consequences of alternatives for the long-term storage (up to 50 years), including storage until disposition, and disposition of weapons-usable fissile materials from U.S. nuclear weapon dismantlements under the responsibility of the DOE. Long-term storage of nonsurplus inventories of weapons-usable plutonium (Pu) and highly enriched uranium (HEU) are required for national defense purposes, while the disposition of surplus weapons-usable Pu is necessary in order to implement our national nonproliferation policy. In addition to the No Action Alternative, this PEIS assesses three storage alternatives (that is, upgrade at multiple sites, consolidation of Pu, and collocation of Pu and HEU) at six DOE candidate sites located across the country. These sites are Hanford Site, Nevada Test Site, Idaho National Engineering Laboratory, Pantex Plant, Oak Ridge Reservation, and Savannah River Site. Although they are not candidate sites for storage, Rocky Flats Environmental Technology Site (RFETS) and Los Alamos National Laboratory are assessed for the No Action Alternative. For the disposition of surplus Pu, three alternative categories (that is, deep borehole, immobilization, and reactor) with nine primary alternatives are assessed at several DOE and representative sites for analysis purposes. Evaluations of impacts on site infrastructure, water resources, air quality and noise, socioeconomics, waste management, public and occupational health and safety, and environmental justice are included in the assessment. The intersite transportation of nuclear and hazardous materials is also assessed. DOE's Preferred Alternative is identified in this Final PEIS. The Preferred Alternative for storage is a combination of No Action and Upgrade Alternatives for the various DOE sites, and phaseout of Pu storage at RFETS. The Preferred Alternative for disposition of surplus Pu is to pursue a disposition strategy involving a combination of immobilization and reactor alternatives, including vitrification, ceramic immobilization, and existing reactors.

PUBLIC INVOLVEMENT: The DOE issued a Draft PEIS on March 8, 1996, and held a formal public comment period on the Draft through June 7, 1996. In preparing the Final PEIS, DOE considered comments received via mail, fax, electronic bulletin board (Internet), and transcripts of messages recorded by telephone. In addition, comments and concerns were recorded by notetakers during interactive public meetings held during March and April 1996 in Denver, CO, Las Vegas, NV, Oak Ridge, TN, Richland, WA, Idaho Falls, ID, Washington, DC, Amarillo, TX, and North Augusta, SC. Comments received and DOE's responses to those comments are found in Volume IV of the Final PEIS.



DOE/EIS-0229

Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Comment Response Document

Volume IV - Part A

United States Department of Energy
Office of Fissile Materials Disposition

December 1996

FOREWORD

This is the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (PEIS), prepared by the U.S. Department of Energy, Office of Fissile Materials Disposition. The document is composed of four volumes and a separate Summary. Changes made since the Draft PEIS are shown by change bar notation (vertical lines adjacent to the changes) in this Final PEIS for both text and tables. Deletion of one or more sentences is indicated by the phrase "Text deleted." in brackets. This Final PEIS includes the Preferred Alternative, which is a combination of alternatives. The Preferred Alternative is described in Section 1.6 and Chapter 2 of Volume I, and analyzed in Chapter 4 of Volume II. For all the alternatives, including the Preferred Alternative, a comparison of alternatives is presented in Section 2.5 of Volume I and a summary of impacts is presented in Section 4.6 of Volume II (Part B). Information from these sections is also presented in the Summary.

Volume I contains Chapters 1 through 3 of the PEIS. Chapter 1 includes a description of the history and background of the fissile materials disposition program, the purpose of and need for the proposed action, a summary of changes made to the Draft PEIS, and the Preferred Alternative. Chapter 2 gives a description of the proposed long-term storage and disposition alternatives, a description of how the alternatives were selected and why others were eliminated from further consideration, and a comparison of the alternatives in terms of their potential environmental impacts. Chapter 3 describes the affected environment at candidate long-term storage locations, and at sites and environmental settings for the disposition alternatives.

Volume II (Parts A and B) contains Chapters 4 through 10 of the PEIS. Chapter 4 describes the potential environmental impacts resulting from construction and operation of the proposed long-term storage and disposition alternatives, including the Preferred Alternative. Also contained in this chapter are intersite transportation impacts, a discussion of environmental justice issues, cumulative impacts due to the implementation of the proposed alternatives in addition to other actions at a site, avoided environmental impacts, and a summary of impacts. Chapter 5 provides a list of references used in the preparation of this document. Chapter 6 provides an index to the main text of the PEIS. Chapter 7 is a glossary of key terms used in the document. Chapter 8 is a list of preparers. Chapter 9 lists government agencies and organizations contacted during the preparation of this PEIS. Chapter 10 provides a distribution list for the document.

Volume III contains the appendices to this PEIS. Appendix A contains the fact sheet on the President's *Nonproliferation and Export Control Policy*, and the Joint Statement Between the United States and Russia on Nonproliferation. Appendix B provides specifications for key buildings within each facility complex analyzed in this PEIS. Appendix C describes requirements for construction and operation of the various facilities required to accomplish the storage and disposition activities essential to the alternatives described in this PEIS. Appendix D provides information on overall water usage for the storage and disposition facilities discussed in this PEIS. Appendix E gives a general overview of the Department of Energy (DOE) environmental restoration and waste management program, baseline waste management at DOE sites, and project-specific waste management activities associated with the proposed long-term storage and disposition alternatives. Appendix F provides detailed data supporting the air quality and noise analyses. Appendix G describes the methodology used for intersite transportation risk analysis and provides a summary of hazardous materials shipped to and from DOE sites, plus information on shipping containers. Appendix H evaluates various plutonium waste forms for potential disposal in a high-level waste repository. Appendix I describes operations of a Canadian Deuterium Uranium Reactor. Appendix J identifies the compliance requirements associated with the Proposed Action, as specified by the major Federal and State environmental, safety, and health statutes, regulations, and orders. Appendix K lists the scientific names of common nonthreatened and nonendangered animal and plant species identified in Chapters 3 and 4. Appendix L includes the supporting data used for assessing the No Action

Alternative in the socioeconomics sections of this PEIS. Appendix M presents detailed information on the potential health risks associated with releases of radioactivity and hazardous chemicals from the proposed storage and disposition alternatives during normal operations and from postulated accidents. Appendix N describes different concepts for, and provides cost and benefit information on, the multipurpose reactor. Appendix O provides a description of facilities and operations for a can-in-canister approach to plutonium immobilization at the Savannah River Site in South Carolina. Appendix P describes the potential environmental impacts of using the Manzano Weapons Storage Area in New Mexico for the long-term storage of plutonium pits. Appendix Q identifies the potential health impacts from the storage of Rocky Flats Environmental Technology Site plutonium pits at the Pantex Plant in Texas. Appendix R discusses the aircraft crash and radioactive release probabilities for proposed storage and disposition facilities at Pantex Plant in Texas. A separate Classified Appendix was also prepared, which provides detailed analysis results for intersite transportation risks based on classified inventories of materials stored at DOE sites.

Volume IV (Parts A and B) is the Comment Response Document. It contains an overview of the public comment process, the comments received on the Draft PEIS during the public review period, and the DOE responses to those comments, including identifying changes made to the Draft PEIS in response to public comments.

The Summary provides a brief overview of the PEIS. It includes the purpose of and need for the Proposed Action, a description of the storage and disposition alternatives including the Preferred Alternative, and the potential environmental impacts resulting from these alternatives.

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LIST OF ACRONYMS AND ABBREVIATIONS

AADT	Average Annual Daily Traffic
ACEC	Area of Critical Environmental Concern
ACGIH	American Conference of Governmental Industrial Hygienists
AEA	*Atomic Energy Act*
AEC	Atomic Energy Commission
AGV	automated guided vehicle
ALARA	as low as reasonably achievable
ALE	Arid Lands Ecology Reserve
ANL-W	Argonne National Laboratory-West
APSF	Actinide Packaging and Storage Facility
AQCR	Air Quality Control Region
ARA	Auxiliary Reactor Area
ARIES	Advanced Recovery and Integrated Extraction System
BEA	Bureau of Economic Analysis
BEIR	biological effects of ionizing radiation
BLM	Bureau of Land Management
BOP	balance-of-plant
BPA	Bonneville Power Administration
BWR	boiling water reactor
CAA	*Clean Air Act*
CANDU	Canadian deuterium uranium
CAS	Chemical Abstracts Service
CCDF	complimentary cumulative distribution function
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
CI	confidence interval
CIC	can-in-canister
CLUP	Comprehensive Land-Use Plan
CMR	Chemistry and Metallurgy Research

COE	Corps of Engineers
Complex	Nuclear Weapons Complex
CRD	Comment Response Document
CRT	Cargo Restraint Transporters
CWA	*Clean Water Act*
D&D	decontamination and decommissioning
DAF	Device Assembly Facility
DCG	derived concentration guide
DHLW	defense high-level waste
DNB	departure of nucleate boiling
DNFSB	Defense Nuclear Facilities Safety Board
DNL	day and night average sound levels
DNWR	Desert National Wildlife Range
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DP	Office of Defense Programs
DRCOG	Denver Regional Council of Governments
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EBR	Experimental Breeder Reactor
EDNA	Environmental Design for Noise Abatement
EIA	Energy Information Administration
EIS	environmental impact statement
EM	Office of Environmental Management
EPA	Environmental Protection Agency
ERR	excess relative risk
ES&H	Office of Environment, Safety, and Health
ESA	*Endangered Species Act*
ETF	effluent treatment facility
FAIR	Forest, Agriculture, Industry, and Research
FCF	Fuel Cycle Facility
FEMA	Federal Emergency Management Agency
FFCA	Federal Facility Compliance Agreement
FFTF	Fast Flux Test Facility

FLPMA	*Federal Land Planning Management Act*
FMEF	Fuels and Materials Examination Facility
FMF	Fuel Manufacturing Facility
FONSI	Finding of No Significant Impact
FR	Federal Register
FSAR	Final Safety Analysis Report
GBZ	Glass-bonded zeolite
GESMO	Generic Environmental Statement on Mixed Oxide
GIS	Geographical Information System
GMA	*Growth Management Act*
GMODS	Glass Material Oxidation Dissolution System
HAD	hazard analysis document
Hanford	Hanford Site
HE	high explosives
HEAST	Health Effects Summary Table
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HEU EIS	*Disposition of Surplus Highly Enriched Uranium Environmental Impact Statement*
HFEF	Hot Fuel Examination Facility
HI	Hazard Index
HLW	high-level waste
HQ	Hazard Quotient
HRA EIS	*Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan*
HVAC	Heating Ventilation and Air Conditioning
HWR	Heavy Water Reactor
IAEA	International Atomic Energy Agency
ICPP	Idaho Chemical Processing Plant
ICRP	International Commission of Radiological Protection
INEL	Idaho National Engineering Laboratory
IRIS	Integrated Risk Information System
ISCST2	Industrial Source Complex Short-Term Model Version 2
ISO	International Standards Organization
IWG	Interagency Working Group
K-25	K-25 Site

L/ER	Energy Research Program Office
LA	Limited Area
LAA	Limited Access Area
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Scattering Center
LCF	latent cancer fatalities
LDR	Land Disposal Restriction
LEU	low-enriched uranium
LIGO	Laser Interferometer Gravitational-Wave Observatory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LOB	Laboratory Office Building
LWR	Light Water Reactor
MAA	Material Access Area
MACCS	Melcor Accident Consequence Code System
MC&A	Material Control and Accountability
MD	Office of Fissile Materials Disposition
MEI	maximally exposed individual
MHR	Modular Helium Reactor
MMI	Modified Mercalli Index
MOX	mixed oxide
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAGPRA	*Native American Graves Protection and Repatriation Act*
NAS	National Academy of Sciences
NCDC	National Climatic Data Center
NCRP	National Commission of Radiological Protection
NEIC	National Earthquake Information Center
NEPA	*National Environmental Policy Act*
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFS	Nuclear Fuel Services Fuel Fabrication Plant
NHPA	*National Historic Preservation Act*
NIOSH	National Institute of Occupational Safety and Health
NMSF	Nuclear Material Storage Facility

NMSM	Nuclear Materials and Stockpile Management
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NRHP	National Register of Historic Places
NTS	Nevada Test Site
NTS EIS	*Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*
NWI	National Wetlands Inventory
NWPA	*Nuclear Waste Policy Act*
NWS	National Weather Service
OCRWM	Office of Civilian Radioactive Waste Management
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PA	Protected Area
Pantex	Pantex Plant
Pantex EIS	*Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*
PBF	Power Burst Facility
PCV	Primary Containment Vessel
PEIS	programmatic environmental impact statement
PEL	Permissible Exposure Level
PFP	Plutonium Finishing Plant
PFP EIS	*Plutonium Finishing Plant Stabilization Environmental Impact Statement*
PIDAS	Perimeter Intrusion Detection and Alarm System
PNNL	Pacific Northwest National Laboratory
PPA	Property Protection Area
PRA	probabilistic risk assessment
PSAR	Preliminary Safety Analysis Report
PSD	Prevention of Significant Deterioration

PUREX	Plutonium-Uranium Extraction Plant
PWR	pressurized water reactor
R&D	Research and Development
RCRA	*Resource Conservation and Recovery Act*
REA	regional economic area
RIA	reactivity insertion accident
RFETS	Rocky Flats Environmental Technology Site
RIMS II	Regional Input-Output Modeling System
RL	Richland Operations Office
ROD	Record of Decision
ROI	region of influence
RSWF	Radioactive Scrap and Waste Facility
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SAR	Safety Analysis Report
SARA	*Superfund Amendments and Reauthorization Act*
sd	standard deviation
SDWA	*Safe Drinking Water Act*
SEB	Security Equipment Building
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SISMP	Site Integrated Stabilization and Management Plan
SMR	Standardized Mortality Ratio
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SRR	standardize rate ratio
SRS	Savannah River Site
Stockpile Stewardship and Management PEIS	*Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*
Storage and Disposition PEIS	*Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement*
SST	safe secure trailer
START	Strategic Arms Reduction Talks

TA	Technical Area
TAN	Test Area North
TCLP	toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environmental Conservation
TDS	total dissolved solids
TI	transport index
TLV	Threshold Limit Values
TNRCC	Texas Natural Resources Conservation Commission
TRA	Test Reactor Area
TRU	transuranic
TSCA	*Toxic Substance Control Act*
TSD	Transportation Safeguards Division
TSP	total suspended particulates
TSR PEIS	*Tritium Supply and Recycling Programmatic Environmental Impact Statement*
TVA	Tennessee Valley Authority
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Survey
VOC	volatile organic compound
VRM	Visual Resource Management
WAC	Waste Acceptance Criteria
Waste Management PEIS	*Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*
WIPP	Waste Isolation Pilot Plant
WMIS	Waste Management Information System
WNP	Washington Nuclear Power
WPPSS	Washington Public Power Supply System
WSA	Weapons Storage Area
WSCC	Western Systems Coordinating Council
WSCF	Waste Sampling and Characterization Facility
Y–12	Y–12 Plant
Y–12 EA	*Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Level at the Y–12 Plant, Oak Ridge, Tennessee*
YMSCO	Yucca Mountain Site Characterization Office
ZPPR	Zero Power Physics Reactor

CHEMICALS AND UNITS OF MEASURE

^{o}C	degrees Celsius
Ci	curie
cm	centimeter
CO	carbon monoxide
CO_2	carbon dioxide
Co-60	cobalt-60
Cs	cesium
Cs-137	cesium-137
CsCl	cesium chloride
Cu	copper
dB	decibel
dBA	decibel A-weighted
^{o}F	degrees Fahrenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
g	gram
G	gravitational acceleration
gal	gallon
Gd	gadolinium
GWd	gigawatt-days
ha	hectare
H_2	hydrogen
HF	hydrogen fluoride
HNO_3	nitric acid
hr	hour
I-129	iodine-129
in	inch
k_{eff}	effective neutron multiplication factor
kg	kilogram
km	kilometer
km^2	square kilometer

Kr	krypton
kV	kilovolt
l	liter
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
mCi	millicurie
mg	milligram
mi	mile
mi^2	square miles
min	minute
mph	miles per hour
mrem	millirem (one thousandth of a rem)
MW	megawatt
MWe	megawatt electric
N_2	nitrogen
nCi	nanocurie (one-billionth of a Curie)
Ni	nickel
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
oz	ounce
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocurie (one-trillionth of a Curie)
PM_{10}	particulate matter less than or equal to 10 microns
ppm	parts per million
Pu	plutonium
PuCl	plutonium chloride
PuO_2	plutonium dioxide
rad	radiation absorbed dose
rem	roentgen equivalent man
RfC	Reference Concentration
RfD	Reference Dose

s	second
SO_2	sulfur dioxide
Sr-90	strontium-90
t	metric ton
Tc-99	technetium-99
ton	short ton
U	uranium
U-233	uranium-233
U-234	uranium-234
U-235	uranium-235
U-236	uranium-236
U-238	uranium-238
UF_6	uranium hexafluoride
UNH	uranyl nitrate hexahydrate
UO_2	uranium dioxide
U_3O_8	triuranium octaoxide
VOC	volatile organic compound
yd	yard
yr	year
µg	microgram (one-millionth of a gram)

METRIC CONVERSION CHART

To Convert Into Metric			To Convert Out of Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor
exa-	E	$1\,000\,000\,000\,000\,000\,000 = 10^{18}$
peta-	P	$1\,000\,000\,000\,000\,000 = 10^{15}$
tera-	T	$1\,000\,000\,000\,000 = 10^{12}$
giga-	G	$1\,000\,000\,000 = 10^{9}$
mega-	M	$1\,000\,000 = 10^{6}$
kilo-	k	$1\,000 = 10^{3}$
hecto-	h	$100 = 10^{2}$
deka-	da	$10 = 10^{1}$
deci-	d	$0.1 = 10^{-1}$
centi-	c	$0.01 = 10^{-2}$
milli-	m	$0.001 = 10^{-3}$
micro-	μ	$0.000\,001 = 10^{-6}$
nano-	n	$0.000\,000\,001 = 10^{-9}$
pico-	p	$0.000\,000\,000\,001 = 10^{-12}$
femto-	f	$0.000\,000\,000\,000\,001 = 10^{-15}$
atto-	a	$0.000\,000\,000\,000\,000\,001 = 10^{-18}$

Chapter 1
Issue Categories

1.1 INTRODUCTION

In February 1996, the Department of Energy (DOE) published the *Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement* (Storage and Disposition Draft PEIS). This PEIS analyzes the direct, indirect, and cumulative environmental effects of reasonable alternatives for the long-term storage and disposition of weapons-usable fissile materials. Following the guidelines set forth in the *National Environmental Policy Act* (NEPA), DOE established a comment period to allow the public to review and comment on the Storage and Disposition Draft PEIS. The public comment period was originally from March 8 through May 7, 1996 (61 FR 9443); however, in response to public request, DOE extended the comment period through June 7, 1996 (61 FR 22038). Comments were accepted as late as June 24, 1996.

During the comment period, public meetings were held at eight locations. Figure 1.1–1 shows the dates and locations of these meetings. Five of the public meetings were joint meetings to obtain comments on both the Storage and Disposition Draft PEIS and the *Draft Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (Stockpile Stewardship and Management PEIS). Two of the joint meetings (Amarillo, Texas, and North Augusta, South Carolina) also included the *Draft Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* (Pantex EIS). The public meetings were directed by a neutral facilitator, and comments and concerns were recorded by notetakers.[1] In addition to public meetings, the public was encouraged to provide comments via mail, fax, telephone (toll-free number), and electronic bulletin board (Internet).

Attendance at each meeting and the number of comments recorded and documents received via other methods during the public comment period are presented in Tables 1.1–1 and 1.1–2, respectively. Attendance numbers for the public meetings were based on the number of participants who completed and returned registration forms. A number of comment documents submitted during the public meetings were recorded as part of the minutes. In some instances, the same comment documents were also submitted as hand-ins at the end of the meeting. In these cases, these documents were analyzed once, as part of the minutes or as stand-alone comment documents. A list appears at the beginning of each public meeting response document showing all the hand-ins that were included as part of the minutes and the page numbers on which they can be found in the *Comment Response Document* (CRD).

Each comment document received by mail, fax, telephone, or electronic bulletin board was marked with the date of receipt and assigned a sequential document number according to its origin (for example, F-001 was assigned to a faxed submission, this tracking code appears in the lower right-hand corner of the scan). The document then was processed through the comment analysis and response system for inclusion in the CRD. A total of 6,543 comment documents were submitted by various organizations and individuals. Several comment documents addressed the Stockpile Stewardship and Management PEIS and Pantex EIS. Copies of these documents were forwarded to those programs for inclusion in the corresponding CRDs. These comments were not addressed in the Storage and Disposition CRD.

[1] In order to ensure that all comments were accurately recorded by the notetakers, transcripts of the proceedings of each meeting were taken. These transcripts are not included in the Storage and Disposition CRD, but have been archived in the Administrative Record for the PEIS.

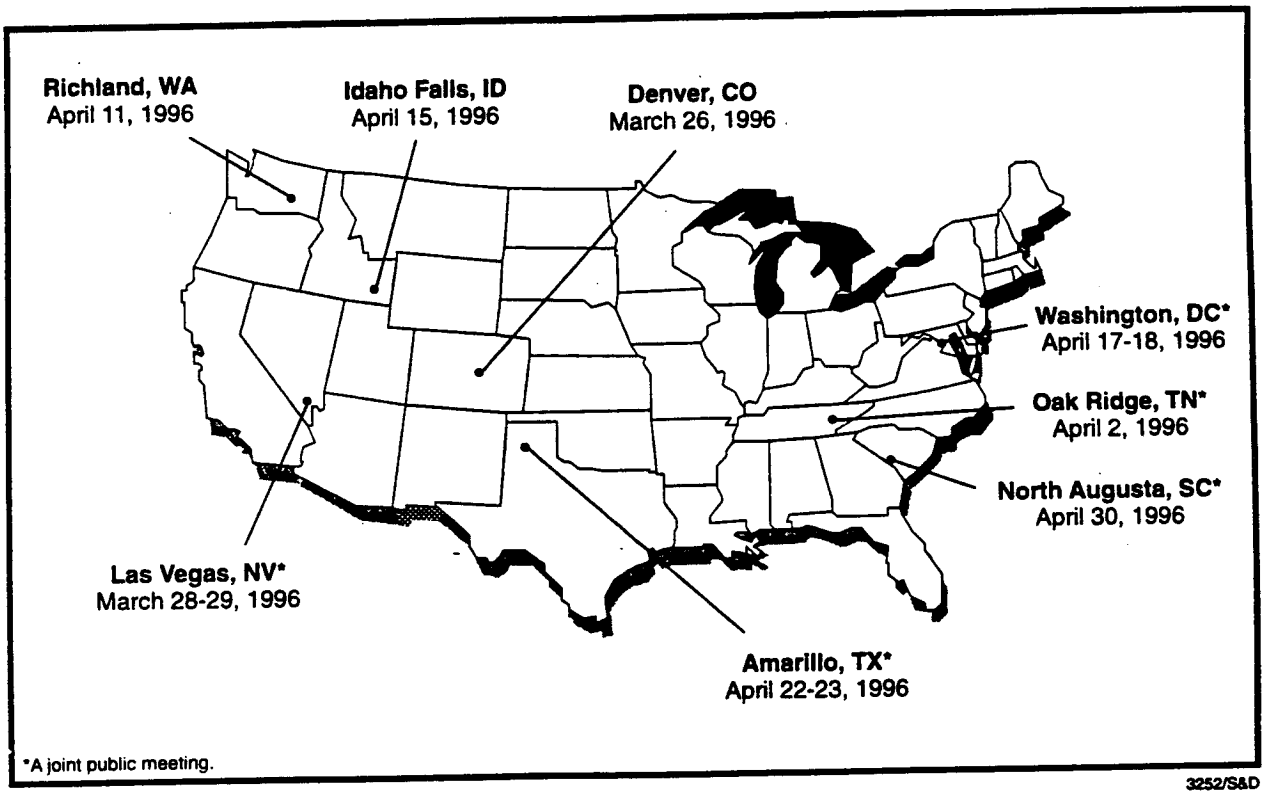

Figure 1.1–1. Dates and Locations of Public Meetings.

Table 1.1–1. Meeting Attendance and Comments

Public Meetings	Attendance	Comments
Denver, CO	39	33
Las Vegas, NV	71	40
Oak Ridge, TN	84	12
Richland, WA	107	24
Idaho Falls, ID	75	34
Washington, DC	132	35
Amarillo, TX	102	17
North Augusta, SC	124	55
Total	**734**	**250**

Table 1.1–2. Document and Comment Submission Overview

Method of Submission	Documents Received	Comments
Hand-ins at Public Meetings	61	182
Mail-in	159	922
Campaign Documents (letters, postcards, hand-ins)	6,203	6,829
Fax	58	410
Telephone	54	75
Electronic Bulletin Board	8	24
Total	**6,543**	**8,442**

1.2 ORGANIZATION

The CRD has been organized into the following sections:

- Chapter 1 describes the comment analysis and response process.
- Chapter 2 presents the changes made to the Storage and Disposition Draft PEIS.
- Chapter 3 presents the scanned images of original documents received during the public comment period. These images are marked with sidebars denoting the identified comments, and the responses that correspond to those comments.

Tables are provided at the end of this chapter to assist readers in locating comments regarding the Storage and Disposition Draft PEIS. Comments were identified and categorized by issue (for example, Policy/Purpose and Need/Scope) and assigned a six-digit issue bin number. An issue bin is the term used for a general topic under which to identify like comments for proper response. Table 1.2–1 lists the issue categories and corresponding issue bin numbers. Issue bins are divided into three separate categories defined as Level 1, Level 2, and Level 3. Level 1 issue bins include the various Fissile Materials Disposition Program topics included in the Storage and Disposition Draft PEIS. Level 2 issue bins represent a subdivision of the Level 1 topics and provide for further definition of the specific topic. Level 2 issue bins include the various storage and disposition alternatives and environmental resource/issue areas evaluated in the Storage and Disposition Draft PEIS. Level 3 issue bins designate the specific site at which the specific topic and/or alternative may occur. The majority of identified comments were responded to on a one-to-one basis. Comments that are similar in content were given the same response.

Table 1.2–2 identifies public meeting attendees and the location of comments and responses from each meeting. Table 1.2–3 lists the individuals, agencies, companies, organizations, and special interest groups that submitted comment documents. Commentors are listed alphabetically by last name or organization name, along with the corresponding page number on which the actual comment document appears. Also listed in this table are the issue bin numbers assigned to the comments found within each document.

For convenience, the information in Table 1.2–3 was then broken out into three separate tables. Table 1.2–4 lists the agencies, companies, organizations, and special interest groups that submitted comments, corresponding page numbers on which the actual comments appear, and assigned issue bin numbers. Table 1.2–5 provides an alphabetical list of individuals who submitted comments, corresponding page numbers on which the actual comments appear, and assigned issue bin numbers. Table 1.2–6 lists those documents considered to be multiple signatory[2] documents, page numbers on which the actual comments appear, and assigned issue bin numbers.

As discussed in Section 1.1, documents were received by mail, fax, telephone, or electronic bulletin board. In some instances, multiple documents were received from a single commentor. To ensure that all comments submitted by an individual or organization were included in the CRD, multiple documents were treated simultaneously. If, during the review, variations in the documents were identified, the documents were treated separately. If the documents were identical (presenting verbatim comments), only one of the documents was reviewed and scanned for inclusion in the CRD. Commentors wishing to view comments similar in content should refer to Table 1.2–7, which lists the issue bins in which comments were grouped and the page numbers where the comments are located. Multiple page numbers indicate several comments on the same issue. In addition, Tables 1.2–8 through 1.2–14 list commentors who submitted documents that were classified as postcard or letter campaigns. The postcards and letters were part of campaigns conducted by various organizations and special interest groups to express either support of or opposition to the Fissile Materials Disposition Program. Although many postcards and letters were received for these campaigns, only one scanned image is shown in Chapter 3 for each campaign.

[2] A multiple signatory document is a document that has been signed by more than two individuals.

Table 1.2–1. Issue Bins

Level 1		Level 2		Level 3	
01	Policy/Purpose and Need/Scope	.00	General	.00	All Comments
		.01	Storage		
		.02	Disposition		
		.03	International		
		.04	Definition of Alternatives/ Selection of Alternatives		
		.05	Screening Process		
		.06	Domestic Policy		
02	Storage	.00	General	.01	Hanford
		.01	No Action	.02	NTS
		.02	Multiple Sites	.03	INEL
		.03	Consolidate	.04	Pantex
		.04	Collocate	.05	ORR
		.05	Siting/Regulatory	.06	SRS
				.07	RFETS
				.08	Other
03	Disposition (common activities)	.00	General	.01	Hanford
		.01	Pit Disassembly/Conversion	.02	NTS
		.02	Plutonium Conversion	.03	INEL
		.03	Siting/Regulatory	.04	Pantex
				.05	ORR
				.06	SRS
				.07	RFETS
				.08	Other
04	Disposition (borehole)	.00	General	.00	All Comments
		.01	Direct		
		.02	Immobilized		
		.03	Siting		
		.04	Regulatory		
05	Disposition (immobilization)	.00	General	.01	Hanford
		.01	Vitrification	.02	NTS
		.02	Ceramic	.03	INEL
		.03	Electrometallurgical	.04	Pantex
		.04	Siting/Regulatory	.05	ORR
				.06	SRS
				.07	RFETS
				.08	Other
06	Disposition (reactors)	.00	General	.01	Hanford
		.01	MOX Fuel Fabrication	.02	NTS
		.02	Existing Commercial	.03	INEL
		.03	Partially Completed	.04	Pantex

Table 1.2–1. Issue Bins—Continued

Level 1		Level 2		Level 3	
		.04	Evolutionary	.05	ORR
		.05	CANDU	.06	SRS
		.06	Siting/Regulatory	.07	RFETS
				.08	Other
				.09	Generic
				.10	Global Commons
07	Cost/Schedule	.00	General	.00	All Comments
		.01	Facility/Technology		
		.02	Comparison of Costs		
		.03	Russia		
		.04	Canada		
08	NEPA Process	.00	General	.00	All Comments
		.01	Comment Period	.01	Opinions
		.02	Public Participation		
		.03	Decision Process/ROD		
09	Environmental Resources	.00	General	.01	Hanford
		.01	Land	.02	NTS
		.02	Site Infrastructure	.03	INEL
		.03	Air and Noise	.04	Pantex
		.04	Water	.05	ORR
		.05	Geology and Soils	.06	SRS
		.06	Biological	.07	RFETS
		.07	Cultural	.08	Other
		.08	Socioeconomic		
		.09	Public Occupational Health and Safety–Radiological Impacts and Facility Accidents		
		.10	Public Occupational Health and Safety–Hazardous Chemical Impacts		
		.11	Waste Management		
		.12	Environmental Justice		
10	Transportation	.00	General	.00	All Comments
		.01	Emergency Response		
		.02	Accident Analysis		
		.03	Classified Appendix		
11	Relationship to Other Actions	.00	General	.01	Hanford
		.01	NEPA	.02	NTS
				.03	INEL
				.04	Pantex

Table 1.2–1. Issue Bins—Continued

Level 1		Level 2		Level 3	
				.05	ORR
				.06	SRS
				.07	RFETS
				.08	Other
12	Ultimate Disposal	.00	General	.00	All Comments
		.01	HLWR (Yucca Mtn)		
		.02	WIPP		
		.03	Other Wastes		
13	Security, Including Terrorism	.00	All Comments	.00	All Comments
14	Other Technology Issues	.00	General	.00	All Comments
15	Not Applicable Comments	.00	All Comments	.00	All Comments
16	Editorial Comments	.00	All Comments	.00	All Comments

Table 1.2–2. Index of Attendance at Public Meetings

Public Meeting Attendees	Document Page No.
March 26, 1996—Denver, Colorado	3–722 to 3–728
Afternoon Session	
Aguilar, Christopher, EPA, Denver, CO	
Atwater, John, Golden CO	
Auble, Luanne, Northwest Metro Chamber of Commerce, Arvada, CO	
Fager, Cal, Arvada, CO	
Groves, Linda, Tracy, CA	
Hardin, Sharon, SSOC, Westminster, CO	
Hudson, Miller, Denver, CO	
Korkia, Ken, Rocky Flats Citizens Advisory Board, Westminster, CO	
Lee, Pete, DOE/Rocky Flats Environmental Technology Site, Golden, CO	
Navarro, David M., USWA Local 8031, Westminster, CO	
Rippetoe, Joe, Arvada, CO	
Romanelli, Richard, Washington Public Power Supply System, Richland, WA	
Ross-Lee, Mary Jane, DOE/Rocky Flats Environmental Technology Site, Golden, CO	
Sedgely, Jeanie, Rocky Flats Local Imports Initiative, Arvada, CO	
Smith, Frank, Boulder, CO	
Stone, James, Rocky Flats Cleanup Commission, Lakewood, CO	
Werth, Kenneth, Rocky Flats Citizens Advisory Board, Westminster, CO	
Evening Session	
Anderson, Jerry, Rocky Flats, Westminster, CO	
Brinsfield, Wes, Tenera, San Francisco, CA	
Ciarlo, James, Boulder, CO	
Consani, Keith, Broomfield, CO	
Crouch, Jeanne, ETCI, Inc., Denver, CO	
Etchart, Patrick, DOE/Rocky Flats Environmental Technology Site, Golden, CO	
Groves, Linda, Tracy, CA	
Hatfield, Scott, Tau Beta Pi, Boulder, CO	
Hingerty, Arthur M., University of Colorado; Dept. of Political Science, Boulder, CO	
Holm, Victor, Lakewood, CO	
Hudson, Miller, Denver, CO	
Johnson, Karen, Littleton, CO	
Kine, Peter, Department of Energy/OIG, Lakewood, CO	
North, Karen, Project Phoenix (SETI), Boulder, CO	
Parker, Douglas A., Arvada, CO	
Parkhurst, Lyman, Arvada, CO	
Ryan, Kay, Special Projects, Boulder, CO	
Smits, Jill, ERA Lab, Arvada, CO	
Smits, Dennis, U.S. Geological Survey, Denver, CO	
Thompson, Gary H., RFETS/Kaiser Hills Rocky Flats Citizens Advisory Board, Northglenn, CO	
Transue, Martin, Rocky Flats (K-H), Arvada, CO	
Trenary, Alan, Broomfield, CO	

Table 1.2–2. Index of Attendance at Public Meetings—Continued

Public Meeting Attendees	Document Page No.
	3–742 to 3–751

March 28, 1996—Las Vegas, Nevada

Evening Session

Ace, Mary H., Washington Public Power Supply System, Richland, WA
Armstrong, Dennis, Department of Energy/WMD, Las Vegas, NV
Barre, Richard, Bechtel Nevada, Las Vegas, NV
Battaglia, Carmen, Bechtel Nevada, Las Vegas, NV
Bechtel, Dennis, Clark Company, Nuclear Waste Division, Las Vegas, NV
Blodgett, Jim, Department of Energy/NV, Las Vegas, NV
Borden, John, Las Vegas, NV
Bradfield, Felicia, Tetra Tech, Las Vegas, NV
Calfin, Kathleen, UNLV
Campbell, Bruce, Mason & Hanger, Amarillo, TX
Chakrabarti, Andy, Woodward Clyde, Washington, DC
Chrisman, Robert, Las Vegas, NV
Cotter, Joy, Bechtel Nevada, Las Vegas, NV
Devlin, Sally, Pahrump, NV
Dillaplain, Michael, Nevada Test Site Community Advisory Board, Henderson, NV
Edwards, Thomas O., Bechtel Nevada, Las Vegas, NV
Flangas, William, Las Vegas, NV
Foster, Will, Las Vegas, NV
Founds, Nanette, Department of Energy/Albuquerque Operations Office
Frishman, Steve, State of Nevada NWPO, Carson City, NV
Harney, Corbin, Shundahai Network, Batre Mountain, NV
Harrison, Diane, Department of Energy
Henderson, James, Bechtel Nevada, Las Vegas, NV
Hudlow, Grant, Pahrump, NV
Irwin, Hank, Sandia National Laboratory, Livermore, CA
Knutson, Reinard, Nuclear Abolition Summit, Las Vegas, NV
Kok, Kenneth, LATA, Las Vegas, NV
Manning, Mary, Las Vegas Sun Newspaper, Las Vegas, NV
McGee, Curt, Bechtel Nevada, Las Vegas, NV
McGowan, Tom, Las Vegas, NV
Palmer, Gary, Defense Programs
Riccardi, Michael, Las Vegas, NV
Smith, Robert, SAIC, Las Vegas, NV
Smith, D.
Stewart, Carrie, PAI, N. Las Vegas, NV
Stewart, Lana, Bechtel Nevada, Las Vegas, NV
Szymanshi, Jerry, TRAC-NA, Las Vegas, NV
Talbot, Edward B., Sandia National Laboratory, Livermore, CA
Treichel, Judy, Nevada Nuclear Waste Task Force, Las Vegas, NV
Tullman, Ed, Department of Energy
Walker, John, State of Nevada NWPO, Carson City, NV
Zavattado, Peter, Las Vegas, NV
Zimmerman, Janene, Las Vegas, NV

Table 1.2–2. Index of Attendance at Public Meetings—Continued

Public Meeting Attendees	Document Page No.
March 29, 1996—Las Vegas, Nevada	3–742 to 3–751
Morning Session	
Allen Gylan C., Department of Energy/NV, Las Vegas, NV	
Bourn, Michael, Amarillo Economic Development Corporation, Amarillo, TX	
Brown, Chris, Campaign for Nevada's Future, Las Vegas, NV	
Burton, Thomas, Nevada Indian Environmental Coalition, Reno, NV	
Cebe, Jim, HPD/Department of Energy/NV, Las Vegas, NV	
Devlin, Sally, Pahrump, NV	
DiSanza, E. Frank, Department of Energy/EM	
duBartolo, Russell, Clark Company, Nuclear Waste Division, Las Vegas, NV	
Flangas, William, Las Vegas, NV	
Freeland, William, YMSCO, Las Vegas, NV	
Glines, Chad, Department of Energy/NV, Las Vegas, NV	
Goin, Patty, North Las Vegas, NV	
Golden, Bobby, Department of Energy/NV/EPD, Las Vegas, NV	
Gurka, Becky, Las Vegas, NV	
Hayes, Dennis, Bechtel Nevada, Las Vegas, NV	
Hudlow, Grant, Pahrump, NV	
Iden, Barbara, Las Vegas, NV	
Irwin, Hank, Sandia National Laboratory, Livermore, CA	
Leskover, Christy, Bechtel Nevada, North Las Vegas, NV	
Nielsen, Richard, Citizen Alert, Las Vegas, NV	
Prins, Gretchen, Las Vegas, NV	
Ruggieri, Joseph, Henderson, NV	
Schutte, Dale, Nevada Test Site Citizens Advisory Board, Pahrump, NV	
Seddon, William, AECL Technologies, Inc., Rockville, MD	
Talbot, Edward B., Sandia National Laboratory, Livermore, CA	
Vasconi, William, International Brotherhood of Electrical Workers, Las Vegas, NV	
White, Roy, Bechtel Nevada, Las Vegas, NV	
Wilcox, Debbie, Las Vegas, NV	
April 2, 1996—Oak Ridge, Tennessee	3–752 to 3–755
Morning Session	
Benchit, Robert B.	
Bernander, Ken, CNS	
Bevard, Bruce, Oak Ridge National Laboratory, Oak Ridge, TN	
Boles, Ronald, OCAW Local 3288, Knoxville, TN	
Brandon, Norman, Nuclear Fuel Services, Inc., Erwin, TN	
Brooks, Alfred, Oak Ridge, TN	
Cagle, Gordon, Lockheed Martin Energy Systems (Y–12), Oak Ridge, TN	
Campbell, Bruce, Mason & Hanger, Amarillo, TX	
Carleton, Teresa, WCS, Inc., Oak Ridge, TN	
Chardos, Jim, TVA, Hollywood, AL	
Chesney, Bill, Rogers Group, Inc., Oak Ridge, TN	
Devine, Terry, Frankfurt, KY	
Deweese, Adam, TDEC/Department of Energy–Oversight Division, Oak Ridge, TN	
Franklin, James, Oak Ridge, TN	

Table 1.2–2. Index of Attendance at Public Meetings—Continued

Public Meeting Attendees	Document Page No.
April 2, 1996—Oak Ridge, Tennessee (continued)	3–752 to 3–755
Gallaher, Rickey, OCAW Local 3288, Kingston, TN	
Garber, Sandra L., Knoxville, TN	
Hearron, Stan	
Hickman, H. D., Citizens for National Security	
Holman, Garry S., Los Alamos National Laboratory, Livermore, CA	
Huffman, Clark, HEI, Oak Ridge, TN	
Hunter, Hayes, Knoxville, TN	
Hunter, Joyce, Knoxville, TN	
Hutchison, Ralph, OREPA, Oak Ridge, TN	
Juba, Robert (Bob), Amarillo Economic Development Corporation, Amarillo, TX	
Kite, Harvey T., Oak Ridge, TN	
Larkin, David, Washington Public Power Supply System, Richland, WA	
Maienschein, F.	
McCullough, William, Oak Ridge, TN	
McDuffie, H. Fritz, Oak Ridge National Laboratory, Oak Ridge, TN	
McMillan, G. Jarvis, Presbyterian Church, USA, Hendersonville, NC	
Michener, L. R., ERDA, Kingston, TN	
Miles, Ricky C., TVA–Bellefonte Nuclear Plant, Hollywood, AL	
Miskelley, Ray, Department of Energy/ORO, Oak Ridge, TN	
Monroe, William E., TDEC/DOE–Oversight Division, Oak Ridge, TN	
Nisley, Steve S., TDEC/DOE–Oversight Division, Oak Ridge, TN	
Okulczyk, G. M., TDEC/DOE–Oversight Division, Oak Ridge, TN	
Philippone, Richard L., Oak Ridge, TN	
Pruett, Roy, East Tennessee Economic Council	
Ragan, Guy, SAIC, Oak Ridge, TN	
Rhoton, Amy, Lockheed Martin Energy Systems	
Rice, Dean, Senator Fred Thompson, Knoxville, TN	
Robinson, Charlotte L., LOC-CAP, Oak Ridge, TN	
Schroeder, Charles, Commonwealth Edison Co., Downers Grove, IL	
Sigal, Lorene, Oak Ridge, TN	
Speller, Wayne, Lockheed Martin Energy Systems/ER, Oak Ridge, TN	
Spellman, Donald, Oak Ridge National Laboratory, Oak Ridge, TN	
Stethen, Steve, Lockwood Greene Tech.	
Taylor, Ellen, Los Alamos National Laboratory, Germantown, MD	
Trauger, Donald B., Oak Ridge, TN	
Valentine, Ken	
Wamp, Zach, United States House of Representatives, Washington, DC	
Webb, Jennifer L., Lockheed Martin Energy Systems/EMD, Oak Ridge, TN	
Wilcox, Jr., William J.	
Wills, Harry, Oak Ridge, TN	
Yard, Charles R., TDEC/Department of Energy–Oversight Division, Oak Ridge, TN	
Evening Session	
Agle, Angela C., Oak Ridge, TN	
Alban, Alexander, Lockheed Martin Energy Systems Central Engineering, Oak Ridge, TN	
Bevard, Bruce, Oak Ridge National Laboratory, Oak Ridge, TN	

Table 1.2–2. Index of Attendance at Public Meetings—Continued

Public Meeting Attendees	Document Page No.
March 28, 1996—Oak Ridge, Tennessee (continued)	3–752 to 3–755
Burdett, Robert B.	
Cagle, Gordon, Lockheed Martin Energy Systems (Y–12), Oak Ridge, TN	
Collier, Thomas, Oak Ridge, TN	
Dillow, Weldon, Clinton, TN	
Gallaher, Rickey, OCAW Local 3288, Kingston, TN	
Gunning, John E., Bechtel Environmental, Oak Ridge, TN	
Holman, Garry S., Los Alamos National Laboratory, Livermore, CA	
Juba, Robert (Bob), Amarillo Economic Development Corporation, Amarillo, TX	
Lanford, Jeff, Horne Engineering, Oak Ridge, TN	
Lemons, Thomas, Knoxville, TN	
Miles, Ricky C., TVA–Bellefonte Nuclear Plant, Hollywood, AL	
Morrow, Margaret K., Lockheed Martin Energy Systems, Oak Ridge, TN	
Moses, David, American Nuclear Society, Oak Ridge, TN	
Peelle, Robert, Oak Ridge, TN	
Philippone, Richard L., Oak Ridge, TN	
Red, Stanley, Oak Ridge Planning Commission, Oak Ridge, TN	
Reid, Sandra, Oak Ridge, TN	
Sanford, Steven, Nashville, TN	
Schroeder, Charles, Commonwealth Edison Company, Downers Grove, IL	
Scott, Frank, ICWU, Clinton, TN	
Sigal, Lorene, Oak Ridge, TN	
Smith, Ray, Facilities Management Organization (Y–12), Oak Ridge, TN	
Stout, James D., Lockheed Martin Energy Systems (Y–12), Oak Ridge, TN	
Taylor, Ellen, Los Alamos National Laboratory, Germantown, MD	
Tilton, Janis, Nashville Peace Action	
Venratecan, Paona, TDEC/Department of Energy–Oversight Division, Oak Ridge, TN	
April 11, 1996—Richland, Washington	3–756 to 3–776
Afternoon Session	
Ace, Mary, Washington Public Power Supply System, Richland, WA	
Baker, Jack W., Washington Public Power Supply System, Richland, WA	
Belsey, Dick, Hanford Advisory Board, Portland, OR	
Blair, Walter, Westinghouse Hanford Corporation/Hanford Advisory Board, Richland, WA	
Brown, Pam, City of Richland, Richland, WA	
Burn, Joseph, Washington Public Power Supply System, Richland, WA	
Cabreau, Louis P., Pasco, WA	
Campbell, K. Perry, Dames & Moore, Richland, WA	
Carosino, Bob, Department of Energy/Richland, Richland, WA	
Ciminera, Michael, Dames & Moore, Richland, WA	
Claudson, Thomas, Science and Engineering Services, Inc., Richland, WA	
Clayton, Danette, Pasco, WA	
Clayton, Nathan, Pasco, WA	
Cook, John, Dames & Moore, Richland, WA	
Davenport, Les, Richland, WA	
Fraley, David W., Washington Public Power Supply System, Richland, WA	
Gerber, Michele, Westinghouse Hanford Corporation, Richland, WA	

Table 1.2–2. Index of Attendance at Public Meetings—Continued

Public Meeting Attendees	Document Page No.
April 11, 1996—Richland, Washington (continued)	3–756 to 3–776
Gority, Scott W., Pacific Northwest National Laboratory, Richland, WA	
Gueuther, Charles, Fluor Daniel	
Guzzetta, David J., Dames & Moore, Richland, WA	
Haass, Carolyn, Department of Energy/Richland, Richland, WA	
Heacock, Harold, TRIDEC (Tri City Economic Development Council), Kennewick, WA	
Heaston, Suzanne, U.S. Senator Slade Gorton, Kennewick, WA	
Heiks, Ron, Seimens Power Corporation, Bellevue, WA	
Heineman, Robert E., Battelle-Northwest, Richland, WA	
Hildreth, Norton T., Richland, WA	
Hoyt, Richard C., Westinghouse Hanford Corporation, Richland, WA	
King, Joe, City of Richland, Richland, WA	
Klos, D. Bruce, Westinghouse Hanford Corporation, Richland, WA	
Larkin, David, Washington Public Power Supply System, Richland, WA	
Lawrence, Michael J., Pajarito Scientific Corporation, Los Alamos, NM	
MacQuarrie, Evelyn M., MACTEC, Richland, WA	
McMaumau, Don	
Miller, Vera, Dames & Moore, Richland, WA	
Mitchell, Sue, Numatec, Inc., Richland, WA	
Mitchell, Bernice, Richland, WA	
Morgan, Jim, Richland, WA	
Moyer, Robert, COGEMA, Inc., Poulsbo, WA	
Munn, Wanda, Richland, WA	
Naber, James, SAIC, Bellevue, WA	
Ogg, Daniel G., Defense Nuclear Facility Safety Board, Richland, WA	
Robinson, Ray, Ray K. Robinson, Inc., Richland, WA	
Rodriguez, Annabelle, Department of Energy/Richland, Richland, WA	
Sanderson, William, Westinghouse Hanford Corporation, Richland, WA	
Steffen, Jim, Westinghouse Hanford Corporation, Kennewick, WA	
Stephens, Karl, KEPR-TV, Pasco, WA	
Szempruch, Rich, Kennewick, WA	
Takaro, Tim, University of Washington, Seattle, WA	
Venetz, Ted, Westinghouse Hanford Corporation, Richland, WA	
Volpentest, Sam, TRIDEC (Tri City Economic Development Council), Kennewick, WA	
Watts, Jim L., Oil, Chemical & Atomic Workers Int. Union, Local 1-369, Richland, WA	
Wilde, Richard, Rust Federal Services, Richland, WA	
Williamson, Craig, Richland Fire & Emergency Services, Richland, WA	
Yerxa, Jon, Department of Energy/Richland, Richland, WA	
Evening Session	
Absher, Ken	
Absher, Jan, Department of Energy/Richland	
Baker, Tom, Westinghouse Hanford Corporation, Richland, WA	
Bliss, Ronald, Westinghouse Hanford Corporation, Kennewick, WA	
Bowman, Leo, Richland Chamber of Commerce, Richland, WA	
Brown, Pam, City of Richland, Richland, WA	
Carosino, Bob, Department of Energy/Richland, Richland, WA	

Table 1.2–2. Index of Attendance at Public Meetings—Continued

Public Meeting Attendees	Document Page No.
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Cox, Grady, Kennewick, WA	
Davis, Robert, Pasco, WA	
Dobbin, Ken, Westinghouse Hanford Corporation, Richland, WA	
Domina, Kirk, Richland, WA	
Dunigan, Paul, Richland, WA	
Ferns, Tom, Kennewick, WA	
Floyd, Ben, Benton County, Prosser, WA	
Foreman, Bob D., Richland, WA	
Gerber, Michele, Westinghouse Hanford Corporation, Richland, WA	
Haler, Larry, City of Richland, Richland, WA	
Hammond, R.S., Richland, WA	
Hankins, Shirley, Washington State Legislator, Richland, WA	
Hodje, Ralph B., Oil, Chemical & Atomic Workers Int. Union, Local 1-369, Pasco, WA	
Holmes, Diane, Fluor Daniel, Richland, WA	
Hoyt, Richard C., Westinghouse Hanford Corporation, Richland, WA	
Hunter, John, Parsons, Richland, WA	
Janett, Joy, Kennewick, WA	
Keenan, Richard, Raytheon, Richland, WA	
King, Jeffrey P., Richland, WA	
Klute, Terrence A., Richland, WA	
Kyriazis, George, City of Kennewick, Kennewick, WA	
Larkin, David, Washington Public Power Supply System, Richland, WA	
Lewis, Jim, DOE–Bonneville Power Administration, Richland, WA	
Martell, Lance, Oil, Chemical & Atomic Workers Int. Union, Local 1-369, West Richland, WA	
McCalmant, Grant L., Kennewick, WA	
Mecca, Sharon, Richland, WA	
Mix, Teresa Lee, Richland, WA	
Nelson, Ronald, Kingston, WA	
Parks, Robert J., Kennewick, WA	
Power, Max, Washington State Department of Ecology, Olympia, WA	
Randolph, Karen, Department of Energy/Richland	
Rogas, Phil, Littleton, CO	
Rogers, Gordon, Pasco, WA	
Salinas, Eustole, Richland, WA	
Segna, Don, Advanced Nuclear & Medical Systems, Richland, WA	
Steffen, Jim, Westinghouse Hanford Corporation, Kennewick, WA	
Strawn, Sandi, Benton County, Kennewick, WA	
Szempruch, Rich, Kennewick, WA	
Takaro, Tim, University of Washington, Seattle, WA	
Tebb, G. Thomas, Washington State Department of Energy, Kennewick, WA	
Tupper, George, Richland, WA	
Van Reenen, Timothy, Oil, Chemical & Atomic Workers Int. Union, Richland, WA	
Vultey, Aleci, Oil, Chemical & Atomic Workers Int. Union, Local 1-369, Richland, WA	
Waltar, Alan, Richland, WA	

Table 1.2–2. Index of Attendance at Public Meetings—Continued

Public Meeting Attendees	Document Page No.
April 11, 1996—Richland, Washington (continued)	3–756 to 3–776
Wilkerson, Noah Lee, Jr., Richland, WA	
Woodcock, Gerald, Richland, WA	
April 15, 1996—Idaho Falls, Idaho	3–729 to 3–741
Afternoon Session	
Abbott, David, Lockheed Idaho Technology Company, Idaho Falls, ID	
Anderson, A.D., Department of Energy–Idaho Operations Office, Idaho Falls, ID	
Beck, Jim, Lockheed Idaho Technology Company, Idaho Falls, ID	
Bendixsen, C. Lee, Lockheed Martin Idaho Technologies, Blackfoot, ID	
Benedict, Bob, Argonne National Laboratory, Idaho Falls, ID	
Brown, Lloyd C., Lockheed Martin Idaho Technologies, Idaho Falls, ID	
Burns, Casey, Idaho Falls, ID	
Calvin, Elisha, Idaho Falls, ID	
Commander, John, Idaho Section ANS, Idaho Falls, ID	
Darnell, G. Ross, Idaho Falls, ID	
Dold, Ann, INEL Oversight/State of Idaho, Idaho Falls, ID	
Downs, Jerry, State of Idaho, Idaho Falls, ID	
Freund, George A., Idaho Falls, ID	
Hain, Kathleen, Department of Energy–Idaho Operations Office, Idaho Falls, ID	
Hamilton, Ellie, Chubbuck, ID	
Hardy, Marsha, Idaho Falls, ID	
Hinckley, Jana K., Eastern Idaho Technical College, Idaho Falls, ID	
Huebner, Martin, Idaho Falls, ID	
Hughes, Ernie, Department of Energy–Chicago Operations Office, Chicago, IL	
Jarrell, Christopher, Shelley, ID	
Jobe, Lowell A., Idaho Falls, ID	
Kidwell, Jennifer, Idaho Falls, ID	
Larkin, David, Washington Public Power Supply System, Richland, WA	
Lewis-Kido, Gail, Lockheed Idaho Technology Company, Idaho Falls, ID	
Loomis, Brandon, Post Register, Idaho Falls, ID	
Lussie, William G., Lockheed Idaho Technology Company, Idaho Falls, ID	
Lyon, Larry, Eastern Idaho Technical College, Idaho Falls, ID	
McEligot, Donald M., Idaho National Engineering Laboratory, Idaho Falls, ID	
McIntire, Thomas D., Lockheed Martin Idaho Technologies, Idaho Falls, ID	
Middleton, Cathy, BNFL Inc., Idaho Falls, ID	
Moyer, Robert, COGEMA, Inc., Poulsbo, WA	
Myers, Joy, Dubois, ID	
Pugmire, Paul, Argonne National Laboratory, Idaho Falls, ID	
Richardson, Andrew, Blackfoot, ID	
Ryskamp, John M., Idaho National Engineering Laboratory, Idaho Falls, ID	
Scherbinske, Peggy, Blackfoot, ID	
Smith, Michael, Eastern Idaho Technical College, Idaho Falls, ID	
Tanner, John, Idaho Falls, ID	
Twitchell, Roger, Department of Energy–Idaho Operations Office, Rigby, ID	
Wade, Marshal A., Eastern Idaho Technical College, Idaho Falls, ID	
Ward, Sonne, Future Free Transportation; Nova Plasma Technologies Inc., Hamer, ID	

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Wood, Warren, Los Alamos National Laboratory	
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Darnell, G. Ross, Idaho Falls, ID	
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Freund, George A., Idaho Falls, ID	
Hardy, Marsha, Idaho Falls, ID	
Herring, Steve, Idaho ANS, Idaho Falls, ID	
Hoggan, Elaine, Hamer, ID	
Hughes, Ernie, Department of Energy–Chicago Operations Office, Chicago, IL	
Hurt, William L., National Spent Fuel Program, Idaho Falls, ID	
Kahn, Steve, Idaho Falls, ID	
Kahn, Dave, Idaho Falls, ID	
Larkin, David, Washington Public Power Supply System, Richland, WA	
Larsen, R. G., Idaho Falls, ID	
Merritt, Alan, Idaho Falls, ID	
Middleton, Cathy, BNFL Inc., Idaho Falls, ID	
O'Halleran, Thomas, Lockheed Idaho Technology Company, Idaho Falls, ID	
Pugmire, Paul, Argonne National Laboratory, Idaho Falls, ID	
Rose, David, Idaho Falls, ID	
Sterbentz, Jim, Lockheed Martin Idaho Technologies, Idaho Falls, ID	
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Tshaeche, Al, Idaho Falls, ID	
Tyler, Bob, Idaho Falls, ID	
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Walten, Leon, Argonne National Laboratory	
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Andrews, Wayne, DNFSB, Washington, DC	
Bellvarde, John, Department of Energy/Oakland Operations Office, Oakland, CA	
Bengelsdorf, Harold D., Bethesda, MD	
Bergman, Heather, Numark Assoc. Inc., Washington, DC	
Blakley, John, Jr., Mason & Hanger/Pantex, Amarillo, TX	
Burn, Joseph, Washington Public Power Supply System, Richland, WA	
Campbell, Bruce, Mason & Hanger/Pantex, Amarillo, TX	
Chase, Steve, Department of Energy	
Clements, Tom, Greenpeace International, Washington, DC	
Curtiss, James R., Winston & Strawn, Washington, DC	
Daniel, Jim, Department of Energy/EH	

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Dove, Gordon, Systematic Management Services, Germantown, MD	
Draper, Robert L., Winston & Strawn, Washington, DC	
Ehrlich, Edward, General Electric–Nuclear Energy, San Jose, CA	
Fletcher, Michael, AECL Technologies Inc., Rockville, MD	
Guais, Jean-Claude, WSMS-ISA Inc., France	
Hahn, Dick, Department of Energy/DP-22	
Hara, Akihiko, Federation of Electric Power Companies of Japan, Washington, DC	
Heppner, Paul G., Sandia National Laboratory, Arlington, VA	
Hite, Ron, Babcock & Wilcox Company, Lynchburg, VA	
Hofer, Gregory, Raytheon Engineers and Constructors, New York, NY	
Horner, Daniel, Nuclear Control Institute, Washington, DC	
Hughes, Allen, Woodbridge, VA	
Hurt, Robert Davis, DNFSB, Washington, DC	
Irwin, Hank, Sandia National Laboratory, Livermore, CA	
Jancik, Lori, Federation of Electric Power Companies of Japan, Washington, DC	
Juba, Robert, Amarillo Economic Development Corporation, Amarillo, TX	
Krishna, Paul M., TRW Inc., Washington, DC	
Lyons, Blythe, Energy Resources International, Washington, DC	
Madison, Robin M., Bechtel National, Inc., Washington, DC	
Mann, Melissa, Edlow International Company, Washington, DC	
McClary, Richard, Department of Energy/NE-60	
McElroy, Bernie, AT/LMES, Washington, DC	
McMillen, Matthew, Energetics, Washington, DC	
Meigs, Marilyn F., BNFL, Inc., Washington, DC	
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Mills, Loring, Stevensville, MD	
Moglen, Damon, Greenpeace International, Washington, DC	
Monroe, Robert, Bechtel National, Inc., Washington, DC	
Naughton, William F., Commonwealth Edison Co., Downers Grove, IL	
Newton, John W., Department of Energy, Germantown, MD	
Sazawal, ViJay, COGEMA/NUMATEC, Bethesda, MD	
Seliger, Kel, City of Amarillo, Amarillo, TX	
Shallo, Frank A., COGEMA, Inc., Bethesda, MD	
Sloan, David, Nukem, Inc., Stamford, CT	
Smith, Stephen, Exchange Monitor Publications, Washington, DC	
Todd, Doug, Battelle, Washington, DC	
Wells, Nikita, Defence Conversion Technology, Inc., Washington, DC	
Williams, Gary, Argonne National Lab, Washington, DC	
Yeager, Jim, Department of Energy	
Yevsikov, Victor, Defence Conversion Technology, Inc., Bethesda, MD	
Zerm, Ronald W., Mason & Hanger/Pantex, Amarillo, TX	

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Blakley, Jr., John, Mason & Hanger/Pantex, Amarillo, TX	
Blumenthal, Anita, Washington Nuclear Corporation, Potomac, MD	
Braitsford, Beatrice, Snake River Alliance, Pocatello, ID	
Bryson, Maurice, Department of Energy/NN-42 (LANL), Rockville, MD	
Buchanan, Ronald, Lynchburg, VA	
Buer, David, Nevada Desert Experience, Las Vegas, NV	
Burn, Joseph, Washington Public Power Supply System, Richland, WA	
Campbell, Bruce, Mason & Hanger/Pantex, Amarillo, TX	
Carde, Margaret, Concerned Citizens for Nuclear Safety, Santa Fe, NM	
Cash, Cathy, Nuclear Energy Overview, Washington, DC	
Chander, Jaysi, Physicians for Social Responsibility/MPN, San Francisco, CA	
Chang, Tom, Department of Energy/Oakland	
Chung, Justin, U.S. Committee for START II, Washington, DC	
Coaham, Jay, Concerned Citizens for Nuclear Safety, Santa Fe, NM	
Coffin, Patricia, Department of Energy/DP-45, Washington, DC	
Cullen, Genevieve, Ray F. Weston, Inc., Washington, DC	
Donning, Art, Department of Energy/DP-15, Washington, DC	
Draper, Robert L., Esq., Winston & Strawn, Washington, DC	
Ehrlich, Edward, General Electric–Nuclear Energy, San Jose, CA	
Epstein, Arnold, Department of Energy/DP, Germantown, MD	
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Forsythe, Jan, Lockheed Martin/Idaho, Arlington, VA	
Gattis, Beverly, STAND, Amarillo, TX	
Gay, Corey, Institute for Science & International Security, Washington, DC	
Greenstein, Michele, Physicians for Social Responsibility, Washington, DC	
Gudgell, J. Dallas, Snake River Alliance, Boise, ID	
Hanson, Glen, Battelle, Albuquerque, NM	
Hayes, David, Defense Nuclear Facilities Safety Board, Washington, DC	
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Schaeffer, Robert A., Military Production Network, Belmont, MA	
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Slater, Alice, Economist Allied for Arms Deduction, New York, NY	
Teclair, Carolyn, Department of Energy/PO-91	
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White, William, Defense Nuclear Facilities Safety Board, Washington, DC	
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Woltsthal, John, Department of Energy/NN-42	
Worthington, Jim, Sheetmetal Workers International, Stanwood, WA	
Wujciak, Steve, VOLPE National Transportation Center, Cambridge, MA	
Yourish, Karen, Weapons Complex Monitor, Washington, DC	
Zavadowski, Richard A., Nuclear Fuel Services, Inc., Washington, DC	
Zerm, Ronald W., Mason & Hanger/Pantex, Amarillo, TX	
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Dewey, Amy, State Senator Teel Bivins' office, Amarillo, TX	
Fike, David, Mason & Hanger, Amarillo, TX	
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Gage, Belle, Amarillo Chamber of Commerce, Amarillo, TX	
Gleghorn, Ginnie, The Perryman Group, Amarillo, TX	
Goebel, Jerry, Elliott/Russell, Amarillo, TX	
Halliday, Thomas, Battelle–Pantex, Amarillo, TX	
Harris, Bill, ANRCP, Amarillo, TX	
Hooten, David, Mason & Hanger, Panhandle, TX	
Juba, Bob, Amarillo Economic Development Corporation, Amarillo, TX	
Keenan, Kevin, Mission Advocacy, Golden, CO	
Kenney, Heidi, Mason & Hanger, Amarillo, TX	
King, Henry, Amarillo, TX	
Knight, Stacy, Amarillo Chamber of Commerce, Amarillo, TX	
Molberg, Gary, Amarillo National Bank, Amarillo, TX	
Nelson, Paul, Texas A&M University, College Station, TX	
Peddicord, Kenneth, Texas A&M University System, College Station, TX	
Rosette, Wayne, North Texas Section American Nuclear Society, Glen Rose, TX	
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Lemming, John	
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Martillotti, Joseph A., Texas Dept. of Health/Bureau of Radiation Control, Amarillo, TX	
McBride, Jim, Globe-News	
McFadden, Greg, KGNC News, Amarillo, TX	
Miller, Bryan, Amarillo, TX	
Molberg, Gary, Amarillo National Bank, Amarillo, TX	
Mulder, Roger	
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Pharr, Marshall, SDS, Amarillo, TX	
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Attardo, Lewis C., SRRDI, Aiken, SC	
Birt, Gretchen, TriCounty Alliance, Barnwell, SC	
Bolen, James, Department of Energy/Savannah River, Aiken, SC	
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Davis, Marion, Teamsters Local Union #509, Bamberg, SC	
Edwards, Dana L., Citizens for Environmental Justice, Savannah, GA	
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Garniewicz, Richard, Westinghouse Savannah River Company, Augusta, GA	
Geddes, R. L., N. Augusta, SC	
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Gore, Kathleen, Exploration Resources, Athens, GA	
Graf, Eugene L., N. Augusta, SC	
Gregory, Johnny, Spartanburg, SC	
Hardeman, Jim, GADNR Environmental Protection Division, Atlanta, GA	
Harris, Krista, Exploration Resources	
Hawkins, Monte, Westinghouse Savannah River Company, N. Augusta, SC	
Hodge, Altsert, Metro Augusta Chamber of Commerce, Augusta, GA	
Irwin, Chuck, Augusta, GA	
Johnson, Thomas, Jr., Department of Energy/Savannah River, N. Augusta, SC	
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Utley, Charles N., Hyde Park & Aragon Park Improvement Committee, Inc., Augusta, GA	
Van Namen, Robert, Duke Power Company, Charlotte, NC	
Van Sickle, Linda, Exploration Resources, Athens, GA	
White, Carolyn, Citizens for Environmental Justice, Savannah, GA	
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Wolfe, Ginny, Westinghouse Savannah River Company, Aiken, SC	
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Dewes, John, American Nuclear Society, Savannah River, New Ellenton, SC	
Duane, John, Westinghouse Savannah River Company	
Erwin, William, Westinghouse Savannah River Company, Aiken, SC	
Finklea, Sam, SC DHEC, Columbia, SC	
Flake, Tim, Westinghouse Savannah River Company, Clarks Hill, SC	
Floyd, Edward E., Laborer Union 1137, Augusta, GA	
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McCranie, Gary, Westinghouse Savannah River Company, North Augusta, SC	
McDonell, William R., Westinghouse Savannah River Company (Retired), Aiken, SC	
Miller, Ralph S., Evans, GA	
Murfl, June, Aiken Chamber of Commerce, Aiken, SC	
Nason, Maurice, RCS, Inc., North Augusta, SC	
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Rocky Flats Citizens Advisory Board, Westminster, CO, Tom Marshall	01.00.00, 01.01.00, 01.02.00, 01.06.00, 05.01.08, 08.00.00, 08.02.00, 08.03.00, 08.03.01, 09.09.07, 10.00.00	3–810
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Sanford & Associates, Nashville, TN, Charles S. Sanford	09.03.05, 09.10.08	3–837
Savannah River Site Citizens Advisory Board, Savannah, GA, Bob Slay	01.04.00, 06.02.08, 08.03.00, 08.03.01, 10.00.00	3–841
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H		
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Hanford Advisory Board, Portland, OR, Merilyn B. Reeves	01.00.00, 07.00.00, 08.00.00, 08.02.00, 08.03.00, 08.03.01, 09.00.01, 09.11.01, 10.01.00, 11.00.01, 15.00.00	3–312
Hanford Communities, Richland, WA, Joseph C. King	08.03.01, 10.00.00, 10.02.00	3–323
Hanford Communities, Richland, WA, Larry Haler	01.00.00, 01.02.00, 01.03.00, 01.04.00, 01.05.00, 05.01.01, 05.01.08, 05.02.08, 06.03.08, 06.05.08, 07.00.00, 08.00.00, 08.02.00, 08.03.00, 08.03.01, 09.00.01, 09.08.01, 09.09.08, 09.10.08, 09.11.00, 09.11.08, 10.00.00, 10.01.00, 10.02.00, 11.00.01, 13.00.00	3–330
Hanford Watch, Portland, OR, Lynn Sims	08.01.00	3–353
Hanford Watch, Portland, OR, Paige Knight	08.03.01, 09.00.01, 14.00.00	3–354
Health Professionals for Global Survival, Montreal, QC, Eric Notebaert	08.03.01	3–361
I		
ICF Kaiser Engineers/DANA Engineering Incorporated, Kennewick, WA, William P. Dana	09.08.01	3–372
IES Utilities, Cedar Rapids, IA, Walter Nodeen	08.03.01	3–373
L		
League of Women Voters, Columbia, SC, Mary T. Kelly	01.06.00, 06.00.08, 08.02.00, 08.03.01, 09.11.08, 11.00.06	3–419
League of Women Voters, Hilton Head Island, SC, Patricia Tousignant	08.03.01	3–421

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Monterey Institute of International Studies, Monterey, CA, Tariq Rauf	08.03.01	3–460
N		
Nevada Nuclear Waste Task Force, Inc., Las Vegas, NV, Judy Treichel	01.04.00, 02.00.08, 02.03.08, 04.00.00, 08.02.00, 08.03.00, 08.03.01, 10.00.00, 11.01.08	3–483
Nez Perce Tribe, Lapwai, ID, Samuel N. Penney	08.01.00, 08.02.00	3–493
Nuclear Awareness Project, Uxbridge, ON, Irene Kock	01.03.00, 08.03.01	3–531
Nuclear Awareness Project, Uxbridge, ON, Irene Kock	08.01.00, 08.02.00	3–540
Nuclear Control Institute, Washington, DC, Paul Leventhal	01.02.00, 01.04.00, 01.06.00, 05.00.06, 05.00.08, 05.01.08, 06.01.08, 07.00.00, 07.01.00, 07.02.00, 08.00.00, 08.01.00, 08.03.00, 08.03.01, 09.09.08, 10.00.00, 10.02.00, 13.00.00	3–545
Nuclear Energy Institute, Washington, DC, Marvin S. Fertel	01.00.00, 01.05.00, 01.06.00, 06.06.08, 08.03.01, 09.09.08, 13.00.00	3–592
Nuclear Information and Resource Service, Washington, DC, Mary Olson	01.02.00, 01.04.00, 06.01.08, 08.03.01, 09.04.08, 09.09.08, 09.11.08	3–595
O		
Oak Ridge Environmental Peace Alliance, Oak Ridge, TN, Ralph Hutchison	01.00.00, 01.01.00, 01.04.00, 01.06.00, 02.05.05, 08.00.00, 08.03.01, 11.00.05, 15.00.00	3–599
Oak Ridge Reservation Local Oversight Committee, Oak Ridge, TN, Amy S. Fitzgerald	01.00.00, 01.04.00, 05.03.08, 08.02.00, 08.03.00, 08.03.01, 16.00.00	3–613
Oil, Chemical, & Atomic Workers International Union, Richland, WA, Jim L. Watts	08.03.01	3–617
Operation Commonsense, Amarillo, TX	08.03.01	3–621
ORISE, Oak Ridge, TN, Robert Menard	08.02.00	3–623
P		
Pajarito Scientific Corporation, Los Alamos, NM, Michael J. Lawrence	01.03.00, 06.00.09, 08.03.01	3–631
Panhandle 2000, Amarillo, TX, Jerry Johnson and Wales Madden, Jr.	01.00.00, 01.03.00, 01.06.00, 07.00.00, 08.03.01, 09.00.04, 09.08.04, 09.09.04, 10.00.00	3–637
Panhandle Area Neighbors And Landowners, Panhandle, TX, Doris and Phillip Smith	01.04.00, 08.03.01, 09.00.04, 09.04.04, 09.08.04	3–649
Panhandle Ground Water Conservation District No. 3, White Deer, TX, C. E. Williams	08.03.01	3–656
Panhandle Plastic Surgery, Amarillo, TX, John C. Kelleher, Jr.	08.03.01	3–658
Peace Action Texas, Dallas, TX, Jan Sanders	01.06.00, 08.02.00, 08.03.00, 08.03.01, 09.04.08	3–663
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R		
Rocky Flats Citizens Advisory Board, Louisville, CO, Rueben O. Maes	01.04.00	3–808
Rocky Flats Citizens Advisory Board, Westminster, CO, Tom Marshall	01.00.00, 01.01.00, 01.02.00, 01.06.00, 05.01.08, 08.00.00, 08.02.00, 08.03.00, 08.03.01, 09.09.07, 10.00.00	3–810
Rocky Flats Cleanup Commission, Inc., Lakewood, CO, James S. Stone	08.03.00, 14.00.00	3–815
S		
Sanford & Associates, Nashville, TN, Charles S. Sanford	09.03.05, 09.10.08	3–837
Savannah River Site Citizens Advisory Board, Savannah, GA, Bob Slay	01.04.00, 06.02.08, 08.03.00, 08.03.01, 10.00.00	3–841
Seattle Woman Act for Peace/Women Strike for Peace, Seattle, WA	01.03.00, 01.04.00, 01.06.00, 06.01.01, 06.01.08, 08.00.00, 08.01.00, 08.02.00, 08.03.01, 12.00.00, 13.00.00	3–845
Sierra Club National Nuclear Waste Task Force, Tallahassee, FL, Ellen Winchester	01.02.00, 01.04.00, 01.06.00, 08.03.01, 09.09.08	3–853
Sierra Club, Virginia Chapter, Virginia Beach, VA, Robert F. Deegan	08.03.01	3–855
Snake River Alliance, Boise, ID, Robert McEnaney	01.02.00, 01.04.00, 01.05.00, 01.06.00, 05.03.03, 05.03.08, 08.03.00, 08.03.01, 09.02.08, 09.11.08, 11.00.08, 11.01.08	3–871
Southwest Research and Information Center, Albuquerque, NM, Don Hancock	01.00.00, 01.01.00, 01.02.00, 01.04.00, 01.06.00, 02.00.08, 08.00.00, 08.03.00, 08.03.01, 09.00.08, 09.04.04, 09.08.08, 09.09.08, 09.11.08, 10.00.00, 10.03.00, 11.00.08, 16.00.00	3–879
Southwest Research and Information Center, Albuquerque, NM, Don Hancock	08.02.00	3–888
Southwestern Public Service Company, Amarillo, TX, William T. Crenshaw	07.02.00, 08.03.01, 09.00.08, 09.08.04, 15.00.00	3–889
Spike Enterprises and Tabor Group, San Antonio, TX, Tadeo Zywicki	08.03.00, 09.04.04	3–900
STAND of Amarillo, Amarillo, TX, Beverly E. C. Gattis	08.00.00, 08.03.01, 13.00.00	3–903
State of Colorado, Department of Public Health and Environment, Denver, CO, Steve Tarlton	07.00.00, 09.09.07	3–905
State of Florida, Department of Community Affairs, Tallahassee, FL, Ralph Cantral	08.01.00	3–907
State of Georgia, Department of Natural Resources, Atlanta, GA, Harold F. Reheis	08.03.01	3–908
State of Idaho, Office of the Governor, Boise, ID, Governor Philip E. Batt	08.03.00, 08.03.01	3–909

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State of Michigan, State Representative, Lansing, MI, Karen Willard	10.00.00	3–924
State of Nevada, Department of Administration, Carson City, NV, Julie Butler	01.00.00, 01.02.00, 08.03.00, 09.01.02, 09.08.08, 10.00.00, 11.00.08, 15.00.00	3–926
State of Oregon, Department of Energy, Salem, OR, John Savage	01.00.00, 01.03.00, 01.04.00, 01.05.00, 04.03.00, 06.01.08, 06.05.08, 06.06.08, 08.00.00, 08.02.00, 08.03.00, 08.03.01, 09.00.08, 09.01.01, 09.04.01, 09.05.01, 09.06.01, 09.07.01, 09.09.01, 09.09.08, 09.11.01, 10.00.00, 10.01.00, 10.03.00, 11.00.00, 13.00.00, 14.00.00	3–940
State of Oregon, Department of Energy, Salem, OR, Mary Lou Blazek	01.00.00, 01.02.00, 01.04.00, 05.00.08, 06.00.09, 06.01.08, 06.01.09, 07.00.00, 07.02.00, 08.02.00, 08.03.00, 08.03.01, 09.00.08, 09.05.08, 09.09.08, 10.00.00, 11.00.08, 12.00.00	3–957
State of South Carolina, Department of Parks, Recreation and Tourism, Columbia, SC, James E. Newman	08.00.00, 08.03.00, 12.00.00	3–965
State of South Carolina, Office of the Governor, Columbia, SC, Rodney P. Grizzle	08.00.00	3–966
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State of Texas, Department of Health, Austin, TX, Joseph A. Martillotti	01.00.00, 09.00.04, 09.01.04, 09.09.04, 15.00.00, 16.00.00	3–979
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State of Texas, Office of the Governor, Austin, TX, Governor George W. Bush	08.03.01	3–984
State of Texas, Office of the Governor, Austin, TX, Roger Mulder	06.05.08, 07.02.00, 08.01.00, 08.03.01, 09.00.04, 09.00.08, 09.04.04, 09.04.08, 09.10.08, 09.11.08, 10.00.00, 12.01.00, 15.00.00	3–985
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State of Texas, State Representative, Austin, TX, David Swinford	08.03.01, 15.00.00	3–1003
State of Texas, State Representative, Austin, TX, John Hirschi	08.03.01, 09.04.04, 09.08.04	3–1005
State of Texas, State Senator, Austin, TX, Senator Tom Haywood	08.03.01	3–1007
State of Washington, Department of Ecology, Kennewick, WA, Max S. Power	01.00.00, 01.06.00, 08.00.00, 08.03.00, 08.03.01	3–1011
State of Washington, Department of Ecology, Olympia, WA, Mark Wallace	01.04.00, 01.06.00, 05.00.08, 08.00.00, 08.01.00, 08.02.00, 08.03.01, 15.00.00	3–1014

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State of Washington, State Senator, Olympia, WA, Patricia S. Hale	06.01.01, 08.03.01	3–1026
T		
Tennessee Valley Authority, Hollywood, AL, Nicholas C. Kazanas	09.04.08, 09.06.08, 09.07.08, 09.09.08, 09.11.08, 10.02.00	3–1032
Teton Technologies, Inc., Idaho Falls, ID, Bill Quapp	14.00.00	3–1037
Texas Natural Resource Conservation Commission, Austin, TX, Dan Pearson	01.00.00, 09.03.04, 09.04.04, 09.09.04	3–1046
Texas Tech University Health Sciences Center, Amarillo, TX, Arthur A. Nelson	08.03.01	3–1052
Thomas J. Watson Research Center, Yorktown Heights, NY, Richard L. Garwin	01.03.00, 08.03.01, 15.00.00	3–1054
U		
United States Arms Control and Disarmament Agency, Washington, DC, Dan Fenstermacher	01.04.00, 06.01.08, 12.00.00	3–1066
United States Environmental Protection Agency, Denver, Co, C. Mark Aguilar	01.00.00, 01.06.00	3–1079
United States Environmental Protection Agency, Washington, DC, Richard E. Sanderson	01.04.00, 09.01.01, 09.09.08, 09.12.06	3–1081
United States House of Representatives, Flint, MI, Congressman Dale E. Kildee	10.00.00	3–1086
United States House of Representatives, Mt. Clemens, MI, Congressman David E. Bonoir	10.00.00	3–1087
United States House of Representatives, Amarillo, TX, Congressman William Thornberry	08.03.00	3–1088
United States Senate, State of Texas, Senators Phil Gramm and Kay Bailey Hutchison	08.03.01, 09.00.04	3–1093
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W		
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Westminster City Hall Comments, Westminster, CO, Kenneth Werth, et al.	01.00.00, 01.06.00, 05.00.07, 07.00.00, 08.03.00, 08.03.01, 09.04.07, 14.00.00	3–1127
WOMBYN	01.00.00, 08.03.01, 09.12.08, 14.00.00	3–1164
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Alley, Clyde, Amarillo, TX	09.08.04, 09.08.08, 09.12.08	3–4
Anderson, Amy Louise, Kalamazoo, MI	08.03.01	3–43
Anderson, Mrs. Gabe, Jr., Amarillo, TX	08.03.01	3–44
Anderson, Robert C., Kalamazoo, MI	08.03.01	3–45
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Arnold, Marvin, Amarillo, TX	08.03.01	3–49
B		
Bamberry, Ed, Blackfoot, ID	08.03.01	3–62
Belisle, Mavis, Panhandle, TX	01.06.00	3–63
Birkenfeld, Darrel, Nazareth, TX	08.03.01	3–69
Blake, Barbara, San Jose, CA	08.03.00, 08.03.01	3–70
Boardman, Charles, Saratoga, CA	01.03.00, 01.06.00, 07.02.00, 08.03.01	3–74
Bohlander, Cecil, Pampa, TX	08.03.01, 13.00.00	3–81
Bolen, James E., Aiken, SC	01.00.00, 15.00.00	3–83
Bonner, Patrick, South Gate, CA	01.04.00, 08.03.01, 09.04.04, 09.09.04	3–84
Brechin, Vernon J., Mountain View, CA	01.00.00, 01.04.00, 06.01.09, 08.02.00, 08.03.01, 09.00.06, 09.01.02, 09.02.08, 09.11.08, 10.00.00, 10.03.00, 16.00.00	3–86
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Bresee, Brian, Las Vegas, NV	08.03.01	3–94
Bright, Horace T., Spartanburg, SC	08.03.01, 11.01.04	3–96
Brodie, Rosemary E., Seattle, WA	08.03.01	3–97
Brunnenkant, C., Seattle, WA	01.03.00	3–98
Burditt, Robert B., Oak Ridge, TN	01.04.00, 01.05.00, 01.06.00, 02.00.08, 06.05.09, 08.03.01, 09.01.04, 09.09.08, 11.01.05, 13.00.00	3–100
Burns, Casey, Idaho Falls, ID	08.03.01, 15.00.00	3–104
C		
Campbell, Dawn, Washington, NJ	08.03.01	3–114
Charless, Addis, Jr.	08.03.01, 09.04.04, 09.09.04	3–129
Christianson, Marlene, Pocatello, ID	08.03.01	3–131
Chubb, Walston, Murrysville, PA	01.02.00, 05.00.08, 07.01.00	3–132
Cinquemani, D. K. & F. L., Montclair, NJ	08.03.01	3–134
Clarton, Wayne, Rigby, ID	08.03.01	3–152
Coops, Melvin S., Santa Rosa, CA	08.03.01	3–174
Cramer, Jerry	08.03.01	3–177

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Darnell, G. Ross, Idaho Falls, ID	01.00.00, 01.04.00, 14.00.00	3–179
Davenport, Leslie C., Richland, WA	01.04.00, 08.03.01, 15.00.00	3–181
Davis, Isabel, Canyon, TX	09.04.04	3–184
Detten, Danny	09.04.04	3–185
Devorak, Judith	08.03.01	3–186
Dorwart, Robert J., Seattle, WA	08.03.01	3–187
Dryer, Ted, Portland, OR	08.03.01	3–188
Dutton, Herb and Lydie, San Jose, CA	08.03.01	3–191
E		
Eiden, Max A.	08.03.01, 09.05.03, 10.00.00, 12.00.00	3–193
Ellis, Jennifer L.	08.03.01	3–195
Ewald, Linda, Knoxville, TN	08.03.01, 15.00.00	3–203
F		
Fager, Cal, Arvada, CO	04.02.00	3–208
Fenmore, Carol, Pocatello, ID	08.03.01	3–213
Fitzgerald, Kara	08.03.01	3–214
Fitzgerald, Pete, Blackfoot, ID	08.03.01	3–215
Flangas, William A., Las Vegas, NV	01.06.00, 08.02.00	3–216
Flomenhoft, Mark, Seattle, WA	08.03.01	3–217
Foreman, Bob D., Richland, WA	08.03.01	3–219
G		
Geary, B., Tulsa, OK	01.04.00, 01.06.00, 08.03.01, 13.00.00	3–223
Gerrels, Elsworth, San Jose, CA	01.00.00, 01.03.00, 01.06.00, 05.01.08, 08.00.00, 08.02.00, 08.03.00, 08.03.01	3–272
Gilbert, Kim	08.03.01	3–280
Gilkison, Joseph M., Martinez, GA	08.03.01	3–281
Goergen, Charles R., Aiken, SC	08.03.01	3–282
Goodell, Richard S., Amarillo, TX	08.03.01	3–283
Goodwin, Marian, Blackfoot, ID	08.03.01	3–284
Graf, Eugene L., North Augusta, SC	04.01.00, 09.00.08, 15.00.00	3–285
Gramstorff, Jeanne B., Farnsworth, TX	08.03.01, 09.04.04	3–286
H		
Hannum, William H., Naperville, IL	01.05.00, 09.08.08	3–356
Hanson, Steven, Rexburg, ID	08.03.01	3–357
Harley, Mary Lou, Bridgetown, NS	01.00.00, 01.03.00, 08.03.01, 15.00.00	3–358
Hatfield, Scott, Boulder, CO	05.00.08, 05.03.03, 08.03.01	3–360
Herring, Steve, Idaho Falls, ID	08.03.01, 09.00.08	3–363

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Hind, Kurt	08.03.01	3–366
Hodge, Ward J., Marlette, MI	08.03.01	3–367
Holden, Paula, Seattle, WA	08.03.01	3–370
Hyatt, Linda, Dallas, TX	08.03.01	3–371
J		
Jobe, Lowell A., Idaho Falls, ID	08.03.01, 14.00.00	3–374
Johnston, Rob	08.03.01	3–375
Jolley, Michael F., Chubbuck, ID	08.03.01	3–376
K		
Kahn, David K., Idaho Falls, ID	01.00.00, 01.02.00, 01.04.00, 01.05.00, 08.02.00	3–377
Keesler, Mike, Rigby, ID	08.03.01	3–381
Keevan, Marcia, Amarillo, TX	08.02.00, 09.04.04, 09.05.04	3–382
Keisimeyer, W. H., Augusta, GA	01.04.00	3–387
Kelley, David K., Amarillo, TX	08.03.01, 15.00.00	3–388
Kimberley, Stephen L., Eugene, OR	08.03.01, 14.00.00	3–389
King, H. H., Amarillo, TX	09.00.04, 09.00.08	3–390
King, Joan O., Sautee, GA	01.00.00, 08.01.00, 08.02.00, 08.03.01, 15.00.00	3–391
King, Joan, Sautee, GA	08.01.00, 08.03.01	3–393
Kleinau, S. K., et al., Kemble, ON	08.03.01	3–394
Kline, Connie, Willoughby Hills, OH	08.02.00, 08.03.01	3–402
Knight, Stacy	08.03.01	3–403
Koeberl, Dwight D., Seattle, WA	01.02.00, 08.03.01	3–404
Korth, Michael, West Richland, WA	07.00.00, 08.03.01	3–405
L		
LaBorde, Mrs. Leo, Amarillo, TX	08.03.01	3–407
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Lancaster, Colleen, Brentwood, TN	08.03.01	3–409
Langer, Sidney, San Diego, CA	01.03.00	3–410
Lawless, W. F.	14.00.00	3–412
Leventhal, Paul, et al.	01.04.00, 01.06.00, 08.00.00, 08.02.00, 09.09.08, 10.00.00, 10.02.00	3–426
Lewis, Marvin, Philadelphia, PA	08.03.01	3–433
Lindstrom, Judy M., Pleasant Hill, TN	08.03.01	3–434
Litt, Valerine, Oak Ridge, TN	08.03.01	3–435
Locke, John W. and Joyce C., Amarillo, TX	08.03.01	3–436
Losey, David C., Aiken, SC	01.02.00	3–438
Lowrey, Michael J., Amarillo, TX	08.00.00	3–439

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Manning, Sam P., Spartanburg, SC	08.01.00, 08.03.01	3–441
Manning, Sam P., Spartanburg, SC	08.03.01	3–442
Manning, Sam P., Spartanburg, SC	08.03.01	3–444
Mare, Lisa K., et al.	08.03.01, 09.04.02, 14.00.00	3–445
Mayson, W. Penland, Jr., Augusta, GA	08.03.01	3–448
McFarland, Lewis L., Portland, OR	08.03.01	3–450
Miller, Scott, Boise, ID	08.02.00	3–451
Mills, Loring E., Stevensville, MD	01.00.00, 08.03.01, 09.00.08, 09.09.08	3–452
Mills-Rekdal, Sheila, et al.	01.04.00, 08.03.01, 09.00.04	3–456
Miner, Ruth Allan and Mendelson, Emanuel S., Philadelphia, PA	08.03.01	3–459
Montgomery, David, Sultan, WA	01.06.00	3–467
Murphy, Jim, Amarillo, TX	08.03.01	3–469
Murray, Alexander P., Gaithersburg, MD	01.00.00, 01.02.00, 01.04.00, 02.00.08, 06.00.08, 06.01.08, 08.01.00, 09.01.08, 09.11.08, 12.00.00, 16.00.00	3–470
Myers, Joy, Dubois, ID	01.02.00, 01.03.00, 01.04.00, 01.05.00, 01.06. 00, 04.02.00, 04.03.00, 06.00.08, 07.01.00, 07.02.00, 08.03.01	3–475
N		
Naughton, William F., Downers Grove, IL	06.01.09, 06.02.09, 06.05.09, 08.03.01	3–478
Neusch, Trish, Panhandle, TX	08.03.01, 09.02.04, 09.04.04	3–480
Newman, R. I., Fripp Island, SC	01.06.00, 07.02.00, 08.00.00, 08.03.01, 09.00.08, 09.09.08	3–486
No Name Submitted	09.00.08	3–494
No Name Submitted	06.05.08, 07.02.00, 09.00.04, 09.07.04, 09.10.08, 09.11.08, 10.00.00, 12.01.00	3–495
No Name Submitted	14.00.00	3–502
No Name Submitted	08.03.01	3–504
No Name Submitted	08.03.01	3–505
No Name Submitted	08.01.00, 08.03.01, 09.05.08	3–506
No Name Submitted	08.03.01	3–508
No Name Submitted	08.03.01	3–509
No Name Submitted	04.00.00, 04.01.00	3–510
No Name Submitted	07.01.00	3–511
No Name Submitted	12.00.00	3–512
No Name Submitted	09.09.08	3–513
No Name Submitted	08.03.01	3–514

Table 1.2–5. Index of Commentors, Private Individuals—Continued

Commentor Information	Issue Bin Numbers	Page Number
No Name Submitted	02.00.04, 08.00.00, 09.00.04, 09.01.04, 09.03.04, 09.04.04, 09.06.04, 09.07.04, 09.11.04, 10.00.00, 10.02.00	3–515
No Name Submitted	01.00.00, 08.03.01, 09.08.04, 15.00.00	3–521
No Name Submitted	08.03.01	3–523
No Name Submitted, Idaho Falls, ID	08.03.01	3–524
Noah, J. Christopher, Evans, GA	08.03.01, 11.00.08, 12.01.00	3–525
Norris, Karen, Boulder, CO	15.00.00	3–527
Norris, Karen, Boulder, CO	15.00.00	3–529
O		
O'Neill, John E., Madison, IN	01.04.00, 15.00.00	3–598
Olson, D., Victor, ID	08.03.01	3–619
Olson, Kim, Victor, ID	08.03.01	3–620
Osborne, Jeri, Amarillo, TX	01.05.00, 08.00.00, 08.03.01, 09.00.08, 09.09.04	3–624
Osborne, Jim, Amarillo, TX	08.03.01, 09.04.04	3–627
Oud, Alora, Ruppee, ID	08.03.01	3–629
Oversby, Virginia M., Livermore, CA	14.00.00	3–630
P		
Pangborn, Sally MacArthur, Seattle, WA	01.00.00, 08.03.01	3–635
Paruchuri, Kavendra	01.00.00, 01.06.00, 08.00.00, 08.02.00	3–660
Peace Action Texas, Dallas, TX, Jan Sanders	01.06.00, 08.02.00, 08.03.00, 08.03.01, 09.04.08	3–663
Peelle, Bob, Oak Ridge, TN	01.00.00, 02.00.08, 02.04.08, 07.02.00, 08.03.01, 13.00.00, 15.00.00	3–667
Peters, Don, Pocatello, ID	08.03.01, 09.04.03, 12.00.00	3–670
Peterson, Daniel E., Seattle, WA	01.03.00, 08.03.01	3–671
Peterson, Merry Ann, Seattle, WA	06.00.08, 08.03.01, 15.00.00	3–673
Picardo, Robin, Las Vegas, NV	08.03.01	3–677
Poe, W. Lee, Jr., Aiken, SC	01.00.00, 04.00.00, 04.03.00, 08.03.01, 09.00.08, 09.08.08, 09.09.08	3–678
Pottson, Ted, Amarillo, TX	08.03.01	3–681
Public Meeting Oral Comments, Amarillo, TX	06.01.08, 08.00.00, 08.03.01, 09.00.08, 09.04.04, 09.08.04, 09.11.08, 09.12.08	3–682
Public Meeting Oral Comments, North Augusta, SC	01.00.00, 01.03.00, 01.04.00, 01.06.00, 04.00.00, 04.03.00, 05.01.08, 06.00.08, 06.01.06, 08.00.00, 08.02.00, 08.03.00, 08.03.01, 09.00.06, 09.06.06, 09.09.06, 09.11.06, 09.11.08, 09.12.06, 09.12.08, 15.00.00	3–711
Public Meeting Oral Comments, Denver CO	01.00.00, 01.02.00, 01.03.00, 01.04.00, 01.05.00, 01.06.00, 02.00.08, 02.01.07, 04.00.00, 04.02.00, 05.00.08, 07.01.00, 08.03.00, 08.03.01, 09.11.08, 13.00.00, 15.00.00	3–722

Table 1.2–5. Index of Commentors, Private Individuals—Continued

Commentor Information	Issue Bin Numbers	Page Number
Public Meeting Oral Comments, Idaho Falls, ID	01.00.00, 01.02.00, 01.03.00, 01.04.00, 01.05.00, 01.06.00, 07.01.00, 08.00.00, 08.03.00, 08.03.01, 09.08.03, 09.09.08, 12.00.00, 12.01.00, 14.00.00, 15.00.00	3–729
Public Meeting Oral Comments, Las Vegas, NV	01.00.00, 01.02.00, 01.03.00, 01.05.00, 02.00.08, 06.05.08, 08.02.00, 08.03.00, 08.03.01, 09.00.02, 09.01.02, 09.07.02, 09.08.02, 10.00.00, 10.01.00, 11.01.02, 12.00.00, 12.01.00, 13.00.00, 14.00.00	3–742
Public Meeting Oral Comments, Oak Ridge, TN	01.04.00, 01.06.00, 06.00.09, 08.00.00, 08.02.00, 08.03.01, 09.08.08, 13.00.00	3–752
Public Meeting Oral Comments, Richland, WA	01.00.00, 01.02.00, 01.03.00, 01.06.00, 02.00.01, 03.01.08, 06.00.08, 06.01.08, 07.00.00, 08.00.00, 08.01.00, 08.02.00, 08.03.00, 08.03.01, 09.09.08, 10.01.00, 11.00.01, 15.00.00	3–756
Public Meeting Oral Comments, Washington, DC	01.00.00, 01.06.00, 05.00.08, 05.01.08, 06.01.08, 06.01.09, 07.00.00, 08.00.00, 08.02.00, 08.03.00, 08.03.01, 09.00.08, 09.03.08, 09.10.08, 09.11.08, 10.00.00, 10.02.00, 14.00.00	3–777
R		
Rask, William C., Lakewood, CO	01.00.00, 01.04.00, 14.00.00	3–791
Reynolds, Robert, Victor, ID	08.03.01	3–795
Richards, Matt, San Diego, CA	05.01.08, 05.03.08, 07.00.00, 07.01.00, 07.03.00, 08.02.00, 12.00.00, 14.00.00	3–796
Rogers, Gordon J., Pasco, WA	01.06.00, 08.03.01, 11.00.01, 11.01.01	3–823
Ruddy, Karen, Amarillo, TX	08.03.01	3–825
Rumsy, Russ	08.03.01	3–826
Ryskamp, John M., Idaho Falls, ID	01.03.00, 08.03.01	3–827
Ryskamp, John M., Idaho Falls, ID	11.01.08	3–828
Ryskamp, John M., Idaho Falls, ID	09.00.08, 16.00.00	3–829
S		
Salanis, Eustolne, Jr., Richland, WA	08.03.01	3–830
Salisbury, Diana, Sardinia, OH	01.02.00, 01.04.00, 02.00.08, 02.01.08, 08.03.01, 09.00.08	3–831
Scott, Richard G., Amarillo, TX	08.03.01	3–844
Seewald, William H.	01.00.00, 01.02.00, 01.06.00, 08.01.00, 09.00.04, 09.04.08	3–849
Shennum, Mary L., Amarillo, TX	01.04.00, 09.00.04	3–851
Shillinglaw, Faun, Appleton, WI	08.03.01	3–852
Sims, Lynn, Portland, OR	01.00.00, 01.06.00, 08.02.00, 08.03.01	3–856
Sims, Lynn, Portland, OR	08.03.01	3–859
Singleton, Don, Amarillo, TX	08.03.01	3–860
Singleton, Donna	08.03.01	3–861
Slaggle, Norbert, Shamrock, TX	08.03.01	3–862

Table 1.2–5. Index of Commentors, Private Individuals—Continued

Commentor Information	Issue Bin Numbers	Page Number
Smith, Doris	08.03.01, 09.00.04	3–863
Smith, Doris Berg, Amarillo, TX	01.05.00, 08.03.01, 09.00.08, 09.04.08, 12.03.00	3–865
Smith, Frank White, Boulder, CO	01.01.00, 14.00.00, 15.00.00	3–867
Speiser, Joshua, Seattle, WA	08.03.01	3–898
Stein, Jerry, Happy, TX	08.03.01	3–1027
Stock, Sidney, Bellevue, WA	08.03.01	3–1028
Szempruch, Rich, Kennewick, WA	08.01.00	3–1029
Szempruch, Rich, Kennewick, WA	01.00.00	3–1030
T		
Thomas, Anita, Pocatello, ID	08.03.01	3–1056
Thomas, L. B., Albuquerque, NM	01.00.00, 01.02.00, 01.05.00, 02.00.08, 04.00.00, 11.00.08	3–1057
Thompson, Gary	01.04.00, 01.06.00, 08.03.01	3–1060
Thorpe, Mignon S., Upper Montclair, NJ	08.03.01	3–1062
Turner, Charles W., Seattle, WA	14.00.00	3–1063
W		
Wakely, Lila, Lava Hot Springs, ID	08.03.01	3–1099
Wallis, Walter, Palo Alto, CA	01.04.00	3–1100
Walter, Carl E., Pleasanton, CA	01.03.00, 07.00.00, 07.02.00, 08.00.00, 08.02.00, 13.00.00	3–1101
Walton, Barbara A., Oak Ridge, TN	01.00.00, 08.02.00, 08.03.01, 09.05.08, 16.00.00	3–1107
Werth, Kenneth F., Arvada, CO	01.06.00, 14.00.00	3–1116
Werth, Kenneth F., Arvada, CO	08.03.01, 14.00.00	3–1119
White, C. E., Jr., Idaho Falls, ID	08.03.01	3–1159
Wilcox, Robert H., Martinez, GA	01.00.00, 06.00.09, 08.03.01	3–1160
Wilcox, Rodney C., Aiken, SC	08.03.01	3–1161
Wilson, Steve, Aiken, SC	01.00.00, 08.03.01	3–1162
Wink, Anna Marie, Amarillo, TX	08.03.01, 09.00.04	3–1163
Wood, M. R., Seattle, WA	08.03.01	3–1168
Y		
Yevsikov, Victor V., and Well, Nikita I., Bethesda, MD	01.00.00, 13.00.00, 14.00.00	3–1170
Young, Faith, Dixon Springs, TN	08.03.01	3–1177
Younghans, Lorraine, Beatty, NV	08.03.01	3–1178
Z		
Zeller, Myra	15.00.00	3–1179
Zepeda, Barbara, Seattle, WA	15.00.00	3–1180

Table 1.2–6. Index of Commentors, Multiple Signatory Documents

Commentor Name/Organization	Issue Bin Numbers	Page Number
Barlow, Sheila	08.03.01, 09.04.02, 14.00.00	3–445
Brooks, Christine		
Heller, Sherry		
Guipe, Rachel		
Mare, Lisa K.		
Mills, Ellen D.	01.04.00, 08.03.01, 09.00.04	3–456
Mills-Rekdal, Sheila		
Rekdal, Andrew		
Rekdal, Randy		
Greenpeace International, Tom Clements	01.06.00, 05.03.08, 08.00.00, 08.02.00, 09.09.08, 09.11.08, 10.02.00, 13.00.00	3–426
National Resources Defense Council, Christopher E. Paine		
Nuclear Control Institute, Paul Leventhal		
Nuclear Information Resource Service, Michael Mariotte		
Nuclear Waste Citizens Coalition, Fred Miller		
Physicians For Social Responsibility, Daryl Kimball		
Public Citizen, Bill Magavern		
Union of Concerned Scientists, Jennifer Weeks		
Women Strike for Peace, Kathryn Crandall		
Ahmol, N.	08.03.01	3–394
Albarda, Hans		
Alcock, Norman		
Baltaz, Diane		
Benvenuti, Paul		
Bladen, Georgia		
Bladon, Eleanor		

Table 1.2–6. Index of Commentors, Multiple Signatory Documents—Continued

Commentor Name/Organization	Issue Bin Numbers	Page Number
Bruer, Paul M.	08.03.01	3–394
Burger, Stuart		
Cooper, Kathy C.		
Cemeron, Caroline		
Coupland, Carol		
Dean, Barbara M.		
Dumsoll, John		
Dunlop, Heather		
Eberhart, Eric		
Ellis-Whitney, Bernice		
Ford, Paul		
Golding, Christopher		
Hall, Robert		
Hamm, Douglas		
Hepf, Marcella		
Heggs, Ryan		
Hemmo, J. L.		
Jueline, John		
Kerbs, Benna		
Kleinau, S. K.		
Kock, Irene		
Kruetzer, Vitold		
Kuellmer, Jim		
Kulla, Eddy		
Lalonde, Jean		
Lyons, John and Charles		
Margetts, David		
McQuall[1]		
McQuail, F.		
Moore, June		
Nickerson, Nure		
Nunn, Tom		
Ochman, Stefan		

Table 1.2–6. Index of Commentors, Multiple Signatory Documents—Continued

Commentor Name/Organization	Issue Bin Numbers	Page Number
Ohrt, Russ	08.03.01	3–394
Ohrt, Sandra-Jean		
Osborne, Justin		
Osborne, Tanya		
Ponlton, Sandra		
Pym, Cathie		
Pym, Janet		
Pym, Jeff		
Ronn, Rick		
Ruland, Carol		
Stanley, Cathy		
Straughan, Wayne		
Taylor, Susan		
Tompkins, Edith		
Tompkins, Ruth		
Wheeler, Margaret C.		
William, Yake		

[1] Legible portion of commentor names appear in this table.

Table 1.2–7. Index of Issue Bins

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01.01.00	3–53, 3–606, 3–607, 3–811, 3–869, 3–880, 3–881, 3–971, 3–1022
01.02.00	3–25, 3–26, 3–28, 3–33, 3–41, 3–53, 3–132, 3–149, 3–150, 3–166, 3–253, 3–254, 3–338, 3–377, 3–404, 3–438, 3–472, 3–473, 3–476, 3–545, 3–597, 3–725, 3–731, 3–744, 3–759, 3–763, 3–765, 3–789, 3–812, 3–832, 3–849, 3–854, 3–873, 3–879, 3–933, 3–958, 3–960, 3–1057, 3–1112, 3–1113, 3–1114
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01.04.00	3–22, 3–73, 3–84, 3–86, 3–101, 3–137, 3–159, 3–179, 3–182, 3–223, 3–254, 3–267, 3–288, 3–331, 3–336, 3–338, 3–379, 3–380, 3–387, 3–428, 3–457, 3–470, 3–472, 3–475, 3–483, 3–551, 3–559, 3–590, 3–595, 3–596, 3–598, 3–603, 3–607, 3–613, 3–650, 3–676, 3–712, 3–713, 3–714, 3–715, 3–724, 3–734, 3–753, 3–791, 3–809, 3–831, 3–842, 3–846, 3–851, 3–853, 3–872, 3–875, 3–876, 3–880, 3–940, 3–944, 3–960, 3–974, 3–1019, 3–1022, 3–1023, 3–1060, 3–1067, 3–1085, 3–1100, 3–1111, 3–1166
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01.06.00	3–22, 3–64, 3–75, 3–101, 3–124, 3–211, 3–216, 3–221, 3–223, 3–253, 3–273, 3–287, 3–288, 3–289, 3–290, 3–294, 3–310, 3–365, 3–420, 3–427, 3–428, 3–467, 3–475, 3–490, 3–545, 3–546, 3–550, 3–556, 3–557, 3–558, 3–594, 3–604, 3–605, 3–606, 3–645, 3–660, 3–666, 3–676, 3–713, 3–715, 3–722, 3–730, 3–731, 3–753, 3–761, 3–779, 3–780, 3–811, 3–812, 3–823, 3–845, 3–846, 3–847, 3–849, 3–853, 3–854, 3–857, 3–871, 3–872, 3–874, 3–881, 3–883, 3–884, 3–976, 3–982, 3–1011, 3–1016, 3–1018, 3–1060, 3–1079, 3–1080, 3–1116, 3–1134, 3–1165
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02.00.04	3–515
02.00.05	3–975
02.00.08	3–29, 3–101, 3–156, 3–472, 3–484, 3–667, 3–668, 3–724, 3–742, 3–831, 3–880, 3–1059
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05.01.01	3–344
05.01.06	3–292
05.01.08	3–169, 3–258, 3–276, 3–344, 3–345, 3–553, 3–713, 3–781, 3–802, 3–812
05.02.08	3–345
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06.00.08	3–155, 3–268, 3–420, 3–473, 3–476, 3–673, 3–713, 3–758
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06.01.01	3–53, 3–846, 3–1026
06.01.06	3–713, 3–718
06.01.08	3–22, 3–25, 3–28, 3–54, 3–154, 3–189, 3–471, 3–472, 3–474, 3–555, 3–557, 3–586, 3–587, 3–596, 3–682, 3–761, 3–780, 3–787, 3–846, 3–946, 3–960, 3–1067
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06.02.09	3–170, 3–266, 3–267, 3–478, 3–1113
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07.03.00	3–797
08.00.00	3–11, 3–29, 3–189, 3–228, 3–275, 3–290, 3–291, 3–292, 3–314, 3–318, 3–349, 3–426, 3–439, 3–487, 3–515, 3–547, 3–550, 3–602, 3–606, 3–626, 3–662, 3–683, 3–718, 3–730, 3–754, 3–756, 3–777, 3–778, 3–781, 3–782, 3–812, 3–847, 3–879, 3–883, 3–903, 3–942, 3–965, 3–970, 3–1012, 3–1018, 3–1102, 3–1166
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09.00.01	3–314, 3–349, 3–354
09.00.02	3–747
09.00.04	3–10, 3–14, 3–18, 3–67, 3–79, 3–107, 3–111, 3–112, 3–390, 3–456, 3–495, 3–496, 3–519, 3–644, 3–650, 3–849, 3–851, 3–863, 3–980, 3–990, 3–1093, 3–1095, 3–1163
09.00.06	3–89, 3–136, 3–712
09.00.08	3–10, 3–54, 3–138, 3–153, 3–155, 3–161, 3–189, 3–199, 3–285, 3–363, 3–364, 3–390, 3–453, 3–489, 3–494, 3–626, 3–679, 3–683, 3–685, 3–781, 3–829, 3–831, 3–866, 3–882, 3–884, 3–885, 3–891, 3–915, 3–947, 3–958, 3–987, 3–992
09.01.01	3–942, 3–947, 3–948, 3–1084
09.01.02	3–87, 3–89, 3–745, 3–933
09.01.03	3–161
09.01.04	3–101, 3–408, 3–516, 3–980
09.01.08	3–473
09.02.04	3–481
09.02.08	3–89, 3–877
09.03.03	3–916
09.03.04	3–516, 3–1049
09.03.05	3–837
09.03.08	3–154, 3–781
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09.04.08	3–596, 3–665, 3–850, 3–866, 3–995, 3–1033, 3–1034
09.05.01	3–948
09.05.03	3–193
09.05.04	3–384, 3–1096
09.05.08	3–506, 3–959, 3–1107
09.06.01	3–154, 3–942
09.06.04	3–518
09.06.06	3–714
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09.07.01	3–946
09.07.02	3–742
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09.07.04	3–500, 3–517
09.07.08	3–1033
09.08.01	3–144, 3–341, 3–372
09.08.02	3–747
09.08.03	3–157, 3–729
09.08.04	3–6, 3–14, 3–15, 3–17, 3–521, 3–647, 3–650, 3–685, 3–895, 3–1005
09.08.08	3–5, 3–12, 3–154, 3–155, 3–356, 3–679, 3–755, 3–885, 3–929
09.09.01	3–951
09.09.03	3–916, 3–917
09.09.04	3–84, 3–129, 3–625, 3–646, 3–684, 3–917, 3–980, 3–1047, 3–1048
09.09.06	3–136, 3–137, 3–716
09.09.07	3–812, 3–905
09.09.08	3–24, 3–28, 3–101, 3–118, 3–156, 3–171, 3–334, 3–335, 3–429, 3–430, 3–453, 3–489, 3–513, 3–571, 3–572, 3–573, 3–574, 3–575, 3–576, 3–577, 3–578, 3–579, 3–580, 3–581, 3–593, 3–596, 3–679, 3–730, 3–731, 3–759, 3–853, 3–882, 3–883, 3–916, 3–917, 3–946, 3–950, 3–959, 3–1033, 3–1035, 3–1081, 3–1084
09.10.08	3–335, 3–501, 3–778, 3–837, 3–917, 3–992,
09.11.01	3–313, 3–348, 3–945, 3–946, 3–950, 3–1023, 3–1024
09.11.03	3–154, 3–916
09.11.04	3–517, 3–518
09.11.05	3–976
09.11.06	3–718
09.11.08	3–11, 3–88, 3–155, 3–156, 3–159, 3–221, 3–267, 3–336, 3–419, 3–473, 3–497, 3–596, 3–683, 3–714, 3–715, 3–716, 3–726, 3–780, 3–876, 3–882, 3–991, 3–1033, 3–1035, 3–1166
09.12.06	3–136, 3–716, 3–717, 3–1085
09.12.08	3–6, 3–15, 3–684, 3–712, 3–715, 3–1164
10.00.00	3–89, 3–144, 3–176, 3–193, 3–325, 3–326, 3–327, 3–341, 3–342, 3–343, 3–344, 3–430, 3–484, 3–498, 3–519, 3–546, 3–547, 3–562, 3–563, 3–566, 3–644, 3–743, 3–746, 3–747, 3–780, 3–811, 3–842, 3–881, 3–914, 3–916, 3–924, 3–929, 3–930, 3–949, 3–958, 3–991, 3–1086, 3–1087
10.01.00	3–313, 3–348, 3–746, 3–757, 3–950

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10.03.00	3–88, 3–884, 3–949
11.00.01	3–312, 3–313, 3–331, 3–348, 3–757, 3–758, 3–824, 3–947
11.00.05	3–603
11.00.06	3–137, 3–420
11.00.08	3–23, 3–525, 3–874, 3–882, 3–931, 3–959, 3–974, 3–1058
11.01.01	3–824, 3–1024
11.01.02	3–747
11.01.04	3–96
11.01.05	3–101, 3–974, 3–976
11.01.08	3–26, 3–29, 3–252, 3–484, 3–828, 3–874, 3–875, 3–974, 3–1022
12.00.00	3–11, 3–193, 3–255, 3–473, 3–512, 3–670, 3–729, 3–734, 3–743, 3–788, 3–798, 3–846, 3–959, 3–965, 3–1067
12.01.00	3–41, 3–499, 3–526, 3–731, 3–743, 3–747, 3–990
12.03.00	3–865
13.00.00	3–41, 3–81, 3–101, 3–166, 3–223, 3–288, 3–339, 3–365, 3–547, 3–594, 3–668, 3–722, 3–726, 3–746, 3–754, 3–845, 3–903, 3–953, 3–1101, 3–1170
14.00.00	3–40, 3–41, 3–180, 3–226, 3–228, 3–229, 3–258, 3–269, 3–355, 3–374, 3–389, 3–413, 3–446, 3–503, 3–630, 3–729, 3–733, 3–735, 3–743, 3–777, 3–782, 3–791, 3–799, 3–802, 3–815, 3–867, 3–943, 3–1037, 3–1063, 3–1116, 3–1119, 3–1130, 3–1147, 3–1164, 3–1170
15.00.00	3–17, 3–29, 3–46, 3–83, 3–104, 3–118, 3–136, 3–138, 3–160, 3–181, 3–204, 3–209, 3–285, 3–307, 3–310, 3–315, 3–359, 3–388, 3–391, 3–440, 3–521, 3–527, 3–529, 3–598, 3–604, 3–669, 3–674, 3–711, 3–712, 3–713, 3–714, 3–716, 3–724, 3–725, 3–733, 3–757, 3–867, 3–892, 3–930, 3–979, 3–993, 3–1003, 3–1018, 3–1055, 3–1179, 3–1180
16.00.00	3–23, 3–89, 3–153, 3–154, 3–156, 3–267, 3–268, 3–473, 3–613, 3–829, 3–884, 3–980, 3–1107

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)

No Location Submitted
Albralto, Paul
Anderson, E.
Ballon, Mike
Dean, Brandy
Ekouth, R. B., Jr.
Elliott, Mary L.
Frigt, Dean
Garcia, Marilyn
Godwin, Michael
Gooden, H.
Gutierez, Luis J.
Gutierrez, Santiago
Harris, Donna
Jones, Darren K.
Laja, Alvaro
LaRoche, Yephon
Lax, B. J.
Lester, T. H.
May, Jerry
Medull, James T.
Mitchell[1]
Navanete, Felipe, III
Nolan, A.
O'Rand, Rodney
Roberts, Jerry
Rodriguez, Willis
Sam[1]
Scott, Betty
Short, Bert
Stafford, Carol F.
Strange, Ronnie
Tarr, Janet
Velasquez, Bobby
Wardell, Steven L.
Whitiley, David

CALIFORNIA

Compton
Smalls, Biggy

Livermore
Shepodd, Tim

CUBA

Guantanamo Bay
Fox, Brian C.
Fox, Stephanie

GEORGIA

Valdosta
Cox, Brandy
Fox, Sean C.

NEW MEXICO

Hobbs
Martin, Jackie
Martin, Melton

OKLAHOMA

Shattuck
Patal, Narendra K.

TEXAS
Adams, Leon
Coleman, Chris
Ingels, Dana
James, Jesse P.
Jennings, Wendy R.
Milm, Dale A.
Scott[1]
Swan, Stacie
Williams, Jan
Wright, A. R.

Alanreed
Dorsey, Catherine
Martin, Rebecca E.

Amarillo
Abbananto, Cheryl L.
Abernathy, Jeannie
Abesha, Sisay A.
Abola, M. C.
Abraham, David
Abrahamson, Steven
Abshire, Linda
Acker, Sherri
Acklin, Merle W.
Acrey, Melinda
Adams, Barbara
Adams, Gary
Adams, Lori
Adamski, Robert
Adcox, Debbie K.
Addington, Jeffery L.
Adelman, Louise
Adelman, Stanley I.
Aget, Nicholas A.
Aguayo, Sonya
Aihn, John H.
Ailson, R., Jr.
Ainey, Dennis
Akin, Tom E.
Alb, Tarey
Albus, Joe
Albus, Teresa
Alderete, John
Alexander, Judy
Alexander, Louise
Alexander, Stacy L.
Alfa, Rich
Alford, Robin
Alford, Tony
Alivdrez, Joe B.
Alkrin, Joseph J.
Allen, Bill J.
Allen, Cody
Allen, Dale E.
Allen, Dean
Allen, Della
Allen, Diane
Allen, Fredia
Allen, Gary L.
Allen, Howard E.
Allen, James
Allen, John R.
Allen, Karen
Allen, Tanita
Allen, William R.
Alley, Peggy W.
Allison, Julie
Allison, Loyce R.
Allison, Phyllis
Alsorta, Terri
Althaus, Mae E.
Altman, Mattie
Altman, Robert
Altschwagon, Carl
Alvarado, Diana
Alvarado, Manuel
Alvarez, Jamie
Alvarez, Juan
Alvarez, Thomas S.
Alvarez, Toni R.
Alvarez, Y. P.
Alxal, Linda
Ambers, H.
Ambers, Lauren
Amenor, Fred
Ammons, Drexel
Amy[1]
Anderson, Bonnie L.
Anderson, Debra D.
Anderson, Donna
Anderson, Fred G.
Anderson, Jim
Anderson, John L.
Anderson, Kae
Anderson, Kathryn
Anderson, Kirk
Anderson, May
Anderson, Robbie
Anderson, Tony
Andrada, Elizabeth
Andrews, Kerman
Andrews, Pauline
Angel, Mano
Angel, Raul V.
Angel, Sylvia
Anghin, Lynn
Anldridge, Katrina
Anthony, Brenda
Antony, Laura
Apeland, Diane
Archer, Aurelia
Archer, C.
Archinal, Bill
Archulito, Samuel
Ardcock, Beverly
Arful, K. J.
Arher, Robert
Arkaifie, Doris
Arkaifie, Grace
Arkaifie, Sam
Armstrong, Debbie
Armstrong, Shellie
Arney, Marguerite
Arnid, Carla
Arnold, Jim
Arnold, Perry K.
Arnold, Shirley
Arnold, Sue
Arriaga, Rodolfo
Arroyo, Frank
Arthurs, Phyllis
Arwine, Barbara
Asberry, Donnell
Asen, Linda M.
Ashcraft, Robert
Ashland, Gary
Ashlock, Lynn, Jr.
Ashton, Jerry
Ashworth, Jeny
Atchley, Michael D.
Ater, Justin
Atkins, Charles
Atkins, Judy
Atkinson, Joe
Atkinson, King D.
Atler, Diane
Atley, Patti
Auman, Eva M.
Auman, Laurence E.
Aurouze, Dorothy
Austin, Brenda
Austin, Duane
Austin, Maurice S.
Austin, Scott
Austin, Steven J.
Austin, Virginia
Austin, Zach
Autrey, Emmett A.
Autrey, Linda
Autry, Carol
Autry, David T.
Avant, Dewayne
Avery, Joyce
Avery, Sandy K.
Avirette, Don
Ayers, Jon R.
Ayola, Luis
B, Anthony
Babash, Craig
Babb, Chuck
Bachman, Shawna
Backing, George
Backus, Larry P.
Bacon, Howard C.
Baer, Bret
Bagley, James
Bagot, Donald
Bahn, Judy
Bahr, Mike
Bailey, Cathy
Bailey, Debbie
Bailey, Donald A.

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Bailey, James
Bailey, Jean
Bailey, Lauren
Bailey, Martha
Bailey, Mike
Bailey, Tammy
Baily, D.
Bain, Chris
Baker, Albert
Baker, April
Baker, David
Baker, David E.
Baker, Gary G.
Baker, Jerry S.
Baker, Kermit
Baker, Kim
Baker, Mary
Baker, Raymond E.
Baker, Robert
Baker, S.
Baker, Shawn
Baker, T. G.
Baker, Vicki
Baldock, Lester L.
Baldwin, Johnny
Baldwin, Lynne
Ballard, Curtis
Balvin, David
Bambs, Keith
Ban, Nancy J.
Banera, Gloria A.
Banister, Barbara K.
Bankhead, Herbert
Banner, Edwin C.
Barbee, Virginia
Barclay, Alana
Barclay, Billy W.
Barclay, Olan
Barcroft, Mary
Bark, Tony
Barkee, Virginia
Barker, Christine
Barksdale, Timothy
Barlow, Donna
Barlow, Ruby
Barn, Robert
Barnard, Carolyn
Barnard, J.
Barnert, D.
Barnes, Kenneth R.
Barnes, Mark
Barnett, Dean
Barnett, Patti
Barnett, Royce
Barney, J. C.
Barnhill, Carol
Barrera, Arturo
Barrett, Ernie
Barrett, Lee
Barrett, Louise
Barrett, N. E.
Barrick, Bruce
Barringer, Ernest W.
Barron, Susie
Barry, Lyndon
Bartels, Mark S.
Bartes, Patsy J.
Bartlett, Jeane
Barton, Blaine
Bartos, Abel J.
Basinger, Ray E.
Bass, A.
Bass, Jason L.
Batchlear, Denby
Batchlear, Lany
Bates, Shelley
Bates, Tracie A.
Batly, W. N.
Batten, W. E.
Baty, Curtis
Baucom, Kaye
Baucom, Milba
Bauer, Leonard
Baugh, Royce
Bauman, Robert, Jr.
Bausman, Sarah
Beach, Lisa
Beagles, D. H.
Beam, Deborah A.
Bean, Richard L.
Beard, Dora
Bearden, Jeff
Bearden, Jim
Beatly, B.
Bechnul, Jerry
Beck[1]
Becker, Steven H.
Beckley, James
Beddou, R. Dean
Beddow, Vicky
Beebe, Sandra
Begley, Mike
Behannon, Samuel F.
Beird, Jerry J.
Belcher, Beckie
Belcher, Luther
Bell, David A.
Bell, Dawn
Bell, Doyla
Bell, Gene
Bell, George
Bell, John A.
Bell, Joyce
Bell, LeDon
Bell, Mary B.
Bell, Sally
Bell, Sally R.
Bell, Sherral
Bell, William J.
Belles, Margie
Bellher, Patricia L.
Bellieu, Rodney
Belott, Kim
Benavidez, F.
Bends, Maria
Benge, Dianna
Benge, Jeff
Benge, Mike
Bengston, Carolyn
Benjamin, Chantal
Benjamin, D. K.
Benley, Mark
Bennett, Bill
Bennett, JoAnn
Bennett, Jonathan
Benson, Carl
Benson, Gordon
Bentle, Marcia E.
Bentle, Mark
Bentley, Linda
Bentley, William
Benton, J. Mac.
Benton, Jan
Beny, Donald G.
Berg, Howard
Berge, Karl
Berger, Ervin C.
Berggren, Rodger
Berlinger, Phyllis
Bernart, Carolyn
Berner, Steven J.
Bernie, Brad
Berry, Angie
Berry, D'Ann
Berry, Jim
Berry, Pam
Berry, Rick
Berry, Ronald K.
Berry, Toni
Berry, Trava L.
Betamount, Daniel
Bethel, Cora
Bethel, Linda
Betts, Myrl
Beuers, Johnenne
Beukenkamp, Ronald
Bevens, Betty L.
Bevers, Lee
Beyer, Don
Beyer, Glenn W.
Beyers, Jesse
Bice, Lori A.
Bidwell, J. Brian
Biggins, L. Dale
Biggs, A. D.
Bilguy, Dewain
Bill McKaskle.
Billington, B. A.
Billington, Cledon
Billington, Elizabeth
Bills, Gretchen
Bills, R.
Billy[1]
Bim, Diane
Binbresca, Yolanda
Bindenfield, Robert
Bingham, William B.
Binrschmitt, F.
Bippus, L. Kirt
Birge, Glenna J.
Birkbeck, Thomas E.
Birkenfeld, Nadine
Birkenfeld, Robert
Birleheard, Andrea
Birtaid, John S.
Birtciel, Gwen
Bishop, Johnnie L.
Bishop, Lorita
Bjork, Troy
Black, Brent
Black, Donna
Black, Douglas
Black, Edward L.
Black, H. W.
Black, Jett
Black, Skip
Blackwelder, Doris
Blackwelder, H.
Blackwell, Dean
Blackwell, Donald G.
Blackwell, Mary Jane
Blackwell, Rose
Blain, Charles M.
Blake, Chad
Blake, Sandy
Blake, Wade
Blakely, John, Jr.
Bland, Wanda
Blandford, Janice
Blankenship, O. J.
Blankinship, J. Etta
Blanton, Charles K.
Blanton, Peggy
Blashill, D. L.
Blatzheim, James
Blaylod, R. O.
Blucher, Donnie
Blucker, Carol
Bluge, Redawna
Boatwright, Patricia
Boaz, Maryann
Bob[1]
Bodey, J. M.
Bods, Jettea
Boese, Connie A.
Boggs, Greg
Bohannon, Lenora
Bohensky, Debra
Bol, S. L.
Bolden, Jason
Bolk, Debbie
Bolton, Anita
Bomar, Dori
Bomar, Glenna
Bond[1]

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Bonifield, Tamara
Bonner, Norma J.
Booker, Jou D.
Boone, Curtis G.
Boone, Steven A.
Boone, Wanda
Booth, Alan
Bordley, C.
Boren, James
Borfier, Brad
Borg, Peggy A.
Borger, Jean P.
Borger, C., Jr.
Borger, Larry
Borger, Mike
Borver, David E.
Bostick, Debbie
Bouchard, Larry
Boudreau, Renee
Boudreaux, Glenn
Boughman, Lou
Bounds, Gerald
Bovey, Terry
Bowen, Bill
Bowers, Ashley E.
Bowles, Chrissa
Bowles, Josh
Bowling, Kerry
Bowman, Michael
Bowman, W. A.
Bowser, John L.
Boyce, Peter M.
Boyce, William C.
Boyd, Dennie
Boyd, Ernie
Boyd, Robin
Boyer, Larry E.
Boykin, Todd W.
Boyle, Aaron
Boynton, Raymond
Bozena, Joseph
Brack, Dayton F.
Brack, Katherine J.
Brack, Kye
Brackens, Alesandra
Brackens, Anna
Braddock, Mary
Braddock, Sherri
Bradley, Barbara
Bradley, Ed
Bradshaw, James M.
Bradshaw, Janet
Brady, Carla R.
Brady, Johnny
Brady, R. J.
Bran, D.
Brand, Curtis
Branden, Lydell
Brannon, C.
Brannor, Quincy
Branson, J. D.
Branson, Jerall D.
Branstutter, G. H.
Brantley, Frances L.
Brashears, Sue A.
Bratcha, Leigh
Brattin, Gordan
Brauler, Tracy
Braussard, Lyddie
Bray, Charlotte
Brazille, Doris
Breazeale, Dianne
Breeding, Russell
Bregano, Rhonda
Bremer, Carol
Brenner, Mike
Brewa, Gail
Brewer, Stuart R.
Brewit, Rob
Bribon, Shala
Brice, Bobby
Bridgen, M.
Bridges, Edwin
Briggs, Bettye
Briggs, Billy T.
Briggs, Linda
Brigman, John
Briley, Steven
Brimson, Laura E.
Brinkley, Curtis T.
Brinkley, Pam
Brint, R. P., III
Briseni, Mary
Brister, Ben
Brits, Danny
Britten, Danny
Britten, Kay
Britten, Mark
Brock, Merl
Brock, Richard C.
Brock, Shirley
Brohlin, Billie B.
Brohlin, Linda
Brokens, Martin M.
Bron, Daine
Brookes, James N.
Brooks, Brandy
Brooks, Claud
Brooks, D.
Brooks, Dan
Brooks, Leon
Brooks, Marc
Brooks, Phyllis
Brooks, William
Broom, Randall L.
Broseh, Teresa
Brow, Bonnie
Brown, B. A.
Brown, Bertha
Brown, Christie
Brown, D. Jerome
Brown, D. L.
Brown, J. R.
Brown, Joanne
Brown, Kathy
Brown, Kenneth L.
Brown, Larry
Brown, Lesley
Brown, Michael L.
Brown, Neely
Brown, Ronald
Brown, Shaun
Brown, Shawn
Brown, Toshiko K.
Brown, Vastine C.
Brown, Virgil
Brownley, H. E.
Brucker, Craig
Bruckner, Ben
Bruling, Brenda
Brunsor, Kinney
Brunton, Joey D.
Brunton, Rita
Bryan, Everett
Bryan, Michael R.
Bryant, Betty
Bryant, Bruce
Bryant, F. B.
Bryant, James
Bryant, R. W.
Bryant, Sam
Bryson, Neal
Bryson, Peggy S.
Buatos, John
Bubly, Thomas
Bucks, Teresa
Budzynski, Jo Anna
Buell, Sharon M.
Bughnon, Frank
Bugley, Austin
Bukleck, Janice C.
Bulholz, Janice K.
Bull, Douglas
Bull, Walter S.
Bullard, Arthur
Bullard, Deena
Bullion, Karen S.
Bullock, Mary
Bullock, Robert A.
Bullrug, Donna
Bundy, Kevin
Bundy, Pauline
Bunhhatta, Jimmy
Bunney, George
Burdett, Brad
Burdett, Thomas L.
Burge, Marla
Burge, Richard
Burgett, Charles
Burian, Judith N.
Burk, Judith L.
Burk, Norman
Burke, Lance M.
Burke, Patrick C.
Burke, Richard L.
Burkhead, Byron
Burklialton, Tom
Burks, Don
Burks, R. N.
Burks, Susan
Burlfield, Saul
Burling, Gerald H.
Burnam, Becky
Burnelt, Adrian
Burnett, Roy
Burney, Shannon
Burns, R. H.
Burns, Rhett
Burnschmitt, Linda
Burris, Barbara
Burrows, K.
Burrus, Troy
Burruss, John W.
Burton, D. K.
Bush, Lance
Bush, Laura L.
Bush, Steve
Bussey, Brenda
Bustos, Edward
Bustos, Ricardo
Butler, Jeff
Butler, L. K.
Butler, Linda
Butler, M.
Butler, P. J.
Butler, Steve
Butrie, Bruce
Butts, Marshall W.
Buyers, William T.
Buzzer, Patricia D.
Byars, Lyle E.
Bybee, Billy M.
Byers, Linda
Byrd, Alvis
Byrd, David
Byrd, N.
Byrd, Thomas E.
Byrum, Robert J.
Byrums, Dick
C. P.
Cabello, Simona
Cabrera, Pablo M.
Cagle, Anson
Cagle, Bob
Cain, Artis
Cain, Donna
Cain, Ronnie
Cald, Daniel
Caldin, Terry
Caldwell, Charles D.
Caldwell, Debbie
Caldwell, Kristine
Caldwell, Shannon
Calhoun, Sherry
Calhoun, Terry

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Callahan, Amy
Callahan, Stan
Callan, Bob
Callaway, Kirby
Callaway, Steve
Callen, Bob
Callihan, S. F.
Callihan, S. P.
Calvo, Juan
Calzaretta, Robert
Camarille, Maurice
Campbell, Alonza
Campbell, Charlie
Campbell, Cleckel
Campbell, Dana N.
Campbell, Don
Campbell, Dwight S.
Campbell, Ervin
Campbell, Jean
Campbell, Kerry
Campbell, Linda
Campbell, Martha
Campbell, R. B.
Campbell, Scott E.
Campbell, Shimika
Cane, J. J.
Cannon, Randall L.
Cano, Irma
Cantweld, J. L.
Cantwell, Don
Cappuiz, Luis
Caranto, E. R.
Cardwell, Melinda
Cardwell, Pamela A.
Cargill, Larry D.
Carleson, Thomas G.
Carleton, Newton C.
Carlile, J. C.
Carlisle, Allan
Carlock, Wanda
Carlson, John R.
Carlt, Christalle
Carpenter, Brenda
Carpenter, Max
Carpenter, Robert
Carpenter, S. Dean
Carper, Don C.
Carper, Glenda J.
Carr, Mae
Carr, Terence B.
Carraseo, Elva
Carrington, Denese
Carroll, Annie
Carry, Kimberly
Cart, Helen
Carter, Beth
Carter, Cindy
Carter, Ike
Carter, Linell
Carter, Lois
Carter, Matthew
Carter, Randy
Carter, Susan
Carter, Troy
Carter, Walter I.
Carthe, Jack
Carther, Chris
Cartwright, Billie J.
Cartwright, Bonnie
Carv, Nector
Carwile, Dorothy
Casey, Sabrina A.
Cash, William
Casias, Bevery
Castellano, Leonard
Castello, Rodalfo
Castillo, Betty J.
Castillo, Jessica
Castillo, Juanita
Castillo, Marco A.
Castleberg, Duane
Castleberry, Ed
Castleberry, Roger
Cataldi, Steve
Cate, Marie
Catherall, Pete
Cathy, Michele
Caudle, Geary M.
Caufman, Linda
Cawthron, Tiffani C.
Ceballor, Roger
Celey, Bobby
Cemanilla, Mary
Cempuzeno, Azael
Ceoneales, Leslie
Ceraf, Dan
Cerrantez, Ernie
Cervantez, Marie
Chadwick, Leona
Chadwick, Williams J.
Chalreels, Jerold
Chambers, Vicki
Chandler, Cheryl
Chandler, Doug
Chany, Vicki
Chapman, D.
Chapman, Jacqueline G.
Chapman, Jerry
Chapman, Ruth L.
Charleomean, Pauline M.
Charles, Rick
Charter, Jeffrey
Chavez, Jesus S.
Chavez, Kendra
Chavez, Robert
Cheek, Cheryl
Cheek, Robert
Chelf, Richard
Chermault, Kerry
Chevez, Raymond P.
Chickle, Richard A.
Chifford, Geoff
Childress, Jay
Childs, Debra
Chipman, Lisa
Chism, Diane
Chism, Grace
Chisum, D. R.
Chreders, Miles
Christian, Charles R.
Christopher[1]
Christy, Melinda
Chroscinski, Lilianna
Chumney, Roger D.
Clancy, Mona
Clark, Annette
Clark, Bill
Clark, Charles D.
Clark, Doug
Clark, Floyd K.
Clark, Gene
Clark, George
Clark, Travis W., II
Clark, Kye
Clark, Lisa
Clark, Malcolm
Clark, Mary D.
Clark, Todd
Clary, Cathy
Clary, Vicki
Clay, Coye D.
Clayt, O. R.
Clayton, Gail
Cleavenger, Dever C.
Cleckest, Lonnie M.
Clem, Shirley L.
Clem, Tommy G.
Clemens, Pamela
Clements, J.
Clements, M. F.
Clements, Wendell L.
Clemmer, James
Cler, Eddie
Click, Bob
Click, Clifford N.
Click, Kathy
Clifton, Brenda
Clifton, Johnny
Clifton, Tricia
Cline, Shirley
Clorrette, Charlotte
Close, Debra
Cloud, Curtis A.
Cloud, Sherra
Clowe, Kevin
Cluighorway[1]
Coats, Lyndal
Cobb, Vera
Cochran, Audrey A.
Cochran, Robert J.
Cockrell, Britt
Cockrell, Gary
Cockrell, Glenn, Jr.
Cockrell, Marsha
Coffey, Danny
Cogasin, Rick
Coker, Johnny L.
Cole, Donna M.
Cole, Robert D.
Coleman, Brian
Coleman, Danielle D.
Coleman, Danny
Coleman, Dorothy B.
Coleman, Kennedy
Collens, Ken
Collier, Bill
Collins, E. T.
Collins, Jean
Collins, Jeffrey C.
Collins, Karen
Collins, N. Susan
Collins, Peggy
Collins, Russ
Combs, Bret
Combs, James R.
Comer, Ken
Comer, Mary M.
Comer, Terri
Coniglio, Diana
Conklin, Danny H.
Conklin, Woody
Conley, Pat
Conn, Bill
Conn, Kenneth R.
Connally, Randy
Connelly, Mike
Conner, Hilton J.
Conner, Jerri
Conner, Martha J.
Conner, Robert W.
Connor, J. Michael
Contreras, Guadalupe
Contreras, Phillis A.
Contreron, K.
Conturas, Richard
Conturor, Henry
Conway, Forrest
Cook, Carl
Cook, Dennis L.
Cook, Glennda
Cook, Iona M.
Cook, Kathy
Cook, Ken
Cook, Missy
Cook, Preston
Cook, Ralph
Cook, Scott
Cook, Sherran
Cook, Vicky
Cooke, Paul
Cookrey, A. E.
Cooks, James A.
Cooley, June
Cooper, Benny R.
Cooper, Bobbie

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Cooper, Cheryl
Cooper, Jennifer
Cooper, Winfield B., Jr.
Cooper, Paul
Cooper, Weldon D.
Copeland, David
Copeland, Maria
Copeland, Rob
Coppinger, Michael L.
Corbitt, Elbert L.
Corbitt, Frances E.
Corden, Glen A.
Corington, Michelle L.
Cornelison, Irenda
Cornelius, Lillian
Correia, Sandra
Corteri, Bobby
Cossabone, Jaynie
Cost, Sharon
Cost, Steven
Costley, Karen S.
Costs, Juan A.
Cotgreave, Stan
Coursey, Scott
Coury, Kirk A.
Couture, Celeste
Coventry, Melinda
Coventry, Neil
Covert, Lee
Covington, Annette
Cowan, Charles
Cowen, Alvin
Cowrey, Michael J.
Cox, Doris M.
Cox, Ed
Cox, Glenda G.
Cox, Larry
Cox, Lou Ann
Cox, Lynn
Cox, Terry J.
Coyne, Mary
Craig, Sherrill J.
Craig, Wendell
Crain, Robin
Crane, Robert M.
Craven, Raphel C., Sr.
Crawford, Cary
Crawford, Cindy J.
Crawford, Cynthia
Crawford, Jerry G.
Crawford, Mary
Crawford, Randy L.
Crawford, Vivian
Crawly, Keith
Creeden, Daniel
Creeden, Guwan H.
Crenshaw, W. T.
Crespin, Albert E.
Creswell, Cynthia
Criste, Tamara A.
Crockett, Jeannette R.
Croft, William M., III
Cromer, Barbara
Crook, Patricia
Croosti, Gracie
Cross, Kathy
Crossland, John M.
Crouch, Claudia
Crow, E. B.
Crowley, Brenda
Crowley, Jerry
Crumpler, William A.
Crutchmer, J. T.
Cruz, Helen
Cuamb, Charlie
Cude, Bruce
Cudriggs, Philip J.
Culk, Peggy
Cull, William T.
Cullins, Joel
Cullreath, Dave
Culp, Gary
Culthel, J. D.
Culwell, Kay
Cummins, Dan
Cunnigham, Cindy
Cunningham[1]
Cunningham, Conald
Cunningham, J. Pat
Cunningham, Juna A.
Cunningham, Richard C.
[1]Cunningham, Rose
Curie, Jose H.
Curnes, Rodney
Curphey, G. Don
Currie, W. R.
Curtay, Gayle
Curtis, Lesia
Curtis, Melony
Curtis, Roy E.
Cutting, Betty
Czewski, Tom
Daberwick, Daniel B.
Daily, Kim
Dain, Charles O., Jr.
Dalhour, Harold
Dallas, Daniel D.
Dallas, Dwayne
Dalton, DeRema
Dammier, Charles D.
Dan, Laura
Daniel[1]
Daniel, Bruce W.
Daniel, Deborah
Daniel, Judy
Daniel, Marilyn K.
Daniel, Scott
Danny, E. W.
Darnall, Rex
Darnell, Mark
Darwin, R. H.
Dasen, Rod
Date, Gayle
Daulton, Beverly
Davenport, James F.
Davenport, Patricia Y.
Davenport, Sandra
Davey, Beverly
Davids, Jack
Davidson, Andrea P.
Davidson, E. W.
Davidson, Edna I.
Davidson, Janice
Davidson, Melissa
Davidson, Nancy
Davidson, Robert
Davidson, S. N.
Davies, Mildred
Davis, B. J.
Davis, Barbara
Davis, Bill J.
Davis, Brenda
Davis, D. Linda
Davis, David L.
Davis, Dick
Davis, Don R.
Davis, Ed
Davis, H. J.
Davis, J.
Davis, James E.
Davis, James H.
Davis, Jan
Davis, Janie
Davis, Janie S.
Davis, Jody
Davis, John
Davis, Kathy
Davis, Kirk
Davis, Lavonna
Davis, Lucretia J.
Davis, M. R.
Davis, Pam
Davis, Pat
Davis, Ray
Davis, Richard H.
Davis, Scott
Davis, Sue C.
Davis, Terry
Davis, William R.
Dawdy[1]
Dawdy, Tom
Dawkins, Pattilou
Dawson[1]
Day, D.
Dayn, Paul
Dazzi, Carl W.
de Codes, Pedro
de la Britone, B.
De la Gaga, Ramiro
De Los Santo, Joe
De Los Santos, Jamie
De Vine, Richard C.
Deal, Johnny
Dean, Patrick
Dean, Richard
Dean, Sharon C.
Dean, Wallace R.
Deaton, Paula
Deaver, Jeff
Deaver, Sandra
Deckard, Jo
Deckard, R. K., Jr.
Deckard, Rocky D.
Deen, Barbara
Dees, Celia
DeGray, Cheryl
DeLeon, Gilbert
Deline, Karen
Delone, Kevin N.
Demerson, S. E.
Dempsey, Debbie E.
Demvy, Craig
Dendy, Nichelle
Denemey, Tim
Denney, Linda
Dennis, Karen
Denny, Sharon
Denton, Dennis
Denton, Gary E.
Denton, Nancy
Dentor, Dan
Derden, Cliff
Desmone, Will
Determan, Richard
Devaney, Claud W.
DeVanny, Amogene F.
Devore, David K.
Dewey, Amy
Dexter, Robert F.
Diaz, Al
Diaz, Blanca E.
Diaz, Delfine
Diaz, Dolores
Diaz, Frankie
Diaz, Guadalupe
Diaz, J. R.
Diaz, Jacob
Diaz, Jesus T.
Diaz, Marcus
Diaz, Prazedez H.
Diaz, Ray
Dick, Timothy J.
Dickens, James E.,
Dickerson, Janette
Dickerson, Linda G.
Dickerson, Nancy
Dickey[1]
Diley, Kelly J.
Dillaha, Yvonne
Diller, Gerald
Diner, Clifford
Dionizio, A. James.
Divens, Joyce
Dixon, Cathy S.
Do, Phat

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Dockeny, Gena
Dodge, Melissa E.
Dodson, Shellia
Dodson, Stacy
Dodson, Tim
Dogen, Roy
Doggett, John D.
Doggett, Kimberly A.
Doherty, Vickie
Dollar, Roger
Domine, Mark J.
Dompe, Jacki
Don[1]
Donald, Jessie
Dora[1]
Doran, Kay
Dorm, Monica
Dorsey, Danny
Doty, Dennis
Dougherty, Paige
Dougherty, Tina
Douglas, Robert C.
Douglass, Rebecca
Downs, H. G.
Doyle, Dale W.
Drake, Dan
Drake, Donald
Drake, Troveta
Draper, Jerold
Draper, John E.
Draper, Rose
Drezek, Casimer
Driver, Brooke
Drummond, Jeff
Drummond, John C.
Drummond, Penny L.
Dryden, Colleen
Dryden, G. R.
Dryden, John L.
Dryden, Kim
Duck, Aaron
Duck, Don
Duck, Sandy
Dudley, Joyce
Dufer, Bill
Duffy, Jerry
Dugan, Tessa
Duggan, Rowina
Dugie, Bonnie
Duila, Mike
Duke, Manuel
Dulton, Pat
Dunca, James R.
Duncan, Bettie A.
Duncan, Ernie
Duncan, Eugene
Duncan, George
Duncan, Glenn
Duncan, Jeanette
Duncan, Kevin
Duncan, Richard
Duncan, Tracy
Duniven, Betty
Dunlap, Genell
Dunlap, Linda
Dunn, Della
Dunn, Frances
Dunn, Jim
Dunn, Paul E.
Dunn, Roy L.
Dunnam, Kay
Dunson, Steve
Dunstam, Roland W.
Durham, C. E., Jr.
Durham, Phillip, Jr.
Durham, W. W.
Durley, Joycelyn
Dussler, Larry
Dyer, Richard
Dyke, Angie
Eaby Ph.D., Allen
Eades, Rita
Earls, Matt
Early, Lynn
Early, Nathan
Easley, Doug
Eastepp, Ruth
Easthman, James L.
Eastland, Cindy
Easton, Rose
Econtriz, C.
Eddington, Diana
Edes, Kathryn
Edes, Melvin
Edmondsen, Ronald
Edward, Tim
Edwards, Carol
Edwards, Daena
Edwards, David W.
Edwards, Debra
Edwards, Jan
Edwards, Krista
Edwards, Ora
Edwards, Terri
Egoodkin, Alan
Egoodkin, G.
Eichelmann IV, John
Elbum, Ken
Elders, LaDonna
Elfelt, J. M.
Elison, Paul H.
Elliot, Judy A.
Elliott, Angelia
Elliott, Bill
Elliott, Cathy A.
Elliott, Dale
Elliott, David
Elliott, Robert L.
Elliott, Ron
Ellis, Barbara
Ellis, Berna R.
Ellis, Chad
Ellis, Mark T.
Ellis, Sammie
Ellis, Thomas S.
Elliston, Wayne
Elly, J. Dianne
Elsen, Charles
Elsen, Mike
Elvebar, Ron
Ely, J. Diane
Embrey, Brad
Eminger, Randy
Enewally, Jean
Enge, Roby D.
Engle, William T.
English, George W., III
Ennis, Rick
Enriquez, Belen
Ernee, Carolyn
Ervin, Cindy
Erwin, Lela I.
Escofo, David M.
Escole, Sharon
Esparza, Josie
Espinoza, Margo
Esquivel, Melissa
Estep, Dean
Estes, Peggy
Etheridge, Steve
Eudey, Cheri L.
Eudey, Sandi
Eustace, Cheryl
Evans, C. Glenn
Evans, Gayle
Evans, Gaylord
Evans, Mike
Evans, John H., P. E.
Everett, Brian
Everett, James D.
Everett, Marian
Everhart, Vanessa
Everitt, Stephen
Everly, David
Evers, Kathy
Evilen, Grady
Ewing, Bobby D.
Ewing, Gloria
Eyland, Ronnie G.
Eyre, Randy J.
F. J.[1]
Faggan, Janice
Fahnert, Lou
Fain, Cecil
Fair, Wayne
Fairrow, Nannette
Fairweather, Guy S.
Fajardo, Maria
Fajardo, Marie
Fajardo, Raymond T.
Falk, Kenneth
Falkner, Richard
Falram, Jimmy
Fanen, Steve
Fansher, Darell
Fansler, Tony
Farley, Larry
Farley, Robert
Farrell, Betty
Farrell, Linda M.
Farris, Thomas D.
Farwell, Fenton
Fassauer, Juan
Fathers, Warren
Faubion, B. O.
Faulknu, George
Faust, Shelley
Felder, Floyd
Fellers, Jim
Fellers, Vicki
Felton[1]
Felton, Stephen
Fenley, Bob
Ferguson, Alan
Ferguson, Charlene
Ferguson, David
Ferguson, Greg
Ferguson, Jerry W.
Ferguson, W. Dan, Jr.
Ferraneso, Aime
Ferris, D. G.
Fetterson, Geraldean C.
Fewell, Walt
Fiel, John A.
Field, Paul P.
Field, R. E.
Fields, D. K.
Fields, Rebecca A.
Fike, David
Fike, Leslie O.
Filmore, Susan
Filsouf[1]
Fincher, Beverley
Fincher, Jimmy
Fincher, Johnny
Fincher, Larry
Fincher, Larry G.
Finchino, Timmy
Finchy, A.
Findley, Gerald L.
Findley, Melinda
Finky, Todd
Finland, Barbara
Finley, Troy
Finney, P. E.
Fiore, Frank
Fiorenza, Donna
Fipton, E. L.
Fisher, Alice L.
Fitz, Amy
Fitzgerald, D. R.
Fitzgerald, Jimmy C.
Fitzgerald, Joy
Fitzhugh, Ken
Flake, Lonnie O.

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Flemming, Brian
Fletcher, Marshall
Flood, Ed
Flora, Jerry
Florek, Christopher
Florek, Danuta
Florence, Nelda
Florentine, Susana
Flores, A. C.
Flores, Dora
Flores, Mary T.
Flores, Paul
Flores, Johnny R., Sr.
Floris, Johnny
Flowers, Gary
Flowers, Gussie
Flowers, Lois
Flowers, Melissa
Flowers, Peny
Flowers, Timothy L.
Fogg, Karen
Folley, Elaine
Fondau, Grant W.
Foran, Richard D.
Forbes, Cynthia
Ford, Barry N.
Ford, Kim
Ford, Lydia
Ford, Modrey
Ford, Pat
Ford, Patrice B.
Ford, Roland
Ford, Ronald Q.
Ford, Terry
Fore, Terry W.
Foreman, Wesley D.
Forester, Marty
Forger, Karen S.
Forrest, Bedford
Forrest, Reva
Forrester, Arla V.
Forrester, Carmen M.
Forresth, Juana L.
Forsyth, Douglas R.
Forsythe, Cindy
Forsythe, Robert J.
Fortenberry, Kevin W.
Fortin, E. R.
Fortunato, Michele
Foster, James L.
Foster, Mary
Foster, Michael H.
Foster, Raymond
Fowler, Brian W.
Fowler, Pamela
Fowler, Sabrina
Fox, Betty
Fox, Donna
Fox, Gerald E.
Fox, Laura
Fox, Nelda
Fox, Robert E.
Francis, J. C.
Francis, James M.
Francis, Robert
Francis, Velma
Franklin, Darrell R.
Franklin, Rosie
Franks, Bill R.
Franks, Patsy
Frasier, S. J.
Frauberfield, Earl
Freeman, Barry L.
Freeman, Warren J., Jr.
Freenan, Ward B.
Frenayel, C.
French, Bob
French, Perci D.
Freshnock, Helen
Fresland, Ted
Frey, Brenda D.
Friemel, Fred
Frisbie, Sylvia
Fristoe, Phillip
Fritts, W. R.
Frot, Michael S.
Frow, W. R.
Fruscella, Steven G.
Fry, Ann
Fry, Dustin
Fry, Roxanne
Frymoyer, Debbie
Frymoyer, R. D.
Fuento, Gerald
Fuento, Lucille
Fuitt, Bridget
Fullbright, Leslie
Fuller, Dorothy
Fuller, Rodney
Fulta, John S.
Fults, Becky
Funderburk, Roxane
Funsler, Sarah
Funth, J.
Furgat, Judy
Fussell, Rich
Fyfe, Sara
Fyfe, Taylor D.
Gable, Jim
Gadman, David
Gadman, Lucille
Gadola, Thcarl
Gadry, Kristy K.
Gafant, Ricky
Gafford, Virginia
Gage, Belle
Gage, James B.
Gaines, Mona
Gallegos, George
Gallegos, Mark
Galloway, Jake
Galloway, Judy
Galvan, Teresa
Galvin, Jan
Galvin, Jerry O.
Gamblin, Cindy
Gamblin, Reginald D.
Gamblin, Robbie
Gamblin, Terry E.
Gamklin, Jo
Gampy, Reve
Ganbiel, Ben
Gance, Pamela K.
Gann, Dena
Gann, Richard
Ganna, Denise
Gants, Daryl
Gantt, Parker
Garcia, Dawn S.
Garcia, Gloria J.
Garcia, Daniel, III
Garcia, Joe M., Jr.
Garcia, Peggy
Gardner, Dennis
Gardner, J.
Gardner, Sheri
Garland, John, Jr.
Garrett, Douglas
Garrett, L.
Garrett, Laverne
Garrett, Rhonda M.
Garrett, Richard D.
Garrin, Chip
Garyala, Jim
Garza, Stefanie
Garza, Veronica
Gaston, Gene
Gates, John W.
Gaut, Jean
Gaven, John H.
Gawof, J.
Gaydez, Juan
Gazzaway, David
Gee, Brenda
Gentleman, Dorothy
George[1]
George, James P.
George, Pam
Gerald[1]
Gerald, Robert E.
Gerber, Sue
Gerhu, Donald
Gervasi, Stephany
Geue, Stephen H.
Ghormly, B.
Giambra, Anna M.
Gibbins, Donald C.
Gibre, Michael P.
Gibson, Gary L.
Gibson, Glynda
Gibson, Janene
Gibson, Jill
Gibson, Joy
Gibson, Mila
Gibson, Ray
Gibson, Terry
Gifford, James E.
Giham, Jeff
Gilbert, Janice
Gilbert, Melanie
Gilbert, Michael L.
Gilbreath, Betty
Gilbreath, T. J.
Gilbreth, Lisa B.
Gilderland, Morgan
Giler, Johny H.
Gill, Paige
Gilley, E. Ray
Gillham, Janice E.
Gillis, Jerry G., Jr.
Gilmore, Sandy
Gilstig, Alice
Gimpell, Henry
Gipson, Michelle
Gist, Boyd
Givens, A. F.
Glasscock, Denis J.
Glassman, Laura
Glenn, Bobbie
Glenn, Dori R.
Glenn, Greg
Glenn, James M.
Glenn McMennamy.
Glover, Elizabeth T.
Glover, Jeffrey
Gobelin, Joanne C.
Goble, E. Phillip
Godwin, Marybeth
Goebel, Jerry
Goelizer, Richard V.
Goetz, Jason J.
Goforth, Don
Goldston, Rodney W.
Golin, Truitt C.
Gomez, Francisco
Gomez, Trinnie
Gonce, Michael
Gonce, Pam
Gonzale, Joe R.
Gonzales, C.
Gonzales, Candace
Gonzales, Charlene
Gonzales, Nancy A.
Gonzalez, Letisia
Gonzalez, Valery
Good, Patricia
Goodell, Annice
Goodell, John W.
Goodell, Richard S.
Gooden, Harvey K.
Gooden, Jerry D.
Goodfellow, Karin
Goodfellow, Phillip
Goodin, Jean
Goodrich, Leticia A.

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Goodrich, Robert W.
Goodwin, Mary
Gordon, R.
Gore, Charles W.
Gore, Shannon
Goss, Tom
Gougt, Paul
Gourley, Patricia
Gower, Richard
Goze, Bartella
Gozet, Luke
Graff, Amy
Graham, Brenda
Graham, Wendy
Graham, William L.
Grant, Harlin
Grant, Mark
Grant, Marlene
Grant, Stacy
Grantham, David
Graves, Albert D.
Graves, Patsy C.
Gray, David L.
Gray, William J., II
Gray, Jack
Gray, Larry V.
Gray, Rosemary
Greaser, Bill
Greaser, Melynie
Greear, Kenny
Green, C. E.
Green, David G.
Green, Don
Green, Tim
Greene, Carrie
Greenly, George D.
Gregg, James
Gregory, Gary D.
Gresham, Dwayne R.
Griego, Andrew
Griffin, John R.
Griffin, Kathryn
Griffin, Leslie
Griffis, Crystal M.
Griffis, James M.
Griffith, Robert, Jr.
Griggs, Linda
Grime, Jerry
Grimes, Gary J.
Grimes, Paula
Grimes, Rick
Grims, J. W.
Grisbaum, F. G.
Grist, John
Gross, Joe L.
Grotsby[1]
Grubbs, Sharon
Guenero, Kristi
Guerry, Jim
Gugr, James R.
Guhl, Robert
Guildman, Robert
Guinn, Gary K.
Guinn, Mary
Guleke, N. V.
Gulley, Faye
Gully, John
Gunning, Nathan
Guston, Joseph G., Jr.
Guthrie, Beverly
Gutierez, Edward R.
Gutierrez, Jonathon
Gutierrez, Kelly
Guzman, Gilbert
Guzman, Joseph
Guzman, Marilynn
Guzman, Mike
Gwen, Michael E.
Gwyn, Gary
Gwyn, Lynn
Gwynn, Sharon
Hadaway, Tom
Haddock, JoAnn
Hagemeier, Jim
Hager, Lela H.
Hagerman, Sharon
Hagerman, Steve
Hagermi, Swanson
Haggard, Randall
Hahn, Gerry
Hahn, Scott
Hakimi, Charla
Hale, Clara
Hale, Emil
Hale, Jan
Hale, Jerry L.
Hale, Allen M., Jr.
Hale, Linda
Hale, Shawn
Hale, William H.
Hales, Melana
Haley, Chris
Haley, Janie C.
Hall, Allen K.
Hall, Beverly J.
Hall, Bobby
Hall, Brenda J.
Hall, David L.
Hall, Helen C.
Hall, J. D.
Hall, Jonnie
Hall, James, Jr.
Hall, Ken
Hall, Pamela
Hall, Rachel D.
Hall, Russell F.
Hall, Steve L.
Hall, Wesley
Hallett, Steven G.
Halley, James
Halliday, Debra M.
Hallmark, Charlotte
Halsted, Phillip R.
Haman, Bermal
Hamburger, Richard L.
Hamilton, Cullray
Hamilton, Henry H.
Hamilton, J. M.
Hamilton, Richard A.
Hamilton, Roushell
Hamilton, Vivian
Hammer, Kevin
Hammock, Barbara
Hammock, Iona P.
Hammuts, Michael C.
Hampton, Benjamin C.
Hancock, Janetta
Hand, Patricia
Hand, Patrick
Hand, Teri
Handley, Debbie
Handley, Don F.
Handley, Shirley
Handly, Jeff
Hanes, Phyllis
Hanks, David
Hann, Todd
Hanna, A. Lea
Hans, Roger L.
Hanson, Cindy
Hanson, Russell
Happer, Sandra
Harbin, Elizabeth A.
Harbin, Jim
Harbour, Elda Z.
Harden, Greg
Hardin, Carri
Hardin, Jack
Hardy, Cathy
Hardy, Guy A.
Hardy, Steve
Hare, Krystal
Hargrove, Kevin L.
Harl, Carl D.
Harl, Claue M.
Harlow, Kevin P.
Harlow, Tracy
Harman, Cheryl
Harmon, Jacquiline
Harnle, Brad
Harp, Robert D.
Harrelson, Misti
Harris, Allen
Harris, Bill
Harris, Carla
Harris, Cathie L.
Harris, Gary C.
Harris, Jeff
Harris, Lisa
Harris, Lucille
Harris, Melva
Harris, Pat
Harris, Sharon
Harris, Timothy W.
Harris, W. J.
Harrison, H. H.
Harrison, J. W.
Harrison, Sue
Hart, Hali
Hart, Jen
Hart, Mike
Harter, Paul
Hartfelder, Eric
Hartwell, Jessie
Hartzen, Charlene
Harvell, Ira S.
Harvey, Damon
Harvey, LaFonda
Haseloff, Rod
Hash, Kelley
Haskins, Chris
Haskins, Sandra
Hasslils, Leroy R.
Hatch, Dan
Hatcher, Russ
Hatchett, Capres S.
Hathaway, Janice
Hathaway, Troy
Hatley, Paula
Havelaker, Verl D.
Havins, Nola M.
Havron, Vivien S.
Hawke, Brad
Hawkin, Jon M.
Hawkins, Charles
Hawkins, David L.
Hawkins, Joe
Hawkins, Karen W.
Hawkins, Kathy Jo
Hawkins, Roger W.
Haye, Robbie N.
Hayes, Sheila
Haygood, Paul
Haynes, J.
Haynes, Phil, Jr.
Haynes, Mike
Haynie, Gary A.
Hays, Selina
Haywood, Mike
Head, Billy
Heady, Susan
Healy, Jimmy D.
Heard, Shirley
Heare, Robbie
Heath[1]
Heath, Mulkey, Jr.
Heave, Mark E.
Heckman, Mark
Hecto, M.
Hedgecoln, Gary R.
Hedtke, Roy R.
Heffley, Kenneth O.
Hefner, James R.
Hegwer, Todd
Heisler, Brian

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Helalde, Joe
Helsley, Linda
Helton, Bill D.
Helton, Jim
Helton, Phyllis K.
Helton, Virginia K.
Helyes, Vivienne
Hemma, David
Hemphill, Sharon J.
Henard, Kay
Henderson[1]
Henderson, Deborah
Henderson, Emmitt
Henderson, Kim W.
Henderson, LaToy
Henderson, Mary C.
Henderson, Pat
Henderson, Paul D.
Henderson, Sandra
Henderson, Tricia
Hendrick, Christina D.
Hendrick, Cory
Hendrick, Jason
Hendricks, Vaughn P.
Hendrix, Bessie
Hendrix, Sherri
Henke, E. J.
Henke, Robert E.
Henley, Johnny
Henning, Paul
Hennis, Steve F.
Henry, Arlie N.
Henry, C. R.
Henry, Russell
Henry, William R.
Henslee, Gale W
Henson, Jamie
Henson, Ritchy
Hernandez, Abe
Hernandez, Aurora
Hernandez, Jennelle
Hernandez, Michael
Herndon, Eddie
Hernon, Den
Herr, Gordon W.
Herr, Wayne L.
Herrera, Alberto
Herring, Earl
Herring, Kathleen M.
Herring, Mary Ann.
Herring, Susan
Herron, Joan
Hester, Barbara
Hester, Roger, Jr.
Hetgla, Gary S.
Heuton, Luann
Heuton, Randall
Heyt, Carla
Hferp, Paul
Hibbs, Robert I.
Hichabay, Jerry L.
Hickam, Patsy
Hickman, Carolyn
Hickman, Ron
Hickmott, Charles
Hicks, James P.
Hicks, Michelle
Hicks, Teresa
Hielse, Jeanette
Hiett, Robert
Higgins, Dona
Higgins, H. A.
Higgins, P.
Higis, Eric A.
Hileman, E. G.
Hill, Barry
Hill, Bradley L.
Hill, Chandra
Hill, Ferrell G.
Hill, Gerald
Hill, JoAnne
Hill, Alan, Jr.
Hill, Kevin
Hill, Lori
Hill, Marianne
Hill, Marilyn
Hill, Neil R.
Hill, Weldon E.
Hill, Zoe
Hilletter, Jason
Hillin, Clifford K.
Hillman, Mike
Hillman, Teresa
Hills, Charles R.
Hincir, Debbie
Hinderliter, V. L.
Hiner, Amy
Hiner, Arla
Hiner, Billy
Hinkle, Lloyd J.
Hinojosn, A.
Hinton, J. D.
Hintz, Douglas
Hisbon, Billy M.
Hizzinbotham, Darren
Hodge, Bennee
Hodge, Dana
Hodge, Greg
Hodge, Janet
Hodge, Myrtle
Hodges, Carolyn
Hodges, Deborah
Hodges, Gary
Hodges, Kent
Hodges, Tom
Hoffey, Rex
Hoffman, Phillip
Hoglund, Kenneth
Holcave, Valerie
Holeman, Keith
Holeman, Valerie
Holland, Brenda J.
Holland, D. C., Sr.
Holley, Drew
Holley, Melissa
Hollings, Datea L.
Hollingsworth, Claud
Hollis, Karen
Hollis, Tim
Hollis, Tom
Holloway, Debbie
Holly, Scott
Holm, Jay E.
Holman, Leslie
Holmes, Micah
Holt, George
Holt, Jay D.
Holt, Jerry
Holwick, Gary
Holy, John A.
Homsly, Deborah
Honaker, Jean
Hond, Matthew
Honea, Bobby
Honea, James C.
Honea, Joseph H.
Honemy[1]
Honly, Jimmy
Hooker, Vicki
Hooks, Wanda S.
Hooper, Lisa
Hooper, Teri
Hoopes, Chris D.
Hoots, Kathy
Hoover, Darrell
Hopper, Mike
Hopson, Jim
Horn, Diana
Horn, Henry
Horn, Shurlie
Horne, Earl S.
Horner, Jimmie
Horton, Garland M., Jr.
Horton, Tom
Hough, Sandra
Houk, Randy G.
House, Chandra
Houssman, Genie
Howard, Alvin
Howard, Anita
Howard, Barbara
Howard, C.
Howard, Walter A.
Howe, Louis, Jr.
Howe, Little B.
Howell, J. Franklin, Jr.
Howell, Lynn
Howell, Mike
Howester, Larry
Howke, Jim
Howry, Emmett, Jr.
Hoyl, Susan M.
Hoyt, Les
Hubbard, Amy
Huckabay, Wade L.
Huddleston, Dennis E.
Hudson, I. A.
Hudson, John
Hudson, Murray
Hudson, Pam
Hudson, Richard G.
Hudson, Richard V.
Hudspeth, John A.
Hudspeth, Tom
Huff, Ima J.
Huff, Javett E.
Huff, Julie
Huff, Tony
Hugg, Lynn
Hughes, Amy
Hughes, Finnis
Hughes, Greg
Hughes, James
Hughes, Karen
Hugo, Clayton
Hulez, W.
Hulquist, Heidi
Hulquist, JoAnn
Hulquist, Robert C.
Hulsey, Art
Hulsey, Carl
Hulsey, Jan
Hulsey, Janelle
Humanly, George
Humbert, David W.
Hunley, Sheila
Hunt, Darryle L.
Hunt, John C.
Hunt, Kraig
Hunt, Lisa
Hunter, John C.
Hunter, Roy
Hurt, Andrew
Hurt, Patricia
Huseman, Dwayne
Huseman, Terry
Husler, James
Hutcheson, George C.
Hutson, E.
Hutter, Mathew B.
Hutton, Sandy
Hyatt, Katrina
Hyde, Homer H., Jr.
Hyde, Steve
Hyde, Teresa
Hyden, Joyce
Hyman, Kathy
Smith, I.
Immel, K. Jill
Immel, Katherine J.
Ingalls, M. D.
Ingerton, Sally
Ingle, Robert
Ingles, Connie
Ingraham, Joanna

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Intusla, Sandra M.
Irnelas, H. R.
Irons, Kimberly
Irvin, Cindie
Irvin, James
Irvin, Margaret L.
Irwin, Shirley N.
Isaacs, Bonnie
Isabell, Ronald
Isgrigs, Nancy
Isham, Raymond
Isley, Melvin
Isley, R., Sr.
J., Richard H.[1]
Jack, Greg
Jack, Mark A.
Jackovich, Anne
Jackson, Connie
Jackson, Dan
Jackson, Donald W.
Jackson, E. C.
Jackson, Elsie
Jackson, Joe
Jackson, Mary A.
Jackson, Mel
Jackson, Phillis K.
Jackson, Sheila J.
Jackson, Shirley A.
Jacob, Linda
Jacobi, B.
Jacobs, Roger
Jacobson, Lee
James, Pavela L.
James, Richard W.
Jameson, Ann
Jameson, Joyce M.
Jamhsen, Henry
Jan, R. L.
Jappson, Ralph
Jarvis, S.
Jay, Kenneth
Jean[1]
Jeans, Betty L.
Jeans, Carl E.
Jeffers, Franklin
Jeffers, Gilbert
Jeffers, Randall C.
Jeffers, Terri
Jefferson, Dale R.
Jefferson, Judy
Jefferson, L. J.
Jeffery, R. B., Jr.
Jenell-Massaner, Helen
Jenkins, Sammie
Jenkins, Seger
Jenks, Darren
Jennings, Janice
Jennings, Jimmy
Jennings, John B.
Jens, Debra
Jenson, Howard
Jerm, Larry K.
Jeter, Gene
Jeter, Terry
Jett, Joe S.
Jetter, Alonzo O.
Jewett, Jack L.
Jewett, Pamela
Jewett, Tammy
Jimeney, Linda
Jimenez, Alex, Jr.
Johannsen, Paula
Johns, Keith L.
Johnson, A. E.
Johnson, B.
Johnson, C. D.
Johnson, C. H.
Johnson, Cathy
Johnson, Dale
Johnson, Donna
Johnson, Douglas
Johnson, Eddie
Johnson, Glenda
Johnson, H. J.
Johnson, James D.
Johnson, Jane
Johnson, John P.
Johnson, Jon L.
Johnson, B. R., Jr.
Johnson, Raphael, Jr.
Johnson, Larry J.
Johnson, Lindsey A.
Johnson, M. T.
Johnson, Martin
Johnson, Neta
Johnson, P. L.
Johnson, Patsy A.
Johnson, Paul C.
Johnson, Perry
Johnson, Randy
Johnson, Robin
Johnson, Ruby
Johnson, S.
Johnson, Sylvia M.
Johnson, Trina
Johnson, Virginia B.
Johnson, Woody A.
Johnston, David G.
Johnston, Dennis
Johnston, Redell
Johnston, Von
Jolly, Steve R.
Jolse, Jerry
Jones, Audrey
Jones, Barry
Jones, Barry D.
Jones, Billy F.
Jones, C. M.
Jones, Carla
Jones, D.
Jones, Denise
Jones, Donnie
Jones, Eddie
Jones, Eliza
Jones, Francis R.
Jones, Gail
Jones, Garland D.
Jones, Harold
Jones, Joe T.
Jones, Johnnie R.
Jones, Robert W., Jr.
Jones, Keith A.
Jones, Kevin W.
Jones, Larry
Jones, Lisa
Jones, Marci
Jones, Margie A.
Jones, Marianne
Jones, Mary L.
Jones, Melanie
Jones, Patsy
Jones, Paula
Jones, Phyllis
Jones, Randall S.
Jones, Rebecca
Jones, Rhonda J.
Jones, Richard P.
Jones, Robert
Jones, Sandra
Jones, Shannon
Jones, Sharon
Jones, Stephen
Jones, Tobi
Jones, Tom
Jones, Troy E.
Jones, Valerie
Jones, William C.
Jordan, Toni
Jose, A.
Joseph, E.
Joyner, Janice
Joyner, Luther B.
Juarez, Felipe, Jr.
Judson, Alan
Juengling, Jon
Juett, Jane F.
Juett, W. E.
June L.
Justice, Carl E.
Justice, Lola
Kabetzke, Melva
Kaczmarek, Andy
Kaczmarek, Doris K.
Kaczmarek, Doug
Kaczmarek, John
Kaff, Patrick
Kahn, Bob
Kahn, Martin
Kahn, Regina M.
Kalka, Ruleen L.
Kalki, Douglas W.
Kaluzuick, Frances A.
Karnes, Terri
Karnitz, Maurice
Karr, Kennard G.
Karr, Linda
Karrit, Robert
Kay, Kelly
Keadle, Stanley G.
Kealey, John
Keaton, C. Dean
Keaton, Lawrence, P. E.
Kech, Ann
Keck, John M.
Keen, Christa
Keenan, R. W.
Keene, Richard
Keith, J. M.
Keith, Jim W.
Keller, Jennifer
Keller, Ross
Kelley, Angela K.
Kelley, Charles H.
Kelley, John P.
Kelley, Judy
Kelley, Mike
Kelley, Ray
Kelly, Pat E.
Kelsee, Carmen
Kelting, Kyle
Kemmerling, Chris
Kemp, Carl L.
Kendrick, Roy
Kennedy, Leslie, Jr.
Kennedy, Kenneth
Kennedy, Lance
Kennedy, Laureen
Kennedy, Linda
Kennedy, Mike
Kennedy, R. T.
Kennedy, Shawn
Kenner, Catherine J.
Kenney, E. Joy
Kenney, Heiadi
Kenney, Mona
Kens, Clarence
Kessel, Mike
Kessler, Billy
Kesterson, Kay
Keys, Margaret
Keys, Robert
Keyser, Louis
Keyser, Oliver
Khan, Waseem
Kidd, Robert
Kilarski, David
Kilarski, Teri
Kile, Tom
Killey, Everett D.
Kilpatrick, Kevin
Kimbell, Dewayne
Kimbell, Jerald
Kincaid, Virginia
King, B.
King, Benjamin R.

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
King, Carol
King, Charles
King, David R.
King, Henry H.
King, James W.
King, Jane H.
King, Jerry D.
King, John
King, Lesa
King, M. Don
King, Mike
Kinkad, Donna J.
Kinkade, Alvin R.
Kinzer, Bill
Kinzy, Marvin
Kiplie, Mark
Kirby, Fred
Kirchgissne, Pat
Kirkland, Eyde
Kirkland, J.
Kirkpatrick, Hugh
Kirkpatrick, Larry
Kirris, Tom
Kista, Shey
Klause, Cindy
Kleffman, Angela
Klingeam, Judith
Knapp, Clayton
Knapp, Erma
Knapp, James H.
Knapp, Kevin P.
Knapp, Wes
Knerr, Reinhard
Knight, Angie
Knight, Johnny
Knight, Kathy S.
Knight, Michael G.
Knight, Stacy
Knighton, Evelyn F.
Knighton, Havon
Knowles, Brent
Knur, K.
Koch, Jettie
Kocher, Heidi
Koenig, Bobby J.
Koetting, Henry
Kohman, Jan
Kohn, Erwin
Kollmar, B. W.
Koontz, David
Kozak, Mary
Kraman, David
Krantel, David
Krasbon, Beverly
Kraus, Jerry
Kraus, Lori Jean
Kreidel, James
Kresee, Scott
Kritselis, Richard
Kritser, John
Kriyan, Charles E.
Krumwiede, Frank S.
Krupnick, Dave
Kruse, Harold D.
Kruse, N. A.
Kuehl, Rick
Kuga, Lawrence F.
Kuhler, James
Kuhlman, Nicci
Kuhn, Lavona
Kuhr, Robert
Kumar, Subodh
Kwoath, Carolyn D.
Labus, Evelyn
Lace, Rom M.
Lacer, Lorene
Lackeg, L. A.
LaCruz, Richard D.
Lacufer, Sue
Lacy, Bob
Lacy, Wilford L.
Ladd, Max
Lafiesta, Vincent A.
LaFrance, M. K.
Lain, Gil
Lain, Mary
Lake, H. R.
Lake, Sandra J.
Laley, Shauna
Lamberson, Billie
Lambert, Robby
Lambert, Scott
Lamkin, Juna
Lamkin, Nita M.
Lampbor, Wayne
Lana[1]
Lana, Ramon
Lancaster, Diane
Landers, J. K.
Landford, George
Lane, Charles R.
Lane, Georgiana L.
Lang, Carl M.
Lange, Rose
Langford, Mathew J.
Langley, Gayle
Langstead, Brad F.
Lanham, Mason
Lanham, Thomas F.
Lanham, Trish
Lanier, Sean R.
Lankford, Jim P.
Lapp, S. L.
Larkan, Kenny
Larson, Gary
Lasalla, Amy
Lassiter, Laquita
Latham, James
Latham, Tully E.
Laughter, E. D.
Laughter, Steve
Lauren, Vic M.
Laursen, Chris N.
Law, Mike
Lawgley, Marc
Lawler, B.
Lawler, Kelly
Lawler, Terry
Lawler, Yvette
Lawles, Amanda
Lawly, Clint
Lawrence, Kevin A.
Lawrence, Sue
Lax, Nathaniel J.
Lay, William
Lazzara, Debra
Lazzara, Salvatore
Le, Wilson
Leach, Frank D.
Leake, Craig
Lear, Dana M.
Leard, Mike
Leasure, Lanette
Leather, Doyle
Leather, Elizabeth
Leatherwood, Shea
Leazenby, Dorothy
Lebow, Floyd
LeCrone, Stephen
Lee, Casey
Lee, Cindy
Lee, David C.
Lee, Gail
Lee, Greg
Lee, Irlene
Lee, Robert E.
Lee, Tommy C.
Leedy, Billy
Lemmas, Michael
Lemming, John F.
Lemoux, Grant
Len, Robert
Len, W. R.
Lens, Stephen H.
Leonard, Patricia
Leopard, Samuel R.
Leos, Howard R.
LePage, Neil
Ler, Mike
Lermon, Terri
Lester, Darlene
Lester, Kim
Lester, Larry
Lethohers, Kevin
Leverett, Lynn A.
Leverett, Paula
Leveting, Leroy J.
Levi, Barbara
Levy, Mike
Lewallen, Larry
Lewell, John W.
Lewellen, J. R.
Lewis, Effie M.
Lewis, Gary E.
Lewis, H. W.
Lewis, Norma
Lewis, Rosie L.
Lewis, Susan
Lewis, Tracie
Lieberenz, Don
Lierttk, Earl L.
Liggitt, Jim
Lightfoot, Elaine
Lill, Cynthia
Lill, Kandy
Lill, Scott A.
Limoges, Fran
Lincoln, Louie
Lincoln, Michele K.
Lindemann, Kenneth
Lindler, John R.
Lindley, Barbara
Lindley, Sharon
Lindsay, Ronald
Linton, Roy W.
Linville, R. B.
Lipton, E. L.
Lirnstad, Oleta J.
Lison, Terry M.
Liston, R. R.
Litho, Amarillo
Little, Kenny
Little, Kristi
Little, Tommy
Loc Ba, Phan
Locke, John G.
Lockwood, Joe
Loewald, Jeff
Loggins, Jack
Logsdon, Steven
Lolley, Robert E.
Lomenzo, Anita
Long, David
Long, DeAnn
Long, Kevin C.
Long, Russell E.
Long, Rustin G.
Longbine, Angie
Longer, Carol
Looman, R. Dana
Lopez[1]
Lopez, Augustine
Lopez, Bonnie
Lopez, Chris E.
Lopez, Diane
Lopez, Laura
Lopez, Paul
Loter, Larry
Louis, E. W.
Lovato, Roger
Love[1]
Love, Billy
Lovelady, Cletus
Lovelady, Meredith
Lovett, Yimena

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)	Maddax, Calissa	Mantel, Carrie	Martinez, Jenifer	McAdams, R. M.	McDabb, Ron
Lowe, David A.	Madison, Virginia	Manuso, Phil	Martinez, Larry T.	McAfee, John	McDaniel, Anita K.
Lowe, Lyndal B.	Madlid, Anastasio	Map, Richard	Martinez, Priscilla	McAfee, Paula	McDaniel, Jane
Lowe, Sylvia P.	Madsen, Helen	Maples, Darlenne	Martinez, Robert	McAlister, Margie	McDonald, Ginger
Lower, James W.	Maes, Robert	Maram, Sharon	Martinez, S.	McAlpine, Rick	McDonald, James E.
Lowery, Claude B., Jr.	Maes, Stella	March, Chuck	Martinez, Valentino	McAnear, Monte	McDonough, M. R.
Lowney, David	Mafa, Leon A.	March, Norma W.	Maserang, Dwayne D.	McBride, Betsy	McDowell, Kevin
Lowry, Betty	Magee, Lisa	Marcum, Gene	Mason, Brandon	McBride, Dan	McDowell, Stephen D.
Loyd, Cathy D.	Mager, Roberta	Marcur, Jackie	Mason, Cheryl	McBride, Elizabeth	McDuffee, Jason
Lucas, Bruce A.	Maggi, J. A.	Mareng, Tracy	Massey, Jan K.	McBride, Geraldine	McEachern, Marla
Lucas, Randy J.	Magness, Julie	Mares, Robert	Massucci, G.	McBride, Steve	McElreath, Cherry
Lucas, Roger	Magoniak, Wayne	Mares, Virginia	Matherly, Nicki	McCafferty, Bryon	McElreath, Edna
Lucere, Jennifer	Magouirk, Beverly	Marez, Eli	Mathes, Becky	McCafferty, Kim	McElreath, Jennifer
Lucero, A. V.	Magreil, Steve	Mark[1]	Mathiasmierer, M. R.	McCaffree, James R.	McElreath, Richard
Lucero, Kristi	Mahaffee, Ernest	Mark, C.	Mathis, Darla	McCall, Jack O.	McElreath, Wayne
Lucero, Penny	Mahaffee, Ronda	Markham, Bonner	Mathis, Gala	McCandliess, Davie	McElwain, Kurt
Lucero, Tom S.	Mahan, Geary	Marlow, Donnie A.	Matlock, Harold	McCann, Elizabeth	McGinger, Linda
Luck, James L.	Mahony, Kevin	Mars, Archie C.	Matney, Kevin L.	McCarty, Ken	McGlaun, Tom
Luck-Jones, Holly	Mailhot, Donna L.	Marsh, Donna	Matter, Andrew K.	McCarty, Sue	McGowan, S.
Luera, Debie	Mailhot, Robert	Marsh, Janetta	Matthews, Andrew A.	McCarty, William	McGrath, Daniel
Luera, Dorothy	Malacara, Elena	Marsh, Pam	Matthews, Carl	McCaslin, Mike	McGwen, Brandon
Luhman, Michael	Malacara, Robert	Marsh, Patsy A.	Matthews, Richard	McClain, Catana	McHugh, Miriam M.
Luman, Gary D.	Maldonado, Ismael	Marshall, Jo Ellen	Matthews, Unie	McClair, Juan	McIntosh, Angela
Lumer, Wendell	Maldrou, Owen	Martenz, D. P.	Mauch, Brent	McClelland, Luke	McKee, Jim
Lumpkins, Benny	Malecha, Gaylord M.	Martin, David R.	Maxey, A.	McClelland, Luke C.	McKenny, James A.
Lumpkins, D.	Malecha, Juanita M.	Martin, Kathy	Maxfield, S. R.	McClenny, Mark T.	McKenzie, Helen
Luna, Horacio	Mallecke[1]	Martin, Krista	Maxwell, Gary	McColleen, Robert	McKillip, West
Luna, Kay	Mallinger, Frank E.	Martin, Lea	Maxwell, Geraldine	McCollun, Lynda	McKinney, Evan
Lundberg, Janice	Malone, James E.	Martin, Luan	May, Bobby R.	McCortt, Joe B.	McKinnon, Barry
Lutgens, Charlotte	Malone, R. G.	Martin, Michael A.	May, David	McCoslin, Gene	McKinny, Josh
Lutgens, Everett	Malone, Robert	Martin, Phil	May, Mike	McCown, Kent &	McKnight, B. M.
Lutz, Betsy	Malone, Sandra	Martin, Shannon	Mayes, Berkli	Chantel	McKnight, Michael H.
Lyles, Brandy	Malone, Theresa	Martin, Virginia	Mayes, Loretta	McCox, Mark	McKnight, Patti
Lyles, Chris J.	Malone, Thomas	Martinez, Albert	Mayfield, Terry L.	McCracken, Larry	McKown, Paula
Lynch, Bunton T.	Malve, Mark	Martinez, Cynthia	Mayhall, James F.	McCrary, Laura P.	McLain, Bryan
Lynch, Chris	Mamor, Jemma	Martinez, Dorothy	Mayhew, Wynne A.	McCreary, Jan	McLamb, D. D.
Lynch, Izetta	Mandt, Werner F.	Martinez, Esther	Mayo, Jeffrey S.	McCreary, John A.	McLaughlin, C. E.
Lynch, Richard L.	Mann, Cheri	Martinez, F. G.	Mays, Dona M.	McCullough, Gail	McLaughlin, Susan
Lyons, Gary O.	Manne, Billy	Martinez, Felipe	Mays, Joy M.	McCurdy, Linda	McLaughlin, W. L.
Lytle, Cathe	Manning, Bob	Martinez, J. S.	Mays, Sam	McCurry, Lometa	McLean, William T. J.
Mackie, Carole	Manning, Molly	Martinez, James R.	Mc, Gary	McCurry, Sherry	McLemore, Katie

[1]*Legible portion of commentor names appear in this table.*

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
McMahl, Ernest
McMahon, Fred V.
McMarty, Ley
McMell, Lecishia
McMenamim, J. K.
McMenamin, Kyle
McMennamy, J. M.
McMennamy, Peggy L.
McMillian, Flora
McMurry, Herbert
McNabb, Barbara
McNalty, T.
McNeice, Sharon
McNertney, B. J.
McNutt, Jimmy
McPherson, Anita L.
McPherson, Joella
McQuay, Bekki
McReece, Casey
McReynolds, Glenda
McSpadden, Dick
McVean, Ronald C., Jr.
McWilliams, Karen
McWilliams, Mark
McWilliams, Steve
Meadlock, Jon
Meadows, Sharon
Mechenbier, Mark
Medford, Tim
Medley, Elva
Meeks, Debra
Meier, James S.
Meier, Stacey L.
Meixner, Joan
Melby, Gary
Melear, Francie A.
Melton, Jim
Melton, Mike
Mendez, Isaac G.
Mendez, Mark
Mendez, Rosalinda M.
Mendiole, Dora
Mendoza, Hector M.
Mendoza, Lydia
Mendoza, Pete
Mener, David
Mercer, Eleanor
Mercer, William
Merrick, Jim
Merrick, Joyce
Merrill, Eddie D.
Merrill, Mildred
Merrill, Verna F.
Merriott, Celia
Merriott, Mikey
Merton, Vernon O.
Merwether, Ken
Mesa, Louie
Mesio, Julia Z.
Metcalf, Dean
Metcalf, John E.
Metz, Curtis G.
Meyer, David
Meyer, John A.
Meyer, Thomas O.
Meyer, Wesley
Meza, Antoinette
Mibel, Edward
Michaels, David
Michaels, Jo
Mickey, Brack
Mierer, Byul
Miken[1]
Mikliostes, Danny
Milburn, Nancy
Miles, E. A.
Miles, Tony
Miljan, Mary
Miller, Barbara
Miller, Belinda K.
Miller, Brian
Miller, Buddy
Miller, C. J.
Miller, Carol
Miller, Doug
Miller, Edward L.
Miller, Fawn
Miller, Harrison
Miller, Kaye
Miller, Lavana
Miller, Lillie P.
Miller, Lynn
Miller, Marcia
Miller, Mark
Miller, Oth.
Miller, Russell E.
Miller, Vernon W.
Millikin, Margaret
Millon, Ricardo
Mills, Diana
Mills, J.
Mills, J. P.
Mills, Todd N.
Mills, Trenton E.
Minden, Marcella
Mings-Spindle, Sherry
Minor, Gary
Minter, Jeff
Minton, W., Jr.
Minton, Justin S.
Miranda, Ann K.
Mirels, Mary L.
Miskimen, Michelle L.
Mitchell, Annette
Mitchell, Brad
Mitchell, Donald L.
Mitchell, Erma
Mitchell, Genevieve
Mitchell, Glen A.
Mitchell, Jerry
Mitchell, Kris C.
Mitchell, Lonny
Mitchell, Michael
Mitchell, Patricia
Miter, W. W.
Moberly, Lee
Mobry, Larry D.
Modewell, Weldon
Moeller, Virginia
Moerlia, Steven P.
Molina, Javier G.
Molly, Gary
Monroe, Cameron
Monroe, Jacque
Monroe, Willie E.
Monson, Katherine
Monson, Scott
Montague, Hazel
Montague, Jackie L.
Montano, Roberto
Montano, Willy
Montes, Elliot J., Jr.
Montgomery, Ebb
Montgomery, H. C.
Montgomery, Kyle
Montgomery, Pamela
Montgomery, Rouena
Moody, David
Moody, Evelyn B.
Moody, Robert W.
Moon, Lanae
Mooney, Penny
Moore, Arthur D.
Moore, Bellie J.
Moore, Chelsea
Moore, Chris
Moore, Connie
Moore, Darren G.
Moore, Darrold G.
Moore, Deborah K.
Moore, Donald L.
Moore, Doris
Moore, Gary D.
Moore, George
Moore, Jeff R.
Moore, Melvin, Jr.
Moore, Kay
Moore, Kevin
Moore, Kyle L.
Moore, Martin W.
Moore, Mary
Moore, Missy
Moore, Robert
Moore, Roland
Moore, Say Dale
Moore, Stephen R.
Moore, Vikki
Moraniec, Tony
Moranied, Thomas J.
Mordic, Ramona M.
Morehead, Mike
Moreland, Douglas
Moreland, Morris
Morgan, Billy
Morgan, Buddy
Morgan, Cathy
Morgan, Connie
Morgan, Dale
Morgan, Dan R.
Morgan, K.
Morgan, Kip
Morgan, Loyd
Morgan, M.
Morgan, Melissa J.
Morgan, Rey
Morlsie, Richard
Morren, Garry
Morris, Allen L.
Morris, Clayton L.
Morris, D. M.
Morris, Jackie D.
Morris, Jerry A.
Morris, Martin
Morris, Sandy
Morris, Shelley
Morris, Tommy
Morris, Vilma M.
Morrison, Dean
Morrison, Jo
Morrison, Juli
Morrison, Michael
Morrison, Shawnda
Morro, Allen
Morrow, Don
Morta, Margaret
Morton, Arthur R.
Morton, Brenda
Moseley, Cynthia
Moseley, Dennis T.
Moseley, Neil
Mosely, Jon
Mosley, Terry D.
Mosly, LaVonda
Moss, Don
Moss, Ellen
Moss, Jean
Mota, Juan A.
Mounce, Anita
Moytt, Richard
Muelleny, Mark
Mulber, Guy
Mulkey, Jerrel R.
Mulkey, Sharyn
Muller, Gary L.
Mullins, Celeste P.
Mullins, Emma
Mullins, H. A.
Mullins, Lisa
Mullins, Mary
Mullins, Ralph
Mullins, Rhendy
Muncy, Nancy
Mundell, O. A.
Mundell, W. R.
Munlores, Tim

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Murray, Bill
Murray, George
Murray, Tammy T.
Murrow, Sanford J.
Musick, Moira S.
Musslewhite, David
Myer, Jimmy
Myer, Robert D.
Myers, Doris M.
Myers, Jerry
Myers, Pam
Mylanta, David
Nabb, Sheba
Nail, Anne H.
Nance, Bonnie L.
Nance, Gene
Nance, Roger A.
Nanesf, Daphne
Napier, S. L., Jr.
Nava, Barbara
Nava, Leroy
Navarrete, Adrian
Navarrete, Ismael
Navarreth, R.
Navarrette, Beverly
Navola, Gina
Naylor, C. K.
Naylor, Keltor B.
Nayola, Hilario V.
Neal, Kellie
Nebhut, Gary
Neck, Maureen
Neda, James R.
Neece, Norman W.
Needham, Syrena
Neel, Larry
Neely, Jean
Neill, Dan
Nelson, Jeanette
Nelson, John
Nelson, Jose L.
Nelson, Pam
Nelson, Pat
Nelson, Wanda
Nemoede, Ronnie
Nenin, Don
Nester, David C.
Neumann, Cindy
Nevins, Cynthia
New, Ginger
New, Josh
New, L. E.
Newfield, Debbie
Newkirk, Norma
Newman, Chris
Newman, Mike
Newton, Jack
Ngley, Russell
Nguyen, Tuyet
Nichelson, Laura
Nicholas, Dwain C.
Nichols, Dennis C.
Nichols, Walter
Nicholson, Gareth J.
Nicholson, Gil
Nicholson, Laura
Nickel, Robert
Nickels, Angela
Nickels, Connie
Nickerson, Jerry
Nickerson, Norma
Nickerson, Roger
Nickles, Nancy
Nife, Nelson
Nivena, Tom
Nixon, Leta
Nokes, Denise
Nolan, Louis
Nolan, Richard M.
Noland, Bill
Nolen, Rosemary
Nomelli, Nicki
Nones, Lewis W.
Nordyke, Steve
Nore, Terry
Norman, Joe A.
Norrell, George B.
Norris, Howard
Norris, Kim
Norris, Tracie
Norsaman, Francis W.
Northrop, Betsy
Northrop, D.
Norton, Bill
Norton, W. N.
Novak, J. D.
Novak, Vicky
Nowak, Bob
Nowak, Mary
Nugent, Rod
Nugerton, R. R.
Nuna, Clyde A., Sr.
Nunez, Debra
Nunley, Jim L.
O'Brien, Inge
O'Brien, Pat
O'Dell, Johnnie
O'Grady, Pat
O'Hair, Shellie
O'Hara, Karen
O'Kelley, Cecil E.
O'Kelly, Gene
O'Tanger, Betty
Oberle, Kaye
Oberle, Larry
Oden, Farrin C.
Oge, David K.
Oilon, Charles
Okerson, Ronnie
Olguin, Wade
Olighent, Carol E.
Olinger, Melvin
Oliphant, V. H.
Oliver, Carol
Oliver, Catrise
Oliver, Celestine
Oliver, Dan
Oliver, Dominique T.
Oliver, Kerry
Oliver, Elmo, Sr.
Olives, Patrick A.
Olsen, Joe C.
Olson, Connie
Onccan, Dorinda L.
Onelus, Wanda
Opitz, Steve
Or, Suttam
Orcutt, Jim T.
Ornela, Richard
Ornelas, Pamela J.
Orneles, Donna
Orr, Albert
Ort, C.
Ortega, Elia
Ortega, Henry
Ortega, Michell
Ory, Marie J.
Osborn, Gordon
Osborn, Judy
Osborne, Alton Z.
Osborne, Kenneth W.
Osly, Jerry L.
Ott, Richard A.
Ottoson, William
Overlin, Karon
Overto, Tammy
Owen, John F.
Owens, Ben
Owens, Berle
Owens, Delores J.
Owens, Juanita B.
Owens, Sally
Pace, C.
Pace, Jeff L.
Pacheo, Nancy
Pachla, Catherine M.
Pack, Callan
Packard, Jana
Packer, Rosezetta
Padilla, Judy M.
Padilla, Michael J.
Pair, Glenda L.
Palacio, Cathy
Palacio, Faye
Palacio, Mark E.
Palcock, Mike
Palmer, Jade
Palmer, Nita
Palmet, Michael
Panbrat, Elizabeth
Panell, Denzal
Panthers, Don
Papp, Attila G.
Papp, Joseph S.
Parfait, K.
Parge, Earl W.
Parge, Kent R.
Paris, Karen
Paris, R. E.
Park, Jerrod
Park, Linda
Parker, Barbara
Parker, Carolyn
Parker, Dudley
Parker, James L.
Parker, John
Parker, Kimberlee K.
Parker, Leroy
Parker, P. J.
Parks, Billy D.
Parks, Melissa
Parks, Pam
Parrack, Phil
Parrie, Mary
Parrie, Walter
Parrish, Al
Parrish, Gary V.
Parrott, Sandra C.
Parson, James
Parsons, Mary Y.
Parton, Kristin P.
Pascal, Brenda
Passmore, Christopher N.
Passmore, Robin
Pat, Glenn B.
Pate, Shelia
Patrick, Pat
Patterson, Ed
Patterson, Gwen
Patterson, Matt
Patterson, Steven
Patterson, Tom R.
Patts, Charles
Pawal, Christopher
Paye, Robert W.
Peak, Jackie
Peal, John R.
Pearce, Jim Bob
Pearson, Carol A.
Pearson, Marvin
Pearson, Susie
Peddy, Sharon
Pederson, Tim
Pedigo, Roy G.
Pedroza, Mitzi
Peery, Paula
Peiur, Kenneth
Pekins, Sam
Peller, Jan
Pellerin, Margie
Pelton, Angela
Pelton, G. K.
Pelton, Wayne
Pendleton, Ida

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Pendleton, Kim
Penn, Arturo, Jr.
Pennal, Hugh A.
Pennal, Novelle
Pennington, Maggie
Pennon, Cynthia
Percival, Richard
Peres, Joe
Perez, Roseann
Perez, Vidal
Perkins, Bobby
Perkins, Britt
Perkins, Connie
Perkins, Dianne
Perkins, Jeff
Perkins, Kathy
Perkins, Lovey J.
Perrin, Glenn
Perry, Beth
Perry, Bobby K.
Perry, Christina
Perry, Danny R.
Perry, David
Perry, Janice
Perry, Lois J.
Perry, Metzi
Perry, Theresa
Perry, Vicki
Petterborg, Jeri D.
Pettit, Terry
Petty, Faye L.
Pey, Randy
Pgeatt, Margaret A.
Phagan, Carl J.
Pham, Huynh Van
Phansana, Sawang
Phelan, Patrick
Phele, Wayne C.
Phelps, Judy
Phelps, Ryland L.
Phillips, Carol
Phillips, Casey
Phillips, Gary D.
Phillips, Harry H.
Phillips, Herman
Phillips, J. O.
Phillips, Joe
Phillips, Leslie
Phillips, Margaret
Phillips, Ralph A.
Phillips, Ross
Phillips, Sandra
Phillips, Vicki
Phinny, Ronald
Pickering, Alice
Pickett, Donald
Pickett, Gale
Pico, Tina
Pierce, Gail
Pierce, Kenneth
Pierce, LaDena
Pierce, Robert J.
Pierce, Travis
Pierson, Maurice L., Jr.
Pikula[1]
Pillard, Susan E.
Pillsbury, Tim
Pingel, Charlotte
Pink, Cheryl
Pinkston, Jane
Pirkle, Yvonne
Pittman, Bill
Pittman, Dean
Pittman, Michael C.
Pitts, Henry D.
Plaster, Ronnie J.
Platt, Paul
Pleasant, Robert P.
Plemons, Pamela
Pletcher, Kristin
Plunk, Olon
Poer, David
Poer, David G., Sr.
Poindexter, Jeff
Pointer, Michael
Poirot, James
Polk, Jacque
Polley, Les
Polrado, Charlotte
Pomeroy, Jan
Pomeroy, Steven
Pompa, David
Pompa, Raul
Pompa, Ruben
Pond, Deanna
Pool, David
Pool, Patty
Pool, Willie
Poole, Dawna
Poole, M. R.
Poore, Everett E.
Pop, Johnny D.
Pope, Danny B.
Pope, J. R.
Pope, Linda M.
Porter, John
Porterfield, Dayle
Portier, J. E.
Pos, Stanley
Poteet, Steven
Pott, Jack W.
Potts, Kenneth B.
Poundexter, Debra
Pounds, Carol
Pounds, Kenneth
Pounds, Michael
Povert, James L., Jr.
Powell, Amy
Powell, Bruce L.
Powell G.
Powell, Mark W.
Powers, Faith
Powers, Kyle
Powers, Pearl
Powles, Chad
Poyner, Ruthie M.
Poynor, Curtis L.
Prather, Dump
Prather, Linda
Prather, Mark
Pratt-Mullins, James
Preiss, Alden J.
Prew, Ronald
Price, Denise
Price, H.
Price, Teresa J.
Pride, Katrisa
Priest, James
Printiny, C.
Prise, Glynn
Pritchett, Palm
Proby, Juareen
Proctor, Betty
Proctor, William E.
Proffer, Lyndon
Pruchard, J.
Pruett, Billy J.
Pruett, Eleanor
Pruitt, Jen R.
Pryor, Jack
Pryor, Walter
Przilas, Colette
Ptashne, Lola
Ptashne, Paul
Pugh, Tom
Pullman, Mary
Pullman, Walter R.
Pulse, William L.
Pulsifor, Shawn
Punkston, Robert
Purcell, Charles M.
Puroff, Chris A.
Purviance, Marcie
Purviance, Tim A.
Pushong, Suzan L.
Puton, Kyle
Quackenbush, W. M.
Quality Service & Supply, Inc.
Quan, Deborah S.
Quenstone, Jean
Quin, A. C.
Quine, David
Quintana, Telis B.
Quinto, Al
Quinto, Jacki L.
Quinto, Peggy
Rab, Phil
Race, Dawn
Rachels, Beverly
Rack, Robert E., Jr.
Rad, Daryl
Rael, J.
Rahis, Gary
Rains, John
Raleigh, Margaret
Raleigh, Willie
Ralhin, J. T.
Ralston, Mark
Ramirez, Christie
Ramirez, F. B.
Ramirez, Juan
Ramirez, Margie
Ramirez, Morris B.
Ramirez, Rene
Ramirez, Rodney
Ramirez, Taryl
Ramiro[1]
Ramn, Eddie
Ramos, Lennet D.
Randall, Mark
Randolph, Matthew M.
Rasberry, Barbara
Rasmussen, Angelia
Rauqel, Lupe
Rawley, Marty
Rawlin, Marty
Ray, Andy
Ray, J. D.
Ray, Richard L.
Ray, Roger
Rea, David
Read, Weldon P.
Ream, Aleta
Ream, Jasmen C.
Ream, Joe
Reams, Cary
Reasoner, David
Reaves, Gary W.
Rector, Rita L.
Reda, Dan
Reda, Rachelle
Redd, Jan
Redman, Loretta
Redman, Rick
Reece, Ted
Reecer, Vickie
Reed, Ava
Reed, Carl
Reed, Chris
Reed, Debbie
Reed, Dennis S.
Reed, Garry A.
Reed, Laura
Reed, LaVada
Reed, Linda
Reed, Madonna L.
Reed, Marjorie
Reed, Michael S.
Reed, Wayne
Reed, Y.
Reele, Jean W.
Reep, Jack
Reese, Edwin E.
Reeves, David

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Reeves, Leslie
Reeves, Shirley
Regan, Joseph S.
Reid, Anne A.
Reid, Don R.
Reid, Jim
Reilly, Sean
Reining, Carol
Remans, Tarenda
Rendon, Daniel L.
Rendon, Jake
Renfro, Frank
Renteria, Dedra
Renteria, Albert D., Jr.
Renteria, Ladonna
Renteria, Tina
Renturia, Nadine
Reurce, Eugene
Reyes[1]
Reyes, Deangelo
Reyman, Marla
Reynolds, Carl
Reynolds, Debra
Reynolds, Gloria
Reynolds, Harley
Reynolds, Kenneth R.
Reynolds, Kevin P.
Rhea, Linda
Rhoads, Don
Rhodes, Danny
Rhodes, Diane
Rhodes, Nathalie
Rhyme, Tammy
Rice, Michael
Rice, Ronna
Rice, Sherrie
Rich, Karla J.
Rich, Terry L.
Richard, John C.
Richardson, Benny R.
Richardson, Gary
Richardson, Karen
Richardson, Vaughn E.
Richerson, Carla
Richey, Barry
Richey, David
Richmond, Robert C.
Rick, Shane
Rickstrew, Velda
Rickwark, Sahra
Riddle, Diana L.
Riddle, Evelyn G.
Riepma, Helen
Rigdon, Mary
Riggle, Betty I.
Riggs, Dale A.
Riggs, Steven
Rigs, T.
Rikac, Frank
Riles, Stephen
Riley, Catherine
Riley, Jeffrey
Riley, Kent D.
Riley, Rusty
Rimball, Rame J.
Rinehart, Donnie
Rinella, Joe
Riney, Lillian N.
Ringbaru, Nillie
Riojas, Daniel
Rios, Shana
Rippy, Carol A.
Rippy, D. J.
Rippy, O. G.
Rising, William
Risley, Lloyd V.
Ritchie, Louis
Rittenh, Joe
Ritter, Debbie
Rivers, Dee S.
Rlęu, Jon S.
Roach, Peggy
Roadstof, Robert K.
Roan, Tim
Robards, Larry
Robbins, Adam T.
Robert, James M.
Robert M.
Roberts, Allen J.
Roberts, Cara
Roberts, Doug
Roberts, Kevin D.
Roberts, L. K.
Roberts, Larry D.
Roberts, Margaret
Roberts, Nancy
Roberts, Paul A.
Roberts, Richard
Roberts, Thalard M.
Robertson, Cheryl
Robertson, Deloris
Robertson, K.
Robinson, C.
Robinson, Carol A.
Robinson, Cristal
Robinson, Jennifer
Robinson, Scott
Robinson, Tamara
Roblez, Mary
Robuso, Terrie
Rockery, Susan
Rodarte, Isaac, Jr.
Rodarte, Rachel
Roddahl, Dorothy N.
Roddahl, Jeff
Roderidle, Robby
Rodilla, Jesus
Rodin, Donna
Rodin, L. W.
Rodin, Verna
Rodin, Wayne A.
Rodriguez, Eliseo
Rodriguez, Elizabeth
Rodriguez, Paul
Rodriguez, Rene
Rodriguez, Steve
Rodriguez, Tawnya
Rogers, Allen W.
Rogers, Carla J.
Rogers, Gary
Rogers, Jimmy C., II
Rogers, M. J.
Rogers, Mark J.
Rogers, Martin
Rogers, Melvin
Rogers, Patrick
Rogers, Ralph D.
Rogers, Robert R.
Rogers, Shane
Rogers, Sharon
Rogers, Thelda
Rogers, Tommy E.
Rogers, Tonya
Rohane, Jerry
Roland, Tonya L.
Rollins, J. M.
Rollins, Tracy
Romero, George
Romo, Jesse J.
Ronald[1]
Roof, Ronnie
Rosale, Michele
Rose, Diane
Rose, Diane J.
Rose, Gregory L.
Rose, Jody
Roslada, Clarence
Ross, David K.
Ross, Randall L.
Rossiter, Len
Roth, Robert A.
Rothe, Bill
Rough, Marsue
Round, Gerald E.
Roush, Dale
Roush, Dean A.
Rousset, George L.
Rousset, Maria C.
Rowe, Robert
Rowland, Phylecia
Roy, Marjorie
Royal, Johnnie
Rud, Vern L.
Rudd, Barbara F.
Rudd, Miranda
Rudder, Connie
Ruddy, Karen
Ruddy, Victor
Rudgy, Linda
Rue, Michael W.
Rufenacht, Sonja
Rufus, Bruce
Ruggles, Audrie
Ruggles, Ola Faye
Ruiz, Joe A.
Ruland, Jackie
Rulefus-Hatchett, Marie L.
Runnels, Nancy
Runul, B.
Rus, Leonard
Ruse, George R.
Ruse, Susan
Rush, Dan
Rush, Edith
Rusk, E. A.
Rusk, Ray
Russell, Barbara
Russell, Bob
Russell, E. G.
Russell, Kristi
Russell, Linda
Russell, Pam
Russell, T.
Rut, John
Ruth, Emerson K.
Ruthardt, R.
Ruvolo, Garry
Ruzich, Bobby L.
Ryals, Charles
Ryan, Marci
Ryan, Mike
Ryan, Willie
Ryder, Earl A.
Ryder, Nancy
S., Ricky[1]
Saadeh, Constantine
Sachse, B. J.
Sackretter, Stacey
Sadesky, Raymond A.
Saenz, Armando A.
Sahnai, Tom
Sain, D. R.
Sakot, Jarne
Salage, J. A.
Salajar, Leo
Salazar, Esther
Salazar, JoAnn
Saldaia, Gilbert W.
Saldivar, Carlos
Saldwin, Cindy
Salk, Bryan
Salley, S. Dan
Salter, A. L.
Samples, Johnny M.
Sanchez, Dale
Sanchez, Daniel R.
Sanchez, Elvira
Sanchez, Louis
Sanchez, Richard
Sanchez, Rojelio
Sanchez, Theresa J.
Sancid, Anthony
Sandefur, Larry
Sanders, A.

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Sanders, Anderson H.
Sanders, Donna
Sanders, Eddie
Sanders, Erin
Sanders, James
Sanders, Donald R., Jr.
Sanders, Judy
Sanders, Kim
Sanders, Monroe
Sanders, Perry A.
Sanders, Ronald D.
Sanders, Sandy
Sandorral, Cris T.
Sandoval, Jimmie, Jr.
Sandra, A.
Sanford, Barbara
Sara, B.
Sarah, Lynn
Sarrah, Richard S.
Sarrit, Donnie
Sasueda, Mary A.
Satterwhits, George
Sauer, C. Edmond, Jr.
Sauer, Tina D.
Saunders, Janice
Saunders, Russell N., Jr.
Savage, Edward L.
Savage, F. Cleo
Savage, James
Savage, L. Faye
Savage, Lewis M.
Savage, Roy
Scales, Joe
Scates, Shirley
Scheetz, John
Scheller, Jack
Scheller, Kerry
Scherer, Susan E.
Schieffer, Kathy
Schlegel, Randy
Schmidt, Michael S.
Schneider, Arthur
Schnieck, LaDonna
Schogh, M. J.
Schomberg, Joy
Schrader, B.
Schuelke, Rhonda
Schuler, Jed, Jr.
Schuster, J. E.
Schutz, Deannie
Schway, Tim
Scott, Brenda F.
Scott, David
Scott, J.
Scott, Joyce
Scott, Keith T.
Scott, Monty
Scott, R.
Scott, Sharon
Scott, Tabot
Scott, Tommy R.
Scott, William C.
Scroggins, Cynthia M.
Scruggs, Alan
Scuel, Richard
Seaman, Nadene
Seath, Gene
Sehr, Eric
Seitz, Roy D.
Seitz, Shannon
Seitz, Sue
Selbing, Clinton
Selby, Jerry
Selby, S. C.
Self, Darla
Self, Joe
Self, Mark C.
Sell, Garland D.
Sell, Sharon
Sell, Tony
Selman, J.
Selman, Lucille
Sena, Anthony
Sena, Pat
Sena, Steve
Sennelbeck, Bice
Septon, Joe
Sepulveda, Carlos A.
Serran, Rocky
Session, Hugh
Sessions, Trude[1]
Setapen, James and Carol
Sewal, Russell
Sexton, Randy
Sgen, Mike
Sgiderouiz, Carolyn
Shackfone, Jerry
Shafer, Kent M.
Shaffer, Edward
Shaklee Board, Tammy
Shaltry, Jon L.
Shannon, Kelly
Shannon, Nicole
Shapy, John
Sharp, Mary K.
Sharp, Randy L.
Sharpley-Prichard, Frank
Shasell, Timothy
Shaw, Paul A.
Shawn, Duane
Shead, A.
Shead, Dickie J.
Sheble, Timothy
Shee, Marcie F.
Sheets, Jeff
Sheffield, Loyd L.
Shelton, Eva M.
Shelton, Evelyn
Shelton, Johnnie K.
Shepard, Harrison
Shepherd, Mike
Shepherd, Sally
Sheriff, J. W.
Sherman, Stuart
Sherwood, Nellie
Sheth, Raj O.
Shields, E. S.
Shields, Larry
Shina, Terral
Ship, Shelli
Shipman, Donn
Shipp, Lori
Shirly, Herman O.
Shoels, Arthur
Shores, Connie
Short, Everett
Short, S. K.
Shuffield, Richard E.
Shugart, Carolyn
Shumaker, D. E.
Shurbet, Robin
Shuttleworth, Robert J.
Sicola, Tony
Siddert, Paul
Sidney, Jeffrey
Sidy, Michael B.
Sifuentez, Cathy
Sifuenty, Richard
Sill, Glyda D.
Silvio, Manuel
Simmon, Judie, Jr.
Simmons, Doris
Simmons, John
Simmons, Judson
Simmons, Terese
Simms, Kenda J.
Simms, Tim
Simons, Jay
Simpson, Hermis P.
Simpson, Nancy
Sims, Billy A.
Sims, Carol A.
Sims, Clark G.
Sims, Freeda
Sims, James
Sims, Kennye
Sims, Louise
Sims, Stoney
Singh, Dinya
Singleton, Andy
Sisco, Robert H.
Sisemore, Trent
Sisemore, Trish
Sisneros, Luis U.
Sittenge, Michele
Sizemore, Marsha
Skidman, B. D.
Skinner, Robert M., Jr.
Skinner, Margarett A.
Skorzak, Tommy
Skrabits, Frank C.
Skypala, Cindy
Skypala, Greg
Slagh, Carolyn
Slattery, Barbara
Slauson, Melinda
Slayton, Sherrie
Slesick, Ginny
Slesick, Len
Sliter, June
Sloan, Pam
Sloger, Michelle
Smalley, Melissa
Smallwood, Kelly
Smart, Diana
Smart, Kenneth D.
Smart, M.
Smiley, C.
Smiley, Randy
Smiley, Rick
Smith, Albert A.
Smith, Arlin
Smith, Bill J.
Smith, Bobby
Smith, Brenda N.
Smith, Carla
Smith, Cindy
Smith, Clif
Smith, Dani
Smith, David L.
Smith, DeJay
Smith, Dicky
Smith, Don
Smith, Donnie
Smith, Dwight L.
Smith, Erma L.
Smith, Gerry
Smith, Grant
Smith, Guy
Smith, Gwen
Smith, Harold
Smith, Herman W.
Smith, Howard S.
Smith, James A.
Smith, James E.
Smith, James M.
Smith, Jim E.
Smith, Ken
Smith, Kerri
Smith, Kevin
Smith, Larry W.
Smith, Linda
Smith, Lisa
Smith, Loren D.
Smith, M.
Smith, Mel
Smith, Michael E.
Smith, Nancy
Smith, Patty
Smith, Paul
Smith, Randal C.
Smith, Richard V.
Smith, Rick
Smith, Rick D.
Smith, Ricky

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Smith, Robert
Smith, Ruby
Smith, Sandra
Smith, Sharon B.
Smith, Shirley
Smith, Soila
Smith, Syvil N.
Smith, Terri
Smith, Tommy
Smith, Vince
Smith, Wanda
Smithee, Jason W.
Snead, Ron
Snel, Jerry D.
Snell, Craig
Snider, Lewis F.
Snow, Eddie
Snyder, Carolyn
Snyder, James
Snyder, James R.
Snyder, W. E.
Solano, Sona A.
Somerville, John D.
Sonifield, Hugh
Soopes, Carson N.
Sosa, Ester
Soseber, Britt D.
South, Daniel F.
South, Jane L.
Southern, Leo
Sowa, Paul
Sowers, Tom
Spalding, Dexter
Spalding, Sandra
Spam, Rob
Spangler, Terry
Spanos, Jon
Sparks, Robert B.
Spear, Lerone
Spear, Walter
Speech, Carl B.
Speelman, Herbert W.
Spence, Robert C.
Spencer, Gene
Spencer, Linda G.
Spencer, Tom
Spier, Kathy
Spiker, Gregory M.
Spiker, Maxine
Spiker, Rick
Spine, Alvin F.
Sprague, Mary
Spray, Robert L.
Spring, Shawn W.
Springs, Elaine S.
Sproul, Elizabeth A.
Stacey, Horace
Stacy, Melody
Staddard, L. D.
Stadler, David
Stafford[1]
Stafford, Diana
Stafford, Janice
Stafford, Lowell T., Sr.
Stakes, Yvonda
Stalcup, Sreglinde
Stalk, Dennis
Stalling[1]
Stallings, Ellen
Stambaugh, Ann
Stambaugh, Stephanie
Stan, James R., Jr.
Stand, Laurie
Standard, Sam
Standefer, A. M.
Stange, Angela
Stanley, Melissa
Stanley, W.
Stansell, Mary
Stapleton, Claudia
Stapp, Chris E.
Stapp, Dale
Stapp, Renee
Stapp, Renie
Stare, Suzy
Starfield, Martha
Stark, Emil
Starky, Dedi
Starr, Walter
Stater, Brice
Stater, Lavonna
Stauder, T. J.
Stauffer, Becky
Stautzenberger, P. R.
Stebbins, Christine
Stebbins, Jeff
Steebill, Linda
Steele, Bobby
Steele, Mary E.
Steele, Roy E.
Steen, Jerry
Steen, Susan M.
Steffens, Keri
Stephen, Robert
Stephen, William R.
Stephens, Briget
Stephens, Clayton R.
Stephens, Dawn
Stephens, Mandy
Stephens, Mary
Stephenson, Carole
Stephenson, Connie
Stephenson, David
Stephenson, Rhonda
Stephenson, Sharon F.
Sterling, Bessie
Steven[1]
Stevens, Gary
Stevens, Jan
Stevens, Jo
Stevens, Judith M.
Stevens, Patricia A.
Stevens, Robert A.
Stevens, Ted
Stewart, Beth A.
Stewart, Daniel C.
Stewart, Jimmy
Stewart, Margaret
Stewart, Rachelle
Steyn, Robert B.
Stickrel, William J.
Stidd, Kenny, Jr.
Stidham, David C.
Stiles, Charlene
Stine, Robert
Stingley, Nona
Stinnett, Jim
Stins, Edith
Stinsman, Melody
Stinson, John, Jr.
Stockard, Jim
Stoddam, Steve
Stoddard, Clint L.
Stoddard, Michelle
Stoddard, Raymond E.
Stoeseth, Bob
Stokes, Kyle R.
Stone, Fay
Stone, Jim
Stone, Kenny
Stone, L.
Stone, Richard C.
Storal, Eddie
Storment, Bill
Storseth, Barbara
Storseth, Barre
Storseth, Marjorie
Stotts, April
Stout, Doris
Stout, J. D.
Stout, Rhonda
Stout, Tonya
Stovich, Laurence
Stowers, Kelly
Straham, Shirley
Strain, LeAnn
Straley, Kimbra R.
Stramp, Sally
Stran, Glenn W.
Strange, Joe M.
Straughnety, Kurt L.
Straus, LaRayma
Streeter, Mary
Streu, Oliver
Stroud, David
Strouse, Beatrice
Strouse, Eugene E.
Stuart, Leonard C.
Stubben, Alice
Stubben, D. J.
Stubblefield, Peggy
Stucky, Flory A.
Stucky, Charles, III
Stultan, Scott
Stultz, Bob
Stumbo, Mike
Stumon, Mary
Stump, Merrill
Sturgess, Tina F.
Styers, David
Styers, Karen E.
Suarez, Jesse
Subramonian, M. K.
Suhl, Vickie L.
Suitflon, Wayne
Sukay, Frank K.
Sullivan, Katrinka
Sullivan, Tracy
Sullusis, Doug
Sultemeier, Karl
Sulton, Patricia
Suly, John E.
Summer, Cynthia
Summer, Jo
Sumna, R. O.
Sumner, Jennifer
Sumner, Machelle
Superdock, Tracy L.
Supina, Larry
Susan[1]
Sustaita, Diana
Sustaita, Ralph
Sustanta, Daniel R.
Sustante, Rick
Sutton[1]
Sutton, Julie
Swader, H.
Swafford, Connie
Swafford, Stephanie E.
Swaim, Patricia
Swaim, Shirley
Swain, Billy D.
Swain, Shelly
Swanson, O.
Swendell, Garry
Swicegood, Erica L.
Swicegood, Steve
Switzer, Joseph R.
Tabor, Barbara
Tabor, Clyde
Tabor, Jerry
Tabor, Tom
Tagine, Richard L.
Talberry[1]
Taledo, Freddie
Tallock, Nancy
Talsas, Art
Tamango, Rafael
Tankesly, Fabian
Tapp, Bernie
Tapp, Randy
Tarango, Dixie
Tarbox, Kathy
Tarro, T. Wade
Tarter, Wayne

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Tarver, Sallie
Tate, Pat
Tatum, Sarah
Tayler, Sharon
Taylor, C. M.
Taylor, Darla
Taylor, Don W.
Taylor, E. Lee
Taylor, Eddie
Taylor, Franklin R.
Taylor, Jay R.
Taylor, Juanda
Taylor, Lia
Taylor, Linda
Taylor, Margret
Taylor, Michele
Taylor, Randy
Taylor, Regina
Taylor, Rita
Taylor, Ruby
Taylor, Shelia
Taylor, Tania
Taylor, Teressa
Taylor, Tim
Teague, Bill
Teague, John
Teague, Ruth
Teel, Stephen
Teichmann, P. A.
Telford, Carolyn
Telley, Frances
Tenorie, Jerry
Terroph, John W.
Terry, Bryan
Terry, Eddie D.
Terry, Ray, Jr.
Teter, Kevin
Tezak, Gea
Tezak, Lloyd
Thaggard, Carol
Than, Phat
Thayer, Rhonda
Theran, Lewis N.
Thibodeaux, Greta A.
Thilodeaux, A. L.
Thipsipasom, Thip
Thomas, Amber
Thomas, Brenda
Thomas, Charlotte
Thomas, Douglas
Thomas, Eric Q.
Thomas, Charles S., II
Thomas, Irven L.
Thomas, Tommy L., Jr.
Thomas, Larry V.
Thomas, Laurie
Thomas, Mark
Thomas, Mike
Thomas, Pam
Thomas, Shirley
Thomas, Tony
Thomason, Dick
Thomason, Gerald R.
Thomason, Seth
Thomeson, Joy
Thompsen, Carrey
Thompson, Alfred W.
Thompson, Bailey
Thompson, Chuck
Thompson, Dale
Thompson, Dale R.
Thompson, Dick
Thompson, Dick R.
Thompson, G. B.
Thompson, Jackie
Thompson, L. O'Brien
Thompson, Marion
Thompson, Marzella
Thompson, Michelle
Thompson, Mike
Thompson, Priscilla J.
Thompson, Troy
Thompson, Vicki
Thornber, Robert
Thornberry, Misty
Thorne, Don
Thornton, Lynda
Thoush, Jettie
Thrash, Betty
Thron, Timothy G.
Thurmon, Beth
Tidwell, C. E.
Tidwell, Frances
Tiffany, Paul
Tiffin, Floyd
Tigart, Michael D.
Tigwell, Steven
Tillman, Ronnie
Tim, Joey B.
Timmons, Robin
Tinkler, Scott A.
Tinsley, DeRema
Tiodomann, Tom A.
Tipps, Tanya
Todd, Frank
Todd, Kelly
Tolbert, Ronnie
Tolbert, W. A.
Toledo, David J.
Tomseca, Lucy R.
Tonn, Beverly
Toponce, Mary
Topper, Dena
Torczon, Marcus
Torres, Manuel, Jr.
Travelers Inn
Travis, Diane
Treat, Mike
Tredway, Kim
Treece, Michael E.
Trent, Dennis
Treveno, Rosa
Trevine, Lisa
Trevizo, Alonzo
Trindall, Randy
Tripin, L.
Tripples, James
Trook, Dale
Trook, Gary D.
Trotter, Betty A.
Troublefield, Adabeth
Troutman, Mark
Troyer, Steven D.
Trujillo, Frank
Truman, Ron
Tseng, C. W.
Tubbs, Diana
Tucker, Bill
Tucker, Dylan
Tucker, Janet
Tucker, Jeff
Tugwell, Venetia
Tung, Susie
Tunky, John
Tunnell, Kerri
Tuny, Gregory
Tupin, Charla E.
Turner, Beth
Turner, Cassie
Turner, Debbie
Turner, Dickie W.
Turner, Cleveland, III
Turner, Johnny L.
Turner, Lorie
Turner, Michael E.
Turner, Novell
Turner, Scott
Turpin, Billy R.
Turpin, Howard L.
Turpin, Johnny
Twombly, Randy C.
Tyler, Earl C.
Tyler, Jim
Tyler, Ken
Tyler, Ronnie
Tyler, Tracy E.
Uhrich, Roger
Ulch, Angela
Ulch, David
Unger, Eric W.
Unruh, Judith M.
Upchurch, Bill
Upton, Cleta F.
Upton, Ricky D.
Urton, Mike
Uselton, Jim
Usrey, Grozella
Utsey, Alan
Utsey, B. G.
Vadive, Paul
Valdez, Beatrice
Valdez, Debra W.
Valdez, Gloria
Valdez, Terri
Valdy, John
Valentine, Joe W.
Valenzuela, Jesse
Vallejo, Adrian
Valluzuela, C.
Valois, Doug
Valuerde, Alice
Van Ostrand, Robert S., Jr.
Van Scheper, Craig
Van Trapp[1]
VanBrunt, Katherine M.
VanDoran, Dustin
Vann, Candy
Vasquez, Jennifer
Vasquez, Vincent
Vaughan, Cindy
Vaughan, Pete
Vaughn[1]
Vaughn, Alphonso
Vaughn, Carol
Vaughn, Dennis W.
Vaughn, Horace H.
Vaughn, Ken
Veitefeuille, Edward M.
Velasquez, Andy
Velasquez, Tonia
Velasquez, Tracy
Velebil, Dana R.
Velky, John
Venable, Eva
Venable, Jerry
Venhaus, Bernard
Venson, Billy
Verna, J. Scott
Vernon, J. Bob
Verporeun, Ashley
Vertefeuille, Barbara
Vest, Kim
Veteto, David
Vicker, Linda
Vickers, Linda D.
Vickers, Lisa R.
Vicki[1]
Vidlack, Bill
Vieth, Regine
Villa, Alice L.
Villalon, Rosalio
Villaneal, Trinidad A.
Villaneil, Oscar
Villasenor, Margaret
Villesent, Maida
Villesent, Manuel P.
Villya, Arnold
Vincent, Dianne
Vincent, James
Vincent, Russell
Vinson, William C.
Virder, Kenny
Vitaliani, Ernest M.
Vivaron, David

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Vocher, John M.
Vodgeming, Daniel
Von Uetz, Gaut
Voss, James W.
Vuch, D.
W. F. [1]
Waddell, John
Waddell, Marjerie C.
Wade, B. J.
Wade, Paula
Wade, R. Dale
Wagner, Brenda
Wagner, Kittie
Wagnon, Susan
Wagnor, Judy
Wakefield, Roger C.
Waldron, Linda
Waldy, Carol J.
Waleigh, Colleen
Walker, B. C.
Walker, Billie
Walker, Charles D.
Walker, Cindy
Walker, DeAnna
Walker, Ronnie
Wall, Brad
Wall, Dave
Wall, Pete
Wall, Raylene
Wall, Ronald M.
Wallace, Sherita S.
Waller, Kathy
Wallesch, Shayne E.
Walling, Jimmie R., Jr.
Walls, James W.
Walser, Caroll
Walsh, Donald W., Jr.
Walsh, Nichole
Walter, D.
Walter, George
Waltermann, H. A.
Walters, Betty
Walters, John M.
Walters, Steven
Walton, Cheri
Walton, Debbie
Walton, Neil
Wamsiot, David
Wang, P. Jeffrey
Ward, Gary
Ward, J.
Ward, John Q.
Ward, Paula
Ward, Randy
Wardrell, Greg
Wardwell, Storm
Ware, Arthur
Ware, Bill
Ware, Richard
Ware, Tisha
Warehime, C. D.
Warehime, Sandy
Waren, Gary
Warren, Billy G.
Warren, Bridget M.
Warren, Elizabeth
Warren, Jeff
Warren, Jon L.
Warren, Judy
Warren, Omar
Waters, David K.
Waters, Jennifer B.
Waters, K.
Waters, Robert W.
Watson, Cheryl J.
Watson, Garry H.
Watson, Matt
Wattentenrger, Mack
Weatherby, William H.
Weatherly, Dewayne
Weatherly, Karen
Weatherly, M. Jean
Weatherly, Nancy
Weathers, George C.
Weathorne, Daniel
Weaver, Helen
Webb, Evelyn
Webb, Gayle
Webb, Jeff
Webb, Jerry E.
Webb, Ronald
Webb, Sylvia
Webster, William
Weedler, Debi
Weegard, Steve
Weeks, Shane
Weems, Bill
Weidner, Brian
Weir, Grady
Weir, Mary F.
Weirneid, W.
Weise, Bill
Weiss, Chris
Welch, Charles
Welch, Charlotte
Welch, Gregory W.
Welch, Linda
Welchlen, Todd A.
Welk, Barbara
Weller, Jimmy C.
Weller, Tom
Wells, Ben T.
Wells, Charles
Wells, Dee
Wells, Donna L.
Wells, Gene
Wells, Keith L.
Wells, Mary L.
Wells, Patsy B.
Wells, Rebecca J.
Welter, David M.
Weng, Dan
Wentworth, Anne
Wermeich, Ann D.
West, George
West, James
West, K.
West, Larry
West, Sheila
Westall, Steve
Westen, Sherry
Westfield, Matt
Westman, Virginia
Westmorelan, Carl
Westmoreland, Faye
Weston, Jim
Wetel, K. C.
Wetts, John R.
Wetut, Bill
Whalen, Diana
Whartey, Richard
Whatley, Sheila
Wheeler, Bob
Wheeler, Deanie E.
Wheeler, Judy
Wheeler, Kent
Wheeler, Scott
Wheeler, Sheri
Whetzel, Randy
Whicker, L. V.
Whipple, Carolyn G.
Whitacre, Johnny L.
Whitaker, Terry J.
White, Brian
White, Charles W.
White, Clayton
White, Thelma
White, W. S.
White, William R.
Whitefield, S.
Whitehead, Don
Whitfield, Betty L.
Whitfield, Cindy
Whitler, W.
Whitley, Jason P.
Whitley, Kathy
Whitten, Joe
Whittington, Steve
Whitworth, Seth L.
Whritenour, Glenn
Wie, W. Scott
Wieck, Jeff
Wieck, Robert L.
Wiedrich, Cory
Wiefong, Richard
Wiels, Angela
Wiems, James
Wiginton, Tommy
Wilborn, Cary D.
Wilcot, Gary
Wilcox, R.
Wilcox, Ronald D.
Wilder, Larry
Wiley, Russell C.
Wilhelm, D. R.
Wilhelm, Van
Wilkas, Elizabeth
Wilkes, Robert C.
Wilkins, Wayne
Wilkinson, David
Will, David
Willard, Ann
Willborn, Terry
Willhelm, Joyce M.
Willhite, Martin B.
William, Donald R.
Williams, Andre
Williams, B. R.
Williams, Betty
Williams, Bill
Williams, Billy S.
Williams, Byrant
Williams, Cindy
Williams, Cynthia G.
Williams, Dan E.
Williams, David
Williams, David E.
Williams, Deborah L.
Williams, Dennis
Williams, Douman
Williams, Gary W.
Williams, H.
Williams, Henry P.
Williams, Janice
Williams, Jeffrey
Williams, Jerry C.
Williams, Jim D.
Williams, Jimmy
Williams, Joe D.
Williams, Judy
Williams, Ken
Williams, Laurie
Williams, Levon B.
Williams, Linda
Williams, Michael L.
Williams, Myra
Williams, Pat
Williams, Tia
Williams, Tish
Williams, W. Wayne
Williamson, Paul H.
Willingham, C.
Willis, Angie
Willis, Howard M.
Willis, Katherine
Willis, Sandra
Willmon, Linda J.
Willsey, Jay
Willsey, J. David, Jr.
Willsey, Sharla
Willson, W. J.
Wils, Troyce
Wilson, Carolyn
Wilson, Charlotte A.
Wilson, Eileen L.

[1] Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Amarillo (continued)
Wilson, Frank
Wilson, Gene
Wilson, Gerald
Wilson, Glenn E.
Wilson, Howard
Wilson, Ken
Wilson, Kerri D.
Wilson, Kina L.
Wilson, Larry J.
Wilson, Laura
Wilson, Lisa
Wilson, Marilyn
Wilson, Nella
Wilson, Suzanne
Wilson, Valorie
Wimberly, Chris
Wingrone, Jane L.
Wink, B.
Winkle, Cassie
Winkler, Peggy S.
Winters, Lori
Wirdirl, Henry L.
Wirtz, Paul
Wise, LaPaeslla
Wise, Michael
Wise, R. David
Witcher, Jones
Witherspoon, Dede
Witherspoon, Tara G.
Withrow, Taylor
Witmne, Debbie
Witt, Scotty C.
Wolden, Monica
Wood, C. A.
Wood, Cory
Wood, Flint
Wood, Joe
Wood, Ronn
Woodall, Vernon D.
Woodard, Jim
Woodberry, Lorenzo
Woodburn, Charles R.
Woodburn, Randy
Woode, David A.
Woode, Regina
Woods, Angela L.
Woods, Anita Y.
Woods, Craig
Woods, Robert, Jr.
Woods, Tommie
Woods, Virginia S.
Woodward, Larry
Woodword, Ronnie
Wookun, David H.
Woolsy, Robin
Wootton, Deborah
Wright, Craig
Wright, Harold
Wright, Jennifer
Wright, John
Wright, John D.
Wright, Josephine Y.
Wright, Karl
Wright, Katie
Wright, Lisa
Wright, Louise
Wright, Marianne
Wright, Mike
Wright, Muriel
Wright, R. E.
Wright, Randy
Wright, Robert
Wright, Robert M.
Wton, Don
Wyatt, Ava
Wylie, Debbie
Wyre, Charles S.
Yaeger, Lisa
Yaksick, Judo
Yald, Tony
Yarbough, Sharon
Yarbough, Shawn
Yarbrough, Earl V.
Yarbrough, Jeff
Yates, D. A.
Yates, Jeanie
Yeary, Bret
Yerslen[1]
Ynojosa, Joe
Ynojosa, Julie
Yorger, David G.
York, Billy
York, Douglas C.
York, Rod L.
Yost, John
Young, Billie
Young, Jeffrey P.
Young, Joel
Young, Pete
Young, Radall S.
Youngblood, Reginald
Youngblood, Robert
Yourer, Don
Yuger, Jerry
Yul, R.
Yume, J.
Zambrano, Louis A.
Zambrano, Louis S.
Zamora, Frank S.
Zamora, Gilbert
Zamora, O. L.
Zann, David
Zanora, Richard
Zentura, Jabut
Zerm, Ronald W.
Zimmer, Jill
Zimmer, Mark
Zimmerman, Anne
Zimmerman, John
Zimmerman, Shirley
Zinckey, Earl W.
Zint, E. H.
Zioekowski, Jane
Zrygley, Jan
Zunega, Sal
Zuniga, Terri

Borger
Alexander, Brain G.
Anders, John
Baldwin, D. L.
Barringer, Bob O.
Belton, Paul
Byrd, Larry S.
Carlile, Jeff
Deleon, Arnold
Diaz, Jerry E.
Drenes, David
Duncan, Michael
Durham, Denise
Foster, Joel B.
Foster, Lisa C.
Hindman, Scott
Jones, Howard L.
Lewis, Gail
Lonelu, Kathy
Looms, Martha
Luxson, Susan
Marshall, Elaine
McWilliams, H.
McWilliams, Lauri
Mihm, Joe C.
Milner, Dale A.
Muf, Randy D.
Mullan, Bers G.
Neaslit, James
Pierce, Sherry
Rangel, Rudy F.
Reed, Carrie
Rhoten, Mark
Richardson, Mahlon
Schmitz, Dirk
Sheffirl, Jesse
Teimbue, Randy
Thompson, Robbin L.
Tindall, Connie
Whitron, Tom
Williams, Inez
Wilson, Betty

Boys Ranch
Brongleton, Patsy
Crist, Andrew K.

Brookshire
Griffin, Edward R., Jr.

Bushland
Blesson, Mike
Gillis, Melody
Holloday, Sammie E.
Scott, Sam J.
Wagner, Kenneth D.

Canyon
Adams, Jacki
Adinddell, Tom
Alexander, Coy
Alexander, Vernon O.
Alford, Charles E.
Allen, Burt
Anderson, James E.
Angelo, James W.
Avent, Brenda A.
Bain, Sharon
Baird, Jay
Baize, Todd
Barnard, LaRue
Basher, Chad
Beard, Patty
Beck, Amy
Bell, Zachary
Blochteres, Jerry L.
Blyton, Anna
Brach, Terry
Bray, Alice
Bray, Scott
Britten, Jay M.
Broomley, Sony
Brown, M. Keith
Buckner, Dale E.
Burgtorf, Annette
Caldwell, Teresia
Calhoun, Russ
Campbell, John D.
Cargett, Rhonda
Carrea, Albert
Cervantez, Melba
Chapman, David
Chavez, Ralph
Chris[1]
Clark, J. R.
Clayton, Phil
Clemens, Carla
Clements, Keith
Clinton, Beryl D.
Collier, Christy
Conner, Jack
Coronado, Ramon
Cotier, Kevin
Couner, Beverly
Craig, Alan R.
Craig, Cindy
Cunningham, Retta M.
Davis, Evon
Dickenson, Samuel J.
Doug, Chris
Duggan, Brad G.
Dunly, Jerry
Eaton, Charlotte
Eiler, Michael
Evans, Judy
Fox, Deffine
Garner, Dennis
Goss, Keith
Guffey, Cindy
Halford, Larry D.
Hall, Mark

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Canyon (continued)
Hammons, Kendra
Harris, S. Todd
Havran, Mike
Hayes, Jack
Henry, Bob
Henry, Della
Henry, Jeff
Hightower, Dayna
Hoffman, Wendy
Hopson, Richard D.
Howard, Rozanna
Hudson, Howard L.
Hunt, David
Ithaca, Jerry
Jenkins, Jimmy D.
Jeter, Brent
Johnson, Jerry
Johnson, Jerry D.
Jones, Angela
Keys, Kim
King, Denise
Kinney, Alan J.
Kirbet, Steve
Kloos, Glenn
Landry, Roy
Langford, Michael J.
Lard, Archie
Learcy, DeeDee
Lema, Louis
Lemon, Ron
Lewis, Kelly
Lovelett[1]
Lowell, W.
Magee, Destry Z.
Mahli, Todd
Mahlin, Ginny
Manley, Wilton
McClendor, Bud
McElroy, Carla
McGryor, B. C.
Meier, Alan
Moldenhauer, Jerry
Moldenhauer, Linda
Moulder, W. W.
Pleteka, John
Podzsanny, Tim
Prichard, John E.
Ray, Sharon
Redden, Jim
Renteria, Bea
Reynolds, Kay
Roberts, Jay C.
Rowe, Loreen
Rowell, R. S.
Russell, B.
Russell, Shelly
Salaza, Carmen
Sandridge, Jay
Saturn, Eddie
Scarborough, J. D.
Schoenbah, Monty
Schraw, Michael
Scott, David C.
Scott, Linda
Scott, Michael
Seals, Billy
Sedno, Tame
Shepherd, Tommy
Shoemaker, Ruth R.
Simon, Jim
Smith, Chester
Smith, Michael K.
Smith, Robert F.
Stanley, Jennifer
Stevens, Jim
Tallant, Johnny
Tatum, Kathy
Tatum, Ryan
Tinsley, Linda M.
Tinsley, Michael A.
Umphery, James C.
Usleton, Darlene
Vauhilk, Eddy
Wagner, Shawn
Waller, Bradley
Watson, Willie M.
Weaver, Willie
Webb, Charles
West, G. T.
Whipple, Leigh
Williams, Ben
Williams, Danny L.
Williams, Gregg
Wilson, Ross
Witt, Mary R.
Woodard, Donna W.
Woodland, James S.
Wynn, Susie

Channing
Crain, David
Dodson, Scott

City
Epperson, John

Clarendon
Biddingfield, Wanda
Carter, Steve
Griffin, Jim
Hamilton, R. J.
Harder, Wayne
Hill, Kelly
Horn, Ellen J.
Howard, Sue
McAnear, Ronnie
Pereval, C. D.
Sell, Ann
Thompson, Marian
Watson, Betty
Winters, Gary E.

Claude
Aduddell, Rex
Armatrout, Sharon
Ashuntt, Larry
Awalt, George T.
Battenfield, Glenda
Battenfield, Kenneth
Bron, C. H., III
Brown, Britt C.
Cartwright, Jay B.
Cartwright, John
Cartwright, Pam
Cash, Zaleta
Christian, Anna
Christian, Tom
Collins, Van E.
Davis, Elizabeth P.
Eddler, V.
Ellis, Frankie
Felund, Michael
Ganley, Matt
Gass, Kathy
Haler, Chester
Haney, Harold R.
Haney, JoAnn
Hatfield, Donna
Hugg, Rhonda
Jones, Linda
Knipp, A.
Kraves, Jerry
Otto, Thomas L.
Pewell, Billy
Rutherford, L. Paul
Scott, J. C.
Sherman, Debbie
Smith, Johnnie L.
Smith, Pat
Stanton, Robert
Voyles, Terry D.
Weber, Mary Rose
Wheeler, David N.
Whihkel, A.
Whitney, Robert C.
Wood, Jim
Wood, Mary
Woodard, Kathy

Dalhart
Barber, Barbara A.
Burly, Rud
Finch, Jim
Rice, Carolyn
Salvertt, Charles R.

Dawn
Chambers, Kenneth L.
Chambers, Pat

Dimmit
Cobb-Gregory, Dana
Portwood, Tommy D.
Vance, Susie

Dimmitt
Gunn, Billie J.
Marsh, Calvin
Murdock, Bobby

Dumas
Adams, Gloria
Alvard, Terry
Brunsan, Joe
Cearly, Mike
Crafton, Mike
De Shage, Tracy
Kauffman, Bryan
Larner, Thomas C.
Mulanax, Carol
Payne, Dee
Puley, Jett
Reid, Tanya
Rie, Emmut
Thaxton, Wanda

El Paso
Mayfield, Billy

Fritch
Beaudrie, Jhanzzen T.
Brinisom, Roy D.
Buchanan, V.
Butcher, Galelma J., III
Church, Richard L.
Cockell, Glenn C.
Dun, Sandra
Durr, Sandra
Foster, A. G.
Foster, Charles
Foster, Helen C.
Foster, Patricia
Hefley, Teresa
Herbst, Clifton D.
Jester, Gene
Johnson, H. P.
Knox, T. Shane
Loftin, Elaine
Loftman, Lewis
Mack, Bobby G.
Mark, Bobby, Jr.
McKinney, Zella M.
Moore, Robert A.
Pickett, Troy E.
Piles, Earl A.
Roberts, Janet
Satterfield, H. D.
Senett, Toby
Smith, Ruth
Stevens, John D.
Thurston, Patty
Tyson, Michael G.
Viner, Angie
Wilson, Ryan

Groom
Ashford, Jerry
Brillen, Gary W.
Britten, Susan R.
Downs, Curtis
Downs, Dondra S.

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

Groom (continued)
Jackson, Ken
Koetting, Janice
Lewis, Millard H.
Lyler, Don
Martin, Christopher D.
Martin, Daniel
Martin, Glenda
Martin, Sherry
Master, Daniel E.
Miller, Ila
Moroneu, Carolyn
Stapp, Ellis E.
Stapp, Ralie L.
Stephens, Brent

Happy
Bailey, Stephen
Collier, Edgar J.
Grissom, Michael R.
Johnson, Connie
McCarley, Holly
Moyer, Lonnie
Phillips, Katrina

Hartley
Perkins, Shirley

Hedley
Knodes, Anthony

Hereford
Boozer, Douglas M.
Cruz, Jordan L.
Gauthreans, Robert P.
Karr, Donald
Katlth, Chris
Manning, Ellen
McDaniel[1]
McDaniel, Gene
Ramirez, Roger
Rivera, Eliseo
Serra, Robert C.
Shahoun, Antoinetta
Short[1]

Horebord
Torbit, John P.

Lefors
Kemph, Wilbur L.

Lelia Lake
Shields, Donald M.

Memphis
Crockett, Becky

Meta
Wright, Jim

Miami
Juarez, Ray

Pampa
Alva, Jack A.
Beck, Tina
Berry, Lequeta L.
Bleakley, David
Dalton, Derik W.
Davis, Kevin
Davis, Michael
Dull, Allan
Ferguson, Matt
Fore, Gordon L.
French, Jan
Frost, Bryan
Hammer, Tommy G.
Hill, Brenda
Hill, Patricia
Jerome, Angie
Johnson, V. L.
Keller, Gary
Noel, Jerry N.
Ramirez, Ernest
Raulston, K. R.
Redeemer, Wanda
Robinson, Frank
Sarlen, Kenneth
Smith, Paul
Steward, Kenny
Stout, Bobby L.
Stroup, E. O. Jack
Stroup, M.
Swaney, R. Z.
Tatum, Thomas
Taylor, Kevin
Tidwell, Cathy

Panhandle
Baker, Cindy
Batler, William
Bentler, Ricky
Boothe, G. L.
Brasher, Toni Z.
Brasher, Traci L.
Brass, Rodney
Britten, Fred
Britten, J. Ryan
Brogger, Mark A.
Brown, Hank
Brown, James G.
Byers, Bradley
Clark, Janice
Coffee, Vicky L.
Crow, James O.
Crow, Peggy L.
Curley, Delores
Daves, David B.
Davis, Lauri
Doe, Cynthia D.
Don[1]
Eagle, Kent
Elder, Michael E.
Eller, Rebecca G.
Elliott, Cody
Ewing, Corey
Fleming, J. L.
Flowers, T. C.
Forbes, Ronald L.
Freeman, E. Benal
Friend, David C.
Fussell, Lyla
Garcia, Frank
Garcia, Rick
Hammer, Donald
Hammer, Ronia
Hardy, Calu
Harfton, Janet
Held, Leslie
Heli, Elizabeth
Henderson, L. B.
Hensley, Dan
Hetzler, Vicky
Hoffman, William W.
Hootem, David
Howard, Frank
Howard, Kelly
Hurt, Laquita
Hutching, F. Alvin
Irvin, Joe
Kennedy, Glen J.
Kinion, Charlotte A.
Kirkland, Cleo
Kirkland, Judith
Koenig, Colleen M.
Lambessa, Aimee
Lane, Georgia
Leffel, Rick
Leffew, Kimbel
LeGrand, Harry
Lewis, David
Littan, Brenda
Littan, Max
Logsdon, J. L.
Lord, Mark
Mansel, Donald H.
Mayfield, E. G.
McDonald, David E.
McGregor, Shirley
McLeod, Bill
McLeod, Glenna
Mitchell, Henry G.
Molve, Matthew D.
Neusch, John W.
Nichols, Shane
Nix, Kent
Nunn, Darlene
Nunn, Larry
Painter, Johnny R.
Partain, Rudy L.
Pitt, Jackie
Ralston, Karla
Ranfston, Cary
Riley, John
Rollins, Michael
Rusk, Scott
Saenz, Karen
Smith, Dee Dee
Smith, Duane
Smith, Charles H., Jr.
Smothermors, Tammy
Snow, James A.
Spear, Kirk
Stringfellow, Pat
Stroope, J.
Truman, Phillip
Urbanezyk, Megan
Vaughn, Glenn
Ware, Glenda
West, James E.
Whitehead, Randy
Willard, P. S.
Williams, Kenny
Wilson, Bill
Wiseman, David E.
Witt, Toni
Woodland, N. E.
Woods, J. M.
Woods, L.
Yarger, Sondie
Zamoro, James M.

Plainview
Tyler, Jimmy Don.

San Antonio
Leos, Antonie R.

Sanford
Buck, Greg

Skellytown
Crow, Cathy
Crow, Harold D.
Harris, Bill
Houghton, Greg
McKissick, Roy B.
Stephenson, B. J.

Stannett
Chisum, Matt

Stinnett
Fike, A. L.
Lewis, William S.
Shelton, David
Thompson, Judy

Sunray
How, Jean H.

Turkey
Howard, Connie

Vega
Henderson, Bill
Tanck, Leon

White Deer
Dominguez, Arthur
Downey, David
Downey, Laura
Mapers, Billie R.
Maple, Sam
Martin, R. E.
McAnear, E. C.
Milton, S.
Nicholson, Don
Norton, Becky

[1]Legible portion of commentor names appear in this table.

Table 1.2–8. Individuals and Organizations that Submitted Public Meeting Hand-ins as Part of Campaign 1 (Page 3–106)—Continued

White Deer (continued)
Phillis, Stacy M.
Rhoads, A. E.
Rhoads, Evelyn
Standefer, Frances K.
Standefer, R. W., Jr.
Vigil, Manuel
Ware, M. D.
Wheeler, Carolyn

Wildorado
Moore, Ben
Moore, Dolores

Table 1.2–9. Individuals and Organizations that Submitted Letters as Part of Campaign 2 (Page 3–107)

TEXAS

Amarillo

Acoma Pine Animal & Bird Clinic, Tom S. Gerald
Amarillo College
Amarillo National Bank, Gary Molberg
Amarillo Tri-State Fair, Cheri Christensen
AZ Tire
Bills, Gretchen
Boatman's First National Bank
Buck, L.
Budweiser Distributing Company, Dean Morrison
Canyon Drive Lumber Company, Royce Barnett
Coldwell Banker, Robert E. Garrett
Coldwell Banker, Randall C. Jeffers
Coldwell Banker, Tom Roller
Dawdy, Ann
Harrington Regional Medical Center, Stephen H. Gens
Page & Associates Contractors, Inc.
Sarzynski, Mike
Sell and Griffin, R. Wayne Moore
Sell and Griffin, Garland D. Sell
Shelton, Eva M.
Southwestern Bell Telephone
Sprouse, Mozola, Smith & Rowley, P.C.
Stokes, Yvonda
Senator of the State of Texas, Teel Bivins, District 31
Villasenor, Manny P.

Austin

Texas House of Representatives, Committee on Environmental Regulation

Table 1.2–10. Individuals and Organizations that Submitted Postcards as Part of Campaign 3 (Page 3–109)

No Location Submitted

Abbett, Kathleen
Aiken, Bill
Albrecht, Annette
Albrocht, Roger
Alexander, Thelma
Allen, Martha A.
Anderson, Lois H.
Androdu, Mary
Armstrong, Leah
Artho, Joe
Asner, Ed
Atchley, Patty
Baker, Ramona
Balsiger, George
Banks[1]
Barnes, Debra
Barnes, Ernestine
Baudy, William
Bell, Karen
Belsey, Dick
Belsey, Ashira
Berend, Dora
Bieri, Alvena
Binkley, D. D.
Birkenfeld, Darryl
Blarton, Shae
Boodin, Galim
Braziel, Amanda
Brek, N.
Brisbin, Sharon
Brock, Thelma
Bronneman, Rita
Brorman, Myrna
Brorman, Elaine
Buckmaster, Armarena
Buileson[1]
Buster[1]
Cadenhead, Ernest
Calvert, Rita
Canfield, Stephanie
Carlson, Norma
Carlson, Betty Jo
Carter, Bart
Carter, Sandy Purcell
Carthel, Brooke
Caviness, Brent
Caviness, Kay Lynn
Charless, Mary C.
Cheshire, Sandi
Clark, Rita Wells
Claudio, Lydia
Clearinger, Billy
Clements, W. L.
Colley, Vina K.
Conkeeright, Janice
Conkeeright, Jim
Cooney, Peggy G.
Cooney, D. B.
Cooney, Peggy G.
Cooper, Shirley
Cooper, Margaret O.
Corbett, Henry J.
Corodrey, Sharon
Cox, Jean
Craighead, David
Craighead, Betty
Crain, Mary Tom
Craven, Nancy
Crossett, A.
D'Nan, Elizabeth
Dadt, Charwezel
Daniel, Louise
Darwin, Carol
Daseth, Robert
Davis, Camille
Davis, Isabel
Davis, Beverly A.
Davis, Marla J.
Davsen, Yurive M.
Dawson, Norma
Dawson, Gordon R.
Dazey, M. L.
DeBrangostickel, Maria
Deies, Delores
Delbert L.
Denise, Elizabeth L.
Denton, John L.
Detton, Floyd
Deuns, Arthur
Dietz, Kevin
Dillen, Robert M.
Dillen, Theresa
Dillihoy, Herold
Dixon, David
Dixon, Billie
Dorrow, Tom
Dudenhoeffer, Mike
Dumas, Lloyd
Dunn, Pamela
East, Brian
Elliott, Nancy
Emery, Mary
Escanilla, L.
Escobol, Linda
Fraser, Stephanie
Freemil, Neysa
Friemel, Neysa
Gabel, Jim
Gaber, Welch
George[1]
Georgia[1]
Geraldine[1]
Gibben, J.D.
Gideon, Ron
Gilbert, Betty
Gilliam, Linda
Gilmore, Steve
Glancork, Ashlee
Glern, Lynda
Golden, Richard
Golden, Mae
Gonzales, Patsy
Goodin, Marian
Goss-Werner, Irene
Gray, William T.
Gray, Bill
Groatgut, Gertrude
Gwann, Joe
Hajeh, Linda
Hall, Joyce A.
Hansen, Ruth Ann
Hansen, Eric
Hardef, Deborah
Harine, Kathie
Harris, Garland M.
Harvey[1]
Hatfield, Bobby
Hawkins, Mary G.
Hedgecoke, Stephanie
Helt, Mary
Herbert[1]
Hernandez, Shelli
Hershey, Olive
Hicks, Mildred
Higgins, Alberta
Hill, Fred
Hiller, Merilyn C.
Hinds, Peter C.
Hirsch, R.
Hollingsworth, Dale
Hollingsworth, Jean
Huffines, Heidi
Hutchison, Ralph
Hysinger, Becky
Ivy, Deloris
Jack, Mike
Jiestiel, Richard
Johan, Lou
John[1]
Johnson, Leroy
Jones, M. L.
Kalka, Keith
Keener, Carla K.
Keith, Gary
Kelly, Mary E.
Kenedy, Rozella
Kifsherty, Yvonne
King, Carl L.
Kirkpatrick, E. F.
Kleushen, Carl
Kleushens, Helen
Koetting, Dana
Koster, Jeanne
Kotara, Ronall
Lathom, Gene
LeGate, Della
LeGate, Nolan L.
Light, Kayte
Lipton, Katie
Lipton, Richard
Lowe, Joseph
Mank, Evans R.
Marlirn, Christina
McClellan, J.R.
McClellan, Sandra
McDougal, Eloise
McDougal, Eloise
McElhaney, Jan B.
McGee, Donna L.
McGowan, Lucy
McKinney, Jake
McLarty, Dorothy
McMurtry, Allan
McMurty, Brandon
Middleton, Ronnie
Miles, Jacquelyn
Miller, Janet M.
Miller, Garry D.
Minchew, Linda
Minchew, Richard D.
Mohr, Dan
Moles, Mike
Moore, Mary
Mosiley, Richard
Munsell, F. Darrell.
Munsell, J.
Nark, Mark
Newburg, Madonna
Nielsen, Richard A.
Norwood, Helen
O'Brien, Bill
Olson, Betty D.
Ordaz, Martina
Patton, Robert W.
Patton, Nancy P.
Pitts, Alan
Podson, Ted
Poteet, Billie B.
Primer, Mildred
Pugh, Yvonne D.
Raizen, Ben
Rankin, Denise
Raschke, Helen J.
Rekdal, Sheila K.
Reyna E.
Reyna E.
Richard B.
Ricker, Frances R.
Rissman, Adera R.
Rivers, Lamar J.
Robert[1]
Robinson, Richard
Rohrback, Arline
Romero, Louis
Rounsavell, R. S.
Rounsouell, Bob D.
Rountree, Claudia
Rowntree, Anna
Ruiz, Brendon
Russ, Doris
S., Deborah
Salbeck, Albert A.
Salih, Sharon K.
Sanborn, Hugh W.
Sanders, Kim D.

[1]Legible portion of commentor names appear in this table.

Table 1.2–10. Individuals and Organizations that Submitted Postcards as Part of Campaign 3 (Page 3–109)—Continued

No Location Submitted (continued)
Sanderson, Robert
Sanford, Hugh
Savage, Virginia
Schlab, Tom
Schumacher, Ida
Schumacher, W.
Seaglitm, Besty
Seewald, W.
Shang[1]
Sides, Harold
Sikora, Robert
Slater, Alice
Smith, P.
Smith, Phalba
Smith, Greg W.
Smith, Gail B.
Snodgrass, Tamara
Snodgrass, Gary
Solomen, Henry L.
Sorbert, Edward M.
Springer-Froese, Mary
St. Clair, Shelley
Stein, Richard
Stein, Janie
Stein, Nicholas
Stengel, A. C.
Steve[1]
Stewart, Sharon
Streun, Cynthia
Sulis, Shirley
Swan, Lila
Taff, Joe
Taff, Joyce M.
Taff, Amber
Taylor, Donna
Thayer, G. RIchard
Theine, Jeanmarie
Thompson, James L.
Thompson, Sandie
Thompson, Sally A.
Tooley, Kerry
Torres, Dee
Torres, Amanda
Trevizo, Elena
Trevor, Gene
Tucker, Tracy
Underwood, Vivian
Varga, Judith A.
Vaughn, Joanna & Larry
Vilkowski, Leo
Wah, Edith
Walter, Helen
Wancura, Marianne
Ward, Rick
Ward, Barry
Weber, Roserita
Werner, Robert
Wetmore, Gladys
Wetmore, Don
White, Jack
Williams, Jim
Wink, Shaun L.
Witkowski, Louise
Wood, H.
Young, Monte K.
Young, Cole
Young, Terri

ALABAMA

Cullman
McGehee, Mary

CALIFORNIA

Elk Grove
Grandmothers for Peace

San Bernardino
Yaroslow, G.

Silverado
Meddick, Sherry

South Gate
Bonner, Patrick

COLORADO

Colorado Springs
Springer-Froese, Peter

FLORIDA

Miami
Raup, William W.

ILLINOIS

Vienen Hills
Mary[1]

KANSAS

Newton
Frey, Mark

Wichita
Mohr, Nick

MASSACHUSSETTS

West Falmouth
Micks, Pat

MINNESOTA

St. Paul
Broda, R.

Alamogordo
Lisec, David F.
Lisec, Ann

NEW MEXICO

Albuquerque
Bunting, D.

Chimayo
Glendinning, Chellis

NEVADA

Las Vegas
Knutsen, Reinard

OHIO

Euclid
Fallswalk, Janet

OKLAHOMA

Noble
Mattek, Phyllis

Oklahoma City
Berry, Rick

Stillwater
Cunningham, Clarence M.

PENNSYLVANIA

Pittsburgh
Rush, Molly

TENNESSEE

Dawn
Wimberley, Dori

Houston
Loe, Claire

TEXAS
Snell, Don

Amarillo
Battles, Margaret
Bennett, Hood
Campbell, G. G.
Charless, Addis
Davin, A.
Diocese of Amarillo
Duggan, Carla J.
Goldstein, Nathan
Graves, Sonya
Hall, Kathy
Hyde, Scott
Jeniss, John
Kelly, Sue
Klinke, Agnes
LaBorde, Dorothy P.
Lebow, Sherri
Marsliz, Wendy & Stanley
Martindale, Julie
McFaul, Teresa
McGee, Bob
Molesworth, Ann
Morris, Susan
Murphy, James P.
Nicholson, Melanie
Nobles, G. C.
North Fork Building & Design
Oppermann, Bobbie J.
Patton, Pat
Revell, Cathy
Rewl, Dian C.
Sanchez, Emily
Seewald, Hughes
Shennum, Mary L.
Smith, Ernestine
Smith, P.
SoRelle, Sara
Villarreel, Silvia
Vincent, J.
Waters, Carolyn
Zimmerer, Leo & Mary

Arlington
Kaska, Mary Jo

Austin
Barbee, Adrienne
Belisle, James
Brister, Bob
Butts, Nina
Cominis, Joan
Dolley, John
Hadden, Karen
Hannoy, Michael
Harrington, James C.
Helms, Patricia G.
Kloppe, E. G.
Larson, Dennis
Lippmann, Lilli
Lippmann, Otto
Lowerre, Richard
Matthews, Craig E.
Ricker, George M.
Russell[1]
Simpson, Cheryl
Sullivan, Elisabeth
Texas Alliance for Human Needs
Texas Conference of Churches
Zachary, Doug

Blanco
Rossignol, Steve

Bonham
Marshall, Joyce

Borger
Collard, Janan
Rankin, Rebecca

Brownfield
Henson, Joe H.

Canyon
Campbell, Ron
Ensey, Christi

College Station
Bradshaw, Susan E.

Corpus Christi
De Long, Mary E.
De Long, Richard

[1]Legible portion of commentor names appear in this table.

Table 1.2–10. Individuals and Organizations that Submitted Postcards as Part of Campaign 3 (Page 3–109)—Continued

Dallas
Buchanan, JoAnn
Cooper, Robert
Davis, Richard D.
Nuttels, Craig
Schermbeck, Jim

Dawn
Miller, Genevieve O.
Wimberly, Bill

Denton
Smith, Robert M.

Dimmitt
Ball, Yslita
Clark, Deann

Dumas
Lindahl, Larry
Lindahl, Mary

Earth
Latham, Berniece

El Paso
Dinsmoor, Mary H.
Hammett, Mary K.
Ikle, Matthew

Farwell
Gober, W.

Fort Worth
Abigail, Brown
Burnam, Earl H.
Hall, William
Hall, William

Friendswood
Fusti, Karen E.
Friona[1]

Georgetown
Roberts, Ruth

Grand Prairie
Warden, Dolly

Greenville
Mosa, Jeanette A.

Happy
Stein, G.

Hereford
Allison, Ruth C.
Allison, J. R.
Brumley, Jason
Brumley, Janice
Cargs, Bill
Carlson, Elmer
Cox, Gladys
Cox, Donald R.
Davis, Raymond
Davis, Raymond
Dziuk, Alfred E.
Formby, Chip
Formby, Lisa
Foster, Delores V.
Foxhoven, Deborah
Gee, Mona
Goilscher, Diane
Hendershot, Larry
Higginbotham, Nedra
Higginbotham, Raymond
Higgins, Hilten
Higgins, Peggy
Hoelscher, Richard C.
Hopper, Dave
Kleuskens, Tonya
Oglesby, Cecil
Oglesby, Ella
Paul[1]
Schlabs, Laura
Schlabs, Charles
Schlabs, Richard
Schlabs, Geraldine
Schultz, Margret
Sobman, J.
Steiert, Kerrie
Steiert, Jim
Stengel, Charlie
Strafuss, Carl
Strafuss, Joan
Wilson, Shirley
Womble, Joan
Wossible, Benny
Yosten, Marian

Houston
Golding, Bert
Kaplanwald, Jerome
Loe, Lee
Titus, Mary P.
Titus, Jim

Lubbock
Caldwell, Addie B.
Cochran, Clarke E.
Crawford, A. W.
Gray, Martha
Kleuskens, Heather
Pemchlile, Thomas
Vines, Mary M.

Medino
Isaacs, Florence

Muleshoe
Bell, Mary Lynn

Nazareth
Birkenfeld, Herman
Birkenfeld, Marilyn

Newcastle
Wendel, Jeannine P.
Wendel, Duane

Pampa
Arnold, Jerry
Thrasher, H.

Panhandle
Chair[1]
Detten, Danny G.
Osborne, Jim
Osborne, Jeri
Smith, Phillip

Post
Earl, Lewis H.

Richardson
LaGreca, Mary H.

San Antonio
Maher, Peter
McKenzie, Phyllis
Wah, Thein

Shamrock
Schlegel, Norbert

Spring
Sherlock, Charles N.
Sherlock, Dorothea

Sunray
Ferguson, Katrina
Yanke Farms

Tulia
Jones, Pamela

Tyler
Edelson, Elihu

VERMONT

Lyndonville
Morrissette, Sherlyn B.

VIRGINIA
Louisa[1]
Kretzman, Steve

WASHINGTON

Bremerton
Hudson, Jackie

Dallas
Schumacher, Alex C.

Seattle
Speiser, Joshua

[1]Legible portion of commentor names appear in this table.

Table 1.2–11. Individuals and Organizations that Submitted Postcards as Part of Campaign 4 (Page 3–110)

WASHINGTON
Domina, Kirk
Kennewick
Janett[1]
McCalmant, Grant L.
Parks, Robert J.

Pasco
Hodge, Ralph B.

Richland
Klute, Terrence A.
Mix, Teresa
Reenen, Timothy V.
Veesteeg, Aleci
Wilkerson, Noah L.

West Richland
Martell, Lance

Table 1.2–12. Individuals and Organizations that Submitted Letters as Part of Campaign 5 (Page 3–111)

TEXAS

Amarillo
Bhasker, Constance
Lebow, Michael G.
Lebow, Sherri
Rudd, Terry
Rudd, Mysti

Table 1.2–13. Individuals and Organizations that Submitted Postcards as Part of Campaign 6 (Page 3–112)

CALIFORNIA

Salida
Wancura, Mauarine S.

COLORADO

Colorado Springs
Dudenhoeffer, Mike
Spring-Froese, Mary
Stein, Janie
Thayer, G. Richard
Tucker, Tracy
Young, Terri

KANSAS

Meade
Cottrell, J. M.

Newton
Frey, Mark

Wichita
Mohr, Nick

NEW YORK

New York
Hedgecoke, Stephanie

OKLAHOMA

Norman
Hardersen, Diane

Oklahoma City
Berry, Rick

TEXAS

Amarillo
Campbell, G. G.
Charless, Addis
Diocese of Amarillo
Garcia, Danna
Goldstein, Nathan
Harding, Jim
Janet[1]
Kedeentern, Mike
Kelly, Sue
Martindale, Julie
McFriel, Teresa
Morris, Angela
Morris, Susan
Morris, Henry
Murray, Minnie
Nobles, G. C.
North Fork Building & Design
Rains, Kim
Seewald, William H.
Smith, Ernestine
SoRelle, Sara
Wink, Clarence F.

Austin
Helms, Patricia G.
Matthews, Craig E.
Vaughn, Joanna R.
Young, Marte K.

Clarenden
Bell, Mary Lynn

Claude
Blanton, Joe

College Station
Bradshaw, Susan E.

Corpus Christi
De Long, Mary E.

Dallas
Buchanan, Jolinn

Dawn
Miller, Genevieve O.

Denton
Smith, Marshall

El Paso
Hammett, Mary K.

Fort Worth
Sckora, Judith

Georgetown
Roberts, Ruth

Hereford
Steiert, Kerrie

Houston
Brown, Deborah

Medino
Isaacs, Florence

Newcastle
Wendel, Duane
Wendel, Jeannine P.

Pampa
Arnold, Jerry
White, Jack

Panhandle
Detten, Danny G.
Gray's Baling
Osborne, Jim
Smith, Phillip
Wink, Frank M.

Perryton
Allred, Kathy

WASHINGTON

Dallas
Schumacher, Alex C.

Seattle
Darrow, Gordon R.

Table 1.2–14. Individuals and Organizations that Submitted Postcards as Part of Campaign 7 (Page 3–113)

No Location Submitted
Detten, Delores
Detten, Donald

TEXAS

Panhandle
Smith, Mark

Chapter 2
Changes Made to the Draft Programmatic Environmental Impact Statement as a Result of Public Comments

2.1 INTRODUCTION

During the 92-day public comment period, DOE received a total of 8,692 comments (Tables 1.1–1 and 1.1–2) on the Storage and Disposition Draft PEIS. DOE considered and responded to all comments received during the comment period. Several issues emerged from public comments. Some of these issues necessitated changes in the Storage and Disposition Draft PEIS. These changes were incorporated into the Storage and Disposition Final PEIS. A summary of the major comments received and changes made to the Draft PEIS appears below.

2.2 COMMENTS RECEIVED

Approximately 80 percent of the comments received consisted of mail-in letter and postcard campaigns which expressed either support of or opposition to the use of various sites or alternatives. Most commentors were in favor of transforming surplus plutonium (Pu) into non-weapons-usable forms. Some favored the Reactor Alternatives which would convert the surplus Pu to mixed oxide (MOX) fuel, burn the MOX fuel in reactors, and gain a resultant energy and economic benefit. Other commentors favored the Immobilization Alternatives, specifically the Vitrification Alternative, the conversion of the surplus Pu into a non-weapons-usable form without the use of reactors. A few commentors were in favor of the Borehole Alternatives. However, most commentors opposed the Borehole Alternatives on the basis of environmental, safety, safeguards, and security concerns. A number of commentors expressed the opinion that the surplus Pu should remain in present locations for future energy or weapons use, or until new technologies are available for disposition.

Since MOX technology is not a readily available technology in the United States, several commentors were concerned with security and involvement by foreign nations in the U.S. disposition program. Commentors wanted assurance that the MOX fuel would not be part of the commercial market and would remain under DOE's ownership.

A number of commentors were concerned about the Canadian Deuterium Uranium (CANDU) Reactor Alternative and the manner in which the operation would be conducted with the Canadian Government. Commentors expressed concerns with U.S. and Canadian agreements that would be developed if the CANDU Reactor Alternative were selected as the Preferred Alternative, as well as Canadian compliance with their own environmental laws and regulations. Further concern was raised over the safety, security, and environmental issues associated with the transportation of the materials to Canada.

Some commentors stated that the U.S. Nonproliferation Policy does not encourage the civil use of Pu or Pu processing for either nuclear power or nuclear explosive purposes. The commentors requested that the PEIS address the possibility that the MOX option would have an adverse effect on U.S. Nonproliferation Policy by encouraging its use in civil nuclear power programs and by encouraging Pu reprocessing and recycling. However, other commentors were concerned that DOE should not make statements that would expressly prohibit future reprocessing. DOE acknowledges the public concern for nonproliferation. As discussed in the PEIS, the reactor option would utilize a once-through fuel cycle. Spent fuel from disposition would be disposed of with other commercial reactor spent fuel. This is consistent with U.S. policy since no Pu in the spent fuel would be recycled.

Some commentors indicated that the isotopic composition of the residual Pu in the final waste forms is an inappropriate criterion by which to assess proliferation risks because it perpetuates a myth that reactor-grade Pu cannot be used to make workable weapons. In the opinion of these commentors, isotopic degradation does not constitute a compelling argument in favor of the MOX option. DOE acknowledges that, although it may be possible to make a nuclear weapon from spent commercial reactor fuel, this can only be done with extreme difficulty by individuals with a great deal of experience in handling and processing nuclear materials. DOE believes that the disposition of weapons Pu through the use of MOX fuel in reactors would meet the Spent Fuel Standard in creating a radiological barrier that makes the Pu as difficult to retrieve and reuse in weapons as Pu in spent commercial fuel. The use of this technology would allow for the Pu to be disposed in a geologic repository, the same as for spent commercial fuel.

Commentors encouraged DOE and the United States to become the world leader in the safe, secure, and timely disposition of Pu. Commentors favored U.S. promotion of worldwide nonproliferation of surplus Pu.

A large number of comments were received about the duration of the original 60-day comment period. The concern was that the Draft PEIS was complex and the original comment period too short to allow for a detailed and thorough review. The comment period was subsequently extended to a total of 92 days.

Commentors indicated either support of or opposition to the use of existing facilities. Existing facilities were considered in the Draft PEIS to the extent practicable. For example, for storage of surplus Pu, the Upgrade Alternative would use existing facilities at various sites. For disposition, existing reactors in the United States and Canada are included as alternatives.

Some commentors requested that DOE have a formal economic analysis to evaluate the cost of each alternative. Several commentors requested that such a comparative cost analysis be available for public review.

Some commentors proposed that DOE evaluate additional alternatives for the management of Pu and highly enriched uranium (HEU).

2.3 CHANGES MADE TO THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

In response to comments received on the Storage and Disposition Draft PEIS, as well as other improvements in data and analyses, the Storage and Disposition Final PEIS has been modified in the following respects:

- Revisions were made throughout the Summary and Sections 4.6 and 4.7 to modify the discussion of cumulative impacts and ranking of sites. As a result of comments received during the comment period, all comparative language was removed from the description of the analyses of the alternatives. This was done to provide unbiased analyses to the decisionmaker.

- Some commentors requested that DOE consider additional disposition alternatives, including the use of the Fast Flux Test Facility (FFTF), deep burn reactors, and mononitride reactors. The use of advanced reactors such as deep burn reactors and mononitride reactors was considered but eliminated due to the technical immaturity, attendant costs, and lengthy development and demonstration efforts required to bring the technologies to a viable, practical status and enable disposition options to be initiated with certainty. The FFTF would be considered for Pu disposition if first selected for tritium production. The FFTF is not a reasonable, stand alone alternative because it is in a standby status awaiting shutdown and because it could not satisfy the criterion of completing the disposition mission within 25 years. A discussion of FFTF for this purpose is included in Appendix N. In all, 37 different alternative options were considered by DOE for disposition of Pu. DOE has made revisions to the Summary and Chapter 2 of the Final PEIS to clarify how the screening process was used for selection of reasonable alternatives.

- Section 4.7.3 was modified to address the cumulative impacts for the disposition alternatives.

- Section 4.9, which includes Impacts on Uranium Mining and Nuclear Fuel Cycle Industries, Avoided Environmental Impacts of Using MOX Fuel Instead of Traditional Low-Enriched Uranium Fuel in Nuclear Power Plants, and Avoided Environmental Impacts of Using Nuclear Power Plants Instead of Fossil Fuel Power Plants, was expanded and clarified. Avoided impacts to air quality and waste generated were added to the Final PEIS.

- Los Alamos National Laboratory (LANL) was analyzed for No Action and Storage Phaseout and is included in the Final PEIS. Of the 2.7-metric ton (t) (2.97-short ton [ton]) inventory of Pu at LANL, approximately 1.5 t (1.65 tons) fall within the scope of this PEIS and have been analyzed for storage and disposition.

- Public and occupational health and safety sections were rewritten to clarify methodologies used for the calculation of accidents.

- Section 4.2.6.9 (Public and Occupational Health and Safety) was reanalyzed due to revised badged worker numbers at the Savannah River Site (SRS). New data were provided for the No Action Alternative and the Upgrade Alternative.

- Some commentors requested more information on the can-in-canister technology concept which is a variant of the Vitrification and Ceramic Immobilization Disposition Alternatives. Appendix O, describing the two can-in-canister technology concepts at SRS, was added to the Final PEIS.

- The accident analysis for the Existing Light Water Reactor (LWR) Pu Disposition Alternative was enhanced to further address the comparative impacts and risks of operating an existing commercial uranium-fueled LWR with MOX core. The analysis of a representative Advanced Boiling Water Reactor (BWR) for the Evolutionary LWR Alternative was modified to quantitatively address the "absolute" risks associated with MOX-fueled reactor operations. A more detailed explanation was added to various accident analysis methodology sections to clarify issues related to the technical approach and the basis for modeling assumptions used in the PEIS. The analyses are in accordance with DOE's Office of NEPA Policy and Assistance guidelines for the preparation of EISs. The results, which have a quantitative basis, are presented in applicable sections of the Final PEIS.

- Changes to various technical issues raised by commentors, including data discrepancies or inconsistencies, were incorporated into the Final PEIS for a number of environmental resources.

- Some facility locations for the storage alternatives were clarified in the Final PEIS. In the Draft PEIS, the Consolidation Alternative at the Pantex Plant (Pantex) had two different locations, either north of Zone 11 or in Zone 12 South. The Final PEIS designates only Zone 12 South for consolidation activities. For the SRS Upgrade Alternative, the description has been changed to clarify that the proposed new storage facility is the Actinide Packaging and Storage Facility (APSF), and vault space would be expanded to meet the long-term storage needs. The APSF will be operational before the year 2005, which is the baseline year for No Action in the PEIS.

- The socioeconomic sections were revised due to updated population projections for all Bureau of Economic Analysis (BEA) regions and changes to the employment requirements for Pu conversion, pit disassembly, and MOX fuel fabrication facilities. Employment changes were also made to the Storage Upgrade Alternative at the Hanford Site (Hanford), Pantex, and the Idaho National Engineering Laboratory (INEL). In addition, the affected environment for site employment has been

updated for the Nevada Test Site (NTS), Hanford, SRS, INEL, and the Oak Ridge Reservation (ORR).

- Lawrence Livermore National Laboratory (LLNL) was eliminated from the transportation analysis in Section 4.4.

- The epidemiology sections have been updated in Section M.4.

- Commentors noted that transportation of fissile materials is one of their major concerns with the Fissile Materials Disposition Program. The ground transportation between sites, in the event a consolidation alternative was selected, could increase the potential for traffic accidents. International transportation and specific border crossings for shipment of MOX fuel to Canada for the CANDU Reactor Alternative was also identified as a concern. DOE acknowledges the public's concern, and in response, the transportation analyses in Section 4.4 and Appendix G of the Draft PEIS were expanded. The revisions address security measures for land and sea transport, emergency preparedness, and clarify the results of analyses performed.

- The Preferred Alternative, based on a combination of storage and disposition alternatives, has been identified and analyzed.

- Appendix N, which in the Draft PEIS summarized the operational aspects of the multipurpose reactor, has been revised for this Final PEIS to provide information on the costs and benefits of conducting separate tritium production and Pu disposition missions versus the costs and benefits of carrying out one multipurpose mission. Included in Appendix N is a cost comparison of using new Advanced LWRs or Modular Helium Reactors and a discussion of issues regarding the use of the FFTF (a liquid metal reactor at Hanford) for tritium production and Pu disposition.

- Appendix P has been added to the Final PEIS to provide a description of using the Manzano Weapons Storage Area (WSA) near Albuquerque, NM, to store Pu pits. This appendix also describes the resulting environmental impacts, based on information provided in the Pantex EIS. This appendix was added because DOE's PEIS Preferred Alternative separates the long-term storage of pits from non-pit materials, in which case, Manzano WSA no longer appears unreasonable under the Preferred Alternative for pit storage. However, since DOE's preferred site for interim storage of pits is Pantex (as described in the Pantex EIS) and the majority of pits are already located in storage at Pantex, it did not seem reasonable for DOE to consider a site other than Pantex for the long-term storage of Pu pits, because weapons assembly/disassembly would continue at Pantex in any case. Construction of a new storage facility at Manzano would create needless expense and transportation risk.

- Appendix Q has been added to the Final PEIS to describe the operations and human (radiological) health impacts associated with Pu pits being transferred from the Rocky Flats Environmental Technology Site (RFETS) to Pantex, repackaged in Zone 12 South, and placed in storage in Zone 4 West at Pantex, as part of the Preferred Alternative for storage. The information presented in this appendix is based on the Pantex EIS analysis of storing the Pu pits already at Pantex.

- Appendix R has been added to the Final PEIS to discuss aircraft crash and radioactive release probabilities for proposed storage and disposition facilities at Pantex.

Chapter 3 contains the scanned images of original documents received during the public comment period. These images are marked with sidebars denoting the identified comments and the responses corresponding to these comments.

Chapter 3
Comment Documents and Responses

This chapter presents documents submitted to DOE on the Storage and Disposition Draft PEIS, comments recorded in public meetings and identified from documents, and DOE's response to each comment. The responses to comments identical or similar in nature were repeated throughout the document. Comments that were assigned the same issue bins indicate that they pertained to the same general topic (see Table 1.2–1) but may not necessarily have the same response.

In most instances, the response is found on the same page as the corresponding comment. However, in cases where many comments were identified on a single page, the responses to those comments may appear on following pages.

A number of responses to comments refer to documents providing analysis for the technical, cost, schedule, and nonproliferation policy of the storage and disposition alternatives separate from the PEIS. These documents are as follows:

- *Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition* (DOE/MD-0003)
- *Technical Summary Report for Long-Term Storage of Weapons-Usable Fissile Material* (DOE/MD-0004)
- *Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives*

The two Technical Summary Reports were initially made available to the public for comment in July 1996. The Nonproliferation Assessment was first made available to the public for comment in October 1996, and a series of public meetings were held in October and November 1996 to receive public comment. The comments that were received on each of these documents were considered by DOE, and appropriate changes, clarification, and additional information are provided in updates to the documents which were again made available to the public beginning in November 1996.

The results of these analyses as well as the environmental analysis and public comments will be included in the decisionmaking process.

Storage and Disposition of Weapons-Usable Fissile Materials Final PEIS

AHOUSE, LORETTA, SEATTLE, WA
PAGE 1 OF 2

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): Loretta Ahouse
Address (optional): 1305 - 41 Ave Suite #208
Seattle WA 98110

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. Materials Immobilization/Vitrification - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

I support immobilizing of plutonium (and high level nuclear wastes). I am not sure that from the summary of tonight's presentations explained the differences between the various immobilization options. 1/08.03.01

2. Deep borehole disposal - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

The untreated disposal into a deep borehole option is ridiculous and should not be considered at all 2/08.03.01

3. Reactor Options - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

This option would only encourage future development of nuclear power which I oppose. It is not a viable option - economically it makes no sense to use Pu as reactor fuel and nuclear waste is still a problem 3/08.03.01

4. Storage Options - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

M-222

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, alternatives involving reactors must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Please use this space to write down any additional comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

My first comment is on the public comment process. This meeting in Seattle would have benefitted from allowing more time for citizens to speak instead of listening to the experts. The discussion groups were very helpful and should have had more time. 4/08.02.00

Any decisions that are made about these issues has to bear in mind the Pu will be around longer than any govt. We must use a technology that best protects future generations, as well as us & ours. 5/01.00.00

M-222

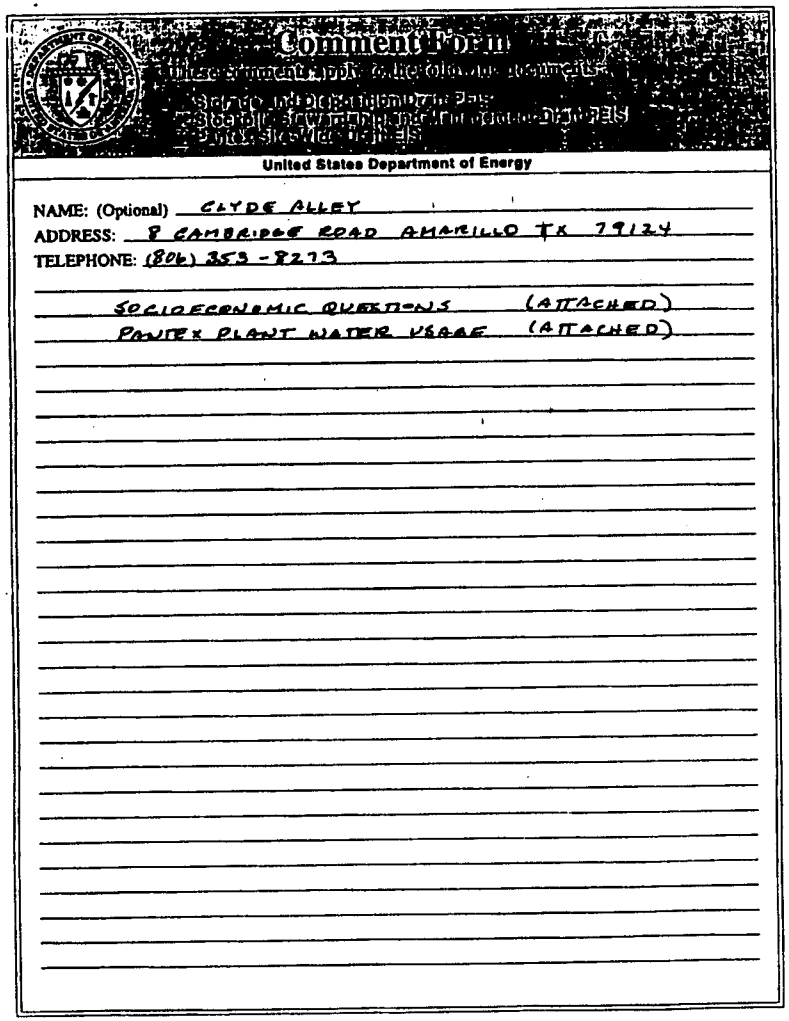
08 02 00 **Comment Number 4**

Comment noted. However, the Seattle meeting was not sponsored by DOE. DOE was an invited guest.

01 00 00 **Comment Number 5**

Comment noted.

ALLEY, CLYDE, AMARILLO, TX
PAGE 1 OF 5



Comment Form

United States Department of Energy

NAME: (Optional) CLYDE ALLEY
ADDRESS: 8 CAMBRIDGE ROAD AMARILLO TX 79124
TELEPHONE: (806) 353-8273

SOCIOECONOMIC QUESTIONS (ATTACHED)
PANTEX PLANT WATER USAGE (ATTACHED)

M-125

SSM PEIS and S&D PEIS
SOCIOECONOMIC QUESTIONS

* Please explain why LLNL and LANL Stockpile Management budgets show projected increases from 1996 to 2004 since the US has terminated the development of new nuclear weapons ?
  Ref. SSM PEIS Preferred Alternatives Report, pp 26,30.

* Are these projected increases in Stockpile Management at the two labs based on transferring missions to them which have previously been done at the production plants ?

* Please elaborate on a statement made on page 34 of the SSM PEIS Preferred Alternatives Report that " personnel from the laboratories could perform assembly / disassembly for some weapon surveillance operations to improve the programmatic tie between Stockpile Stewardship and Stockpile Management ".
  - Would laboratory personnel replace Pantex personnel for this work ? If not, explain.
  - Would this add to the projected layoffs at Pantex ? If not, explain.
  - Would the laboratory personnel be trained and certified to perform this work ?
  - What organization(s) would be responsible for safety, safeguards, and conduct of operations associated with this work ?
  - Explain how this would improve Stockpile Stewardship and Management ?

* Under Phaseout (page S-21) of the S&D PEIS the statement is made " All of the regional economic areas surrounding the DOE sites would experience a loss in employment with

1/09.08.08

M-125

09 08 08 **Comment Number 1**

With the exception of RFETS, the phaseout of existing storage facilities at DOE sites would involve, at most, the loss of 200 direct jobs (Hanford and SRS). At Pantex, the phaseout would only affect five jobs, and no jobs would be lost at INEL. The impacts of these employment losses on the affected regional economies would be minimal. As stated in the PEIS, the regional economies in which the DOE sites are located are too large to be adversely affected by such a small decrease in employment at one site. Although the phaseout of storage facilities at RFETS would involve a greater number of workers, the impact on the regional economy would still be small because of the plant's location near a large metropolitan area. The PEIS analyses (including analyses of socioeconomic impacts), along with technical and cost studies, nonproliferation considerations, and public comments will be considered by DOE in the Record of Decision (ROD).

phaseout. However, compared to total employment in these areas, the loss of jobs would have no or negligible impacts at all the DOE sites."
- For which sites would the impact be negligible ?
- For which sites would the impact be significant ?
- What is the basis for determining the significance of the impacts ?
- How does the DOE plan to use this significance in their selection process ?

1/09.08.08 cont.

* The socioeconomic analyses of the three EIS's are not consistent. The SWEIS (p. S-17) assumes 1.65 indirect jobs in the region for every job at Pantex. The SSM PEIS (p. S-32) assumes 1.16 and the S&D PEIS (p. 4-205) assumes 3.51.
  - Please explain these differences ?
  - Why didn't the DOE use the analysis of the Amarillo Economic Development Commission (AEDC) which is based on local knowledge of the area ? Their analysis gives a ratio of 2.87 to 1 (REF. Chamber Quarterly, 2nd Quarter, 1996, Amarillo Chamber of Commerce).

2/09.08.04

* Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, and President Clinton's February 11, 1994 Memorandum for the Heads of all Departments and Agencies requires an analysis of environmental effects on low-income and minority populations to include human health, social, and economic effects.
  Why do the draft SWEIS, SSM PEIS, and S&D PEIS analyze only human health effects of the proposed actions and not the social and economic effects as required ?

3/09.12.08

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09 08 04 Comment Number 2

The number of indirect jobs generated by the Proposed Alternatives was based on the Regional Input-Output Modeling System (RIMS II) model developed by BEA. The multipliers used in the model are available for every economic region in the Nation (each of the DOE sites). This allowed a consistent method to be applied to all sites. Site-specific numbers should be used in site-specific EISs. Section 4.1.8 of the PEIS has been modified to clarify the utilization of the RIMS II model.

Projections of the number of indirect jobs generated depends on a number of factors, including the activity performed, the type of data used, and the methodology employed. The Storage and Disposition PEIS evaluates the socioeconomic impacts for the storage and disposition of fissile materials at Pantex, while the Stockpile Stewardship and Management PEIS evaluated the impacts of weapon assembly and disassembly operations. The activities of the two programs are quite different and each requires very different inputs for production. The availability of inputs within the region determines the size of the multiplier.

09 12 08 Comment Number 3

Socioeconomic impacts are analyzed in detail in all of the environmental statements noted by the commentor. The Storage and Disposition PEIS analyzes potential socioeconomic impacts for all of the Proposed Alternatives. For those alternatives that would add a new mission to a particular DOE site, there would be no adverse socioeconomic impacts. In fact, the analyses indicate that the impacts of these alternatives would be small but beneficial to the affected regional economies. There would be no environmental justice issues associated with these alternatives. For those alternatives involving phaseout of storage facilities, the job loss would be very small in all cases except RFETS. Even in the case of RFETS storage facility phaseout, the employment loss would have a minimal impact on the local communities and on the regional economy. Hence, there would be no environmental justice impacts from these alternatives.

* In the draft SWEIS (p. S-17) it is stated that at the 500 weapon activity level Pantex " would support 2,400 direct jobs and 3,949 secondary jobs" and that " personal income additions to the economy would be reduced to $365 million annually ?
-Please explain why this degree of economic loss would not only be an adverse but a Significant Adverse impact to the community.
- At the 500 weapon activity employment level what would be the impact to the revenues for the governing bodies within the Pantex ROI compared with the current revenues presented in Table 4.11.1.6-1 (p.4-165) ?

* In the draft SSM PEIS (I-4-450) please explain the statement
" The downsizing A/D and HE fabrication alternative would result in the addition of 280 workers at Pantex "
- If the statement is incorrect what would be the result ?

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ALLEY, CLYDE, AMARILLO, TX
PAGE 5 OF 5

WATER USAGE : PANTEX PLANT

* Plant used 230 million gallons in 1995.
  - Texas Tech Farms used 66 million gallons (29%) of the total plant water usage.
  - Nuclear weapons operations used 163 million gallons (71%).
* Amarillo Water District consumed 16 billion gallons in FY 1995.
* Pantex Plant including Texas Tech Farms used 1.4% as much water as Amarillo District.
* Nuclear weapons operations used 1% of the water used by Amarillo.
* Considering the water also used for irrigation, the Plant withdrew 0.6% of the regional withdrawal from the Ogellala aquifer.* Nuclear weapons operations consumed 0.43% of the regional withdrawal.
* Draft Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components, March 1996, page S-15.

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AMARILLO CHAMBER OF COMMERCE, AMARILLO, TX, TOM PATTERSON
PAGE 1 OF 1

AMARILLO
CHAMBER OF COMMERCE

April 24, 1996

Secretary Hazel O'Leary
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washiington, D.C. 20585

Re: Comments on Stockpile Stewardship and Management (SSM) PEIS and Fissile Materials Storage and Disposition (MD) PEIS

Dear Secretary O'Leary:

Under separate cover we are forwarding to your office two boxes of cards addressed to the U.S. Department of Energy, Office of Reconfiguration and the U.S. Department of Energy, Office of Fissile Materials, addressing the Stockpile Stewardship and Management (SSM) PEIS and Fissile Materials Storage and Disposition (MD) PEIS. These cards have been signed by over 6000 Amarillo residents, further emphasizing our continuing support for DOE functions in Amarillo. 1/08.03.01

Enclosed is a copy of the card indicating support for weapons assembly and dissembly, and continuation of the high explosives function at Pantex. We shall continue to look forward to opportunities for additional stewardship functions at Pantex.

We believe Amarillo to be a strong candidate for continuing storage and future material disposition operations. We believe the community is in perfect harmony with the Department, both believing that all functions in the future should be safe and environmentally sound. 1/08.03.01 cont.

We are grateful for the Department's consideration.

Yours very truly,

Tom Patterson
President & CEO

M-204

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Storage and Disposition of Weapons-Usable Fissile Materials Final PEIS

AMARILLO ECONOMIC DEVELOPMENT CORPORATION, AMARILLO, TX, BOB JUBA
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Amarillo Economic Development Corporation

April 6, 1998

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, DC 20026-3786

By facsimile to: 1-800/820-5158

RE: Comments and questions regarding the Storage and Disposition of Surplus Fissile Materials (S&D) Programmatic Environmental Impact Statement (PEIS)

Dear Sir or Madam:

Thank you for the chance to comment on this document that is of great importance to the Pantex Plant, and consequently to the economic vitality of the Texas panhandle.

I also appreciate DOE's commitment to operating in an environmentally sound fashion. The continuation of environmentally sound operating and management principles at Pantex supersedes and is paramount to all further comments about continuing or new missions at Pantex.

Pantex is ideally situated to continue the storage of surplus fissile materials. It makes sense logically and financially to store surplus fissile materials removed from weapons at the DOE's only assembly/disassembly site, Pantex. Further, Pantex has safely stored plutonium weapons components on-site on an interim basis since the facility began nuclear weapons operations in the early 1950s. Because it makes sense to store surplus fissile materials at Pantex, then the DOE should also consider Pantex as the preferred site for environmentally sound disposition options. 1/08.03.01

After having studied the Draft S&DPEIS documents, I offer the following comments(•) and questions(o) to the DOE for inclusion in the comment summary document:

- In the Summary (p.S-46), it is stated that, "When the other DOE programs previously identified in this section are considered, the rank order of DOE sites in terms of their descending potential for cumulative impacts changes to SRS, INEL, Pantex, NTS, Hanford and ORR." A similar statement appears on p. S-47. 2/09.00.08
  - o What does this statement mean? It is obscure and demands an explanation that is concise, clear, to the point, and supported by evidence.
- In the Summary, under the environmental impacts for the No Action and Long-Term Storage alternatives "adverse impacts" on Pantex water resources are 3/09.00.04

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F-012

08 03 01 Comment Number 1

The Department of Energy acknowledges the comment in support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 00 08 Comment Number 2

The Department of Energy did not intend to give the perception that the sites were ranked. The language in the cumulative impacts section of the Summary has been revised to better reflect the impact analysis in the Final PEIS. In addition, reference to "adverse" impacts has been deleted. Revisions made to the Final PEIS are reflected in the Summary.

09 00 04 Comment Number 3

Based on comments received, Section 4.2.4.4, *Water Resources*, was revised, as well as the Summary. There was no intention to "bury" impacts or to portray Pantex, the Pantex region, or the Texas Panhandle region in a negative fashion. Each DOE site was analyzed and studied in the same manner and presented in the PEIS accurately per these analyses and studies. Revisions made to the PEIS text are included in the Summary of the Final PEIS.

Office of Fissile Materials
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shown for all alternatives except the Phaseout alternative (pp.S-18 through S-21).

In Section "4.2.4.4 Water Resources," however, the following statement is made, "In regard to all of the above alternatives and related actions, the alternatives are not expected to have an adverse impact on water resources at Pantex." (p.4-192)

- If no adverse impacts are expected on the water resources in regard to "all alternatives and related actions," why do statements regarding "adverse impacts" to water resources at Pantex appear in the important Summary document?
- Why is the "no adverse impacts on water resources" statement "buried" in the second of three volumes instead of showing up in the Summary document under environmental impacts?

3/09.00.04 cont.

- In the Summary it is stated (p. S-21) that "Potential adverse impacts to waste management would occur at Pantex, ORR (all three options), and SRS, because the construction of sanitary, utility, and process wastewater treatment systems to treat nonhazardous liquid wastes may by required."
  - How can the construction of facilities and systems to treat waste have the potential to adversely impact the management of waste? Is this a significant environmental impact as intended by §1502.1 of the NEPA regulations?

4/09.11.08

- The Summary discusses three plutonium disposition categories (deep borehole, immobilization and reactor) consisting of nine alternatives, and ultimate high-level waste disposition.
  - If the immobilization alternatives and reactor alternatives (except CANDU) result in the same ultimate disposition, viz., a high-level waste (HLW) repository, what is the cost/benefit of the reactor alternatives?

5/07.02.00

  - Doesn't "HLW repository" mean the DOE's High-Level Nuclear Waste Repository at Yucca Mt., Nevada?

6/12.00.00

  - What would constitute ultimate disposition in the case of the CANDU reactor alternative? Would the Canadians be allowed to send the resultant high-level nuclear waste back to the U.S.?

7/12.00.00

- Volume I, Summary, Attachment A, Summary table indicates that for every alternative the impact at Pantex would be the same or less than the impact at other sites under consideration.

8/08.00.00

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09 11 08 Comment Number 4

The conceptual design for the consolidated and collocated storage facilities and the disposition facilities have, as part of their design, waste management facilities that would treat and package all waste generated in accordance with the *Resource Conservation and Recovery Act* (RCRA), and other applicable Federal and State statutes and DOE Orders. The impacts of having to construct the waste management facilities are captured in other resource areas such as land use and air quality. The text referring to "potential adverse impacts" to waste management has been deleted. The commentor is correct that the construction of waste management facilities will not adversely impact the management of waste.

07 02 00 Comment Number 5

A cost analysis for the alternatives was performed concerning those activities before final disposition in a geologic repository; this cost data, along with technical and schedule data, was provided in the Technical Summary Report for disposition in July and October 1996.

12 00 00 Comment Number 6

Not necessarily. "HLW repository" refers to a high-level waste geologic repository as envisioned under the *Nuclear Waste Policy Act* (NWPA). Although work is being done to characterize the Yucca Mountain site, no final decision regarding the suitability of Yucca Mountain has been made.

12 00 00 Comment Number 7

For the CANDU Reactor Alternative, no spent fuel would be returned to the United States. The material would become part of the Canadian spent fuel program.

08 00 00 Comment Number 8

At the time the Draft PEIS was published, DOE had not identified a Preferred Alternative. There were no preferred sites for any of the storage or disposition

AMARILLO ECONOMIC DEVELOPMENT CORPORATION,
AMARILLO, TX, BOB JUBA
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- What is the basis for news reports indicating that other sites are leading in the consideration for this mission? 8/08.00.00 cont.

- Under Phaseout (p.S-21) of the S&D PEIS, the following statement is made: "All of the regional economic areas surrounding the DOE sites would experience a loss in employment with phaseout. However, compared to total employment in these areas, the loss of jobs would have no or negligible impacts at all the DOE sites." 9/09.08.08
  - For which sites would the impact be negligible?
  - For which sites would the impact be significant?
  - What is the basis for determining the significance of the impacts?
  - How does the DOE plan to use this significance in their selection process?

- In the draft S&D PEIS, under Long-Term Storage Alternatives (p.S-48), it is stated that:

  Among the DOE sites under consideration, Pantex has the greatest potential to experience adverse cumulative impacts, particularly because of its relatively small, compact area. Water resources and biological resources would be vulnerable, and land resources, air quality, cultural resources, socioeconomics, ...public and occupational health and safety, waste management, intersite transportation, and environmental justice could be susceptible to adverse cumulative impacts." (A parallel statement follows on the same page as regards the Disposition Alternatives. There is no analysis presented to support this statement.) (Emphasis added.)

The draft SWEIS, however, presents conclusions on the cumulative impacts of the Proposed Action and the draft S&D PEIS collocation alternative - the bounding alternative used for the analysis. In some cases conclusions include draft WMPEIS impacts. Quotations are from Section 4.xx.5.1 if the draft SWEIS. Conclusions are:

Plant Facilities and Infrastructure

"...additional oil...would be required. ...would increase electrical consumption from 90,200 megawatthours per year to a maximum of 179,614 megawatthours per year. ...additional electrical lines would be needed." Draft WMPEIS impacts are included. (p.4-20)

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missions. A Preferred Alternative has been identified in the Final PEIS. The ROD will be based not only on environmental analyses, but also on technical, cost, national policy considerations, and public input.

09 08 08 Comment Number 9

With the exception of RFETS, the phaseout of existing storage facilities at DOE sites would involve, at most, the loss of 200 direct jobs (at Hanford and SRS). At Pantex, the phaseout would only affect five jobs, and at INEL no jobs would be lost. The impacts of these employment losses on the affected regional economies would be minimal. As stated in the PEIS, the regional economies in which the DOE sites are located are too large to be adversely affected by such a small decrease in employment at one site. Although the phaseout of storage facilities at RFETS would involve a greater number of workers, the impact on the regional economy would still be small since the plant is located near a large metropolitan area. The PEIS analyses (including analyses of socioeconomic impacts), as well as technical and cost studies, Nonproliferation Policy considerations, and public input will be considered by the decisionmaker in reaching the ROD.

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Land Resources

"...direct effects of land use would be negligible." (p.4-25)

Geology and Soils

"No ...effects on the geologic resources are anticipated. Soil impacts during operation are expected to be minimal." (p.4-54)

Water Resources

Water for "construction and operation would require 295 million gallons per year and 301 [million(?)] gallons per year, respectively. ...increase in wastewater generation ...would be 174,000 million gallons per year. ...no exceedance of...discharge limit. During operations, wastewater would be recycled, causing no impacts." Draft WMPEIS impacts are included. (p.4-85)

Air Quality

During construction, ambient "concentrations of all pollutants...would remain within...standards. During operation, concentrations...are predicted to be in compliance..." (p.4-117)

Acoustics

"Due to the size of the site, noise emissions from construction equipment would not be expected to cause annoyance to the public." (p.4-13)

Biotic Resources

"...would disturb 232 acres of habitat. Construction would adversely affect some animal populations." (p.4-145) [Note: "Cumulative impacts to terrestrial resources or threatened and endangered species would be minimal." (S&DPEIS p.4-860)]

Cultural Resources

"Impacts to prehistoric or historic resources are not anticipated." (p.4-153)

Socioeconomic Resources

"Construction and operation of new storage facilities would require 1.524 and 676 workers, respectively." (p.4-171)

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Intrasite Transportation - not addressed in the S&DPEIS

Waste Management

"...impact on...waste management activities by increasing the generation of TRU, LLW, LLMW, HW, and NHW." (p.4-203) [Note: "...the worst alternative in the WMPEIS may increase the need for additional treatment facilities. The consolidation of Pu storage with HEU storage...would increase the need for treatment and disposal facilities." (S&DPEIS p. 4-861)]

Human Health

"Normal operation of the new collocated storage facility...would result in impacts that are within applicable regulatory limits. The risks of adverse health effects to the public would be small." (p.4-239)

Aircraft Accidents

Any alternative "would reduce aircraft accident probability." (p.4-252)

Interste Transportation of Nuclear and Hazardous Materials

"...the potential fatalities would be .481" from transportation of Pu and HEU from storage sites to Pantex. (p.4-274) [Note: Total potential fatalities range from .293 to 1.080 at the six candidate sites; only ORR has a smaller impact than Pantex. A footnote states that the results are from radiological and nonradio-logical risk for the life of the project. (S&DPEIS p.4-778)]

Environmental Justice

"...if there were any health impacts...these impacts would not appear to disproportionately affect minority or low-income populations." (p.4-285)

The statements make it appear that it is DOE's intention to eliminate Pantex from consideration as a long-term storage site.

Please enumerate which cumulative impacts are potentially adverse and explain why you believe each is greatest at Pantex. In each case, please discuss the basis for the conclusion and whether you think the potential adverse cumulative impact is significant as a discriminator among sites. | 10/09.00.04

The socioeconomic analyses of the three EISs are not consistent. The SWEIS (p.S-17) assumes 1.65 indirect jobs in the region for every job at Pantex. The | 11/09.08.04

F-012

09 00 04 Comment Number 10

The Department of Energy did not intend to give the perception that the sites were ranked. The cumulative impact analysis in Section 4.7 of the PEIS does not attempt to rank the potential for cumulative impacts at the sites. The language in the Summary has been revised to better reflect the impact analysis in Section 4.7.

09 08 04 Comment Number 11

Projections of the number of indirect jobs generated depend on a number of factors, including the activity performed, the type of data used, and the methodology employed. The Storage and Disposition PEIS evaluates the socioeconomic impacts for the storage and disposition of fissile materials at Pantex, while the Stockpile Stewardship and Management PEIS evaluated the impacts of weapon assembly and disassembly operations. The activities of the two programs are quite different and each requires very different inputs. The availability of inputs within the region determines the size of the multiplier.

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SSMPEIS (p.S-32) assumes 1.16 and the S&DPEIS (p.4-205) assumes 3.51. 11/09.08.04 cont.

- Please explain these differences.

- The Amarillo Economic Development Commission (AEDC) analysis, based on local knowledge of the area and a regional impact study performed by Dr. Ray Perryman of Southern Methodist University, gives a ratio of 2.87 additional jobs in the region to every one Pantex job (for a total job multiplier of 3.87). 12/09.08.04

- Why didn't the DOE consult with the AEDC and/or the City of Amarillo and use the expert analysis that local taxpayers had already paid for?

- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, and President Clinton's February 11, 1994, Memorandum for the Heads of all Departments and Agencies requires an analysis of environmental effects on low-income and minority populations to include human health, social, and economic effects. 13/09.12.08

- Why do the draft SWEIS, SSMPEIS, and S&DPEISs analyze only human health effects of the proposed actions and not the social and economic effects, as required?

Thank you for your attention to these comments and questions.

Sincerely,

Bob Juba
Pantex Retention and Expansion Coordinator

cc: Hon. Mac Thornberry
Hon. Kel Seliger

F-012

09 08 04 Comment Number 12

The number of indirect jobs generated by the Proposed Alternatives was based on the RIMS II model developed by BEA. The multipliers used in the model are available for every economic region in the Nation (each of the DOE sites). This allowed a consistent method to be applied to all sites. Site-specific numbers should be used in site-specific EISs. Section 4.1.8 of the PEIS has been modified to clarify the utilization of the RIMS II model.

09 12 08 Comment Number 13

Socioeconomic impacts are analyzed in detail in all of the environmental statements noted by the commentor. The PEIS analyzes potential socioeconomic impacts for all of the alternatives. For those alternatives that would add a new mission to a particular DOE site, there would be no adverse socioeconomic impacts. In fact, the analyses indicate that the impacts of these alternatives would be small but beneficial to the affected regional economies. There would be no environmental justice issues associated with these alternatives.

AMARILLO ECONOMIC DEVELOPMENT CORPORATION, AMARILLO, TX, VANCE REED
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Mr. Vance Reed
President, Amarillo Economic Development Corporation

Comments on the Stockpile Stewardship & Management PEIS,
the Storage & Disposition of Fissile Materials PEIS, and
the Pantex Site-Wide EIS

Thank you for this opportunity to provide input to the Department of Energy regarding the operation of the Pantex plant. I would like to address two primary issues tonight regarding Pantex's future: 1) the environment, and 2) jobs.

Starting with the environment, I would like to reiterate this community's adament position that all work performed at Pantex continue to be done in a fashion that protects the environment. While the public has heard a great deal about "contamination" at Pantex, there has been little media attention given to the nature of pollution problems at Pantex. Most contaminants at Pantex are related to solvents and hydrocarbons that are very similar to those that would be found at practically any large manufacturing facility. This community is very reassured by the fact that Pantex has not had contamination problems from radioactive materials, such as occurred at Rocky Flats and Hanford.

The Amarillo Economic Development Corporation views Pantex in much the same manner as we view other large manufacturers in terms of presenting risks to the environment. For instance, if we were recruiting a computer chip manufacturer, we would realize that these plants have hazardous waste streams including arsenic and other heavy metals. The A.E.D.C. would only recruit a company that is committed to full compliance with E.P.A. and state environmental regulations. High tech businesses have created whole new industries and thousands of jobs, while working with very hazardous substances. This shows that protection of the environment and job creation can go hand-in-hand.

Likewise, we believe that Pantex can be a site where good, high-paying jobs are created in a work environment that includes potentially dangerous materials. When

TX-038

AMARILLO ECONOMIC DEVELOPMENT CORPORATION, AMARILLO, TX, VANCE REED
PAGE 2 OF 2

measured in terms of total payroll, Pantex is by far the area's largest employer. With 3,500 employees at the plant, a job multiplier of 3.67 shows that Pantex is responsible for a total of over 13,500 jobs in this region. This multiplier was established by Dr. Ray Perryman at Southern Methodist University. The multiplier reflects the fact that the money that Pantex brings into the local economy supports many retail, medical, educational, finance, insurance and real estate jobs. All told, employment related to Pantex represents over 12% of all jobs in the Amarillo metropolitan area. I urge the D.O.E. to correct the socio-economic impact portions of all three EIS documents to accurately reflect the impact of Pantex on our local economy. 1/09.08.04

Because of the importance of Pantex to our local economy, the A.E.D.C. is very pleased that Pantex has been chosen as the preferred site for continued assembly and disassembly functions. We also believe this decision is in the best economic interests of the nation, as it saves more than 1.5 Billion dollars to American taxpayers. I also urge the D.O.E. to continue the high explosive fabrication mission that is currently performed at Pantex. Again, this not only protects jobs in our region, it saves American taxpayers 50 Million dollars compared with the cost of moving these operations to New Mexico.

For Pantex's future, the D.O.E. should locate storage and disposition missions at Pantex, as long as they can be done in an environmentally safe fashion. I urge the Department to make use of the expertise of the Amarillo National Resource Center for Plutonium. This resource center, which is operated by the University of Texas System, the Texas A&M University System, and the Texas Tech University System, can provide world-class evaluation of disposition options. I believe the Amarillo area will prove to be an outstanding operating environment for those storage and disposition functions that have been fully scientifically evaluated and safely implemented. 2/08.03.01 3/15.00.00

Once again, thank you for the opportunity to address you in this workshop tonight.

TX-038

09 08 04 **Comment Number 1**

The number of indirect jobs generated by the Proposed Alternatives was derived using the RIMS II model developed by BEA. The multipliers used in the model are available for every economic region in the Nation (each of the DOE sites). This allowed a consistent method to be applied to all sites. Site-specific numbers should be used in site-specific EISs. Section 4.1.8 of the PEIS has been modified to clarify the utilization of the RIMS II model.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

15 00 00 **Comment Number 3**

Comment noted. The Amarillo National Research Center for Plutonium currently provides support to DOE for the Materials Disposition Program.

AMARILLO NATIONAL BANK, AMARILLO, TX, GARY MOLBERG
PAGE 1 OF 2

Amarillo National Bank

GARY MOLBERG
VICE PRESIDENT
and
MARKETING DIRECTOR

April, 3, 1996

U.S. Department of Energy
Office of Fissile Materials
PO Box 23786
Washington, DC 20026

RE: Comment on stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile materials Draft Programmatic Environmental Impact Statements (PEISs).

Thank you for the opportunity to comment on the U.S. Departments of Energy's (DOE) Programmatic Environmental Impact Statements (PEISs) on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials. Please also consider this my comment on the Pantex Site-Wide Draft Environmental Impact Statement, since most of the issues addressed in these documents are identical.

I strongly believe that any current and future functions at Pantex will be conducted in a safe and environmentally sound manner. Our first priority is to ensure any expansion at Pantex be implemented in a way that does not impair the health or safety of area residents or have an adverse affect on the environment. These goals serve as a prerequisite to any current or future activities at Pantex, including expansion. 1/09.00.04

I. Generally. I am pleased that the DOE selected Pantex as the preferred alternative for assembly and disassembly and has canceled all plans to transfer this to the Nevada Test Site (NTS). Pantex is the best site for maintaining the integrity of the U.S. Nuclear stockpile and attaining maximum efficiencies and cost savings.

II. Stockpile Stewardship and Management & Programmatic Environmental impact Statements

1.Pantex is the best place to site new construction/stewardship activities. Pantex is the most cost-effective for any new construction of SSM facilities. First, the labor costs, utility rates, and water and land availability at Pantex as well as political and public

M-012

09 00 04 **Comment Number 1**

Potential environmental consequences of each Pantex alternative were analyzed in the PEIS. Results of these environmental analyses will be given full weight, along with other factors such as cost, technical risk, schedule, and national security requirements, in the process of selecting the storage strategy and site and disposition strategy and technology for the Fissile Materials Disposition Program. Pantex will continue to operate in compliance with all Federal, State, and local regulations.

AMARILLO NATIONAL BANK, AMARILLO, TX,
GARY MOLBERG
PAGE 2 OF 2

support, are more amendable than those at any other Complex site. The location of additional defense-related activities at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost to the American people. In its deliberations, DOE should insist that budgetary comparisons between Pantex and the other sites are accurate, and include capital, transportation, training, remediation, and other costs.

2. Pantex is the best site to continue High Explosives fabrication. Consistent with the strengths listed above for increased stewardship and management duties, the high explosives (HE) functions should also remain at Pantex. It is only logical that if assembly/disassembly functions remain at Pantex then the HE fabrications should also be present at the corresponding site. Pantex must retain HE capabilities in order to process the inventories already on site for dismantling. T
ransferring of HE functions from Pantex will cost tax payers from $40 to $50 Million. It is also important to have HE facilities at weapons production/assembly site if there should ever be a need for new weapons production.

III. Fissile Materials (Plutonium) Storage and Disposition PEIS. Pantex has handled assembly and disassembly of nuclear weapons for more than 40 years and has done so in a safe and efficient manner. A challenge faced after dismantling a significant portion of nuclear stockpile is processing or disposal of the materials that remain. Pantex could continue to store plutonium which is already at the site and upgrade facilities for any and all storage options being considered by the DOE. This could all be done at minimal cost and difficulty. 2/08.03.01

IV. Conclusion. Based upon these reasons, I respectfully urge DOE to designate Pantex as the preferred alternative site for all existing and new stockpile management and stewardship functions as well as consolidation of all plutonium storage and disposition and any related functions. Thank you for the opportunity to comment on these documents.

Respectfully yours,

Gary Molberg

M-012

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

AMARILLO NATIONAL RESOURCE CENTER FOR PLUTONIUM, AMARILLO, TX, DALE E. KLEIN
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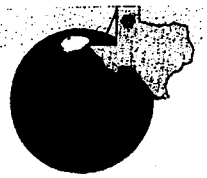

Amarillo National Resource Center for Plutonium

A Higher Education Consortium of The Texas A&M University System, Texas Tech University, and The University of Texas System

June 6, 1996

Department of Energy
Office of Fissile Materials Disposition
PO Box 23786
Washington, DC 20026-3786

The Amarillo National Resource Center for Plutonium's Senior Technical Review Group has reviewed portions of the Storage and Disposition of Weapons-Useable Fissile Materials Draft Programmatic Environmental Impact Statement. After careful and deliberate discussion, the Group agreed upon the enclosed comments, and we hereby formally submit them as part of the formal public comment period for the draft PEIS, which ends June 7, 1996.

We very much appreciate the opportunity for our Review Group to comment, and look forward to the Department's response.

Sincerely,

Dale E. Klein
Governing Board Chairman

Enclosure

600 South Tyler • Suite 800 • Mail Box 12098 • Amarillo, TX 79101 • 806-376-5533 • Fax 806-376-5561

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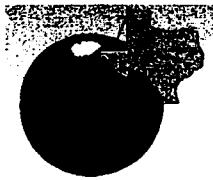

Amarillo National Resource Center for Plutonium

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Comments and Recommendations
Based on the PEIS Briefings
and
Reactor-Based Plutonium Disposition Options

Submitted By

Senior Technical Review Group
Amarillo National Resource Center for Plutonium

March 1996

600 South Tyler • Suite 800 • Mail Box 12008 • Amarillo, TX 79101 • 806-376-5533 • Fax 806-376-5561

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A Report of the
Senior Technical Review Group
March 1996

The Senior Technical Review group met on March 11 and 12, 1996, to review the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement, and to review the reactor-based plutonium disposition options.

The Group once again emphasized the urgency of both the U.S. and Russia moving forward with selecting and implementing plutonium disposition options.

Comments and recommendations based on the PEIS briefing:

The DOE representatives gave a reasonably detailed presentation on the draft PEIS on "Storage and Disposition of Weapons-Usable Fissile Materials." Based on this presentation and an examination of several parts of the Summary document, the Review Group has several concerns, indicated in the following comments.

The absence of significant discussion on safeguards and security in the presentation was striking. We understand this is a result of limitations on what is to be included in a PEIS. We further understand that the PEIS is only one of three "pathways" to the decision on storage and disposition of weapons materials, the other two being costs and proliferation issues. (This is clearly described on page S-1.) However we believe any public discussion of the PEIS should explicitly describe these three factors because the fundamental concerns relate to the safeguards and security aspects. 1/01.06.00

We are skeptical about the feasibility of the deep borehole concept, which has been included as a "reasonable" disposition option. Obtaining approval for a site will be difficult. Licensing the site for an approach never examined by EPA or NRC will be extremely time consuming. We realize that the deep borehole concept has some potential advantages, but we remain skeptical about being able to achieve these on a competitive timescale. Proceeding with this option is inconsistent with our previous recommendation to proceed with plutonium disposition on an urgent basis. In our judgement, this option should not be described as "reasonable" but, rather, as "not necessarily unreasonable". 2/04.04.00

We were surprised to find that electrometallurgical treatment continues as a "reasonable" option for immobilization. Previous presentations to the Review Group had indicated this approach was being dropped. We believe it should have been. 3/01.04.00

Some of the Review group believe that elimination from the PEIS of the European MOX fabrication/irradiation option is inappropriate and decidedly premature. Under NEPA, exclusion of this option from the PEIS will preclude further consideration. However, environmental impacts of this option are almost exclusively overseas and are therefore excluded from NEPA coverage. Thus, there is no environmental impact basis for excluding the option. The reason cited for elimination of this option is that European fabricators have expressed an unwillingness to fabricate U.S. plutonium for irradiation in European reactors primarily because of the fabricators' concern that this would have an adverse impact upon the market for reprocessing services, which they also offer. This objection, however, would not necessarily apply to a limited program of irradiating a few assemblies or even a few reloads. Moreover, commercial objections might be subject to reversal for policy reasons and because of future changes in the market. Indeed reactor grade MOX fabrication and irradiation already are licensed and commercially proven activities in Europe. NRC licensing of MOX might be achieved quickly, but there is no guarantee of this. This existing capability provides the potential for acceleration of the disposition process if the political and commercial problems, as well as transportation issues, can be resolved. Therefore some members 4/06.01.08

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01 06 00 **Comment Number 1**

The purpose of the Proposed Action is, in part, to establish the technical and program infrastructure that will enable the United States to take unilateral action or negotiate reciprocal actions with other nations for the disposition of surplus weapons-usable Pu. This PEIS addresses the environmental impacts of the reasonable alternatives for DOE's Proposed Action. Analyses of the cost, schedule, technical, and Nonproliferation Policy impacts are described in separate documents to support DOE's ROD. The technical, cost, and schedule documents were made available for public review beginning in July 1996. The nonproliferation analysis was made available to public beginning in October 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the analysis of the Nonproliferation Policy as it relates to the PEIS alternatives.

04 04 00 **Comment Number 2**

Comment noted.

01 04 00 **Comment Number 3**

The *National Environmental Policy Act* requires consideration of all reasonable alternatives. Although the Electrometallurgical Treatment Alternative for disposition of weapons-usable Pu is not as technically mature as other alternatives considered in the PEIS, it was considered to have sufficient maturity to be retained as an alternative in the Final PEIS. Further, the National Academy of Sciences (NAS) recognized this alternative, dependant upon successful demonstration. Section 2.4.4.3 of the Final PEIS has been modified to note recent conclusions from the National Research Council.

06 01 08 **Comment Number 4**

Comment noted. The basis for exclusion of the European MOX Fabrication/ Irradiation Option is included in the Screening Report. Section 2.1.4 of the PEIS provides further explanation on the exclusion of this alternative, due to a lack of capacity to complete the disposition mission, the institutional complexities such as transportation, security, and other geopolitical factors.

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of the Review Group believe that the European pathway to early implementation, particularly through initial demonstrations of the disposition process, should not be foreclosed at this time. 4/06.01.08 cont.

The Summary (page S-15) indicates the possibility of using LWRs both for the disposition of plutonium and for the production of tritium. We consider that, both from a policy and public perspective, these two requirements should be kept separate, and should not be accomplished in the same reactor or reactors. The Office of Fissile Material Disposition should be involved only in the various aspects of storage and disposition of plutonium and HEU, and not in the production of new weapons material. 5/11.00.08

Finally, the Review Group strongly objects to misleading presentations in the Summary, for example, of what are purportedly calculations of latent cancer fatalities in the public and the work force for various disposition options. While we have not reviewed the entire draft PEIS, the following comments, based upon review of the Summary, indicate our concerns: 6/16.00.00

(1) We were informed that it was assumed that new nuclear plants would not displace any existing operating units of any kind. This is an insupportable assumption. 7/06.04.08

(2) Figures S-14 through S-18, S-23, S-25, S-27 through S-31, and S-39 through S-44 are unclear in their comparison among existing LWRs, partially completed LWRs, and evolutionary LWRs. A reader easily could conclude that evolutionary LWRs will cause more latent cancer fatalities, emit more radiation and produce more radioactive waste than existing LWRs. Yet they have been designed to reduce both radioactive emissions and radioactive waste. We were informed that these descriptions were based on two requirements: (a) actual data were used for existing plants, but maximum allowable limits were used for unfinished or evolutionary plants; (b) no error bars or uncertainty limits were allowed to be used, leading the reader to conclude the graphs are accurate. Both requirements lead to highly misleading presentations, which are accentuated by not having an explanation in appendices A and B to put the calculations into perspective. We understand that the DOE Office of General Counsel ordered that no error bars be shown. The General Counsel should be asked to reconsider this order since it affects the determination of technical issues.

(3) The figures used to describe the impact of the proposed operations are misleading as they lack the perspective of existing baseline values and, in some instances, a time-frame. Also the scales on which the data are displayed exaggerate very small effects. For example: 8/01.00.00

a) Figures S-17 and S-18 are for the life of operation. They indicate that during this period the operation's radiological impact on cancer fatalities would be less than 3.5 or less than 6 additional cancer deaths among the resident and worker populations, respectively. However, they do not reflect the several million "spontaneous" (non-radiation related) cancer deaths that would be expected to occur among these populations during the same period. Nor do they indicate the bounds of the uncertainties around these estimates, thus the reader could conclude that the estimates are precise. However, both BEIR and NCRP have indicated that, at very low doses, zero effect is within the range of likelihood. Specifically the National Committee for Radiation Protection, in Report #121, 'Principles and Application of Collective Dose in Radiation Protection', recommends "When the collective dose is smaller than the reciprocal of the relevant risk coefficient, the risk assessment should note that the most likely number of excess cancer deaths is zero. This recommendation applies in this case, which the reader can only discover by reading the Appendices carefully."

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However the option is retained for the utilization of European MOX fabrication to fulfill short term MOX fuel needs as explained in Section 2.4.5.1 of the PEIS.

11 00 08 **Comment Number 5**

Comment noted.

16 00 00 **Comment Number 6**

Based on comments received, the Summary for the Draft PEIS was revised. Revisions made in the Final PEIS are reflected in the Summary.

06 04 08 **Comment Number 7**

If a new reactor was built, it would operate to provide electricity to a competitive marketplace. No displacement of existing capacity per se is envisioned but the market would be the arbiter of any displacement.

01 00 00 **Comment Number 8**

Based on public comments, the Summary of the Draft PEIS was revised. The Comparison of Alternatives charts (figures) were removed, and the text was expanded and revised. Chapter 4 of the PEIS has been revised to include an explanation of low doses. Chapter 4 has also been revised to reflect "total" impacts and wastes from operating existing LWRs using MOX fuel, as well as the "net" incremental impacts (that is, the difference in spent fuel between uranium-fueled and MOX-fueled operations).

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b) Figure S-22 is another example of deceptive graphics in which the graphics developed to describe risks misrepresent the impact of the proposed operations in that they do not include baseline values (levels). The reader will not realize that the chart shows additional low level waste generated by the alternatives. The several thousand times greater volume generated by evolutionary LWRs compared to existing LWRs is because the large volume generated by the existing LWRs is not included in the chart. Also, Figures S-4 through S-13 give no indication whether they represent total or additions to existing quantities or, for that matter, whether the numbers shown for different options have been calculated on the same basis. 8/01.00.00 cont.

We recommend that the figures be revised where applicable to reflect existing operations and the cancer death rate among the general, non-exposed population.

(4) In several parts of the text, it is stated that "the dose to the population living within 80 km (50 mi) of the site would be within 100 person-rem per year". However, the reader is not told whether this is acceptable or how it compares with other population doses, including those received from natural sources. 9/09.09.08

In summary, the Review Group is skeptical about some of the retained alternatives, disturbed about the misleading character of the Summary, and concerned about the lack of discussion of the major reason for the program, i.e., the safeguards and security (or proliferation) issue.

Comments on Reactor Disposition Options

The DOE Team presented the status of the efforts to evaluate the disposition option that would utilize LWRs or CANDUs. The STRG's comments on the review are as follows:

LWR OPTIONS

The team reported that the major technical focus in utilizing LWRs has been on full core loading of mixed U-Pu oxide (full MOX core), revealing some developmental issues primarily associated with relatively new applications of burnable absorbers. To avoid potential delays in resolving these technical issues and in licensing a newer technology, DOE has shifted its emphasis to evaluating partial (1/3) core loading of MOX fuel. 10/08.03.01

While disappointed that the DOE did not begin by focusing on the 1/3rd core option, the STRG endorses this shift and a strategy that would apply the partial MOX core in the initial stages of a disposition campaign, followed by full MOX core applications when the developmental problems are resolved. The STRG recommends that this strategy, including development work, be defined in detail, along with an implementation plan that reflects the urgency of starting a disposition option. The strategy and implementation plan should include the following characteristics: 11/07.00.00

(1) Proven technology for the initial applications:

-MOX fuel and reactor designs should be patterned on existing commercial MOX experience; European design and operational experience should be utilized fully. DOE should consider obtaining all such pertinent experience from the Europeans and make it available to U.S. utilities that have shown strong interest in the MOX disposition option. 12/06.02.08

-Changes in the number of control rods or the configuration of the reactor vessel head or internals should be barred from consideration for partial core loading.

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09 09 08 Comment Number 9

Proposed 10 CFR part 834 (see 58 FR 16268) would require an as low as reasonably achievable (ALARA) program and would generally limit the potential annual population dose to 100 person-roentgen equivalent man (rem)/year (yr) from all pathways combined for DOE activities. The radiation exposure to the public is limited by the maximum individual dose of 100 millirem (mrem)/yr. To compare the population dose from the Proposed Alternatives to the natural background radiation, the PEIS presented the percentage of the population dose for each alternative relative to the natural background radiation.

08 03 01 Comment Number 10

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input. The environmental analyses included in the PEIS and the technical cost and schedule analyses included in the Technical Summary Report addresses both full and partial MOX cores.

07 00 00 Comment Number 11

Generally, the goal is to complete disposition within 25 years after the ROD. The storage decision will be for long-term storage, up to 50 years. Schedule data, along with technical and cost data, were provided in Technical Summary Reports of both storage and disposition in late July 1996.

06 02 08 Comment Number 12

The reactor cores and the reactor vessel designs would be engineered when particular reactors are selected. Although significant modifications are not envisioned, precluding design and hardware changes to existing reactors need not occur. All necessary changes will be considered in costing the alternatives. In considering necessary reactor modifications all available information, including European experience as applicable, will be utilized.

-Pu metal conversion processes should be selected that will provide oxide with essentially the same characteristics as present commercially used MOX, (excepting the Pu isotopic distribution and possibly some gallium residue in the MOX fuel). | 13/03.02.08

-Existing facilities should be used wherever practical at each stage (conversion, fuel fabrication, and reactor operation). There is potential through this approach to reduce the time to start the disposition and the costs of the disposition process as well as to minimize the introduction of new facilities which will later have to be decommissioned. DOE should also take into account potential difficulties in documenting design basis and equipment qualifications for existing facilities. The STRG concurs with the DOE position to consider initially only those reactors that will not require license renewal or extension during the length of the disposition program. | 14/01.02.00

(2) Program Acceleration Planning

-The STRG is concerned that there is an insufficient sense of urgency in pursuing the disposition options. The new formulation of strategy and planning should place first priority on timeliness, given that the security and health & safety requirements are met. Cost is an important factor but should not be subjugated to timeliness. | 15/07.01.00

-Emphasis should be given to narrowing down the reactor burning options to permit greater focus. Seventeen sub options in this category were identified as still under evaluation.

-In-depth review of licensing issues should be sought with NRC on the several vendor partial MOX core designs, including the impact of the weapons Pu isotopic distribution.

-The STRG considers it important to demonstrate as soon as possible the adequacy of full scale MOX fuel assemblies derived from weapons grade Pu. Specifically:

(a) Since MOX fabrication appears to be on the critical path, strategies should be defined to accelerate the fabrication of such demonstration lead assemblies. European commercial facilities should be considered as well as experimental-level facilities in the U.S. National Laboratories. | 16/06.01.08

(b) Early demonstration of lead MOX fuel assembly irradiation in commercial reactors should be sought, including European reactors that are already licensed for MOX operation. Elimination of the Euratom MOX fabrication/reactor burning option should be reconsidered if elimination would preclude such early demonstrations. | 17/06.01.08

-The DOE team cited many political and commercial difficulties in utilizing western European capability for the reactor disposition option. Since there is high technical potential to start the process much sooner by that route, the political and commercial issues should continue to be addressed aggressively.

(3) Necessary R&D

-An effective R&D program should be mounted to evolve as rapidly as possible to the utilization of full MOX core so as to minimize the number of reactor sites and their auxiliary facilities and associated transportation and security requirements. | 18/06.01.08

-The R&D program will need to include in the development of MOX fuel fabrication facilities the impact of using new burnable absorbers as well as reactor design and fuel reliability issues related to new burnable absorber design features. | 19/06.01.08

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03 02 08 Comment Number 13

If a Reactor Alternative is chosen as part of the ROD for Pu disposition, the MOX fuel fabrication process would meet all the appropriate reactor fuel specifications. The feed material needed to fabricate MOX fuel, produced using pit and non-pit processing technologies, would meet the specifications of the MOX process.

01 02 00 Comment Number 14

Comment noted.

07 01 00 Comment Number 15

The Department of Energy recognizes the "sense of urgency" for timely disposition of surplus Pu. Accordingly, in the ROD for this PEIS, DOE will select a technology strategy for disposition with the goal to complete disposition within 25 years thereafter. Schedule data were provided in the Technical Summary Report in late July and October 1996; this information will be considered in the ROD. Furthermore, DOE will immediately begin preparation of tiered NEPA reviews to analyze specific locations and technology variants for disposition activities, and will begin disposition immediately following the tiered, location-specific decisions.

06 01 08 Comment Number 16

Fabrication and use of MOX fuel using reactor-grade Pu is a mature, industrial scale technology in Europe with at least three vendors actively fabricating MOX fuel. There are some differences introduced by the use of weapons-grade Pu, which DOE is addressing as part of an ongoing weapons-grade MOX fuel research and testing program.

06 01 08 Comment Number 17

The Department of Energy is moving forward with activities to test the fabrication of MOX fuel from weapons-usable Pu and its performance in LWRs and heavy water reactors.

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(4) Scope

-All criteria governing the disposition process should be included in the strategy and planning. Security and proliferation resistance should be treated explicitly, criteria that were not strongly treated during the DOE team presentations. | 14/01.02.00 cont.

-Arbitrary budget constraints, as distinct from defining a focused, cost effective plan, should not be imposed on the planning process. The appropriate full scope of the needed program should be defined, permitting a later, more intelligent application of budget restraints if necessary. | 20/07.00.00

CANDU OPTIONS

The DOE team reported that no technical difficulties had arisen in the full core MOX application, that the much shorter fuel pins could be more easily handled in the existing MOX fabrication facility (FMEF) at Hanford, and that political acceptance at this time in Canada was good although the new administration was reviewing the issue.

The small size of the CANDU assemblies raises questions as to the sufficiency of the radiation barrier to comply with the spent fuel standard. The proposed solution was to raise their proliferation resistance to the LWR spent fuel level by latching many assemblies together to increase the radiation level and make them more bulky. Effort is also underway to raise the Pu level in the design to try to achieve a fuel cost reduction of about a factor of two. | 21/06.05.08

The STRG comments on the LWR option also apply to the CANDU option where applicable. Further, the fact that CANDU reactors use on line refueling could result in some increase in proliferation risks. | 22/06.05.08

JOINT U.S./RUSSIAN STUDIES

The LWR disposition option is included in an overall study with the Russians of a broad array of disposition options. This effort is particularly important since it provides the potential for a "middle way" for Russian cooperation (quid pro quo) in the disposition process: between their present preference for the untimely and costly fast reactor disposition option and their complete rejection of weapons Pu direct disposal and immobilization options. This prospect is justification in itself for vigorous pursuit by the U.S. of the LWR disposition option. | 23/01.03.00

SPENT FUEL STANDARD

In defining the components of the spent fuel standard, isotopic denaturing should be included. Although the practical level of isotopic denaturing does not eliminate potential diversion for terrorist nuclear explosive use, it is a significant additional barrier to host nation re-use or rump nation military use. | 24/01.02.00

UTILITY COOPERATION IN THE MOX FUEL DISPOSITION PROCESS

The efforts to explore the interest of the utilities in assisting in the commercial LWR disposition option are important to achieving timely implementation of the option. There is concern, however, that the incorporation of a tritium production mission with the excess weapons Pu disposition mission will introduce complexity, delay, and increased public apprehension into the disposition mission. The STRG also expressed concern on reversing the long-standing U.S. policy of separating nuclear weapons production from nuclear electricity production. As indicated in the STRG comments on the draft PEIS, the Office of Fissile Material Disposition should be involved only in the various aspects of storage and disposition of weapons grade Pu and highly enriched U. | 25/11.01.08

F-049

06 01 08 **Comment Number 18**

The Department of Energy is considering the possible use of full MOX cores for the reactor disposition of surplus Pu. Uncertainties with the use of full MOX cores are being evaluated as part of the fuel qualification program.

06 01 08 **Comment Number 19**

Comment noted.

07 00 00 **Comment Number 20**

Comment noted.

06 05 08 **Comment Number 21**

The Canadian proposal is to fasten 24 fuel bundles into a module to increase the size, weight, and radiation level and achieve the same resistance to theft and diversion as LWR spent fuel. The online refueling will require additional efforts to safeguard the CANDU reactor, but is achievable (see *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Materials Storage and Plutonium Disposition Alternatives*, October 1996).

06 05 08 **Comment Number 22**

Although CANDU reactors require more intensive actions to safeguard than LWRs, International Atomic Energy Agency (IAEA) safeguards are already in place for CANDU reactors in Canada, irrespective of the Pu disposition mission.

01 03 00 **Comment Number 23**

Comment noted.

01 02 00 **Comment Number 24**

Isotopic denaturing is not considered a proven technology for Pu disposition and would take time for it to be proven. This would not meet the schedule and cost criteria for consideration as a reasonable alternative for implementation.

11 01 08 **Comment Number 25**

Comment noted.

AMERICAN FRIENDS SERVICE COMMITTEE, DENVER, CO, RALPH HUTCHISON
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6 May 1996

The Honorable Hazel O'Leary
United States Department of Energy
1000 Independence Avenue SW
Washington, DC 20085

Dear Secretary O'Leary:

In February of 1996, the Department of Energy (DOE) released the Draft Programmatic Environmental Impact Statement (PEIS) on the Storage and Disposition of Weapons -Usable Fissile Materials. We are gravely concerned that the document itself, as well as several aspects of DOE's approach to disposing of weapons-usable fissile materials, is substantially flawed. We have outlined our primary concerns below, and request that DOE provide another opportunity for public comment after these concerns are addressed in a revised Draft PEIS. 1/08.03.01

Disposing of surplus plutonium and highly-enriched uranium is one of the most urgent and significant international security matters of our time. The National Environmental Policy Act (NEPA) dictates that DOE present a credible and accurate discussion of reasonable alternatives in its review of this issue. Further, the potential consequences of an inappropriate decision compel DOE to demonstrate better than its normal quality of NEPA performance - ensuring particularly that the nonproliferation and cumulative impacts of its decision are soundly addressed. The current Draft PEIS meets neither of these standards. 2/01.00.00

The most glaring lapse is the continuing confusion between the objectives of fissile materials disposition and nuclear industry subsidization. For environmental, nonproliferation, economic, and other policy reasons, the proposed use of mixed oxide (MOX) fuel as a means of plutonium disposition should be flatly rejected as unreasonable. In the presence of other means to safely dispose of excess plutonium, there is no sound reason whatsoever for giving as much credence to a MOX alternative(s) as DOE does in the Draft PEIS. 3/01.02.00 4/08.03.01

The only apparent reason for continuing to emphasize the use of MOX fuel is pressure from people who stand to gain economically and/or politically from its selection. The Draft PEIS is woefully inadequate in its consideration of the nonproliferation and cumulative impacts of this alternative. A more thorough analysis of MOX use would raise significant concerns about, for example, its link to future reprocessing and long -term US policy regarding reliance on a plutonium fuel cycle. Any analysis of MOX fuel for plutonium disposition which does not thoroughly and explicitly evaluate such related matters is insufficient and should not be the basis for decisions. 5/06.01.08

In addition to these far reaching policy concerns, the Draft PEIS fails to adequately discuss safety issues associated with the use of MOX fuel. The Draft PEIS, for instance, does not adequately consider the high thermal power of MOX spent fuel and the related implications for the cost and safety of a high-level waste repository. This issue was raised by the National Academy of Sciences in its 1995 reactor options study for 6/09.09.08

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08 03 01 Comment Number 1

As noted in presentations at the public meetings, DOE welcomes public input throughout the decisionmaking process, which includes the formal NEPA comment periods, scoping, and reviewing the Draft PEIS, as well as during the period of time after issuance of the Final PEIS leading up to the ROD. DOE believes that the Draft PEIS was adequate for the purposes of soliciting public comments, and does not intend to issue another draft.

01 00 00 Comment Number 2

The Final PEIS has been revised to reflect comments received, including revisions to cumulative impacts in Section 4.7. Analyses of nonproliferation impacts are presented in a separate document, *Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives,* and will be considered in DOE's ROD. This document was available for public review in October 1996 and public meetings were held in October and November 1996 on this nonproliferation study.

01 02 00 Comment Number 3

The Department of Energy is complying with NEPA by analyzing a range of reasonable alternatives for implementation of the Proposed Action. Accomplishing nonproliferation and meeting the intent of the Spent Fuel Standard is not a subsidization of the nuclear industry. This can be achieved through any of three disposition categories; Reactors, Immobilization, or Deep Borehole.

08 03 01 Comment Number 4

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input. The NAS considered the use of the Reactor Alternatives using MOX fuel as a disposition option. This was further considered and confirmed in the Screening Report. Therefore, the Reactor Alternatives using MOX fuel are reasonable alternatives under NEPA, and accordingly the PEIS provided a complete analysis of the reactor alternatives.

AMERICAN FRIENDS SERVICE COMMITTEE, DENVER, CO,
RALPH HUTCHISON
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plutonium disposition. The Draft PEIS also inadequately addresses the potentially greater consequences of an accident in a reactor loaded with MOX fuel. | 6/09.09.08 cont.

The consideration of MOX fuel is not the only deficiency in the Draft PEIS. The document fails to consider all reasonable alternatives for the long-term storage of weapons-usable fissile materials, particularly plutonium pits. The Pantex Site-Wide Environmental Impact Statement acknowledges that interim storage of pits at Department of Defense (DOD) facilities, specifically at Kirtland Air Force Base's Manzano Weapons Storage Area, is a reasonable alternative. Accordingly, the DOD is a cooperating agency in that Pantex EIS. The Draft PEIS rejects this alternative for long-term storage without adequate explanation. Among the potential advantages of using an existing facility which should be better evaluated in the PEIS are cost savings from avoiding new construction and faster implementation. | 7/01.05.00

Further, the Draft PEIS fails to consider alternatives for plutonium storage containers. Only one container is analyzed despite the fact that this container is not yet certified and is admittedly not appropriate for storage of plutonium in all the variety of forms in which it currently resides throughout the complex. A range of adequate containers and storage conditions should be examined in order to ensure that plutonium stabilization and storage can be done safely. | 8/02.00.08

The Draft PEIS should also more fully consider activities associated with the processing and interim storage of plutonium and highly enriched uranium that will be required to transition this material from its current status at various sites around the complex to the preferred form(s) for long-term storage. The draft PEIS seems to presume that such processing and repackaging receives comprehensive NEPA coverage in some other document(s). That is not the case. Instead, existing NEPA documents considering interim stabilization and storage are incomplete. All related issues have not been addressed separately and certainly not comprehensively. Moreover, there are numerous outstanding safety concerns (e.g., seismic safety at the Savannah River Site reprocessing canyons) which raise questions about the adequacy of those NEPA documents which have been completed. | 9/11.01.08

Finally, the Draft PEIS contains no cost estimates and no detailed design information on buildings and facilities. Such information is necessary to identify reasonable alternatives and evaluate their environmental impacts. But that information will not be available to the public until some time after the comment period. Such information is essential to the public discussion and should be made available for public review and comment. | 10/08.00.00

These concerns make clear that the Department has much work to do before it can produce an adequate Draft PEIS on the storage and disposition of weapons-usable fissile materials. The public should expect no less that a fully sufficient NEPA analysis for this very important issue.

In conclusion, we want to emphasize that completing an adequate Draft PEIS should not be an excuse for failure to take appropriate action in several areas of disposition policy. Construction of a pilot vitrification plant to demonstrate the safe stabilization of plutonium residues, for example, would not foreclose any options considered in the PEIS. Moving forward with a pilot vitrification plant will instead signal the Department's resolve to safeguard plutonium rather than to stockpile it, as well as to address some existing environmental, health, and safety issues. Moving forward will also provide additional information about the details of immobilization of plutonium in glass - information that would be useful in preparing an adequate PEIS. | 11/15.00.00

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06 01 08 **Comment Number 5**

Comment noted. The President's Nonproliferation Policy says that the United States will not recycle Pu. Burning weapons Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel. This would not be a subsidization of the nuclear industry. As noted in response to Comment Number 2, DOE has prepared both cost and nonproliferation analyses for public review; in the ROD, DOE will consider the cost and nonproliferation information along with environmental analyses, schedule and technical analyses, and public comments.

09 09 08 **Comment Number 6**

The human health and safety impacts from normal operations and facility accidents for all three Reactor Alternatives, existing LWRs, partially completed LWRs, and evolutionary LWRs using MOX fuel are evaluated and documented in the Final PEIS. Appendix H, *High-Level Waste Forms Comparative Analysis*, provides an analysis of the thermal and radiation conditions of the waste form's performance in the repository.

01 05 00 **Comment Number 7**

Combined storage of pits and non-pit Pu at the Manzano WSA was originally eliminated as a reasonable alternative in the Draft PEIS. After considering separate storage of pits from non-pit Pu, the option to store these pits at the Manzano WSA no longer appears unreasonable. The Manzano WSA was evaluated in the Pantex EIS and Section 2.1.3 of the Final PEIS. The Final PEIS was revised to clarify the consideration of the Manzano WSA for combined storage, and a description of the WSA was included in Appendix P.

02 00 08 **Comment Number 8**

The PEIS assumes that all surplus Pu at Hanford, INEL, Pantex, SRS, RFETS, and LANL has been transformed to a stable form that meets the DOE *Standard Criteria for Safe Storage of Pu Metals, and Oxides* (DOE-STD-

AMERICAN FRIENDS SERVICE COMMITTEE, DENVER, CO, RALPH HUTCHISON
PAGE 3 OF 4

If you have questions or would like to further discuss our concerns, please contact either Ralph Hutchison at (423) 483-8202 or Brian Costner at (803) 256-7298. We appreciate your attention to our concerns and look forward to hearing from you soon.

Sincerely,

Ralph Hutchison

Ralph Hutchison, on behalf of:

American Friends Service Committee, Denver, CO
Citizen Alert, Las Vegas, NV
Concerned Citizens for Nuclear Safety, Santa Fe, NM
Economists Allied for Arms Reduction, New York, NY
Energy Research Foundation, Columbia, SC
Environmental Defense Institute, Troy, ID
Institute for Energy and Environmental Research, Takoma Park, MD
Nashville Peace Action, Nashville, TN
Native Americans for a Clean Environment, Tahlequah, OK
Oak Ridge Environmental Peace Alliance, Oak Ridge, TN
Panhandle Area Neighbors and Landowners, Panhandle, TX
Peace Farm, Amarillo, TX
Physicians for Social Responsibility, Washington, DC
Rocky Mountain Peace Center, Boulder, CO
Serious Texans Against Nuclear Dumping, Amarillo, TX
Snake River Alliance, Pocatello, ID
Southwest Research and Information Center, Albuquerque, NM
Tri-Valley CAREs, Livermore, CA
Western States Legal Foundation, Oakland, CA

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3013-94) for materials greater than 50-percent Pu or the *Criteria for Interim Safe Storage of Pu-Bearing Solid Materials* (draft in preparation by DOE) for material with less than 50-percent Pu. Stabilization of the material and the impacts are not within the scope of this PEIS, but have or will be analyzed in other NEPA documents, as appropriate. The material would be stored in containers consistent with the transportation of the materials on or to the site. Containers analyzed for storage of pits include the FL container (currently certified) and the AT-400A (currently under review for certification). Material would not be moved and stored in the AT-400A container without proper certification. Other containers were analyzed for the transportation of other Pu materials (for example, the BUSS R-1 cask for cesium (Cs) and the MO-1 for MOX fuel). Appendix G, "Intersite Transportation," provides the analysis of the containers used for transportation and storage for Pu and HEU.

11 01 08 **Comment Number 9**

The Department of Energy has an ongoing materials stabilization program under the Office of Environmental Management (EM), to stabilize, process, and package various materials including weapons-usable fissile materials. The NEPA coverage for stabilization of the weapons-usable fissile materials is beyond the scope of this PEIS. Appropriate NEPA documents have or will be prepared, as necessary, for the stabilization of various materials, including weapons-usable fissile materials, under DOE's Materials Stabilization Program. This PEIS analysis begins at the point that the surplus weapons-usable fissile materials are in a form suitable for storage or disposition.

08 00 00 **Comment Number 10**

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in late July 1996. Final Summary Reports reflecting public input were made available to the public in October and November 1996. Results of the nonproliferation analysis were made available in October 1996. Each of these analyses, along with the environmental analysis and public input, will be integrated into the DOE's decisionmaking process.

15 00 00 **Comment Number 11**

Comment noted. DOE will include pilot and demonstration projects, as appropriate, in moving toward implementation of the disposition technologies.

AMERICAN NUCLEAR SOCIETY, JAMES DEWES PAGE 1 OF 1

AMERICAN NUCLEAR SOCIETY - SAVANNAH RIVER SECTION STATEMENT REGARDING STORAGE AND DISPOSITION OF WEAPONS-USEABLE FISSILE MATERIALS DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

My name is John Dewes and I am Vice Chairman of the Savannah River Section of the American Nuclear Society. Our local section consists of some 800 scientists and engineers in the Central Savannah River Area. On behalf of the Section, I would like to make a statement concerning the Storage and Disposition of Weapons-Useable Fissile Materials Draft Programmatic Environmental Impact Statement.

We believe that all of the long term storage options are acceptable from the standpoint of environmental, safety and health. We also believe that any of the Long Term Storage sites proposed have sufficient infrastructure to handle the engineering & design of such a facility. 1/08.03.01

We strongly support the recommendations contained in the American Nuclear Society Special Panel Report on the Protection and Management of Plutonium[1], a Panel chaired by Glen T. Seaborg, who discovered Plutonium almost 60 years ago. This report recommended implementation of the reactor irradiation option for disposal of surplus weapons-useable plutonium.

The stated goal of the PEIS is to make surplus plutonium inaccessible and unattractive for use as nuclear weapons. We believe that the reactor irradiation option has several advantages over the other options in meeting this goal. It is the only option that converts weapons grade plutonium to reactor grade plutonium. This is a crucial point, because our weapons testing history indicates that, although possible, it is extremely difficult to build a successful nuclear weapon from reactor grade plutonium, and that the infrastructure required to either build a successful weapon or to purify the plutonium to weapons grade presents a tremendous barrier to diversion. The reactor irradiation option is also the quickest way to reach the goal of the Spent Fuel Standard for protection from misuse. 2/08.03.01

Jill Lytle, Deputy Assistant Secretary, in her prepared comments for the Citizens Advisory Board Plutonium Forum, indicated that she wanted a "sustainable decision", one which considers the issue in light of other decisions under review and one that garners long term public support. The decision should therefore reflect the long term need to protect the public from diversion of the materials in question. The French have recognized this issue, and are currently taking advantage of the long term protection associated with the use of mixed oxide fuel for their civilian stockpiles of plutonium.

We believe that if the mission of the DOE is to ensure a stable energy supply for our country's needs, then the energy value of the plutonium, estimated at 32 billion dollars, should be considered when selecting the preferred alternative. Plutonium is not a waste - it is the closest thing to a peace dividend our country will ever see. We also believe that the DOE needs to pay attention to scientific facts related to plutonium rather than irresponsible and irrational statements made concerning its toxicity and potential impact on the population. 3/08.03.00 4/01.00.00

We strongly urge you to select the reactor irradiation option as the most beneficial and effective method for dispositioning of weapons-useable fissile material. Thank you for the opportunity to provide comment on this important issue. 2/08.03.01 cont.

[1] Protection and Management of Plutonium, American Nuclear Society Special Panel Report, Glen T. Seaborg, August 1995.

SR-005

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for long-term storage of fissile materials. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 00 Comment Number 3

Comment noted.

01 00 00 Comment Number 4

Comment noted.

AMERICAN NUCLEAR SOCIETY PAST-PRESIDENTS COUNCIL, A. DAVID ROSSIN
PAGE 1 OF 7

A LETTER TO THE SECRETARY OF ENERGY WITH COMMENTS ON THE DRAFT PEIS ON STORAGE AND DISPOSITION OF WEAPONS-USABLE MATERIALS FROM THE ANS PAST-PRESIDENTS COUNCIL

April 28, 1996

Hon. Hazel O'Leary, Secretary
U. S. Dept. of Energy
1000 Independence Ave. SW
Washington, DC 20585

Attention: Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
Washington, DC 20026-3786

By Fax: 800-820-5156

Dear Secretary O'Leary,

On August 10, 1995, the ANS Past Presidents Council submitted a letter regarding the Plutonium Disposition PEIS which analyzes alternatives for DOE future action. Among other things, our letter warned that, by implication, the PEIS could be used to claim that an open process had been used to eliminate reprocessing from all future nuclear fuel cycle decisions.

According to DOE, the IP says that this is not the case, and that the PEIS does not apply to commercial nuclear fuel cycles. However, we believe that some persons will choose to try to use this EIS to try to establish such prohibitions. Since irradiated MOX fuel is no different from any commercial reactor spent fuel (and some of us have participated in the irradiation of MOX fuel assemblies in licensed commercial reactors in the U. S.) any decision on future reprocessing of spent fuel, regardless of whether plutonium atoms in it came from excess weapons material or not, has no place in this EIS. And therefore any decisions about processes to be used for disposition of excess weapons material cannot have any bearing on future decisions by the United States about reprocessing of any commercial spent fuel. 1/01.02.00

Our letter asked that this be made clear. DOE's response (Letter from Greg Rudy, Acting director, Office of Fissile Materials Disposition to John Graham, President ANS, Sept. 8, 1995 - copy attached) says:

"... any subsequent reprocessing and extraction of plutonium from that spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of this report."

M-077

01 02 00 Comment Number 1

The Department of Energy noted the comment requesting a statement in the Summary making it clear that future reprocessing decisions are beyond the scope of this PEIS. A clarifying statement was included in the Summary of the Final PEIS.

AMERICAN NUCLEAR SOCIETY PAST-PRESIDENTS COUNCIL,
A. DAVID ROSSIN
PAGE 2 OF 7

We fully agree. We expected to find this statement explicitly made in the PEIS. We have not found it. It belongs in the "SCOPE OF THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT" section on Page S-4 of the SUMMARY of the EIS draft dated February 1996.

We have not found this statement in the PEIS, although we must admit that, in light of the volume of the report, we might have missed it. In any event, it belongs in a very visible place in the SUMMARY. We believe that failure to include this statement in a visible place in the SUMMARY may result in misreading and abuse of the document. This was one of the key points of our earlier comments.

We see no reason why this statement, a statement made very explicitly in Mr. Rudy's letter, should not be clearly made. We are counting on you to see that this is done. 1/01.02.00 cont.

It may sound like an item of limited interest at this time. We do not believe this to be the case. In any event, we do not feel that the Department has any reason for anything less than a full and complete response to our request.

Should the Department fell differently, we urge you to contact us at once.

If the Final EIS is published without clarifying this issue, in a manner as clear as we have suggested above, a clear basis will exist for a court challenge to the EIS, which a court might find would require a reprinting and redistributing of the entire EIS. This would be a waste of Federal funds which we would be disappointed to see.

We thank you for your attention to this matter.

Sincerely,

A. David Rossin for

The American Nuclear Society Past-Presidents Council

(Signatures appear on the last page of the enclosed letter dated August 10, 1995.)

M-077

Department of Energy
Washington, DC 20585

September 8, 1995

Mr. John Graham
President
American Nuclear Society
555 North Kensington Avenue
La Grange Park, IL 60526

Dear Mr. Graham:

Thank you for your letter to Secretary O'Leary dated August 10, 1995, and its enclosed letter from past presidents of the American Nuclear Society (ANS) regarding the Implementation Plan for the Department's Programmatic Environmental Impact Statement (PEIS) on surplus plutonium disposition. I have been asked to respond to your letter because, as the Acting Director of the Office of Fissile Materials Disposition, I am responsible for the PEIS.

In their letter, the past ANS presidents raise the concern that "the implementation plan systematically eliminates from debate every option that involves any future possibility of reprocessing of spent nuclear fuel." The letter requests that the pros and cons of spent fuel reprocessing be discussed in the PEIS.

The specific purpose of the Department's PEIS effort is to evaluate alternatives for the disposition of surplus weapons-usable plutonium that would render the plutonium as inaccessible and unattractive for reuse in nuclear weapons as the much larger and growing quantity of plutonium that exists in spent nuclear fuel from commercial power reactors. This condition is referred to as the "Spent Fuel Standard." As noted in the PEIS Implementation Plan, the use of plutonium as mixed oxide fuel in reactors is being evaluated as one of the potential disposition options. If an alternative using mixed oxide fuel in reactors were to be selected, the surplus plutonium would eventually be contained in spent fuel and, by definition, the "Spent Fuel Standard" would be achieved.

While the PEIS will discuss the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of plutonium from that spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort. The fact that the PEIS will evaluate disposition of surplus weapons plutonium through use in mixed oxide fuel, but will not further evaluate reprocessing of the spent fuel, will not foreclose policy or technology options, nor will it prejudice future decisions regarding the management or disposition of the spent fuel.

I hope this response has helped to better explain the Department's perspective and our intended path forward for the PEIS on the disposition of surplus weapons plutonium.

Sincerely,

Greg Rudy
Acting Director
Office of Fissile Materials Disposition

Printed with soy ink on recycled paper

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AMERICAN NUCLEAR SOCIETY PAST-PRESIDENTS COUNCIL, A. DAVID ROSSIN
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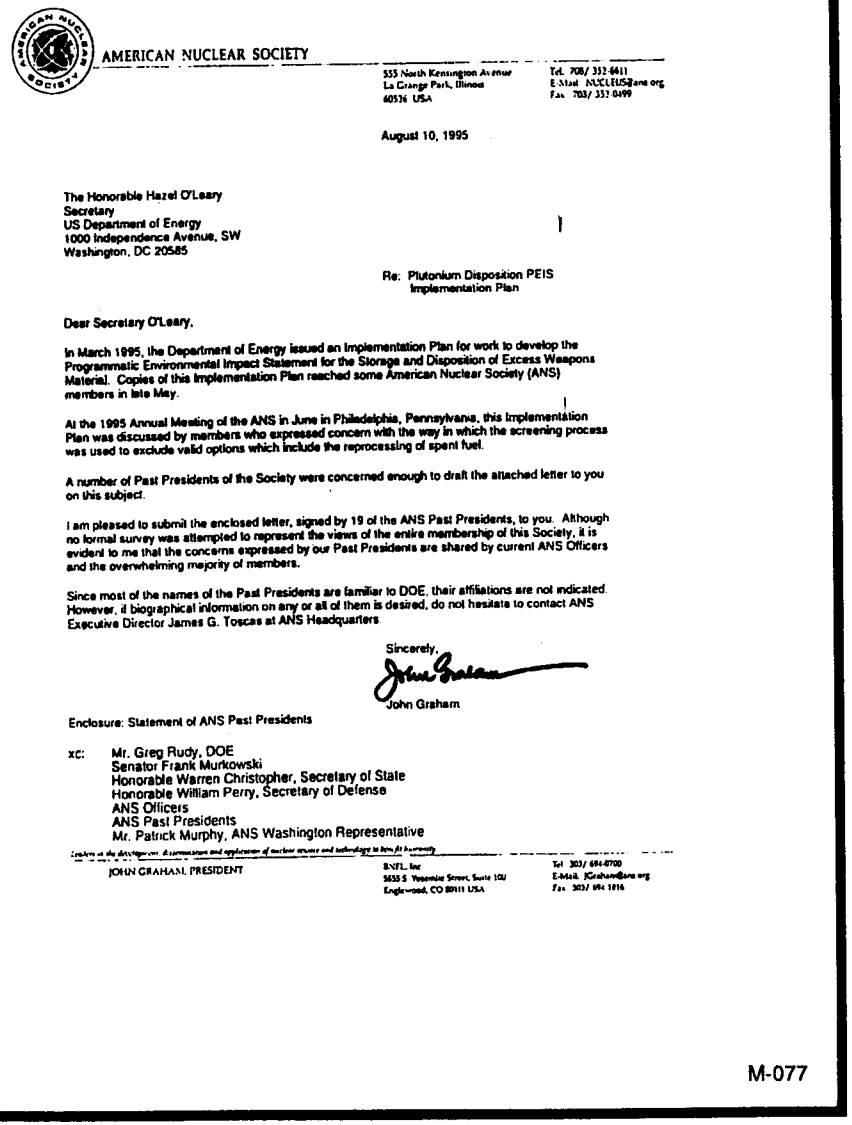

AMERICAN NUCLEAR SOCIETY

555 North Kensington Avenue
La Grange Park, Illinois
60526 USA

Tel. 708/ 352-6611
E-Mail NUCLEUS@ans.org
Fax 703/ 352-0499

August 10, 1995

The Honorable Hazel O'Leary
Secretary
US Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Re: Plutonium Disposition PEIS
Implementation Plan

Dear Secretary O'Leary,

In March 1995, the Department of Energy issued an Implementation Plan for work to develop the Programmatic Environmental Impact Statement for the Storage and Disposition of Excess Weapons Material. Copies of this Implementation Plan reached some American Nuclear Society (ANS) members in late May.

At the 1995 Annual Meeting of the ANS in June in Philadelphia, Pennsylvania, this Implementation Plan was discussed by members who expressed concern with the way in which the screening process was used to exclude valid options which include the reprocessing of spent fuel.

A number of Past Presidents of the Society were concerned enough to draft the attached letter to you on this subject.

I am pleased to submit the enclosed letter, signed by 19 of the ANS Past Presidents, to you. Although no formal survey was attempted to represent the views of the entire membership of this Society, it is evident to me that the concerns expressed by our Past Presidents are shared by current ANS Officers and the overwhelming majority of members.

Since most of the names of the Past Presidents are familiar to DOE, their affiliations are not indicated. However, if biographical information on any or all of them is desired, do not hesitate to contact ANS Executive Director James G. Toscas at ANS Headquarters.

Sincerely,

John Graham

John Graham

Enclosure: Statement of ANS Past Presidents

xc: Mr. Greg Rudy, DOE
Senator Frank Murkowski
Honorable Warren Christopher, Secretary of State
Honorable William Perry, Secretary of Defense
ANS Officers
ANS Past Presidents
Mr. Patrick Murphy, ANS Washington Representative

Leaders in the development, dissemination and application of nuclear science and technology to benefit humanity

JOHN GRAHAM, PRESIDENT

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AMERICAN NUCLEAR SOCIETY PAST-PRESIDENTS COUNCIL, A. DAVID ROSSIN
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AMERICAN NUCLEAR SOCIETY

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August 10, 1995

The Honorable Hazel O'Leary
Secretary
US Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Re Plutonium Disposition PEIS
Implementation Plan

Dear Secretary O'Leary.

We have reviewed the Plutonium Disposition PEIS Implementation Plan (IP) dated March 1995. We realize that this effort has been in progress for almost two years and that work on the PEIS has already proceeded based on this plan. However, we respectfully request that this plan be withdrawn and a new Implementation Plan be developed which would meet the minimum requirements for preparation of a Programmatic Environmental Impact Statement on the Long-Term Storage and Disposition of Weapons-Usable Fissile Materials (PEIS). This Implementation Plan does not do so. We will explain why below.

This IP systematically eliminates from debate every option that involves any future possibility of reprocessing of spent nuclear fuel. In so doing, it eliminates the opportunity for the public even to hear about options that may be shown to be highly desirable from non-proliferation, waste management, environmental, and long term economic points of view. The reasons offered could, if allowed to stand, be applied blindly in the future decision-making on nuclear power fuel cycles. This risk, we believe, would be both serious and improper.

We recognize that there are people who believe the opposite, but the analyses that have been presented to support their views have not been convincing. In any case, there is no valid reason to prevent those arguments, pro and con, from being fairly and openly aired in this PEIS. In fact, based on the history of the Environmental Policy Act, analysis of real options would be required.

Although disclaimers are offered to say that the PEIS refers only to excess weapons material, DOE has chosen to call all separated plutonium, regardless of isotopic composition "weapons usable." By implication, the PEIS could be used to claim that an open process had been used to eliminate reprocessing from all future nuclear fuel cycle decisions. The IP says that this is not the case, and that the PEIS does not apply to commercial fuel cycles. But the reasons for these systematic exclusions are in themselves weak. Not considering these options in the PEIS could well give the public a seriously incomplete picture.

The options that would allow reprocessing have been eliminated from discussion by the use of "screening criteria." Many persons, including some of us, provided input during the comment period at public meetings and in writing about the danger of using screening criteria to silence debate on real alternatives. Despite our comments, DOE has decided to preclude a full and fair consideration of alternatives.

M-077

AMERICAN NUCLEAR SOCIETY PAST-PRESIDENTS COUNCIL,
A. DAVID ROSSIN
PAGE 6 OF 7

August 10, 1995 Page 2

We are all very familiar with the EIS process. We all recall decisions that went as high as the Supreme Court with regard to what had to be included in an EIS in order to make it a valid part of the process. With this in mind, we offer the following for your consideration:

1. One cannot legally screen out a particular process on the grounds of "lack of technical maturity" when it is or has been in actual operation, and in some cases is in full commercial operation.

2. One cannot legally screen out a particular process on the basis of "theft/diversion" when processes (actually based on technology developed in the US) are in commercial operation in two countries with fully adequate and demonstrated resistance to theft and diversion.

3. One cannot legally screen out an option on the basis of a so-called "policy" of prohibiting reprocessing when such a Presidential policy has not been subjected to public debate, when it has been applied for five years, then rescinded for 12 years, and then stated again in late 1993 as a reality rather than a national policy. Such a so-called policy itself cries out for open public discussion.

Considering DOE's policy of openness that you have declared, the tactic of disallowing technologically viable options by screening them out of a programmatic environmental assessment in advance, without a sound and compelling basis, should be repugnant to you.

Each of us has agreed to be available to you and your staff to discuss this matter. However, we urge you to act promptly to withdraw this IP. In its present form, we find it hard to imagine that either it, or more importantly a PEIS based on it, would survive a court test, in light of the extensive legal history that has been developed over the past 25 years.

Sincerely,

Past Presidents of the American Nuclear Society
(signatures appear on the following page)

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AMERICAN NUCLEAR SOCIETY PAST-PRESIDENTS COUNCIL,
A. DAVID ROSSIN
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SIGNED BY THESE MEMBERS OF THE ANS PAST-PRESIDENTS COUNCIL:

Manson Benedict — Dr. Manson Benedict
Vincent S. Boyer — Mr. Vincent S. Boyer
Karl Cohen — Dr. Karl P. Cohen
Ed Fuller — Mr. Ed Fuller
Joseph M. Hendrie — Dr. Joseph M. Hendrie
William R. Kimel — Dr. William R. Kimel
Harry Lawroski — Dr. Harry Lawroski
Milt Levenson — Mr. Milton Levenson
Miles C. Leverett — Dr. Miles C. Leverett
James R. Lilienthal — Mr. James R. Lilienthal
Walter B. Loewenstein — Dr. Walter B. Loewenstein
Robert L. Long — Dr. Robert L. Long
M. Jack Ohanian — Dr. M. Jack Ohanian
A. David Rossin — Dr. A. David Rossin
Chauncey Starr — Dr. Chauncey Starr
Ronald C. Stinson — Mr. Ronald C. Stinson
Alan Walter — Dr. Alan Waltar
Alvin M. Weinberg — Dr. Alvin M. Weinberg
Bertram Wolfe — Dr Bertram Wolfe

M-077

AMERICAN NUCLEAR SOCIETY, IDAHO FALLS, ID, JOHN COMMANDER

PAGE 1 OF 1

IANS Statement Re: Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement

My name is John Commander. I am Vice-Chair of the Idaho Section of the American Nuclear Society, and represent some 900 members located predominately in Southeast Idaho. On behalf of the section, I would like to make a statement concerning the Storage and Disposition of Weapons Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

We believe that all of the long term storage options are acceptable from the standpoint of safety and environmental impact; however' the option for the Collocation of the Plutonium and Highly Enriched Uranium receives our support as the most favorable alternative. We also believe that any of the Long Term Storage sites proposed could be designed to be acceptable. 1/08.03.01

We believe that the Plutonium Disposition Alternatives which involve disposal with out utilization as fuel for use in reactors are unacceptable. We support the recommendations contained in the ANS Special Report on the Protection and Management of Plutonium (Special Panel Report, Glen T. Seaborg August 1995). This report recommended implementation of the reactor irradiation option for disposal of surplus weopons-usable plutonium. 2/08.03.01

The Special Panel Report also recommended continuation of development work on reprocessing and breeder (Integral Fast Reactor) as a promising approach to proliferation-resistant fuel cycle. We strongly support this recommendation also. 3/14.00.00

Sincerely,
John Commander

170 Fieldstream Lane
Idaho Falls, ID. 83404

ID-004

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Collocation Alternative. Decisions on storage alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

14 00 00 **Comment Number 3**

During the screening of alternatives for inclusion in the PEIS, a Reactor-Burning concept was evaluated involving a variation of the Integral Fast Reactor concept. However, this concept, which would use a reactor fuel cycle design still requiring development, would be more costly and require a longer timeframe than other mature reactor options. The development program was terminated by the Administration and Congressional action. Since Pu disposition can be accomplished using existing technologies, this advanced technology for Pu disposition is less reasonable than other Reactor Alternatives for Pu disposition.

AMERICAN NUCLEAR SOCIETY

Position Paper Abstract - Disposition of Plutonium

Short-Term: Surplus Weapons Plutonium

1. We strongly support conversion of all plutonium released from weapons stocks to a form in which it is protected from theft or seizure by intense radioactivity (the "spent fuel standard"). Place immediate emphasis on protecting stocks as securely as when they were active weapons. We urge that higher priority and attention be devoted to assuring that this standard is being met. — 1/01.02.00

2. We recommend prompt implementation of the reactor irradiation option for disposition of surplus U.S. and Russian weapons plutonium, employing available reactors in the United States and Russia, or in third countries. — 2/06.00.09

3. The time schedule for both initiation and completion of conversion should be shortened. — 3/07.01.00

4. All released plutonium in the United States and Russia should be placed under international safeguards as early as possible.

Longer-Term: Civil Plutonium

5. Energy demand, especially for electric power, is increasing steadily in the developing countries. We cannot and should not wish these countries to forgo the benefits of abundant energy that the industrial world has enjoyed for so long. — 4/01.03.00

6. The use of nuclear energy will take place primarily in industrialized countries, making fossil fuel resources more accesible and affordable for use in the developing world.

7. Current proven reserves of reasonably priced uranium are insufficient to support a long-term, major contribution of nuclear energy to meeting world energy demand. Breeder reactors can overcome this limitation.

8. The issue of the proper level and structure of development on the breeder and other advanced reactor systems calls for further assessment. We urge that this be undertaken. — 5/14.00.00

9. The recent U.S. decision to stop all development work on reprocessing and the breeder should be reversed.

10. The development of permanent waste repositories is essential, since these will be needed for either spent fuel or fission product waste disposal. — 6/12.01.00

11. We see no need for international uniformity in selection of fuel cycle options. — 4/01.03.00 cont.

12. The IAEA should place increased emphasis on containment and surveillance and other nonaccountancy safeguards measures. — 7/13.00.00

13. The IAEA should be called on to review the adequacy of national measures for protection of nuclear materials against subnational threats.

14. It is essential that the IAEA be assured of the financial, technical and manpower resources and the political support necessary to carry out its increasingly vital tasks. — 4/01.03.00 cont.

WA-021

01 02 00 **Comment Number 1**

Comment noted.

06 00 09 **Comment Number 2**

Comment noted. However, disposition of foreign weapons-usable materials is beyond the scope of this PEIS.

07 01 00 **Comment Number 3**

Comment noted.

01 03 00 **Comment Number 4**

Comment noted.

14 00 00 **Comment Number 5**

Liquid metal breeder reactors were not considered reasonable alternatives for Pu disposition in the PEIS since more time and greater cost would be incurred to complete construction than with LWRs.

While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, there would not be any subsequent reprocessing and extraction of Pu from that spent fuel. The U.S. policy concerning reprocessing is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort.

The President's Nonproliferation Policy says the United States will not recycle Pu. Burning weapons Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel.

12 01 00 **Comment Number 6**

Comment noted. Site characterization is currently being performed for a geologic repository in accordance with the NWPA, and further environmental analyses will be performed as necessary.

13 00 00 **Comment Number 7**

Comment noted. The emphasis that IAEA places on various safeguards measures is not a part of this environmental analysis. IAEA inspectability is considered in the technical and nonproliferation analysis and will be integrated into DOE's decisionmaking process.

3819 Devonshire Avenue
Kalamazoo MI 49006-2703
Friday, 31 May 1996

J. David Nulton, Director
NEPA Compliance & Outreach
U.S. Department of Energy
Office of Fissile Materials Disposition, MD-4
Forrestal Building
1000 Independence Ave., S.W.
Washington, D.C. 20585

Dear Mr. Nulton,

The following comments are in response to the draft Programmatic Environmental Impact Statement on the Storage and Disposition of Weapons-Usable Fissile Materials:

At the present time, the No Action Alternative appears to be the logical and reasonable choice. As is pointed out in the PEIS, the No Action Alternative would have no or negligible adverse impacts to land resources, site infrastructure, air quality, and geology and soils at all of the DOE sites under consideration. 1/08.03.01

Other alternatives, especially in this time of existing federal budgetary problems, involve large expenditures of money and energy resources for the construction of new facilities (e.g. a vitrification facility, or a ceramic immobilization facility, or a MOX fuel fabrication facility) or the deep borehole concept. Also, all of the other alternatives involve excessive intersite transportation of nuclear materials between the source and the processing facilities and the final destination.

Although permission has apparently not been granted by the Canadian government, transportation of the MOX fuel to the Ontario Hydro Nuclear Bruce-A Generating Station in Ontario appears to be a poor idea. As is pointed out in the draft PEIS: "Potential adverse intersite transportation impacts related to the transportation of MOX fuel could occur because of the increased risk of traffic accident fatalities." 2/08.03.01

Obviously, there is no perfect answer to the horrendous problem of dealing with this nuclear fissile material. We have created this problem without ever having given serious consideration to that day in the future when we would need to make some effort to face the reality of disposing of this weapons-usable fissile material with the minimal adverse affect on the people and the environment.

Sincerely,

Amy Louise Anderson

Amy Louise Anderson

M-252

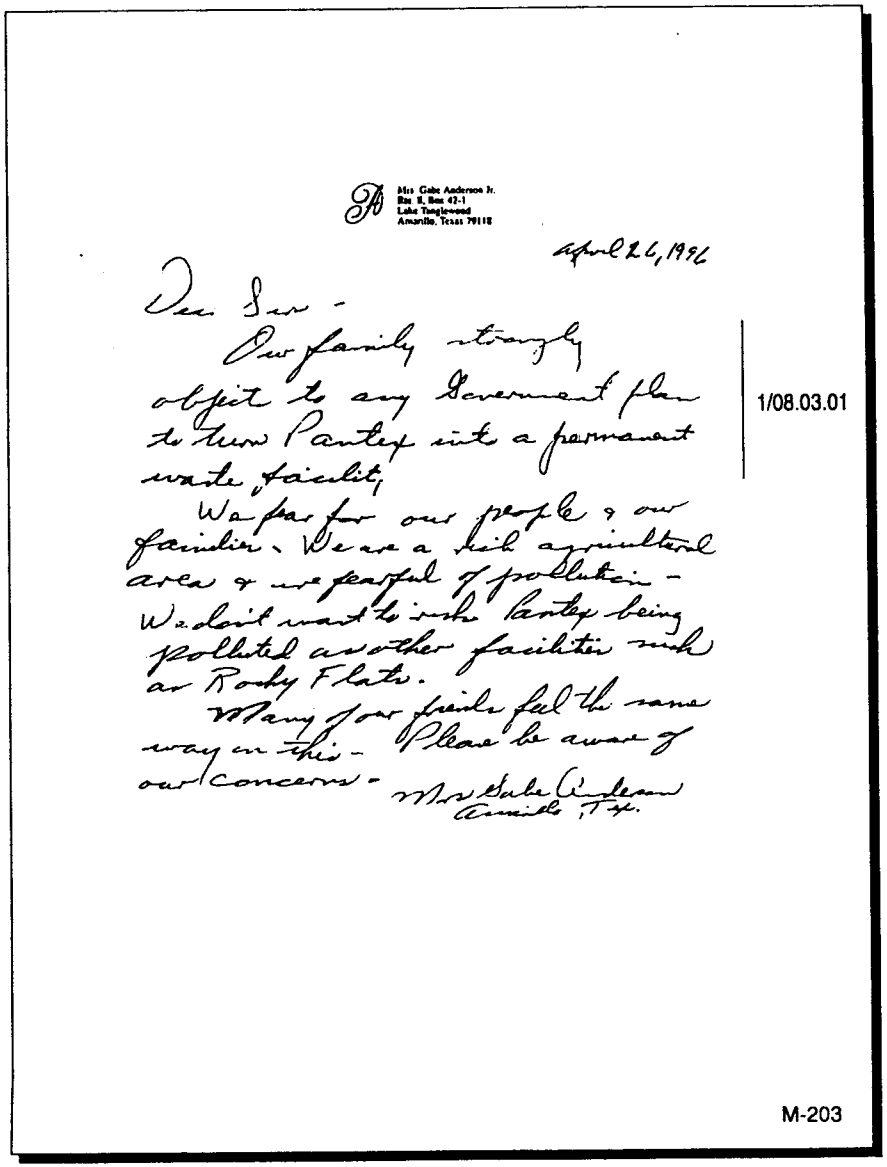
08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the No Action Alternative for long-term storage and disposition of fissile materials. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. This will include an appropriate level of analysis concerning the CANDU Reactor Alternative. In addition, according to the Canadian Government, implementation of the CANDU Reactor Alternative would be subject to Canadian Federal and Provincial policies and regulations and require health, safety, and environmental assessments before issuance of a Canadian license. (See the letter from the Canadian Embassy in Washington, DC, dated June 6, 1996, reproduced in this CRD.)

ANDERSON, MRS. GABE, JR., AMARILLO, TX
PAGE 1 OF 1



Mrs Gabe Anderson Jr.
Rte 8, Box 42-1
Lake Tanglewood
Amarillo, Texas 79118

April 26, 1996

Dear Sir -

Our family strongly object to any Government plan to turn Pantex into a permanent waste facility.

We fear for our people & our families. We are a rich agricultural area & we fearful of pollution - We don't want to see Pantex being polluted as other facilities such as Rocky Flats.

Many of our friends feel the same way on this - Please be aware of our concerns -

Mrs Gabe Anderson
Amarillo, Tx.

1/08.03.01

M-203

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

3819 Devonshire Avenue
Kalamazoo MI 49006-2703
Friday, 31 May 1996

J. David Nulton, Director
NEPA Compliance & Outreach
U.S. Department of Energy
Office of Fissile Materials Disposition, MD-4
Forrestal Building
1000 Independence Ave., S.W.
Washington, D.C. 20585

Dear Mr. Nulton,

The following comments are in response to the draft Programmatic Environmental Impact Statement on the Storage and Disposition of Weapons-Usable Fissile Materials:

At the present time, the No Action Alternative appears to be the logical and reasonable choice. As is pointed out in the PEIS, the No Action Alternative would have no or negligible adverse impacts to land resources, site infrastructure, air quality, and geology and soils at all of the DOE sites under consideration. 1/08.03.01

Other alternatives, especially in this time of existing federal budgetary problems, involve large expenditures of money and energy resources for the construction of new facilities (e.g. a vitrification facility, or a ceramic immobilization facility, or a MOX fuel fabrication facility) or the deep borehole concept. Also, all of the other alternatives involve excessive intersite transportation of nuclear materials between the source and the processing facilities and the final destination.

Although permission has apparently not been granted by the Canadian government, transportation of the MOX fuel to the Ontario Hydro Nuclear Bruce-A Generating Station in Ontario appears to be a poor idea. As is pointed out in the draft PEIS: "Potential adverse intersite transportation impacts related to the transportation of MOX fuel could occur because of the increased risk of traffic accident fatalities." 2/08.03.01

Obviously, there is no perfect answer to the horrendous problem of dealing with this nuclear fissile material. We have created this problem without ever having given serious consideration to that day in the future when we would need to make some effort to face the reality of disposing of this weapons-usable fissile material with the minimal adverse affect on the people and the environment.

Sincerely,

Robert C. Anderson

Robert C. Anderson

M-253

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the No Action Alternative for long-term storage and disposition of weapons-usable fissile materials. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. This will include an appropriate level of analysis concerning the CANDU Reactor Alternative. In addition, according to the Canadian Government, implementation of the CANDU Reactor Alternative would be subject to Canadian Federal and Provincial policies and regulations and require health, safety, and environmental assessments before issuance of a Canadian license. (See the letter from the Canadian Embassy in Washington, DC, dated June 6, 1996, reproduced in this CRD.)

APPALACHIAN PROPERTIES,
NATHAN COGGINS
PAGE 1 OF 1

APPALACHIAN PROPERTIES
(615) 753-9500
(615) 753-8773 fax

ATTENTION: DOE

FROM: Nathan Coggins

DATE: 3/11/96

# of pages: 1

please call if total transmission was not recieved

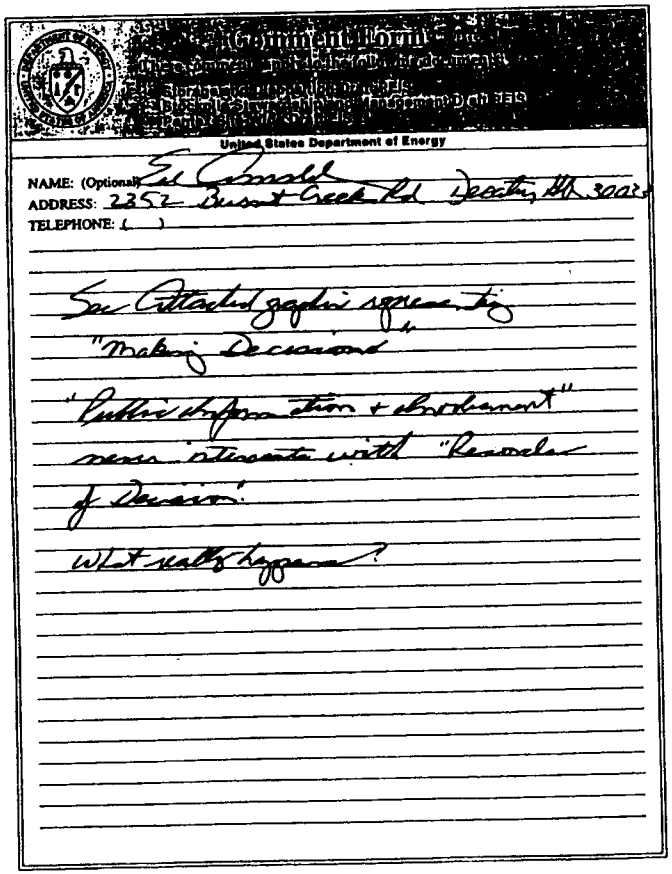
Dear Doe:
You may wish to consider a work shop or a field office near the blending sites. We live near Erwin and would like to attend and have input as to the safty of our community. 1/15.00.00

Thank you

F-002

15 00 00 **Comment Number 1**

Blending is not within the scope of the PEIS.


Comment Form
United States Department of Energy
NAME: (Optional) Ed Arnold
ADDRESS: 2352 Burnt Creek Rd Decatur, GA 30032
TELEPHONE: ( )
See Attached graphic supporting
"Making Decisions"
"Public Information + Involvement"
needs integrated with "Remainder
of Decision"
What really happened?

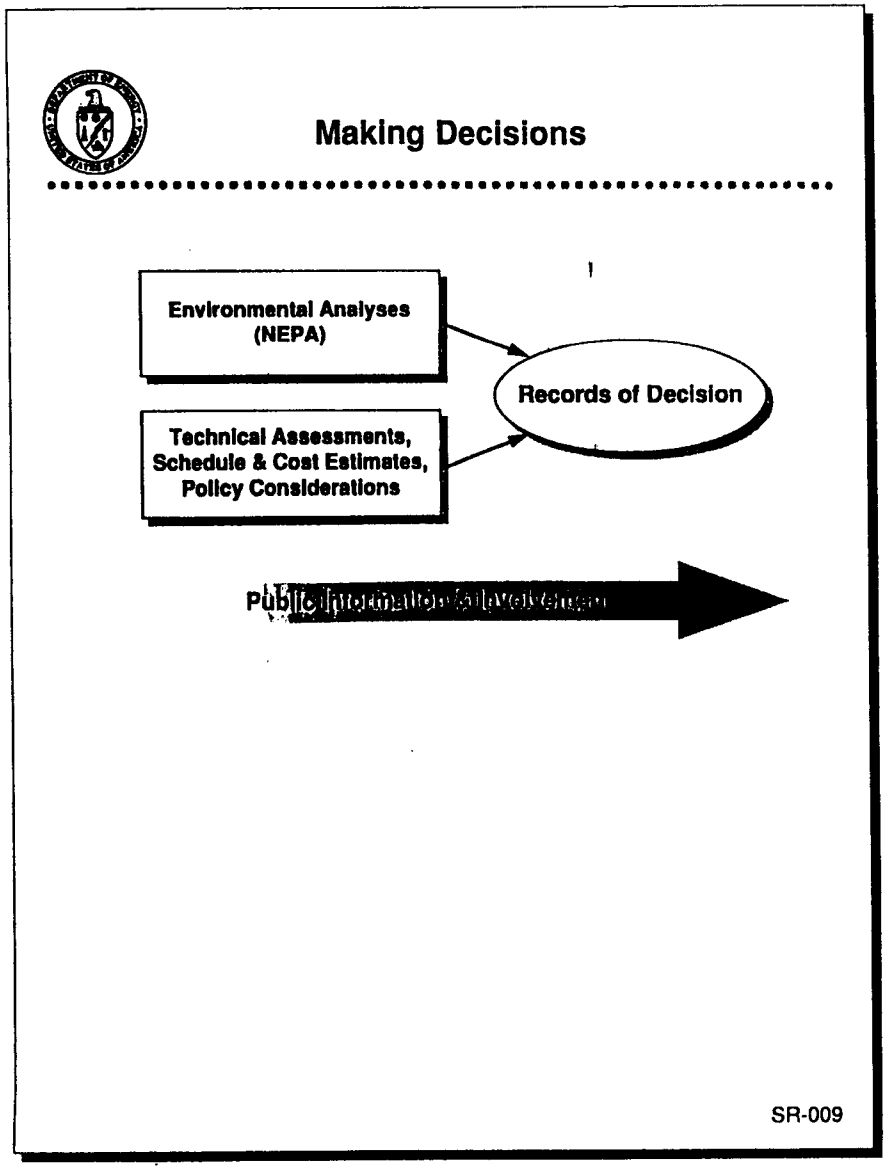
1/08.03.00

SR-009

08 03 00 **Comment Number 1**

Public information and involvement intersect with the ROD since all public comments on the Draft PEIS are available to the decisionmaker at the time the decision is made.

ARNOLD, ED, DECATUR, GA
PAGE 2 OF 2



ARNOLD, MARVIN, AMARILLO, TX
PAGE 1 OF 1

U.S. Department of Energy
Office of Reconfiguration
P O Box 3417
Alexandria, VA 22302

U.S. Department of Energy
Office of Fissile Materials
P O Box 23786
Washington, DC 20026

Comments on Stockpile Stewardship and Management (SSM) PEIS: I support the selection of Pantex for weapons assembly and disassembly functions. I strongly favor the continuation of high explosives functions at Pantex, and oppose any plan to move these functions to the national labs. Since Pantex is the most cost-effective DOE facility and enjoys the strongest local support, I also support the addition of other environmentally sound stewardship and management functions at Pantex.

Comments on Fissile Materials Storage and Disposition (MD) PEIS: I believe that Pantex should be chosen as the location for fissile materials storage and disposition functions. Pantex already stores surplus plutonium, and has the needed safety and security capabilities to cost-effectively accommodate an expanded role. Fair budgetary comparisons, strong local support, and national security concerns, should lead DOE to choose Pantex for new fissile material storage and disposition functions that are conducted in a safe and environmentally sound fashion.

1/08.03.01

Name: Marvin Arnold Address Amarillo TX

PC-003

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

B. R. BARFIELD CO. INC., AMARILLO, TX,
B. R. BARFIELD
PAGE 1 OF 1

THE **B. R. BARFIELD** CO.
INCORPORATED
P O Box 9510 Amarillo, Texas 79105 (806) 376 5588

April 10, 1996

U. S. Department of Energy
Office of Reconfiguration
P. O. Box 3417
Alexandria, Virginia 22302

U. S. Department of Energy
Office of Fissile Materials
P. O. Box 23786
Washington, DC 20026

Over one hundred years ago, my great-grandparents came to Amarillo. My grandfather was the first president of the Amarillo Board of Trade (predecessor of the Amarillo Chamber of Commerce) in 1906, my father was on the board of the Chamber in the 1936, and I served as president of the organization in 1961. With deep roots and a large investment in Amarillo, involvement and a strong interest in community affairs has always been a commitment.

I respectfully urge DOE to designate Pantex as the preferred alternative for all existing and new stockpile management and stewardship functions as well as consolidation of all plutonium storage and disposition and any related functions. 1/08.03.01

Sincerely yours,

B. R. Barfield

Continuing a Tradition of Service Since 1889

M-038

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

BNFL, INC., WASHINGTON, DC,
MARILYN F. MEIGS
PAGE 1 OF 11

BNFL Inc.

BNFL Inc.
1776 Eye Street, N.W. Suite 750
Washington, D.C. 20006-3700
Tel (202) 785-2635
Fax (202) 785-4037

May 6, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

Ref: Draft PEIS in Storage and Disposition of Excess Weapons-Usable Fissile Materials

Dear Sirs:

On behalf of BNFL, I am pleased to submit the attached comments and documents in reference to the Department's Draft Programmatic Environmental Impact Statement on Storage and Disposition of Excess Weapons-Usable Fissile Materials.

In addition to the enclosed information, BNFL would be willing to provide additional material in support of the final PEIS if the Department requests such information, and if the information is already in the public domain. BNFL has over 30 years experience in the stabilization, storage, handling, and transport of plutonium products, and in the manufacture of mixed oxide fuel. That experience, and the environmental impacts of those activities, are well documented and would be relevant to the Department's present undertaking.

I thank you for the opportunity to provide input to this very important process.

Yours truly,

Marilyn F. Meigs

Marilyn F. Meigs
Vice President

M-218

BNFL, INC., WASHINGTON, DC,
MARILYN F. MEIGS
PAGE 2 OF 11

Attachments:

1. BNFL Statement for the Record
2. Basis for Economics and Waste Data
3. "Disposition of Weapons Plutonium: Reuse or Vitrify?", M. Meigs, USCEA Fuel Cycle Conference, Boston, March, 1994.
4. "Licensing of the Sellafield MOX Plant", A.J. Tilstone and R.J. Page, BNFL plc.
5. "Environmental Statement for the Proposed Sellafield MOX Plant", BNFL plc, October, 1993.
6. "Effective Nuclear Materials Control and Accountancy for Commercial Mixed Oxide Fuel Fabrications Plants in the Untied Kingdom", B.A. Burrows and D. S. Macphee, BNFL plc, and G. P. Snape, AEA Technology, IAEA-SM-333/12.
7. "MOX Technology - An Effective Way to Reduce Plutonium Stockpiles", D.S. Macphee, B.C. Hexter, and M.P. Young, March, 1996.

M-218

BNFL, INC., WASHINGTON, DC,
MARILYN F. MEIGS
PAGE 3 OF 11

BNFL Statement for the Record
on draft PEIS,
Storage and Disposition of US Excess Weapons Plutonium

- As a world leader in the handling, treating, processing, storing, and transporting of commercial-grade plutonium products, including Mixed Oxide (MOX) fuel, BNFL is pleased to provide input into the DOE draft PEIS on Storage and Disposition of Excess Weapons-Grade Pu.

- With respect to either storage or final disposition of excess weapons plutonium, it is in the US best interests to utilize existing, proven technologies, where available, instead of embarking on long, uncertain, and oftentimes wasteful pursuits of alternatives that might look good in theory, but may never prove out in practice.

- Thus, with respect to storage of plutonium, whether consolidated or not, DOE could avoid costly delays by utilizing designs that are already in use in Western Europe and approved by the appropriate regulatory bodies and by the International Atomic Energy Agency. In view of the urgency of providing safe packaging and storage of these plutonium materials, as identified by the Defense Nuclear Facility Safety Board's recommendations in 94-1, the US cannot afford to waste time and money "reinventing the wheel", and is better off pursuing a cookie-cutter approach in this instance. 1/01.01.00

- With respect to disposition of plutonium, BNFL has engineering, manufacturing, safety, licensing, and environmental experience in MOX fuel fabrication and handling that is directly applicable to the draft PEIS. For the record, some of this documentation is offered to DOE at this time, including design and safety cases for the BNFL Sellafield MOX plant, licensing experience, and BNFL's nuclear materials control and accountancy approach. BNFL is willing to make available any other non-proprietary data that would be useful to the finalization of the PEIS document and other DOE documents that will provide the basis for a Record of Decision on Pu disposition 2/01.02.00

- While US experience in the manufacture and use of MOX fuel was prematurely terminated in the 70's, experience in Western Europe has continued to mature over the last 30 years to the point where, today, it is a fully developed and deployed industry that the US can look to with confidence for information and assistance in the deployment of a similar MOX program in the US for once-through burning of excess weapons plutonium. 3/06.01.01

- In contrast, very little is known about the immobilization of plutonium in glass or ceramic, let alone the impact of the deep borehole burial option, and therefore one has to assume great uncertainties, requiring extensive research and development, with little assurance of success. 4/08.03.01

M-218

01 01 00 **Comment Number 1**

Comment noted.

01 02 00 **Comment Number 2**

Comment noted. DOE appreciates the useful information provided.

06 01 01 **Comment Number 3**

Comment noted.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's opposition to the disposition alternatives. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

BNFL, INC., WASHINGTON, DC,
MARILYN F. MEIGS
PAGE 4 OF 11

- Even if immobilization technologies were fully understood and the environmental and cost impacts were similar to that of MOX use, one cannot complete the comparison of options without including the huge energy and environmental "offset" values of the MOX option, which I will summarize here (see attached background information on these calculations):

  Energy Value. Assuming that all 38 MT of excess weapons-grade Pu were manufactured into MOX fuel, this would give rise to new fuel worth 1.6 - 2.1 Billion dollars, and would produce approximately 45 GW years of electricity worth approximately $32 billion in revenues! 5/09.00.08

  Waste generated. Since MOX fuel displaces uranium fuel that would otherwise have to be obtained by mining, milling, and enriching uranium, one has to consider the wastes that the vitrification option would generate because of the need for new uranium fuel. Thus, vitrifying 38 MT of Pu would not only generate additional repository waste volumes in the form of approximately 320 cu. meters of extra HLW glass, the vitrification of this Pu would result in 5.3 million additional cu. meters of mill tailings and 3900 cu. meters of enrichment tails caused by the mining of uranium to displace the plutonium as new reactor fuel!

- BNFL's experience in transporting plutonium products, including MOX fuel, should give the US ample data base to conclude that transportation of MOX can be done safely. Thus, even the option of European manufacture of MOX fuel, requiring trans-Atlantic shipments of materials, can be viewed as environmentally sound and more than adequately safe for serious consideration under this PEIS. 6/08.03.01

- Special weight should be given to options that enable rapid implementation and encourage similar actions within the Former Soviet Union. After all, the real threat of this material is not the inventory stored here in the US, but the inventory that exists in Russia. The sooner we get on with a disposition path here that is compatible with Russian methods of disposal, the more likely Russia will proceed with its own disposition. It is no secret to everyone in this room that the Former Soviet Union views its excess weapons plutonium as an asset that should be utilized as MOX fuel! A similar program in the US would provide impetus to both countries. 7/01.03.00

- Special weight should be given to the ability to rapidly deploy the option under question. The only option that could be implemented in any reasonable timeframe, without the need for endless R&D, is the MOX option. BNFL, for one, is prepared and capable of implementing a US MOX program from the day the ROD is announced! BNFL would be prepared to commit its existing manufacturing facilities to the early production of Lead Test Assemblies, followed by the manufacture of initial core loads utilizing any available excess capacity at its plants in Sellafield. BNFL has also stated, in its Expression of Interest to DOE in February of this year, that it would be prepared to construct a new facility as a privatized venture on US soil, for continued manufacture of MOX fuel to serve the US Pu Disposition program until its completion. 8/06.01.08

M-218

09 00 08 **Comment Number 5**

The scope of this PEIS is not intended to provide an analysis of the benefits and impacts of generating energy as a consequence of burning MOX in a reactor. Its intent is solely to analyze the environmental and socioeconomic impacts of the disposition of weapons-usable fissile materials through reactor burning. The PEIS compares the amount of waste generated from burning MOX in a reactor to the amount of waste generated from mining, milling, and enriching uranium for a similar amount of reactor fuel.

08 03 01 **Comment Number 6**

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

01 03 00 **Comment Number 7**

Comment noted.

06 01 08 **Comment Number 8**

Comment noted.

- To summarize, the Western European's extensive experience in MOX fuel provides overwhelming evidence that the MOX options under consideration in the draft PEIS are superior to the other options, not only in terms of environmental, health, and safety aspects, but also in terms of cost/benefit, ability for rapid deployment, and compatibility with the Former Soviet Union's objectives.

6/08.03.01 cont.

M-218

BNFL, INC., WASHINGTON, DC,
MARILYN F. MEIGS
PAGE 6 OF 11

BASIS FOR ECONOMIC AND WASTE DATA

ECONOMICS

1) Value of MOX fuel:

Based on ave. U fuel cost of $1.5M/T HM

$$38\text{T Pu} \times \frac{1\text{T fuel}}{0.035\text{TPu}} \times \frac{\$1.5\text{M}}{\text{THM}} = \$1.63\text{B}$$

(higher value if U costs go up)

2) Revenues:

$$38\text{TPu} \times \frac{1\text{T fuel}}{0.035\text{TPu}} = 1086\text{ T fuel}$$

$$1086\text{T fuel} \times \frac{44\text{GWd}}{\text{T}} \times 35\%\text{ efficiency} \times \frac{\text{yr}}{365\text{d}} = 45\text{GWyrs.}$$

$$45\text{ GW yrs} \times \frac{\$0.07}{\text{kWh}} = \$32\text{B}$$

WASTE GENERATED

1) GLASS LOGS: (assumes 5% incorporation into glass)

$$38\text{T Pu} \times \frac{1\text{T glass}}{0.05\text{T Pu}} \times \frac{170\text{cu.m}}{0.4\text{T}} = 323\text{cu.m. glass}$$

2) MILL TAILINGS

$$38\text{T Pu} \times \frac{1\text{T fuel}}{0.035\text{T Pu}} = 1086\text{ T fuel}$$

For an equivalent U fuel, 3.7% enrichment at 0.25% tails, feed factor is 7.5
Therefore, 1T fuel needs 7.5 TU = 8.84T as U3O8 ore

Assuming density of 1.8g and an ore grade of 0.1%,
cm3

$$1086\text{ T fuel} \times \frac{8.84\text{T ore}}{\text{T fuel}} \times \frac{\text{cm3}}{1.8\text{g}} = 5.3\text{Mcu. meters mill tailings}$$

3) ENRICHMENT TAILS

Feed factor of 7.5 gives 1T prdt and 6.5 T tails

Therefore, 1086T fuel gives (1086 x 6.5) = 7059T enrichment tails

$$7059\text{T} \times \frac{1\text{cm3}}{1.8\text{g}} = 3900\text{ cu. meters enrichment tails}$$

M-218

DISPOSITION OF WEAPONS PLUTONIUM:

REUSE OR VITRIFY?[1]

M. Meigs, BNFL Inc.

USCEA FUEL CYCLE CONFERENCE

BOSTON, MARCH 1994

M-218

Licensing of the Sellafield MOX Plant

A.J. Tilstone
R.J. Page

British Nuclear Fuels plc
Risley, Warrington, WA3 6AS

M-218

ENVIRONMENTAL STATEMENT

for the proposed

Sellafield MOX Plant

British Nuclear Fuels plc

M-218

EFFECTIVE NUCLEAR MATERIALS CONTROL AND ACCOUNTANCY FOR COMMERCIAL MIXED OXIDE FUEL FABRICATION PLANTS IN THE UNITED KINGDOM

B.A. BURROWS, D.S. MACPHEE
British Nuclear Fuels plc,
Risley, Warrington, Cheshire

G.P. SNAPE
AEA Technology,
Windscale, Seascale, Cumbria

United Kingdom

Abstract

EFFECTIVE NUCLEAR MATERIALS CONTROL AND ACCOUNTANCY FOR COMMERCIAL MIXED OXIDE FUEL FABRICATION PLANTS IN THE UNITED KINGDOM.

A mixed oxide (MOX) fuel demonstration facility (MDF), constructed under a joint project between British Nuclear Fuels plc (BNFL) and AEA Technology, is now operating satisfactorily, qualification programmes are complete and production is under way. BNFL now intends to build a full size production plant called the Sellafield MOX Plant (SMP) Achieving effective and efficient nuclear materials control and accountancy (NMCA) has been an important consideration during the formulation of these projects and throughout the detailed design work. The goal is to achieve the highest NMCA and safeguards credentials in a flexible and highly commercial manufacturing environment.

1. INTRODUCTION

The production of mixed oxide (MOX) fuel is not a new process; many tonnes of MOX have been safely and successfully loaded into reactors around the world. The construction of MOX plants at Sellafield to handle recycled plutonium, coupled with the capability of BNFL's Oxide Fuel Complex (OFC) to process recycled uranium, effectively closes the fuel cycle. Such facilities are important elements of a responsible fuel management strategy and serve the needs of customers who express a wish to utilize their valuable fissile materials recovered from reprocessing.

MOX TECHNOLOGY - AN EFFECTIVE WAY TO REDUCE PLUTONIUM STOCKPILES

Duncan S Macphee
General Manager Projects
BNFL Engineering Ltd
Salford Quays
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Brian C Hexter,
General Manager Engineering Business
BNFL Engineering Ltd
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Malcolm P Young
Technical Manager, SMP
BNFL Engineering Ltd
Salford Quays
MANCHESTER M5 2SP
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(+44) 161-952 6000

ABSTRACT

BNFL is one of only two organisations in the world to offer a full range of services in support of the nuclear fuel cycle, including fuel manufacture and spent fuel reprocessing. As a major reprocessor of spent nuclear fuels, BNFL is committed to the effective utilisation of its customers' reprocessing products. The provision of a MOX fuel fabrication facility is an essential part of this strategy.

BNFL has accumulated considerable R&D experience of MOX fuel, including flowsheet development studies, the manufacture of fuels of different form and type, and property measurements on both irradiated and unirradiated MOX fuel. A key component of this R&D programme has been the development of a high energy milling process, known as the Short Binderless Route (SBR), which achieves extremely homogeneous MOX powder and offers a number of advantages for processing feed powders derived from weapons-grade plutonium.

BNFL Engineering Ltd. is currently installing plant and equipment in a new, commercial-scale MOX fuel fabrication facility it has designed and constructed for its parent company at the Sellafield site. The plant design incorporates 'state-of-the-art' international safeguards and material accountancy provisions designed to meet IAEA and Euratom standards.

In concentrating on the design and construction of the new Sellafield MOX Plant (SMP), this paper aims to show that the utilisation of such technology can reduce plutonium stockpiles by degrading weapons-grade plutonium through fabrication of MOX fuel, with subsequent generation of electricity in thermal nuclear reactors. This paper also discusses BNFL's experience in the MOX technology arena and provides an insight into the capabilities of BNFL Engineering and its approach to major projects. In particular, it addresses the safeguards provisions appropriate to accommodate feed materials arising from nuclear weapons decommissioning programmes.

I. INTRODUCTION

Since plutonium was first separated more than 50 years ago, the element has been at the forefront of public debate. Whilst it is viewed as a dangerous and toxic material by the public at large, there is little doubt that it has the potential to provide a major source of energy to the world population providing it is carefully and effectively managed.

In order to release the potential energy from plutonium, it can be mixed with uranium to make Mixed Oxide Fuel (MOX) for use in thermal nuclear reactors in place of standard uranium fuel. The technology base for MOX utilisation spans more than 30 years. The first thermal MOX fuel was manufactured in the early 1960s and loaded into a European PWR in 1963. In 1965 MOX fuel was loaded into the Sexton reactor in USA and in 1978 the Beznau reactor in Switzerland was loaded with its first MOX assemblies.

Over the past 17 years the use of MOX fuel in thermal reactors across Europe has grown significantly with utilities in Belgium, Switzerland, Germany and France adopting the policy to recycle the plutonium dioxide product from reprocessing. In the US, however, the use of MOX fuel stopped in the early 1980s when a national policy not to reprocess spent fuel was adopted and the Yucca Mountain storage project was formulated.

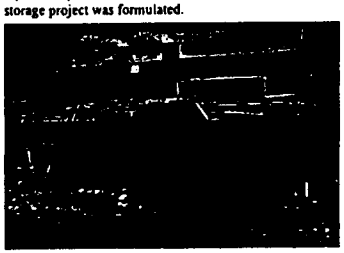


Figure 1 - The Sellafield MOX Plant under construction

M-218

BAMBERRY, ED, BLACKFOOT, ID
PAGE 1 OF 1

Comment ID: P0028
Date Received: April 18, 1996
Name: Ed Bamberry
Address: 1181 Packer Drive
Blackfoot, ID
Phone: 208-785-1623

Transcription:

I would like to comment that I am in favor of the Department of Energy processing plutonium, preferably in the reactors, and also the second I guess would be to contain the waste, any waste, in a glassified or a container for storage. Thank you for this time to let me explain my views on this. Bye. | 1/08.03.01

P-028

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

It is my intent this evening to speak briefly to each of the Programmatic Environmental Impact Statements, and reserve comments on the Pantex Site Wide EIS until the June public meeting.

These documents are being addressed in this community as an economic and jobs issue. While the local economy is undeniably important, both of these PEIS drafts deal with issues that have national and international implications, ~~and they deserve to be considered with that light~~. Those implications involve national and international security; the involve decisions about nuclear waste that we have been unable to make decisions about for more than 50 years; and they involve introducing new technologies with a wide range of health, ~~and~~ safety and environmental risks They deserve to be considered in that light, read thoughtfully and carefully, and addressed with more than pep rallies about jobs.

The stockpile Stewardship and Management PEIS, does not ~~state~~ adequately make a case for development of of more than $2.6 billion in new capital cost and $2 billion in development of a ~~new~~ new super computer. The reliability of US nuclear weapons has been tested over and overegain. The French just recently completed a series of tests designed to allow them to continue nuclear weapons development by simulated tests and computer

TX-065

the proposed new facilities and believe they have any purpose other than continued weapons development.

The storage and disposition options provide us w good choices; reasonably so, because there are none. The emphasis on the spent fuel standard may leave us with a false sense of security — virtually every country which has developed nuclear weapons has done so from spent nuclear fuel. It may ~~prevent~~ provide some level of security from theft by terrorists, but the nuclear nations of the world themselves hold hostage each other and the non-nuclear nations.

We have for more than 50 years been unable to resolve the issue of what is to be done with spent nuclear fuel - producing pure Pu, or other materials equally as toxic, is more problem, not solution —

Mavis Belisle
HCR 2 Box 75
Panhandle TX 79068
335-1715

1/01.06.00

TX-065

01 06 00 **Comment Number 1**

Comment noted. Most weapons produced in other countries used Pu from specialized reactors, not commercial reactors. The Spent Fuel Standard provides the most rapid path for converting Pu to a much more proliferation-resistant form. While the residual Pu could be recovered through the reprocessing of this form, it would be as difficult to retrieve as the Pu from the much larger inventory of spent fuel produced over many decades of commercial reactor operation.

BENTON COUNTY COMMISSIONER, BENTON COUNTY, WA, SANDI STRAWN
PAGE 1 OF 2

TESTIMONY OF
COMMISSIONER SANDI STRAWN
BENTON COUNTY, WASHINGTON
at the
U.S. DEPARTMENT OF ENERGY HEARING
APRIL 11, 1996
RICHLAND, WA

Re: Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Good evening. My name is Sandi Strawn and I am a Benton County Commissioner. I represent the county in which most of the Hanford Reservation is located. I am providing testimony tonight on behalf of the entire Board of Benton County Commissioners.

The outbreak of peace has presented us with a decidedly better future and a significant challenge. Plutonium warheads -- those very items we once felt were so necessary -- now are surplus to our needs. Peace is at hand, but this country's work is not yet done.

I want to offer several pieces of input to your Draft Programmatic EIS.

1. Keep moving forward.

We are pleased to see the Department of Energy is taking steps to address this challenging set of issues. The Department has evaluated a host of potential approaches, and has made significant progress by developing the set of alternatives outlined in the Draft EIS. We applaud your effort to date, and encourage you to keep pressing ahead on this internationally important issue. The complexities of the problem should not be used as a reason for avoiding any action. The "No-Action" and "Long-term Storage" alternatives are neither acceptable nor effective. 1/08.03.01

2. Follow the recommendation of independent experts. 2/08.03.01

The National Academy of Sciences has suggested fabrication of plutonium into reactor fuel is one of the few promising alternatives in management and disposition of fissile materials.

3. We are willing to continue to do our part.

We recognize two of the critical steps in plutonium disposition could be supported at the Hanford Site. Those steps are the fabrication of mixed oxide fuel at the Fuels and Materials Examination Facility, and the fissioning of that fuel at WNP 2 and the Fast Flux Test Facility (FFTF). 3/08.03.01

As the host county government, we support the use of these facilities and the Tri-Cities area technical resources for these two activities. This should stand in contrast to the situation in Nevada, where the most notable product of intergovernmental relations has been a delay in solving national problems.

WA-018

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to continuing or long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's support for new missions at Hanford. Decisions on storage and disposition of weapon-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

BENTON COUNTY COMMISSIONER, BENTON COUNTY, WA, SANDI STRAWN
PAGE 2 OF 2

4. The mixed oxide fuel approach is the least costly and quickest path.

As a representative of taxpayers, we urge you to use proven technologies whenever possible. When this is done, the costly steps of investigation and experimentation are avoided. The mixed oxide fuel approach has been proven viable in this country and others. No new technologies are needed, and parties have offered you their technologies and facilities to pursue this alternative. The mixed oxide fuel approach will allow us as a nation to take the biggest possible bite out of this problem with the least resources, and in the shortest period of time. 4/08.03.01

We urge you to move quickly to reduce the quantity of material which could find its way into irresponsible hands, and to quickly help the former Soviet states to reduce their stockpiles of nuclear material. The mixed oxide approach will provide the quickest demonstration of our seriousness, it will embrace a pathway that the Russians may emulate, and it will reduce stockpiles of materials.

These are the things we are FOR. Now let me mention one we are against.

5. Consolidation of plutonium at Hanford is not necessary.

The Draft EIS poses as an option the consolidation of all surplus plutonium materials at the Hanford Site. We strongly object to this approach. Benton County residents have been and will continue to willingly fulfill our part of the solution. We recognize our responsibilities to safely manage, stabilize, and dispose of the substantial amount of plutonium already existing at Hanford. But, we will not become the nation's dumping ground for all plutonium scrap and mixed waste. There are already enough items on our Hanford cleanup "to-do" list. Movement of plutonium materials should only occur right before treatment. 5/08.03.01

Thank you for conducting a hearing in Richland to hear from those who are most directly affected by DOE actions. We urge you to continue forward with timely development of technically sound and fiscally responsible solutions to these very important issues.

Sandi Strawn
4/11/96

WA-018

08 03 01 Comment Number 4

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 5

The Department of Energy acknowledges the commentor's opposition to the Consolidation Alternative at Hanford. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

BILL WOLFE CUSTOM HOMES, AMARILLO, TX,
BILL K. WOLFE
PAGE 1 OF 2

Bill K. Wolfe
President

Bill Wolfe CUSTOM HOMES

(806) 358-6441

4425 Tiffani Drive
Amarillo, Texas 79109

April 5, 1996

U.S. Department of Energy
Office of Reconfiguration
P O Box 3417
Alexandria, Virginia 22302

U. S. Department of Energy
Office of Fissile Materials
P O Box 23786
Washington, DC 20026

Re: Comment on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile materials Draft Programmatic Environmental Impact Statements (PEISs).

Thank you for the opportunity to comment on the U. S. Departments of Energy's (DOE) Programmatic Environmental Impact Statements (PEISs) on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials. Please also consider this my comment on the Pantex Site-Wide Draft Environmental Impact Statement, since most of the issues addressed in these documents are identical.

First and foremost, I maintain that any current and future functions at Pantex must be conducted in a safe and environmentally sound manner. Any expansion at Pantex must be implemented in a way that does not impair the health or safety of area residents or have an adverse affect on the environment. 1/09.00.04

Second, I maintain that the history of Pantex and the Texas Panhandle communities have been one of lower cost than other facilities, a safer and more environmentally sound operation and of overall strong community support for the operation.

M-030

09 00 04 Comment Number 1

Potential environmental consequences of each Pantex alternative were analyzed in the PEIS. Results of these environmental analyses will be given full weight, along with other factors such as cost, technical risk, schedule, and national security requirements, in the process of selecting the storage strategy and site and disposition strategy and technology for the Fissile Materials Disposition Program. Pantex will continue to operate in compliance with all Federal, State, and local regulations.

BILL WOLFE CUSTOM HOMES, AMARILLO, TX,
BILL K. WOLFE
PAGE 2 OF 2

Third, I further maintain that the movement of any existing functions from Pantex to other locations are not cost effective uses of our (yours and mine) tax dollars. The high cost of new facilities would far outweigh any other theorized savings that come from a facility with historically higher costs.

Finally, I maintain that if any movements of operations are to be considered, the operations that have provided safe, cost effective and productive performance over the years should receive additional work rather than having any work removed. Therefore, Pantex should be the natural location for expanded functions. Because of its performance record and its available facilities, Pantex should be the preferred location for any weapons work. 2/08.03.01

Sincerely,

Bill K. Wolfe

M-030

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

BIRKENFELD, DARREL, NAZARETH, TX
PAGE 1 OF 1

Comment ID: P0037
Date Received: May 1, 1996
Name: Darrel Birkenfeld
Address: HCR 2, Box 19
Nazareth, TX

Transcription:

I am a concerned citizen calling to voice my strong and unconditional opposition to any storage or disposition of radioactive nuclear waste or plutonium or anything regarding that, that is outlined in the PEIS program or proposition of the Department of Energy. I'm totally against this storage because of the unforeseen and yet totally unworked-out difficulties with storing this plutonium over the aquifer. I also want to voice my opposition to this idea of making any area in our country a national sacrifice place which is what would happen if plutonium is stored in our region. We're undergoing our own economic problems that we need to find solutions to, but this is not one of them, and I again voice my opposition to any storage or disposition of plutonium or radioactive nuclear waste in the Panhandle of Texas. Thank you. 1/08.03.01 2/08.03.01

P-037

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's concerns with the long-term storage and disposition of weapons-usable fissile materials. Decisions on storage and disposition of fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

BLAKE, BARBARA, SAN JOSE, CA
PAGE 1 OF 2

May 6, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
J. David Nulton
P.O. Box 23786
Washington, DC 20026-3786.

I am sending the following comments with regard to your February 1996 Draft Programmatic Environment Impact Statement for the Disposition of Weapons-Usable Fissile Materials.

I am deeply concerned that the DOE is not taking more timely and positive action in establishing a disposition program which will, with the Russians, convert the plutonium stockpiles in both countries into spent fuel. | 1/08.03.00

The reactor option makes sense, and can with a high degree of confidence, use the plutonium instead of uranium fuel to produce electricity, and in the process, change the plutonium to other forms and make it radioactive. The reactor process also consumes some of the plutonium. Many reactor owners have told the DOE they are willing to work with them and use their reactors to convert the plutonium so that it would not be useful for weapons. Give the job to the utility companies and let them get on with making the world a safer place. | 2/08.03.01

The Russian economy is in turmoil and I have read about attempts to smuggle bomb making materials. How much longer can we study the topic and have the luxury of two year PEIS studies without doing something real with the material.

DOE seems to be catering to special interests or trying to make everyone happy. Enough with Washington politics and special or regional interest catering! I read where some politicians from the Savannah River area were trying to get DOE to build a new nuclear reactor (from a Swedish company no less) at Savannah River to make tritium and burn plutonium. If existing reactors are available why wouldn't you use them instead. It is obvious that their proposal for a new reactor is their attempt to create jobs for their area. I also think the idea of having Canadian reactors burn the plutonium is unacceptable. Are we throwing the problem over our fence and letting the Canadians put in under their rugs because we can't decide whose rug to bury it under here in this country? I also think we shouldn't be paying the Canadians or making fuel for their reactors when a U.S. utility is willing to do it and maybe in the process, lower my rates. Isn't it enough the DOE has wasted more than two years on an environmental impact study that must have cost tens of millions of dollars and we are two years further down the road without anything being done or even having an agreement with the Russians. This seems like DOE catering to Al Gore and his rich environmentalist cronies. | 2/08.03.01 cont. | 3/08.03.01 | 1/08.03.00 cont.

F-033

08 03 00 Comment Number 1

The Department of Energy is working to make decisions on these very important issues in a timely manner using all available information such that wise, sustainable decisions can be implemented in a deliberate, properly scheduled manner.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. This will include an appropriate level of analysis by Canada before any decision on burning Pu in a CANDU reactor is implemented.

I read where Greenpeace was objecting to using reactors for the job. Enough of those nutcakes. They don't represent mainstream America. They are paid professionals and ignorant, elitist, wealthy volunteers, more interested in saving whales while humans starve in Appalachia or the Northwest because Greenpeace forced a coal mine or lumber mill to shut down. They don't have solutions and they propose Utopian nonsense. They are obstructionist who, in this situation would have both the U.S. and Russia do nothing, while if we wait long enough, eventually the material will go back into bombs-if not in Russia than maybe possibly IRAN or IRAQ ? or even worse, into a terrorist bomb in the center of Washington DC or in my city ?

The other options being evaluated by DOE appear pie-in-the-sky, make-work R&D programs. Putting plutonium in glass and burying it seems dangerous. The scientist really don't know what will happen to the glass 50, 100, or 1000 years from now. I expect they could also spend years and years and millions and millions of more dollars on R&D and still not be ready to put the plutonium into a safe form of glass. The Greenpeace people say that's better than reactors but they also don't want the glass (or anything else for that matter) buried at Yucca Mountain. They are hypocrites. I also understand that it would be an easy matter for the U.S. or Russia to remove the plutonium from the glass if either wanted to. Therefore, that doesn't make sense either.

I want to show my support for the common sense approach offered by the utilities and their reactors. The National Academy of Sciences recommended OVER TWO YEARS AGO, that the plutonium should be put into reactors and turned into spent fuel. The DOE has since spent those two years studying every other harebrained idea and the reactor process is no further along. I want to protest DOE's lack of action and urge the DOE to get the process going before it is too late. 2/08.03.01 cont. 1/08.03.00 cont.

Yours Truly,

Barbara Blake

Ms. Barbara Blake
6545 Farm Hill Way
San Jose, CA 95120

F-033

BOARD OF COUNTY COMMISSIONERS, LAS VEGAS, NV, LORRAINE HUNT
PAGE 1 OF 2

LORRAINE HUNT
Commissioner

Board of County Commissioners
CLARK COUNTY GOVERNMENT CENTER
500 S GRAND CENTRAL PKY
PO BOX 551601
LAS VEGAS NV 89155-1601
(702) 455-3500 FAX (702) 383-6041

May 7, 1996

U.S. Department of Energy
1000 Independence Ave. S.W.
Washington, D.C. 20585
Attention: Ms. Hazel O'Leary, Secretary

SUBJECT: STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Dear Secretary. O'Leary:

I am a Commissioner of Clark County, Nevada, a community with over 60 percent of Nevada's population, in addition to being one of the more rapidly growing metropolitan areas in the United States. I am writing to express some concerns about the manner in which the Department of Energy (DOE) is proposing to resolve a severe national problem with the final resolution of the nation's radioactive and mixed radioactive waste issues.

While my immediate concerns are in reference to a proposal, recently described at a workshop in Las Vegas, to consider the storage of weapons-usable Fissile Materials (more commonly known as Plutonium "pits") at the Nevada Test Site (NTS), my concerns address a host of issues associated with the NTS.

As you are probably aware, the NTS is being considered as a storage, treatment and disposal site for a considerable amount of the waste that has been generated in the nation's weapons development program. This is, of course, in addition to the hundreds of nuclear weapons tests that have been detonated over the years and the proposal to place all the nation's commercial spent nuclear fuel and defense high-level waste at the NTS. Now this proposal. Where will it end?

Nevada, because of its relatively small population and national political strength seems to be always automatically considered as a final solution when proposals such as these are generated.

DOE needs to be more creative in crafting final solutions. Nevada has obviously performed ably in doing its part in ending the "cold war." It is willing to continue to do its part in the final resolution of the onerous waste problems confronting the nation. Other parts of the nation, however, also need to do their part as well. 1/01.00.00

M-241

01 00 00 Comment Number 1

Comment noted. DOE is also considering sites in other states for the various storage and disposition alternatives analyzed in this PEIS. To obtain public comments, DOE held meetings near each of the potentially affected sites and a national meeting in Washington, DC. DOE also participated in meetings, open to the public, sponsored by different organizations at which the sponsors collected public comments which were forwarded to DOE. Technical, schedule, cost, and nonproliferation analyses along with environmental analyses will be used by the decisionmaker in determining the ROD. These documents were made available for public review beginning in late July 1996.

BOARD OF COUNTY COMMISSIONERS, LAS VEGAS, NV,
LORRAINE HUNT
PAGE 2 OF 2

Secretary O'Leary
May 7, 1996
Page Two

The final solution of this problem needs to include states and communities, other than Nevada. DOE and the nation needs to interject more equity into the final cleanup process and not take the line of least resistance and automatically foist all the waste and nuclear materials on one locale. This will be work for DOE, but is the only way to ensure that just as many communities and states benefitted (as well as contributed to the defense efforts) from the jobs and wages that accrued from this program, that they will also share in the waste and material disposal side. 1/01.00.00 cont.

It should be noted that there are communities that have recognized this inequity and have worked to redress it. The NTS Community Advisory Board and the Fernald Ohio group, for example, have interacted to develop a more equitable solution to these issues.

As a result of their discussions what was originally an alternative to transport a high proportion of the waste to Nevada has been modified to one where a considerable amount of the waste will remain safely stored, in Ohio, some to a private incinerator in Utah, and yes, some for final disposal in Nevada. This is an equitable solution that could be emulated throughout the nation. It also offers the added benefit of reducing the amount of material (and consequence to added cost) that must be transported on U.S. highways, and thereby, reduce another source of potential accident and exposure to the public. 2/01.04.00

We are certain that you will support these valuable, positive efforts to solve, I reiterate, in an equitable manner, these serious problems.

Nevada, because of geography and history have limited transportation options. Much of the material consequently may end up being transported through one of the more vibrant communities in the United States. In a tourist-based economy we, understandably, have great concerns.

I look forward to the initiation of a constructive dialogue on these issues.

Sincerely,

Lorraine Hunt
Commissioner

cc: Thomas Grumbly, Under Secretary
Clark County Board of Commissioners
Donald L. Shalmy
James Ley
Richard B. Holmes

M-241

01 04 00 Comment Number 2

The disposition alternatives evaluated in the PEIS will produce various types and quantities of waste. Some of this waste will be disposed of onsite, while other quantities will be shipped offsite for disposal. As part of the implementation process and depending on the type of waste, DOE will consider alternatives for onsite versus offsite disposal in order to define an approach that will reduce cost, transportation requirements, and potential exposure of the public to radiological releases and contaminants, and will be consistent with decisions associated with other NEPA reviews, such as the *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (Waste Management PEIS).

BOARDMAN, CHARLES, SARATOGA, CA
PAGE 1 OF 5

May 5, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786.
(FAX) 1-800-820-5156

Please accept my comments on the "Draft Programmatic Environmental Impact Statement for the Disposition of Weapons-Usable Fissile Materials." Feb. 1996.

Regards,

Charles Boardman
19444 Via Madronas Ct.
Saratoga, CA 95070

F-034

The PEIS should include a cost-benefit risk assessment which accounts for both the timeliness and risks of each option, each should be pro-rated against a potential order of magnitude cost estimate and environmental impact costs to the nation if the weapons useable material were to be stolen or diverted. 1/07.02.00

The existing reactor option has the most technical maturity and is truly industrially proven. The track record of industrially based projects has much higher credibility than those within Government programs. The PEIS record of decison process therefore should include a cost-risk analysis of the R&D and industrial develpment and shakedown costs of other options which, given the DOE /Government driven development of those other programs, should certainly merit high-risk grades which would covert to high cost grades. DOE is also reminded that the National Academy strongly suggested that cost not be a major factor in addressing the risk of weaons usable plutonium. The speed, reliability, and low risk of the reactor option should therefore be overriding even if there is a cost differential due to licensing, fuel testing requirements, and DOE's political /policy decision that it needs a U.S. MOX fabrication facility. 2/08.03.01

Facility construction for that MOX facility is much more definitive than a facility for the still developmental technologies associated with the other options.

Continued consideration of the CANDU option is difficult to justify, given the willingness of U.S. utilities to undertake the mission. It is an affront to the American taxpayer to subsidize Canadian companies which are competing with U.S. electric producers with O&M or irradiation fee payments or with free fuel when those could be provided to U.S. utility companies. 3/01.03.00

DOE also seems overly concerned with the use of reactors contributing to the proliferation problem. Electric production reactors are not involved in proliferation activities and are committed to thorough safeguards practices in accordance with IAEA requirements. It is simplistic to think the other nations of the world who lead the U.S. in MOX technology anyway will be impacted in their continued use of it. If the U.S. chooses to forgo a specialized use of that technology for Pu disposition. It is clear the U.S. program would involve only a limited number of reactors dedicated to a non-proliferation mission because that offers the fastest, most reliable solution for the disposition mission. We would be cutting off our noses to 4/01.06.00

F-034

07 02 00 **Comment Number 1**

Parallel with the preparation of the PEIS, DOE conducted cost, schedule, technical, and nonproliferation assessments of each alternative. The results of these parallel studies were provided in a Technical Summary Report issued in July 1996 and a Nonproliferation Assessment Report issued in late 1996. The results of these evaluations will be factored into the ROD for storage and disposition of weapons-usable fissile materials.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 03 00 **Comment Number 3**

The *National Environmental Policy Act* requires the analysis of a range of reasonable alternatives for a Proposed Action. There are no indications that the CANDU Reactor Alternative is not reasonable from the environmental perspective.

01 06 00 **Comment Number 4**

Comment noted.

BOARDMAN, CHARLES, SARATOGA, CA
PAGE 3 OF 5

spite our faces were we to forgo the LWR option on "principal". Our principal statement would have negligable impact on the risk and in fact would add to the risk by adopting other alternatives that are less rigorous in their capability to perform the mission. We must not miss our window of opportunity with willing US reactor owners and with the Russian plutonium security situation.

In subsequent discussions, it was noted that facilities and production processes for MOX fuel that would be used in a U.S. disposition program could be designed so it would be highly impractical to consider the use of those same facilities for the highly irradiated recycled Pu that would be considered if a commercial MOX program were intended. Furthermore, the facility could be designed for convenient decontamination from low exposure weapons grade Pu and built-in decommission considerations could be designed in so that could be readily achieved upon termination of the disposition program. It is also relevant to explain to the political opponents of LWR disposition that the U.S. disposition program is going to be limited program with only a few plants participating in order to achieve rapid and reliable disposition of weapons for a strategic non-proliferation goal and it is in no way oriented to promote the commercial use of MOX. There are "professional " protest lobbies (Greenpeace for one) that would decry any and all DOE disposition options and especially the LWR option; while others recognize the facility of the LWR option and decry the environment risks of geological disposal of vitrification products. Yet they offer no alternate solution to the environmental threat of doing nothing and the role they play in further delaying meaningful disposition.

4/01.06.00
cont.

<u>Involved locales and common sense public good</u>

Some professional environmental protesters would have the DOE abandon consideration of all near term options and spend additional decades in R&D on "still unidentified, ultimate disposition methods" which, of course, must have no potential for environmental impact. Pursuing a longer term solution for the much less threatening proliferation risk from reactor grade plutonium, instead of focusing on the near term security issues stemming from weapons grade plutonium, could result in the proverbial "locking of the barn door after the horses are stolen".

Few activities, if any, undertaken in modern industrial society have no risk. Society chooses to drive automobiles despite 50,000 traffic fatalities yearly. The risks of no action and action too long delayed are much greater than those highly improbable risks that some would demand we avoid in

F-034

arriving at a record of decision and getting on with the program as expediently as practical.

When the general public and their political representatives are given these facts through public meetings and other information initiatives which the Department of Energy should be undertaking, and when they are made aware that the use of MOX fuel in reactors to convert weapons usable materials to spent fuel is a quick, reasonable and practical solution to the threat of diversion and otherwise relatively easy reuse that might be achieved with other options, the LWR option should win broad public and political acceptance.

Public responses at PEIS public scoping meetings in 1995 and this year's draft PEIS comment meeting have clearly demonstrated broad community support in those locales that are candidates for Pu disposition activities. There have been significant expressions of state and local level political and public support. The candidate communities are knowledgeable of the real nature of the plutonium hazard, (not the hyped hysterics that some portray) have favorable experience with plutonium activities, are comfortable with the real issues of plutonium handling and processing activities which will be common to all disposition options, and are confident in the ability of well-managed organizations to conduct the program safely and in an environmentally sound way. Particular locations which have had poor experiences with DOE facilities, or those with a well-established culture of opposition by special interests to DOE and nuclear-related operations are clearly not being considered as sites for program activities and should therefore not be a factor. A key, therefore, to achieving an accurate and meaningful public consensus lies in appropriately identifying and obtaining a consensus of those local and regional stakeholders who are truly affected.

Because U.S. national security is potentially affected by a lack of action as much as by specific actions taken in addressing this excess weapons material threat, special interests and/or bias and ideological critics who would seek to block the program with protests in the name of having "a higher vision" than the rest of us, or even by legal challenges, despite it otherwise being a broad-based acceptable solution, are doing a gross disservice to our county. The overwhelming public interest clearly lies in implementing an effective and timely solution. A solution which has broad public and political consensus, which is being hampered by a limited special interest challenge, has a strong argument for passing over those objections, especially when they are clearly politically motivated, largely procedural, filled with slanted and inflammatory "scare tactic

F-034

BOARDMAN, CHARLES, SARATOGA, CA
PAGE 5 OF 5

rhetoric" or otherwise without substantive merit, considering the all the risks and options.

DOE disposition actions must remain focused on the nature and potential of the immediate threat of divergence of weapons useable materials and the timeliness and reliability of the response and solution to the threat offered by the proposed options, and not on "micro" issues of cost, support or non-support of nuclear power, value or use of the Pu material, and local or regional economic or political interests.

The LWR option would seem to be the only credible option for the U.S. to offer the Russians to enter into a bilateral program. Anything that does less, does nothing to reduce the threat of diversion of Russian material which will remain at risk until converted into a form not readily useable in weapons. 5/08.03.01

F-034

08 03 01 Comment Number 5

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

BOATMEN'S
FIRST NATIONAL BANK
OF AMARILLO

DOWNTOWN CENTER
701 South Taylor
Post Office Box 1331
Amarillo, Texas 79180
806 378-1400

JOE M. STANGE
Vice President
806 378-1607

April 19, 1996

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, DC 20026

I appreciate the chance to comment on the U.S. Department of Energy's (DOE) Programmatic Environmental Impact Statements (PEIS's), Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&A) of Weapons - Usable Fissile Materials. These three areas affect Pantex, Amarillo, and the Panhandle area in a significant manner.

One of my concerns is the continuing expansion and operation of Pantex that would be conducive to the environment and health matters. This continued operation and expansion of Pantex must be conducted in a safe and environmentally sound manner with proper evaluation and research being completed. 1/09.00.04

The decision by the DOE to select Pantex as the preferred alternative for assembly and disassembly is certainly appreciated and I think this reflects the confidance in Pantex. Also, the cost related to moving this facility would be prohibitive. However, by failing to recognize Pantex as the preferred site for new stockpile management facilities the DOE has overlooked the best site to attain maximum efficiencies and cost savings.

I am sure Pantex is the most cost effective facility for any new construction of SSM facilities such as labor costs, utility rates and water and land availability at Pantex. It would be a natural to consider Pantex for an alternative site to compliment the activities at the Los Alamos National Laboratory. DOE makes no mention of a strategic plutonium reserve that is necessary to meet future national security needs, even though the PEIS mentions that strategic storage should be co-located with disassembly. Pantex should be a preferred site for such a project in coordination with the management functions. When the basic technical capabilities are already located at a site such as Pantex with its excellent

M-045

09 00 04 Comment Number 1

The Department of Energy is committed to maintaining existing facilities to ensure safe operation for the life of the facilities. For all storage and disposition alternatives being evaluated at Pantex, compliance with all Federal, State, and local regulations and DOE Orders is an integral and important part of each storage or disposition facility design.

BOATMEN'S FIRST NATIONAL BANK OF AMARILLO, AMARILLO, TX, JOE M. STANGE
PAGE 2 OF 2

record it would be most cost effective to use that location. In their discussion process, DOE should use budgetary comparisons, and capital requirements, available transportation, skilled people, and other costs.

For basically the same reason mentioned above the High Explosives (HIE) fabrication should remain at Pantex. The SSM draft admits that Pantex must retain HE capabilities to process the inventories already on site from the dismantling process which certainly would be the least expensive alternative. When everything is considered transferring the HE function from Pantex would cost taxpayers over $40M. Also, if it becomes necessary for new weapon production, it would be very important to have the HE facilities at the weapons production and assembly site.

With Pantex being the only authorized facility for assembly and disassembly of nuclear weapons, they have maintained an excellent record of safety and efficiency for over 40 years. DOE is considering several option regard Plutonium Storage and Disposition (PEIS) which is a result of the dismantling. Pantex could continue to store plutonium which is already at the site and upgrade the facility for an and all storage being considered by the DOE with minimized cost. It makes no sense at all to recreate storage facilities at another location and then unnecessarily transport large amounts of plutonium across the country from Pantex. 2/08.03.01

Based upon these reasons, I respectfully urge DOE to designate Pantex as the preferred alternative site for all existing and new stockpile management and stewardship foundations as well as consolidation of all plutonium storage and disposition and related functions.

Thanks for allowing individuals to express their thoughts.

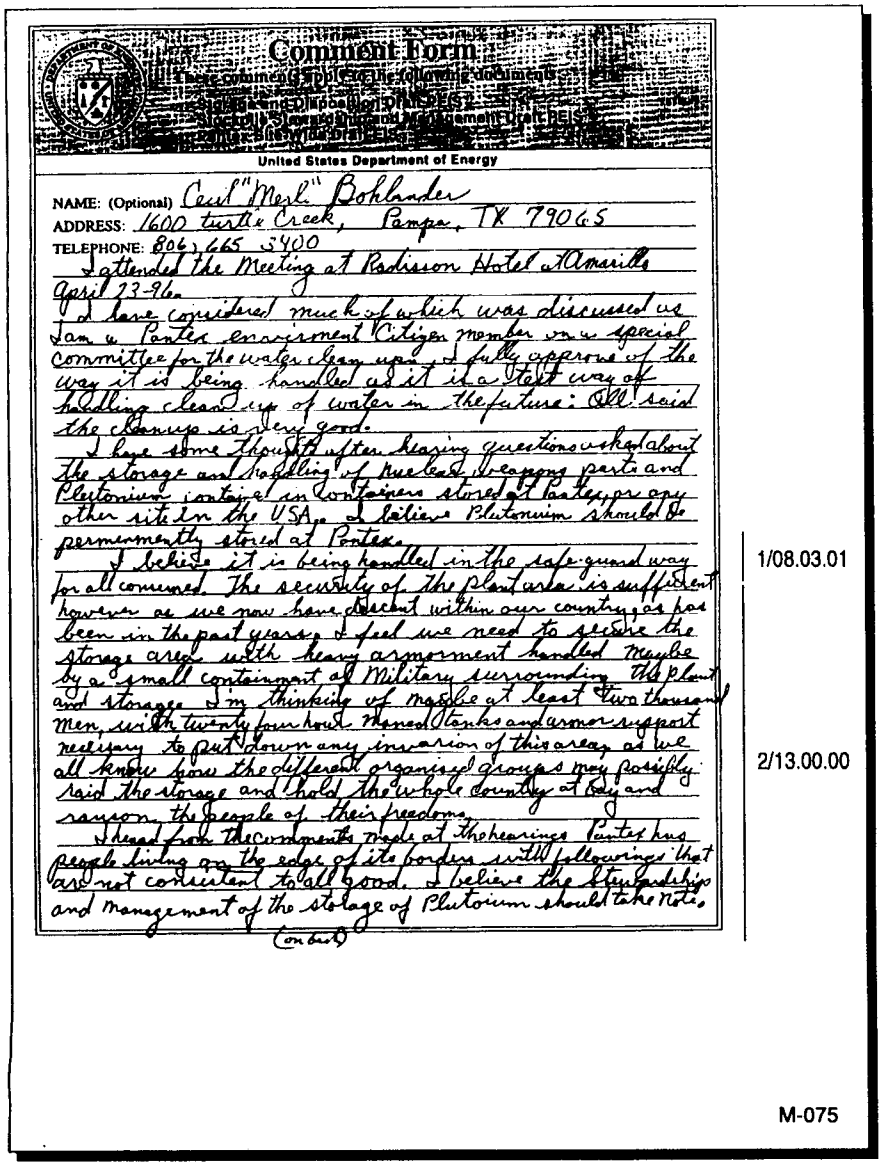
Sincerely,

Joe M. Stange
Vice President

M-045

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



Comment Form

United States Department of Energy

NAME: (Optional) Cecil "Merl" Bohlander
ADDRESS: 1600 Turtle Creek, Pampa, TX 79065
TELEPHONE: 806) 665 5400

I attended the Meeting at Radisson Hotel Amarillo April 23-96. I have considered much of which was discussed we am a Pantex environment Citizen member on a special committee for the water clean ups. I fully approve of the way it is being handled as it is a fast way of handling clean up of water in the future. All said the cleanup is very good.

I have some thoughts often hearing questions asked about the storage and handling of nuclear weapons parts and Plutonium containers stored at Pantex or any other site in the USA. I believe Plutonium should be permanently stored at Pantex.

I believe it is being handled in the safe guard way for all concerned. The security of the plant area is sufficient however as we now have threat within our country as has been in the past years. I feel we need to secure the storage area with heavy armorment handled maybe by a small contingent of Military surrounding the plant and storages I'm thinking of maybe at least two thousand men with twenty four hour Armed Tanks and armor support necessary to put down any invasion of this area, as we all know how the different organized groups may possibly raid the storage and hold the whole country at bay and ransom the people of their freedoms.

I heard from the comments made at the hearings Pantex has people living on the edge of its borders with followings that are not convenient to all Good. I believe the Stewardship and Management of the storage of Plutonium should take note.

Cont'd

1/08.03.01

2/13.00.00

M-075

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

13 00 00 **Comment Number 2**

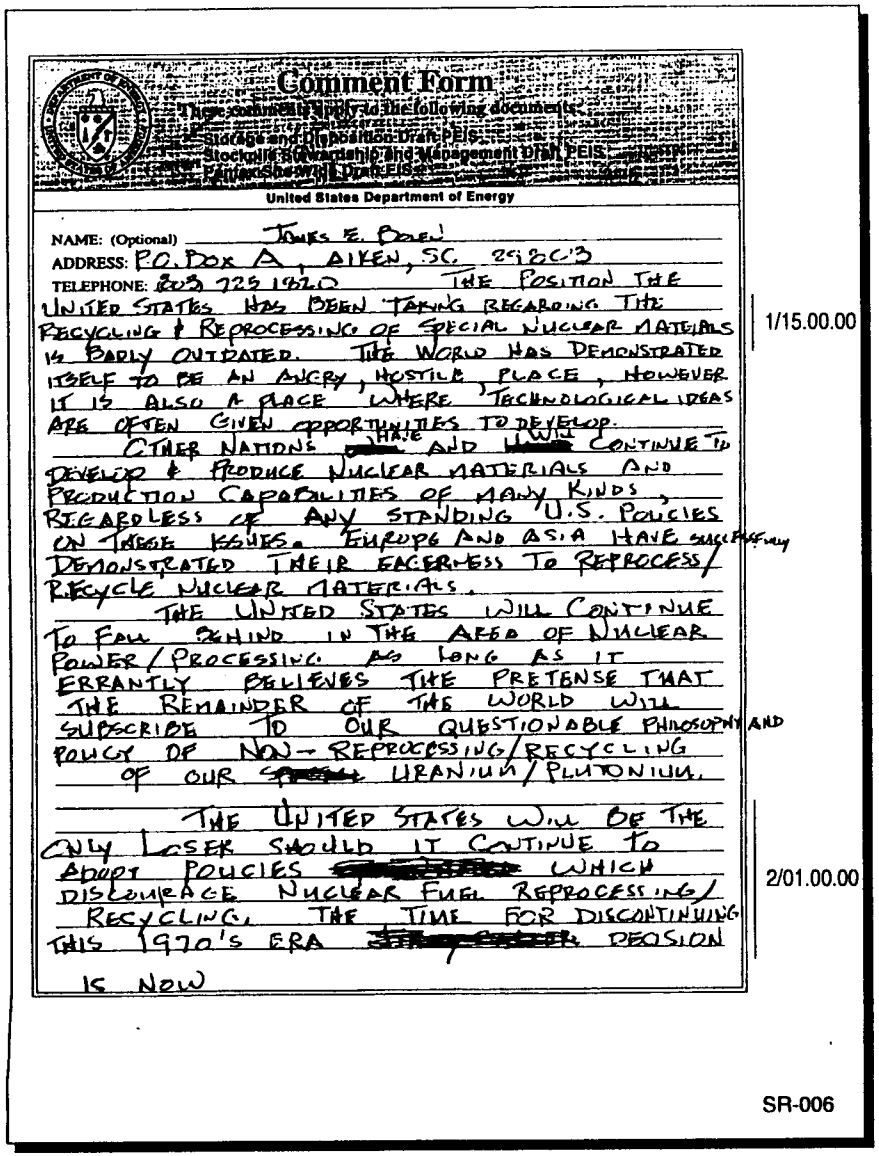
Comment noted. Prior to implementation of the Proposed Action, a well-thought-out security plan that meets international standards would be in place. Facilities would be inspected by IAEA, as appropriate.

BOHLANDER, CECIL, PAMPA, TX
PAGE 2 OF 2

I am 71 yrs old, Retired
had my own Companies for many yrs
Contractor, building gas + oil related plants
setting heavy equipment throughout the
central U.S.

M-075

BOLEN, JAMES E., AIKEN, SC
PAGE 1 OF 1



Comment Form

These comments apply to the following documents:
Storage and Disposition Draft PEIS
Stockpile Stewardship and Management Draft PEIS
Pantex Site-wide Draft EIS

United States Department of Energy

NAME: (Optional) JAMES E. BOLEN
ADDRESS: P.O. BOX A, AIKEN, SC 29803
TELEPHONE: 803 725 1820

THE POSITION THE UNITED STATES HAS BEEN TAKING REGARDING THE RECYCLING & REPROCESSING OF SPECIAL NUCLEAR MATERIALS IS BADLY OUTDATED. THE WORLD HAS DEMONSTRATED ITSELF TO BE AN ANGRY, HOSTILE, PLACE, HOWEVER IT IS ALSO A PLACE WHERE TECHNOLOGICAL IDEAS ARE OFTEN GIVEN OPPORTUNITIES TO DEVELOP. 1/15.00.00

OTHER NATIONS HAVE AND WILL CONTINUE TO DEVELOP & PRODUCE NUCLEAR MATERIALS AND PRODUCTION CAPABILITIES OF MANY KINDS, REGARDLESS OF ANY STANDING U.S. POLICIES ON THESE ISSUES. EUROPE AND ASIA HAVE SUCCESSFULLY DEMONSTRATED THEIR EAGERNESS TO REPROCESS/RECYCLE NUCLEAR MATERIALS.

THE UNITED STATES WILL CONTINUE TO FALL BEHIND IN THE AREA OF NUCLEAR POWER/PROCESSING AS LONG AS IT ERRANTLY BELIEVES THE PRETENSE THAT THE REMAINDER OF THE WORLD WILL SUBSCRIBE TO OUR QUESTIONABLE PHILOSOPHY AND POLICY OF NON-REPROCESSING/RECYCLING OF OUR URANIUM/PLUTONIUM.

THE UNITED STATES WILL BE THE ONLY LOSER SHOULD IT CONTINUE TO ADOPT POLICIES WHICH DISCOURAGE NUCLEAR FUEL REPROCESSING/RECYCLING. THE TIME FOR DISCONTINUING THIS 1970'S ERA DECISION IS NOW 2/01.00.00

SR-006

15 00 00 **Comment Number 1**

Comment noted.

01 00 00 **Comment Number 2**

While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of Pu from that spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort. Although the PEIS evaluates disposition of surplus weapons Pu through use in MOX fuel it does not further evaluate reprocessing of the spent fuel. This does not foreclose policy or technology options nor does it prejudice future decisions regarding the management or disposition of the spent fuel.

BONNER, PATRICK, SOUTH GATE, CA
PAGE 1 OF 2

9616 Deeble St Apt A
South Gate CA 90280
May 5, 1996

To the United States Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington DC 20026-3786

I am seriously concerned about the Programmatic Environmental Impact Statement prepared for the Department of Energy regarding Storage and Disposition of Weapons-Usable Fissile Materials.

Although I recognize the need to assure safe, secure, long-term storage and disposition of the significant quantities of surplus fissile materials, I believe this document fails to address very important issues. Additional alternative sites must be considered. 1/01.04.00

In reviewing the alternative for the possible future of the Pantex site in the Texas Panhandle, it becomes evident that all of the nation's weapons-usable plutonium not in active warheads would be stored at Pantex.

Before 1989, plutonium pits were never stored at Pantex. But with the closing of Rocky Flats, Pantex has become the interim storage site for at least 12,000 pits. Now this document proposes storing not only plutonium pits, but other more undesirable forms of plutonium.

Pantex is being considered for a plutonium pit disassembly/conversion facility to cut the pits and process them into metal or oxide, a plutonium conversion facility to process other types of Plutonium, a facility to mix plutonium with uranium, nuclear power reactors, and storage of spent fuel from the reactors, and storage of all mixed waste generated from these processes.

The document fails to address the impact on agricultural products produced in the Texas Panhandle. And it fails to address the location of Pantex above the Ogallala aquifer, which provides groundwater for the plains of Texas and seven other Midwestern food producing states. Pantex has already contaminated the fine-grained layer of water-bearing sands above the Ogallala aquifer with high explosives, chemicals, solvents, and radionuclides. With the downward migration of the recharging waters, how long will it be before the Ogallala is contaminated? 2/09.09.04 3/09.04.04

Food is our nation's most important product and must be protected.

M-163

01 04 00 **Comment Number 1**

Comment noted.

09 09 04 **Comment Number 2**

The PEIS considers and analyzes the impacts to prime farmlands potentially caused by air emissions and radiation releases to determine any effects on agricultural products. Statements can be made that part of a region's economy (for example, agriculture) would be adversely impacted by a release of nuclear material.

09 04 04 **Comment Number 3**

Current and future operations at Pantex are not expected to affect the water quality of the Ogallala Aquifer. However, since this aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge), Pantex operations contribute to the depletion of the Ogallala Aquifer and are analyzed in the PEIS.

The Texas Panhandle is too valuable an agricultural area to be jeopardized by using it for plutonium storage, processing and waste. 4/08.03.01

Sincerely

Patrick Bonner

M-163

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

BRECHIN, VERNON J., MOUNTAIN VIEW, CA
PAGE 1 OF 6

June 7, 1996

Vernon J. Brechin
255 S. Rengstorff Ave. #49
Mountain View, CA
(415) 961-5123

DOE-Office of Fissile Materials Disposition
c/o SAIC-PEIS
P.O. Box 23786
Washington, DC 20026-3786

Dear Sir:

What follows are my:

Public Comments on the
"Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement" - February 1996
(DOE/EIS-0229-D).

Henceforth, the document, upon which I am commenting upon, will be referred to as "S&D DPEIS." This document was a product of the U.S. Department of Energy's Office of Fissile Materials Disposition.

General comments:

This S&D DPEIS document did a better job of presenting and analyzing the numerous alternatives then did some of the other EISs that I have reviewed. I counted 16 alternatives in this draft document and found that to be excessive. If one adds in the site options, the number of overlapping and interacting alternatives climbs to over a hundred. This does not help the public or other agencies to analyze the options. I was glad to see that the Department had dropped the accelerator based transmutation scheme as being too uncertain. 1/01.04.00

I hope the final S&D DPEIS drops all the alternatives that do not lead directly to very near-term stabilization and storage. The chosen storage form should be ready for disposal in a High Level Nuclear Waste Repository or be ready for conversion to such a form. All the alternatives, that lead to the production of MOX fuel for use in a wide variety of reactors, should be dropped. These schemes are clearly designed to prop-up nuclear power advocates despite the clear economic uncertainty of future nuclear power development. The department's biggest environmental headaches resulted from the feeding of fissile materials into reactors. Until, the department is actually engaged in the final disposition of reactor produced wastes, they should not be suggesting the deliberate production of more reactor produced wastes. 2/01.04.00 3/08.03.01

I favor the long-term storage alternative that involves the "collocation of plutonium and highly enriched uranium at a single site." I suggest that you reconsider a site which you apparently 4/08.03.01 5/01.04.00

M-266

01 04 00 **Comment Number 1**

Comment noted. While the PEIS evaluates a significant number of technical alternatives and sites, DOE feels this is not an excessive number since two proposed actions are being evaluated: long-term storage and disposition of weapons-usable fissile materials. Furthermore, the same six DOE sites are evaluated for both storage and disposition.

01 04 00 **Comment Number 2**

Comment noted.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for the Collocation Alternative. Decisions on storage alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 04 00 **Comment Number 5**

Combined storage of pits and non-pit Pu at the Manzano WSA was originally eliminated as a reasonable alternative in the Draft PEIS. After considering separate storage of pits from non-pit Pu, the option to store these pits at the Manzano WSA no longer appears unreasonable. The Manzano WSA was evaluated in the Pantex EIS and Section 2.1.3 of the Final PEIS. The Final PEIS was revised to clarify the consideration of the Manzano WSA for combined storage, and a description of the WSA was included in Appendix P.

dropped with little explanation. This site is at Kirtland Air Force Base's Manzano Weapons Storage Area. This site could quickly accommodate pit storage, and the construction of new storage facilities could be performed quickly and economically due to the existing infrastructure that surrounds the base. — 5/01.04.00 cont.

In the "Disposition" options, I favor the "vitrification" alternative in the "immobilization" category. My second choice is for "Ceramic Immobilization" either in the "Immobilization Category" or in the "Deep Borehole Category." The processing site should be located at the single site where the surplus fissile materials are stored. — 6/08.03.01 7/08.03.01 8/08.03.01 9/08.03.01

Upon close examination, of the four thick volumes that constitute the S&D DPEIS, it became clear to me that many of the proposals were highly conceptual in nature. It seems that little thought has gone into the cost and the interrelatedness of most of the numerous proposals. This makes it difficult for the public and other agencies to evaluate the merits of the various proposals. The DOE should reduce the alternatives down to five or less, provide an end depth analysis, and then reissue another draft S&D DPEIS document. — 1/01.04.00 cont.

I will now comment on specific problems I have found in this 14 pound stack of documents. All 18 Figures which show the outline or the boundaries of the Nevada Test Site need to be corrected. The portion of the test site, withdrawn under Public Land Order 1662 is not shown on your maps. This portion of the test site extends to the east and lies next to the northeast corner of Area 15. A depiction of this area can be found on page 4-10 in Part A of Volume 1 in the "Draft Environmental Impact Statement for the Nevada Test Site and Off-site Locations in the State of Nevada" - January 1996 (DOE/EIS 0243). All the other maps in this document are also in error. This is due to a deliberate attempt to hide the existence of this area which was once known as Area 51. For 38 years this deception has been propagated throughout all levels of DOE HQ including the Inspector Generals office. The deception has made its way into documents that are presented to Presidential and Congressional oversight committees. DOE has issued hundreds of tons of documents, containing these deceptive maps, which are now found in government repository libraries all across this country. The Cold War has ended and its about time this deception was ended. Please correct the map drawings in the following figures. — 10/09.01.02

S&D DPEIS
Volume I

p.2-18	Figure 2.2.2-1.	2935-NTS/S&D
p.2-19	Figure 2.2.2-2.	2936-NTS/S&D
p.2-35	Figure 2.2-2.	2958-NTS/S&D
p.2-62	Figure 2.3.2.2-3.	3175/S&D
p.2-63	Figure 2.3.2.2-4	3176/S&D
p.2-71	Figure 2.3.3.2-3.	3139/S&D
p.2-72	Figure 2.3.3.2.4.	3138/S&D
p.2-78	Figure 2.4-2.	2940-NTS/S&D
p.3-68	Figure 3.3.1-1.	2468-NTS/S&D
p.3-69	Figure 3.3.1-2.	2574-NTS/S&D

M-266

08 03 01 Comment Number 6

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 7

The Department of Energy acknowledges the commentor's support for the Ceramic Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 8

The Department of Energy acknowledges the commentor's support for borehole disposition using the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 9

Comment noted.

09 01 02 Comment Number 10

On June 20, 1958, *Public Land Order 1662* reserved approximately 15,540 hectares (ha) (38,400 acres) for use by the Atomic Energy Commission (AEC) in connection with NTS. The lands described under this Public Land Order are not considered for any storage and disposition alternative. Therefore, the figures in the PEIS do not depict the land area withdrawn under *Public Land Order 1662*.

BRECHIN, VERNON J., MOUNTAIN VIEW, CA
PAGE 3 OF 6

p.3-76 Figure 3.3.4-1. 2404-NTS/S&D p.3-77 Figure 3.3.4-2. 2405-NTS/S&D p.3-81 Figure 3.3.5-1. 2406-NTS/S&D p.3-83 Figure 3.3.6-1. 5125-NTS/S&D p.3-86 Figure 3.3.6-2. 2408-NTS/S&D Volume II p.4-792 Figure 4.5.1-3 2994-NTS/S&D p.4-793 Figure 4.5.1-4 2995-NTS/S&D Volume III p.M-32 Figure M.2.5-1 2957-NTS/S&D	10/09.01.02 cont.
Summary Volume After the "METRIC CONVERSION CHART" a fact sheet should be provided that briefly describes the characteristics of Pu-239 including its half-life and why it needs to be isolated from the human environment for over a quarter million years. I suggest that you obtain the fact sheet from the Institute for Energy and Environmental Research in Takoma Park, Maryland.	11/08.02.00
Page S-1, Box that describes what constitutes "Weapons-Usable Fissile Materials" It states "All isotopes of Pu..." As such, the Summary Volume and Volume I should state clearly on the "COVER SHEET" and in the "TABLE OF CONTENTS" that a classified appendix has been prepared which involves the separation of plutonium-242, at Savannah River Site's F-Canyon reprocessing facility, for use in the DOE weapons program. The reasons for this classified appendix needs to be explained and all aspects of this project, that have environmental consequences, need to be declassified.	12/10.03.00
Page S-4, "SCOPE OF THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT" Third paragraph. This should mention the many metric tons of Pu-239 that lie below the 11 underground nuclear explosion testing sites in the U.S.	13/01.00.00
page S-6, "Development of Disposition Alternatives" "(7)Euratom mixed oxide (MOX) fuel fabrication/reactor burning." It appears that the various MOX options could only be justified if, in the short-term, we paid a premium for Euratom to process our fuel. This alone, should have disqualified all the MOX options. This MOX option, including the need to utilize European facilities, is also mentioned on page S-15 and on the last few lines under "Reactor Category" on pages-23. Since the Europeans cannot support our long-term program we would have to build our own MOX fuel fabrication plant. In the second to the last paragraph on page S-32 it is suggested that a MOX fabrication plant would have virtually no environmental impact on DOE sites. If this is so, then why does such a plant have to go through a gauntlet of licensing procedures that could prevent the plant from ever going into operation?	14/06.01.09
Page S-7, Middle of second paragraph. It should be made clear that while all the MOX fuel will be consumed, most of the Pu-239 will remain in the wastes that is discharged from the reactors.	15/09.11.08

M-266

08 02 00 **Comment Number 11**

Based on the comment, the half-life of Pu-239 has been included in the text of the PEIS (Chapter 7, *Glossary*).

10 03 00 **Comment Number 12**

The foreword acknowledges the Classified Appendix and includes a brief description of its content. The appendix cannot be declassified at this time.

01 00 00 **Comment Number 13**

These materials are not considered weapons-usable and, therefore, are not included in the scope of this PEIS.

06 01 09 **Comment Number 14**

Comment noted. DOE is evaluating various sites in the United States for MOX fuel fabrication using surplus weapons-usable Pu. DOE is also considering some initial MOX fuel fabrication in Europe (for example, Lead Test Assemblies and core loads). Initial fabrication in Europe could accelerate the start date by a few years.

09 11 08 **Comment Number 15**

The Summary of the Draft PEIS was revised to state that MOX fuel is not actually consumed through irradiation, but Pu-239 is fissioned. The MOX fuel would be used in the reactor until it meets the Spent Fuel Standard or is no longer usable for generation of electric power. Upon removal, the spent MOX fuel assemblies would still have some Pu-239 similar to spent conventional uranium fuel assemblies.

Page S-34, "Partially Completed Light Water Reactor Alternative" First line of the third paragraph. "Use of a partially completed LWR where construction of the reactor, turbine and auxiliary buildings, and cooling towers and ponds has been halted would involve the completion of these facilities with the implementation of this alternative." The use of the U.S. DOE to prop up a severely failed private project is not an appropriate use of tax dollars. | 16/08.03.01

Volume I

Page 2-110, "Transportation." The second line indicates that High Level Waste (HLW) would be transported "...(via pipeline)." There was no further description or analysis of this option. It was also not clear how the cesium-137 capsules would be transported and I did not see any analysis of this issue. | 17/10.00.00

Page 3-67, First line.
Change 350,000 ha to 322,195 ha and change 864,000 acres to 796,160 acres. The later values are the legal values. | 18/09.01.02

Page 3-227, Second paragraph, sixth line.
"However, some stored nuclear materials will require additional processing or conversion into forms suitable for continued safe storage, use or transportation to other DOE sites." If this statement is in reference to the plutonium-242 at Savannah River Site's F-Canyon reprocessing facility, then the PEIS should make this clear. If the reference is to some classified activity then this fact should be clearly stated in the PEIS. | 19/09.00.06

Volume II

Page 4-443, First paragraph, first line.
"During the post-closure period, the borehole array area of 25 ha (60 acres will be declared a limited access area indefinitely,..." The S&D PEIS should explain, in detail, what is meant by the term "indefinitely." At the end of the paragraph, the term "perpetuity" is used. Again, the reader deserves to know what is meant by the use of this term. The last line then states that "Such restrictions could be institutionalized by constructing drilling barriers and installing a variety of permanent markers." Just how permanent would these markers need to be? Should we expect the institutionalized DOE bureaucrats to maintain these barriers long after our federal government has collapsed? Could this provide job security for the next quarter million years? | 20/09.02.08

I suggest that the terms Indefinitely, Institutionalized, Perpetually and Perpetuity be added to the Glossary. | 21/16.00.00

And a final note:
In Volume III, on page G-23 there is "Figure G.4-4. AT-400A Packaging for the Transport of Plutonium Pits." The plutonium-239 pit is the heart of a nuclear weapon and I do realize why the pit sphere in the center is not drawn to scale. In any case, there has been a mix-up in the labeling of the shipping container parts | 22/10.00.00

M-266

08 03 01 **Comment Number 16**

The Department of Energy acknowledges the commentor's concern about the disposition of Pu using the partially completed LWR (commercial). Decisions on the disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

10 00 00 **Comment Number 17**

Further information concerning this statement regarding the Vitrification Alternative can be found in Section 4.4 and Appendix G of the PEIS. Data summaries regarding the transport of high-level waste (HLW) as well as Cs pellets are located in Table 4.4.2.2–1.

09 01 02 **Comment Number 18**

The NTS land area as presented in the PEIS is identical to that in the *Nevada Test Site Development Plan* and the *Final Environmental Impact Statement for NTS and Offsite Locations in the State of Nevada, Volume I, Chapters 1-9, Part A*, January 1996. Section 4.2.2.1 of the Final PEIS was revised to reference these documents.

09 00 06 **Comment Number 19**

The information presented in Chapter 3 of the PEIS depicts the "Affected Environment" for the various storage and disposition sites analyzed in the document. The affected environment descriptions provide the context for understanding the environmental changes that may be brought about by implementation of the Proposed Action and alternatives.

Consequently, Section 3.7 describes environmental conditions as they currently exist at SRS. This includes some material which was identified in the *Plutonium Working Group Report on Environmental, Safety and Health (ES&H) Vulnerabilities Associated with DOE's Plutonium Storage* as requiring corrective actions to ensure compliance with high-priority ES&H requirements. These corrective actions are assumed to have been completed as part of the No Action

BRECHIN, VERNON J., MOUNTAIN VIEW, CA
PAGE 5 OF 6

diagram. The labels "Stainless Steel/Foam Insert Cover (Lower)" and "Containment Vessel Lower Shell" have been interchanged. I suggest that this be corrected. 22/10.00.00 cont.

-END-of comments

Sincerely,

Vernon J. Brechin

Vernon J. Brechin

cc. Kathleen A. McGinty - Council on Environmental Quality
William D. Dickerson - EPA
Christopher Paine - Natural Resources Defense Council (NRDC)
Arjun Makhijani - Institute for Energy and Environmental Research (IEER)
Joan Glickman - Public Accountability (HQ DOE)
Dan W. Reicher - PDAS for Policy (HQ DOE)
Robert Alvarez - DAS for Natl Sec & Env Rest Pol (HQ DOE)
Senator John Glenn - (Ohio)
Senator Harry Reid - (Nevada)
Senator Richard H. Bryan - (Nevada)
Stephen I. Schwartz - Nuclear Weapons Cost Study Group The Brookings Institution, Wash., DC

M-266

Alternative, and, prior to transportation to any storage or disposition site, analyzed in the PEIS. A brief description of the corrective actions planned under the No Action Alternative for SRS are presented in Section 2.2.6 of the PEIS.

09 02 08 Comment Number 20

Words such as "indefinitely" and "in perpetuity" are used in this case because the fissile materials emplaced at the Deep Borehole Disposal Facility would be required to remain safe, secure, and monitored by national means of detection for a very long time. Since the half-lives of Pu-239 (24,500 years) and its fissile decay product, U-235 (7.1×10^8 years) are so long, the intended use of these two words is essentially the same.

An important criteria every reasonable disposition alternative must meet is "to provide resistance to retrieval, extraction, and reuse by the host nation." To satisfy this criteria, the borehole complex will be made as visible as possible to domestic and international means of detection. One way this can be done is to make the borehole array a limited access area (LAA) and restrict surface activities around the array "indefinitely." Installing highly visible permanent markers makes the deep borehole array easier, for means of detection, to locate and observe during the post-closure period. Thus, this action will allow any monitoring agency to determine if the area is being entered on a regular basis. By installing barriers to drilling, any attempt by the host or other nation, to extract the material from the deep borehole array would take more time than if the barriers were not there. The additional retrieval time will ensure that any interested, monitoring agency would be able to detect and react to the excavation attempt long before the material could actually be extracted.

The Department of Energy expects that if a Deep Borehole Alternative is selected, these or similar actions would be put in place and used until such time that meeting this criteria was no longer important to our national interests.

16 00 00 **Comment Number 21**

These terms are used in a manner consistent with common usage, and therefore, not included in the Glossary.

10 00 00 **Comment Number 22**

The commentor is correct, and the change was made to Figure G.4–4.

BREEDING, PAULA
PAGE 1 OF 2

I don't live by Pantex, but I do own land across from Pantex. I am considered an environmentalist ~~although~~ I have never hugged a tree in my life. I am very concerned about the water in our area. It looks like our City Fathers would be, since they are pumping our water from underneath Pantex, and it can hurt them as much as any one. However they bragged about drinking water at Rocky Flats, so I guess we can't expect much from them.

Some people try to dismiss as being tree huggers,

I don't want PU stored here. However we are doing it now, and I expect Pantex to be the dumping ground for PU. I am not a NMBE person. I don't want it here but I don't think someone else should have the problem. It is also too dangerous to transport. 1/08.03.01

We are asking for disaster if PU processing comes to Pantex. We will be another Rocky Flats, and probably worse.

There was an editorial in the paper today by a Pantex employee. He said in part "In the event that Pantex is chosen to do new types of work and a different mission, the work force will decide whether to proceed or not. All the approval from the DOE, the labs, Congress and the President himself will not persuade Pantexans to do

TX-058

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Waste/hazardous material treatment/handling operations are regulated to minimize the potential for releases of hazardous substances to the soil or surface water which could then migrate to the groundwater.

something we think should not be done". I guess that is one of the most naive statements I have ever heard. This might happen on private business but I don't think an employee could tell DOE what to do. By the time he finds out how things are and how dangerous they are, it will be much too late. He will also find out he can't make as money as he does at Pantex.

I hope we can find some way to dispose of PU that is not hazardous to our land, water, and air. If we do, then I guess miracles do happen.

TX-058

BRESEE, BRIAN, LAS VEGAS, NV
PAGE 1 OF 2

To DOE;

I am native to Las Vegas and the idea of sending everyone else's garbage in my backyard rings a chord of deep anger.

I sense a spirit of great arrogance those in power have in dealing with our nuclear waste problem. They don't know the Beauty of the desert the way I know it so they take our whole state as a waste land. It's easy for a New Yorker or Floridan to care less when our water is ~~the~~ tainted with nuclear pollutant, or an accident ruins the image of our city as a place of destination.

I don't trust our government to be honest about these matters. They weren't honest to my family living in Southern Utah.

M-040

(Cheap Power)
The State economy's that benifit from Nuclear power should be the the Same states that live with the risK of that benifit.

I am Strongly against Nuclear waste being stored in my backyard. I asK that all this bullying come to an end and that idea of States right's be brought to mind. This State doesn't want your garbage. 1/08.03.01

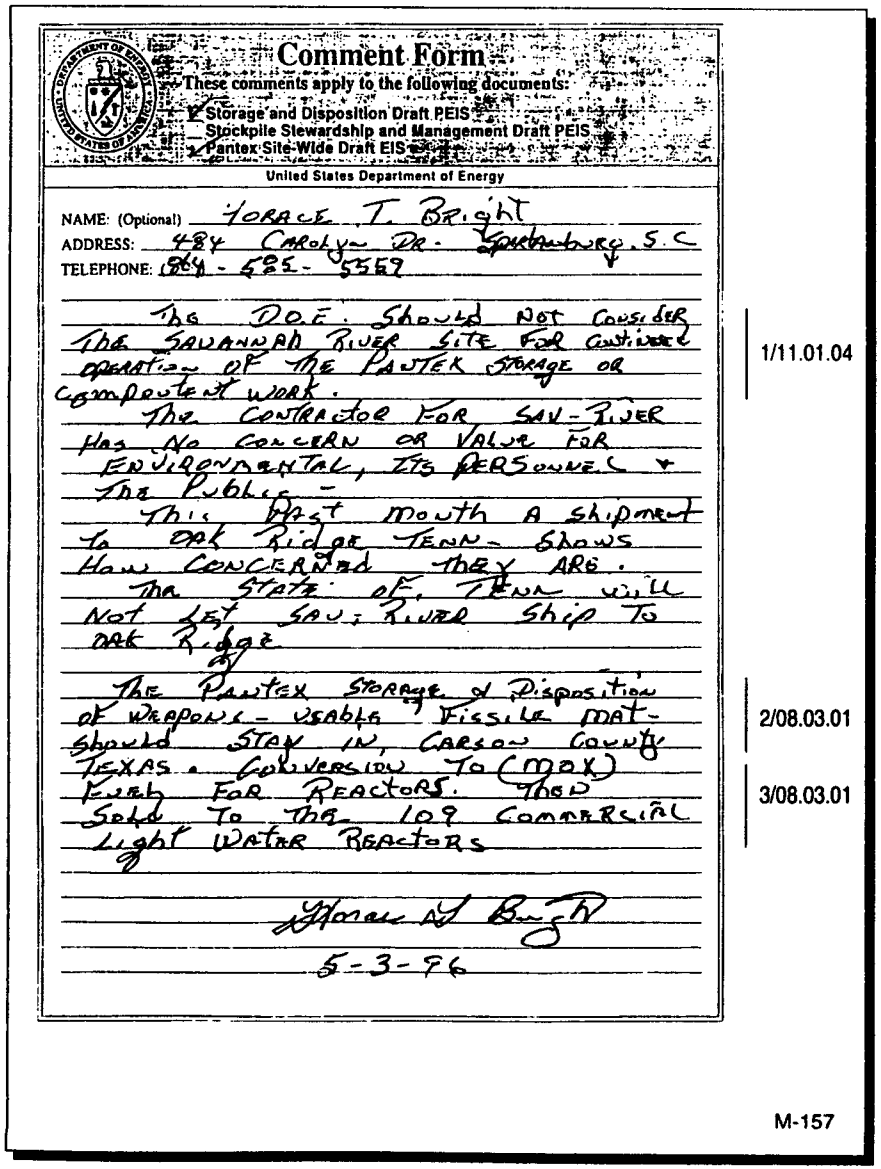
Brian Bresee

M-040

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at NTS. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

BRIGHT, HORACE T., SPARTANBURG, SC
PAGE 1 OF 1



Comment Form

These comments apply to the following documents:
- [x] Storage and Disposition Draft PEIS
- [ ] Stockpile Stewardship and Management Draft PEIS
- [x] Pantex Site-Wide Draft EIS

United States Department of Energy

NAME: (Optional) HORACE T. BRIGHT
ADDRESS: 484 CAROLYN DR. SPARTANBURG, S.C
TELEPHONE: 864 - 585 - 5559

THE DOE. SHOULD NOT CONSIDER THE SAVANNAH RIVER SITE FOR CONTINUED OPERATION OF THE PANTEX STORAGE OR COMPONENT WORK. 1/11.01.04

THE CONTRACTOR FOR SAV-RIVER HAS NO CONCERN OR VALUE FOR ENVIRONMENTAL, ITS PERSONNEL & THE PUBLIC.

THIS PAST MONTH A SHIPMENT TO OAK RIDGE TENN - SHOWS HOW CONCERNED THEY ARE. THE STATE OF TENN WILL NOT LET SAV. RIVER SHIP TO OAK RIDGE

THE PANTEX STORAGE & DISPOSITION OF WEAPONS - USABLE FISSILE MAT- SHOULD STAY IN, CARSON COUNTY TEXAS. CONVERSION TO (MOX) FUEL FOR REACTORS. THEN SOLD TO THE 109 COMMERCIAL LIGHT WATER REACTORS 2/08.03.01 3/08.03.01

Horace T Bright
5-3-96

M-157

11 01 04 **Comment Number 1**

The interim storage of Pantex pits and equipment at SRS was addressed in the Pantex EIS.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the comment in support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

BRODIE, ROSEMARY E., SEATTLE, WA
PAGE 1 OF 1

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): Rosemary E. Brodie
Address (optional): 3812 NE 60th
Seattle, WA 98115

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. **Materials Immobilization/Vitrification** - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.
This must be done for all the radioactive waste. | 1/08.03.01

2. **Deep borehole disposal** - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.
No good | 2/08.03.01

3. **Reactor Options** - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.
No good | 3/08.03.01

4. **Storage Options** - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.
No good | 4/08.03.01

M-248

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for new missions at Hanford. Decisions on storage and disposition of weapon-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's opposition to long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

BRUNNENKANT, C., SEATTLE, WA
PAGE 1 OF 2

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): C. BRUNNENKANT
Address (optional): 12850 - 72 Ave S
Seattle 98178

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by **May 7, 1996**.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. **Materials Immobilization/Vitrification** - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

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3. **Reactor Options** - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

4. **Storage Options** - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites

M-228

Please use this space to write down any additional comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

My primary concern is to dispose of plutonium in a way that it is hard to retrieve it as bomb material

I am interested in moving ahead ~~with~~ in encouraging the Russians to dispose of their PU material, even if it takes some of my tax $. Maybe a first step would be to help the Russians safeguard their weapons grade material 1/01.03.00

Cost should be considered as well.

M-228

01 03 00 **Comment Number 1**

Comment noted.

BURDITT, ROBERT B., OAK RIDGE, TN
PAGE 1 OF 4

April 23, 1996

124 Hampshire Court
Oak Ridge, TN 37830

U. S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

Sir:

I am attaching some specific comments on the Draft Programmatic Impact Statement on the Storage and Disposition of Weapons-Usable Fissile Materials. I have only had a limited amount of time for this review and so I have confined my comments to the summary document, although I have made a cursory review of the other documents. I am particularly concerned about three issues: (1) why Los Alamos, which is scheduled to be a plutonium production facility was not considered as a site, while Oak Ridge, which has no other planned plutonium activities was considered as a plutonium site; (2) why, since Oak Ridge already has storage capability and is anticipated to be an ongoing site with appropriate safety and security provisions, other alternatives for storage are given consideration; and (3) why high risk, expensive disposition alternatives such as borehole disposition are being considered when mixed oxide use in reactors would provide an effective and profitable disposition or disposition in CANDU reactors would be acceptable with appropriate IAEA oversight and inspection. 1/01.05.00 2/01.05.00 3/01.05.00

It would appear that the experimental and wasteful disposition alternatives would also divert dollars that are badly needed for completing programs for waste disposition activities on which billions of dollar have already been expended.

I regret that there was not more involvement in the disposition hearings in Oak Ridge This was an inevitable consequence of the combining of this hearing with the Stockpile Stewardship and Management Program and the assumption that the results of this hearing were inevitable and acceptable and that there were significant uncertainties about the SSMP hearing results. I believe that even though there was not much participation in the hearings, you would find that a decision to site a plutonium processing facility in Oak Ridge would lead to a major uproar, as would a decision to move uranium storage out of Oak Ridge 4/08.03.01

Robert B Burditt

Sincerely, Robert B. Burditt
Retired Program Manager for Weapons Manufacturing Development, Y-12

Attachment

M-057

01 05 00 Comment Number 1

The selection process for candidate storage sites, including the criteria for selection and reasons for elimination, is described in Chapter 2 of the PEIS.

01 05 00 Comment Number 2

Under NEPA, DOE is required to look at a range of reasonable alternatives where HEU storage could be accomplished, and to compare the environmental impacts of storage at this range of sites. The storage decision will be based on technical, cost, schedule, and nonproliferation considerations as well as the analyses in the PEIS.

01 05 00 Comment Number 3

This PEIS analyzes the environmental impacts of a range of reasonable alternatives that are within acceptable environmental limits. Analyses of the cost, schedule, technical, and Nonproliferation Policy impacts of these alternatives are presented in separate documents to support DOE's ROD. The documents related to technical, cost, and schedule analyses were made available for public review beginning in late July 1996. The nonproliferation analysis was made available to the public beginning in October 1996.

08 03 01 Comment Number 4

The Department of Energy acknowledges the commentor's opposition to new missions at ORR. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

DISPOSITION QUESTIONS

Page S-2 Why is 50 years considered long term? What happens after that? Has any thought been given to truly long range impacts, 100 years or more?	5/02.00.08
Page S-6 Why is Los Alamos not considered as a potential site, since this is the one place where Pu production activities are scheduled? How can Los Alamos do Pu production without a storage capability?	1/01.05.00 cont.
Page S-13 What validation do we have for the borehole concept?	6/01.05.00
Page S-13 How can we evaluate alternatives without knowing that we have an acceptable site?	7/01.04.00
Page S-14 Do we really believe the radiation field would deter a committed terrorist?	8/13.00.00
Page S-14 Why the push for EMT and vitrification over established oxide technology?	9/01.04.00
Page S-14 Why is the absence of an MOX (mixed oxide) facility considered a problem, but the absence of an EMT (electrometallurgical treatment) or vitrification facility is not considered a problem?	10/01.04.00
Page S-16 Would handling of weapons materials by Canada require a change in Canadian law rather than just government approval	11/06.05.09
Page S-31 Why is it that only at Pantex is the Pu facility considered to be in conflict with the land use plan?	12/09.01.04
Page S-33 Why are we so confident that there will be no spills or exposures with Pu, yet we projected significant releases when discussing beryllium at Oak Ridge?	13/09.09.08
What , if any, non-proliferation safeguards/ inspection provisions have been considered in this study?	14/01.06.00
Is there not an inherent contradiction between this study, which considers Oak Ridge as a site for plutonium operations, and the Stockpile Stewardship and Management Study, which says that locating plutonium will not be considered an option for any facility which is not already involved in plutonium operations?	15/11.01.05

M-057

02 00 08 **Comment Number 5**

Fifty years was used as the timeframe for long-term storage for the environmental analysis. To increase this to 100 years or more would lead to a highly speculative environmental analysis, which would be contrary to the intent of NEPA. Fifty years also covers reasonable facility life cycles.

01 05 00 **Comment Number 6**

The Borehole concept was recommended for consideration in the PEIS by the NAS in their 1994 study, *Management and Disposition of Excess Weapons-Usable Plutonium*. Substantial experience on boreholes has been developed by Russia and other countries. The technology for drilling holes of this depth, diameter, and straightness needed for this kind of Pu disposition exists in the United States today. Technical and licensing issues related to the Borehole concept have been considered by DOE in their technical evaluations of storage and disposition alternatives. The technology appears quite feasible, although more work would have to be done on this concept before it could be implemented.

01 04 00 **Comment Number 7**

All the sites analyzed for the Pu disposition alternatives are acceptable sites. DOE cannot select sites for these alternatives at this time since some alternatives need further actions. For example, to select a site for the Existing LWR Alternative, DOE needs to issue a Solicitation of Interest to the commercial sector and then determine, from responses to the Solicitation, which site would be most suitable for implementing the Proposed Action.

13 00 00 **Comment Number 8**

The intent is to make the surplus Pu as unattractive and inaccessible as spent nuclear fuels. A committed terrorist would have to have the technical specialists and equipment to transport these radioactive materials and conduct extensive remote chemical processing in order to extract the Pu for weapons use.

01 04 00 **Comment Number 9**

The PEIS attempted to analyze all alternatives consistently. No preference was expressed within the Draft PEIS for immobilization over other alternatives. A Preferred Alternative is identified in the Final PEIS. In addition to the environmental analyses reflected in the PEIS, DOE has conducted technical, schedule, cost, and policy evaluations of each alternative. All of these factors will be considered in reaching the ROD.

01 04 00 **Comment Number 10**

As described in this PEIS, for Pu disposition, various sites were used for analysis purposes to provide an estimate of their environmental impacts. For each alternative, existing facilities, if possible, were used to provide reference data. If there were no existing facilities, such as the case of MOX fuel fabrication, the conceptual design of a new facility was used for the environmental analysis.

06 05 09 **Comment Number 11**

Several agreements would require negotiations with the Canadians to implement the CANDU Reactor Alternative. No modifications to Canadian law have been identified.

09 01 04 **Comment Number 12**

As discussed in Section 4.3.4.1.1, page 4–526 of the Draft PEIS, Zone 4 is the proposed location for the vitrification facility at Pantex. The master plan of the *Pantex Plant Site Development Plan* designates Zone 4 for weapons and weapons components staging. Therefore, the potential action would be inconsistent with the current site development plan. However, Pantex could revise the site development plan in accordance with the proposal. The Proposed Action would be in compliance if this change is approved, resulting in no impact to land resources. Section 4.3.4.1.1 of the Final PEIS was revised to include this condition.

09 09 08 **Comment Number 13**

The human health risk of exposure from normal and accidental releases of Pu is considered for all of the alternatives and presented in this PEIS. Chapter 4 and Sections M.2 and M.5 quantify the impacts of normal operational and accidental releases of Pu. Beryllium operations that are conducted at ORR are not within the scope of the alternatives under consideration in the PEIS.

01 06 00 **Comment Number 14**

All long-term storage and disposition alternatives considered in the Storage and Disposition PEIS would be subject to IAEA safeguards and inspections if implemented. These provisions would apply until the materials achieved a proliferation-resistant condition. Independent of the PEIS, DOE has conducted a nonproliferation assessment of each technology alternative. The results of these assessments will be factored into the ROD on the Storage and Disposition PEIS.

11 01 05 **Comment Number 15**

The ORR storage site at the Y–12 Plant (Y–12) is a candidate storage site being analyzed in the Storage and Disposition PEIS since it currently stores weapons-usable HEU. Six DOE sites, including ORR and other generic and specific sites, are analyzed to provide perspectives for the extent of environmental impacts from the various reasonable alternatives.

BURNS, CASEY, IDAHO FALLS, ID
PAGE 1 OF 2

Casey Burns
1438 Ashment Apartment 1
Idaho Falls, ID 83404
April 15, 1996

Have you ever turned on the television, light bulb, or microwaved a hot dog? How would you like it if this were not possible not only for you, but for your children and grandchildren as well? Part of the electricity used to cook that hot dog, power the T.V., and light the light bulb comes from nuclear power. Isn't it interesting one nuclear reactor provides more power per day than all the hydroelectric dams on the Snake River combined, without damaging the habitat of the fish?

Idaho doesn't have to become a waste repository. What Idaho needs to become is a leader concerning the future of spent nuclear fuel. With your knowledge about the subject, surely you can see that the only feasible solution is to reprocess this spent fuel at the Idaho Chemical Processing Plant. There is one catch however, in order to process this spent fuel, there needs to be a waste repository site. There are sites already waiting to be opened at WIPP and Yucca Mountain. As Idaho was one of the leaders in the forefront of shutting these projects down, Idaho needs to be a leader in the reopening of these waste repositories. Then we can deal with Idaho's main concern: spent nuclear fuel being stored at the INEL. 1/08.03.01

The spent fuel will not go away, however the implementation of WIPP and Yucca Mountain, along with the restart of the Idaho Chemical Processing Plant, will provide a solution for the nuclear waste issue. What the Department of Energy needs to do is to implement a complete nuclear fuel cycle and, at the same time, show the American public the benefits of nuclear energy. If these two sites were operational, the Idaho Chemical Processing Plant could start up again and reclaim the fuel. Uranium is a natural resource that is NOT renewable and needs to be recycled. 2/15.00.00

There are people who would like the general public to believe that the nuclear industry is not safe. This is just not true! With the stringent guidelines implemented by both the United States Nuclear Regulatory Commission and the Department of Energy, we are safer today than we have ever been. There is

ID-003

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for new missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input. However, the President's Nonproliferation Policy says the United States will not recycle Pu. The operation of the Idaho Chemical Processing Plant (ICPP) is beyond the scope of this PEIS.

15 00 00 **Comment Number 2**

Idaho National Engineering Laboratory is one of six candidate storage sites considered in the PEIS. DOE will base its final decisions on the results of environmental analyses, information from technical and economic studies, national policy objectives, and public input. Decisions regarding potential repositories for transuranic (TRU) waste, HLW, and spent fuel will be made by DOE pursuant to separate NEPA reviews. DOE is committed to removing spent nuclear fuel from INEL by 2035, although such spent fuel is beyond the scope of this PEIS. Similarly, the operation of the ICPP, and associated socioeconomic benefits, is beyond the scope of this PEIS.

greater probability for accidents involving automobiles than in the nuclear industry. I'll bet you don't see people protesting against automobiles! There are also people who would like the public to believe the nuclear industry releases tons of pollutants into the atmosphere. This also is a complete fabrication. Whenever radiation is released accidentally, it is true that the measurement is in curies. However, when radiation is released on purpose, the measurement used is microcuries.

Go up Taylor Mountain in Idaho Falls early one morning and take a good look around, the haze you see is us, slowly killing the environment as well as ourselves. Each year over two hundred million tons of pollutants are introduced into the atmosphere by coal fired power plants! Of this two hundred million tons, there are significant quantities of radiation being released into the environment, including Radium-226! Are we supposed to bury our heads in the sand and do nothing about this? My answer is ABSOLUTELY NOT!! If we don't press forward with safe, clean, high efficient power plants, whether they be nuclear or not, I see nothing but a bleak future for generations to come.

Are you aware of the economic benefits spent nuclear Navy fuel has upon our state? By allowing spent nuclear Navy fuel shipments into Idaho along with the start up of the Idaho Chemical Processing Plant, we would be able to offset some of the layoffs that employees of the INEL have been suffering. This would contribute greatly to the economy of Eastern Idaho as well as the rest of the state. As Idaho's third largest employer, the INEL provides thirteen percent of the tax base. Where is that thirteen percent going to be cut from the budget? Who is going to take responsibility, and provide for the families of the workers who have lost their jobs!?

2/15.00.00 cont.

The public is not educated well enough about the nuclear age to feel safe about it. In lieu of this, I encourage you to visit one of the Radiation Safety Programs at the Eastern Idaho Technical College in Idaho Falls, or at Idaho State University in Pocatello. I would be very interested in hearing your feelings and policies concerning the nuclear industry and specifically, the Idaho National Engineering Laboratory.

Sincerely,

Casey Burns
Radiation Safety Student
Eastern Idaho Technical College

ID-003

CAMPAIGN 1
PAGE 1 OF 1

U.S. Department of Energy
Office of Reconfiguration
P O Box 3417
Alexandria, VA 22302

U.S. Department of Energy
Office of Fissile Materials
P O Box 23786
Washington, DC 20026

Comments on Stockpile Stewardship and Management (SSM) PEIS: I support the selection of Pantex for weapons assembly and disassembly functions. I strongly favor the continuation of high explosives functions at Pantex, and oppose any plan to move these functions to the national labs. Since Pantex is the most cost-effective DOE facility and enjoys the strongest local support, I also support the addition of other environmentally sound stewardship and management functions at Pantex.

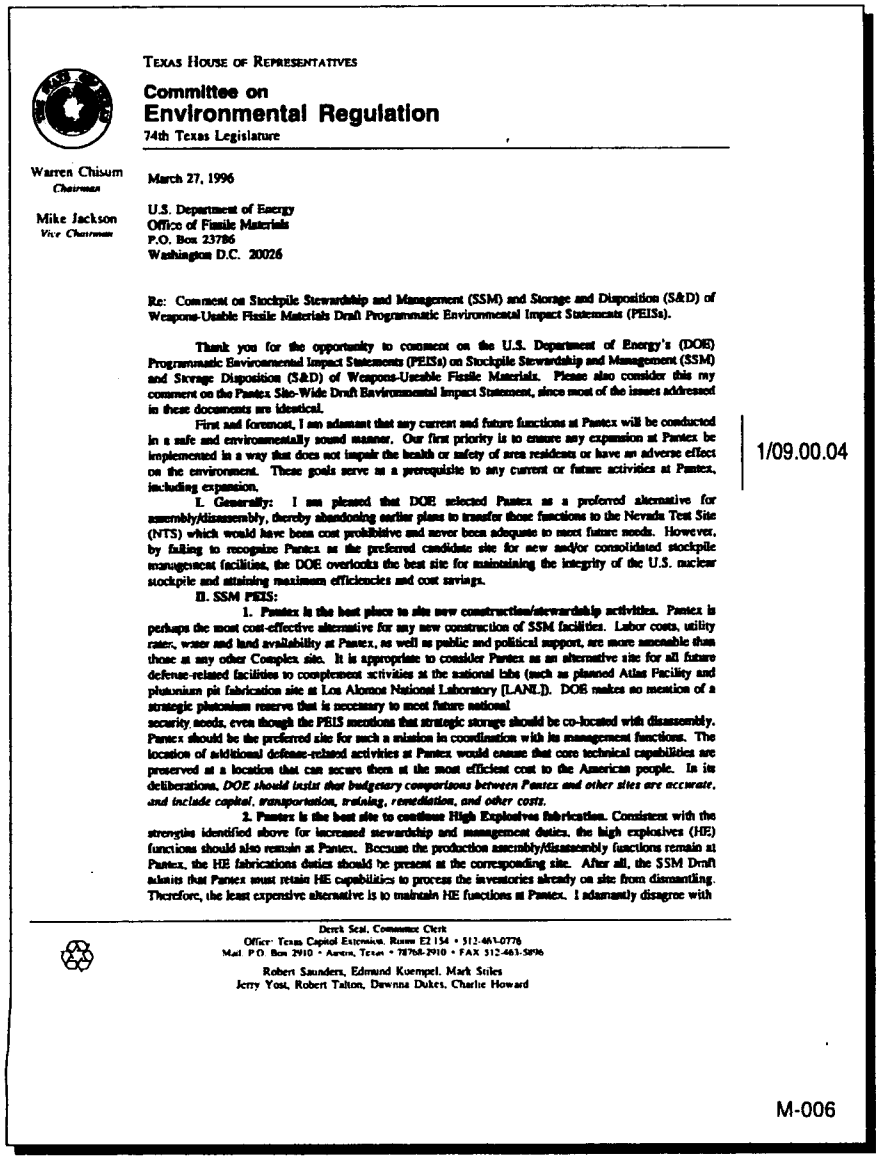
Comments on Fissile Materials Storage and Disposition (MD) PEIS: I believe that Pantex should be chosen as the location for fissile materials storage and disposition functions. Pantex already stores surplus plutonium, and has the needed safety and security capabilities to cost-effectively accommodate an expanded role. Fair budgetary comparisons, strong local support, and national security concerns, should lead DOE to choose Pantex for new fissile material storage and disposition functions that are conducted in a safe and environmentally sound fashion. 1/08.03.01

Name: [illegible] Address PO Box 50741

TX-001

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



TEXAS HOUSE OF REPRESENTATIVES

Committee on
Environmental Regulation
74th Texas Legislature

Warren Chisum
Chairman

Mike Jackson
Vice Chairman

March 27, 1996

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington D.C. 20026

Re: Comment on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statements (PEISs).

Thank you for the opportunity to comment on the U.S. Department of Energy's (DOE) Programmatic Environmental Impact Statements (PEISs) on Stockpile Stewardship and Management (SSM) and Storage Disposition (S&D) of Weapons-Useable Fissile Materials. Please also consider this my comment on the Pantex Site-Wide Draft Environmental Impact Statement, since most of the issues addressed in these documents are identical.

First and foremost, I am adamant that any current and future functions at Pantex will be conducted in a safe and environmentally sound manner. Our first priority is to ensure any expansion at Pantex be implemented in a way that does not impair the health or safety of area residents or have an adverse effect on the environment. These goals serve as a prerequisite to any current or future activities at Pantex, including expansion.

1/09.00.04

I. Generally: I am pleased that DOE selected Pantex as a preferred alternative for assembly/disassembly, thereby abandoning earlier plans to transfer those functions to the Nevada Test Site (NTS) which would have been cost prohibitive and never been adequate to meet future needs. However, by failing to recognize Pantex as the preferred candidate site for new and/or consolidated stockpile management facilities, the DOE overlooks the best site for maintaining the integrity of the U.S. nuclear stockpile and attaining maximum efficiencies and cost savings.

II. SSM PEIS:

1. Pantex is the best place to site new construction/stewardship activities. Pantex is perhaps the most cost-effective alternative for any new construction of SSM facilities. Labor costs, utility rates, water and land availability at Pantex, as well as public and political support, are more amenable than those at any other Complex site. It is appropriate to consider Pantex as an alternative site for all future defense-related facilities to complement activities at the national labs (such as planned Atlas Facility and plutonium pit fabrication site at Los Alamos National Laboratory [LANL]). DOE makes no mention of a strategic plutonium reserve that is necessary to meet future national security needs, even though the PEIS mentions that strategic storage should be co-located with disassembly. Pantex should be the preferred site for such a mission in coordination with its management functions. The location of additional defense-related activities at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost to the American people. In its deliberations, *DOE should insist that budgetary comparisons between Pantex and other sites are accurate, and include capital, transportation, training, remediation, and other costs.*

2. Pantex is the best site to continue High Explosives fabrication. Consistent with the strengths identified above for increased stewardship and management duties, the high explosives (HE) functions should also remain at Pantex. Because the production assembly/disassembly functions remain at Pantex, the HE fabrications duties should be present at the corresponding site. After all, the SSM Draft admits that Pantex must retain HE capabilities to process the inventories already on site from dismantling. Therefore, the least expensive alternative is to maintain HE functions at Pantex. I adamantly disagree with

Derek Seal, Committee Clerk
Office: Texas Capitol Extension, Room E2.154 • 512-463-0778
Mail: P.O. Box 2910 • Austin, Texas • 78768-2910 • FAX 512-463-5896

Robert Saunders, Edmund Kuempel, Mark Stiles
Jerry Yost, Robert Talton, Dawnna Dukes, Charlie Howard

M-006

09 00 04 Comment Number 1

Potential environmental consequences of each alternative at Pantex were analyzed in the PEIS. Results of these environmental analyses will be given full weight, along with other factors such as cost, technical risk, schedule, and national security requirements, in the process of selecting the storage and disposition strategy. Pantex will continue to operate in compliance with all Federal, State, and local regulations.

the statement in the draft PEIS that there are no advantages to siting high explosives at Pantex as opposed to the national labs. The capital outlay alone necessary for transfer is cost prohibitive. In addition, should future need arise for new weapons production, it will be critical to have the HE facilities at the weapons production/assembly site.

III. Fissile Materials (Plutonium) Storage and Disposition PEIS: As the sole DOE-authorized facility for assembly and disassembly of nuclear weapons, Pantex has historically handled these functions in a safe and efficient manner for more than forty years. One of the challenges faced after dismantling a significant portion of the nuclear stockpile is processing or disposal with the materials that remain. The DOE is considering several options. Once again, acknowledging cost savings considerations, Pantex could continue to store plutonium which is already at the site and upgrade facilities for any and all storage options being considered by the DOE with minimal cost and difficulty. Pantex currently subhouses more than 8,000 surplus pits and plans are being made to ship additional pits from Rocky Flats to Pantex. It makes little sense to re-create storage facilities at another site and then unnecessarily transport large amounts of plutonium across the country from Pantex. The budgetary and political costs for such a decision would be enormous. Because of these costs, Pantex also should be designated the preferred site for any disposition options and related functions. It makes budgetary and policy sense to site disposition where storage already exists. Furthermore, it makes no sense from any perspective, budget or otherwise, to site strategic storage at one site and surplus at another. Pantex should be selected for both storage functions. Pantex has the necessary safety, security, and surveillance capabilities to accommodate an expanded role with minimal costs and it is the production site closest to Los Alamos, the planned pit fabrication site.

IV. Conclusion: Based upon these reasons, I respectfully urge DOE to designate Pantex as the preferred alternative site for all existing and new stockpile management and stewardship functions as well as consideration of all plutonium storage and disposition and any related functions. Again, thank you for the opportunity to comment on these documents.

Sincerely,

Warren Chisum

Warren Chisum

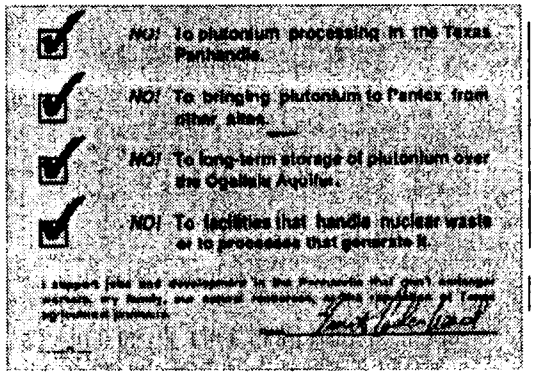
WC/sg

2/08.03.01

M-006

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



1/08.03.01

2/08.03.01

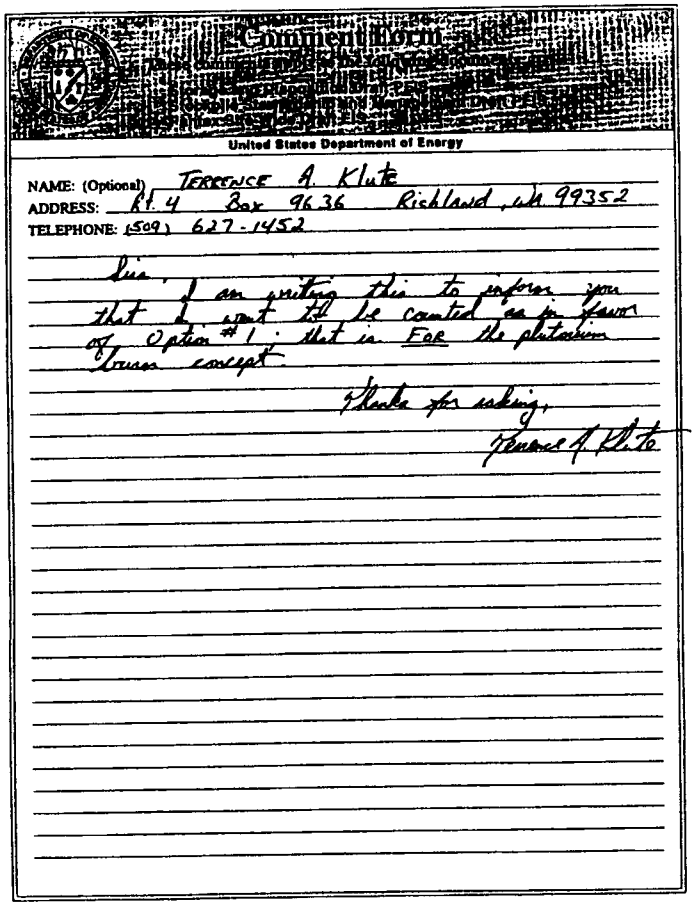
PC-004

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

Comment noted.



Comment Form

United States Department of Energy

NAME: (Optional) TERRENCE A. KLUTE
ADDRESS: Rt. 4 Box 9636 Richland, WA 99352
TELEPHONE: (509) 627-1452

Sir,
I am writing this to inform you that I want to be counted as in favor of Option #1 : that is For the plutonium immobilization concept.

Thanks for asking,
Terrence A. Klute

1/08.03.01

WA-012

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

April 24, 1996

The United States Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

I am seriously concerned that the Programmatic Environmental Impact Statement prepared for the Department of Energy regarding storage and disposition of weapons-usable fissile materials suggests Pantex in Carson County, Texas as a likely place for plutonium pit disassembly and conversion. This document fails to address the negative effects plutonium missions could have on the people, agriculture, and water of the Texas Panhandle

Processing plutonium generates an incredible amount of radioactive waste as well as other undesirable contaminates. These types of operations have contaminated other parts of the country and the cost has been high - in lives, land use, and billions of dollars in cleanup.

The Texas Panhandle is prime agricultural farmland. Nothing should ever be done at Pantex that would risk this valuable part of the country. The food produced here is shipped all over the world. The quality of these food products would be questionable if Pantex is used for plutonium storage or processing.

It is estimated that one quarter of all jobs in the Panhandle are agriculture related. The loss of these jobs would devastate this area. Contamination of farmland or water resources in such a productive part of the country would affect the entire world. After all, food is a commodity all need. It must be protected. 1/09.00.04

The Ogallala aquifer is the source of groundwater for drinking and irrigation in Texas and seven other food producing states. Pantex is located over this aquifer and operations there have already contaminated the water bearing sands above the aquifer. We must not allow any water resource so important to become unsafe or unusable for any reason. The processing of plutonium would surely do this.

Therefore, plutonium should not be stored or processed at the Pantex plant. Shipping plutonium or highly enriched uranium to Pantex from already contaminated sites is not in the best interest of Texas or the rest of the country. The suggestion that the DOE use Pantex as the site for plutonium storage, processing, or waste management is shortshighted and ill conceived. Following such a suggestion puts us all at risk. 2/08.03.01

Sincerely,

Constance Q. Bhasker

M-051

09 00 04 **Comment Number 1**

Radiological and chemical releases resulting from the Proposed Actions for normal operations are analyzed in the PEIS and would be within Federal and State regulatory limits. Therefore, the quality of agriculture in the Panhandle would not be affected, and agriculture-related employment in the Panhandle region would remain unaffected.

Also, current and future operations at Pantex are not expected to affect the water quality of the Ogallala Aquifer. However, the PEIS acknowledges that this aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge); the PEIS analyzes whether and the extent to which potential Pantex operations under the various alternatives could contribute to the depletion of the Ogallala Aquifer.

Current and future operations at Pantex are not expected to impact the soil used for agriculture and farming in the Pantex region. All activities will be limited to Pantex and any impacts to the surrounding areas are within Federal, State, and local regulatory limits.

The PEIS includes analyses on the radiological and chemical impacts to workers and the public from both normal operations and accidents. These analyses also address the effects to local plant and animal resources as well as the effects on prime farmland.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

CAMPAIGN 6
PAGE 1 OF 1

April 22, 1996

To the United States Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

In a democracy the voice of all people should be listened to and considered in decision-making when policies so greatly affect grassroots America. Being concerned with the preservation of rural America, I am seriously troubled by the Programmatic Environmental Impact Statement prepared for the Department of Energy regarding Storage and Disposition of Weapons-Usable Fissile Materials.

Although I recognize the need to ensure safe, secure, long-term storage and disposition of the significant quantities of surplus fissile materials, which include plutonium (Pu) and highly enriched uranium (HEU), I believe this document fails to address very critical human issues. 1/09.00.04

In reviewing the alternative for the possible future of Pantex, it becomes very evident that all of the nation's weapons-usable plutonium not in active warheads would be stored at Pantex - 20,000 pits, plus much of the plutonium now at Rocky Flats Plant, Colorado; Hanford, Washington; Los Alamos, New Mexico; Savannah River, South Carolina; and the Idaho National Engineering Laboratory.

Before 1989, plutonium pits were never stored at Pantex. However, with the closing of Rocky Flats, Pantex is the interim storage site for at least 12,000 pits. Now this document proposes not only storing plutonium pits, but other more undesirable forms of plutonium.

Once stored at Pantex, this site is being considered for a plutonium pit disassembly/conversion facility to cut the pits and process them into metal or oxide; a plutonium conversion facility to process other types of Pu; a facility to mix plutonium with uranium to make mixed oxide fuel (MOX); nuclear power reactors to use the MOX fuel, plus storage of the spent fuel from the reactors, as well as storage of all the mixed waste generated from all these processes. It is processing of plutonium which has contributed to the national environmental degradation which saddles our nation with a $300 billion dollar cleanup problem.

This document states there would be few negative effects from doing any and all of these activities at Pantex. What the document fails to address is the impact on the good reputation of our agricultural products. Agriculture is the one industry which has consistently sustained the Panhandle for decades.

The food chain begins here in the prime agricultural farmland of the Texas Panhandle. The meat products and cereal grains produced here are shipped throughout the world; 25% of the Nation's beef is produced and processed here. The quality and wholesomeness of these products would be placed in jeopardy with the siting of these processes at Pantex. Without production agriculture this part of Texas would cease to exist. When one of every four people is employed in an agriculture related job, the loss to this High Plains trade area of those jobs would create untold problems.

A second issue the document fails to address is the location of Pantex above the Ogallala aquifer, the source of groundwater for the plains of Texas and seven other Midwestern food producing states. With high explosives, chemicals, solvents, and radionuclides, Pantex has contaminated the fine grained layer of water bearing sands above the Ogallala aquifer. With the downward migration of the recharging waters, how long will it be before the Ogallala itself will be contaminated? 1/09.00.04 cont.

Water and agriculture are the real wealth of the Texas Panhandle. Without them there would be no "Texas Panhandle." We cannot stand by and allow these resources to be compromised in any way. Food is the most important commodity we have - it must be protected.

Not all alternatives for siting these processes at other sites were analyzed in this document. Before choosing a preferred alternative, other options need to be considered. The siting of these missions at Pantex seems shortsighted and ill-conceived. The environmental impact in conjunction with these processes has the potential to devastate this food producing region.

The Panhandle is too valuable to be used as a plutonium storage, processing and waste facility. 2/08.03.01

Sincerely,

Mary E. De Long
Richard A. De Long

M-062

09 00 04 **Comment Number 1**

Radiological and chemical releases resulting from the Proposed Actions for normal operations would be within Federal and State regulatory limits. Therefore, the quality of agriculture in the Panhandle would not be affected, and agriculture-related employment in the Panhandle region would remain unaffected.

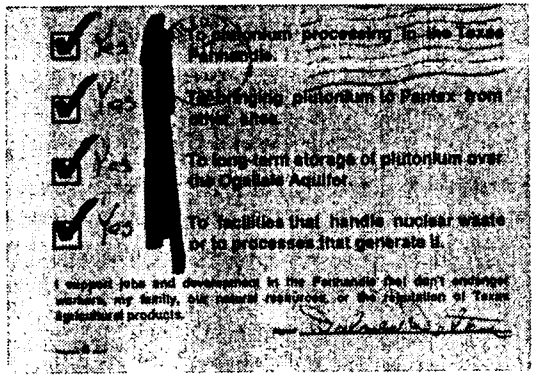
Also, current and future operations at Pantex are not expected to affect the water quality of the Ogallala Aquifer. However, since this aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge), and since Pantex operations contribute to the depletion of the Ogallala Aquifer, impacts to the acquifer were analyzed in the PEIS.

Current and future operations at Pantex are not expected to impact the soil used for agriculture and farming in the Pantex region. All activities will be limited to Pantex and any impacts to the surrounding areas are within Federal, State, and local regulatory limits.

The PEIS includes analyses on the radiological and chemical impacts to workers and the public from both normal operations and accidents. These analyses also address the effects to local plant and animal resources as well as the effects on prime farmland.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



PC-069

1/08.03.01

2/08.03.01

3/08.03.01

1/08.03.01 cont.

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

If Pantex is chosen for long-term storage mission, storage facility design and operations would assure safety, health, and integrity of the Ogallala Aquifer.

08 03 01 **Comment Number 3**

Any generation and handling of nuclear waste resulting from fissile materials storage and disposition activities will include measures that ensure public and worker health and safety.

CAMPBELL, DAWN, WASHINGTON, NJ
PAGE 1 OF 1

June 10 1996
45 Broad St.
Wash. N.J. 07882

U.S. DOE
Office of Fissile Material Disposition
P.O. Box 23786
Wash. DC. 20026-3786

Storage and Disposition of Weapons-usable Fissile Materials: MOX.

We are disturbed about proposals to use Plutonium in Nuclear Power Plants. Do we need any more opportunities for terrorists to acquire fissionable materials.

How many plants to process MOX are possibly in the billion dollar class; which nuclear waste products would be increased.

We urge you to stop this outrageous proposal.

Sincerely yours,
Dawn Campbell

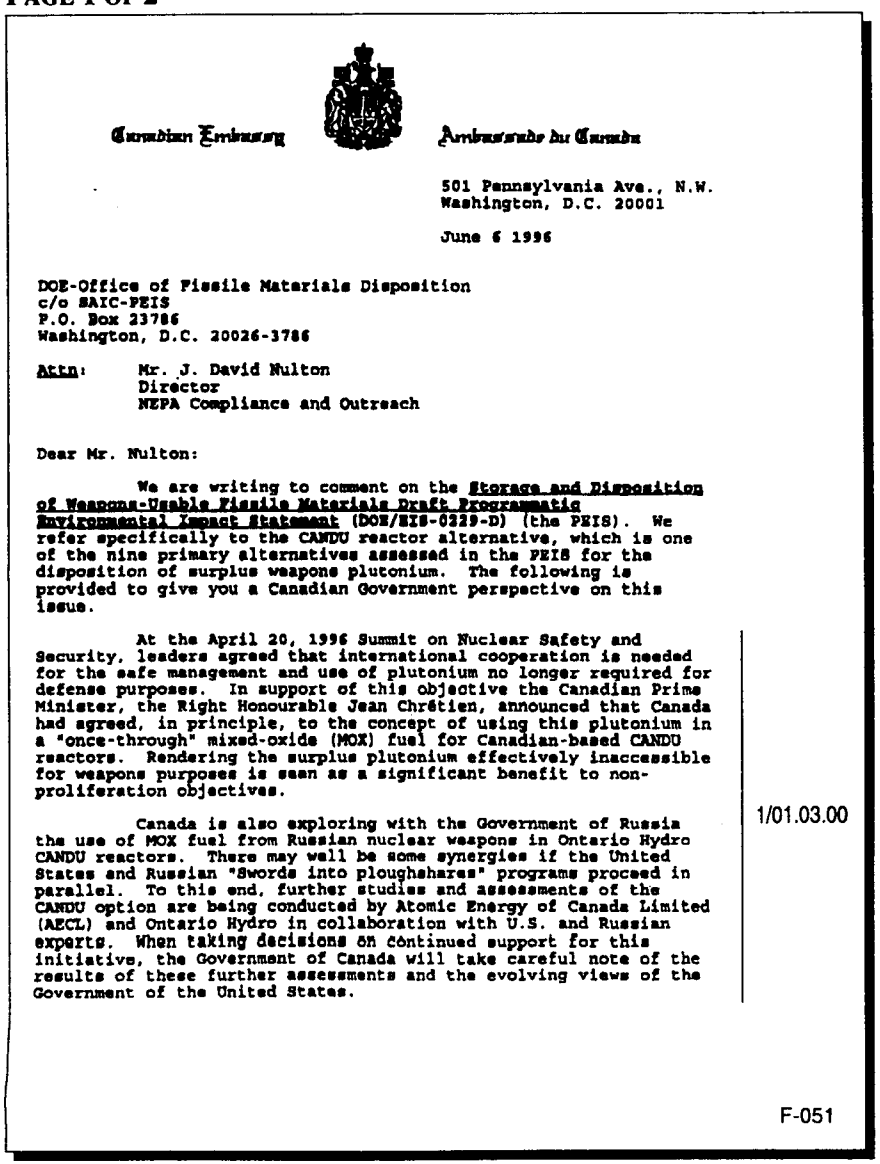
1/08.03.01

M-291

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

CANADIAN EMBASSY, WASHINGTON, DC,
BRIAN MORRISEY
PAGE 1 OF 2



Canadian Embassy — Ambassade du Canada

501 Pennsylvania Ave., N.W.
Washington, D.C. 20001

June 6 1996

DOE-Office of Fissile Materials Disposition
c/o SAIC-PEIS
P.O. Box 23786
Washington, D.C. 20026-3786

Attn: Mr. J. David Nulton
Director
NEPA Compliance and Outreach

Dear Mr. Nulton:

We are writing to comment on the **Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement** (DOE/EIS-0229-D) (the PEIS). We refer specifically to the CANDU reactor alternative, which is one of the nine primary alternatives assessed in the PEIS for the disposition of surplus weapons plutonium. The following is provided to give you a Canadian Government perspective on this issue.

At the April 20, 1996 Summit on Nuclear Safety and Security, leaders agreed that international cooperation is needed for the safe management and use of plutonium no longer required for defense purposes. In support of this objective the Canadian Prime Minister, the Right Honourable Jean Chrétien, announced that Canada had agreed, in principle, to the concept of using this plutonium in a "once-through" mixed-oxide (MOX) fuel for Canadian-based CANDU reactors. Rendering the surplus plutonium effectively inaccessible for weapons purposes is seen as a significant benefit to non-proliferation objectives.

Canada is also exploring with the Government of Russia the use of MOX fuel from Russian nuclear weapons in Ontario Hydro CANDU reactors. There may well be some synergies if the United States and Russian "Swords into ploughshares" programs proceed in parallel. To this end, further studies and assessments of the CANDU option are being conducted by Atomic Energy of Canada Limited (AECL) and Ontario Hydro in collaboration with U.S. and Russian experts. When taking decisions on continued support for this initiative, the Government of Canada will take careful note of the results of these further assessments and the evolving views of the Government of the United States.

1/01.03.00

F-051

01 03 00 **Comment Number 1**

The Department of Energy appreciates the interest of the Canadian Government in this important international activity. DOE has worked closely with Canada to determine if such an alternative would work, and if so, how to best implement it.

CANADIAN EMBASSY, WASHINGTON, DC,
BRIAN MORRISEY
PAGE 2 OF 2

Canada has been a Party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) since it entered into force in 1970. Through the NPT, Canada made an international commitment not to develop or acquire nuclear weapons. Canada has a long history of initiating and supporting measures to strengthen the international non proliferation regime. The CANDU option for reducing the accessibility of surplus weapons material -- whether of U.S. or Russian origin -- is entirely consistent with Canada's nuclear weapons non-proliferation policy. The full scope of Canada's nuclear program is covered by International Atomic Energy Agency (IAEA) safeguards. The IAEA has confirmed its ability to reliably safeguard CANDU reactors.

Canadian government policy does not exclude the use of plutonium as a reactor fuel, but the cost of producing plutonium makes it an uneconomic alternative to natural uranium for the CANDU reactor. Using MOX fuel from existing plutonium in a productive endeavour, such as the generation of electricity, could make economic sense for Canada. The CANDU MOX initiative is confined to the possible use of existing plutonium no longer required for defense purposes and is not related to a commercial plutonium fuel cycle.

MOX fuel fabrication using reactor grade plutonium is now a well known technology employed in Germany, France, Belgium, and Britain, and the use of weapons grade plutonium would be expected to provide an added advantage because of its lower radioactivity. Techniques for transporting and handling MOX fuel for the generation of electricity have been refined over the last 10 to 15 years. The composition of the spent fuel produced by the MOX fuel would be quite similar to that which is currently being produced using natural uranium. The storage of spent MOX fuel would be managed as an integral component of the Canadian spent fuel program. However, the amount of spent MOX fuel produced will be about 15% less than that from the use of natural uranium fuel to generate the same amount of electricity.

If the DOE selects Ontario Hydro CANDU reactors for the plutonium disposition program, implementation would be subject to Canadian federal and provincial policies and regulations. These would include detailed, satisfactory assessments of health, safety and environmental aspects before issuance of an Atomic Energy Control Board (AECB) operating license to Ontario Hydro for the use of MOX fuel. We expect that the public reviews included in the AECB assessment process would focus on issues such as the safe and secure transportation of MOX fuel from the international boundary as well as matters specific to the reactor site.

1/01.03.00
cont.

Yours sincerely,

Brian Morrisey
Minister-Counsellor
Economic and Trade Policy

F-051

CANADIAN ENVIRONMENTAL LAW ASSOCIATION, TORONTO, ON, KATHLEEN COOPER
PAGE 1 OF 3

CANADIAN ENVIRONMENTAL LAW ASSOCIATION
L'ASSOCIATION CANADIENNE DU DROIT DE L'ENVIRONNEMENT

June 17, 1996

United States Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C.
20026-3786
U.S.A.

VIA FAX 202-586-2710

RE: STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS
DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Dear Sirs/Mesdammes,

The Canadian Environmental Law Association (CELA) is a public interest legal clinic within the Ontario Legal Aid Clinic system, and has a mandate to represent citizens' and environmental groups and low income individuals, and promote law reform and public education about environmental matters. CELA has been involved in nuclear issues since the organization was founded in 1970. Please accept our apologies for the lateness of this submission. We hope you will still be able to consider it.

We wish to express our opposition to the importation of plutonium fuel for use in the Bruce "A" Nuclear Generating Station. We have followed this matter closely in recent months - since public information has finally become available - and we have reviewed the submission of Nuclear Awareness Project - colleagues of ours in Canada. We strongly support the Nuclear Awareness Project Submission to the U.S. Department of Energy on the matter of mixed-oxide (MOX) fuel use in CANDU reactors. 1/08.03.01

It appears that your department should be very concerned about the quality of the report from Atomic Energy of Canada Limited. The report contains overly optimistic and even erroneous assumptions about reactor rehabilitation and performance expectations. Such flaws call into question the validity of the entire report.

517 COLLEGE STREET • SUITE 401 • TORONTO • ONTARIO • M6G 4A2
TELEPHONE 416/960-2284 • FAX 416/960-9392 • E-MAIL: cela@web.net

F-069

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. This will include an appropriate level of analysis concerning the CANDU Reactor Alternative. In addition, according to the Canadian Government, implementation of the CANDU Reactor Alternative would be subject to Canadian Federal and Provincial policies and regulations and would require health, safety, and environmental assessments before issuance of a Canadian license. (See the letter from the Canadian Embassy in Washington, DC, dated June 6, 1996, reproduced in this CRD.) Should the CANDU Reactor Alternative be chosen for Pu disposition, further negotiations between the U.S. and Canadian Federal and Provincial Governments will be required before implementation, as well as business negotiations with reactor owners.

CANADIAN ENVIRONMENTAL LAW ASSOCIATION, TORONTO, ON, KATHLEEN COOPER
PAGE 2 OF 3

The excessive cost of this proposal appear to have been misrepresented. The cost alone of retubing Bruce "A", rehabilitating reactors and upgrading security on the site could approach $1 Billion. These costs would be additional to the already excessive costs of running these reactors. Ontario Hydro has been misrepresenting its nuclear program for years as a bargain to Ontario electricity ratepayers. Apparently, this latest proposal is being similarly misrepresented. Ontario's electricity ratepayers are not interested in paying for yet another wasteful megaproject. In the current climate of rate freezes and increased competition, this proposal would seem to be on very shaky economic ground. 1/08.03.01 cont.

Another dubious assumption contained in this proposal concerns the management of the spent fuel. The ongoing Federal Environmental Assessment Panel addressing Canada's high level nuclear waste is considering a proposal from Atomic Energy of Canada Limited that has been found to be technically deficient by many reviewers including the Atomic Energy Control Board, Environment Canada and the Review Panel's own Scientific Review Group. Nor does this proposal, which took fifteen years to prepare, include consideration of spent MOX fuel. Hence, the assumption that this spent fuel can be rolled into that Environmental Assessment process is unwarranted and premature.

We wish to echo the concern expressed by Canadian environmental organizations that the use of MOX fuel would violate the spirit of Canada's non-proliferation stance by removing the separation between Canadian nuclear programs and the military nuclear programs of foreign powers. Many Canadians are opposed to the prospect of this country becoming a dumping ground for foreign military radioactive waste. Canadians are similarly concerned that the use of MOX fuel would create enormous security problems to avoid the theft or diversion of plutonium. 2/15.00.00

Finally, the public health and environmental risks of this proposal are unacceptable. Ontario Hydro's nuclear program already contributes to radioactive contamination, especially tritium pollution which is found at elevated levels near all CANDU reactors. The risk of severe accidents increases as Ontario Hydro's reactors age. And, the AECL report regarding the MOX fuel proposal is deficient in a key are of public health and environmental safety. Plutonium is one of the most carcinogenic substances known and this proposal poses unacceptable risks of criticality accidents. Further, it leaves a proper assessment of criticality risks to the licensing stage. Not only is it unacceptable to downplay and avoid evaluation of such serious environmental and public health risks at this early stage, there is no guarantee that a full environmental assessment will occur at the licensing stage. 3/09.09.08

This proposal has been accompanied by an unseemly level of secrecy, manipulation of information and inadequate public consultation. The misrepresentation of this initiative in the international media as a "swords to ploughshares" success story rarely, if ever, provided Canadians with the full story. We strongly object to this proposal and urge the U.S. Department of Energy to rule out the option of using CANDU reactors located in Canada for plutonium disposition purposes. We support our colleagues in the environmental movement in calling on your department to choose the alternative of immobilizing plutonium within the United States. 4/08.02.00

F-069

15 00 00 **Comment Number 2**

Comment noted. Prior to implementation, further negotiations between the U.S. and Canadian Federal and Provincial Governments will be required, as well as business negotiations with reactor owners. These negotiations will include further environmental analyses, as appropriate. Appropriate security will be maintained during the MOX fuel fabrication, transportation, and reactor cycle for the material.

09 09 08 **Comment Number 3**

The Department of Energy is working with Canadian Government and industry to conduct environmental and health risk analyses for activities in Canada to meet relevant regulatory requirements in both Canada and the United States. These analyses would include impacts from emissions, age of facilities and potential severe accidents, as well as environmental and public health risks.

08 02 00 **Comment Number 4**

Proposed activities and environmental analyses in the United States have been reviewed with the public through a series of public meetings and a comment period. If CANDU Reactor Alternative is chosen, it is DOE's understanding that in Canada there will be appropriate environmental and related analyses, and that the public will be involved in this process. DOE acknowledges the commentor's support for the Immobilization Category of Pu disposition alternative.

We would appreciate a reply to this letter and would like to be added to any of your mailing lists for informing the public about your decisions on this matter. By way of a final question, could you also clarify for us your policy on subsidizing domestic or foreign utilities using MOX fuel made from DOE plutonium?

Thank you. Once again, our apologies for the lateness of this submission.

Yours truly,

CANADIAN ENVIRONMENTAL LAW ASSOCIATION

Kathleen Cooper
Researcher

F-069

CENTER FOR RADIOACTIVE WASTE MANAGEMENT, ALBUQUERQUE, NM, WERNER LUTZE
PAGE 1 OF 6

CeRaM
CENTER FOR RADIOACTIVE WASTE MANAGEMENT

The University of New Mexico
Professor Werner Lutze, Director
209 Farris Engineering Center
Albuquerque, NM 87131-1341
Telephone (505) 277-7964
FAX (505) 277-5433
e-mail: BRBL@unm.edu

Albuquerque, May 1, 1996

Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
Washington, D.C. 20026-3786

Dear Sir/Madam,

Enclosed please find our comment (5 pages including title page and references) on document DOE/EIS-0229-D
Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement
issued in February 1996.

Yours truly,

Werner Lutze,
Professor and Director

M-213

The Zircon Option
for Storage and Disposal of Surplus Plutonium

A 4-Billion-Year Track Record Points to a Simple Solution

Center for Radioactive Waste Management (CeRaM)
The University of New Mexico
151 Farris Engineering Building, Albuquerque, NM 87131-1341
Phone: 505-277-7964; Fax: 505-277-9676; E-mail: BRBL@unm.edu
Dr. Werner Lutze, Director

April 1996

M-213

CENTER FOR RADIOACTIVE WASTE MANAGEMENT, ALBUQUERQUE, NM, WERNER LUTZE
PAGE 3 OF 6

The Case for the Zircon Option

We propose that the U.S. convert its surplus weapons plutonium (WPu) into a ceramic waste form by chemically bonding it with one of earth's most durable minerals: zircon ($ZrSiO_4$). Because zircon is so durable and because WPu bonds so strongly with it, this waste form will,

1/08.03.01

- guarantee safe storage,
- provide unparalleled integrity for deep borehole disposal, or
- with the addition of Cesium-137, easily meet standards for disposal in a civilian repository.

This paper summarizes the merits of the zircon option. We are submitting it as a formal comment on the U.S. Department of Energy's February 1996 draft PEIS on disposition of WPu and are circulating it widely within the policy and scientific communities. We welcome requests for more information.

Our proposal draws on both scientific disciplines and the broad, interdisciplinary approach that characterizes the University of New Mexico's Center for Radioactive Waste Management. We believe scientific, technical, management, and institutional factors together converge to support the zircon option, which capitalizes on physical assets unique to zircon and on key assets zircon shares with the vitrification and MOX fuel options, while avoiding their severe liabilities.

The bottom line. The zircon option delivers a high level of technical and managerial confidence coupled with a low level of institutional risk, and can support either borehole or repository disposal.

An unparalleled database. Zircon is a ubiquitous mineral, and it is ubiquitous because it is durable —so durable that it serves as the standard for age-dating geologic materials. The vast literature on zircon (well over 6,000 publications) provides exceptional understanding of its characteristics. We know with a high degree of certainty how it behaves under a broad range of physical and chemical conditions and over time periods of up to 4 billion years.

Unparalleled performance. In a repository environment, the zircon waste form will outperform both glass and the spent fuel resulting from the MOX fuel option. For a deep borehole, neither glass nor spent MOX fuel are disposal options, whereas the zircon waste form can easily meet borehole disposal standards.

Repository disposal. Zircon can both immobilize and stabilize WPu; its natural affinity with Pu creates a strong chemical bond. Moreover, the durability of that bond can be confirmed through long-term performance assessments drawn from zircon's vast database. The database for predicting how glass will perform is much more limited in scope and geologic time.

Because glass corrodes in groundwater much faster than zircon, it is at greater risk of plutonium release and criticality. The zircon waste form, far more durable, thus offers more flexibility in repository design. And while optimum waste loading will be determined by several factors including safeguard and criticality considerations, zircon can accept up to 10% Pu by weight, with an upper limit still to be established; borosilicate glass can accept only a much smaller percentage. Accordingly, R&D is needed to create glasses that are both more durable and capable of accepting a larger percentage of Pu.

Because zircon is twice as dense as glass it will yield lower volumes of waste and, depending on fabrication processes, may yield them faster, accelerating the schedule for WPu disposition.

Deep borehole disposal. Not only will the zircon waste form itself be exceptionally stable; surrounding it with a barrier of WPu-free zircon in a granitic site that itself contains natural zircon will further constrain WPu-bearing zircon from corroding. The zircon waste form will mimic neighboring and resident zircon; that is, it will most likely do what zircon almost always does, even under high temperatures and high pressures, under

M-213

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. During the screening of alternatives for inclusion in the PEIS, various immobilization forms were considered. The PEIS analyzes immobilization in ceramic and glass forms. The specific ceramic form is not identified. Research and development is both on-going and planned to support a disposition alternative(s), which would include pilot facilities for processes and materials (and could include zircon), as necessary. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

conditions of radiation damage, and in the presence of groundwater: it will tend to stay where it is and change very little.

An existing fabrication technology. To immobilize WPu in zircon it may be most expeditious to simply adapt the existing MOX fuel fabrication process, substituting zirconium oxide and silicon dioxide for uranium oxide. The ceramic pellets that constitute the final waste form can be containerized for storage and transport. To minimize transportation, a fabrication facility could be sited at Pantex, where most WPu is stored; but any site suitable for the MOX fuel or vitrification options will be suitable for zircon, too.

A reliable schedule. The longer it takes to implement an option, the longer WPu remains exposed to the risk of theft or diversion. Consequently, a reliable schedule is itself a safeguard. On this crucial point, zircon has clear advantages over both the MOX fuel and vitrification options.

MOX fuel. This option is technically proven, but if it is implemented domestically it is likely to encounter protracted resistance that will retard its schedule. Not only must a MOX fabrication facility be licensed; reactors must obtain license amendments to burn MOX fuel. Critics who oppose nuclear power, critics who fear that the MOX option will increase risks of proliferation domestically, and critics who fear that the MOX option will send an unwanted signal to other nations—all may intervene in all licensing proceedings. They may also oppose shipments of MOX fuel to nuclear power plants. The MOX fuel option is thus exposed to the risk of delay on numerous fronts. 2/08.03.01

Vitrification. Plutonium has only been vitrified in isolated laboratory experiments. Scaling these experiments up to a production process is without precedent and will pose significant technical uncertainties that must be accurately defined and expeditiously resolved. But any schedule for doing this is called into serious question by the Savannah River vitrification facility for defense waste: despite ample funding it has experienced a long history of delays and a recent shutdown. A schedule for vitrifying WPu is essentially a schedule for what could become another prolonged and costly R&D program. It must therefore be viewed as highly speculative. 3/08.03.01

Zircon. While technical questions must be resolved for zircon, too, because this option can adapt a proven technology—MOX fuel fabrication—questions can be more easily defined and answered than for glass, and forecasts of schedule and cost will be more reliable, coming from market-driven private sector competitors. And unlike the MOX fuel option, the zircon option should not attract intervenors who can retard its schedule.

Reliable—and efficient—quality control (QC). The integrity of the waste form depends on reliable QC. Zircon can use the QC process successfully used in MOX fuel fabrication, but QC for vitrifying WPu has yet to be developed. Zircon enjoys other QC advantages, too. Because each zircon ceramic pellet will be homogenous, each pellet sampled will accurately represent the whole; but glass may not always be homogenous. And because zircon pellets are so much smaller than glass logs, if QC identifies defects, fabrication can be promptly halted with minimal disruption and loss of "product."

Safeguards and criticality controls. An adaptation of an existing fabrication process that already meets safeguard and security standards may more readily meet those standards than a large-scale vitrification process for WPu that has no precedent. For criticality control, the zircon option can meet standards during fabrication and storage; vitrification will require further R&D. And as noted above, after disposal zircon is at far less risk of criticality than glass, which, being less stable, could release WPu more quickly.

A precedent for licensing. DOE's commitment to external regulation ensures that WPu disposition will be subject to oversight in a public forum; indeed, that forum may be defined by Congress. Whoever the regulators, they will find no precedent for licensing vitrification, whereas the MOX fuel fabrication process offers ample precedent abroad. And whatever the licensing process, performance assessment criteria will have to be satisfied; zircon's 4-billion-year track record will be an enormous assist in meeting them.

M-213

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

CENTER FOR RADIOACTIVE WASTE MANAGEMENT, ALBUQUERQUE, NM, WERNER LUTZE
PAGE 5 OF 6

An unambiguous signal of non-proliferation. The potential for proliferation of nuclear materials, particularly within the former Soviet Union, is generating grave international concern. At best, the MOX fuel option appears to be a solution in search of a problem; but within this context, it is a problem: by keeping plutonium in use it will perpetuate security concerns. Moreover, it will do so for benefits that are trivial and even dubious. The electricity yielded by the MOX option would equal a mere few months of the world's total supply of nuclear-generated electricity, and because MOX fuel will cost more than the fuel utilities now burn, they will want subsidies to buy it. 2/08.03.01 cont.

We strongly believe that any benefit derived from the MOX option is far eclipsed by the strategic benefits of a clear commitment to non-proliferation. U.S. selection of irreversible geologic disposal signals that commitment, and can help lead other nations in the direction of greater global security. 4/01.06.00

Definitive closure. The zircon option, like vitrification, offers not just "disposition" of a policy issue, but literal, physical, disposal of WPu. By contrast, after MOX fuel is burned in reactors, up to 50 percent plutonium will remain, requiring further "disposition." Because US policy does not permit reprocessing, the MOX fuel option defers this problem to a future policy scenario yet to be defined.

Winning public acceptance. Finally, DOE must sell the option it selects—to Congress; to the scientific, technical, and policy communities; to the international community; to the American public. The simpler the option, the more readily it can be understood and the more easily it will win acceptance.

Zircon's literally elemental nature, the durability attested to by its 4-billion-year performance record, the availability of a proven technology for fabricating the waste form, and the appeal of a definitive policy signal sent by irreversible disposal can together help win wide popular support for a policy that says, in simple terms,

> Using one of earth's oldest, most durable minerals, we will convert surplus weapons plutonium into an extremely stable waste form that guarantees safe storage above ground and safe disposal deep in the earth.

Fast-tracking the zircon option. Moving aggressively to marshal domestic and international resources, and engaging nuclear states in the former Soviet Union in collaboration, DOE can pursue work in parallel on several fronts.

> **Fabrication**: Solicit from MOX fuel fabricators cost and schedule estimates for adapting that process.
>
> **Regulation**: Petition the Nuclear Regulatory Commission to examine how other nations regulate MOX fuel fabrication and how the US can adapt these procedures.
>
> **R&D and engineering analyses**: 1) Verify chemical durability/long-term performance of the zircon waste form under deep borehole and repository conditions. 2) Determine adaptation of the MOX fuel fabrication process. 3) Determine optimum method for adding Cesium-137 to meet spent fuel standard. 4) Determine optimum percent waste loading. 5) Resolve criticality issues.
> 6) Optimize parameters for safeguards: waste loading, size of the waste form, number of waste-form units. 7) Conform zircon waste form to waste-acceptance specifications developed for disposal.

The United States policy and scientific communities have the talent and resources to operationalize the zircon option quickly, establishing it as the exemplary model that will make the world a safer place. We urge its prompt adoption.

M-213

01 06 00 **Comment Number 4**

Comment noted.

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CHAMBLISS AND BANNER PLIC, CHATTANOOGA, TN, CHARLES N JOLLY
PAGE 1 OF 3

CHAMBLISS & BANNER, PLIC
ATTORNEYS AND COUNSELORS AT LAW
[illegible]
TWO UNION SQUARE
CHATTANOOGA, TENNESSEE 37402-2500
TELEPHONE: [illegible]
FACSIMILE: [illegible]

CHARLES N. JOLLY — DIRECT: [illegible]

April 5, 1996

The Honorable Hazel O'Leary
Secretary of Energy
Forrestal Building
1000 Independence Avenue S.W.
Washington, D.C. 20585

Dear Ms. O'Leary,

I am the Democratic candidate for Congress from the 3rd District of Tennessee. On April 1st of this year I attended the DOE public hearing on the Programmatic Environmental Impact Statement for Stockpile Stewardship and Management as both a concerned citizen and a candidate for Congress. After participating in that public hearing I wish to advise you personally of my deep concern that this administrative proceeding is seriously flawed.

At the risk of stating the obvious, this entire proceeding is about downsizing of DOE's mission in an entirely new geopolitical context. It is obvious that there are several sites, notably including both Los Alamos and Oak Ridge, competing for the stockpiling and stewardship functions which will remain once downsizing is completed.

It is also apparent that a downsizing which simply involved a reduction of existing stockpiling and stewardship activities at existing sites would require no new environmental impact statement. That a PEIS has been prepared at all speaks eloquently to the fact that the DOE plan from the outset has been to perform stockpile and stewardship activities either at new locations and/or to a much greater extent than previously

The documents ostensibly comprising the underlying administrative record in the PEIS amount to more than five inches of reading material of a highly complex and technical nature. Participants at the public hearing, and especially public

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CHAMBLISS AND BANNER PLIC, CHATTANOOGA, TN, CHARLES N. JOLLY
PAGE 2 OF 3

The Honorable Hazel O'Leary
April 5, 1996
Page 2

officials were highly critical of DOE's procedure of making these background documents available only a matter of days before the hearing seriously impairing the public's ability to familiarize themselves with the data and assumptions which underlie the PEIS.

The proceedings were compromised further by the combination of the hearings on stockpile and stewardship PEIS with the hearings on the Storage and Disposition of Weapons PEIS with all of its attendant administrative record. And, although the underlying documents were only available at the last minute there was an abundance of visual aids and even subject specific video which obviously had been prepared well in advance of the Oak Ridge hearing. 1/08.02.00

The net impression was that DOE was not proceeding even-handedly to obtain informed input on a question still undecided. Rather the impression was that DOE was attempting to overwhelm Oak Ridge with paper and slick presentations in an attempt to sell a preordained conclusion which favored Los Alamos without regard for critical facts and factors which favor Oak Ridge.

In this context it should hardly be surprising that the PEIS hearings have been viewed with public skepticism and not inconsiderable resentment. DOE has further compounded an already acute credibility problem by assigning major responsibility for development of the PEIS administrative record to Los Alamos personnel when it is obvious on its face that Los Alamos is one of the sites competing for future stewardship activities. This action destroys any illusion of fairness or objectivity, and instead conjures up visions of foxes designing henhouses. 1/08.02.00 cont.

It is my feeling that the administrative record of this proceeding so abundantly demonstrates a lack of even-handedness that a defensible conclusion to this proceeding is impossible. I urge you to put an immediate end to the travelling road show presenting the Stockpile and Stewardship PEIS and the Storage and Disposition of Weapons PEIS and instead develop a process whereby each of the competing locations can be objectively evaluated in a fair and objective process. 2/08.02.00

Based on my own participation and first hand observation, I would find it impossible to defend DOE's decision making process in this proceeding as it has unfolded.

M-251

08 02 00 Comment Number 1

The combining of meetings was done at the specific request of the public near several DOE sites and not to have any negative impact on the public review process. This request was based upon a need to hear how these documents were related to one another and to avoid requiring public attendance at several meetings spanning several days. The Draft PEIS and reference documents were made available in advance of the public meetings.

08 02 00 Comment Number 2

The Department of Energy does not view the NEPA process as a competition among sites. It is viewed as a process for determining the environmental impacts for a series of alternatives and specific sites. This information then can be presented, along with other information to the decisionmaker so that good sustainable decisions can be made.

CHAMBLISS AND BANNER PLIC, CHATTANOOGA, TN, CHARLES N. JOLLY
PAGE 3 OF 3

The Honorable Hazel O'Leary
April 5, 1996
Page 3

I would appreciate your personal response to this letter at your earliest opportunity and would further request that a copy of these remarks be placed in the administrative record of both the Stockpile and Stewardship PEIS and the Storage and Disposition of Weapons-Usable Fisible Materials Draft PEIS.

Very truly yours,

Charles N. Jolly

cc: U.S. Department of Energy
Office of Reconfiguration
PO Box 3417
Alexandria, Virginia 22302

M-251

CHARLESS, ADDIS, JR.
PAGE 1 OF 2

April 22, 1996

My name is Addis Charless, Jr. I own, live on, and operate a ranch ten miles north of the Pantex facility.

Although I am somewhat comfortable with the current mission at Pantex, I have marked reservations about an expanded role at Pantex that would include permanent storage of plutonium pits, other plutonium scrap, uranium, etc., as well as processing/reprocessing of same, and the possiblity that a nuclear reactor of whatever type might be built there to accommodate any burning of mixed oxide fuel (MOX), or to produce tritium. 1/08.03.01

To expand Pantex's role to accommodate any or all of the above is to me grossly irresponsible in view of the fact that the plant lies above the largest fresh water aquifer in the U. S., and that said aquifer is the lifeblood of this area's agriculture industry. Why the Ogallala aquifer has not been classified as a Class 1 water source is a puzzlement to me. 2/09.04.04

None of the draft PEIS's have adequately addressed what would happen to this area's farm and ranch economy if a significant accident releasing substantial quantities of radionuclides were to occur regardless of how well it were to be cleaned up. I think the public's perception of the contamination would be such that it would make our products unmerchantable not just for the immediately affected area, but for the entire Panhandle's products. 3/09.09.04

TX-043

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 04 04 Comment Number 2

Currently, waste/hazardous material treatment/handling operations are regulated to minimize the potential for releases of hazardous substances to the soil or surface water which could then migrate to the groundwater.

The Ogallala Aquifer has not been classified as a Class 1 (that is, sole source) aquifer since other sources of drinking water are available in areas above this aquifer.

09 09 04 Comment Number 3

Perceived risks are not exactly quantified. The impacts of such perceived risks to a region's economy are more difficult to evaluate. Moreover, NEPA documents do not, as a practice, include market analyses for housing, tourism, or agricultural products. Statements can be made that part of a region's economy (for example, agriculture) would be adversely impacted by a release of nuclear material. However, the degree of that impact cannot be quantified.

CHARLESS, ADDIS, JR.
PAGE 2 OF 2

It is a further contention by Pantex boosters that no substantial water pollution has occurred except for the perched water above the Ogallala aquifer. On June 27, 1995, a water sample was taken from one of my windmill wells and submitted for analysis. The results yielded the following information:

> For 16 high explosives tested for, results were BQL.
> For gross alpha, gross beta, Pu 239/240, Ra 226/228, Sr-90, tritium,
> U 234/238--detected, but below Safe Drinking Water Act maximums.

How much will these levels rise if Pantex's role is expanded? Is it something we are willing to risk? Is it truly necessary for the viability of Amarillo's or the Panhandle's economy? Is short term economic prosperity worth eternal contamination?

2/09.04.04
cont.

TX-043

CHRISTIANSON, MARLENE, POCATELLO, ID
PAGE 1 OF 1

Comment ID: P0009
Date Received: April 18, 1996
Name: Marlene Christianson
Address: 1045 Concord
Pocatello, ID

Transcription:

I would definitely like to tell you no, do not bring anymore of this type of thing to Idaho. We're sitting over an aquifer. I have children and grandchildren growing up in the area. It takes 20-30 years before we know what affect this would have on them. There are lists, endless lists, of train wrecks and derailments over the last this last 3-4 months. It's not safe. It's not necessary. Stop this killing of people in order to learn how to kill more people. 1/08.03.01

P-009

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Section 4.4 and Appendix G provide the results of the transportation analyses indicating that the transportation impacts are minimal.

CHUBB, WALSTON, MURRYSVILLE, PA
PAGE 1 OF 2

April 11, 1996

U.S. Dept. Of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, DC 20026 - 3786

Re: Draft Programmatic EIS for Storage and Disposition of Weapons Usable Fissile Materials (DOE/EIS - 0229D).

Dear Sirs,

The authors of this draft PEIS have accepted conventional wisdoms without due caution or consideration. It is wishful thinking to imagine that fissionable materials can be disposed of as if they were worthless annoyances. This error is expressed in the comment (page A-293) that "Pu (disposed of) is lost forever". Fissionable isotopes have a natural property which gives them a unique value. That property cannot be destroyed by wishful thinking. It is wasteful and futile to bury fissionable isotopes in unguarded, unmonitored graves. An EIS on the storage and disposition of fissile materials must consider the efforts that most people are willing to make to acquire extremely valuable materials. Only worthless trash has a chance of remaining undisturbed after burial. 1/01.02.00

Those who stand in awe of the fissionable isotopes don't seem to appreciate the fact that the separation of one isotope from its sister isotopes is a difficult operation, a "value-added" operation. The current market price of natural uranium is $13.25 per pound or approximately $3300 per pound of separable U-235. That is more than half the current price of refined gold. Separation of isotopes usually increases value by 100 to 10,000 times depending upon the "difficulty" and degree of separation. 95% pure U-235 is probably worth over $3 million per pound, about 500 times the value of pure gold. The fissionable isotope, Pu-239, can be assumed to have a value similar to that of U-235.

The draft PEIS is proposing to store or dispose of 38.2 metric tons of surplus Pu-239 worth about $250,000,000,000. One suggestion involves digging 23 boreholes (graves) about 4 km deep. Each grave is to contain about 180 critical masses of Pu in a 500 foot length of each grave. That suggestion constitutes expensive, hazardous, insecure storage, not disposal. For 5000 years, enterprising grave roobers have outwitted the best efforts of people to take their wealth with them in death. Fissionable isotopes are already appearing on the clandestine markets of a world with maturing plutonium economies. 1/01.02.00 cont.

The suggestion that surplus Pu be adulterated with glass, zeolites and/or Cs-137 is perverse. Dilution is an additional operation requiring expense and resulting in a volume increase. A volume increase will make storage and recovery more expensive. Cs-137 has a half-life of 30 years. It will have to be replenished at least every 300 years. Future supplies of Cs-137 will have to be purchased from countries which have developed economically successful plutonium economies. 2/05.00.08

M-037

01 02 00 Comment Number 1

Comment noted. Use of the Borehole Alternative for disposition would provide barriers to recovery and reuse that do not exist with current storage practices. These include both radiological and physical barriers. Further, if the Borehole Alternative were chosen, it would not be left unguarded. Appropriate monitoring, safeguards, and security measures would be provided. With regard to burning Pu in reactors, some individuals argue that this alternative is more unacceptable than the Borehole Alternative because it results in residual Pu that could, under some conditions, be recovered and used in a weapon. All of the alternatives considered in the PEIS result in Pu being placed in a condition where diversion and reuse is extremely unlikely due to a combination of physical and radiological barriers, administrative controls, and international inspections. NEPA requires that DOE consider a range of reasonable alternatives for Pu disposition, and accordingly, both the Borehole and Reactor Burning Alternatives were included. The preference for continued secure storage noted in this comment is also addressed in the PEIS under the No Action Alternative.

05 00 08 Comment Number 2

Diluting Pu makes it unattractive for reuse in weapons and, hence, enhances nonproliferation goals. A need to reestablish a radiation barrier after 300 years using cesium-137 (Cs-137) would be precluded by geologic disposal of these material forms. As discussed in the PEIS (Appendix H), all surplus Pu disposition alternatives ultimately require geologic disposal.

-2-

The lack of due consideration in this PEIS is clearly demonstrated by the suggestion which requires that the U.S. purchase Cs-137 from a more advanced country. Apparently, there has been no consideration of the environmental-economic impact of spending about $10 billion to build an industrial complex to (1) downgrade the value of our surplus Pu or (2) to recover valuable Pu from the "much larger and growing quantity of Pu that exists in spent nuclear fuel". Only fools would attempt to make a weapon from reactor-grade plutonium. Economically successful companies make products by adding value to their raw materials. Wasteful policies have quintupled the federal debt since 1980. 2/05.00.08 cont. 3/07.01.00

The separated fissionable isotopes of uranium and plutonium command the custodial care due to extremely valuable and potentially dangerous materials. They should be stored in a repository at least as secure as Fort Knox. They must be stored in containers representing a small fraction of a critical mass. The containers must be separated by neutron absorbing barriers or walls. The storage rooms must be able to drain rapidly by gravity if the rooms should start to fill with water for any reason. The economic and environmental damage that might be caused by uninformed or haphazard disposition of fissionable materials could be enormous.

Our government's alleged concern about the imaginary hazards of weapons proliferation from consuming weapons-grade plutonium to produce nuclear electricity is contradictory, as noted above. The government's real concern has to do with the ability of nuclear energy to compete with fossil energy. Secure storage of our surplus fissile materails should be sufficient to satisfy this mean and unpatriotic concern. Continuing growth of the federal debt should force us back onto the road to peace and prosperity within a few years. 1/01.02.00 cont.

Sincerely,

Walston Chubb

Walston Chubb
3450 MacArthur Drive
Murrysville, PA 15668

412-327-8592

M-037

07 01 00 Comment Number 3

Cost data, along with technical and schedule data, were provided in Technical Summary Reports for disposition beginning in late July 1996. Recovery of Pu from the "much larger and growing quantity of Pu that exists in spent nuclear fuel" is outside the scope of the PEIS.

CINQUEMANI, D. K. & F. L., MONTCLAIR, NJ
PAGE 1 OF 1

535 Upper Mountain Avenue
Montclair, NJ 07043-1506
June 5, 1996

U. S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

Storage and Disposition of Weapons Usable Fissile Materials: MOX Proposal:

We are unalterably opposed to the Department of Energy plan to allow commercial nuclear reactors to use MOX, mixed oxide, which as we all know is largely a blend of plutonium and uranium.

1. The initial cost of one or more new plants which would cost at least $1 billion.

2. The use of MOX would greatly increase both the volume and radioactivity of the commercial nuclear power plant waste.

3. There are extremely dangerous proliferation problems posed by commercial power plant use of MOX: 1/08.03.01

a. It is relatively easy to separate the plutonium from the other components of MOX.

b. The transportation of the unused fuel would require military escorts. There would be long trips throughout the U. S. A. and Canada. We assume fuel storage would also require military protection.

c. Terrorism, national and international, is increasing. With so many private "militia" and others, there would be a ready market for MOX.

4. There are at least two options already identified for plutonium: continued storage and vitrification. We favor the latter. 2/08.03.01

Please do not make what is likely to become a catastrophic mistake. The world is lucky to have had but one Chernobyl so far, but there have been so many near disasters. Don't facilitate another unnecessary holocaust.

Sincerely yours,

Dr. D. K. & F. L. Cinquemani

M-261

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

CITIZENS FOR ENVIRONMENTAL JUSTICE,
DEBRA K. ABDALLAH
PAGE 1 OF 4

Rev. Vernell Cutter
Convener

CITIZENS FOR ENVIRONMENTAL JUSTICE

Dr. Mildred McClain
Executive Director

May 7, 1996

Mr. J. David Nulton,
Director
Office of NEPA Compliance and Outreach
Office of Fissile Materials Disposition
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Dear Mr. Nulton;

On the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement, the following comments have been drafted for consideration before the Record of Decision is announced. May I begin with the following observation of the Department of Energy's plan for SRS?

Please note that the Department's "Reasonably Foreseeable Future Progress at SRS," includes the following proposed activities:

1) Storage and Disposition of Plutonium and Highly Enriched Uranium

2) Foreign Research Reactor Spent Nuclear Fuel

3) Highly Enriched Uranium Disposition

4) Interim Management of Nuclear Materials

5) Stockpile Stewardship and Management

6) Tritium Supply and Recycling

7) Waste Management

F-041

CITIZENS FOR ENVIRONMENTAL JUSTICE,
DEBRA K. ABDALLAH
PAGE 2 OF 4

The cumulative impact of the seven proposed activities would have a devastating effect on the populations and environmental status of the states of South Carolina and Georgia. For example, there would be a 6% increase in water usage over the no-action alternative. Collocation would account for approximately 11% of the total annual waste water discharge, along with increased impacts to wetlands and aquatic resources from discharges from proposed facilities. In addition, "minority" and low income communities would be adversely and disproportionately affected in the event of a radiological accidental/intentional/terroristical release. 1/09.00.06 2/09.12.06

Consider that neither of the options of choice in the PEIS for the Storage and Disposition of Weapons-Usable Fissile Materials can eliminate the environmental, safety and health risks, nor the dangers of proliferation. These available options can only reduce the risks, therefore, this paper cites vitrification as the disposition alternative of choice. However, this disposition alternative does not come without severe challenges, particularly in the area of environmental justice.

Data on geographic distribution of low income and minority populations and prevailing wind conditions are used to assess whether toxic/hazardous pollutants and radiological releases from the proposed actions would be emitted disproportionately in the direction of these populations. If SRS is the site of choice for the storage and disposition of Pu there "could be potential environmental justice impacts due to the large low income and minority population residing in two counties adjacent to the SRS" (PEIS). These counties have minority populations of greater that 50 percent and several other counties surrounding the site have populations of greater than 25 percent. Hence, low income and minority populations would be disproportionately affected by an accidental release. Because of this very significant factor, even though vitrification is the method of disposition cited here, please be advised that SRS is not the site of choice 2/09.12.06 cont. 3/08.03.01

It is further recommended that:

pilot plants be constructed to test various vitrification technologies that are specific to the different forms of Pu recommended for vitrification; 4/15.00.00

vitrification must also be proven to be technologically safe; apart from criticality accidents, other types of accidents, such as spills of radioactive materials might occur during the vitrification process; 5/09.09.06

F-041

09 00 06 Comment Number 1

Section 4.7 of the PEIS analyzes the cumulative impacts for all of the Proposed Alternatives. Future site-specific NEPA analyses would provide a more detailed analysis, including further study of wetlands and aquatic resources.

09 12 06 Comment Number 2

The PEIS assessed potential health impacts from the accidental release of radiation for all of the Proposed Alternatives. The Environmental Justice section further evaluated whether such impacts would be disproportionately borne by low-income and minority communities. As discussed in Section 4.5 of the Draft PEIS, data on the distribution of the low income and minority populations and historical information on the prevailing wind conditions indicate that these minority and low-income populations would not likely be disproportionately affected in the event of an accidental release. The PEIS, however, does note that under certain conditions, low-income and minority populations could be disproportionately affected by such an accidental release.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to new missions at SRS. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

15 00 00 Comment Number 4

Comment noted. DOE is currently testing the can-in-canister technology for vitrification. Should DOE choose new vitrification technologies for implementation, a pilot plant would be needed for the demonstration, and NEPA documentation would be prepared, as appropriate.

CITIZENS FOR ENVIRONMENTAL JUSTICE,
DEBRA K. ABDALLAH
PAGE 3 OF 4

Pu vitrification options should be studied as an EIS under NEPA so that a sound decision regarding the choices of technology can be made; 4/15.00.00 cont.

Disadvantage of adding Pu vitrification to DWPF at SRS is the delay in the vitrification of the 34 millions gallons of High Level Waste that are already scheduled for the facility. Far greater potential for environmental contamination exists from the storage this nonvitrified waste. The consequences of such accidents with liquid wastes would also be far more severe than those of accidents that might occur from storage of vitrified high level radioactive wastes. 6/11.00.06

It is hereby recommended that Pu is treated as a waste product rather than as a resource. The disposition of Pu as a waste product would be fairly low in cost (if it is integrated with the current vitrification program at SRS) and it would be rendered highly, proliferation-resistant. However, if SRS is the site of choice for this procedure, then extensive environmental awareness and education must be offered to the surrounding communities, especially those that would be exposed in the event of an accident. These communities must also be made aware of any and all emergency procedures and evacuation routes. Considering the extent that such an accident could have on a population, relocation of these residents is an even more viable option to insure their health and safety. 7/01.04.00

The PEIS also states that radiation exposure is more likely to produce somatic effects than genetic effects as exposure risks to these same individuals who live in the 50 mile radius of the site. They are therefore, at risks from exposure from past and present releases and from any accidental release should Pu be stored and disposed of at SRS. 8/09.09.06

It is further recommended that the following be given full consideration:

Putting Pu in non weapons-usable form as soon as possible, compatible with protection of environment, workers and community health;

Options must in compliance with all environmental,

F-041

09 09 06 **Comment Number 5**

To protect public and workers' health and safety, Pu disposition facilities will be designed to comply with current Federal, State, and local laws; DOE Orders; and industrial codes and standards. This will provide a plant that is highly resistant to the effects of natural phenomena and internal events such as fire and explosion. Furthermore, the PEIS analyzed the probabilities and human health consequences of the potential accidents for proposed Pu disposition alternatives including the Vitrification Alternative.

11 00 06 **Comment Number 6**

Comment noted. Should DOE decide to conduct Pu vitrification at SRS, any schedule conflict would be resolved prior to implementation.

01 04 00 **Comment Number 7**

The determination of whether or not Pu should be considered a waste, is beyond the scope of the PEIS. Furthermore, whether or not Pu is a waste, will not change the range of disposition alternatives addressed in the PEIS. NEPA requires that the environmental impacts for all reasonable alternatives be considered for the Proposed Action. While immobilization is clearly a reasonable alternative, so are reactor burning and boreholes. The non-proliferation risks of each alternative will be carefully considered and factored into the ROD for disposition. Cost, schedule, and technical analyses have been conducted by DOE and will also be factored into the ROD.

09 09 06 **Comment Number 8**

To respond to potential accidents, DOE Orders specify the requirements for emergency preparedness at DOE facilities. Each DOE site has established an Emergency Management Program that incorporates activities associated with emergency planning, preparedness, and response. The emergency plans at each site would be revised to incorporate future DOE requirements and expanded to incorporate the addition of new facilities.

CITIZENS FOR ENVIRONMENTAL JUSTICE,
DEBRA K. ABDALLAH
PAGE 4 OF 4

health, and safety laws and regulations. It must be taken into account the reality that increased handling, processing, and transporting of Pu entails additional new environmental risks; and, that some of these new risks may offset existing risks from present methods of storage; 9/09.00.08

Technology for re-extracting Pu from glass is known; thus, there is no need to continue operating reprocessing plants to produce more Pu that is uneconomical today and will remain so for decades;

Volumes of wastes are increased greatly in reprocessing and is the most dangerous portion of waste is the short-and medium- term which consists of highly radioactive fission products and is in a liquid form which must be stored in tanks; 10/15.00.00

Environmental costs and health risks of reprocessing creates streams of radioactive materials like:

the atmospheric release of C-14 in the form of C-14 dioxide and krypton-85; and,

large volumes of liquid wastes contaminated with radionuclides that are released into the environment.

In conclusion, let us strengthen US and international fissile materials control efforts and do it with in the least costly methods that also subject us to the fewest health, and environmental health and safety risks.

Respectfully submitted:

A Citizen for Environmental Justice,

Debra K. Abdallah

F-041

09 00 08 **Comment Number 9**

Comment noted. Analyses in the PEIS consider the potential environmental impacts of the handling, processing, and transportation of the surplus weapons-usable materials.

15 00 00 **Comment Number 10**

Comment noted.

CITIZENS FOR ENVIRONMENTAL JUSTICE, SAVANNAH, GA, MUSTAFA MOHAMMED
PAGE 1 OF 1

Comment ID: P0035
Date Received: May 1, 1996
Name: Mustafa Mohammed
Organization: Citizens for Environmental Justice
Address: 818 West Carter Street
Savannah, GA

Transcription:

I am in disfavor of the storage of weapons-usable fissile materials at the Savannah River Site. I am also totally against any reform plan such as your consolidated alternative. I am against any of your storage plans. I mean your plan that have for storing this plutonium. I am also in disfavor of the consolidation of plutonium alternatives unless it's at another site. I am also in disfavor of your upgrading of any one of your multiple sites. I am also in disfavor of your no action alternative. I am in favor of actually getting the Savannah River Site out of Savannah period. Thank you. | 1/08.03.01

I am a member of Citizens for Environmental Justice. I am totally against the existence of any borehole being created on the Savannah River Site, of the storage of any plutonium. I am also I think all of your programs, your alternative programs ad subalternative programs, are very primitive. I also are in disfavor of your consolidation alternatives, your upgrading facilities, and also am also not in favor for any of your anything that's dealing with the storage of plutonium at the Savannah River Site, except your consolidation of the plutonium which would hopefully be moved to one of your other five sites, of the other six sites besides the Savannah River Site. Thank you. | 2/08.03.01

P-035

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to new missions at SRS. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

CITY OF AMARILLO, OFFICE OF CITY COMMISSIONER, AMARILLO, TX, HONORABLE DIANNE BOSCH

HON. DIANNE BOSCH
CITY COMMISSIONER
CITY OF AMARILLO, TEXAS

COMMENTS ON THE STOCKPILE STEWARDSHIP AND MANAGEMENT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT, STORAGE AND DISPOSITION OF FISSILE MATERIALS PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT AND PANTEX SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT

THANK YOU FOR THE CHANCE TO ADDRESS THE DEPARTMENT OF ENERGY IN THIS INTERACTIVE WORKSHOP FORMAT. AS AN AMARILLO CITY COMMISSIONER SINCE 1989, I HAVE WITNESSED COUNTLESS D.O.E. HEARINGS ON PANTEX. THE GIVE-AND -TAKE BETWEEN THE AUDIENCE AND THE D.O.E. OFFICIALS IS VERY INFORMATIVE TO EVERYONE IN ATTENDANCE. THE D.O.E. IS TO BE APPLAUDED FOR THE USE OF AN INTERACTIVE FORMAT, AND SHOULD CONTINUE TO USE IT IN FUTURE HEARINGS.

THE D.O.E. IS ALSO TO BE APPLAUDED FOR THE OPEN MANNER WITH WHICH IT HAS, AND CONTINUES TO, ADDRESS LOCAL ENVIRONMENTAL CONCERNS. WE ARE ALSO THANKFUL THAT GOOD MANAGEMENT AT PANTEX BY THE D.O.E.'S CONTRACTORS, MASON & HANGER AND BATTELLE, HAS PREVENTED PANTEX FROM HAVING ENVIRONMENTAL PROBLEMS OF THE TYPE AND MAGNITUDE FOUND AT OTHER D.O.E. SITES. AS IS EVIDENT BY THE LARGE TURNOUT TONIGHT, THIS COMMUNITY STRONGLY SUPPORTS PANTEX, AND THIS

TX-039

SUPPORT COMES IN LARGE MEASURE FROM THE D.O.E.'S COMMITMENT TO OUR LOCAL ENVIRONMENT. THAT CONTINUED COMMITMENT TO THE ENVIRONMENT IS CRITICAL FOR COMMUNITY SUPPORT OF ALL CONTINUED OR NEW MISSIONS AT PANTEX.

REGARDING THE STOCKPILE STEWARD SHIP AND MANAGEMENT PEIS, I STRONGLY SUPPORT THE CHOICE OF PANTEX AS THE PREFERRED ALTERNATIVE FOR THE ASSEMBLY AND DISASSEMBLY MISSION. THIS COMMUNITY IS EXTREMELY PROUD THAT PANTEX PLAYED AN IMPORTANT PART IN WINNING THE COLD WAR, AND WILL CONTINUE TO PLAY A CRITICAL ROLE IN REDUCING THE SIZE OF THE NATION'S NUCLEAR ARSENAL IN THE POST-COLD WAR PERIOD. KEEPING THIS MISSION AT PANTEX IS NOT ONLY THE RIGHT CHOICE FOR AMARILLO, IT ALSO MAKE SENSE FROM A NATIONAL PERSPECTIVE BECAUSE IT MAINTAINS A CONTINGENT PRODUCTION CAPABILITY, AND IT SAVES MORE THAT 1.5 BILLION DOLLARS WHEN COMPARED TO THE COST OF TRANSFERRING THE WORK TO THE NEVADA TEST SITE.

AS LONG AS WE ARE ON THE SUBJECT OF COST SAVINGS AND RETENTION OF PRODUCTION CAPABILITY, THE D.O.E. MUST NOT LET THE HIGH EXPLOSIVE (H.E.) FABRICATION MISSION BE MOVED FROM PANTEX. PANTEX EMPLOYEES HAVE SUCCESSFULLY PERFORMED THIS MISSION FOR MORE THAN FORTY YEARS, AND THERE IS

TX-039

CITY OF AMARILLO, OFFICE OF CITY COMMISSIONER, AMARILLO, TX, HONORABLE DIANNE BOSCH
PAGE 3 OF 4

ABSOLUTELY NO REASON FOR THIS WORK TO BE MOVED. WHEN THE WEAPONS COMPLEX WAS ORGANIZED, IT MADE LOGICAL SENSE TO LOCATE HIGH EXPLOSIVE WORK WITH ASSEMBLY AND DISASSEMBLY. IT STILL MAKES SENSE. FURTHERMORE, THE D.O.E.'S OWN ANALYSIS INDICATES THAT THE COST OF TRANSFERRING H.E. WORK TO NEW MEXICO LABS WOULD BE FIFTY MILLION DOLLARS. IT IS INCONCEIVABLE. THAT THE D.O.E. MIGHT SEEK TO JUSTIFY SPENDING FIFTY MILLION DOLLARS ONLY TO END UP WITH LESS PRODUCTION CAPABILITY IN A LOCATION THAT HAS NEVER PERFORMED THIS MISSION.

IN TERMS OF STORAGE AND DISPOSITION ACTIVITIES, I WOULD FIRST LIKE TO NOTE MY PREVIOUS COMMENTS ABOUT THE NEED TO PROTECT THE ENVIRONMENT. I AM ENCOURAGED BY THE PREVIOUS COMMENTS ABOUT THE NEED TO PROTECT THE ENVIRONMENT. I AM ENCOURAGED BY THE OUTSTANDING ENVIRONMENTAL RECORD THAT PANTEX HAS REGARDING STORAGE OF PLUTONIUM OVER MANY YEARS. I HOPE THAT THE D.O.E. WILL MAKE THE RIGHT CHOICE AND CONTINUE THE SAFE STORAGE OF SURPLUS PLUTONIUM AT PANTEX. I ALSO HOPE THAT THE D.O.E. WILL KEEP IN MIND THAT PLUTONIUM FROM DISMANTLED WEAPONS REPRESENTS A TREMENDOUS INVESTMENT AND MAY PROVE TO BE A VALUABLE ASSET IN CIVILIAN

1/08.03.01

TX-039

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

USE. I URGE THE D.O.E. TO CHOOSE PANTEX AS THE SITE FOR ENVIRONMENTALLY SOUND DISPOSITION ACTIVITIES.

1/08.03.01 cont.

ONCE AGAIN, THANK YOU FOR THE OPPORTUNITY TO COMMENT ON THE D.O.E.'S PLAN FOR THE FUTURE OF PANTEX. PANTEX HAS BEEN AN IMPORTANT PART OF OUR REGIONAL ECONOMY FOR MANY YEARS, AND WE SUPPORT THE CONTINUATION OF ENVIRONMENTALLY SOUND OPERATIONS AT THE PLANT. I WOULD ALSO LIKE TO THANK ALL THE CONCERNED CITIZENS OF OUR COMMUNITY WHO HAVE MAKE THE EFFORT TO ATTEND THIS MEETING TONIGHT.

TX-039

CITY OF RICHLAND, OFFICE OF THE MAYOR, RICHLAND, WA, MAYOR LARRY HALER
PAGE 1 OF 3

Comments of Richland Mayor Larry Haler
April 11, 1996 Public Meeting on Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Good evening. I am Larry Haler, Mayor of Richland. I also serve as Chairman of the "Hanford Communities," an intergovernmental organization that represents the interests of cities and counties most directly affected by Hanford. As you are concluding a long day of meetings, let me extend a somewhat belated welcome to the Tri-Cities!

I have a prepared statement I would like to read and leave with you. We will be submitting written comments within the month.

The Programmatic Environmental Impact Statement, or PEIS, on Storage and Disposition of Weapons-Usable Fissile Materials is of great interest to the City of Richland and the other local governments in this area. Hanford, directly to our north, is identified as one of six DOE candidate sites for long-term storage of weapons-usable plutonium. Two of the disposition alternatives noted in the PEIS are particularly well suited to Hanford.

We would be proud to have Hanford help reduce the global nuclear weapons threat. However, we do have some misgivings. Nearly half of all Hanford workers live in Richland. I am concerned about their health and safety, as well as their economic well-being. Public safety associated with transport of radioactive materials through our communities is a factor we must consider. We must also safeguard the quality of our natural environment. 1/10.00.00

Beyond these tangible issues, we are anxious that our community not be perceived by others in the Pacific Northwest as a dumping ground for radioactive wastes. As DOE is reducing employment opportunities at Hanford, we must recruit new enterprises into this area to remain viable. Positive community image is critically important to our economic diversification efforts. 2/09.08.01

Our formal written responses to this PEIS will be carefully developed. We have appointed a technical advisory committee to explore the health and safety, transportation, and socioeconomic impacts of a new plutonium mission for Hanford. The committee began its analysis this week, and we hope to have our elected governing boards review their work and recommendations by the end of the month.

WA-016

10 00 00 **Comment Number 1**

Transportation safety is assured since Federal regulations require the use of packagings that cannot release dangerous quantities of radioactive material under the most severe accident conditions. During more than 40 years of DOE shipment activity, there has never been an accidental release of radioactive material that has caused injury or death. The maximum potential health risk from transporting materials associated with the Proposed Alternatives are evaluated and presented in Section 4.4 and Appendix G of the PEIS.

09 08 01 **Comment Number 2**

The socioeconomic analysis estimates impacts to employment, income, housing, and community services. These impacts are estimated using standard methodology and can be quantified and compared across sites. The disposal of radioactive wastes from other DOE sites is not within the scope of this PEIS. This PEIS analyzes the expected waste disposal for Proposed Actions at Hanford, and compared the amount to the existing environment.

CITY OF RICHLAND, OFFICE OF THE MAYOR, RICHLAND, WA, MAYOR LARRY HALER
PAGE 2 OF 3

Fabricating plutonium into mixed-oxide, or MOX, fuel and burning it in reactors is one of the disposal options noted in the PEIS. The Washington Public Power Supply System has made a proposal to the Department of Energy to burn a bundle of MOX fuel as a demonstration. Our City Council fully supports the Supply System in this endeavor. We also encourage DOE consider the Supply System's unfinished nuclear power plant on the Hanford Site as a second MOX fuel facility. The Fast Flux Test Facility, or FFTF, provides yet another opportunity for burning of MOX fuel. The FFTF offers additional value in the potential for production of tritium and vital medical isotopes. We also have at Hanford the "Fuel and Materials Examination Facility," or FMEF, the only facility in the country that has been designed and is available to cost-effectively manufacture MOX fuel. 3/08.03.01

As you can see, Hanford offers a complete, safe, and secure industrial complex capable of storing plutonium, manufacturing and burning MOX fuels, vitrifying waste products, and handling spent fuel. The Supply System and private companies have indicated interest in participating in this important endeavor. We have a talented and experienced work force and the industrial infrastructure necessary to perform a plutonium storage and disposal mission. Assuming we achieve necessary public understanding and support and address legitimate concerns through effective mitigative measures, I believe Hanford will prove to be well suited to play a plutonium storage and disposal mission.

In closing, I should mention that the short timeline for commenting on the PEIS has made our review particularly difficult. One problem is that there are very few copies of the PEIS currently available. We have requested additional copies for our committee and hope to receive them soon. I hope you will consider extending the comment period to give the public better opportunity to participate. 4/08.02.00

Thank you again for the opportunity to provide comments this evening. We will be carefully evaluating this opportunity for Hanford to be of service to the nation. You can expect a thoughtful written response to the PEIS from us.

WA-016

08 03 01 Comment Number 3

Liquid metal reactors were not included as alternatives for Pu disposition in the PEIS due to longer time and greater cost required to complete their construction. The FFTF, on the other hand, is an existing reactor and could be used for Pu burning. However, the limited capacity of the FFTF would limit the rate at which Pu could be dispositioned and would require a much longer timeframe for disposition than that which could be achieved with the reactor options addressed in the PEIS.

The Department of Energy is in fact considering the FFTF, pursuant to the ROD for the *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (TSR PEIS). The ROD (December 1995, 60 FR 63878) for the TSR PEIS addressed the FFTF for tritium production as follows:

> A private group has recently suggested that it purchase the FFTF from DOE and that DOE then contract with the private group to make tritium at that facility. In the [Tritium Supply and Recycling Final] PEIS, the use of the FFTF was considered and dismissed as a long-term tritium supply option because the amount of tritium that it could produce would only meet a percentage of the steady state tritium requirements, and it was not reasonable to rely on operating the facility far beyond the end of its design life. However, DOE will evaluate the presentation made by the private group to determine whether the operation of the FFTF might be able to play any role in meeting future tritium requirements. If any changes are warranted to this ROD following that review, or further NEPA documentation is required, DOE will take appropriate action.

The Secretary of Energy has requested a review by the JASONS Panel (eminent academic scholars and scientists) as part of the evaluation of tritium production with the FFTF. Should the outcome of this evaluation lead to a DOE proposal to restart the FFTF for tritium production, additional environmental analyses would be performed, as appropriate. If the FFTF were to be restarted, a substantial portion of the surplus Pu that would be used for MOX fuel could be used to fabricate FFTF driver fuel, thereby achieving the Spent Fuel Standard for Pu disposition through irradiation in the FFTF. Further description of the FFTF has been added to Appendix N of the PEIS.

The Fuels and Materials Examination Facility (FMEF) is considered for use as a long-term storage facility for Pu, and the impacts are included in Section 4.2.1 of the PEIS. For the production of MOX fuel, a generic facility was considered for all six DOE sites. At Hanford, the MOX fuel fabrication facility would be located in the 200-Area adjacent to 200 East. The utilization of the FMEF would be a variant for MOX fuel fabrication at Hanford, which is bounded by the environmental analysis for the MOX fuel fabrication facility located in the 200-Area. Table 2.4–1 of the PEIS provides a brief description for variants which includes "Modification/Completion of existing facilities for MOX fabrication." The storage options for Hanford also include constructing a new facility. Utilization of FMEF for the Upgrade Alternative would not preclude its use to also support Pu disposition activities for either Reactor or Immobilization Alternatives.

08 02 00 Comment Number 4

Additional copies of the PEIS were mailed within 2 days of receipt of the request. The public comment period was extended to a total of 92 days.

CITY OF WEST RICHLAND, WEST RICHLAND, WA,
COUNCILMAN KEN DOBBIN
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Kuhland Evening 4-11-96 1 of 3

Comments of West Richland Councilman, Ken Dobbin
April 11, 1996 Public Meeting on Storage and
Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

The Fast Flux Test Facility (FFTF) will need 800kg
to one metric ton per years of weapons return plutonium
to fuel the multi-missions it will be asked to perform.
The FFTF will use a once-through fuel system that
converts the plutonium to a spent fuel standard. It
will not be recycled.

These FFTF missions include tritium for national
security, medical isotopes for cell-directed cancer
therapy and treatment of other major diseases, and
commercial isotopes for agriculture and industry.

Advanced Nuclear and Medical Systems, called ANMS,
is a consortium of companies negotiating with the
Department of Energy to operate the FFTF to privately
provide these missions for our Nation. ANMS has
widespread Congressional and professional support
for the privatization of the FFTF.

WA-019

CITY OF WEST RICHLAND, WEST RICHLAND, WA,
COUNCILMAN KEN DOBBIN
PAGE 2 OF 3

4-11-96 2 of 3

Comments of West Richland Councilman, Ken Dobbin

ANWS has proposed an alliance with the Washington Public Power Supply System to jointly burn plutonium in the FFTF and WNP-2. That proposal provides synergism between the two facilities and would use the already constructed Fuels and Materials Examination Facility, called the FMEF, for plutonium fuel management.

These facilities take advantage of the national security issues of all those located on the Hanford site. The FFTF and FMEF already have state-of-the-art plutonium security systems. Eleven metric tons of the plutonium is already located on the Hanford site.

The FFTF creates a teaming opportunity with Russia. The United States wants Russia to use a once-through fuel system and not recycle. Russia wants to burn the plutonium in their fast reactors. The FFTF would demonstrate how to convert the plutonium to a spent fuel standard without recycle. They could be rewarded to do likewise.

WA-019

CITY OF WEST RICHLAND, WEST RICHLAND, WA,
COUNCILMAN KEN DOBBIN
PAGE 3 OF 3

Comments of West Richland Councilman, Ken Dobbin

Converting weapons-usable plutonium to a spent fuel standard cooperatively with the Russians while providing needed isotopes is a win-win for both the Hanford area and the Nation.

I urge the Department of Energy to include the FFTF as a viable plutonium disposition option in the Programmatic Environmental Impact Statement on the Disposition of Weapons-Usable Fissile Materials. 1/01.02.00

Thank you,

Ken Dobbin
Councilman, City of West Richland, Washington
Member, American Nuclear Society Eastern Washington Section, Public Information Committee

WA-019

01 02 00 **Comment Number 1**

Liquid metal reactors were not included as alternatives for Pu disposition in the PEIS due to longer time and greater cost required to complete their construction. The FFTF, on the other hand, is an existing reactor and could be used for Pu burning. However, the limited capacity of the FFTF would limit the rate at which Pu could be dispositioned and require a much longer timeframe for disposition than that which could be achieved with the reactor options addressed in the PEIS.

The Department of Energy is in fact considering the FFTF for the TSR PEIS. The ROD (December 1995, 60 FR 63878) for the TSR PEIS addressed the FFTF for tritium production as follows:

> A private group has recently suggested that it purchase the FFTF from DOE and that DOE then contract with the private group to make tritium at that facility. In the [Tritium and Recycling Final] PEIS, the use of the FFTF was considered and dismissed as a long-term tritium supply option because the amount of tritium that it could produce would only meet a percentage of the steady state tritium requirements, and it was not reasonable to rely on operating the facility far beyond the end of its design life. However, DOE will evaluate the presentation made by the private group to determine whether the operation of the FFTF might be able to play any role in meeting future tritium requirements. If any changes are warranted to this ROD following that review, or further NEPA documentation is required, DOE will take appropriate action.

The Secretary of Energy has requested a review by the JASONS Panel (eminent academic scholars and scientists) as part of the evaluation of the tritium production with the FFTF. Should the outcome of this evaluation lead to a DOE proposal to restart the FFTF for tritium production, additional environmental analyses would be performed, as appropriate. If the FFTF were to be restarted, a substantial portion of the surplus Pu that would be used for MOX fuel could be used to fabricate FFTF driver fuel, thereby achieving the Spent Fuel Standard for Pu disposition through irradiation in the FFTF. Further description of the FFTF has been added to Appendix N of the PEIS.

CITY OF WEST RICHLAND, WEST RICHLAND, WA,
COUNCILMAN KENNETH D. DOBBIN
PAGE 1 OF 2

Kenneth D. Dobbin
1843 Blue Heron
West Richland, WA. 99353

May 4, 1996

U. S. Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
Washington, D. C. 20026-3786

COMMENTS ON THE STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Dear Sir:

I respectfully request that you include the Fast Flux Test Facility (FFTF) as a option to disposition either weapons-grade fissile material or reactor grade plutonium. It is an error to omit the FFTF from the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement. The Department of Energy (DOE) is reconsidering the use of the FFTF for defense and medical missions and this fuel material will be needed for its operation. The FFTF can be back on line in less than three years and could play a significant role to reduce what the National Academy of Sciences calls a "clear and present danger" associated with the stockpile of these materials. 1/01.02.00

The FFTF will need between 800 kg and one metric ton (MT) per year of fissile plutonium or uranium to fuel the multiple missions it will be asked to perform. It will use a once-through fuel system that converts the plutonium to a spent fuel standard. The FFTF can disposition a significant quantity of the 38 MT of surplus weapons-grade plutonium or use a portion of the 175 MT of surplus highly enriched uranium over the 30 years of life left in this reactor.

Missions being considered for the FFTF include tritium for national security, medical isotopes for cell-directed cancer therapy and treatment of other major diseases, and commercial isotopes for agriculture and industry. Advanced Nuclear and Medical Systems (ANMS) is a consortium of companies that is negotiating with the DOE to operate the FFTF and privately provide these products for our Nation. ANMS has widespread Congressional and professional support for the privatization of the FFTF.

ANMS has proposed an alliance with the Washington Public Power Supply System to jointly burn plutonium in the FFTF and WNP-2. That proposal provides synergism between the two facilities, a higher disposition rate of weapons usable material, and significant cost savings. The proposal would utilize the already constructed Fuels and Materials Examination Facility (FMEF) for plutonium fuel management. 1/01.02.00 cont.

M-168

01 02 00 Comment Number 1

Liquid metal reactors were not included as alternatives for Pu disposition in the PEIS due to longer time and greater cost required to complete their construction. The FFTF, on the other hand, is an existing reactor and could be used for Pu burning. However, the limited capacity of the FFTF would limit the rate at which Pu could be dispositioned and would require a much longer timeframe for disposition than that which could be achieved with the reactor options addressed in the PEIS.

The Department of Energy is in fact considering the FFTF, pursuant to the ROD for the TSR PEIS. The ROD (December 1995, 60 FR 63878) for the TSR PEIS addressed the FFTF for tritium production as follows:

> A private group has recently suggested that it purchase the FFTF from DOE and that DOE then contract with the private group to make tritium at that facility. In the [Tritium Supply and Recycling Final] PEIS, the use of the FFTF was considered and dismissed as a long-term tritium supply option because the amount of tritium that it could produce would only meet a percentage of the steady state tritium requirements, and it was not reasonable to rely on operating the facility far beyond the end of its design life. However, DOE will evaluate the presentation made by the private group to determine whether the operation of the FFTF might be able to play any role in meeting future tritium requirements. If any changes are warranted to this ROD following that review, or further NEPA documentation is required, DOE will take appropriate action.

The Secretary of Energy has requested a review by the JASONS Panel (eminent academic scholars and scientists) as part of the evaluation of tritium production with the FFTF. Should the outcome of this evaluation lead to a DOE proposal to restart the FFTF for tritium production, additional environmental analyses would be performed, as appropriate. If the FFTF were to be restarted, a substantial portion of the surplus Pu that would be used for MOX fuel could be used to fabricate FFTF driver fuel, thereby achieving the Spent Fuel Standard for Pu disposition through irradiation in the FFTF. Further description of the FFTF has been added to Appendix N of the PEIS.

CITY OF WEST RICHLAND, WEST RICHLAND, WA, COUNCILMAN KENNETH D. DOBBIN
PAGE 2 OF 2

The FFTF, WNP-2, and FMEF can take advantage of reduced security issues associated with all these facilities being located in close proximity on the Hanford Reservation in Washington State. Also, the FFTF and FMEF already have state-of-the-art plutonium security systems. Because Hanford is host to some of this material, it should be considered as one of the disposition locations.

The FFTF also creates a teaming opportunity with Russia. The United States wants Russia to use a once-through fuel system and not recycle. However, Russia wants to use its fast reactors which now are a part of a fuel system that includes recycle. The FFTF could demonstrate how to set up a fast reactor system to burn rather than breed plutonium and convert significant quantities of weapons-usable plutonium to a spent fuel standard without recycle. The US could provide Russia with the technology to extend the life of its BN600 reactor and convert it to a system similar to the FFTF to simultaneously burn the material in both countries.

Converting significant quantities weapons-usable fissile material to a spent fuel standard, providing the US with needed isotopes, and teaming with Russia to persuade them to accept the US stance on a once-through fuel cycle is a win-win for our Nation as well as the world. I strongly urge the DOE to include the FFTF as a viable option in the Programmatic Environmental Impact Statement on the Disposition of Weapons-Usable Fissile Materials.

Sincerely,

Kenneth D Dobbin

Kenneth D. Dobbin

Councilman, City of West Richland, Washington
Member, American Nuclear Society Eastern Washington Section, Public Information Committee

cc: Senator Slade Gorton
Senator Patty Murray
Congressman Doc Hastings

M-168

The FMEF was a candidate storage facility under the Upgrade Alternative for storage of weapons-usable fissile materials.

CLARTON, WAYNE, RIGBY, ID
PAGE 1 OF 1

Comment ID: P0027
Date Received: April 18, 1996
Name: Wayne Clarton
Address: 444 North State Street
Rigby, ID 83432

Transcription:

I'm calling in favor of the plutonium work in Idaho at the INEL, and I'd like to state that I'm in favor it. We have the ability to store it safely, to take care of it. It creates more jobs in the Southeastern Idaho area. We're in favor of it, and like to see it come here. Thanks. 1/08.03.01

P-027

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for additional missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

COALITION 21, IDAHO FALLS, ID, GEORGE A. FREUND PAGE 1 OF 6

Subject:

WEAPONS-USABLE MAT'L DPEIS

COMMENTS ON STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS
DRAFT DPEIS- 21/96-04GF

This comment document (#21/96-04GF) is the companion document referred to in Comment 13 of the Coalition 21 comment document (#21/96-03RK). The comments herein are based on a limited review; they should be considered symptomatic of more pervasive shortcomings.

GENERAL COMMENTS:

A. The Summary does not represent a thoughtful summary of the entire PEIS. It is overburdend with marginally useful details about environmental impact at the expense of better description of the alternatives and of the assumptions related to the various candidate sites (cf specific comments S-4, S-12a&b, S-18b, S-22).

B. The environmental information in the Summary is not only too detailed; it is unnecessarily repetitive leading to internal inconsistencies (comments S-17, S-18a, S-19, S-20a, S-21, S-23b, S-37b, S-46, S-59, S-122). | 1/09.00.08

C. Meaningful comparisons that would allow decisions to be made on environmental factors are often lacking; some comparisons that are included are meaningless.. The only comparisons that are really clear are the obvious ones, i. e. alternatives using existing facilities (ANL-W Electrometallurgical or Existing LWR) have less impact than comparable alternatives involving new facilities (comments S-26b, S-28; S-47a, b&d; S-48a, b&c; S-49b, S-53).

SPECIFIC COMMENTS:

These comments are keyed to the page number of the Summary. Multiple comments on a page are identified by a, b etc. Location on the page is keyed to the paragraph; a partial paragraph at the top of the page is considered the 1st paragraph.

S-3: By its shading, Figure S-1 calls attention only to the one material category not | 2/16.00.00

- more -

F-027

09 00 08 **Comment Number 1**

Based on comments received, the Summary of the Draft PEIS was revised. All revisions made appear in the Summary of the Final PEIS.

16 00 00 **Comment Number 2**

The shading in Figure S–1 is designed for clarity and readability. The figure itself is designed only to show the relationship between the various types of fissile material categories. The figure has been modified for the Final PEIS and Summary.

COALITION 21, IDAHO FALLS, ID,
GEORGE A. FREUND
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covered by either PEIS. It should be used as the basis for text explaining what is meant by each block on the figure.	2/16.00.00 cont.
S-4, 1st para.: Here would be the place to explain that the environmental analysis is based on 50t of Pu and to justify selection of that value.	3/01.00.00
S-5, last para.: Figure S-2 appears five pages after its first mention; too far back.	
S-7(a): 1st para.: The concept of grouping the alternatives into categories is good but is not carried through consistently (see S-37a).	
S-7b: The text after the three boxes does not relate to the last previous subheading on page S-6.	
S-12a: Better coordination between Figure S-2 and Tables S-1, S-2 and S-3 is necessary. Table S-1 does provide appropriate additional detail on Upgrade. Tables S-2 and S-3 should show where at each site the new facilities would be built. Accompanying text should justify these selections.	4/16.00.00
S-12b: The significance of the subalternative for Consolidation and Collocation Alternatives is not clear, since this subalternative is not further identified in subsequent bar graphs (Figures S-4 etc.) or accompanying text.	
S-17: The difference in emphasis (if any) between the section starting on this page and going to page S-36 and the section starting on page S-47 is not clear. The latter section, particularly since it explains the various figures, is much better. The former section seems to give unnecessary and duplicative detail, that would be better captured in a couple of carefully thought-out charts.	1/09.00.08 cont.
S-18a, 7th para: Air quality discussion not adequately related to corresponding text on page S-72. Also should make it clear that the identified sites are the only ones to which this alternative applies.	5/09.03.08
S-18b, 7th para: Comment on cultural/paleontological resources would not apply if the location at INEL were inside an existing fenced area which has been previously disturbed. From a cost and future environmental cleanup standpoint, such a location would surely be selected. This comment applies repeatedly throughout this section.	6/09.07.03
S-19, 3rd para: Page S-91 shows the impact on local road to be at Pantex not at INEL.	7/09.08.08
S-20a, 2nd para: Text on page S-88 indicates an endangered-species impact at Hanford as well.	8/09.06.01
S-20b, 2nd para. Would there be this adverse impact on waste management at INEL if the facility were built inside an existing fenced area with an established infrastructure.	9/09.11.03
S-21: Attachment A does not address Phaseout.	4/16.00.00 cont.
S-22, 5th para: Explain earlier which forms of Pu do not lend themselves to MOX fuel fabrication. Relate to 50/50 split on page S-50 (combination of alternatives) and justify selection of that split.	10/06.01.08
S-23a: Provide distinctive shadings for INEL and NTS bargraphs. Leaving it blank (as	1/09.00.08 cont.

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01 00 00 **Comment Number 3**

Comment noted. In preparing the PEIS, DOE assumed the disposition of approximately 50 t (55 tons) of Pu. Currently, DOE's inventory of Pu for disposition consists of 38.2 t (42.1 tons) of material declared surplus by the President and identified in the Secretary of Energy's Openness Initiative in early 1996, and an additional 14.5 t (15.95 tons) of reactor-grade and fuel-grade Pu that is excess to U.S. defense needs, but which has not yet been declared surplus by the President. The PEIS identifies annual impacts based on throughput requirements identified for each technology. Therefore, if amounts greater than 50 t (55 tons) are eventually declared surplus, annual impacts would be the same but would occur over a longer period of time.

16 00 00 **Comment Number 4**

Comment noted. Based on comments received, the Summary has been revised for the Final PEIS.

09 03 08 **Comment Number 5**

In response to the comment, text was added to the Upgrade Alternative section of the Summary to clarify that the alternative does not apply to NTS, RFETS, or LANL. Text was also added to the air quality discussion of the Upgrade Alternative section in the Summary to clarify that all sites are expected to comply with the ambient air quality standards and guidelines.

09 07 03 **Comment Number 6**

The commentor is correct that construction on previously disturbed land would probably not affect resources that are potentially eligible for placement on the National Register of Historic Places (NRHP). However, other cultural resources could be affected by new ground disturbance. The Summary of the Final PEIS has been revised (Sections S.5 and S.8) to provide a better description of the approach to the environmental impact analysis and the comparison of alternatives.

for NTS) suggests less impact than others; filling it in solid (as for INEL) suggest more impact.	1/09.00.08 cont.
S-23b, Figure S-5: Explain why RFETS material causes a much greater employment impact at Pantex than at other facilities; and why employment impact at ORR is more without RFETS material than with it. How many other such discrepancies exist that I have not identified?	11/09.08.08
S-26a: Change Upgrade bargraphs from solid color to shading.	1/09.00.08 cont.
S-26b: Liquid transuranic waste is listed as a key long-term impact on page S-22. Less than one 55 gal. drum per year (and the same for all sites) does not seem to warrant a separate Figure S-11 in the Summary. INEL is dealing with about 130,000 cu meters of TRU waste.	12/09.11.08
S-28: Decline of local road service is not mentioned in corresponding text on page S-140. The whole subject of service decline seems to be overblown for the INEL. A site that (a) has lost 2600 jobs over the last few years, (b) has recently opened an overpass/merge at its main entrance junction, (c) whose main access road was once at 70mph and has just been raised to 65mph and (d) most of whose employees ride buses, is not likely to have a new local traffic problem.	13/09.08.08
S-37a: The top three bargraph legends on Figures S-14 to S-31 should have the word "Category" instead of "Alternative" associated with them. For the fourth legend Facility should be plural,	4/16.00.00 cont.
S-37b: The LWR Category values in both Figures S-14 and S-15 are different from the corresponding Figures in Section 2.5.2, i.e. -1 and -2.	14/06.00.08
S-46, 5th para: The rank order of cumulative impacts differs from the text in the previous two paragraphs. Doesn't any discussion of cumulative impacts have to include the effects of programs listed in para. 2? If so, what is the distinction between the listings in para. 5 and the statement in para 4 that INEL is among the least vulnerable?	15/09.00.08
S-47a, 2nd para: What is the distinction between "would be vulnerable", "could be vulnerable" (used in other paragraphs), and "could be susceptible"?	
S-47b, 4th para: What are the "key discriminators"? A number of environmental impacts more important than visual resources are not represented graphically.	
S47c, 7th para: The text for the Comparison of Alternatives section that starts on this page appears to be verbatim from Section 2.5 of Volume I. With the exception of Figures S-21 to S-25, the figures are the same, but in this summary the references to the individual figures have been removed and put far further front, away from the explanatory text. Figure S-4 should be referenced at the end of this paragraph and other figures should be referenced in subsequent paragaphs.	1/09.00.08 cont.
S-47d, 8th para: Figure S-5 should be referenced her. in line 5. For a true comparison of alternatives, the bar graphs (and accompanying text) for Upgrade with RFETS	16/02.04.08

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09 08 08 **Comment Number 7**

The Summary table in the Draft PEIS was incorrect. Construction of the consolidated facility could cause a decrease in level of service at both Pantex and INEL. The Final PEIS reflects the correction.

09 06 01 **Comment Number 8**

Endangered species at Hanford may be impacted by implementation of this alternative. The text was revised to reflect potential impacts.

09 11 03 **Comment Number 9**

Language regarding adverse impacts has been modified in the PEIS based on comments received. The Final PEIS provides the necessary information to describe the impacts for the resources analyzed. The Summary of the Final PEIS has been revised (Sections S.5 and S.8) to provide a better description of the approach to the environmental impact analysis and the comparison of alternatives.

06 01 08 **Comment Number 10**

Some of the Pu material for disposition is relatively pure (such as metal in weapons pits) and requires little purification to be usable in MOX fuel. However, some Pu material is mixed with contaminants (such as Pu in halide salts) and requires a considerable amount of purification before it can be used in MOX fuel. For the purpose of analysis, approximately 70 percent of the Pu material does not require extensive purification, and, thus, lends itself for use as MOX fuel. The Final PEIS discusses the 70-percent split of materials in Sections 1.6 and 4.6.

09 08 08 **Comment Number 11**

The number of workers required to operate the Pantex facility with RFETS material would be the same as without the RFETS material (a total of 90 workers would be used in both cases). The numbers used in the Draft PEIS have been updated, and the new numbers and analyses were incorporated into Section 4.2.4.8 of the Final PEIS.

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GEORGE A. FREUND
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material should show the total employment impact on all six sites (the one that accepts the RFETS material plus the other five that do not). In other words, is the total employment impact greater if Pantex accepts the RFETS material than if ORR does? — 16/02.04.08 cont.

S-48a, 4th para: Fatality values reported to the third significant figure are not defensible. Suggest using approximations that say they are (a) likely to be essentially zero for the 0.077 calculated value and (b) zero to one or two for the higher values. This approach worked best in the INEL EIS. — 17/09.09.08

S-48b: What purpose does this comparison for the Upgrade alternative serve the decision maker? Does he have the option to upgrade some of the facilities and not others? If so, that option should be described. The reader and the decision maker will also have difficulty verifying the "least affected "claims because the corresponding Figures (S-9 to S-13) show only the highest impact of each option. In other words the figures do not show the NTS P-tunnel option under Collocation. Finally, does this generalized comparison lump apples and oranges (i. e. positive and negative impacts, and equating land use in some fashion with waste generated)? — 18/02.00.08

S-48c, para 7&8 and S-49a, para 2,4,5 etc: The most important comparisons to be shown are between the Existing LWR and the other Disposition Categories because this is the choice most likely to confront the decision maker. Many of the comparisons that show the Evolutionary LWR to have the highest impact of any alternative are only marginally useful and detract from a clear and succinct comparison of likely alternatives. — 19/01.00.00

S-49a, 5th para: This paragraph should be expanded to include the parameters in Figures S-21 to S-25 and should reference all Figures from S-19 to S-31. — 1/09.00.08 cont.

S-49b, 6th para: Comment S-48a applies here as well. — 17/09.09.08 cont.

S-53: Consistent with the previous comment, Figure S-35 is a meaningless comparison. The note shown on the figure should appear in the text and the Figure should be eliminated. — 1/09.00.08 cont.

S-59 and S-122: Attachments A and B should be eliminated; they appear in Section 2.5 and are much too detailed, repetitive, and often conflicting to be in a Summary.

S-66: Dividing 220 person-rem by 30 millirem suggests that 7300 site workers would be affected by No Action on a long-term INEL storage facility that for most workers would be at least several miles away If the facility were upgraded (page S-77), the average dose would increase significantly but only 64 workers would be affected. Is this reasonable? — 20/09.09.08

S-82: First entry under ORR: "doos" not "dose"

S-141: First two columns, 2nd entry: "then" not "then" — 21/16.00.00

S-152 & S-153: Most of the numerical values under Waste Management are annual rates and should be so indicated. — 22/09.11.08

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The storage options for ORR involve the storage of HEU not Pu. Hence, storage of RFETS material is not among the Proposed Alternatives for ORR.

09 11 08 **Comment Number 12**

Based on comments received, the Summary was revised. All revisions made are in the Summary of the Final PEIS. Specific comments on the amounts of waste being generated were addressed accordingly.

09 08 08 **Comment Number 13**

The level of service on some of the local roads at INEL would likely be reduced during construction and/or operation of several of the storage and disposition alternatives. Similar impacts would be expected at other DOE sites. For the PEIS, the local transportation impacts for each of the sites were modeled using the latest available traffic estimates and the number of additional workers expected to use roads into each site. The revisions made in the Final PEIS are also reflected in the Summary.

06 00 08 **Comment Number 14**

Based on comments received, the Summary of the Final PEIS has been revised and Figures S–14 through S–31 have been deleted because of the confusion they caused; incorrect values were mistakenly presented for some of the LWR alternatives shown in the comparison bar charts for operational land use and maximum direct employment. Sections S.5 and S.8 provide a narrative description of the approach to the environmental impact analysis and the comparison of alternatives.

09 00 08 **Comment Number 15**

The Department of Energy did not intend to give the perception that the sites were ranked. Specifics on how other DOE programs could affect the cumulative impacts associated with the proposed storage and disposition alternatives is addressed in Section 4.7 of the Final PEIS. The cumulative impact discussion presented in the Summary has been revised to better reflect the analysis in the Final PEIS.

Other: ROI for INEL is five counties in this PEIS, six counties in INEL WM EIS, and seven counties in WM PEIS. Numerical differences are small, but what a waste of effort not to have a single consistent ROI for INEL! | 23/09.08.03

George A. Freund

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F-027

02 04 08 **Comment Number 16**

Typically, EISs only assess employment impacts at the local and regional levels for a given action. The Draft PEIS and Summary presented projected changes in employment that could occur at each DOE site from storage upgrade and other storage alternatives. This information provides the decisionmaker with the ability to compare a range of alternative storage actions at each of the individual DOE sites. Based on comments received, the Draft PEIS Summary was revised. Revisions made in the Final PEIS are also reflected in the Summary.

09 09 08 **Comment Number 17**

In order to provide information to the public and decisionmakers, the human health risks and latent fatal cancers were presented in the Draft PEIS even though they are very small numbers. To aid public understanding of the risk numbers, an explanation of how to interpret these risk numbers is also included in Section M.5. Due to the inherent uncertainties associated with risk assessment, the parameters related to human health risk assessment should be kept to two significant digits. Risk numbers more than two significant digits were modified in Chapter 4 of the Final PEIS. Presenting more significant digits does not affect the decisionmaking process, but may prevent the artificial grouping of numbers that may disguise significant discriminators.

02 00 08 **Comment Number 18**

The Preferred Alternative included in the Final PEIS is a combination of storage alternatives. These are covered by the environmental analyses included in the Final PEIS. The impacts shown in the Summary do not lump "apples and oranges" or positive and negative effects on land use with waste.

01 00 00 **Comment Number 19**

The Department of Energy did not intend to give the perception that the sites were ranked. The Final PEIS provides the necessary information to describe the impacts for the resources analyzed. The comparison of alternatives bar charts were removed, and the comparisons are now addressed in the text. It is up to the decisionmaker to determine which impacts are discriminators among sites.

09 09 08 **Comment Number 20**

The radiation dose for workers for the No Action Alternative was estimated for the total workforce on site. For the proposed storage alternatives other than No Action, the dose for the workers was analyzed for workers involved only in the proposed new actions. The radiation dose from No Action is the baseline for the dose of the other Proposed Actions. The calculated dose for each Proposed Alternative is presented as the incremental dose over the No Action Alternative.

16 00 00 **Comment Number 21**

The commentor is correct, and appropriate changes were made to the text.

09 11 08 **Comment Number 22**

Impacts reported in Sections 4.2 and 4.3 tables of the PEIS are clearly marked for annual values, or total lifetime of each campaign, for each of the storage and disposition alternatives. Impacts reported in Sections 2.5, 4.6, and the Summary of the PEIS are also clearly marked for annual values or for the life of each alternative.

09 08 03 **Comment Number 23**

The PEIS defines the region of influence (ROI) as those counties where approximately 90 percent of current DOE and/or contractor employees reside. This definition was applied consistently across all of the sites evaluated in the PEIS. The other documents used slightly different criteria, which accounts for the differences in ROI counties identified in respective documents.

COALITION 21, IDAHO FALLS, ID, RICHARD KENNEY
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Subject:

Coalition 21 DPEIS Comments

COMMENTS ON STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS
DRAFT PEIS - 21/96-03RK

Coalition 21 is a recently organized stakeholders group focusing on the future of technology in Idaho for the 21st century. These comments on the subject draft PEIS are submitted on behalf of our growing number of members. Our ID number for this comment document is 21/96-03RK.

1. The environmental impacts on the INEL from the various alternatives, particularly the ones likely to be implemented there, are acceptable and not likely to exceed significantly the impacts of existing/ongoing activities. This conclusion is based on the experience of our membership rather than on the PEIS Summary document, which we find seriously flawed as a clear explanation of the various alternatives and their environmental consequences (see comment 13 below). | 1/08.03.01

2. Whenever environmental consequences are not a deciding factor, other factors must be considered in reaching rational decisions. Coalition 21 advocates safe, technically sound and proliferation-resistant choices that are fiscally responsible and consistent with Idaho's 1995 Nuclear Waste Agreement. Only then do we advocate their location at the INEL. | 2/08.03.00

3. HEU storage should be consolidated at Oak Ridge, where HEU has been produced for many years and where about two-thirds of the current inventory is stored. | 3/01.04.00

4. Some of the discussion and much of the media coverage of the April 15 public hearing in Idaho Falls focused on whether plutonium is a waste or not. Coalition 21 believes that plutonium becomes a waste only if DOE does not put it to beneficial use prior to final disposition. Accordingly we support the general concept of consolidated long-term storage at PANTEX where about two-thirds of the current inventory exists. However, we prefer the No Action alternative for INEL plutonium, if current or reasonably likely future programs at ANL-W can put it to beneficial use. If those programs do not materialize, the plutonium must be removed by the year 2018, consistent with the transuranic waste provisions of the 1995 Nuclear Waste | 4/09.11.08 | 5/08.03.01 | 6/08.03.01 | 7/08.03.00

- more -

F-028

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for additional missions at INEL. Based on comments received, the Summary of the PEIS was revised and now includes the Preferred Alternative. The bar charts (figures) providing the comparison of impacts for both storage and disposition were deleted from the Summary. The related text was revised to clearly describe the alternatives and clarify the comparison of impacts.

08 03 00 **Comment Number 2**

The Department of Energy acknowledges the commentor's support of new missions at INEL if they are fiscally responsible and consistent with the 1995 *Nuclear Waste Agreement* (October 17 Settlement Agreement/Consent Order).

01 04 00 **Comment Number 3**

Comment noted. The *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (HEU EIS) assumed that all HEU would be transferred to ORR for storage pending a decision on long-term storage. Continued storage at ORR for the "long-term" is one of the alternatives analyzed in the PEIS. Facilities at other sites are included in the PEIS analyses since they are also "reasonable" storage alternatives and, therefore, must be considered according to NEPA. The Preferred Alternative for storage is identified in Chapter 1 of the Final PEIS.

09 11 08 **Comment Number 4**

The Department of Energy acknowledges that, in accordance with 40 CFR 261.4, "Source, special nuclear or by-product material as defined by the *Atomic Energy Act* (AEA), as amended, 42 U.S.C. 2011 et. seq." is not a "solid waste" under RCRA. Section 1.1.1 outlines the materials that fall within the scope of this PEIS.

COALITION 21, IDAHO FALLS, ID,
RICHARD KENNEY
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Agreement. | 7/08.03.00 cont.

5. The National Academy of Sciences study established the "Spent Fuel Standard" as a criterion by which to judge disposition alternatives. One assured way of meeting that standard is to incorporate the plutonium in LWR fuel and then use that fuel to high burnup. Disposal of plutonium through such burnup use in commercial power reactors provides a real "peace dividend" for weapons usable materials. Coalition 21 therefore supports the Reactor category of disposal alternatives.

6. Commercial reactors already produce considerable plutonium, concurrent with burning it up via the fission process. A number of commercial nuclear plants including WPPSS-2 have expressed an interest in using weapons plutonium in their plant. In this instance Coalition 21 recognizes that the environmental consequences (and financial costs) of the Existing LWR alternative are less than those of other Reactor alternatives. | 8/08.03.01

7. The Evolutionary LWR alternative would allow the US to build here one or more of the advanced US designs already being built and tested overseas. It would prevent this technology and industrial base from completely escaping to our overseas competitor nations and would help to ensure a future role for nuclear power in a growing economy that is less dependent on foreign oil. We support this Reactor alternative. The INEL would be an acceptable site, but we do not advocate location at INEL because a new large commercial reactor (even half-size) should be built near load centers, and in conjunction with a utility that already operates nuclear power plants.

8. However, INEL would benefit indirectly from the selection of any Reactor alternative through INEL's continuing technical (and possibly safety testing) support to the Nuclear Regulatory Commission. DOE should provide sufficient financial support to ensure that the underlying technology and core competencies are maintained at INEL, the primary reactor testing facility and designated engineering laboratory for DOE. This INEL mission should be clearly delineated in the Strategic Laboratory Missions Plan now being prepared by DOE. Coalition 21 is commenting separately on the draft plan. | 9/08.03.01 | 10/15.00.00

9. Coalition 21 supports the location of the MOX fuel fabrication facility at the INEL, but we recognize that other DOE sites, such as Hanford where a commercial fuel fabrication facility already exists nearby, are likely to be stronger candidates. | 11/08.03.01

10. According to the EIS, some forms of plutonium will not lend themselves to MOX | 12/08.03.01

- more -

F-028

08 03 01 **Comment Number 5**

The Department of Energy acknowledges the commentor's support of consolidated long-term storage at Pantex. Decisions related to storage will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 6**

The Department of Energy acknowledges the commentor's support for the continued storage of surplus Pu (No Action Alternative) at INEL. Decisions on disposition of weapons-usable fissile materials at INEL, Argonne National Laboratory-West (ANL-W), or other facilities will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 00 **Comment Number 7**

Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input. Part of the decision process takes into consideration existing agreements such as the *1995 Settlement Agreement* among the State of Idaho, DOE, and the U.S. Navy. DOE is committed to compliance with the October 17, 1995, Settlement Agreement/Consent Order.

08 03 01 **Comment Number 8**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 9**

The Department of Energy acknowledges the commentor's support for additional missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses,

COALITION 21, IDAHO FALLS, ID, RICHARD KENNEY
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fabrication. For these forms the INEL, with its vast chemical processing experience, should play a major treatment role, preferably through the ANL-W Electrometallurgical Process (provided that process is successfully demonstrated) or via one of the other immobilization alternatives. If the treated material is shipped in and out of Idaho in a timely manner, such treatment would meet the terms of the 1995 Nuclear Waste Agreement. 12/08.03.01 cont.

11. If DOE selects the immobilization category of alternatives for disposition of all its plutonium, Coalition 21 believes that the ANL-W EM alternative (once successfully demonstrated) is the environmentally best alternative in this category and we support it for that reason.

12. Coalition 21 believes that INEL is a satisfactory location for the plutonium conversion facilities that are common activities for any of the plutonium disposal alternatives. The DEIS overstates the environmental consequences of these and any other new treatment (or storage) facility at the INEL because such facilities would logically be located inside existing fenced areas to take advantage of their infrastructure and their previously disturbed land resources. 13/08.03.01 14/09.01.03

13. The DEIS Summary falls short in its function for several reasons:
(a) Its explanation of environmental consequences is overly repetitive and detailed and thus subject to numerous internal inconsistencies.
(b) Some of its comparisons are meaningless, such as distinguishing the number of cancer fatalities to the third significant figure.
(c) Other aspects of the DEIS are not adequately explained in the Summary (cf. the various Weapons-Usable Fissile Material Categories in Figure S-1).
For more detailed comments on the Summary we refer you to a companion comment document no. 21/96-04GF submitted by one of our members. 15/09.00.08

Coalition 21 appreciates the opportunity to comment on this significant Draft PEIS. We recognize what a tremendous undertaking each such document represents.

Richard L. Kenney 6/9/96

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F-028

technical and economic studies, national policy considerations, and public input.

15 00 00 **Comment Number 10**

Comment noted.

08 03 01 **Comment Number 11**

The Department of Energy acknowledges the commentor's support for construction of the MOX fabrication facility at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, existing agreements, and public input.

08 03 01 **Comment Number 12**

The Department of Energy acknowledges the commentor's support for the Electrometallurgical Treatment Alternative and other disposition alternatives at INEL. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, existing agreements, and public input. In a different context, a limited demonstration of electrometallurgical treatment of EDR-II spent nuclear fuel is underway at ANL-W and is scheduled for completion within the next 3 years, pursuant to the *Environmental Assessment of the Electrometallurgical Treatment Research and Demonstration Project in the Fuel Conditioning Facilities at Argonne National Laboratory-West* (DOE/EA-1148, May 1996).

08 03 01 **Comment Number 13**

The Department of Energy acknowledges the commentor's support for the construction of the Pu conversion facility at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

09 01 03 **Comment Number 14**

Concerning the land area required during operation for the Upgrade Alternatives, the Draft PEIS was revised to identify "disturbed area" as land currently not in use and previously an undisturbed natural habitat. Previously disturbed areas, such as graveled area or any land previously graded and cleared of vegetation, were considered "already disturbed areas." All areas within the existing Protected Area (PA) are classified as "already disturbed areas." The criteria for determining disturbed and undisturbed land area during construction would be the same as for operation.

At INEL, only the Upgrade Alternative would be situated entirely on previously disturbed land ANL-W. A potential location for the Consolidation and Collocation Alternatives at INEL would be undisturbed land east of the ICPP. Section 4.2.3.1 of the Final PEIS reflects the revision.

09 00 08 **Comment Number 15**

Based on comments received, the Summary was revised. The bar charts providing the comparison of impacts for both storage and disposition were deleted from the Summary. The related text was revised to clarify the comparison of impacts.

COLORADO COALITION FOR THE PREVENTION OF NUCLEAR WAR, FRANKTOWN, CO, V. E. PERKINS
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P. O. Box 23786
Washington D.C. 20026-3786

Re: PEIS on Plutonium Storage and Disposition

Dear DOE:

The Board of the Colorado Coalition has authorized me to comment on the PEIS on Plutonium Storage and Disposition. First, we strongly oppose converting our excess PU for use as a reactor fuel. Such use will, in our view, encourage proliferation and it will increase the nuclear waste stream. 1/08.03.01

The principle to keep in mind is that the U.S. must dispose of excess PU in a way that will stop the spread of nuclear materials. In our view, that immediately removes the options of using it as a reactor fuel or putting it into deep bore holes. 2/08.03.01

We think the option of vitrification is the most likely way to immobilize PU and to render it unusable for weapons purposes. We therefore believe that money should be spent on developing this technology and that the PU in question should be stored as safely as possible until this technology can be used to immobilize PU. 3/08.03.01

Sincerely,

V. E. Perkins, Ph.D., Vice-President
THE COLORADO COALITION FOR THE PREVENTION OF NUCLEAR WAR

M-134

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, nonproliferation analysis, and public input.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to the disposition alternatives. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, nonproliferation analysis, and public input.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, nonproliferation analysis, and public input.

COMMONWEALTH EDISON COMPANY, DOWNERS GROVE, IL, WILLIAM F. NAUGHTON

Commonwealth Edison Company
1400 Opus Place
Downers Grove, IL 60515-5701

ComEd

May 4, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

Attention: Draft Programmatic Environmental Impact Statement Comments on
Storage and Disposition of Weapons-Usable Fissile Materials

Dear Madam/Sir:

Commonwealth Edison Company (ComEd) is pleased to have the opportunity to provide comments to DOE's Draft Programmatic Environmental Impact Statement (PEIS). ComEd believes that incorporation of the comments contained herein will improve the overall clarity, consistency, strength of the draft PEIS.

In the Enclosure, ComEd has categorized its comments for DOE's convenience and ease of reference. ComEd believes that the Summary PEIS document should include and highlight all significant findings that distinguish the various alternatives. To that end, ComEd will identify those areas requiring special emphasis in the enclosed comments.

Very truly yours,

William F. Naughton
Project Manager Fuels
Nuclear Strategic Services

enclosure

F-015

ENCLOSURE

ComEd Comments on Draft DOE PEIS
for
Storage and Disposition of Weapons-Usable fissile Materials

GENERAL

- **MOX LWR History.** Since 1963 the Europeans have manufactured, safely loaded, and burned over 400 tons of LWR MOX fuel. The manufacturing and use of MOX fuel is a fully developed and deployed industry that the U.S. can look to with confidence for information and assistance in the deployment of a similar MOX program in the U.S. for the disposition of excess weapons plutonium. — 1/08.03.01

- **Immobilization Uncertainty.** In contrast, while much is known about immobilization of trace amounts of actinides in glass or ceramic, very little is known about the immobilization of plutonium in glass or ceramic, let alone the impact of the deep borehole burial option, and therefore large uncertainties have to be assumed requiring extensive research and development, with little assurance of success. These uncertainties need to be more clearly delineated both in the complete and Summary documents. — 2/04.02.00

- **Rapid Deployment.** Special weight should be given to options that enable rapid implementation and encourage similar actions within the former Soviet Union. After all, the real threat of this material is not the inventory stored in the U.S., but the inventory that exists in Russia. The sooner a disposition path is chosen that is compatible with Russian methods of disposal, the more likely Russia will proceed with its own disposition. The former Soviet Union views its excess weapons plutonium as an asset that should be utilized as MOX fuel. Thus, a similar rapidly deployed program in the U.S. would provide impetus to both countries. — 3/01.03.00

- **Benign LWR Impact.** The advantage to the LWR alternative is clearly the none to minimal impact to land use, visual resources, air quality, local geology, biological (which includes impacts to endangered species, etc.), historic resources, paleontological, resources, etc. as delineated in Draft PEIS pages 4-680 through 4-686. This is in comparison to constructing new facilities or substantially expanding the facilities at the up to 7 DOD sites for the various alternatives evaluated, which may have substantial impact to some if not all the aforementioned environmental concerns. — 4/08.03.01

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08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

04 02 00 **Comment Number 2**

Further information on the technical viability of alternatives was provided in the Technical Summary Report and related alternative summary reports published beginning in July 1996. These documents are referenced in the Final PEIS and were made available to the public.

01 03 00 **Comment Number 3**

Comment noted.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

COMMONWEALTH EDISON COMPANY, DOWNERS GROVE, IL,
WILLIAM F. NAUGHTON
PAGE 3 OF 9

- **CANDU Must Be Evaluated.** Evaluation of environmental impacts must not be limited to inside the U.S. borders unless some normalizing factor can be applied to U.S. options to account for the differences. In particular, the inclusion of the CANDU Reactor alternative with virtually no environmental assessment implies that there are no environmental impacts associated with that alternative. At the Washington, D.C. public meeting DOE indicated that such an impact will be required of the Canadian government. If so, that should be unequivocally stated both in the Summary and detailed PEIS Documents. Additionally, prior to issuance of a final PEIS, the U.S. public should also have an opportunity to comment on the Canadian EIS for the CANDU alternative. 5/06.05.09 6/08.02.00

- **Timely Action Impact.** The draft PEIS should evaluate the need for timely action and the potential environmental consequences for delays in terms of the increased proliferation risk. Also, appropriate benefits should accrue to those options that can be implemented immediately. Thus, the implementation timelines of the various disposition alternatives should be evaluated and compared for their overall environmental impacts. 7/01.00.00 8/08.03.00

- The No Action and Storage options fail to even acknowledge the increased possibility for clandestine diversion and usage of the highly visible nuclear weapons materials by terrorist groups or hostile governments especially since these options most likely will be chosen based on Russian actions. In fact, these essentially are the status quo options from which the "clear and present danger" concerns stemmed. This aspect clearly needs to be addressed in the Final PEIS. 9/13.00.00

- **Decommissioning Environmental Impacts.** Environmental impacts of decommissioning of all facilities have not been included in the PEIS. Only the LWR option is currently planning/accounting for this aspect. The LWR and CANDU are only alternatives that are not impacted in the PEIS as they will be decommissioned whether or not weapons material is dispostion in their facilities. All other alternatives require further review to account for the environmental impacts of decommissioning. These impacts need to be addressed in the Final PEIS. 10/01.02.00

- **Finally, Western European's extensive experience in LWR MOX fuel provides overwhelming evidence that the LWR MOX options under consideration in the draft PEIS are superior to the other options, not only in terms of environmental, health, and safety aspects, but also in terms of cost/benefit, ability for rapid deployment, and compatibility with the former Soviet Union's objectives.**

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06 05 09 **Comment Number 5**

The PEIS states that the environmental impacts in Canada for the CANDU Reactor Alternative are not included, but that such impacts would be addressed in Canada in accordance with Federal law.

08 02 00 **Comment Number 6**

The Canadian Government has informed the United States that they will not start their environmental analysis until the United States has completed its actions and has stated that the CANDU Reactor is the Preferred or one of the Preferred Alternatives. The means by which U.S. citizens can comment on a Canadian environmental analysis process is beyond the scope of this PEIS.

01 00 00 **Comment Number 7**

Analyses of the cost, schedule, and proliferation impacts are discussed in separate documents to support DOE's ROD. The documents related to technical, cost, and schedule analysis were available for public review beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996. A series of public meetings to discuss the proliferation analysis were conducted by DOE prior to issuance of the Final PEIS.

08 03 00 **Comment Number 8**

Schedule information, including the time required to start and complete all of the alternatives, will be provided to the decisionmaker as part of the overall process of making decisions on implementation of alternatives. However, the environmental impacts are not dependant upon the schedule or time required for implementation.

13 00 00 **Comment Number 9**

Analysis of the No Action Alternative is required by NEPA to serve as a baseline. As stated in Chapter 1 of the PEIS, the purpose of the Proposed Action is to provide safe, secure, and cost-effective storage for the uninsurable weapons-usable fissile materials and for the surplus Pu pending disposition, since the disposition process would take time. The intent is to conduct the disposition, maintaining appropriate levels of security until all

MOX FABRICATION FACILITIES

- **May Not Be Needed.** The Draft PEIS states on pages S-15, S-22, and S-32 that a dedicated facility would have to be built at a U.S. site to implement the LWR alternative. ComEd agrees that a facility or facility expansion will be required for the CANDU alternative, but disagrees with DOE that it must be built for the LWR alternative. **A MOX fabrication facility may have to be built, but for the PEIS it should not be required.** Since existing European facilities would be used to meet the interim fuel needs of the existing LWR alternative, **DOE should also explore the environmental impacts/benefits of using existing excess European capacity or elasticity in plant capability to meet the LWR weapons disposition alternative. Both alternatives should be analyzed and evaluated in the Final PEIS.** However, the use of excess European capacity and elasticity should be explored first. Let the ultimate decision be based on an integrated examination and comparison of all the issues associated with a foreign versus domestic MOX fabrication supply. Note that by providing a dual fabricaton facility option that: 11/06.01.09
  1. **For the LWR alternative, the Environmental impact is significantly reduced without a required MOX fabrication facility, not to mentioned the reduced cost of the option;**
  2. **There is no change for the CANDU alternative as a MOX fabrication facility will be needed for either case; and**
  3. A U.S. MOX fabrication facility on a DOE site may negatively impact the Russians from a trust and integrity perspective, as a strong case can be made that such a facility would not be economically justified in the commercial sector. Hence, a Russian perspective could include a hidden agenda, siphoning off weapons plutonium, etc.

- **Adjusts to LWR Alternative.** Requiring the construction of a MOX fabrication facility may add substantially to the perceived risk of the LWR alternative as the environmental impacts of constructing and operating the MOX facility are currently included in the LWR alternative. Thus, alternative or comparative analyses that include both utilization of existing capacity as well as a new facility need to be included in the PEIS to ensure accurate and unbiased comparisons. 12/06.02.08

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surplus Pu materials are taken care of. Security and proliferation are further discussed in the nonproliferation analysis (*Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives*), which was issued for public comment in October 1996 and will be considered in the ROD.

01 02 00 Comment Number 10

Environmental impacts of decommissioning the disposition facilities will be addressed in the next tier NEPA documents, as appropriate, once the sites for these facilities have been determined.

06 01 09 Comment Number 11

Europe is moving toward a balance between the capacity to fabricate MOX fuel and the capacity to utilize MOX fuel in reactors. Additionally, Europe has excess separated Pu stores that they intend to use as MOX fuel as the fuel fabrication infrastructure and reactor infrastructure permits. Therefore, use of European reactors for consumption of U.S. Pu-source MOX fuel would merely displace the use of separated European Pu and result in no net reduction in world inventories of separated Pu. Hence, the statement that Europe has no excess MOX capacity. Additionally, facility utilization projections indicate that, while some excess MOX fuel fabrication capacity may exist in Europe for the next few years, current capacity is soon expected to be fully utilized for commercial MOX fabrication. Therefore, the United States may not be able to rely on the use of existing European MOX fabrication capacity for the entire disposition campaign. However, as a part of efforts to develop weapons-grade Pu MOX fuel, DOE is consulting with European Fuel Fabricators to benefit from their experience in MOX fuel fabrication and may have some MOX Lead Test Assemblies and/or initial core loads fabricated in Europe. Also, participation in the construction and operation of a MOX Fuel Fabrication Facility in the United States will be open to European fuel vendors.

06 02 08 Comment Number 12

It is envisioned that excess MOX fuel fabrication in Europe will be insufficient to satisfy DOE's Office of Fissile Materials Disposition need for

COMMONWEALTH EDISON COMPANY, DOWNERS GROVE, IL,
WILLIAM F. NAUGHTON
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NON-LIGHT WATER REACTOR ALTERNATIVES

- **CANDU**
  1. MOX fabrication facility will be required for this option. — 13/06.05.08
  2. Virtually no environmental impacts were assessed incrementally which is a must to ensure a balanced evaluation.
  3. Comparison of current uranium based CANDU should be assessed with MOX based impact in all aspects.
  4. Extension of designated CANDU plants life should be included as shutdown of the units proposed for the disposition has been considered if the CANDU MOX alternative is not chosen. The plants are already beginning a three-year license renewal (April 11, 1996 Nucleonics Week). Therefore, in the Final PEIS DOE should evaluate this situation as being equivalent environmentally with the building of a "new" plant (same as Evolutionary LWR) with respect to MOX usage. — 14/06.05.08
  5. The CANDU alternative would require fabrication of a much larger quantity of MOX fuel to dispose of the same quantity of plutonium than the LWR alternative. — 13/06.05.08 cont.

- **BOREHOLE**
  1. **Unproven Technology.** This technology is not proven. The risks calculated are estimated based on modeling of an undetermined site, hence there are large uncertainties in the analysis. A more balanced comparison should be made to the risks at existing facilities which are much better defined, being based primarily on extrapolations of existing conditions, which have much less uncertainty. — 15/04.00.00
  2. **Major Uncertainty.** Since for this alternative:
     No site has been specified;
     No previous EIS; and
     No previous licensing experience,
     the siting/licensing of the facility would be time consuming resulting in extended interim storage. Based on the previous DOE experience in a similar arena, specifically the fact that the U.S. has been unable to finalize siting of the HLW facility and the LLW facilities by the various state compacts, the degree of uncertainty of this alternative even being viable within the timeframe of the "clear and present danger" envelope is a major point that needs to be addressed. — 16/04.03.00
  3. The mixing facility will require eventual decommissioning, adding to the burden at both the HLW and compact LLW sites.

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MOX fuel fabrication; thus, a domestic MOX fuel facility would likely be required. Pending operation of the domestic facility, DOE is considering using foreign fuel facilities to make MOX fuel for the initial stage of the Pu disposition campaign.

06 05 08 Comment Number 13

Comment noted.

06 05 08 Comment Number 14

Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. This will include an appropriate level of analysis concerning the CANDU Reactor Alternative. In addition, according to the Canadian Government, implementation of the CANDU Reactor Alternative would be subject to Canadian Federal and Provincial policies and regulations and would require health, safety, and environmental assessments before issuance of a Canadian license. (See the letter from the Canadian Embassy in Washington, DC, dated June 6, 1996, reproduced in this CRD.) Should the CANDU Reactor Alternative be chosen for Pu disposition, further negotiations between the U.S. and Canadian Federal and Provincial Governments will be required before implementation, as well as business negotiations with reactor owners.

04 00 00 Comment Number 15

Since no sites have been selected for a deep borehole and because there are no existing deep boreholes utilized for waste disposal, DOE chose to analyze a generic borehole site for environmental impacts. Some of the other disposition technologies require facilities which are similar to existing facilities in the United States. Therefore, DOE chose to pick representative sites for some of the other disposition alternatives.

04 03 00 Comment Number 16

Further information on the technical viability of alternatives was provided in the Technical Summary Report and related alternative summary reports made available for public review beginning in July 1996.

- **VITRIFICATION**

1. **This technology is not proven with a high content of plutonium and should require extensive and lengthy research, development, and testing in a protype facility before it could be viewed as an alternative for the LWR alternative from an industrial pespective. DOE needs to address this aspect fully in the final PEIS.** 17/05.01.08
2. **This technology, contrary to the LWR alternative, does not reduce the plutonium inventory and does not degrade the plutonium isotopic composition from military grade to reactor grade level.** Thus, it is not comparable to the LWR alternative from a non-proliferation perspective. 18/08.03.01
3. **This technology is not contemplated by the Russians and would therefore,** not bring any advantage in terms of compatibility with the former Soviet Union's objectives.

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05 01 08 **Comment Number 17**

Further information on the technical viability of alternatives was provided in the Technical Summary Report and related alternative summary reports made available for public review beginning in July 1996.

08 03 01 **Comment Number 18**

The Department of Energy acknowledges the commentor's opposition to the Vitrification Alternatives. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

06 02 09 **Comment Number 19**

To get the MOX fuel to the Spent Fuel Standard as soon as possible and then remove it from the reactor, we would necessarily shorten the refueling cycles and cause more spent fuel to be removed from the reactor over the program life. Since the amount of spent fuel, radioactive waste, security, and radiation

COMMONWEALTH EDISON COMPANY, DOWNERS GROVE, IL,
WILLIAM F. NAUGHTON
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LIGHT WATER REACTOR ALTERNATIVE

- **LWR Work Force Unchanged.** The proposed increase of 40-105 workers per single unit at the LWR facilities (Figure on S-141) is totally unrealistic. Other than minor increases to the security force, there would be no incremental change to the site labor force required for MOX utilization. This aspect needs complete revision including the modifications to all the other environmental impacts impacted, e.g. worker carcinogenic risks, etc. — 19/06.02.09

- **Unrealistic LWR Fuel Cycles.** The PEIS (page 4-692) assumes yearly fuel cycles with single cycle MOX fuel assembly usage. This scenario is unrealistic for the commercial LWR alternative, especially for the the necessity of operating and producing a stable and reliable product for its customers. The assumption that LWRs would always be unloading once burned MOX fuel and replacing with fresh MOX does not consider the implications on the remaining fuel in the reactor and the necessary complications and substantial additional wasted resources from the uranium portion of the fuel cycle that would be necessary to effect such a scheme. Some observations about the once through scheme: — 20/06.02.09 — 21/01.00.00
  1. **Spent fuel pools would fill up faster with the once through sheme.** The disposition issue then becomes a high level waste issue which currently shows no indication of being resolved in the intermediate future;
  2. Once burned MOX assemblies will retain **higher residual reactivities** when discharged and will impose new safety and licensing issues on existing Spent Fuel Pool licensing bases, especially in light of the quantities of assemblies being discharged each cycle.
  3. Once burned MOX assemblies with their higher residual reactivities and heat load will impact HLW transportation and disposal within the repository as current requirements on reactivity and heat loads assumes nearly depleted spent fuel.
  4. **The environmental impacts are significantly increased for the once through scheme** versus the current LWR two to three eighteen month fuel cycles. — 22/06.02.09
  5. **Impact on MOX Fabrication.** The requirements for the once through scenario will certainly tax whatever fabrication facility or capacity that is to be used. Additionally, it is questionable that DOE can convert the weapons material rapidly enough into LWR compatible fabrication material to meet such capacity requirements. DOE needs to evaluate their proposed schemes in concert with reasonable fabrication capability. The environmental impacts are directly proportional. A balance needs to be analyzed.

- **For current LWR operations:**
  1. There will be NO increase in spent fuel storage needs; and
  2. All waste forms (HLW, LLW, and Intermediate Waste) will be the same for MOX or uranium fuel cycles.

F-015

protection personnel requirement would increase, there would be a need for additional personnel. Also, the addition of a new fuel handling building would require additional personnel for security. A ratio, derived from a 14-percent increase in the amount of spent fuel generated, would probably impact personnel by approximately 10 percent of that amount, or about 1.4 percent. A four unit BWR normally necessitates about 2,819 people, and 1.4 percent of 2,819 is 39 people. These are conservative considerations used for the environmental analysis. Optimization of the fuel cycle would reduce the personnel requirements.

06 02 09 **Comment Number 20**

The PEIS fuel cycle was an idealized case selected for analyses. Any real fuel cycle would be designed to closely match reactor operating cycles, typically 18 to 24 months.

01 00 00 **Comment Number 21**

Comment noted.

06 02 09 **Comment Number 22**

A real fuel cycle would require a transition from low-enriched uranium (LEU) fuel to MOX fuel in a staged manner where the LEU would be replaced as it is burned out. The PEIS case is an idealized fuel cycle prepared for analyses of environmental impacts.

09 09 08 **Comment Number 23**

Comment noted. Section 4.9 of the PEIS has been modified to further describe avoided impacts.

- **The LWR alternative:**
  1. Destroys plutonium to below weapons grade;
  2. Is consistent with the plans of the Russians and other nuclear weapons countries;
  3. Is an irreversible process and therefore favored by non-nuclear states;
  4. Is based on existing, proven technology; and
  5. Has a portion of the cost offset by revenues from energy production.

4/08.03.01 cont.

- **Environmental Benefits.** The PEIS does not contemplate the environmental benefits associated with lower mining and milling levels for uranium, less energy consumption for conversion and enrichment, and materials and energy necessary for fabrication through the avoidance of purchasing uranium based fuel. Assuming the replacement of 4.5w/o fuel for 40 Mt of Pu, avoids the need for 5 million SWUs and 21.6 million lbs U3O8. The energy required per SWU is 2,150-2400 KWHe per SWU from coal fired stations for USEC gaseous diffusion production. This would result in a substantial decrease in tails production, and, in fact, would result in current tails be used as the blend material to make the MOX. Additionally, the avoided risks associated with not producing traditional uranium fuel assemblies, i.e. mining and milling accidents, transportation of fuel assemblies and materials, worker impacts in all phases including fabrication, etc. need to be credited to the LWR alternative.

- **LWR Offsets.** Additionally, the LWR alternative should be credited with the huge energy and environmental "offset" values as compared to the other alternatives:
  Energy Value - assuming that all 40 Mt of excess weapons grade plutonium were manufactured into MOX fuel, a new fuel worth of $1.6-2.1 billion would result with approximately 45 GW years of electricity worth approximately $32 billion in revenues; and
  Waste Generated - Since MOX fuel displaces uranium fuel that would otherwise have to be obtained by mining, milling, converting, enriching, and fabricating uranium, the wastes that the vitrification option would generate would have to be considered because of the need for new uranium fuel. Thus, vitrifying ~40 MT of PU would not only generate repository waste volumes in the form of approximately 360 cubic meters of extra HLW glass, the vitrification of this Pu would result in 5.6 million additional cubic meters of mill tailings and 3800 cubic meters of enrichment tails caused by the mining of uranium to displace the plutonium as new reactor fuel.

23/09.09.08

- **Offset of Uranium Fuel Transport.** The PEIS indicates an incremental increase in the number of transportation fatalities associated with MOX fuel transport, primarily due to increased number of vehicles used to provide safe transport. Utilization of standard transportation accidents and resulting fatal injuries statistics per number of vehicles may not be accurate when one considers the intent of the increased vehicles, i.e. to ensure safe and secure transport. Presumably, the transport teams would have a significantly lower overall potential accident rate and thus, fatality rate than just that

24/10.02.00

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10 02 00 Comment Number 24

Standard transportation accidents and resulting fatal injuries statistics, per number of vehicles, were used because they are conservative and documented. The number of fatalities is based on several factors including the radiation environment of the package, type of package used, type of vehicle, number of miles to be traveled, and type of roads to be traveled. The standard approach is applied to all alternatives and sites. This is appropriate at the programmatic level.

COMMONWEALTH EDISON COMPANY, DOWNERS GROVE, IL, WILLIAM F. NAUGHTON
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associated with number of vehicles on the road. In this field as well, the extensive experience of MOX transport in Europe without incident may be viewed as an asset. | 24/10.02.00 cont.

F-015

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION, PENDLETON, OR, JAMES R. WILKINSON
PAGE 1 OF 1

DEPARTMENT of NATURAL RESOURCES

Special Sciences and Resources Program

CONFEDERATED TRIBES of the
Umatilla Indian Reservation
P.O. Box 638
PENDLETON, OREGON 97801
Area code 541 Phone 276-0105 FAX 276-3360
Physical Address: Old Mission Hwy 30, Pendleton, OR 97801

30 April 1996

David Nulton
Director, NEPA Compliance and Outreach
Office of Fissile Materials Disposition
U.S. Department of Energy
MD-4 Forrestal Building
1000 Independence Avenue SW
Washington, D.C. 20585

Subject: EXTEND COMMENT PERIOD ON PLUTONIUM DISPOSITION EIS

Dear Mr. Nulton:

Technical staff of the Confederated Tribes of the Umatilla Indian Reservation, Special Sciences and Resources Program (CTUIR/SSRP), formally request a minimum 30-day extension of the public comment period for the Plutonium Disposition Environmental Impact Statement. The current comment period is set to close as of 7 May 1996, and we would request that this be extended until at least 7 June 1996.

1/08.01.00

The basis of this request is DOE's failure to consult with American Indian tribes over this critical issue with profound, far-reaching, and long-term impacts to Tribal communities, particularly in the Western states. Based on the meeting on plutonium disposition held in Seattle this week, it is clear that tribal representatives have not had the time nor opportunity to adequately review the EIS and other relevant information associated with this increasingly complex problem. Tribal communities are likely to be disproportionately affected by whatever plutonium disposition decision eventually results, and therefore, must be fully included throughout the decision process, as required under DOE's American Indian Policy and President Clinton's Executive Order on Environmental Justice.

Thank you very much for your consideration of this request. CTUIR/SSRP staff would like to receive written confirmation of your action. If there are any further questions, please do not hesitate to contact either me, or Tom Glimore, SSRP Research Coordinator, at 541-276-0105 (phone) or 541-276-3360 (fax).

Sincerely,

James R. Wilkinson

James R. Wilkinson
Program Manager
Special Sciences and Resources Program
CTUIR Department of Natural Resources

TREATY JUNE 9, 1855 ◆ CAYUSE, UMATILLA AND WALLA WALLA TRIBES

M-202

08 01 00 Comment Number 1

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

COOPS, MELVIN S., SANTA ROSA, CA
PAGE 1 OF 2

MELVIN S. COOPS
8 Valley Lakes Place
Santa Rosa, CA 95409-5238
Telephone 707-538-1440

June 6, 1996

David Nulton, MD-4
U.S. Department of Energy
Forrestal Building
1000 Independence Ave SW
Washington, DC 20585

Dear Mr. Nulton,

At this time I would like to provide additional comments relating to the PEIS on the "Storage and Disposition of Weapons-Usable Fissile Materials".

I have previously expressed strong recommendations to store, and make available to the U.S. Naval Nuclear Propulsion Program, *all* weapons-surplus highly-enriched uranium-235 (93%) for eventual utilization as naval reactor fuel; and to create a special reserve supply of lesser enriched uranium fuels (average 50 % enrichment) for use in development of modern sodium-cooled fast reactor systems that certainly will be needed in the U.S. for electrical power generation in the near future, as was recommended by the National Academy of Sciences as their top priority item in their recent evaluation of U.S. national energy development requirments. (Please see my letter to Greg Rudy, MD-1, dated December 22, 1995).

The current international situation relating to weapons development activities by *many* foreign countries, demands that the U.S. maintain its nuclear options in an intelligent and judicious manner. In particular, the apparent reversal of political trends in Russia, and the continuing economic and military buildups in China, Pakistan, Iran, and other potential world trouble-spots, requires that the U.S. *not* unilaterally discard its nuclear options and capabilities. I believe that we should proceed with dismantlement of our surplus old weapon systems, but that we must retain in readily available form, the critical nuclear material recovered from the dismantlement program for possible use for an indefinite period. The cost to accomplish this is practically nothing, since storage of plutonium in metal form for long periods of time is well understood, simple, and quite inexpensive (all facilities and equipment exists), compared to other options being proposed. Attempting to convert plutonium to a permanently-useless form, (short of destruction by fission) is naive, unintelligent, and downright dangerous to future generations. Storing this material for future use, hopefully as fast-reactor fuel, is a wise and prudent investment both for the U.S. economy, and as insurance against undesirable military eventualities.

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I strongly urge the USDOE, and Congress, that the DOE should recover all existing military plutonium in the form of metal castings, sealed under vacuum in welded stainless-steel containers, for long-term storage. This option is absolutely practical for at least 50 years, and probably suitable for hundreds of years more. This option will permit a long-term evaluation of the status of world politics over the next decade and permit a truly realistic evaluation by our own next generation. The Russian state will pursue this approach whether we do or not, and it is in our best national interest to do the same. Any other option at this time, would be gambling with the future of this country and possibly the future of many of the democracies of our current world. 1/08.03.01

Sincerely yours,

M.S. Coops

Melvin S. Coops, ScD
Retired Nuclear Chemist

F-054

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for long-term storage of fissile materials. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

COUNTY OF ST. CLAIR, OFFICE OF EMERGENCY MANAGEMENT, PORT HURON, MI, JEFFREY A. FRIEDLAND
PAGE 1 OF 1

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OFFICE OF EMERGENCY MANAGEMENT

County of St. Clair, Michigan

204 BARD STREET, PORT HURON, MICHIGAN 48060

JUDITH KEEGAN, Chairperson, St. Clair County Board of Commissioners
JEFFREY A. FRIEDLAND, Coordinator

June 4, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington D.C. 20026-3786

REF: Storage and Disposition of Weapons Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

I am writing with concern regarding the options presented in the reactor category of disposition alternatives in the above Programmatic Environmental Impact Statement.

It is apparent that the Canadian Deuterium Uranium (CANDU) reactors located near Kincardine, Ontario is a facility that would utilize the plutonium based mixed oxide fuel that could result from the proposed refinement facility in the Washington state. This would create a lengthy transportation route through densely populated areas.

St. Clair County would be included in this transportation route as both Interstates 69 and 94 merge near the Blue Water International Bridge to Ontario. As the emergency management coordinator for the county, I have serious concerns regarding the volumes of traffic on these interstates and the ability of local emergency response units to handle an emergency situation involving the proposed product movement. The current volume of hazardous materials has overwhelmed these units without even considering the proposed hazard.

If the CANDU option is one that is seriously being considered, I would strongly urge your Department to consider a transportation route through Canada from a point further west of Michigan as the route through St. Clair County is unacceptable in my opinion.

I thank you for the opportunity to comment on this important issue.

Sincerely

Jeffrey A. Friedland

1 Government of Service

1/10.00.00

M-257

10 00 00 Comment Number 1

Under NEPA, DOE is required to evaluate a range of alternatives for Pu disposition. In that regard, the disposition of Pu in CANDU reactors is one of nine different disposition alternatives analyzed in the PEIS. Six specific sites and a generic site are evaluated for fabricating MOX fuels for Pu disposition. As a result, the transportation analyses performed in the PEIS consider multiple routes from potential MOX fuel fabrication sites to potential reactor sites. Although the Port Huron/Sarnia border crossing is mentioned in the PEIS as a convenient point for the CANDU fuel shipments to pass from the United States to Canada, our analysis also reflects other possible routes.

The Draft PEIS did not identify a Preferred Alternative for Pu disposition. A Preferred Alternative is identified in the Final PEIS and a disposition decision is expected to be made by the end of the year. The decision will take into account environment, safety (including transportation), and health factors, as well as technical, cost, schedule, and nonproliferation considerations. After the ROD (which will include technology approaches), which is expected in late 1996, follow-up analyses, negotiations, and specific agreements over several years will be required before implementation.

CRAMER, JERRY
PAGE 1 OF 1

My name is Jerry Cramer and I reside at 3650 West 42nd Avenue.

I'm here to speak in favor of Plutonium Disposition Project. I can't think any better way to reduce our stockpile of plutonium than making fuel out of it to produce electric power for the Pacific Northwest. Burning plutonium is also very compatible with DOE's Hanford cleanup mission.

I feel the Supply System deserves this project because they have worked very hard to reduce the cost of power and operating the power plant more reliably. I don't think anyone can argue that they succeeded on both counts. Burning plutonium will reduce the cost of power for the Supply System, and ratepayer even more. 1/08.03.01

Plutonium disposition is a win - win situation for the Tri-City economy. This will make the Supply System a long term asset to our area instead of a big questions mark. If this venture has a positive result it could also pave the way for completion of #1 for the same purpose. 2/08.03.01

Another asset is the FMEF facility that is already built that will be used process the fuel, and create many additional jobs. 3/08.03.01

The Plutonium Disposition project would be a great start in showing the rest of the world, especially Russia, that the United States is serious about reducing their plutonium stock pile to make our world a safer place and hopefully someday no one will need to fear destruction or complete annihilation from an awful bomb made from plutonium.

WA-015

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

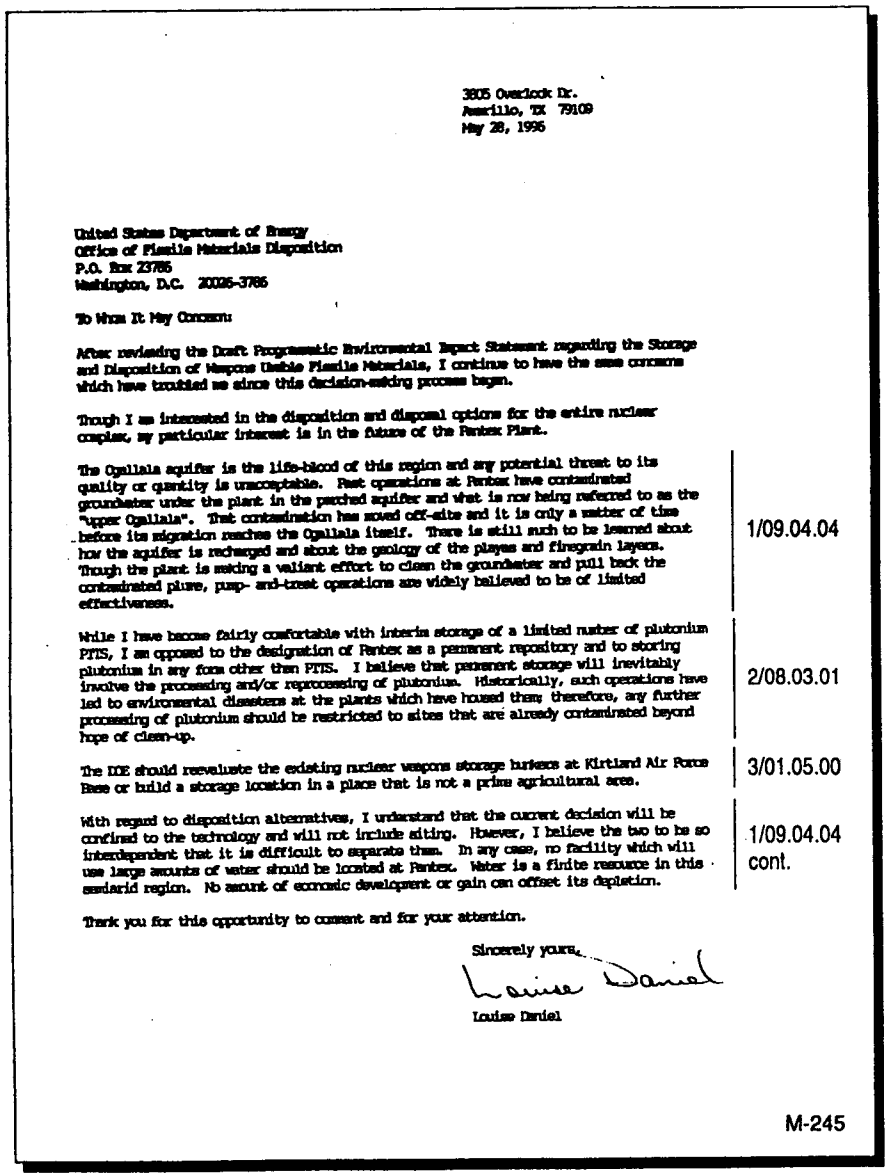
08 03 01 Comment Number 2

Comment noted.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's support for new missions at Hanford. Decisions on storage and disposition of weapon-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

DANIEL, LOUISE, AMARILLO, TX
PAGE 1 OF 1



3805 Overlook Dr.
Amarillo, TX 79109
May 28, 1996

United States Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

To Whom It May Concern:

After reviewing the Draft Programmatic Environmental Impact Statement regarding the Storage and Disposition of Weapons Usable Fissile Materials, I continue to have the same concerns which have troubled me since this decision-making process began.

Though I am interested in the disposition and disposal options for the entire nuclear complex, my particular interest is in the future of the Pantex Plant.

The Ogallala aquifer is the life-blood of this region and any potential threat to its quality or quantity is unacceptable. Past operations at Pantex have contaminated groundwater under the plant in the perched aquifer and what is now being referred to as the "upper Ogallala". That contamination has moved off-site and it is only a matter of time before its migration reaches the Ogallala itself. There is still much to be learned about how the aquifer is recharged and about the geology of the playas and finegrain layers. Though the plant is making a valiant effort to clean the groundwater and pull back the contaminated plume, pump- and-treat operations are widely believed to be of limited effectiveness. 1/09.04.04

While I have become fairly comfortable with interim storage of a limited number of plutonium pits, I am opposed to the designation of Pantex as a permanent repository and to storing plutonium in any form other than pits. I believe that permanent storage will inevitably involve the processing and/or reprocessing of plutonium. Historically, such operations have led to environmental disasters at the plants which have housed them; therefore, any further processing of plutonium should be restricted to sites that are already contaminated beyond hope of clean-up. 2/08.03.01

The DOE should reevaluate the existing nuclear weapons storage bunkers at Kirtland Air Force Base or build a storage location in a place that is not a prime agricultural area. 3/01.05.00

With regard to disposition alternatives, I understand that the current decision will be confined to the technology and will not include siting. However, I believe the two to be so interdependent that it is difficult to separate them. In any case, no facility which will use large amounts of water should be located at Pantex. Water is a finite resource in this semiarid region. No amount of economic development or gain can offset its depletion. 1/09.04.04 cont.

Thank you for this opportunity to comment and for your attention.

Sincerely yours,

Louise Daniel

Louise Daniel

M-245

09 04 04 Comment Number 1

The Department of Energy acknowledges the commentors concern about the Ogallala Aquifer. The PEIS assesses the impacts to the Ogallala Aquifer from the various alternatives, should such activities be located at Pantex.

Waste/hazardous material treatment/handling operations are regulated to minimize the potential for releases of hazardous substances to the soil or surface water that could then migrate to the groundwater.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to long-term storage of Pu pits and other forms of Pu at Pantex. Decisions related to future missions at Pantex will be based upon environmental analysis, technical and economic studies, national policy considerations, and public input.

01 05 00 Comment Number 3

Combined storage of pits and non-pit Pu at the Manzano WSA was originally eliminated as a reasonable alternative in the Draft PEIS. After considering separate storage of pits from non-pit Pu, the option to store these pits at the Manzano WSA no longer appears unreasonable. The Manzano WSA was evaluated in the Pantex EIS and Section 2.1.3 of the Final PEIS. The Final PEIS was revised to clarify consideration of the Manzano WSA for combined storage, and a description of the WSA was included in Appendix P.

May 1, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

Dear PEIS Committee Members:

There are two ways to cause true nonproliferation, both of which require destruction of all excess materials that can be used by terrorists and rogue nations to manufacture nuclear weapons. One way is to blow up all of the world's excess weapons-usable materials, and that is unthinkable. The other method, a beneficial method, is to destroy the weapons-usable material while creating electricity. Incidentally, all sources of weapons-usable material, including spent nuclear fuel, must be considered in your deliberations, otherwise we are wearing blinders. 1/01.00.00

Technological facts must prevail in our decisions. Political decisions can be disastrous.

We citizens have been told repeatedly that solutions like the Integral Fast Reactor cannot be considered because accomplishment cannot be achieved in 10 years. That, of course, is illogical and unrealistic because you routinely talk of placing "waste" in Yucca Mountain, which is scheduled to open in 2010, and may never open. When we are talking environmental impacts, we must be realistic. When we are dealing with dangerous materials that can last for tens of thousands of years, even millions of years, it is illogical to limit our evaluation of solutions to 10 years. This is particularly true when terrorists and rogue nations are involved. 2/01.04.00

Your efforts are governed by environmental impact logic. Environmental impact does not end in 10 years, it goes on far beyond our ability to predict. Therefore, the following factors must be included in you decision making process:

1. Fossil fuels will be essentially depleted in the 21st Century and their cost will increase dramatically with time.

2. Fossil-fuel fired power plants are spewing huge quantities of radioactive and hazardous contaminants into our atmosphere.

3. The world's supply of uranium will be consumed in today's nuclear reactors in about three decades.

M-127

01 00 00 Comment Number 1

Converting surplus Pu into MOX fuel for use in reactors is a reasonable disposition alternative that would generate electricity. Fissile materials present in spent nuclear fuel are not considered weapons-usable since separation of the relevant isotopes from these highly radioactive materials requires significant remote chemical processing.

01 04 00 Comment Number 2

The Integral Fast Reactor concept was considered in the Screening Report and was disqualified based on technical maturity and other factors.

DARNELL, G. ROSS, IDAHO FALLS, ID
PAGE 2 OF 2

4. America and the world want and need an ultimately safe, clean, abundant, inexpensive, and inexhaustible electrical energy source. But so far, the combination of specifics disqualifies coal, crude oil, natural gas, solar, hydropower, geothermal, wind, wood, and dung.

5. Spent nuclear fuel still contains some 99% of its original energy, and it also contains plutonium that could be used by terrorists. It is not waste.

6. The Integral Fast Reactor cannot melt down, even if left unattended, even with safety equipment failure, even with sabotage. It is configured so it cannot create plutonium, yet it can consume large quantities of plutonium and actinides in each fuel loading. It can extract the 99% of remaining energy in spent nuclear fuel. Its waste is much smaller than that of current nuclear reactors and the waste is thousands of times safer than spent nuclear fuel. The Integral Fast Reactors will be so incredibly efficient that they can provide all of the world's electricity for nearly 10,000 years with existing fuel. Logically, the Integral Fast Reactor will be ultimately safe and inexpensive when compared to the known alternatives for the future. 3/14.00.00

We can't plan for the future in the future, we must plan for the future now. Considering the foregoing facts and the need for true nonproliferation, there is one logical solution for the PEIS, the Integral Fast Reactor.

NOTE: Because the Integral Fast Reactor can extract the 99% of remaining energy in spent nuclear fuel, we must ensure that spent fuel remains in a form that can be recovered and sent directly to Integral Fast Reactors for consumption at some future date.

In summary, when we can consume these weapons-usable materials in the Integral Fast Reactors of the future while generating electricity, saving precious fossil fuels, improving the environment, and saving tax payers money, we must seriously consider that course of action.

Thank you for accepting my response to this most important issue.

Sincerely,

G. Ross Darnell
Retired (Lockheed Idaho Technologies Corporation)

M-127

14 00 00 Comment Number 3

During the screening of alternatives for inclusion in the PEIS, a Reactor-Burning concept was evaluated involving a variation of the Integral Fast Reactor concept. However, this concept, which would use a reactor fuel cycle design still requiring development, would be more costly and require a longer timeframe than other mature reactor options. The development program was terminated by the Administration and Congressional action. Since Pu disposition can be accomplished using existing technologies, there is no justification for developing this advanced technology for Pu disposition.

Leslie C. Davenport
Senior Engineer, Nuclear Safety (Retired)
1922 Mahan Avenue
Richland, WA 99352

May 7, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

Gentlemen:

Please include the following in the record of public comments for the "Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement." It summarizes what I feel should be done to partially solve this problem. If there are questions, please phone/fax me at (509)-946-4409.

STORAGE OBJECTIVE

The objective should be to minimize cost and risk (by upgrading multiple sites and/or constructing new facilities, by converting to stable forms, by promptly disposing of unusable scrap and waste, and by providing acceptable safeguards & security and environmental health & safety).
Consolidate all Safeguards Categories I, II and some III quantities of plutonium and highly enriched uranium (whether to be disposed as surplus, or kept as needed for specific national programs) at a minimum number of sites. Construction of new storage facilities versus upgrading current facilities should be decided on the most effective cost and timeliness basis to achieve the goals of safeguards & security, and environmental health & safety. The cost to package Pu for 50-year safe storage should be minimized by consolidating this work in one location (where the plutonium oxide is to be stored long term) as long as Pu can be safely transported to this site for such ultimate repackaging. For national security, the primary long-term storage site (two for unirradiated Pu, and one for unirradiated HEU) should not be collocated. The handling and storage of Safeguards Categories I and II surplus materials should be to the "Stored Weapons Standard." Only Hanford, Pantex, and Y-12 at Oak Ridge should be considered as candidate sites for the long-term storage of all Safeguards Category I and II weapons-usable plutonium and high enriched uranium.

1/08.03.01
2/08.03.01
3/08.03.01
4/08.03.01

Interim Storage of Surplus Plutonium (Pu)

About 55% of the currently surplus Pu is at Pantex as metal (primarily as Pits), and should be kept there in interim storage in upgraded facilities (until it can be finally disposed). However interim storage should not be extended longer than necessary because of the negative political signals for nonproliferation and arms reduction. Pu metal at the other sites should be prepared in acceptable form for shipment to, and interim storage at, Pantex (or possibly Hanford if not in Pit form). The Pu metal at Rocky Flats and small amounts at Idaho, LLNL, LANL, and "Other Sites" should receive priority for shipment to Pantex or possibly Hanford before the Pu metal at Savannah River is shipped. In any event all Pu metal should be prepared for interim safe storage promptly.

5/15.00.00

M-170

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Collocation Alternative. Decisions on storage alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for the Consolidation Alternative. Decisions on the storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's concern with the Collocation Alternative. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for long-term storage of fissile materials. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

15 00 00 **Comment Number 5**

Comment noted.

DAVENPORT, LESLIE C., RICHLAND, WA
PAGE 2 OF 3

Oxides, unirradiated fuel, and other forms of plutonium should be put into stable forms as quickly as possible for interim safe storage at and shipment between sites, with usable resulting oxides shipped to Hanford, metal shipped to Pantex or Hanford, and unirradiated fuel kept at or shipped to an upgraded site(s). Unusable scrap and waste should be stabilized and disposed of promptly, probably by vitrification (or safe storage until vitrification), because a vitrification facility is to be constructed at Hanford (e.g., a facility that is already planned for construction and to which a parallel line designed for criticality control could be added, rather than developing new technology and building a new facility at another site). The Waste Isolation Pilot Plant (WIPP) could provide disposal for these smaller quantities of vitrified waste containing Pu.

Pu in irradiated fuel should eventually be stored above ground in dry storage casks, possibly being consolidated at Hanford where this is already planned.

Interim Storage of Surplus High Enriched Uranium (HEU)

About 49% of the currently surplus HEU is at Oak Ridge, primarily at the Y-12 plant. I agree with the proposals in "PEIS Data Report: Upgrading the Y-12 Plant for Long-Term HEU Storage," Y/ES-043/R2, February 1996; and feel that Y-12 should be the US repository for storage of both unirradiated HEU needed for specific national programs, and that awaiting disposal as surplus HEU. Beyond upgrades currently in progress to increase storage capacity, improve infrastructure, and convert HEU to stable forms, the primary remaining capital project is to improve the resistance of some Y-12 storage facilities to design basis seismic events and tornadoes (Natural Phenomena Hazard Upgrades). | 6/01.04.00

All unirradiated HEU at other sites should be put into stable forms as quickly as possible for safe storage at and shipment between sites, with the resulting materials shipped to Y-12 as quickly as is reasonable. An exception could be short-term storage of HEU from newly dismantled Pits at Pantex. As stated above, unusable scrap and waste should be stabilized and disposed of promptly, probably by vitrification (or safe storage until it can be vitrified), because a vitrification facility is already running at Savannah River and another is to be constructed at Hanford.

As stated above, HEU in irradiated fuel should eventually be stored above ground in dry storage casks, possibly being consolidated at Hanford where this is already being planned. | 6/01.04.00 cont.

DISPOSITION OBJECTIVE

The options for long-term disposition of usable surplus plutonium should seek to meet the "Spent Fuel Standard," and for usable surplus HEU should seek to blend the HEU down to low enriched uranium (LEU) usable in civilian power reactors." For the usable Pu, I prefer Pit disassembly and/or Pu conversion followed by MOX fuel fabrication and use in an existing reactor or partially completed LWR. For the unusable Pu and HEU that can not be used in civilian power reactors, I would like to see the material vitrified and disposed of as promptly as possible. Vitrification at Hanford would allow adding cesium-137 and/or high-level waste to provide a radiation barrier for nonproliferation purposes. | 7/08.03.01 | 8/08.03.01

Disposition of Surplus Pu

I support the spent fuel option that would use the surplus Pu in fabricating mixed oxide (MOX) fuel for once-through use in commercial nuclear power reactors. This could be done by disassembling Pits at Pantex, shipping in approved Pit containers to Hanford, converting Pits and other source material to usable oxides at Hanford, fabricating into MOX fuel at Hanford, and using as fuel in reactors. The resultant spent fuel would then be disposed of in a high-level waste repository. | 7/08.03.01 cont.

M-170

01 04 00 Comment Number 6

The analyses of cost, schedule, technical, and Nonproliferation Policy impacts of the various reasonable alternatives for the Proposed Action are presented in separate documents to support DOE's ROD. These documents were available for public review beginning in late July 1996.

08 03 01 Comment Number 7

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 8

The Department of Energy acknowledges the commentor's support for new missions at Hanford. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

The Fuels & Materials Examination Facility (FMEF) at Hanford is a DOE owned facility that was constructed for safe storage of Safeguards Category I or II quantities of Pu and HEU, and has a remote fabrication line usable for producing MOX fuel. Although this facility has never been used for fissile material work, this was its original purpose and the facility exists with very little need for changes to meet current safeguards & security and environmental health & safety requirements. I would like to see Washington Public Power Supply System's WNP-2 reactor at Hanford, and possibly the three Palo Verde reactors in Arizona, used to burn up this MOX fuel. I believe all four reactors were designed so that they can burn MOX fuel and would take less licensing effort through the NRC to permit this. If additional reactors are deemed necessary, I support completion of construction of WNP-1 at Hanford. The two WNP reactors, the FMEF facility, and appropriate storage vaults are physically all on the Hanford reservation, which would reduce risk and security problems during transport. I do not support the evolutionary LWR alternative due to the long time delay in starting actual disposition. However, acceptable methods include the CANDU reactor alternative, selling the Pu to Japan, France, or the United Kingdom; or in the short-term fabricating MOX fuel assemblies in an existing European MOX fuel fabrication facility. 7/08.03.01 cont. 8/08.03.01 cont. 9/08.03.01 10/08.03.01

Disposition of Surplus HEU

Approximately 60% of the surplus HEU (103 of 174 metric tons) is in forms that may allow it to be usable for down blending to LEU. Additional surplus HEU that can be converted to usable LEU on a cost effective basis should also be included. This blending to LEU should be started as soon as possible, but at no slower rate than can be sold at a reasonable return price for commercial use

Sincerely,

Leslie C. Davenport

Leslie C. Davenport,
Senior Engineer, Nuclear Safety (Retired)

M-170

08 03 01 **Comment Number 9**

The Department of Energy acknowledges the commentor's opposition to the Evolutionary LWR Reactor Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 10**

Comment noted.

DAVIS, ISABEL, CANYON, TX
PAGE 1 OF 1

Raima Isabel Davis
Rt. 1 Box 213-Z2
Canyon, TX 79015
(806) 499-3509

United States Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

I am concerned about the disposal and storage of nuclear wastes at a site within 30 miles of my home and directly over my water supply. We live in a area which is not served by a water supply provided by a municipality. We have our own well which is tapped directly into the Ogallala Aquifer. It is frightening to think that in a few years I may be drinking contaminated water without even knowing it. | 1/09.04.04

Even if the possibility of contamination did not exist, the accelerated draining of the aquifer necessitated by the processing of nuclear wastes is a threat not only to agriculture, but to the quality of life in the Texas Panhandle. The aquifer is being drained at an alarming rate by irrigation of crops. We must find a way to use less water, not more.

Surely there is a site available which is not over an aquifer that supplies water to 8 food producing states. The Chamber of Commerce of Amarillo and the Department of Energy are using faulty logic to protect current jobs at the expense of our very survival in the future.

Please do not store surplus plutonium at Pantex. Please do not process plutonium at Pantex, and please do not store hazardous wastes at Pantex. | 1/09.04.04 cont.

Sincerely,

Isabel Davis

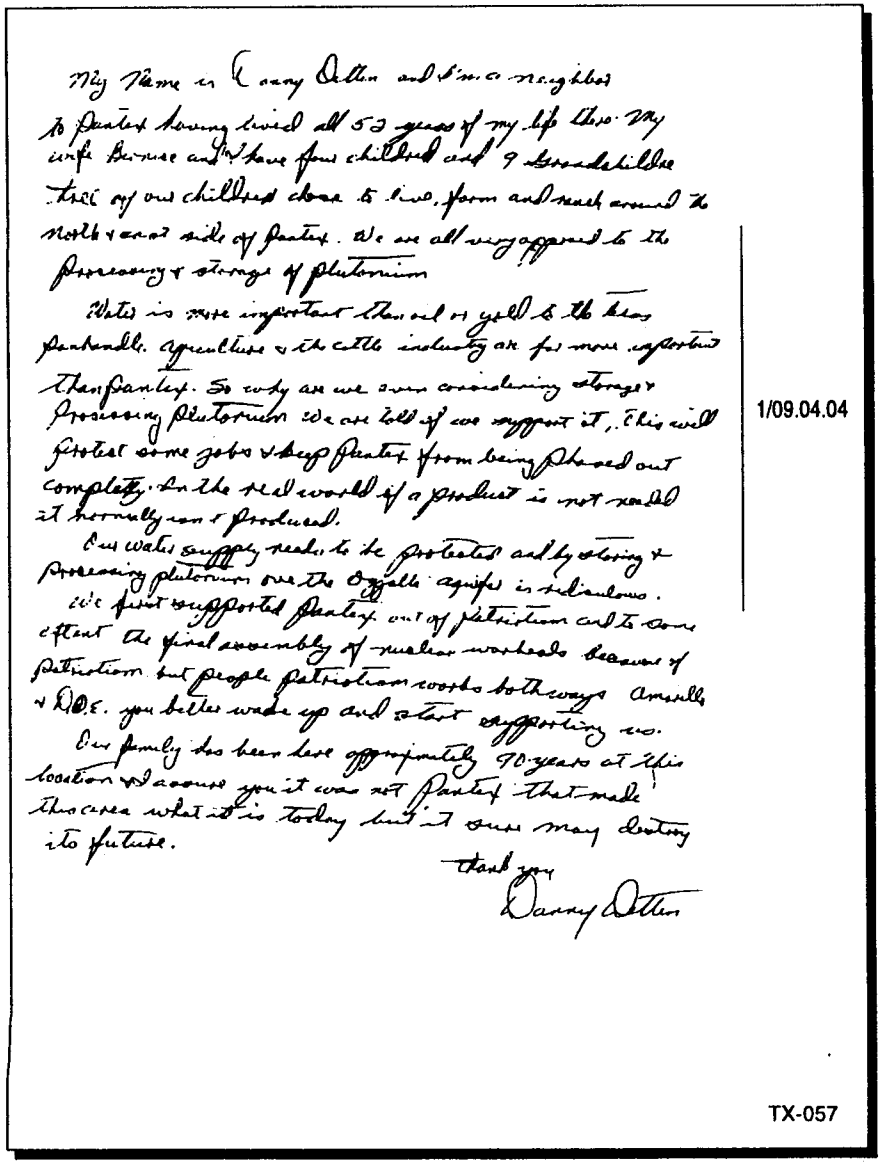
Isabel Davis
A Citizen of Randall County, Texas

M-193

09 04 04 Comment Number 1

The Department of Energy acknowledges the commentator's concern about the Ogallala Aquifer. The PEIS assesses the impacts to the Ogallala Aquifer from the various alternatives, should such activities be located at Pantex. Waste/hazardous material treatment/handling operations are regulated to minimize the potential for releases of hazardous substances to the soil or surface water that could then migrate to the groundwater.

DETTEN, DANNY
PAGE 1 OF 1



My Name is Danny Detten and I'm a neighbor to Pantex having lived all 52 years of my life there. My wife Bernice and I have four children and 9 Grandchildren three of our children chose to live, farm and ranch around the North and east side of Pantex. We are all very opposed to the processing & storage of plutonium

Water is more important than oil or gold to the Texas Panhandle. Agriculture & the cattle industry are far more important than Pantex. So why are we even considering storage & processing plutonium. We are told if we support it, this will protect some jobs & keep Pantex from being phased out completly. In the real world if a product is not needed it normally isn't produced.

Our water supply needs to be protected and by storing & processing plutonium over the Ogalla aquifer is ridiculous.

We first supported Pantex out of patriotism and to some effect the final assembly of nuclear warheads because of patriotism but people patriotism works both ways Arnold & D.O.E. you better wake up and start supporting us.

Our family has been here approximately 90 years at this location & I assure you it was not Pantex that made this area what it is today but it sure may destroy it's future.

thank you
Danny Detten

1/09.04.04

TX-057

09 04 04 Comment Number 1

The Department of Energy acknowledges the commentor's concern about the Ogallala Aquifer. The PEIS assesses the impacts to the Ogallala Aquifer from the various alternatives, should such activities be located at Pantex.

Waste/hazardous material treatment/handling operations are regulated to minimize the potential for releases of hazardous substances to the soil or surface water that could then migrate to the groundwater.

DEVORAK, JUDITH
PAGE 1 OF 1

Comment ID: P0017
Date Received: April 18, 1996
Name: Judith Devorak
Address:

Transcription:

I'm calling to say keep that stuff out of Idaho. The Governor was wrong to let you start bringing any of it in. It should have stayed in court longer. Keep it out of Idaho. | 1/08.03.01

P-017

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

DORWART, ROBERT J., SEATTLE, WA
PAGE 1 OF 1

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): Robert J Dorwart
Address (optional): 4422 NE 65th St
Seattle, WA 98115

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1 800-820-5156. Comments must be submitted by **May 7, 1996**.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. Materials Immobilization/Vitrification - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

We needed immobilized fissile materials in the form of natural occurring Uranium. There is no way to prevent mining Uranium ore, so it will effective. Generations (many) down the road there will be no other adequate energy source except solar. 1/08.03.01

2. Deep borehole disposal - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

A Good place for fissile products, but we shouldn't deprive future generations of what may be the only energy source remaining by making them totally unavailable. 2/08.03.01

3. Reactor Options - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

I believe we should do some of this scene. We are rapidly consuming chemical fuels (which will not be made up again) by natural processes (Production of Helium). Maximizing the production of Nuclear power will put off an energy ~~[illegible]~~ crisis which is almost upon us. 3/08.03.01

4. Storage Options - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

M-224

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the Immobilization Alternatives. Decisions on disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

DRYER, TED, PORTLAND, OR
PAGE 1 OF 1

Comment ID: P0004
Date Received: April 16, 1996
Name: Ted Dryer
Address: 7037 SW 54th
Portland, OR

Transcription:

I'd like to suggest that the Department strongly consider putting the nuclear waste into glass. None of the other options seems safe enough to me. Thank you very much. | 1/08.03.01

P-004

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

DUKE POWER, CHARLOTTE, NC,
ROBERT VAN NAMEN
PAGE 1 OF 2

By Fax (1-800-820-5156) and by Mail

DUKE POWER

May 6, 1996

Department of Energy
Office of Fissile Materials Disposition
c/o SAIC- PEIS
P.O. Box 23786
Washington DC 20026-3786

Subject: Comments on DOE document "Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (DOE/EIS-0229-D)

This letter is provided to the Department of Energy to give comments on the subject document. Duke Power appreciates the opportunity to participate in the process and looks forward to the timely resolution of all outstanding issues so that the task of disposing of the excess plutonium may begin. The use of plutonium as LWR MOX fuel is a proven technology which is readily adaptable to the US light water reactors and will ensure a timely and cost effective disposition program. The following comments are offered for consideration by DOE as it prepares the Final Environmental Impact Statement and progresses to a Record of Decision. 1/08.03.01

- The use of MOX fuel as the primary disposition mechanism is the only option which meets the non-proliferation goals of the program and, at the same time, extracts the great energy potential associated with the material.

- The Final Environmental Impact Statement should fully account for all benefits associated with burning the plutonium as MOX fuel including the avoided mining and enrichment (power intensive) requirements which would be required if MOX fuel were replaced by UO2 based fuel. 2/09.00.08

- Timely and predictable disposition plans should be laid out and followed. Any scenario delaying the disposition should be penalized due to the potential adverse environmental consequences associated with storage. 3/07.00.00

- All potential environmental impacts should be considered in evaluating the alternatives, not just those within the US borders. 4/08.00.00

- Use of existing MOX fabrication capacity in Europe should be seriously considered by DOE. Building from the existing European experience and capacity ensures the most rapid and most reliable start to the program. 5/06.01.08

M-181

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 00 08 **Comment Number 2**

Based on comments received, several sections of the Final PEIS include additional analyses. These sections (in Section 4.9) include Impacts on Uranium Mining and Nuclear Fuel Cycle Industries, Avoided Environmental Impacts of Using MOX Fuel Instead of Traditional Low-Enriched Uranium Fuel in Nuclear Power Plants, and Avoided Environmental Impacts of Using Nuclear Power Plants Instead of Fossil Fuel Power Plants. The Avoided Environmental Impacts of Using MOX Fuel Instead of Traditional Low-Enriched Uranium Fuel in Nuclear Power Plants section in the Draft PEIS includes the health impacts avoided to the public and workers for the mining and milling industries. Other avoided impacts to air quality and waste generated were added to the Final PEIS.

07 00 00 **Comment Number 3**

Generally, the goal is to complete disposition within 25 years after the ROD. The storage decision will be for long-term storage, up to 50 years. Schedule data, along with technical and cost data, were provided in Technical Summary Reports of both storage and disposition in late July 1996.

08 00 00 **Comment Number 4**

In accordance with Executive Order 12114, DOE guidelines implementing that Order, the Department of State's Unified Procedures (10 CFR 1021.102), the PEIS considers impacts to the global commons from potential European fuel fabrication and the CANDU Reactor Alternative. In addition, according to the Canadian Government, implementation of the CANDU Reactor Alternative would be subject to Canadian Federal and Provincial policies and

DUKE POWER, CHARLOTTE, NC,
ROBERT VAN NAMEN
PAGE 2 OF 2

Duke would also like to take this opportunity to request that DOE involve all potential licensees (the utilities) ls discussions, plans and projects leading to the licensing of MOX fuel with the Nuclear Regulatory Commission. Capitalizing on the abilities of the commercial sector in implementing the MOX option will result in the most stable, reliable and timely progress on this important program.

6/06.06.08

RVanNamen

Robert Van Namen, Manager
Fuel Management, Nuclear Engineering

M-181

regulations and would require health, safety, and environmental assessments before issuance of a Canadian license. (See the letter from the Canadian Embassy in Washington, DC, dated June 6, 1996, reproduced in this CRD.) Should the CANDU Reactor Alternative be chosen for Pu disposition, further negotiations between the U.S. and Canadian Federal and Provincial Governments will be required before implementation, as well as business negotiations with reactor owners.

06 01 08 **Comment Number 5**

Comment noted.

06 06 08 **Comment Number 6**

Comment noted.

6125 Country Club Parkway
San Jose, CA. 95138

May 6, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786
(FAX) 1-800-820-5156

Subject: *Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (February 1996)*

Dear Director Nulton:

Each time my wife or I read a magazine or newspaper article which discusses the vast amounts of weapons grade materials currently being stored in the former Soviet Union, we cringe at the thoughts of how easily those materials could be diverted to enemies of the United States (Libya, Iran, Iraq, N. Korea, etc., etc.). Within months of reading of the black-market smuggling of plutonium from one of the new Russian republics, the U.S. government would be faced with the detonation threats of a Saddamn Hussein or other militant madman bent on humiliating the American public. This is a totally possible but unacceptable scenario.

In reviewing the draft PEIS, there is only one (1) option that can be implemented in a timely manner in both the United States and Russia. This is also the only option based on proven technologies, thus minimizing technical risks. It is also the only option that could logically be accepted by both involved governments - the existing light water reactor option. Fabrication of mixed oxide fuels is known technology. Operation of commercial nuclear reactors is known technology. The conversion of weapons grade plutonium to spent nuclear fuel is the only true "disposition" option discussed in the PEIS. Involvement of a third country, Canada, should not be considered in solving this American/Russian problem. 1/08.03.01

The "do nothing" option (current Clinton administration position on most critical issues) is totally UNACCEPTABLE. Likewise, options involving long term storage/burials or conversion/immobilization into forms which could be reversed or leave the materials potentially recoverable (e.g., vitrification) should NOT be on the negotiations table. 2/08.03.01 3/08.03.01

F-023

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to continuing or long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to the Immobilization Alternatives. Decisions on disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

The DOE is urged to proceed immediately with the existing LWR option. The time for R&D programs has long past. Stop wasting taxpayer money in funding "voodoo" technologies and responding to "Anti-Everything" organizations. The threat and impact of the loss or theft of Russian (or American) weapons materials is far too great!

1/08.03.01
cont.

Sincerely,

Herb & Lydie Dutton

Mr. & Mrs. H. A. Dutton

F-023

EIDEN, MAX A.
PAGE 1 OF 2

March 14, 1996

U. S. Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
Washington, D.C. 20026-3786

Gentlemen:

It is my opinion that the possible shipment to, and storage of, weapons-usable fissile material at the INEL site in Idaho is and would jeopardize the public health and safety. The transporting of such material to Idaho as recently shown by the catastrophic train accident is not as safe as one would originally think. | 1/10.00.00

1. In simple terms, the INEL is situated upon a high seismic activity geographical area. The attempts of the Department of Energy to show that that is not the case are not well founded. The scientific and geological wisdom is that it is a highly seismic area. | 2/09.05.03

2. The INEL site sits directly over the Snake River Aquifer which supplies water to the Snake River, the rural areas of Idaho, and subsequently to the Columbia River drainage which affects most of Idaho and the States of Oregon and Washington. | 3/08.03.01

3. To store or dispose of radioactive matter at the INEL which is directly above the Snake River Aquifer is clearly not the best alternative to be chosen by the Department of Energy.

I strongly urge the Department of Energy to open a permanent storage repository as had previously been planned and that the storage and disposition of Weapons-Usable Fissile Materials would be more appropriately stored at that site. | 4/12.00.00

In the interim, transporting such material causes unnecessary dangers to the public safety and welfare, which far outbalances any delay which may be incurred in opening a permanent repository. | 1/10.00.00 cont.

Simply put, storing or handling radioactive material above the Snake River Aquifer is not a viable alternative from the safety standpoint. The present contamination at the site, the high runoff of surface waters, the continued polluting of the aquifer are a reality. To compound that by brining more materials to the site simply is not acceptable. | 3/08.03.01 cont.

M-003

10 00 00 **Comment Number 1**

The human health risks of material transportations associated with the proposed Pu storage and disposition alternatives are evaluated and presented in Section 4.4 of this PEIS. The more detailed description of the methodology and supporting data for the analysis is presented in the Appendix G. Transportation of radioactive materials between sites includes health risks for both normal operations and accident conditions to the public and workers.

09 05 03 **Comment Number 2**

Idaho National Engineering Laboratory is situated on the Eastern Snake River Plain, an area of low seismicity. The plain is bordered by the seismically active Centennial Tectonic Belt to the north and the Intermountain Seismic Belt to the east and southeast. Historical and recent seismic data cataloged by the National Oceanic and Atmospheric Administration (NOAA), the National Earthquake Information Center (NEIC), the University of Utah, and the INEL Seismic Network, indicate that earthquakes in the region occur primarily in the Intermountain Seismic Belt and Centennial Tectonic Belt (including the mountains and valleys of the Basin and Range province which bound the plain on the north and south). The seismic characteristics of the plain and the adjacent Basin and Range province are different; earthquakes and active faulting are associated with the Basin and Range tectonic activity, whereas the plain has historically experienced few and small earthquakes. Based on the seismic history and the geologic conditions, earthquakes greater than magnitude 5.5 (and associated strong ground shaking and surface fault rupture) are not likely to occur on the plain.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to new missions at INEL. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

12 00 00 **Comment Number 4**

Comment noted.

EIDEN, MAX A.
PAGE 2 OF 2

U.S. Department of Energy
Office of Fissile Materials Disposition
March 14, 1996
Page 2

I appreciate your consideration of these comments. For more scientific date, please refer to prior Environmental Impact Statements involving the INEL, and scientific materials submitted thereon.

Very truly yours,

Max A. Eiden

MAE:jo

M-003

CALL-IN COMMENTS ON DOE'S PEIS

MS. ELLIS: Jennifer L. Ellis, 222 Cherokee Trail, 37043.

Neither.

A mailing that I have from 2/20 Vision.

I am calling to comment about the Programmatic Environmental Impact Statement. As a medical doctor specializing in preventive medicine, I believe strongly that community and worker safety should be paramount. In order to minimize the dangers related to plutonium and its byproducts, the Department of Energy should look forward to adopting a plan for production of the least amount of new radioactive waste.

I therefore disagree with the three options outlined by the Department of Energy for the disposal of weapons-usable materials. I believe that all three options are dangerous and obsolete.

I encourage the Department of Energy instead to invest in vitrification which, unlike the outlined options, would immobilize plutonium and its dangerous byproducts, and thus also reduce proliferation by removing it from circulation. 1/08.03.01

Thank you.

P-047

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Vitrification (Immobilization) Alternative. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

ENERGY PROBE RESEARCH FOUNDATION, TORONTO, ON, NORMAN RUBIN
PAGE 1 OF 7

THE BOARD OF DIRECTORS
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June 7, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington D.C. 20026-3786 U.S.A.

BY FAX: 202-586-2710 (Original following by mail)

Re: Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS).

To whom it may concern,

Attached please find a submission from Energy Probe on the topic of the proposed use of mixed-oxide (MOX) fuel, containing plutonium from dismantled U.S. nuclear warheads, at the Bruce "A" Nuclear Generating Station. The MOX-CANDU reactor proposal is noted in the Department of Energy (DoE) document *Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement* (PEIS) as one of the options under consideration by the DoE for plutonium disposition.

Energy Probe is a project of Energy Probe Research Foundation, a non-profit environmental organization founded in 1980, dedicated to raising public awareness about energy and environmental issues. Energy Probe Research Foundation has approximately 50,000 supporters, roughly half of them in the province of Ontario.

We have reviewed the relevant sections of the DoE PEIS. We have also reviewed the submission sent to you by Nuclear Awareness Project (Box 104, Uxbridge, Ontario L9P 1M6), and we generally endorse its arguments and conclusions, with some relatively minor exceptions and some additions noted below.

In brief, Energy Probe urges the DoE to rule out the option of using CANDU reactors located in Canada for plutonium disposition purposes unless and until the following conditions are met:

1/08.03.01

- The undertaking must not impose uncompensated costs — financial, environmental, or social — on people in Ontario or elsewhere in Canada;
- The undertaking must not retard Ontario's progress in achieving an open, competitive, and diversified electricity system, characterized by open access for electricity suppliers, and free choice for electricity consumers;
- The undertaking must not proceed without the full, public application of Ontario's

Energy Probe Research Foundation
225 BRUNSWICK AVENUE, TORONTO, ONTARIO M5S 2M6 Phone (416) 964-9223 ext. 226 Fax (416) 964-8239

M-285

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. This will include an appropriate level of analysis concerning the CANDU Reactor Alternative. In addition, according to the Canadian Government, implementation of the CANDU Reactor Alternative would be subject to Canadian Federal and Provincial policies and regulations and would require health, safety, and environmental assessments before issuance of a Canadian license. (See the letter from the Canadian Embassy in Washington, DC, dated June 6, 1996, reproduced in this CRD.) Should the CANDU Reactor Alternative be chosen for Pu disposition, further negotiations between the U.S. and Canadian Federal and Provincial Governments will be required before implementation, as well as business negotiations with reactor owners.

Environmental Assessment Act, or an equivalent testing of its environmental acceptability;

- The undertaking must not proceed without a clear indication that it has the informed consent of the people of Ontario, especially those who will be most directly affected by it.
- If the U.S. government chooses to dispose of its nuclear-weapons plutonium in Canada, rather than within the United States, it must be clearly demonstrated that its decision is in no way motivated by Canada's relative lack of citizen safeguards and rights — both legislated and common-law — that might make implementation easier in Canada than within the U.S..

1/08.03.01 cont.

For reasons outlined below and in the submission of Nuclear Awareness Project, we believe that these conditions are unlikely to be met. We therefore urge the U.S. government to focus its attention on plutonium-disposition options that can be carried out within the United States.

Sincerely yours,

Norman Rubin
Director, Nuclear Research
and Senior Policy Analyst

attachment

M-285

ENERGY PROBE RESEARCH FOUNDATION, TORONTO, ON, NORMAN RUBIN
PAGE 3 OF 7

Energy Probe's Notes Regarding the
Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

by
Norman Rubin
Director, Nuclear Research
and Senior Policy Analyst

June 6, 1996

Canadian impacts "do not apply"!

In the *Draft Programmatic Environmental Impact Statement* (henceforth, "the PEIS"), the "environmental impacts" of the Canadian CANDU option are almost universally described with a single phrase: "Does not apply". The specific areas in which impacts "do not apply" include the following: Land Resources, Site Infrastructure, Air Quality and Noise, Water Resources, Geology and Soils, Biological Resources, Cultural and Paleontological Resources, Socioeconomics, Public and Occupational Health and Safety — itself subdivided into Normal Radiological Impacts, Hazardous Chemical Impacts, and Facility Accidents — and Waste Management.[1]

2/01.03.00

In the two areas where impacts are acknowledged to apply — Intersite Transportation of Fissile Materials and Environmental Justice — those impacts end at the Canadian border.

Of course, most Canadians would consider the impacts, in Canada, of the Canadian CANDU option for the disposition of U.S. nuclear-weapons plutonium to be just as real, significant, and "applicable" as the impacts of the other options in the U.S. And informed Canadians — including Energy Probe — would be concerned that the Canadian and Ontario governments may not give much more attention to these real impacts than this U.S. PEIS does. For example, Canadian federal government officials, up to the Prime Minister himself, seem to have publicly concluded — without any recourse to public process, public opinion, or environmental assessment — that the MOX-CANDU proposal is the best option for disposition of both U.S. and Russian nuclear-weapons plutonium.[2]

In short, we are concerned that the Canadian public (especially Ontario residents) may be treated like citizens of a "banana republic", with neither our own officials nor those of the United States respecting our rights to participate in this important decision. We urge the U.S. government not to take advantage of the weakness of Canada's, and Ontario's, political and legal safeguards in making this decision.

2/01.03.00 cont.

Indeed, we believe that it is consistent with the spirit, and perhaps even the letter, of the U.S. National Environmental Protection Act, that adverse impacts outside the United States be considered before an option is chosen.

M-285

01 03 00 Comment Number 2

After considering public comments, the PEIS has been revised with respect to the CANDU Reactor Alternative. The PEIS includes an appropriate level of analysis, consistent with Executive Order 12114, DOE guidelines, the State Department's Unified Procedures, and DOE regulations at 10 CFR 1021.102 concerning NEPA.

In addition, according to the Canadian Government, implementation of the CANDU Reactor Alternative would be subject to Canadian Federal and Provincial policies and regulations and would require health, safety, and environmental assessments before issuance of a Canadian license. (See the letter from the Canadian Embassy in Washington, DC, dated June 6, 1996, reproduced in this CRD.) Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. Should the CANDU Reactor Alternative be chosen for Pu disposition, further negotiations between the U.S. and Canadian Federal and Provincial Governments will be required before implementation, as well as business negotiations with reactor owners. Should the CANDU Reactor Alternative be selected, agreement with the Canadian Government would be reached on the Pu disposition process.

Energy Probe's Notes, page 2

Regardless of the legal issue, we do not see how you can hope to choose an option that minimizes adverse impacts, without comparing all the impacts of all the options. | 3/09.00.08

Energy Probe's comments on the submission by Nuclear Awareness Project[3]:

It is even clearer than NAP indicates that Ontario Hydro does not plan to retube the 4 reactors of Bruce-A station.

Nuclear Awareness Project writes (*Submission*, p. 1):

> Capacity Factors and Reliability of CANDU Reactors
>
> The Atomic Energy of Canada Limited (AECL) proposal assumes that the four Bruce "A" Nuclear Generating Station reactors will be retubed regardless of whether or not the mixed-oxide (MOX) fuel scheme is implemented, and that these reactors will operate at an average capacity factor of 80% for a further 25 year period. These assumptions are inappropriate, given current debates about the future of the electricity sector in Ontario, and given operating experience at CANDU reactors.
>
> The AECL Final Report *Plutonium Consumption Program - CANDU Reactor Project* notes:
>
> > "It is assumed for the purposes of this study that the Bruce NGS A units will be retubed because there is a demand for electricity."
>
> Retubing is the rebuilding of a CANDU reactor core where all fuel channels are replaced at a cost now estimated by Ontario Hydro at about $350 million per reactor. The DoE should note that the Bruce reactor 2 was shut down in 1995 to avoid this cost and other major repairs, primarily to steam generators. The other 3 reactors are scheduled for retubing starting in 2000, but could instead by shut down at that time. The Bruce "A" Station began operations between 1977 and 1979. It is unlikely that Ontario Hydro will be able to justify the expense of retubing its aging reactors when faced with increasing competition in the electricity sector. [emphasis added; endnotes omitted.]

In fact, according to Ontario Hydro documents and sworn testimony, the other 3 reactors of the Bruce-A station are *not* scheduled for retubing starting in 2000, or at any other time. Rather, they are

M-285

09 00 08 Comment Number 3

A comparison of impacts of all alternatives and options associated with each alternative is contained in Section 4.6 of the PEIS. A cumulative impact analysis has been conducted in Section 4.7, as well, for both storage and disposition. For the CANDU Reactor Alternative, the spent fuel resulting from using MOX fuel in these reactors would be the responsibility of Ontario Hydro, and would be stored and disposed of in accordance with procedures established by the Canadian Atomic Energy Control Board. Interactions with the Canadian public regarding the receipt and use of MOX fuel in Canada will be conducted by the Canadian Government and Ontario Hydro.

ENERGY PROBE RESEARCH FOUNDATION, TORONTO, ON, NORMAN RUBIN
PAGE 5 OF 7

Energy Probe's Notes, page 3

scheduled to be shut down when they reach the end of pressure-tube life, starting in 2000. Ontario Hydro, of course, retains the option of changing its mind and retubing one or more of these reactors. But AECL's assessment of the likelihood of that outcome must be viewed in the context of AECL's historical record of forecasting future events, which can best be described as "laughable". Indeed, it is just as hard in Ontario as in the U.S. to find competent, informed experts who expect to see major capital refits to aging nuclear stations, especially as our electricity system becomes more market-oriented and competitive.Ontario Hydro[4]

In the early 1990s, Ontario Hydro spent a considerable sum — $203 million in Canadian dollars — on its plans to retube two of the reactors of the Bruce-A station — units 1 and 2, in reverse numerical order. In 1993, Ontario Hydro officially "wrote off" that investment, on the grounds that it was not expected to accrue to the benefit of electricity customers.[5]

Furthermore, on March 21, 1994, Ontario Hydro Nuclear submitted its "Strategic Plan for Future Operation of Bruce A Nuclear Generating Station" in writing to the Atomic Energy Control Board.[6]

That document is quite clear in assuring the Atomic Energy Control Board that all four units of Bruce-A will actually reach a premature end of life. Consider, for example, the following specific passages:

- In paragraph 1.0 — "Strategic Plan Overview" — of Attachment 1 of the package and the corresponding chart – "Bruce 'A' Operating Strategy" – Ontario Hydro told the Atomic Energy Control Board that Bruce Unit 1 would "SHUT DOWN JANUARY)" in the year 2000, and gave the explanation "P/T [i.e., pressure tube] LIFE LIMIT". For Bruce Unit 3, the notice "SHUT DOWN APRIL" appears in the year 2008, accompanied by "P/T LIFE LIMIT". For Bruce Unit 4, the notice "SHUT DOWN APRIL" appears in the year 2006, accompanied by "P/T LIFE LIMIT", but it is followed by the following Note: "ADDITIONAL SLAR IN THE 1990'S WILL ENABLE UNIT TO EXTEND PRESSURE TUBE LIFE LIMIT TO APRIL 2011."

- Attachment 4, Section 1, first paragraph, says "... the elements required to ensure safe operation of Units 1 and 2 to their planned end of life (which have now been firmed up) have been incorporated into their operating strategies." Same section, page 2, first complete paragraph says "For Unit 1, an end of life in 2000 is now planned, based on fuel channel creep induced elongation."

These passages make absolutely clear how firm and unambiguous Ontario Hydro has been in assuring the Atomic Energy Control Board that it actually plans to shut down Bruce A Units 1, 3, and 4 in January 2000, April 2008, and April 2011, respectively. Any assurances to the contrary — especially from AECL — should be given little credence.

<u>The fear of exemption from environmental assessment in Ontario is even more well-founded than NAP indicates.</u>
Nuclear Awareness Project writes (*Submission*, p. 4):

Energy Probe's Notes, page 4

> There is no guarantee that the plutonium fuel scheme will undergo an environmental assessment at either the provincial or federal level. An exemption was granted to the Bruce "A" Station in 1976 under the Ontario Environmental Assessment Act, and the use of MOX fuel may come under this exemption.

Indeed, Energy Probe has direct and painful experience in this matter: A legal attempt by Energy Probe to force an Ontario EA of another serious change at an exempted nuclear station — specifically the decision to build an Ontario-wide Tritium Removal [and storage] facility at the Darlington station — was rejected by the Ontario courts. The courts found that the proposal to build the nuclear station, which was exempted from the Ontario Environmental Assessment Act, was extremely vague and general. Therefore, the exemption from Environmental Assessment even covered the later decision to construct an Ontario-wide waste-extraction and -storage facility — on a part of the property that was shown as an open space on the maps drawn when the exemption was granted![7]

Moreover, the Federal Environmental Assessment Panel on High-Level Waste Disposal (see p. 3 of NAP's submission) has already repeatedly indicated its unwillingness to enter into discussions of the potential implications of this proposal on the quantity or nature of high-level nuclear waste in Canada, because it views the proposal as still hypothetical.

As one indication of the treatment of this issue before the Federal Environmental Assessment Panel, following is an intervention on the second day of the hearing by Dr. P. Brown of Natural Resources Canada, explaining why there is no need for that panel to review this proposal:

> THE CHAIRMAN: Microphone number 3?
> DR. P. BROWN: Thank you, Mr. Chairman. Your indulgence, please. This is more of a comment rather than a question.
> The CANDU option -- I just want to clarify one point, and that is that the CANDU option for burning MOX fuel is only a proposal for consideration; it is not a confirmed project. And any project that was there would not start until the year 2000, and, in any event, it would have to meet all applicable Canadian environmental and regulatory requirements before a decision to proceed with the option was indeed given.
> So it is not a fait accompli at this point. Thank you.
> THE CHAIRMAN: Thank you, Dr. Brown.[8]

These recent developments give further credence to NAP's concerns in regard to any federal Environmental Assessment of this undertaking.

ENERGY PROBE RESEARCH FOUNDATION, TORONTO, ON, NORMAN RUBIN
PAGE 7 OF 7

Energy Probe's Notes, page 5

End-Notes

1. See, for example, PEIS, Summary volume, Attachment B: "Summary Comparison of Environmental Impacts for Plutonium Disposition Alternatives", pp. S-122—S-155.

2. See, for example, Mark Nichols, "Debating the CANDU option: Should Canada process plutonium?" in *Maclean's*, May 6, 1996, pp. 46-47; "Plutonium plan to go before G7" in *The Financial Post*, April 17, 1996, p. 2.

3. Nuclear Awareness Project, *Submission to the U.S. Department of Energy Regarding the* Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement, June 6, 1996.

4. This morning's release of *A Framework for Competition, The Report of the Advisory Committee on Competition in Ontario's Electricity System to the Ontario Minister of Environment and Energy*, can only be seen as reinforcing and accelerating this widespread trend.

5. Testimony at the Ontario Energy Board, HR22 hearing, esp. Transcript volume 16, pp. 3174-3178.

6. The document bears Ontario Hydro file number BGA 00531 (P). It was distributed by AECB staff to its Board and to the present author as Board Member Document BMD 94-65A, dated 1994-03-30. This document was also filed (by Energy Probe) as Exhibit 4.2.17 at the Ontario Energy Board on June 8, 1994. As far as we know, this document remains in force and has not been superseded by any subsequent documents.

7. Specific citations on request. First the Ontario lower court dismissed our action, the Court of Appeals declined our Application for Leave to Appeal, without giving any reasons.

8. ENVIRONMENTAL ASSESSMENT REVIEW AGENCY, NUCLEAR FUEL WASTE MANAGEMENT AND DISPOSAL CONCEPT, PUBLIC HEARINGS, MARCH 12, 1996, VOLUME 2, p. 114.

April 30, 1996

Linda Ewald
944 Ponder Road
Knoxville, TN
37923

U.S. DOE, Office of Reconfiguration
P.O. Box 3417
Alexandria, VA 22302

I am writing to comment on the Programmatic Environmental Impact Statement that lays out options for disposing of excess plutonium and Highly Enriched Uranium from dismantled nuclear weapons

I am opposed to option #1, the conversion of plutonium and HEU for use as nuclear ~~reactio~~ reactor fuel. Nuclear reactors produce more dangerous waste to dispose of, it encourages the use of weapons usable materials as fuels, thus increasing the chances of proliferation world-wide and building and maintaining reactors will cost billions of dollars.

1/08.03.01

M-205

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Options #2 and #3 ~~are~~ are also not viable because these wastes are so unstable and long lasting traditional methods for disposal are not applicable. | 2/08.03.01

DOE needs a "nuclear waste standard" to adopt a plan to produce the least amount of new radioactive waste. | 3/15.00.00

Disposal of nuclear materials should limit the amount of processing and transportation.

I encourage investment in worker and community safety and innovative disposition ideas ~~such~~ such as vitrification. | 4/08.03.01

Please listen to academics and independent scientists who have community interests in mind. Thank-you very much.

Sincerely,
Linda Ewald

M-205

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to the disposition alternatives. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

15 00 00 **Comment Number 3**

Comment noted. Waste minimization is an ongoing goal of DOE and will be considered to the extent practicable in the selection and implementation of the alternative(s).

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

F.A.C.T.S., KENMORE, NY,
JAMES RAUCH
PAGE 1 OF 3

F.A.C.T.S.
(For A Clean Tonawanda Site)
"PUTTING THE PIECES TOGETHER"

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Kenmore, NY 14217-0566

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Fax: (716) 876-9552

Office of Fissile Materials Disposition
U.S. Department of Energy
PO Box 23786
Washington, DC 20026-3786

May 27, 1996

Subject: Comments on Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement

1) Fissile materials, plutonium and highly enriched uranium (HEU), can be easily assembled into nuclear weapons. Fissile materials are also very long-lived radioactive materials which are toxic, especially plutonium, to living things. Therefore, it should be apparent that fissile materials pose both grave security and environmental/public health threats, respectively. Because the costs of maintaining both security and environmental isolation of these materials are extremely high, they also represent an enormous economic liability. More than ten years ago, the U.S. government recognized these liabilities and stopped production of plutonium for weapons and commercial use of plutonium.

However, five countries, Britain, France India, Japan and Russia, continue to reprocess spent commercial nuclear power plant fuel, in anticipation of a day when uranium fuel may become scarce or relatively expensive. In the next decade, the amount of commercially separated plutonium in these and additional countries may exceed the amount of plutonium from dismantled weapons.

If the Clinton Administration is serious about the fissile material threats identified above, it must also address, without delay, the growing global commercial production of plutonium, which is bound up with the increased use of nuclear power in economies outside the U.S. The U.S. government can best address this problem by: 1) declaring fissile materials a liability, 2) by exerting influence on the reprocessing countries to phase out both reprocessing and the use of nuclear power, through a frank portrayal of the downside of nuclear energy -- the uneconomic cost of sound, long-term waste management and plant safety issues -- in addition to the weapons proliferation threats and, 3) by encouraging the maximization of energy efficiency and conservation measures in conjunction with the large scale development and production of safe, alternative, renewable power supplies (solar, biogas and wind power). The subsidized transfer of these technologies to the

1/01.03.00

M-255

01 03 00 **Comment Number 1**

Comment noted. The President's Nonproliferation Policy states the United States will not recycle Pu. Burning weapons-usable Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel.

Although it may be possible to make a nuclear weapon from spent commercial reactor fuel, it can only be done with a great deal of difficulty by individuals with extensive experience in handling and processing nuclear materials. The disposition of weapons-usable Pu through the use of MOX fuel in LWRs creates a radiological barrier that makes the Pu as difficult to retrieve and reuse in weapons as Pu in spent commercial reactor fuel. The use of this technology approach would allow for the Pu to be disposed of in a geologic repository the same as commercial reactor fuel. Implementation of the disposition alternatives will serve as an example and encourage other countries to disposition surplus Pu, without reprocessing.

F.A.C.T.S., KENMORE, NY,
JAMES RAUCH
PAGE 2 OF 3

developing countries will reduce the attraction of nuclear enterprises in most cases. 1/01.03.00 cont.

2) We are vigorously opposed to any mixed oxide fuel (MOX) option because: 1) the cost of the MOX fabrication venture is over $2.2 billion, and 2) it will encourage the development of a plutonium fueled reactor economy, an outcome at odds with current U.S. policy. 2/08.03.01

The draft EIS presents a sketchy description of a MOX fuel option using the Canadian CANDU reactors at Bruce A. The EIS states that "spent fuel [from this project]... would be accommodated within the Canadian spent fuel program." In effect we would be dumping responsibility for long-term waste management on the Canadians. This would be very unfair. But it would be typical of the irresponsible and slipshod approach to managing nuclear wastes, both commercial and military, taken by past DOE administrations up to and including the current Clinton Administration DOE.

The Canadians are currently reviewing the issue of spent fuel disposal. This review does not include management of spent MOX fuel. In fact, Atomic Energy Canada Limited (the originator of the CANDU MOX proposal) has boasted that a provincial Environmental Assessment can be avoided under an environmental assessment exemption granted to Bruce A in 1976. So, if this option were to be selected, it would probably not be subject to any public review process by Canadian citizens. This would be exceedingly irresponsible, being even less than the routinely political, instead of scientific, sham environmental review processes conducted by DOE in the U.S. 3/08.03.01

3) At this time, we believe the vitrification of the fissile materials to be the only acceptable option. It would probably cost no more, and perhaps less than the MOX options, without having the fatal flaw of the MOX option, encouragement of a plutonium reactor economy. The cost of expensive shielding could be avoided by vitrifying the fissile material with depleted uranium instead of highly radioactive reactor spent fuel. The glass logs could then be stored in metal canisters made with a gamma-emitter such as cesium-137 to deter theft. 4/08.03.01

Sincerely,

James Rauch

M-255

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Cost considerations were included in the Technical Summary Report for disposition, which was made available to the public in July and November 1996.

The President's Nonproliferation Policy states the United States will not recycle Pu. Burning weapons-usable Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel.

Decisions on disposition of weapons-usable fissile materials will be made based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

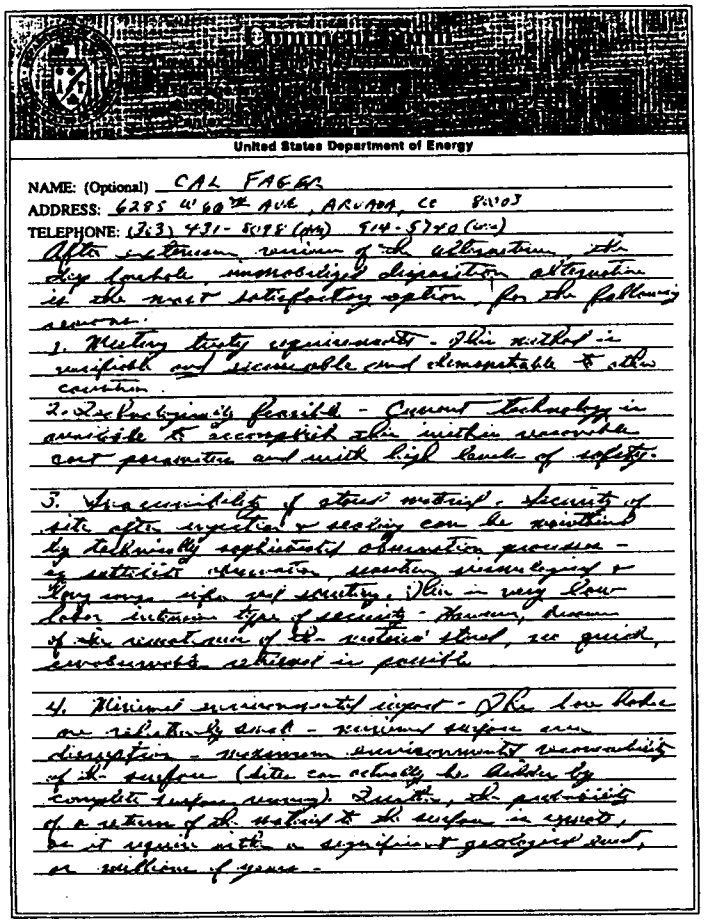
The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. After considering public comments the PEIS has been revised concerning the CANDU Reactor Alternative. The PEIS includes an appropriate level of analysis concerning the CANDU Reactor Alternative, consistent with Executive Order 12114, DOE guidelines, the State Department's Uniform Procedures, and DOE's regulations at CFR 1021.102 implementing NEPA. In addition, according to the Canadian Government, implementation of the CANDU Reactor Alternative would be subject to Canadian Federal and Provincial policies and regulations and would require health, safety, and environmental assessments before issuance of a Canadian license. (See the letter from the Canadian Embassy in Washington, DC, dated June 6, 1996, reproduced in this CRD.) Should the CANDU Reactor Alternative be chosen for the Pu disposition, further negotiations (which would include the disposition of the MOX spent fuel)

Canadian Federal and Provincial Governments will be required before implementation, as well as business negotiations with reactor owners.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. The PEIS analyzes vitrification of Pu along with high-level waste or Cs to provide a radiation barrier. The radiation barrier is necessary to provide proliferation resistance and vitrification with depleted uranium would not provide such proliferation resistance; use of HLW or Cs would require shielded facilities.

FAGER, CAL, ARVADA, CO
PAGE 1 OF 1



Comment Form

United States Department of Energy

NAME: (Optional) CAL FAGER
ADDRESS: 6285 W 60th AVE, ARVADA, CO 80003
TELEPHONE: (303) 431-8098 (HM) 914-5740 (WK)

After extensive review of the alternatives, the deep borehole immobilized disposition alternative is the most satisfactory option, for the following reasons:

1. Meeting treaty requirements - This method is verifiable and accessible and demonstrable to other countries.

2. Technologically feasible - Current technology is available to accomplish this within reasonable cost parameters and with high levels of safety.

3. Inaccessibility of stored material - Security of site after injection & sealing can be maintained by technically sophisticated observation processes - eg satellite observation, seismic surveillance & long range infra red scanning. This is very low labor intensive type of security - However, because of the remotness of the material stored, no quick, unobservable retrieval is possible.

4. Minimal environmental impact - The bore holes are relatively small - minimal surface area disruption - maximum environmental reasonability of the surface (sites can actually be hidden by complete surface recovery). Further, the probability of a return of the material to the surface is remote, as it requires either a significant geological event, or millions of years.

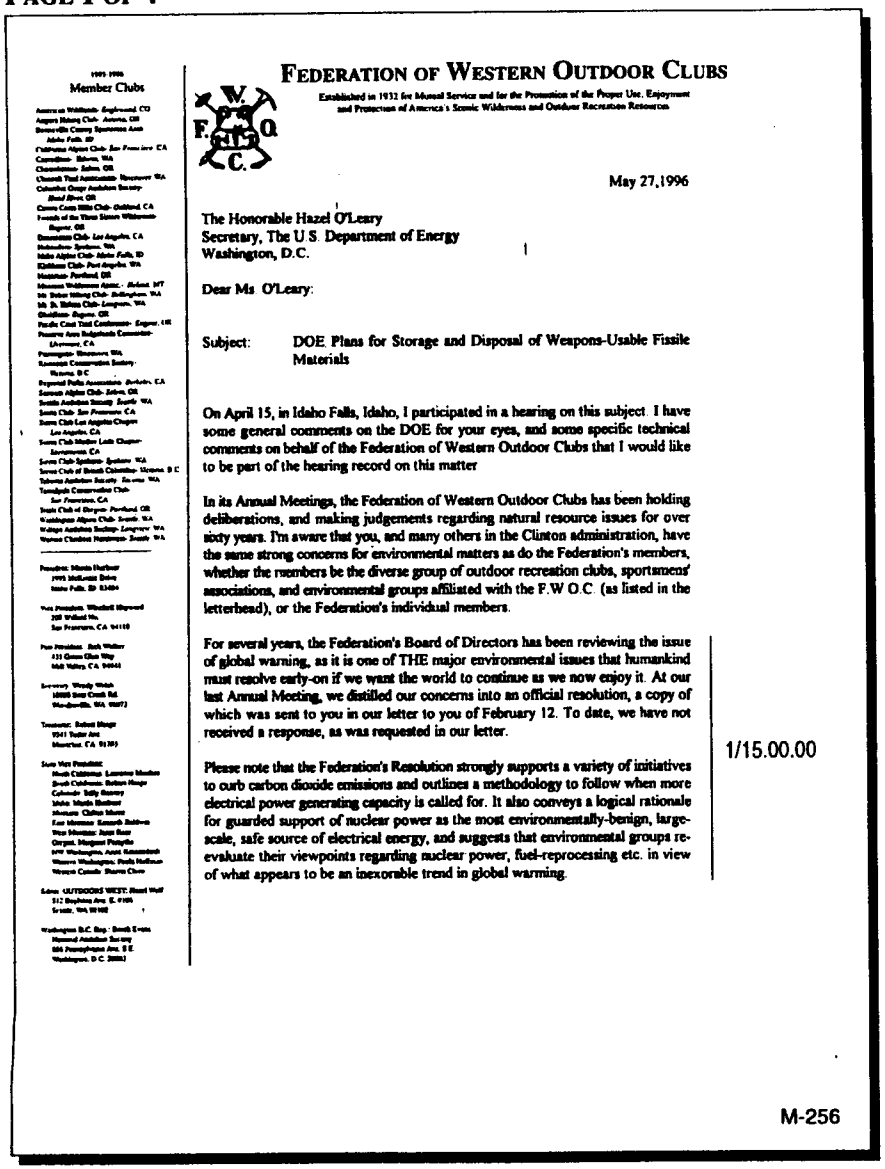
1/04.02.00

CO-002

04 02 00 **Comment Number 1**

Comment noted.

FEDERATION OF WESTERN OUTDOOR CLUBS, IDAHO FALLS, ID, MARTIN F. HUEBNER
PAGE 1 OF 4



1995-1996
Member Clubs

American Wildlands- Englewood, CO
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Bonneville County Sportsmen Assn
Idaho Falls, ID
California Alpine Club- San Francisco, CA
Carmelitas- Edison, WA
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Washington, D.C. 20003

FEDERATION OF WESTERN OUTDOOR CLUBS

Established in 1932 for Mutual Service and for the Promotion of the Proper Use, Enjoyment and Protection of America's Scenic Wilderness and Outdoor Recreation Resources

May 27,1996

The Honorable Hazel O'Leary
Secretary, The U.S. Department of Energy
Washington, D.C.

Dear Ms. O'Leary:

Subject: DOE Plans for Storage and Disposal of Weapons-Usable Fissile Materials

On April 15, in Idaho Falls, Idaho, I participated in a hearing on this subject. I have some general comments on the DOE for your eyes, and some specific technical comments on behalf of the Federation of Western Outdoor Clubs that I would like to be part of the hearing record on this matter

In its Annual Meetings, the Federation of Western Outdoor Clubs has been holding deliberations, and making judgements regarding natural resource issues for over sixty years. I'm aware that you, and many others in the Clinton administration, have the same strong concerns for environmental matters as do the Federation's members, whether the members be the diverse group of outdoor recreation clubs, sportsmens' associations, and environmental groups affiliated with the F.W.O.C. (as listed in the letterhead), or the Federation's individual members.

For several years, the Federation's Board of Directors has been reviewing the issue of global warning, as it is one of THE major environmental issues that humankind must resolve early-on if we want the world to continue as we now enjoy it. At our last Annual Meeting, we distilled our concerns into an official resolution, a copy of which was sent to you in our letter to you of February 12. To date, we have not received a response, as was requested in our letter.

Please note that the Federation's Resolution strongly supports a variety of initiatives to curb carbon dioxide emissions and outlines a methodology to follow when more electrical power generating capacity is called for. It also conveys a logical rationale for guarded support of nuclear power as the most environmentally-benign, large-scale, safe source of electrical energy, and suggests that environmental groups re-evaluate their viewpoints regarding nuclear power, fuel-reprocessing etc. in view of what appears to be an inexorable trend in global warming.

1/15.00.00

M-256

15 00 00 **Comment Number 1**

Although the commentor's prior letter was not a comment on this PEIS, DOE acknowledges its receipt. Consistent with the commentor's comments, this PEIS analyzes carbon dioxide (CO_2) emissions, where appropriate, and examines the use of nuclear reactors (using MOX fuel) for Pu disposition.

FEDERATION OF WESTERN OUTDOOR CLUBS, IDAHO FALLS, ID, MARTIN F. HUEBNER
PAGE 2 OF 4

GENERAL COMMENTS

First, some general comments I am one of many Americans who have seen the bright promise of post WWII nuclear technology become mired in over-regulation, the un-constructive efforts of journalists, the misplaced concerns of some environmental groups, (and I consider myself a hard-core environmentalist!), and the deliberate sabotaging of nuclear technology by alleged "watch-dog groups who can't or won't (like most journalists) distinguish between military nuclear weapons and commercial nuclear power.

A significant detractor from being able to capitalize on the beneficial use of nuclear technology for our country's benefit, is from what I will refer to hereinafter as the Proliferation Paranoids (PPs) Though probably well-intentioned, these misguided people have infested our government and have done more than any other group to hamstring our country's once-leadership in nuclear technology. If PPs had been involved in analogous acts to hamper our national defense rather than hamper civilian nuclear power, some have said they would consider such PPs as traitors to our country. If you have any PPs in your shop, I request you find them employment elsewhere!

Although no attribution was given as to the origin of the various proposals/alternatives discussed at the Idaho Falls hearing, I suspect the PPs had a hand in the proposals for Immobilization (by e.g. by vitrification) and Deep Borehole Disposition. I will first discuss how ludicrous these proposals are, from a financial, ethical/moral, and a technical perspective.

TECHNICAL COMMENTS

1) The DOE representatives at the hearing could not/would not respond to my direct question on how much American taxpayer money had been spent to provide these "surplus" materials, (stated to be 175 MT HEU and 38 MT plutonium), or what weapons-grade plutonium or HEU cost per gram to produce. I made the same request for this information from the local DOE office, and from information officers at DOE Headquarters, to no avail. So, based on what I remember about the cost of the weapons-production facilities from past mining on the Colorado plateau the Feed Materials Production Centers like Fernald, through the diffusion plants and production reactors etc.,through weapons fabrication, I estimate that to protect our country through the Cold War, the American taxpayer willingly forked over about $ 1000/grain to support HEU and Pu production.

2/07.00.00

So, the HEU that's being considered for disposition is estimated to be worth:

$ 1000/gram x 1000 grams/Kg x 1000 Kg/MT x 175 MT= $ 175,000,000,000

If the Plutonium costs a like amount
$ 1000/gram x 1000 grams/Kg x 1000 Kg/MT x 38 MT =$38,000,000,000

M-256

07 00 00 Comment Number 2

The historical (approximately 50 years) acquisition costs for the HEU and Pu are sunk costs for which no single separate financial accounting system was utilized.

Thus, if either the borehole or the immobilization alternative were (heaven forbid) be chosen, this would result in an unproductive, irretrievable loss to the American taxpayer of a fifth of a trillion dollars. | 3/08.03.01

The Immobilization Alternative This calls for the American taxpayer to pay a great deal MORE money (a large but unspecified amount) to change these materials so they aren't attractive to the Bad Guys who would like to do very bad things to our beloved country

The ONLY feasible application of the Immobilization strategy is on plutonium items that can't (for reasons not clear to me) be converted into potential reactor fuel. The rest of such immobilization proposals are a lot of hyper-expensive bunk conjured up by PPs, or their in-house equivalents.

Stated at the Idaho Falls hearing was that the on-going Electro-Metallurgical Project at Argonne National Laboratory-West could be a facility for dealing with non-reactor feasible plutonium. If so, I would recommend that this technical Argonne innovation be vigorously pursued | 4/08.03.01

Deep Borehole Disposition Environmentalists are deeply opposed to inoculating the skin of Mother Earth with any foreign substance, no matter if it is industrial, agricultural, or municipal in origin, or comes from nuclear R & D. The idea of the taxpayers having had to fork-out over $ 200 billion to manufacture these weapons-grade materials, and then spending huge more amounts to bury it in the ground somewhere at more taxpayer expense is downright immoral. It would further squander the financial resource of American citizens, who already have a tough time making ends meet. The Borehole concept borders on the ludicrous and would be downright funny if it weren't apparently a sober suggestion, and is even made more ludicrous by the additionally expensive suggestion to "Immobilize" the Plutonium first. | 5/08.03.01

The absolutely most ridiculous statement made at the hearing was the Russians, too, are considering "Deep Borehole" disposition. It's surprising that a remark like this wasn't treated to out-loud hoots of derision. One does not have to be a member of the State Department to know that Russia is in deep financial difficulty, and would no-way bury this supremely expensive materials in the ground. Only in profligate America could something as bizarre as Deep Hole disposal be advanced. Such moneys should be spent in CLEAN-UP of weapons manufacturing facilities!

The Federation suggests that persons responsible for such providing such "Alternatives" as Immobilization and Deep Borehole disposal be frequently checked for controlled substances. It makes us wonder if they are truly adhering to whatever oath they took when taking office to benefit, guard and protect our country and its citizens.

2) It is apparent that unless weapons-usable HEU and plutonium are to be used for useful (electricity production) purposes, they are properly safeguarded where they now are stored, and it should be | 6/01.06.00

M-256

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to the Borehole and Immobilization Alternatives. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 4

The Department of Energy acknowledges the commentor's support for the Electrometallurgical Treatment Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, existing agreements, and public input.

08 03 01 Comment Number 5

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 06 00 Comment Number 6

Comment noted. DOE is considering, and the PEIS analyzes, both Reactor Alternatives (which would convert surplus Pu to MOX fuel to generate electricity), and the No Action Alternative (which would leave the surplus Pu in safe, secure storage), as the commentor suggests. For surplus HEU, DOE has already decided to blend-down up to 20 percent of the HEU to commercial fuel as decided in the HEU ROD.

FEDERATION OF WESTERN OUTDOOR CLUBS, IDAHO FALLS, ID, MARTIN F. HUEBNER
PAGE 4 OF 4

feasible for such materials to remain where most of the related materials now are, such as HEU at Oak Ridge. In contradiction to the PPs, in-country shipments of such special materials have been proven not to be a legitimate proliferation concern. | 6/01.06.00 cont.

3) The ONLY legitimate role for the surplus HEU/plutonium is to put it to use it for the benefit of U.S. citizens who have already paid dearly to manufacture this material. Several reactor proposals were discussed in the hearing. The Federation is not equipped to make a selection among:

Using the weapons-usable materials as fuel in existing U.S. light water cooled reactors,

Using it in partially completed U.S. light water reactors,or

Using it in evolutionary U.S. light water reactor(s) to be designed/built, or

Using it in Canadian CANDU reactors.

It would appear most beneficial for the long-term interests of the country to design/build some commercial power plant reactor of advanced design, and let the U.S. citizens get a "peace benefit" when these materials are in-reactor burned to provide useful power. | 7/08.03.01

The Federation notes that some U.S. electrical utilities have already expressed interest in using these materials in their reactor This factor is another good reason ignoring the Immobilization and Deep Borehole proposals. We would rather GIVE these materials to the Canadians or the British than see it designated for such stupid and useless purposes.

Very truly yours,

Martin F. Huebner
President
Federation of Western Outdoor Clubs
1995 McKinzie Drive
Idaho Falls, Idaho 83404

Copies to:
- o Idaho State Congressional Delegation
- o Idaho State Legislators and State Officials
- o DOE-Office of Fissile Materials Disposition
  % SAIC-PEIS,PO Box 23786, Washington DC

M-256

08 03 01 Comment Number 7

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

FENMORE, CAROL, POCATELLO, ID
PAGE 1 OF 1

Comment ID: P0008
Date Received: April 18, 1996
Name: Carol Fenmore
Address: 365 Skyline Drive
Pocatello, ID

Transcription:

I'm 100% against bring over 1000 tons of plutonium, the most dangerous element known to man, and possibly storing it over the Snake River Aquifer. It is absolutely insanity and should not even be considered at any cost, jobs or otherwise. It makes me livid. Thank you. My number is (208) 203-0788 and thank you. | 1/08.03.01

P-008

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the transportation of Pu for storage at INEL. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

FITZGERALD, KARA
PAGE 1 OF 1

Comment ID: P0018
Date Received: April 18, 1996
Name: Kara Fitzgerald
Address: none given
Phone : 208-785-0235

Transcription:

I think it'd be a good thing to have the plutonium come to Idaho. Thank you. | 1/08.03.01

P-018

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for additional missions involving Pu at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Comment ID: P0007
Date Received: April 18, 1996
Name: Pete Fitzgerald
Address: Blackfoot [ID]

Transcription:

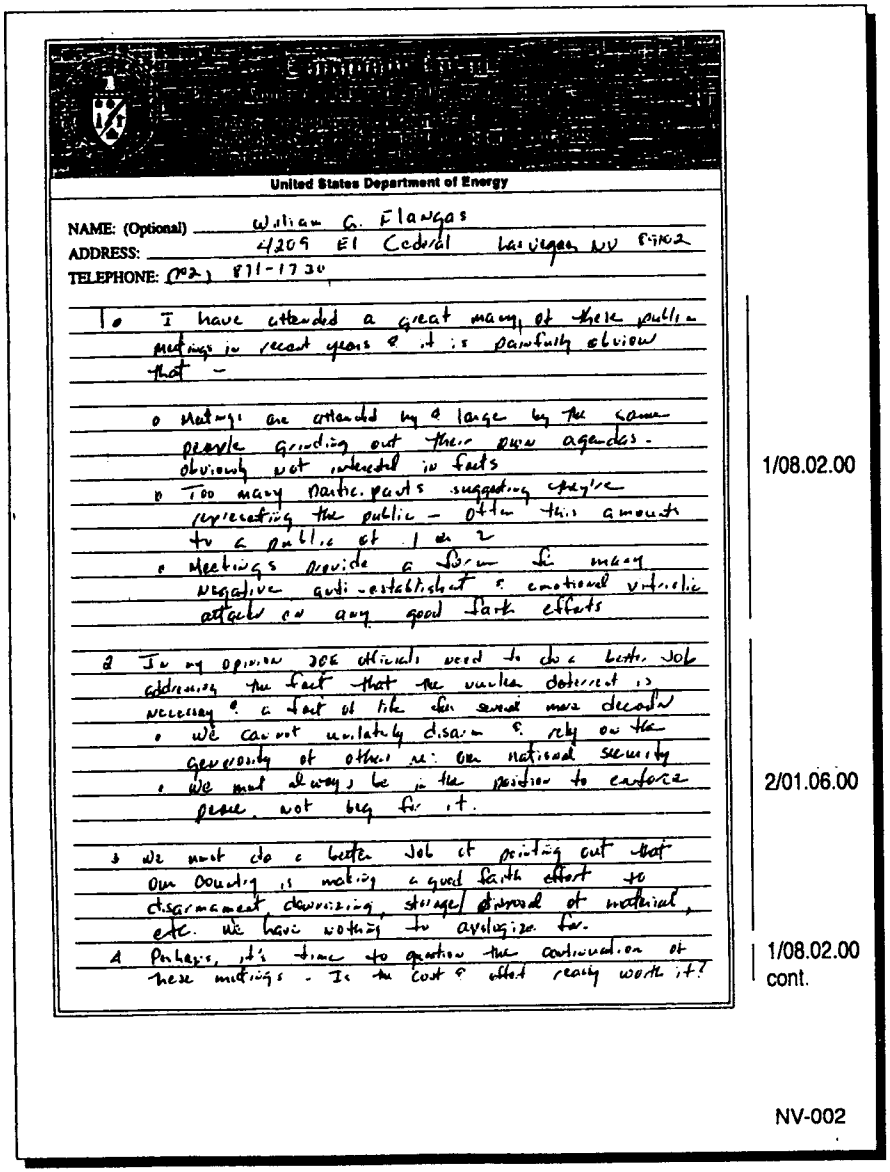
I think we should get that plutonium. It'd bring more jobs for the INEL. We need more jobs in this area. Thank you very much, bye. | 1/08.03.01

P-007

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for additional missions involving Pu at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

FLANGAS, WILLIAM A., LAS VEGAS, NV
PAGE 1 OF 1



United States Department of Energy

NAME: (Optional) William A. Flangas
ADDRESS: 4209 El Cedral Las Vegas NV 89102
TELEPHONE: (702) 871-1730

1. I have attended a great many of these public meetings in recent years & it is painfully obvious that -

- Meetings are attended by a large by the same people grinding out their own agendas. obviously not interested in facts
- Too many partic. pants suggesting they're representing the public - often this amounts to a public of 1 or 2
- Meetings provide a forum for many negative anti-establishment & emotional virtriolic attacks on any good faith efforts

1/08.02.00

2. In my opinion DOE officials need to do a better job addressing the fact that the nuclear deterrent is necessary & a fact of life for several more decades
- We cannot unilately disarm & rely on the generosity of others re: our national security
- We must always be in the position to enforce peace not beg for it.

2/01.06.00

3. We must do a better job at pointing out that our country is making a good faith effort to disarmament downsizing, storage/disposal of material, etc. We have nothing to apologize for.

4. Perhaps, it's time to question the continuation of these meetings - Is the cost & effort really worth it?

1/08.02.00 cont.

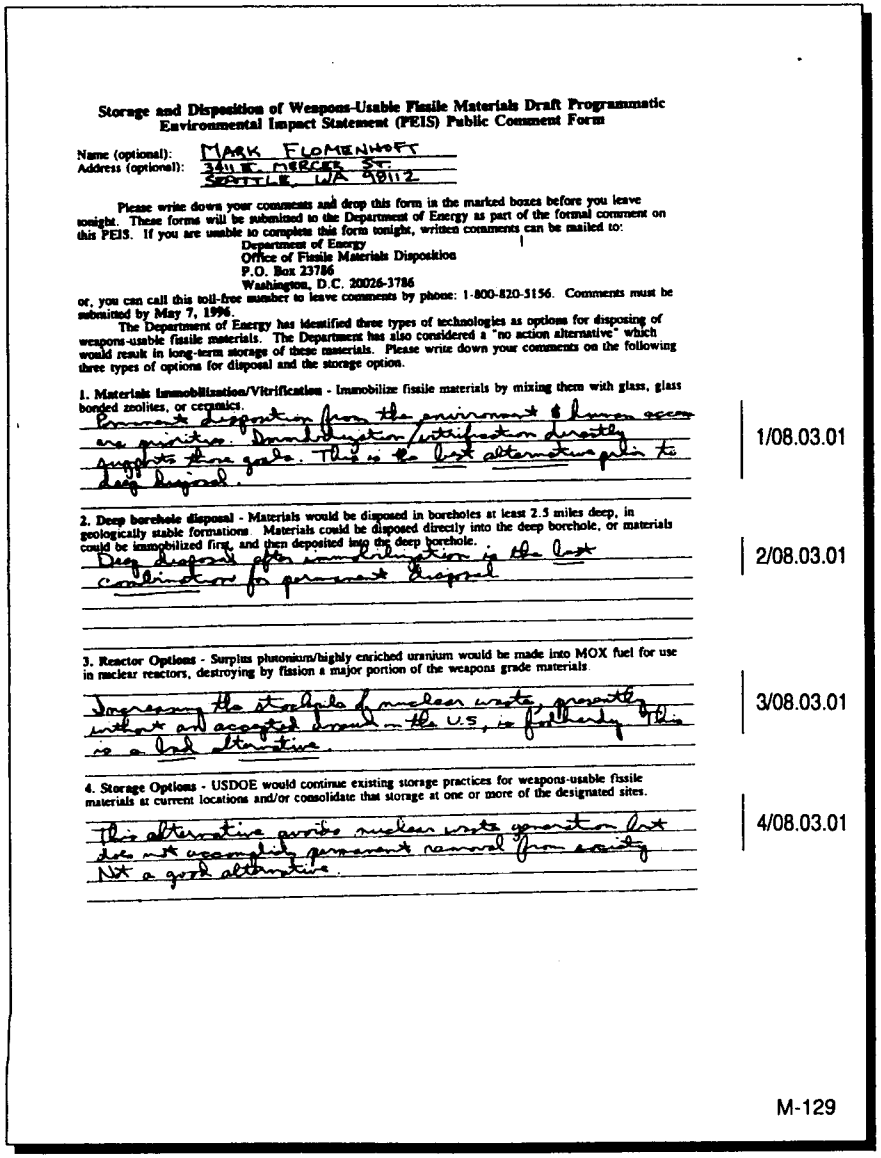
NV-002

08 02 00 **Comment Number 1**

Comment noted.

01 06 00 **Comment Number 2**

Comment noted.



Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): MARK FLOMENHOFT
Address (optional): 3411 E. MERCER ST. SEATTLE, WA 98112

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. Materials Immobilization/Vitrification - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

Permanent disposition from the environment & human access are priorities. Immobilization/vitrification directly supports these goals. This is the best alternative path to long disposal. 1/08.03.01

2. Deep borehole disposal - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

Deep disposal after immobilization is the best combination for permanent disposal 2/08.03.01

3. Reactor Options - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

Increasing the stockpile of nuclear waste, presently without an accepted disposal in the U.S., is politically this is a bad alternative. 3/08.03.01

4. Storage Options - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

This alternative permits nuclear waste generation but does not accomplish permanent removal from society. Not a good alternative. 4/08.03.01

M-129

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's preference for the Immobilization/Vitrification Alternative. Decisions on storage and disposition of weapon-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the Borehole and Immobilization Alternatives. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 4

The Department of Energy acknowledges the commentor's opposition to long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

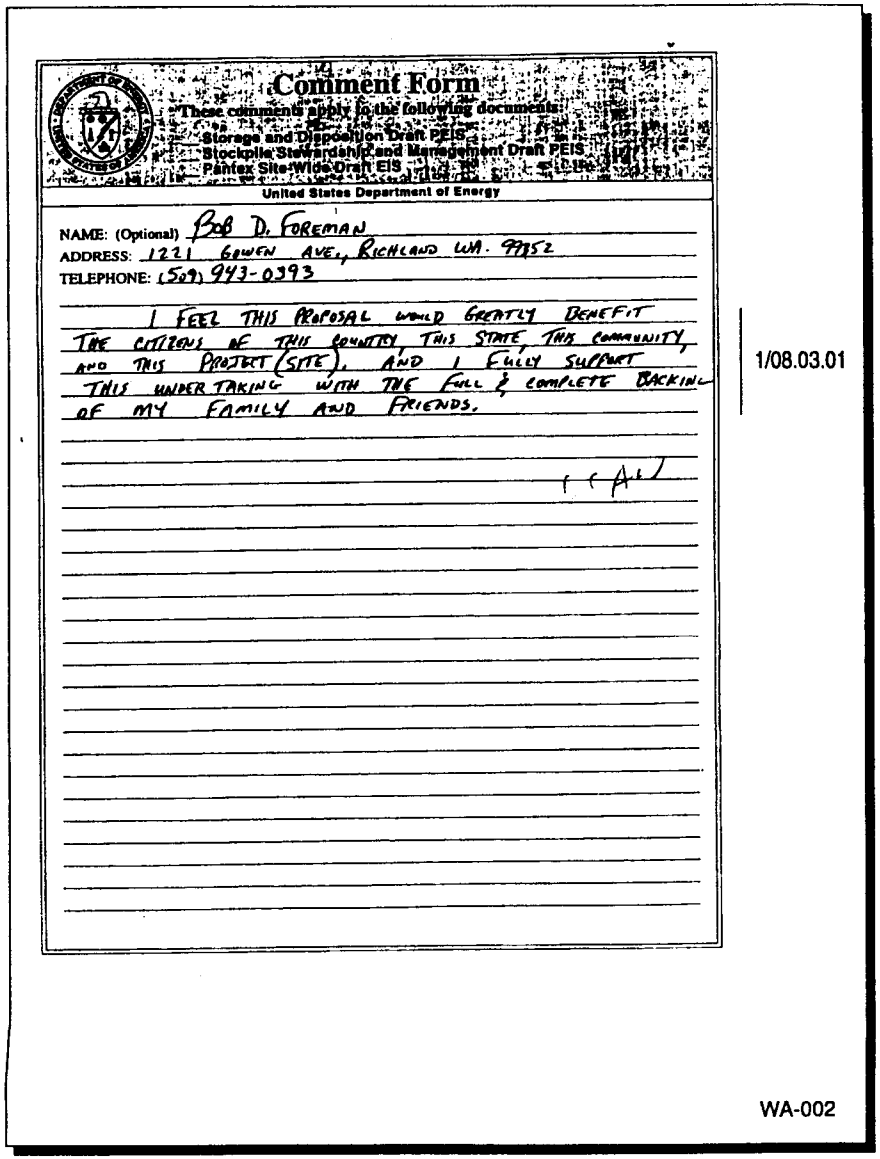
Please use this space to write down any additional comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

There are 3 priorities:
1. Permanent isolation from the public
2. Permanent isolation from terrorists & military application
3. Avoidance of nuclear waste generation.
Only immobilization with deep disposal meets all three objectives.

Mark J Flomenhoft

2/08.03.01 cont.

M-129



Comment Form

These comments apply to the following documents:
Storage and Disposition Draft PEIS
Stockpile Stewardship and Management Draft PEIS
Pantex Site-Wide Draft EIS

United States Department of Energy

NAME: (Optional) Bob D. Foreman
ADDRESS: 1221 Bowen Ave., Richland WA. 99352
TELEPHONE: (509) 943-0393

I FEEL THIS PROPOSAL WOULD GREATLY BENEFIT THE CITIZENS OF THIS COUNTRY, THIS STATE, THIS COMMUNITY, AND THIS PROJECT (SITE). AND I FULLY SUPPORT THIS UNDER TAKING WITH THE FULL & COMPLETE BACKING OF MY FAMILY AND FRIENDS.

1/08.03.01

WA-002

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for new missions at Hanford. Decisions on storage and disposition of weapon-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

GE STOCKHOLDERS' ALLIANCE,
PATRICIA BIRNIE
PAGE 1 OF 1

Date Received: 06/12/96
Comment ID: P0048
Name: Patricia Burney
Address: GE Stockholder's Alliance

Transcription:

Hello, this is Patricia Burney with the G.E. Stockholder's Alliance. And I first want to thank you for having this phone line available for our comments. I am sending a written statement as well which will have my address and phone number so I won't bother you with it now. But I do want to encourage you to oppose the use of MOX, the mixed oxide, as a fuel for commercial nuclear reactors. There are many reasons why that I am stipulating in my letter, but I wanted to just call in with my opposition to it being used. It makes it so much more possible to make the material available for proliferation; it increases the volume and radioactivity of waste that would be generated; it would require military escort when the -- to take care of the unused fuel. There's just so many reasons that it's not wise to follow that option, and we would strongly encourage you instead to use the vitrification process as the choice -- the option that you would choose for this mixed oxide plutonium and uranium. Thank you and I'll send my letter in tomorrow's mail Thank you very much. Bye. 1/08.03.01 2/08.03.01

P-048

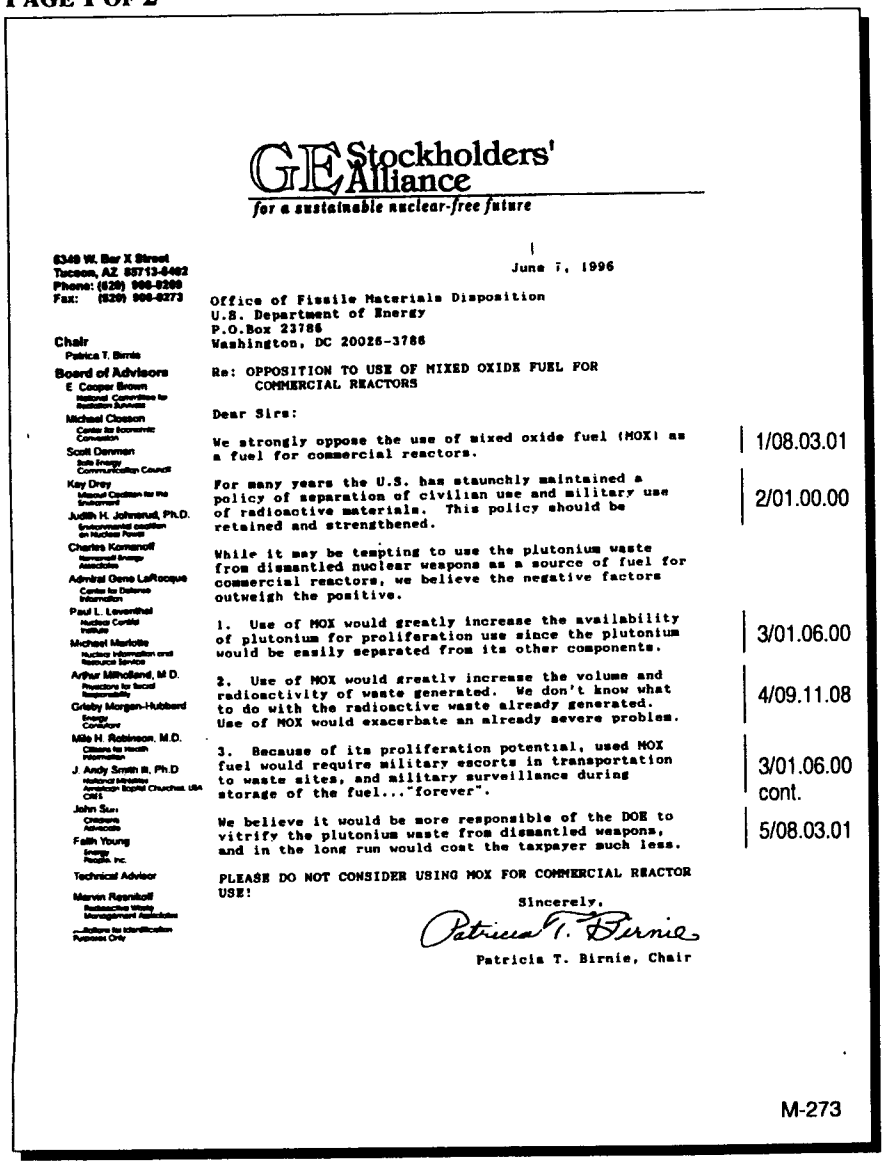
08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

GE STOCKHOLDERS' ALLIANCE, TUCSON, AZ,
PATRICIA T. BIRNIE
PAGE 1 OF 2



GE Stockholders' Alliance
for a sustainable nuclear-free future

6348 W. Bar X Street
Tucson, AZ 85713-6462
Phone: (520) 906-0200
Fax: (520) 906-0273

Chair
Patricia T. Birnie
Board of Advisors
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Scott Denman
Kay Drey
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Crosby Morgan-Hubbard
Milo H. Robinson, M.D.
J. Andy Smith III, Ph.D.
John Stu
Faith Young
Technical Advisor
Marvin Resnikoff

June 7, 1996

Office of Fissile Materials Disposition
U.S. Department of Energy
P.O.Box 23786
Washington, DC 20026-3786

Re: OPPOSITION TO USE OF MIXED OXIDE FUEL FOR COMMERCIAL REACTORS

Dear Sirs:

We strongly oppose the use of mixed oxide fuel (MOX) as a fuel for commercial reactors. | 1/08.03.01

For many years the U.S. has staunchly maintained a policy of separation of civilian use and military use of radioactive materials. This policy should be retained and strengthened. | 2/01.00.00

While it may be tempting to use the plutonium waste from dismantled nuclear weapons as a source of fuel for commercial reactors, we believe the negative factors outweigh the positive.

1. Use of MOX would greatly increase the availability of plutonium for proliferation use since the plutonium would be easily separated from its other components. | 3/01.06.00

2. Use of MOX would greatly increase the volume and radioactivity of waste generated. We don't know what to do with the radioactive waste already generated. Use of MOX would exacerbate an already severe problem. | 4/09.11.08

3. Because of its proliferation potential, used MOX fuel would require military escorts in transportation to waste sites, and military surveillance during storage of the fuel..."forever". | 3/01.06.00 cont.

We believe it would be more responsible of the DOE to vitrify the plutonium waste from dismantled weapons, and in the long run would cost the taxpayer much less. | 5/08.03.01

PLEASE DO NOT CONSIDER USING MOX FOR COMMERCIAL REACTOR USE!

Sincerely,

Patricia T. Birnie

Patricia T. Birnie, Chair

M-273

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 00 00 **Comment Number 2**

Comment noted.

01 06 00 **Comment Number 3**

The safeguards and security of storage of the weapons-usable fissile materials will continue to follow existing applicable regulations and requirements. Furthermore, the facilities would be inspectable by IAEA, as appropriate. Transportation impacts are discussed in Section 4.4 and Appendix G of the PEIS. Armed nuclear materials couriers carefully selected and highly trained to operate tractor-trailers and communication systems would be used. These couriers would also be authorized by the AEA to carry firearms and make arrests in the performance of their duties. No military personnel would be used in DOE's management of weapons-usable fissile materials.

The President's Nonproliferation Policy says the United States will not recycle Pu. Burning weapons Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel.

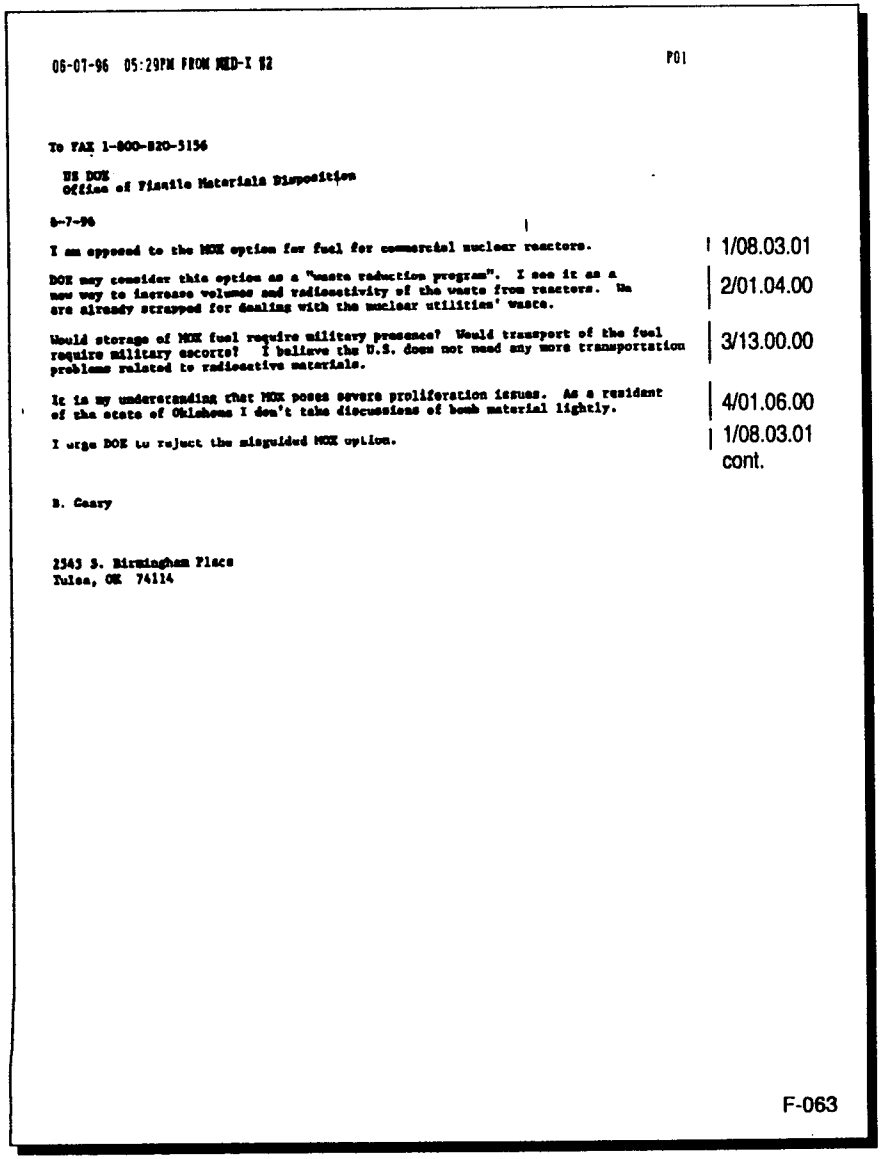
09 11 08 **Comment Number 4**

The MOX Fuel Option is a means of converting weapons Pu to a form that is difficult to retrieve and reuse in weapons. The MOX Fuel Options does not increase the volumes and radioactivity of waste from existing reactors. It replaces the spent fuel that would have been fabricated from other materials

and displaces the spent fuel that would have otherwise been created by other sources of fuel supply. The spent MOX fuel is essentially the same as existing commercial reactor spent fuel. Therefore, it meets the same criteria as other commercial reactor spent fuel in terms of being accepted for placement in a repository. The PEIS acknowledges the fact that constructing and operating a MOX fuel fabrication facility would increase the wastes generated at any sites selected for analyses. The wastes generated for the MOX fuel fabrication facility are presented in Section E.3.2.3. The impacts associated with operating the MOX fuel fabrication facility are presented in Section 4.3.5.1.10.

08 03 01 **Comment Number 5**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



06-07-96 05:29PM FROM MED-X 02 P01

To FAX 1-800-820-5156

US DOE
Office of Fissile Materials Disposition

6-7-96

I am opposed to the MOX option for fuel for commercial nuclear reactors. | 1/08.03.01

DOE may consider this option as a "waste reduction program". I see it as a new way to increase volumes and radioactivity of the waste from reactors. We are already scrapped for dealing with the nuclear utilities' waste. | 2/01.04.00

Would storage of MOX fuel require military presence? Would transport of the fuel require military escorts? I believe the U.S. does not need any more transportation problems related to radioactive materials. | 3/13.00.00

It is my understanding that MOX poses severe proliferation issues. As a resident of the state of Oklahoma I don't take discussions of bomb material lightly. | 4/01.06.00

I urge DOE to reject the misguided MOX option. | 1/08.03.01 cont.

B. Geary

2543 S. Birmingham Place
Tulsa, OK 74114

F-063

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 04 00 **Comment Number 2**

The MOX Fuel Option is not a "waste reduction program." It is a means of converting weapons Pu to a form that is difficult to retrieve and reuse in weapons. The MOX Fuel Option does not increase the volumes and radioactivity of waste from existing reactors. It replaces fuel that would have been fabricated from other materials and displaces the spent fuel that would have otherwise been created by other sources of fuel supply. The spent MOX fuel is essentially the same as existing commercial reactor spent fuel. Therefore, it meets the same criteria as other commercial reactor spent fuel in terms of being accepted for placement in a repository.

13 00 00 **Comment Number 3**

The safeguards and security of storage of the weapons-usable fissile materials will continue to follow existing applicable regulations and requirements. Furthermore, the facilities would be inspectable by IAEA, as appropriate. Transportation impacts are discussed in Section 4.4 and Appendix G of the PEIS. Armed nuclear materials couriers carefully selected and highly trained to operate tractor-trailers and communication systems would be used. These couriers would also be authorized by AEA to carry firearms and make arrests in the performance of their duties. No military personnel would be used in DOE's management of weapons-usable fissile materials.

01 06 00 **Comment Number 4**

The President's Nonproliferation Policy says the United States will not recycle Pu. Burning weapons Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted

for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel.

GENERAL ATOMICS

GA/DOE-027-96
Project 9866
April 30, 1996

Mr. Gregory P. Rudy, Acting Director
Office of Fissile Materials Disposition
U.S. Department of Energy
P.O. Box 23786
Washington, DC 20026-3786

SUBJECT: Comments on Draft Programmatic Environmental Impact Statement (EIS) on Storage and Disposition of Weapons-Useable Fissile Materials

References: (1) R.M. Forssell letter to Howard R. Canter, "Scope for Environmental Impact Statement for Long-Term Storage and Disposition of Weapons-Useable Fissile Material: Plutonium Consumption Modular Helium Reactor," GA/DOE-035-95, February 10, 1995

(2) A.J. Neylan letter to Howard R. Canter, "Programmatic EIS Screening Results," GA/DOE-068-95, June 6, 1995

Dear Mr. Rudy,

This letter provides the comments of General Atomics (GA) on the subject Draft Programmatic EIS. GA has previously provided to DOE via References (1) and (2) its comments on the results of the Screening Process, by which DOE selected the alternatives to be considered in this Programmatic EIS, and on the scope of the Programmatic EIS. Copies of these references are attached to this letter (Attachments 1 and 2). GA requests that the comments in Attachments 1 and 2 be included in the public record as part of its comments on the Draft Programmatic EIS itself. The comments primarily addressed 1) DOE's decision and rationale for not including the Gas Turbine Modular Helium Reactor (GT-MHR) as a reasonable alternative to be considered in this Programmatic EIS and 2) DOE's interpretation of the spent fuel standard as an objective that is not to be exceeded (by eliminating from consideration in this Programmatic EIS all alternatives capable of exceeding the spent fuel standard), without having provided the public with a full comparison of the environmental impacts associated with that decision.

Additional comments are provided with this letter in Attachment 3. These comments address 1) the manner in which DOE has provided only superficial consideration (in a three page appendix to the Programmatic EIS) of multipurpose reactor options for plutonium disposition and tritium supply; 2) the imposed schedule for demonstration of disposition technologies and for completion of disposition and the environmental impacts that result from that schedule; 3) the suitability of final waste forms for permanent disposal in terms of long term safeguards requirements and long term radionuclide containment; 4) issues associated with borosilicate glass as a vitrification option; 5) the viability of using electrometallurgical treatment (pyroprocessing) as an immobilization option; 6) use of a coated particle waste form for plutonium

3550 GENERAL ATOMICS COURT, SAN DIEGO, CA 92121-1194 PO BOX 85608, SAN DIEGO, CA 92186-9784 (619) 455-3000

M-132

GENERAL ATOMICS, SAN DIEGO, CA,
A. J. NEYLAN
PAGE 2 OF 39

Mr. Gregory P. Rudy -2- GA/DOE-027-96

immobilization; and 7) the treatment of certain environmental impacts associated with the CANDU reactor option for plutonium disposition.

GA continues to believe that the GT-MHR (identified as the Plutonium Consumption Modular Helium Reactor [PC-MHR] when applied to the plutonium disposition mission) must be evaluated in the Programmatic EIS because it is a reasonable alternative for plutonium disposition. GA also believes that the manner in which DOE has applied the spent fuel standard is a significant issue that must also be evaluated in the Programmatic EIS, especially in view of the availability of reasonable alternatives such as the GT-MHR, which is capable of exceeding the spent fuel standard and leaving a factor of five less plutonium-239 remaining than reactor alternatives that merely meet the standard. 1/14.00.00 2/01.05.00

The National Environmental Policy Act (NEPA) requires that all reasonable alternatives and significant issues be evaluated in the PEIS process. By addressing all reasonable alternatives and significant issues as required, DOE will provide a strong foundation for the Record of Decision, will avoid the potential for substantial delays in the plutonium disposition effort that might result from legal action as a result of the manner in which DOE has discharged its obligations under NEPA, and will enhance the credibility of DOE's efforts in the eyes of all stakeholders who have an interest in the resolution of the plutonium disposition problem.

GA again respectfully requests that DOE reconsider its decision to exclude the GT-MHR and the interpretation of the spent fuel standard from consideration in the Programmatic EIS. If you have any questions regarding General Atomics' comments or would like further information, please contact Dave Alberstein at (619) 455-2088.

Sincerely,

D. Alberstein for AJN

A.J. Neylan
Vice President, Power Reactor Group

AJN/DA:da

Attachments:

1) GA/DOE-035-95, February 10, 1995
2) GA/DOE-068-95, June 6, 1995
3) Additional General Atomics Comments on the Draft Programmatic Environmental Impact Statement for Storage and Disposition of Weapons-Useable Fissile Materials

cc:

J.D. Nulton, DOE-HQ

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14 00 00 Comment Number 1

The Advanced Deep Burn Reactors Option, including Modular Helium Reactors (MHR), was considered in the screening process. Notwithstanding the many potential benefits of their use, the technical immaturity would call for costly and lengthy development and demonstration efforts to bring them to a viable status. The Screening Committee decided that the increased Pu burn-up offered by this option would not counterbalance its cost, schedule, or technical risks, and therefore eliminated this option from further consideration. Clarification has been provided in Appendix N of the Final PEIS for the various multipurpose reactor concepts.

01 05 00 Comment Number 2

The Department of Energy, in considering the Spent Fuel Standard, did evaluate the adequacy of the Standard versus the greater degree of destruction achievable with other options such as the Deep Burn Reactor and the Accelerator Options in the Screening Report. It was judged that the Spent Fuel Standard is adequate since it would convert the weapons Pu to a form that would make it as difficult to retrieve and reuse in a weapon as the Pu contained in the much larger existing volume of spent fuel from commercial nuclear reactors.

The Department of Energy concluded that the shorter disposition time achievable with more mature technologies was more desirable than the greater Pu destruction that could only be achieved over a much longer time period through the use of Deep Burn Reactors and Accelerators. The NAS also adopted the Spent Fuel Standard as the most acceptable form for conversion of weapons Pu.

ATTACHMENT 1 TO GA/DOE-027-96

GA/DOE-035-95
February 10, 1995

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GENERAL ATOMICS, SAN DIEGO, CA,
A. J. NEYLAN
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GENERAL ATOMICS

GA/DOE-035-95
Project 6301
WBS: 5109.91
February 10, 1995

Mr. Howard R. Canter, Technical Director
Office of Fissile Materials Disposition
U.S. Department of Energy
Washington, DC 20585

SUBJECT: Scope for Programmatic Environmental Impact Statement for Long-Term Storage and Disposition of Weapons-Useable Fissile Material: Plutonium Consumption Modular Helium Reactor

Dear Mr. Canter:

Thank you for the opportunity to meet with you on February 1, 1995, to discuss the status of the Plutonium Consumption Modular Helium Reactor (PC-MHR) in the scoping process for the Programmatic Environmental Impact Statement (PEIS) for Long-Term Storage and Disposition of Weapons-Useable Fissile Materials. During that meeting you did not indicate that the PC-MHR had been eliminated in the screening process for the PEIS. However, we note from the draft report to Congress on the multipurpose reactor, which is dated January 31, 1995, and which GA received from your office for review and comment on February 3, 1995, that the PC-MHR has been eliminated from consideration.

GA will provide its comments on the draft multipurpose report, per your request, via a separate letter. The purpose of this letter is to explain why GA believes that it would be improper to exclude the PC-MHR as an alternative in the PEIS for fissile materials disposition and to request that DOE reconsider its decision to exclude the PC-MHR from evaluation in the PEIS. GA is sufficiently concerned about this matter that it has sought the advice of consultants with expertise in the legal requirements of the National Environmental Policy Act (NEPA). We are advised that our concerns are substantive and have merit relative to the requirements of NEPA.

GA believes that under both the letter and the spirit of NEPA the PC-MHR must be included and evaluated in the PEIS. NEPA regulations require that the PEIS evaluate all reasonable alternatives (40CFR1502.14) and provide in depth analysis of all significant issues (40CFR1501.7 and 40CFR1508.27). While NEPA itself does not provide a benchmark for what constitute "reasonable" alternatives, certain principles are clearly discernable from the applicable regulations and court decisions. While the scope of reasonable alternatives must, of course, be bounded by some sense of feasibility or practicality, it is not permissible to exclude any viable alternatives merely on, for example, policy or political grounds. 3/08.00.00

The PC-MHR is a reasonable alternative for plutonium disposition relative to DOE's nine published screening criteria. Among the alternatives that involve construction of a new reactor dedicated to the plutonium disposition mission, it has superior safety and environmental impact characteristics, very low life cycle cost under government ownership (even when remaining engineering development costs are taken into account), a fuel cycle with superior diversion and proliferation resistance characteristics, and a spent fuel form that is best suited for long term disposal in a geologic repository. The strong interest 4/14.00.00

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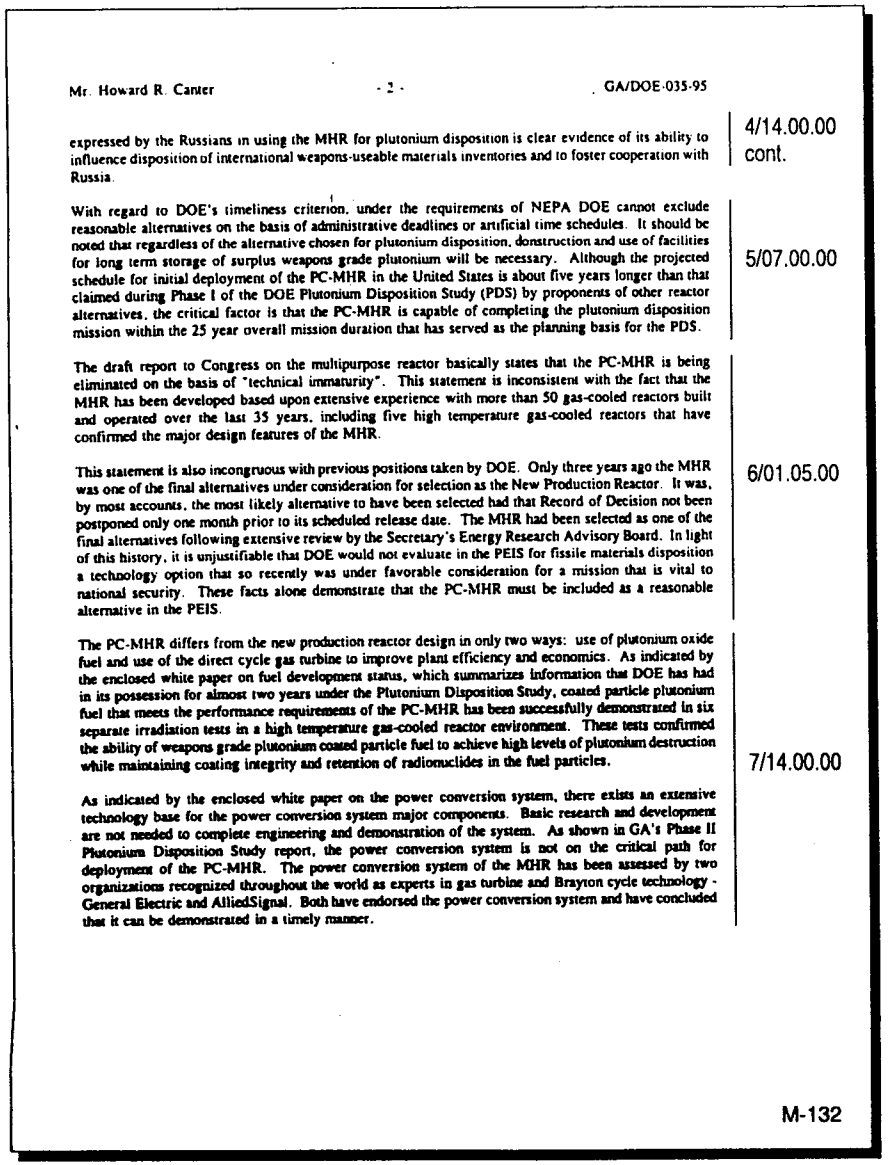
08 00 00 Comment Number 3

The MHRs were considered as Reactor Alternatives in the screening process. The MHRs were not excluded on political grounds. The Screening Committee decided that the increased Pu burn up offered by this option would not counterbalance its cost, schedule, or technical risks, and therefore eliminated this option from further consideration. Clarification has been provided in Appendix N of the Final PEIS for the various multipurpose reactor concepts.

14 00 00 Comment Number 4

To meet the Nation's goals in support of its nonproliferation policies, DOE determined that the "clear and present danger" demands that the disposition of Pu be initiated within approximately a decade. To achieve this objective, an alternative must be nearly ready for development or be an extension of an existing technology. Clarification has been provided in Appendix N of the Final PEIS for the various multipurpose reactor concepts.

GENERAL ATOMICS, SAN DIEGO, CA,
A. J. NEYLAN
PAGE 5 OF 39



Mr. Howard R. Canter - 2 - GA/DOE-035-95

expressed by the Russians in using the MHR for plutonium disposition is clear evidence of its ability to influence disposition of international weapons-useable materials inventories and to foster cooperation with Russia. 4/14.00.00 cont.

With regard to DOE's timeliness criterion, under the requirements of NEPA DOE cannot exclude reasonable alternatives on the basis of administrative deadlines or artificial time schedules. It should be noted that regardless of the alternative chosen for plutonium disposition, donstruction and use of facilities for long term storage of surplus weapons grade plutonium will be necessary. Although the projected schedule for initial deployment of the PC-MHR in the United States is about five years longer than that claimed during Phase I of the DOE Plutonium Disposition Study (PDS) by proponents of other reactor alternatives, the critical factor is that the PC-MHR is capable of completing the plutonium disposition mission within the 25 year overall mission duration that has served as the planning basis for the PDS. 5/07.00.00

The draft report to Congress on the multipurpose reactor basically states that the PC-MHR is being eliminated on the basis of "technical immaturity". This statement is inconsistent with the fact that the MHR has been developed based upon extensive experience with more than 50 gas-cooled reactors built and operated over the last 35 years, including five high temperature gas-cooled reactors that have confirmed the major design features of the MHR.

This statement is also incongruous with previous positions taken by DOE. Only three years ago the MHR was one of the final alternatives under consideration for selection as the New Production Reactor. It was, by most accounts, the most likely alternative to have been selected had that Record of Decision not been postponed only one month prior to its scheduled release date. The MHR had been selected as one of the final alternatives following extensive review by the Secretary's Energy Research Advisory Board. In light of this history, it is unjustifiable that DOE would not evaluate in the PEIS for fissile materials disposition a technology option that so recently was under favorable consideration for a mission that is vital to national security. These facts alone demonstrate that the PC-MHR must be included as a reasonable alternative in the PEIS. 6/01.05.00

The PC-MHR differs from the new production reactor design in only two ways: use of plutonium oxide fuel and use of the direct cycle gas turbine to improve plant efficiency and economics. As indicated by the enclosed white paper on fuel development status, which summarizes information that DOE has had in its possession for almost two years under the Plutonium Disposition Study, coated particle plutonium fuel that meets the performance requirements of the PC-MHR has been successfully demonstrated in six separate irradiation tests in a high temperature gas-cooled reactor environment. These tests confirmed the ability of weapons grade plutonium coated particle fuel to achieve high levels of plutonium destruction while maintaining coating integrity and retention of radionuclides in the fuel particles. 7/14.00.00

As indicated by the enclosed white paper on the power conversion system, there exists an extensive technology base for the power conversion system major components. Basic research and development are not needed to complete engineering and demonstration of the system. As shown in GA's Phase II Plutonium Disposition Study report, the power conversion system is not on the critical path for deployment of the PC-MHR. The power conversion system of the MHR has been assessed by two organizations recognized throughout the world as experts in gas turbine and Brayton cycle technology - General Electric and AlliedSignal. Both have endorsed the power conversion system and have concluded that it can be demonstrated in a timely manner.

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07 00 00 Comment Number 5

During the PEIS scoping process and related public meetings, DOE asked for input on the screening criteria. Some respondents reacted to the timeliness statement that "The technology concept should be demonstrated within approximately 20 years and disposition should be completed within approximately 50 years." These respondents ranked our stated definition of timeliness low indicating that 20 and 50 years was too long and it was important for DOE to start and finish earlier. Clarification has been provided in Appendix N of the Final PEIS for the various multipurpose reactor concepts.

01 05 00 Comment Number 6

The Department of Energy recognizes the potential benefits (unrelated to Pu disposition) that can be offered by the Plutonium Consumption Modular Helium Reactor (PC-MHR) Option. Nevertheless, as explained in Appendix N of the Final PEIS, because this technology needs further development and the benefits do not counterbalance the cost, schedule, or technical risks associated with this option, there is no justification to develop this technology solely for the purpose of Pu disposition. Pu disposition can be accomplished using existing technologies to achieve the Spent Fuel Standard. It is unnecessary to exceed the Spent Fuel Standard since the amount of Pu that could be declared surplus from weapons is much less than the inventory of Pu in commercial spent fuel.

14 00 00 Comment Number 7

The Advanced Deep Burn Reactors Option, including MHRs, was considered in the screening process. Notwithstanding the many potential benefits of their use, the technical immaturity would call for costly and lengthy development and demonstration efforts to bring them to a viable status. The Screening Committee decided that the increased Pu burn-up offered by this option would counterbalance its cost, schedule, or technical risks; therefore, this option was eliminated from further consideration. Appendix N of the Final PEIS provides further explanation related to the various multipurpose reactors.

GENERAL ATOMICS, SAN DIEGO, CA,
A. J. NEYLAN
PAGE 6 OF 39

Mr. Howard R. Canter - 3 - GA/DOE-035-95

Based upon these considerations, GA believes that there is no rational argument, relative to DOE's nine published criteria for the screening of disposition alternatives or to DOE's stated purpose and need for taking action, upon which the PC-MHR can be eliminated from consideration and evaluation in the PEIS. GA is aware that DOE has eliminated some plutonium disposition alternatives based on the assessment that their deployment would be in violation of certain international treaties or other legal considerations. GA is aware, however, of no such institutional considerations that justify elimination of the PC-MHR from evaluation in the PEIS. 8/01.00.00

In addition to GA's concerns regarding the improper exclusion of the PC-MHR from evaluation in the PEIS, there is an additional significant issue which must be addressed in the PEIS. GA believes that the PEIS must consider the adequacy and acceptability of the spent fuel standard. In addition to its many advantages cited above, the PC-MHR is capable of exceeding the spent fuel standard in a single pass of the fuel through the reactor without recycle. The final product resulting from the disposition of weapons grade plutonium in the PC-MHR contains a factor of five less plutonium-239 than that which results from disposition in other reactor options that merely meet the spent fuel standard. If the PC-MHR and other reasonable "deep burn" alternatives are eliminated from evaluation at this time, such elimination will constitute a de facto adoption of the spent fuel standard without the full evaluation required under NEPA. As noted in the National Academy of Sciences (NAS) report on plutonium disposition, "over the long term, however, steps beyond the spent fuel standard will be necessary." The PC-MHR has the capability to take those steps today and provide a one-step, permanent solution to the problem of disposition of surplus weapons grade plutonium with lower total environmental impact than that resulting from the choice of alternatives that merely meet the spent fuel standard and leave the matter of ultimate disposition, and its associated environmental impacts, for future generations. 2/01.05.00 cont.

During the public scoping meetings for the PEIS held in the summer and fall of 1994, the adequacy and acceptability of the spent fuel standard was a subject of much discussion and disagreement. These discussions are partially documented in DOE's PEIS Scoping Meeting Comment Summary Report of November 30, 1994. However, during its presentations in the public meetings on plutonium disposition on December 13-14, 1994, DOE appeared to dismiss this significant issue on the basis that there did not "appear to be strong sentiment for exceeding the spent fuel standard." Members of Congress have also indicated that a consensus has not been reached in Congress on the adequacy of the standard. Questions have been raised regarding whether the alternatives that merely meet the spent fuel standard will adequately meet one of the major national security objectives of the plutonium disposition effort identified in the NAS report and adopted by DOE in its June 21, 1994, Notice of Intent to prepare the PEIS: to minimize the risk that weapons or fissile materials could be reintroduced into the arsenals from which they came.

DOE appears to be adopting the spent fuel standard without providing to the public the results of an objective assessment of the diversion and proliferation resistance and total environmental impacts of alternatives that meet the standard vs reasonable alternatives for plutonium disposition that can exceed the spent fuel standard. The NAS report recommended that efforts to exceed the spent fuel standard not be addressed at this time based upon certain assumptions about deployment time, cost, and technical uncertainty of alternatives that can exceed the standard. These assumptions were not supported by NAS with any specific analyses. The DOE Plutonium Disposition Study later provided such analyses, and the results indicate that some of these assumptions are ill founded. 6/01.05.00 cont.

M-132

01 00 00 Comment Number 8

Comment noted. Appendix N has been revised to provide further explanation concerning the PC-MHR and other multipurpose reactors as alternatives for Pu disposition.

The adequacy of the spent fuel standard is, accordingly, a significant issue which must be evaluated in detail in the PEIS. However, regardless of whether the spent fuel standard is considered in the PEIS and ultimately deemed to be an acceptable interim standard, the PC-MHR is a reasonable alternative for plutonium disposition based on its superior safety and environmental characteristics, cost characteristics, diversion and proliferation resistance, spent fuel form, and level of technical maturity as evidenced by its earlier consideration under the New Production Reactor Program. The ability of the PC-MHR to exceed the spent fuel standard is a readily achievable additional benefit. 2/01.05.00 cont.

In summary, GA believes that the PC-MHR must be evaluated in the PEIS because it is a reasonable alternative for plutonium disposition. GA also believes that the adequacy and acceptability of the spent fuel standard is a significant open issue that must also be evaluated in the PEIS, especially in view of the availability of reasonable alternatives such as the PC-MHR, which is capable of exceeding the spent fuel standard and leaving a factor of five less plutonium-239 remaining than reactor alternatives that merely meet the standard. 1/14.00.00 cont. 2/01.05.00 cont.

NEPA requires that all reasonable alternatives and significant issues be evaluated in the PEIS process. By addressing all reasonable alternatives and significant issues as required, DOE will provide a strong foundation for the Record of Decision, will avoid the potential for substantial delays in the plutonium disposition effort that might result from questions regarding the manner in which DOE has discharged its obligations under NEPA, and will enhance the credibility of DOE's efforts in the eyes of all stakeholders who have an interest in the resolution of the plutonium disposition problem.

GA respectfully requests that DOE reconsider its decision to exclude the PC-MHR and the spent fuel standard from consideration in the Programmatic EIS. 1/14.00.00 cont.

Sincerely,

R. M. Forssell
Senior Vice President
Power Reactor Group

Enclosures:

1) Fuel Development Status of the Plutonium Consumption Modular Helium Reactor (PC-MHR)
2) GT-MHR Power Conversion System - State of the Art Technology

cc:
C.B. Curtis
R.W. DeGrasse
J.D. Nulton
A.I. Cygelman
J.M. Turner, DOE-OAK
S. El Safwany, DOE-OAK

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FUEL DEVELOPMENT STATUS OF THE
PLUTONIUM CONSUMPTION MODULAR HELIUM REACTOR (PC-MHR)

STATUS

Fuel that meets PC-MHR operating requirements has been demonstrated. Additional tests are planned to expand the data base and confirm performance under accident conditions.

BACKGROUND

The PC-MHR can achieve very high levels of weapons grade plutonium destruction without recycle. Destruction of more than 90% of the initially charged plutonium-239 and more than 65% of the initially charged total plutonium is obtained in a single pass through the reactor. This level of destruction makes the discharged plutonium in the spent fuel particularly unattractive for weapons applications relative to the plutonium contained in the spent fuel from other reactor types.

The PC-MHR can achieve this high level of plutonium destruction due, in large part, to the high burnup capability of its plutonium oxide, refractory coated particle fuel. The high burnup capability of this fuel, and its excellent retention of fission product radionuclides, have been demonstrated in irradiation tests of TRISO-coated plutonium fuel conducted in the late 1960s and early 1970s.

The PC-MHR design includes a high pressure, low leakage containment. By taking credit for the enhanced radionuclide retention provided by this containment, the allowable coated particle fuel failure during design basis accident conditions is about a factor of ten larger for the PC-MHR than for the commercial GT-MHR, which has a vented, low pressure containment.

The fuel quality and performance requirements of the PC-MHR during normal operation are similar to performance levels experienced at the Fort St. Vrain reactor, for which more than 30 metric tonnes of TRISO-coated uranium particle fuel were fabricated. This fuel met the required as-manufactured quality levels and, as evidenced by primary coolant radionuclide activity levels that were a factor of 30 less than the design basis, performed much better than required. The core average design basis performance requirement for PC-MHR fuel is a coating failure fraction of less than 4×10^{-4} at an average burnup of about 590,000 MWd/MT (785,000 MWd/MT peak).

Six irradiation tests have been conducted using near weapons grade, highly enriched (88% Pu-239) TRISO-coated plutonium fuel. Five of these tests were performed as part of the Dragon high temperature gas-cooled reactor project (United Kingdom) in the late 60s, and the sixth was performed by General Atomics in the Peach Bottom HTGR in the early 1970s. The fuel for the Dragon tests, which consisted of loose particles in graphite holders, was fabricated by Belgonucleaire in Europe. For the Peach Bottom test, Oak Ridge National Laboratory fabricated the coated particles and standard fuel rod compacts.

These six irradiation tests encompassed a range of irradiation temperatures up to 1450°C and peak fast neutron fluences of up to 2.3×10^{25} n/m^2. Burnups of up to 747,000 MWd/MT were achieved, which resulted in destruction of more than 90% of the initially charged plutonium-239. These irradiation conditions are, with the exception of fast neutron fluence, nearly the same or in excess of those required for the fuel in the PC-MHR. The plutonium fuel like that planned for use in the PC-MHR performed well in these tests, showing release of fission products at a rate that was about a factor of ten less than that required for fuel in the PC-MHR. Based on the results of simulated core heatup tests of other TRISO-coated particle fuels with a range of compositions and irradiation conditions, minimal additional failure of the plutonium fuel particles is expected under accident conditions in which the peak fuel temperature is expected to approach 1600°C.

The plutonium coated particle fuel irradiation test results are consistent with results obtained for other high burnup TRISO-coated fuels. High burnup, highly enriched fuel particles have been under development at General Atomics for more than twenty five years.

The reference fissile fuel particle for the large HTGR designs of the 1973-1982 period was 93.15% enriched uranium carbide featuring essentially the same TRISO coating planned for use in the PC-MHR. In 1978 General Atomics prepared

a safety analysis report on the use of this highly enriched uranium carbide fuel in Fort St. Vrain reload fuel elements. NRC approval for use of this fuel was provided in 1979, based on a review of the safety analysis report and of the irradiation data base for this high burnup fuel.

The irradiation test experience for this fuel at that time included 316,000 particles successfully tested at nominal temperatures from 885°C to 1249°C and fast neutron fluences of 3.5 to 12.0 x 10^{25} n/m^2. A total of 250,000 of these particles were irradiated to burnups of at least 663,000 MWd/MT, and approximately 9,000 particles were irradiated to nominal burnups of 704,000 MWd/MT, which corresponds to destruction of more than 90% of the initially charged uranium-235. Higher burnup levels were achieved in later tests.

NRC approval of use of this fuel in Fort St. Vrain reloads indicates that there is a substantial database that confirms the ability of TRISO-coated particle fuel to achieve high burnup and high levels of destruction of the initially charged fissile material. When these high burnup uranium fuel data are considered in combination with the plutonium fuel irradiation tests in the Dragon and Peach Bottom reactors, it is clear that TRISO-coated plutonium fuel particles can be manufactured to meet operational and safety requirements and to achieve the high levels of plutonium destruction of which the PC-MHR is capable. Table 1 shows a comparison of PC-MHR design conditions with the irradiation experience for high burnup plutonium and uranium TRISO-coated particle fuel.

It should be noted that recent (1990-92) unsuccessful irradiation experience with an experimental, modified fuel design (TRISO-P) for the DOE New Production Reactor and Commercial GT-MHR programs is not relevant to the status of plutonium fuel development. The TRISO-P coating was developed in an attempt to improve as-manufactured quality and inservice performance by about an order of magnitude over the requirements that would apply to PC-MHR fuel. Although the as-manufactured quality was improved, irradiation test results showed that the coating design and fabrication process changes actually resulted in worse inservice performance under irradiation than Fort St. Vrain fuel and previous fuel tests. This modified fuel design has been discarded, and existing prior technology is being utilized. TRISO-coated plutonium fuel for the PC-MHR will be based upon the successful experience obtained on high burnup, highly enriched fissile fuel during the last twenty five years.

Although the results of plutonium fuel irradiation tests obtained to date are positive and performance comparable to PC-MHR requirements was achieved at FSV, more plutonium fuel development work is planned to increase the level of confidence associated with these results and to strengthen the statistical significance of the data. Tests will be conducted on irradiated plutonium coated fuel particles to confirm their behavior under simulated core heatup accident conditions. In addition, the equipment and remote processes used to fabricate plutonium coated particle fuel will be adapted from those used to fabricate uranium fuel and will be qualified for use in a full scale production operation. Plans for these activities have been documented in a plutonium fuel development plan for the PC-MHR.

TABLE 1
COMPARISON OF PC-MHR FUEL OPERATING CONDITIONS
WITH HIGH BURNUP TRISO-COATED FUEL IRRADIATION EXPERIENCE

Parameter	PC-MHR Design Goals	Plutonium TRISO Irradiation Experience	Uranium TRISO Irradiation Experience
Peak Fuel Temperature, °C	1250 (1) 1600 (2)	1275 - 1450	900 - 1550 ~ 2000 (3)
Peak Fast Neutron Fluence, 10^{25} n/m^2 (E > 0.18 Mev)	4.3	2.3	12.0
Peak Burnup, MWd/MT	785,000 (590,000 Avg)	747,000	~750,000

(1) Normal Operating Conditions
(2) Design Basis Accident Conditions
(3) Post Irradiation Heatup Tests

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GT-MHR Power Conversion System - State of the Art Technology

1. Summary

Extensive technology data bases exist for the major GT-MHR power conversion system (PCS) components, including the turbocompressor, bearings, generator, recuperator, and precooler/intercooler. Closed Brayton cycle gas turbine technology is well understood. Some 20 fossil-fired closed cycle gas turbine plants have operated for over one million hours with high reliability and availability.

Based on a highly recuperated and intercooled cycle, an efficiency of about 47% is realizable at a very modest level of turbine inlet temperature (~ 850°C) compared with contemporary open cycle gas turbines.

Experience gained in Germany with the operation of two large helium gas turbine systems (Oberhausen II 50MWe Helium Gas Turbine Plant, and the HHV Test facility) substantiates the claim that helium gas turbine power conversion systems are regarded as state-of-the-art. Within the U.S. there is strong industrial capability to facilitate the transfer of the necessary gas turbine enabling technology to make the GT-MHR a reality within the next ten years.

2. Design Methodology for GT-MHR Power Conversion System

The properties of helium reduce the size and geometrical complexity of the various power conversion components. Dynamic, thermal and structural design procedures, computer codes, and industry standards used are identical to conventional air-breathing gas turbine practices. The existing HTGR materials data base, established over a 3 decade period, involve materials testing in a helium environment by industry and the national laboratories, and is being fully utilized. Fabrication of the power conversion system components can be accomplished with existing techniques, machine tools and processes, and the size of the components is bounded by existing power generation equipment.

3. Turbocompressor

The largest industrial combustion gas turbine operating today is rated at 226 MWe, and units with outputs of over 300MWe are projected to be in utility service before the year 2000. The size of the 285MWe GT-MHR turbocompressor is physically smaller than the aforementioned combustion gas turbine, as a result of the use of helium (at high pressure) as the working fluid. The number of compressor and turbine stages is comparable with existing industrial gas turbines. Compressor and turbine designs are based on a combination of the following: 1) low Mach number, 2) high Reynolds number, 3) clean oxide-free blading surfaces in the closed helium circuit, and 4) close blade-tip clearance for the base-loaded plant (i.e. not subjected to rapid transients) resulting in high efficiency. The turbocompressor is being designed using the same methods, tools, and standards used for aerospace and industrial gas turbines. The performance of helium turbomachinery has been demonstrated in the Oberhausen plant and the HHV test facility.

The turbine inlet temperature of 850°C is about 400°C below that in the aforementioned large industrial gas turbines. This simplifies the turbine design in that un-cooled blades of conventional nickel-base alloys can be used. For the integrated PCS, circumferential static seals are necessary between the turbocompressor and other components and structures. The size of these seals and their operating environment (i.e. temperature and pressure differential) are bounded by existing power conversion systems.

4. Active Magnetic Bearings

The utilization of magnetic bearings has three major advantages: it 1) eliminates the possibility of lubricant ingress to the reactor circuit, 2) provides an on-line diagnostic system for monitoring the health of the rotating assembly, and 3) facilitates adjusting bearing performance on-line. Large vertical rotor systems (centrifuges) have operated successfully with magnetic bearings. While the rotor weight of the GT-MHR is heavier than in applications to date, the thrust bearing unit loadings and peripheral velocities are bounded by current operating experience.

A formidable magnetic bearing technology base exists: over 5500 units with over 8 million hours in operation, including over 160 large turbomachines (e.g. compressors, turboexpanders) with over 1.5 million hours of operation.

5. Generator

Vertical electrical machines are used in boiler feedwater pumps and hydroelectric plants, and only minor modifications to existing generators are necessary for the vertical orientation of the generator in the GT-MHR plant. While the dielectric strength of helium is different from that of air or hydrogen (used in the cooling of conventional generators), only minor modifications to the electrical insulation are necessary. For the AVR and THTR plants the circulators, embodying electric motor drives submerged in helium, performed trouble-free.

6. Recuperator

The use of a compact plate fin recuperator facilitates the installation of a high performance unit (i.e. 95% effectiveness, 2% pressure loss) within the confines of the PCS steel vessel. Existing recuperator technology established by AlliedSignal Aerospace is directly applicable to the GT-MHR. Over 60 recuperated industrial gas turbines (using this type of heat exchanger) have accumulated over 3 million hours of service. Units with 95% effectiveness have been demonstrated in service. The operating environment for these units, in terms of transients and thermal shock, is more severe than would be experienced in the GT-MHR.

Plate-fin heat exchangers are used extensively in the aerospace industry and Allied Signal has produced several million for aircraft systems. The GT-MHR recuperator will benefit from two air-breathing applications, 1) heavy duty industrial recuperators in terms of materials, fabrication, and high temperature service, and 2) aircraft/aerospace heat exchangers in terms of very compact high performance surface geometries.

7. Precooler/Intercooler

The precooler and intercooler are helium-to-water heat exchangers that operate in a very benign environment, with metal temperatures less than 250°F. The technology for the units is essentially commercially available. These units should not be compared with steam generators since the water side is pressurized only to suppress boiling,and stable operation is assured with single phase fluids on both sides of the unit. Since the helium pressure is greater than the water pressure, the issue of water ingress into the reactor circuit, as a result of a tube failure for example; is obviated. A faulted tube can be plugged at the tubesheet, which is external to the vessel and is accessible.

8. PCS Development and Testing

Based on the utilization of gas turbine and aerospace industry technology bases the PCS can be realized without the need for further basic R&D. Early in the program, data from subcomponent tests (e.g. bearings, seals) will be available for inclusion in the PCS final design.

A hallmark of the program will be the testing of the PCS in an integrated test facility. The turbomachine will be operated at full temperature and full speed. The comprehensive nature of the PCS testing program removes a major risk element, and will give designers a high degree of confidence that all of the PCS requirements will be met when the system is operated with a nuclear heat source.

9. Maintenance

While designed to last the 60 year plant life, the major PCS components have been engineered to facilitate ease of removal and replacement. The turbocompressor will be removed at 7 year intervals (for refurbishment), with a spare unit kept at the plant site. Experience gained from the AGR plants in the U.K. in terms of removal, replacement, and handling of large components (in shielded casks) is particularly germane.

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ATTACHMENT 2 TO GA/DOE-027-96

GA/DOE-068-95
June 6, 1995

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GENERAL ATOMICS

GA/DOE-068-95
Project 6301
WBS: 5109.51
June 6, 1995

Mr. Howard R. Canter, Technical Director
Office of Fissile Materials Disposition
U.S. Department of Energy
Washington, DC 20585

SUBJECT: Programmatic EIS Screening Results

Dear Mr. Canter:

General Atomics has received your letter of April 14, 1995, which presented DOE's rationale for excluding the Plutonium Consumption Modular Helium Reactor (PC-MHR) from consideration as a reasonable alternative for plutonium disposition in the Programmatic Environmental Impact Statement (PEIS) for Long Term Storage and Disposition of Surplus Fissile Material. GA has also reviewed the PEIS Implementation Plan and the Summary Report of the Screening Process. This letter provides GA's response to your letter and its comments on these documents.

GA has reviewed these documents in an effort to understand the factors that led DOE to reject the PC-MHR as unreasonable and lacking in technical maturity. This was DOE's conclusion even though the technology was, as recently as 1992, the leading candidate for new tritium production capacity and is still under consideration by DOE for the important mission of tritium production.

The summary screening report characterizes the various alternatives against the eleven screening criteria developed by DOE. GA believes that the criteria used were, in general, appropriate. However, DOE's assessment of the PC-MHR against the criteria is, in some cases, very difficult to understand. GA is concerned, based upon its review and upon information it has received from others, that the exclusion of the PC-MHR from consideration is more closely related to an apparent intention not to support the development of advanced reactors, including the gas-cooled reactor, than it is to any objective consideration of the capabilities of the PC-MHR relative to the screening criteria.

1/14.00.00 cont.

Attachment 1 provides GA's detailed comments on DOE's evaluation of the PC-MHR and proposed exclusion of the PC-MHR from consideration in the PEIS. The attachment addresses the assessment of the PC-MHR against the screening criteria, adoption of the spent fuel standard, and DOE's approach to multipurpose options for plutonium disposition and tritium production.

DOE has rated the PC-MHR low relative to the criterion of Technical Viability in spite of the fact that this reactor technology was, only three years ago, the leading candidate for selection as the New Production Reactor. It has also given the PC-MHR a lower rating than other alternatives that have been demonstrated to a lesser degree or about which there are fundamental questions concerning their capability. Nevertheless, the major reason cited by DOE for excluding the PC-MHR from consideration is its lack of "technical maturity". DOE's view may reflect its opinion on the gas

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turbine design of the MHR recommended by GA versus the earlier steam cycle version of the design. In fact, the reactor technology for both the steam cycle and gas turbine plants is the same. Regarding the gas turbine power conversion system, world leading U.S. and international vendors consider it to be essentially a repackaging of existing industrial and aeronautical technology. Substantial engineering is needed, but there are no feasibility issues. Given adequate funding, a fully tested turbomachine could be delivered to a site in less than seven years (see Attachment 2).

DOE has rated the PC-MHR the same as all other fission options relative to the criterion of Environment, Safety, and Health. This conclusion ignores the facts that the MHR is widely considered to be the safest reactor option available and that its 47% overall plant efficiency, vs 31-33% for those reactor options deemed to be "reasonable" by DOE, results in substantial reductions in environmental impacts. DOE's own Draft PEIS for Tritium Supply and Recycle makes the safety advantages of the MHR relative to other reactors very clear. 1/14.00.00 cont.

The PC-MHR is rated the same as other reactor technologies that entail construction of a new reactor dedicated to plutonium disposition relative to the screening criterion of Cost Effectiveness. However, DOE provides no quantitative data to support this cost rating or the relative ranking of any of the alternatives in terms of cost effectiveness. The effects of using the gas turbine on life cycle costs of the gas-cooled reactor have yet to be made available to the public because DOE has not made available its report on Phase II of its Plutonium Disposition Study. However, based upon cost analyses using Phase I costing methodology and groundrules, the PC-MHR has a substantial cost advantage over other reactor alternatives (see Attachment 3). Hence, DOE's rating of the PC-MHR as the same as other reactor alternatives against the criterion of Cost Effectiveness is incorrect and adds to the distorted overall ranking of the PC-MHR.

The PC-MHR is given a low rating relative to other reactor alternatives with regard to the Timeliness criterion. The 12.5 year initial deployment schedule of the PC-MHR is a conservative estimate based on the schedule for deployment of the New Production Reactor that was developed by DOE and its contractors on the NPR program and was twice independently reviewed and confirmed. In the screening report, DOE ignores its own schedule and judges the level of certainty in the schedule to be less than that of the alternatives deemed by DOE to be "reasonable", the deployment schedules for which have never been subjected to the level of scrutiny that was applied to the MHR schedule. (In fact, under more aggressive schedule assumptions, in which first core fuel is produced on the fuel development pilot line, the PC-MHR initial deployment schedule can be reduced to 10 years.) DOE also ignores the fact that the PC-MHR has been shown in DOE's own Plutonium Disposition Study to be capable of completing the plutonium disposition mission within the length of time deemed necessary by DOE. DOE has excluded the PC-MHR from consideration in the PEIS on the basis of an artificial schedule requirement that does not reflect that a small delay in beginning the disposition operation is not significant in the overall timeframe for completing the disposition mission. Use of artificial schedules or administrative guidelines as a basis for declaring an alternative to be unreasonable is clearly in conflict with precedents established by NEPA case law. 1/14.00.00 cont.

The PC-MHR is rated lower than the "reasonable" reactor technologies with regard to the criterion for Fostering Progress and Cooperation with Russia and Others. This assessment is not credible because it ignores the fact that the Russians have repeatedly indicated to DOE and to the Gore-Chernomyrdin Commission their desire to destroy surplus weapons grade plutonium in PC-MHRs to be built at Tomsk-7. It also ignores the fact that the Russians have proposed to DOE a cooperative, cost shared MHR design and development program and have initiated the effort with $1.0 million of their own funding. The Russians have taken no such actions in support of the alternatives deemed "reasonable" by DOE.

The summary screening report rates the PC-MHR as relatively low with regard to the Public and Institutional Acceptance criterion. No explanation is provided for this assessment. The PC-MHR offers distinct advantages relative to this criterion based upon its ability to substantially destroy the plutonium, its superior resistance to diversion and reuse of the residual plutonium in a weapons application, its multipurpose capability, and its unequalled safety characteristics. One can only conclude that DOE has chosen to rate the PC-MHR relatively low against this criterion to be consistent with its apparent intention not to develop advanced reactors in the U.S.. To exclude the PC-MHR at the time of the Record of Decision on the basis of policy matters would be legally permissible; to exclude it from consideration in the PEIS as a reasonable alternative on the basis of policy matters is contrary to precedents established under NEPA case law and is not allowed under Council on Environmental Quality NEPA implementing guidance. 1/14.00.00 cont.

It should also be noted that certain of the alternatives deemed "reasonable" by DOE for consideration in the PEIS and rated higher than the PC-MHR against the Public and Institutional Acceptance criterion will present major, unique public acceptance and policy issues. It is difficult to believe that major policy and public acceptance issues would not be involved in making available large quantities of weapons grade plutonium for disposition either in European nations or in Canada. Not only would major safeguards and security issues be raised, but it would also appear inappropriate to give away to other nations the energy value of the plutonium (which was created at the expense of billions of U.S. taxpayer dollars), to export potential U.S. jobs, and to forego U.S. technology development and deployment in favor of support for foreign technology.

The screening report states that the spent fuel standard was generally accepted, except by "proponents of developmental technologies that could go beyond the spent fuel standard". This statement ignores the letter of December 13, 1994, from Senators Thurmond and Hollings and Representatives Spratt and Spence to Secretary O'Leary that questioned the adequacy of the spent fuel standard. It also continues to ignore the numerous comments in the public scoping meetings which indicated that measures beyond the spent fuel standard would be required to provide ultimate disposition of the plutonium, to ensure that the national security objectives of the plutonium disposition effort would be met, and to extract the maximum possible energy value from the plutonium. The DOE letter of April 14 states that, "all fission options which go beyond the spent fuel standard were deemed unreasonable." By precluding all options that can exceed the spent fuel standard prior to detailed, full evaluation in the PEIS, DOE has withheld important information from 2/01.05.00 cont.

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the public regarding the diversion and proliferation resistance of alternatives that exceed the standard relative to those that merely meet it and has perpetuated the myth that these options cannot be deployed in a timely, cost effective manner. 2/01.05.00 cont.

Congress has consistently directed DOE to give full consideration to multipurpose reactors. However, it appears that DOE has not accepted this direction. The Implementation Plan for the PEIS for Fissile Materials indicates that it will not consider any multipurpose option unless a reactor is chosen for tritium supply, and then that it will consider only whether that reactor option might be suited for multipurpose use. No attempt has been made by DOE as part of the NEPA process to compare the costs, benefits, and environmental impacts of a multipurpose reactor against the combined costs, benefits, and impacts of separate projects for the tritium supply and plutonium disposition missions. This approach to the multipurpose reactor appears contrived, will not result in full and fair consideration of multipurpose reactors, and undermines the underlying philosophy of the NEPA process. In a time of growing concern about limits in government resources and about deficit reduction, the manner in which DOE is trying to avoid full and fair consideration of the multipurpose reactor is difficult to understand. 1/14.00.00 cont.

GA is disappointed in the manner in which DOE is approaching these important matters. Under DOE's implementing regulations for NEPA (10CFR1021) there is still an opportunity for DOE to amend the PEIS Implementation Plan to include the PC-MHR and the multipurpose reactor options. We urge DOE to do so. 6/01.05.00 cont.

If you would like to discuss any of these issues in detail, please feel free to call me at any time at (619) 455-2580 or Dave Alberstein at (619) 455-2088.

Sincerely,

A.J. Neylan, Vice President
Power Reactor Group

AJN/DA:da
Attachments

cc:
C.B. Curtis
G. Rudy
J.D. Nulton
P.T. Rhoads
J.M. Turner, DOE-OAK

ATTACHMENT 1 TO GA/DOE-068-95
GENERAL ATOMICS COMMENTS ON DOE's EVALUATION OF THE PC-MHR
AND PROPOSED EXCLUSION OF THE PC-MHR
FROM CONSIDERATION AS A REASONABLE ALTERNATIVE IN THE
PROGRAMMATIC EIS FOR FISSILE MATERIALS DISPOSITION

This attachment provides General Atomics' comments on DOE's treatment of the following matters relative to the PC-MHR and its decision to exclude the PC-MHR from consideration in the PEIS for fissile materials (plutonium) disposition: the assessment of the PC-MHR against the screening criteria, treatment of the spent fuel standard, and DOE's approach to multipurpose options for plutonium disposition and tritium production.

1

Assessment of the PC-MHR Against the Screening Criteria

Technical Viability:

With regard to the Technical Viability criterion, DOE rates the PC-MHR as low relative to other disposition options. The technical viability of the PC-MHR is rated lower than other technologies that have been demonstrated to a lesser degree or about which there are fundamental questions concerning their capability. For example, the technical viability of the PC-MHR is rated lower than that of the ALMR with pyroprocessing, even though the screening report states that this concept "is still under development in a manner different from its intended purpose." The PC-MHR is also rated lower in technical viability than glass immobilization in DWPF, even though the screening report states that this option would require a specially designed melter to be installed and much of the supporting equipment in DWPF to be re-fitted for this application because DWPF was not designed for criticality control.

The ostensible primary reason given for exclusion of the PC-MHR from consideration in the PEIS is its lack of technical maturity. This reason is, however, inconsistent with previous positions taken by DOE. Only three years ago the MHR was one of the final alternatives under consideration for selection as the New Production Reactor. It was, by most accounts, the leading candidate to be selected had that Record of Decision not been postponed only one month prior to its scheduled release date. The MHR had been selected as one of the final alternatives for this vital national security mission following extensive review by the Secretary's Energy Research Advisory Board. In light of this history, it is difficult to justify the DOE decision not to evaluate the MHR in the PEIS for fissile materials disposition. 9/01.05.00

The screening report offers two statements to support the contention that the PC-MHR lacks sufficient technical maturity to be considered in the PEIS as a reasonable alternative for disposition of surplus weapons grade plutonium.

The first statement is the claim that plutonium coated particle fuel is "tested, but not fully demonstrated or proven." In fact, there have been, as DOE is well aware, six successful demonstrations of the capability of weapons grade plutonium coated particle fuel to achieve high levels of plutonium destruction. In contrast, for each of the reactor alternatives that were accepted through the screening process, there is little, if any, irradiation experience whatever with fuels made from plutonium of weapons grade composition. While further demonstration and qualification testing is required for plutonium coated particle fuel (as it will be for weapons grade MOX fuel used in the reactor alternatives deemed "reasonable" by DOE), there have been no feasibility issues identified that would call into question the capability of PC-MHR fuel to perform as required.

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01 05 00 Comment Number 9

Tritium production is a long-term mission of DOE to support national security. Pu disposition is a shorter term mission that DOE must accomplish to meet the Nation's goals in support of its non-proliferation policies. DOE has determined that the "clear and present danger" demands that disposition of Pu be initiated within approximately a decade. Pu disposition can be accomplished in that timeframe using existing technologies to achieve the Spent Fuel Standard.

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The second statement concerns the use of the direct cycle power conversion system, a new application of previously developed components. As noted several times by GA in reports to DOE and in other correspondence with DOE, development of the power conversion system is not on the critical path for deployment of the PC-MHR. The system has been evaluated by two major turbogenerator vendors that are recognized authorities in direct cycle applications. Both have judged that the power conversion system is essentially a repackaging of existing industrial and aeronautical technology. Substantial engineering is needed, but there are no feasibility issues. Given adequate funding, a fully tested turbomachine could be delivered to a site in less than seven years, a schedule that would support deployment on the time scale needed for plutonium disposition (see Attachment 2).

In addition, DOE has had in its possession since May 1993 information on the capability of the gas-cooled reactor to destroy weapons grade plutonium using a more conventional and previously demonstrated steam cycle power conversion system. However, DOE has chosen to ignore this information in developing its rationale for eliminating the MHR from consideration.

Environment, Safety, and Heath:

The summary screening report rates the PC-MHR the same as all other fission options relative to the criterion of Environment, Safety, and Health. This conclusion ignores the facts that 1) the MHR is widely considered to be the safest reactor option available, 2) its 47% overall plant efficiency, vs 31-33% for those reactor options deemed to be "reasonable" by DOE, results in substantial reductions in environmental impact relative to these other reactor alternatives, and 3) gas-cooled reactors have a proven track record of substantially lower radiation exposure to plant workers than any other power reactor type.

The inherent passive safety characteristics of the PC-MHR offer distinct safety advantages over the reactor types that DOE has deemed "reasonable" for consideration in the PEIS. The safety design objectives of the PC-MHR are met through a combination of inherent safety features and design selections that enable passive heat transfer under accident conditions (even loss of coolant or loss of forced coolant circulation) while maintaining fuel temperatures below damage limits. The reactor core is made of all refractory materials that can not melt at high temperatures. The core is slow to heat up under accident conditions, with thermal transients occurring over periods of hours and days rather than seconds or minutes as for other reactor types. Almost all fission products are retained in the refractory coated fuel particles during normal operation and accident conditions, and radioactive release is small. Radiation exposure at the site boundary is less than the Environmental Protection Agency's Protective Action Guidelines, so no off-site actions such as sheltering or evacuation of the public are required, and the risk to public health and safety is minimized. DOE's own Draft PEIS for Tritium Supply and Recycle makes the safety advantages of the MHR relative to other reactors very clear.

Cost Effectiveness:

The PC-MHR is rated the same as other reactor technologies that entail construction of a new reactor dedicated to plutonium disposition relative to the screening criterion of Cost Effectiveness. However, DOE provides no quantitative data to support this ranking or the relative ranking of any of the alternatives in terms of cost effectiveness. The only data that DOE has published regarding plutonium disposition costs are those in its report to Congress that was published following Phase I of the Plutonium Disposition Study. The Phase I report provided relative life cycle costs for various reactor options for plutonium disposition as a function of installed capacity. Costs were developed based on an economic model developed by Oak Ridge National Laboratory personnel under contract to DOE. Information on the gas-cooled reactor in Phase I of the study was developed for the earlier steam cycle version of the plant.

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In Phase II of the Plutonium Disposition Study, GA changed its design to incorporate the direct Brayton cycle gas turbine power conversion system. The primary motivation for this change was the improved plant economics, which result from power conversion equipment simplification and an increase in net plant efficiency from 38% to 47%. The increased efficiency results in increased revenue from sale of electricity to offset the costs of engineering development, design, construction, and operation of the PC-MHR.

Although the report to Congress on Phase II of the Plutonium Disposition was due to be delivered to Congress during the Fall of 1994, DOE has yet to release the report. It is GA's understanding that the report has been completed since the end of 1994. Hence, the effects of changing to the gas turbine on life cycle costs of the gas-cooled reactor have yet to be made available to the public. Using the Phase I economic model, which was provided at DOE's request to GA by the staff at Oak Ridge, GA has calculated the life cycle costs of the PC-MHR and compared them against those of the other reactor technologies evaluated during Phase I of the study. The results show that the life cycle costs of the PC-MHR are substantially lower than those of all other reactor alternatives (see Attachment 3). Informal confirmation of these results has been obtained.

DOE has assumed that alternatives that exceed the spent fuel standard will cost substantially more to develop and deploy than those which merely meet the standard, and it has used this assumption as part of its rationale for eliminating as unreasonable options that exceed the standard. These PC-MHR cost analysis results indicate that this assumption is not well founded.

It is GA's understanding that one of the reasons for the delay in releasing the Phase II Plutonium Disposition Study report was that Oak Ridge was asked by DOE to make changes in the cost analyses in the report. GA is unaware of whether the economic model used in Phase II of the Plutonium Disposition Study is substantially different from that used in Phase I. Hence, GA is also unaware of whether the distinct cost advantage of the PC-MHR will be confirmed by the Phase II report. Nevertheless, based upon available information it appears that the PC-MHR has a substantial cost advantage over other reactor alternatives and that DOE's rating of the PC-MHR as the same as other reactor alternatives against the criterion of Cost Effectiveness is incorrect and adds to the distorted overall ranking of the PC-MHR.

Timeliness:

The PC-MHR is given a low rating relative to other reactor alternatives with regard to the Timeliness criterion. The 12.5 initial deployment schedule for the PC-MHR is a conservative estimate based on the schedule for deployment of the New Production Reactor that was developed by DOE and its contractors on the NPR program and was twice independently reviewed and confirmed. In the screening report, DOE ignores its own schedule and judges the level of certainty in the schedule to be less than that of the alternatives deemed by DOE to be "reasonable", the deployment schedules for which have never been subjected to the level of scrutiny that was applied to the MHR schedule. (In fact, under more aggressive schedule assumptions, in which first core fuel is produced on the fuel development pilot line, the PC-MHR initial deployment schedule can be reduced to 10 years.)

Because the initial deployment schedule for the PC-MHR is a mere 30 months longer than DOE's arbitrary criterion of a ten year initial deployment schedule, and even though the PC-MHR has been shown in DOE's own Plutonium Disposition Study to be capable of completing the plutonium disposition mission within the length of time deemed necessary by DOE, DOE claims that the PC-MHR does not meet its requirement for timely deployment. DOE ignores the fact that the total duration of the plutonium disposition mission (several decades) will dwarf the 30 month difference in initial deployment schedule of the PC-MHR, and that during the entire disposition mission duration plutonium pits and other forms of weapons useable plutonium will be maintained, initially in "interim storage", and will be subject to current vulnerabilities unless safer, more secure modes of

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storage are implemented. The emphasis on early, timely deployment should be more properly placed on "long term storage" options rather than disposition options.

DOE has excluded the PC-MHR from consideration in the PEIS on the basis of an artificial schedule requirement that does not reflect that a small delay in beginning the disposition operation is not significant in the overall timeframe for completing the disposition mission. Use of artificial schedules or administrative guidelines as a basis for declaring an alternative to be unreasonable is clearly in conflict with precedents established by NEPA case law.

Fostering Progress and Cooperation with Russia and Others:

The PC-MHR is rated lower than the "reasonable" reactor technologies with regard to the criterion for Fostering Progress and Cooperation with Russia and Others. This assessment is not credible because it ignores the fact that the Russians have repeatedly indicated to DOE and to the Gore-Chernomyrdin Commission their desire to destroy surplus weapons grade plutonium inventory in PC-MHRs at Tomsk-7. It also ignores the fact that the Russians have proposed to DOE a cooperative, cost shared MHR design and development program and have initiated the effort with $1.0 million of their own funding, matched with an equal amount of funding by General Atomics. The Russians have taken no such actions in support of the alternatives deemed "reasonable" by DOE.

In the April 14, 1995, letter to GA, DOE implies that the 12.5 year initial deployment schedule for the PC-MHR in the U.S. disqualifies it for consideration for deployment in Russia and results in its low rating relative to this criterion. This position ignores the fact that deployment in Russia could be accomplished more quickly and less expensively than in the U.S.. Furthermore, it arbitrarily assumes that Russia would agree to the same screening criteria and weighting factors that DOE has deemed appropriate for selection of options in the U.S.. This is clearly not appropriate, as evidenced by the public statements of Russia on plutonium disposition. If DOE wants to foster progress and cooperation with Russia in plutonium disposition, it must deal with the Russians in a manner that addresses the criteria that are important to Russia. The Russians have judged that the PC-MHR provides an approach to plutonium disposition that addresses these criteria. DOE's apparent lack of willingness to support development of the gas-cooled reactor in the United States is not an appropriate basis for down-rating its ability to foster progress and cooperation with Russia.

Public and Institutional Acceptance:

The summary screening report rates the PC-MHR as relatively low with regard to the Public and Institutional Acceptance criterion. No explanation is provided for this assessment. However, the screening report indicates that there were three elements that contributed to this criterion:

- Ability to create a sustainable consensus
- Socioeconomic impacts
- Policy/statute compatibility

There are no indications that the PC-MHR could not create a sustainable consensus or would have net socioeconomic impacts that are particularly adverse relative to other alternatives for plutonium disposition. In fact, as discussed below, the PC-MHR has significant advantages with regard to public acceptance relative to the reactor alternatives deemed by DOE to be "reasonable". Furthermore, there are no indications that selection of the PC-MHR would require significant legislative or regulatory changes.

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Hence, one can only conclude that DOE has purposely rated the PC-MHR relatively low against this criterion to comply with an apparent intention not to develop advanced reactors in the U.S.. To exclude the PC-MHR at the time of the Record of Decision on the basis of policy matters would be legally permissible; to exclude it from consideration in the PEIS as a reasonable alternative on the basis of policy matters is contrary to precedents established under NEPA case law (Natural Resources Defense Council v. Morton) and is not allowed under Council on Environmental Quality NEPA implementing guidance (Memorandum, Questions and Answers About the NEPA Regulations, 46 Federal Register, 18026, 1981).

The PC-MHR offers distinct advantages over other reactor options with regard to public acceptance. Reactor disposition of surplus weapons grade plutonium is unlikely to be well received by the general public unless the specific reactor technology chosen offers a clear departure from and clear improvement over the nuclear reactor technologies that are in common use today and that have enjoyed less than enthusiastic public acceptance. The PC-MHR represents such a departure. The following points, which were presented by GA in its Phase II Plutonium Disposition Study report to DOE, should have been considered by DOE with regard to public acceptance of the PC-MHR for plutonium disposition.

Use of the PC-MHR for consumption of weapons-grade plutonium offers numerous advantages relative to other plutonium disposition options. These advantages are derived from its high burnup capability, versatility, and inherent, passive safety characteristics, all of which will further contribute to public acceptance.

To obtain public acceptance of the chosen plutonium disposition option, the approach taken must result in a discharge product with minimal attractiveness for weapons applications, and hence no incentive for theft, diversion, or reprocessing. The high burnup capability of the PC-MHR coated particle fuel gives it the demonstrated capability to destroy 90% or more of the initially charged plutonium-239 (and 65% or more of the initially charged total plutonium) so that the weapons-grade material is truly consumed. This level of plutonium destruction is achieved in a single pass through the reactor. The PC-MHR is the only plutonium disposition reactor option that can achieve such high plutonium destruction levels without reprocessing.

Achievement of high burnup is important for obtaining public acceptance of reactor disposition of excess weapons grade plutonium. As discussed in the National Academy of Sciences report on plutonium disposition, the large and growing inventory of plutonium in discharged commercial reactor fuel is of concern with regard to potential proliferation. Use of a reactor technology that achieves higher burnup than that represented by the "spent fuel standard" will enhance the likelihood of public acceptance because it will not be perceived as adding to the existing problem to the extent of other candidate reactor technologies.

Achievement of high burnup without reprocessing is important to both public and political acceptance of reactor disposition of surplus weapons grade plutonium. Reprocessing of spent nuclear fuel in the U.S. has not been allowed under government policy for several years due to concerns regarding nuclear proliferation from the commercial fuel cycle. Much of the opposition to reactor-based plutonium disposition is based on the concern that it would be used as an opportunity to revive a plutonium-based nuclear energy economy. All of the reactor technologies for plutonium disposition that DOE has chosen to include in the PEIS use fuel types that generate new plutonium during operation. The PC-MHR contains no fertile fuel material; all fissions in the core are plutonium fissions, and no new plutonium is created. The PC-MHR is not commonly associated with development of a plutonium based economy, and its deep burn capability could not result in a signal to other nations that rely on plutonium recycling that the U.S. endorses use of plutonium in fuel cycles that create additional plutonium suitable for use in reactors or in weapons applications.

The discharged fuel elements from the PC-MHR are suitable for direct disposal, without further processing (and

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associated opportunity for diversion), in a permanent repository. The discharged fuel is highly undesirable for use as a nuclear weapons material either by terrorists or governments because it is difficult to divert, its plutonium content is difficult to separate, and even if separated the discharged plutonium is difficult to use in a weapons application.

Diversion of the discharged fuel elements is difficult for all the reasons that apply to any reactor spent fuel (high radioactivity, large mass, extensive safeguards and security, etc.), but also for one reason that is unique to the PC-MHR: low plutonium content per fuel element. While the plutonium content in a single spent fuel assembly from a weapons grade MOX-fueled light water reactor (one of the alternatives deemed "reasonable" by the DOE) is of sufficient quantity to use in a weapons application, one would have to divert up to 102 PC-MHR spent fuel elements (each weighing about 250 pounds) to obtain a similar quantity of discharged plutonium. This would require the diversion of about seventeen truckloads of spent fuel shipping casks or three railcars of multipurpose containers containing PC-MHR spent fuel vs one truckload of spent fuel from a weapons grade MOX-fueled light water reactor. Even if such a large quantity of spent fuel were diverted, the technology for separating plutonium from gas-cooled reactor spent fuel has not been developed, in contrast to the light water reactor, for which plutonium separation technology is well established, being practiced, and is known throughout the world. Finally, although any mixture of plutonium isotopes can, in principle, be used to make a nuclear device, the plutonium discharged from the PC-MHR is, due to the high burnup obtained, particularly high in plutonium-240, 241, and 242 content, which makes it substantially more difficult to use in weapons applications than the discharge from reactors that do not achieve as high a burnup level. GA notes that these advantages were recognized also by DOE in the screening summary report, in which the PC-MHR was rated relatively high against other options for the criterion of Resistance to Retrieval, Extraction, and Reuse. However, these characteristics suggest a substantially larger advantage for the PC-MHR than the nominal difference suggested in the DOE analysis.

These matters are straight forward, easily explained, and understandable for a non-technical audience. Thus, public acceptance of use of the PC-MHR for plutonium disposition is likely to be more readily obtained than for the alternatives deemed "reasonable" by the DOE for consideration in the PEIS.

In addition to its suitability for plutonium consumption, the PC-MHR offers other advantages that would enhance public acceptance. One of the most important of these is its versatility. The PC-MHR offers effective use of government money through its ability to perform multiple missions while simultaneously providing electrical generation and advancing power generation science and technology.

Tritium production capability can be provided as needed. The tritium production capability of the gas-cooled reactor was well established on the DOE New Production Reactor Program. The amount of tritium produced by the PC-MHR can be varied by altering core fuel loading or the loading of tritium-producing targets. It can be produced while consuming surplus weapons grade highly enriched uranium in one or more reactor modules dedicated to tritium production, or it can be produced in a coproduction mode while simultaneously consuming surplus weapons grade plutonium. While some have offered the opinion that plutonium disposition and tritium production missions should not be combined and that selection of plutonium disposition technology should not be influenced by the tritium production capability of the candidate technologies, this view does not recognize the importance of using flexible technology for these missions and of making efficient use of government money in a time when federal budgets are tight and deficit reduction is a high priority. A multipurpose plant that combines the plutonium disposition and tritium production missions would not only be economically efficient, but it would also minimize overall environmental impacts by conducting both missions on one site. All of these factors are important considerations in achieving public acceptance of use of reactors for plutonium disposition, and the PC-MHR is particularly well suited in this regard.

The inherent passive safety characteristics of the PC-MHR, as described in the discussion of the Environment, Safety, and Heath criterion, offer distinct safety advantages over the reactor types that DOE has deemed "reasonable" for consideration in the PEIS, and this will also enhance public acceptance. The simple approach to safety design used for the PC-MHR is straight forward, easily explained, and understandable for a non-technical audience. Because the design of the PC-MHR is so different from that of other reactor alternatives, it is less likely to be seen by the public as an offering of more of the same reactor technology that has had highly publicized safety problems and has met to date with only limited public acceptance. It is noteworthy that throughout the initial licensing proceedings and subsequent operating lifetime of the Fort St. Vrain gas-cooled reactor in Colorado, no major intervenor opposition to the plant based upon safety concerns occurred. The safety characteristics of the MHR have been significantly enhanced over those of Fort St. Vrain.

While public acceptance of any approach to plutonium disposition will present challenges, the PC-MHR offers distinct advantages in this regard based upon its ability to substantially destroy the plutonium while not developing a plutonium fuel cycle, its superior resistance to diversion and reuse of the residual plutonium in a weapons application, its multipurpose capability, and its unequalled safety characteristics.

Finally, it should be noted that certain of the alternatives deemed "reasonable" by DOE for consideration in the PEIS and rated higher than the PC-MHR against the public and institutional acceptance criterion will present major, unique public acceptance and policy issues. It is difficult to believe that major policy and public acceptance issues would not be involved in making available large quantities of weapons grade plutonium for disposition either in European nations or in Canada. Not only would major safeguards and security issues be raised, but it would also appear inappropriate to give away to other nations the energy value of the plutonium (which was created at the expense of billions of U.S. taxpayer dollars), to export potential U.S. jobs to other countries, and to forego U.S. technology development and deployment in favor of support for foreign technology. Public acceptance and policy issues would also be raised for the alternative of using existing commercial reactors for plutonium disposition, making a sustainable consensus difficult to achieve.

The Spent Fuel Standard

The screening report states that the spent fuel standard was generally accepted, except by "proponents of developmental technologies that could go beyond the spent fuel standard", and your letter of April 14 states that, "all fission options which go beyond the spent fuel standard were deemed unreasonable." These statements ignore the letter of December 13, 1994, from Senators Thurmond and Hollings and Representatives Spratt and Spence to Secretary O'Leary that questioned the adequacy of the spent fuel standard. They also continue to ignore the numerous comments in the public scoping meetings, such as those at Savannah River, Idaho Falls, Los Alamos, and Livermore, which indicated that measures beyond the spent fuel standard would be required to ensure that the national security objectives of the plutonium disposition effort would be met and that maximum possible energy value would be extracted from the plutonium. Rather than providing a representative sampling of the comments made in support of exceeding the spent fuel standard, DOE merely provides in the implementation plan and the screening summary report a limited, unrepresentative selection of these comments and then dismisses them by claiming that the appropriateness of the spent fuel standard was reaffirmed by the scoping process.

The implementation plan states that detailed evaluations of the diversion and proliferation aspects of the various alternatives to be evaluated in the PEIS will be performed as part of the Record of Decision process. This evaluation should have been conducted and the results should have been made available to the public as part of the screening process so that the public could be fully informed about the implications of merely meeting the spent fuel standard rather than exceeding it. An open evaluation of these matters would have given the public an opportunity

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to judge for itself the acceptability of the spent fuel standard and/or the merits of substantially exceeding the spent fuel standard. By precluding all options that can exceed the spent fuel standard prior to detailed, full evaluation in the PEIS, DOE has withheld this important information from the public and has perpetuated the myth that these options cannot be deployed in a timely, cost effective manner.

Regardless of the question of the acceptability of the spent fuel standard, the PC-MHR is a reasonable alternative for plutonium disposition based on its superior safety and environmental characteristics, cost characteristics, diversion and proliferation resistance, spent fuel form, and level of technical maturity as evidenced by its consideration under the New Production Reactor Program. The ability of the PC-MHR to exceed the spent fuel standard is a readily achievable additional benefit, and the fact that it has the ability to exceed the standard is not an acceptable basis for its exclusion from consideration in the PEIS.

Multipurpose Reactor Options

When work on the New Production Reactor was terminated, Congress authorized and appropriated funds in FY-93 and directed the DOE to undertake assessments of both light water reactor and gas-cooled reactor systems for the multipurpose functions of plutonium consumption, tritium production, and electricity production. The 1995 Energy and Water Appropriations conference report directed the DOE to submit to Congress, within 180 days, a report on the technological feasibility of a multipurpose reactor for the disposition of plutonium and the production of tritium. In a letter to the Secretary of Energy dated December 13, 1994, Senators Thurmond and Hollings and Representatives Spence and Spratt expressed their support for inclusion of a deep burn multipurpose reactor option in the PEISs being prepared by DOE for both tritium production and plutonium disposition.

As indicated, Congress has consistently directed DOE to give full consideration to multipurpose reactors. However, it appears that DOE has not accepted this direction. The Draft PEIS for Tritium Supply and Recycle provides only a comparison of the environmental impacts of tritium production technologies with the impacts of their multipurpose counterparts. The Implementation Plan for the PEIS for Fissile Materials indicates that it will not consider any multipurpose option unless a reactor is chosen for tritium supply, and then that it will consider only whether that reactor option might be suited for multipurpose use. Therefore, if DOE chooses an accelerator for tritium production, multipurpose reactors will not be considered at all for plutonium disposition.

This approach to the multipurpose reactor appears contrived and will not result in full and fair consideration of multipurpose reactors for tritium production and plutonium disposition. It also compromises the underlying philosophy of the NEPA process by effectively precluding alternatives that should result in less total environmental impact than would result from separate projects for each mission. As these evaluations are currently organized by DOE, no effort is being made to compare the costs, benefits, and environmental impacts of multipurpose reactors against the combined costs, benefits, and environmental impacts of the two individual mission technologies. It may well be that DOE could choose the accelerator for tritium production and a nonreactor alternative for plutonium disposition and never provide to the public an assessment of whether a multipurpose reactor could conduct both missions at less cost to the taxpayer and with less total environmental impact. In a time of growing concern about limits in government resources and about deficit reduction, the manner in which DOE is trying to avoid full and fair consideration of the multipurpose reactor is difficult to understand.

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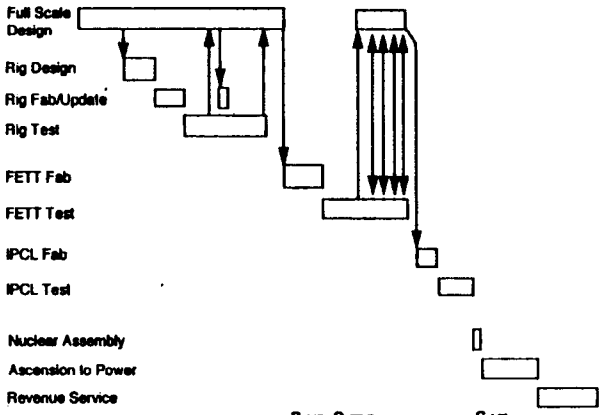
DEVELOPMENT SCHEDULE

Turbomachine Development Schedule Shows First Engine to Test in Less Than 4 Years



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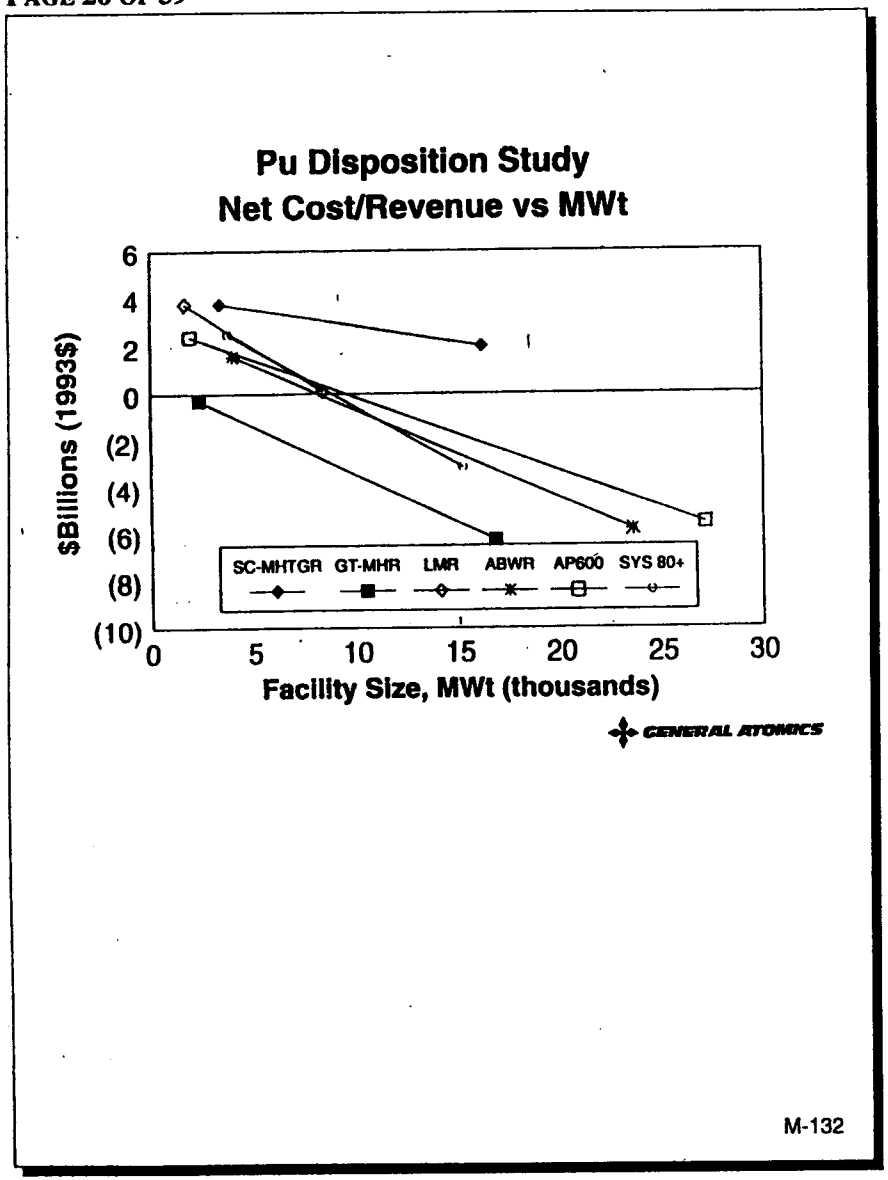

ATTACHMENT 3 TO GA/DOE-027-96
ADDITIONAL GENERAL ATOMICS COMMENTS
ON THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT
FOR STORAGE AND DISPOSITION OF WEAPONS-USEABLE FISSILE MATERIALS

The following comments on the draft Programmatic EIS are in addition to those in References 1 and 2, copies of which are provided as Attachments 1 and 2, respectively.

Multipurpose Reactors

In References 1 and 2, GA expressed its concerns regarding DOE's approach to consideration of multipurpose reactors in the Programmatic EIS. Subsequently, statutory and Conference Report language from the FY-1996 Defense Authorization Bill (S.1124) has directed that funds authorized to be appropriated to the DOE for Fissile Materials Disposition shall be available for "completing the evaluation of, and commencing implementation of, the interim- and long-term storage and disposition (including storage and disposition through the use of advanced light water reactors and gas turbine gas-cooled reactors) of fissile materials...." The Bill also states that, "sufficient funds shall be made available for the complete consideration of multipurpose reactors for the disposition of fissile materials in the programmatic environmental impact statement of the Department."

These technical assessments, cost/benefit comparisons, and related evaluations would, in the case of the "gas turbine gas-cooled reactor", be a follow-on to the plutonium disposition evaluations performed by General Atomics (GA) for the Gas Turbine Modular Helium Reactor (GT-MHR) during fiscal years 1993 - 1995 under the direction of the DOE in accordance with the provisions of the FY-93 DOE Appropriations Bill.

These studies concluded that the GT-MHR can offer substantial capabilities for the simultaneous disposition of surplus weapons grade plutonium and production of tritium. Evaluations to date indicate that a single 2400 MWt standard plant, comprised of four reactor modules, can process more than 80 metric tonnes of surplus weapons grade plutonium over its 40 year design operating lifetime while concurrently producing tritium at 3/8 of the original New Production Reactor Goal Quantity and generating electricity for sale to offset project costs. The 4x600 MWt modular design provides standardization of construction, enhanced availability, flexibility in mission, and meltdown proof reactor safety. The plant achieves ~47% net plant efficiency, generates 1144 MWe, and significantly reduces environmental impact compared to alternative reactor concepts. The resulting spent fuel is suitable for permanent geologic disposal without further treatment. Design and development costs are ~$750M. The first reactor module could be operational in about 10 years (Ref. 3). 9/01.05.00 cont.

In Reference 4, GA submitted to DOE a recommended program plan for evaluation of the multipurpose capabilities of the GT-MHR which, if accepted and implemented by DOE, would provide the information needed by DOE to comply with the FY-96 Authorization Bill. DOE's response to the recommended program plan (Ref. 5) indicated that DOE believes that previously

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conducted studies sufficiently addressed the gas-cooled reactor both for tritium production and for multipurpose use. The response did not, however, indicate how DOE intends to respond to the requirements of the FY-96 Defense Authorization Bill.

The Draft Programmatic EIS for Fissile Materials makes only minimal reference (a three page Appendix N) to multipurpose reactors as an option for fissile materials disposition. It does so in a manner that is not consistent with the spirit or the intent of the National Environmental Policy Act (NEPA) and does not comply with the provisions of the FY-96 Authorization Bill. The discussion is limited to the possibility that an existing LWR could be used simultaneously for plutonium disposition, tritium production, and generation of revenue through production and sale of electricity. The first sentence of Appendix N of the draft Programmatic EIS provides an incorrect definition of multipurpose reactors as reactors that use plutonium in the form of mixed oxide (MOX) fuel. This definition precludes the use of the gas cooled reactor, which uses only fissile plutonium fuel instead of MOX, in a multipurpose application. Reference is then made to the Record of Decision and the Programmatic EIS for Tritium Supply and Recycling, in which the multipurpose reactor was "preserved as an option for future consideration". Contrary to the requirements of the FY-96 Authorization Bill, no discussion is provided of multipurpose advanced light water reactors or of multipurpose gas turbine modular helium reactors. 10/11.01.08

As noted by GA in its comments to DOE on the Programmatic EIS for Tritium Supply (Ref. 6), the treatment of the multipurpose options in that document is superficial, inadequate, and inconsistent with the requirements of the National Environmental Policy Act. The evaluation is neither full nor fair. The environmental impacts of the multipurpose options are compared only with those of the tritium production options. A full and fair assessment would compare the impacts of the multipurpose options with those of separate plutonium disposition and tritium production options combined. Such a comparison was not provided in the Programmatic EIS for Tritium Supply and Recycling, and if it is not provided in the Final Programatic EIS for Storage and Disposition of Weapons-Useable Fissile Materials, DOE will not have complied either with NEPA or with the FY-96 Authorization Bill.

Disposition Schedule

Before the Draft Programmatic EIS was prepared, all potential options for plutonium disposition were screened using criteria given in Reference 7. The criteria are similar to those used by the National Academy of Sciences (NAS) in its 1994 report (Ref. 8). One of the criteria, timeliness, was initially defined by DOE as follows:

> "The technology concept should be demonstrated within ~20 years and disposition should be completed within ~50 years."

As stated, this criterion would have allowed for development of advanced, deep-burn reactor technologies for plutonium disposition, including the GT-MHR. Of equal significance, this criterion would have allowed for a single, approximately 1GW(e) plant (GT-MHR or LWR) to

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It was DOE's decision, during the planning for environmental documents in compliance with NEPA, that the TSR PEIS include the analysis of the Multipurpose Reactor Option. Because tritium supply is a long-term mission of DOE compared to the shorter term mission of Pu disposition, the Storage and Disposition PEIS would incorporate, by reference, information developed in the TSR PEIS. This approach is in compliance with the intent of NEPA. Clarification was added to Appendix N in response to the *FY-96 Authorization Bill.*

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complete the disposition mission (50 metric tonnes of surplus weapons grade plutonium) over the expected operating lifetime of the plant. In other words, the potential environmental impacts would have been limited to those for a single plant.

In Reference 7, the DOE somewhat arbitrarily changed the timeliness criterion to "require that the disposition be able to start within about a decade and be able to be completed within about three decades." The reason stated by DOE in Reference 7 for adopting this shorter schedule was input from the public and stakeholders "relating to the urgency of taking action stemming from the 'clear and present danger' associated with these materials." However, this reasoning is not supported by the DOE's questionnaire data reported in Appendix A of Reference 7 (see Figures 1 and 2, taken from Reference 7). From Figure 1, five of the nine criteria received higher rankings of "very important" than given to timeliness. From Figure 2, the ranking of timeliness relative to the other criteria indicates clearly that the questionnaire respondents viewed timeliness as being of secondary importance. 11/01.02.00

Other factors also do not justify forcing the plutonium disposition mission to a shorter schedule. According to the draft Programmatic EIS, the DOE also proposes to provide a long-term, 50-year storage system for plutonium and highly enriched uranium declared to be non-surplus. The non-surplus material is categorized into naval nuclear fuel, strategic reserves, material for weapons research and development, and programmatic materials. The DOE acknowledges that some of the non-surplus material could be classified as surplus material in the future. During the disposition mission, it is quite possible that surplus and non-surplus material would be stored and secured at common locations. For plutonium being stored and secured at a given location, it would be absurd to determine that material classified as surplus poses a "clear and present danger," while material classified as non-surplus does not pose a similar risk, particularly when the classification boundary could change over time. The "clear and present danger" argument does not justify adoption of the more urgent disposition schedule, since fissile material of potentially unknown classification (surplus or non-surplus) will be in storage for time periods exceeding the more urgent disposition schedule. 12/01.06.00

The DOE acknowledges that the risks for theft and diversion of fissile material are greater in Russia than in the U.S., because of the less stable political climate in Russia. Perhaps the justification for the more urgent schedule is to encourage the Russians to adopt a similarly urgent schedule, thereby reducing the risks of theft and diversion. While plausible, this strategy is not consistent with desires expressed by the Russians. The Russians have actively encouraged development of the GT-MHR for plutonium disposition. As part of a private, cost-sharing initiative with General Atomics and Framatome, Russian engineers and scientists are presently working on the GT-MHR design. At the recent Third International Policy Forum: Management and Disposition of Nuclear Weapons Materials (Lansdowne, VA, March 19-22, 1996) high level Russian representatives confirmed their strong support for continuing development of the GT-MHR for plutonium disposition. Despite growing international support, the DOE has not been receptive to this private initiative and has implied that the GT-MHR could not be deployed in Russia in a sufficiently timely manner relative to DOE's schedule requirements. From Figure 2, it is interesting to note that the criterion "Influence on Russia and Other Countries" was rated 13/01.03.00

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01 02 00 **Comment Number 11**

The Department of Energy did not arbitrarily change the timeliness criteria. DOE asked for public input on the proposed screening criteria through a questionnaire which used the approximately 20- to 50-year timeframe for the disposition timeliness criteria. There were some responders to the questionnaire who felt that this timeframe was appropriate. However, the majority of responders expressed opinions that the timeliness criteria was moderate to very important and that the timeframe (20 to 50 years) was too long. Further, the NAS Report states that disposition using Pu as fuel in reactors could begin within 10 years and be completed within 20 to 40 years.

01 06 00 **Comment Number 12**

The "clear and present danger" is of more concern with Russian materials than with U.S. materials. The "clear and present danger" applies to all materials that are weapons-usable, whether or not they are surplus. The sooner the United States and Russia can disposition surplus materials, the sooner the total volume of material can be reduced. Thus, the "clear and present danger" can be reduced.

The "clear and present danger" cannot be eliminated unless all material is declared surplus and dispositioned. Since this is not likely to occur in the foreseeable future, a safe, secure, and inspectable storage capability, such as that evaluated in the PEIS, must be implemented to assure that non-proliferation objectives in both countries are met.

01 03 00 **Comment Number 13**

Comment noted. DOE is encouraging the Russians to pursue timely Pu disposition by offering technical assistance, conducting joint assessments of the various disposition technologies, and planning joint demonstrations of some of the technologies to remove uncertainties in their viability.

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as being of somewhat greater importance than timeliness.

Finally, in its 1995 report on reactor-related options for plutonium disposition (Ref. 9), the NAS viewed the shorter schedule as a "very severe constraint" that did not provide a useful basis for comparative evaluations. For comparing the various reactor options, the NAS assumed that 50 metric tonnes of plutonium would be processed over the nominal lifetimes of the reactors.

The impacts of adopting the unnecessarily shorter plutonium disposition schedule are:

The shorter schedule eliminates advanced, deep-burn reactor technologies, such as the GT-MHR, from further consideration.

The required number of approximately 1 GW(e) plants is increased from one to two, and the associated environmental impacts are doubled.

The potential for a strong international cooperative program on plutonium disposition and proliferation-resistant fuel cycles that is of great interest to Russia is hampered.

The Programmatic EIS should be expanded to include a flexible schedule that can accommodate disposition of plutonium over the expected reactor lifetime, and advanced, deep-burn reactor options should be evaluated as part of the EIS process. The "clear and present danger" argument is highly subjective and open to a wide range of interpretation. This argument should not be used to eliminate alternatives that require only a slightly longer schedule than that currently dictated by DOE. 14/01.02.00 15/01.04.00

Final Waste Form Characteristics

An important issue for any plutonium disposition strategy is the suitability of the final waste form for permanent disposal. Respondents to the DOE questionnaire (Ref. 7) recommended additional criteria that should be used to screen plutonium disposition technologies, including several criteria related to final waste form characteristics. During the screening process and preparation of the draft Programmatic EIS, DOE gave little consideration to final waste form characteristics and resulting long term environmental impacts, other than the annual volume of high-level waste generated by the various disposition alternatives. 16/01.05.00

Volume alone is a poor measure of the environmental impact of the final waste form. In fact, a larger volume may be an environmental attribute, since the dilution of plutonium (residual plutonium if the waste is spent fuel) provides greater resistance to diversion and proliferation and their substantial negative environmental impacts. Also, geologic repository loading density and required repository land area are determined by decay heat load of the spent fuel and not by physical volume. For the GT-MHR, the annual volume of spent fuel would be about ten times that from a commercial LWR or plutonium disposition LWR, on an equivalent electrical energy basis, but the required land area for GT-MHR spent fuel would be about one-half that required for LWR spent fuel. The greater volume of GT-MHR spent fuel is a consequence of

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01 02 00 Comment Number 14

The cost and schedule analysis was presented in a separate report available for public review beginning in late July 1996. The Advanced Deep Burn Reactors Option, including the MHRs, was considered in the screening process. Notwithstanding the many potential benefits of their use, the technical immaturity would call for costly and lengthy development and demonstration efforts to bring them to a viable status. The Screening Committee decided that the increased Pu burn up offered by this option would not counterbalance its cost, schedule, or technical risks, and therefore, eliminated this option from further consideration.

01 04 00 Comment Number 15

The term "clear and present danger" was used by the NAS in their report on the potential proliferation of weapons materials and referred to the situation in Russia and the former Soviet Republics where weapons materials are not subject to the same strict controls as in the United States. The incentive for choosing technologies that can disposition U.S. materials on a relatively short schedule is to provide an equivalent incentive for Russia to also move forward quickly with disposition.

01 05 00 Comment Number 16

The PEIS provides a comparative analysis of the HLW forms in Appendix H. The purpose of the Proposed Action is to convert the surplus weapons-usable Pu into a form that meets the Spent Fuel Standard for proliferation resistance. Existing, proven waste forms are sufficient to meet the needs of the Proposed Action.

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the low power density of the GT-MHR core, which helps to provide inherent, meltdown-proof safety during normal operation and hypothetical accidents. Approximately 83% of the GT-MHR spent fuel volume is high-purity, nuclear-grade graphite, which by itself would be classified as low-level waste. The high-level waste is confined to the fuel compacts, and the bulk of this waste (99.9%) is contained within the coating layers of the fuel particles. The GT-MHR would destroy and degrade weapons-grade plutonium well beyond the commercial LWR spent fuel standard. The final waste form would be rendered permanently resistant to proliferation, would be contained effectively for geologic time periods by the multiple layers of highly corrosion-resistant ceramic coatings (Refs. 10 through 12), and would be well suited for permanent disposal in a geologic repository. The graphite is also highly resistant to corrosion (Ref. 13) and would serve as an additional protective overpack after permanent disposal. The long-term environmental impacts of permanent disposal would be significantly reduced, and potential high consequence scenarios would be eliminated, including recovery of spent fuel canisters to obtain plutonium for weapons (i.e., the "plutonium mine" issue would be eliminated) and large-scale radionuclide releases caused by severe climatic changes and/or increased seismic activity (i.e., much less reliance would be placed on the geosphere for radionuclide containment). With regard to these issues, GT-MHR spent fuel would be a nearly ideal waste form for permanent disposal (Ref. 14).

In screening reactor technologies for plutonium disposition, the DOE has determined that the commercial LWR "spent fuel standard" was a sufficient end point. The basis for the spent fuel standard stems from the 1994 NAS study (Ref. 8). The NAS recommended that "options for long-term disposition of weapons plutonium should seek to meet a 'spent fuel standard' - that is, to make this plutonium roughly as inaccessible for weapons use as the much larger and growing stock of plutonium in civilian spent fuel." The NAS and DOE have recognized that high levels of radiation are the primary barrier to diversion of plutonium in spent fuel and that this barrier decays over time. The NAS stated that "long-term options will be needed to reduce the proliferation risks posed by the entire global stock of plutonium, particularly as the radioactivity of spent fuel decays," and that "options for reducing these risks include placement of spent fuel in geologic repositories, or pursuit of fission options that would burn existing plutonium stocks nearly completely."

Without performing proper analyses, the DOE has determined that geologic disposal of the waste forms resulting from the alternatives evaluated in the Programmatic EIS will provide the necessary long-term safeguards. In justifying the spent fuel standard, the DOE states in Reference 7 that, "there is a path forward established by the Nuclear Waste Policy Act (of 1982) for disposal of spent fuel in a mined geologic repository, where geologic barriers will reduce the reliance on institutional controls." This conclusion is flawed for the following reasons: 17/12.00.00

There is no consensus among experts that isolation of spent fuel (or immobilized plutonium) in a geologic repository would provide adequate long-term safeguards. It is important to realize that the NAS study (Ref. 8) makes no judgements and draws no conclusions regarding safeguards provided by geologic isolation. According to the Yucca Mountain Total System Performance Assessment (Ref. 15) and to the 1995 NAS report

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12 00 00 **Comment Number 17**

The Pu waste forms being considered for disposal in an NWPA-HLW repository meet the Spent Fuel Standard, and therefore, pose no greater safeguards risk than the disposal of commercial spent nuclear fuel. Further, these materials are classified as CAT IV E, and will be subject to the same safeguard requirements as commercial spent nuclear fuel and defense high-level waste (DHLW).

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(Ref. 9), the eventual loss of institutional controls and human intrusion is considered to be a credible scenario for assessing long-term performance of a repository. An International Atomic Energy Agency (IAEA) advisory group concluded (Ref. 16) that LWR spent fuel "does not qualify as being irrecoverable at any point prior to, or following, placement in a geologic formation commonly described as a 'permanent repository,' and that safeguards should not be terminated on spent fuel." In a recent report (Ref. 17), the U.S. Congress Office of Technology Assessment (OTA) expressed "concerns about leaving plutonium in a repository that might be mined sometime in the future for the purpose of making weapons." This same concern was raised recently by an American Nuclear Society (ANS) Special Panel on Protection and Management of Plutonium (Ref. 18). During a presentation at a recent DOE workshop (Ref. 19), Peterson concluded that "geologic repositories will provide attractive sources of fissile material for nuclear explosives for roughly 200,000 years." These concerns raised independently by NAS, IAEA, OTA, ANS, and others provide strong justification for developing a disposal strategy in which fissile materials are destroyed before geologic disposal, since safeguards and institutional controls cannot be guaranteed for tens of thousands of years.

Even if it were determined that geologic disposal does provide adequate long-term safeguards, there is currently no permanent repository for spent fuel, and there is the distinct possibility that a repository will not be available for many decades. The political controversy associated with the Yucca Mountain repository project has slowed progress considerably. After spending more than $2 billion, there has still been no determination of whether the site is acceptable for disposal of commercial spent fuel. In the screening report (Ref. 7), the DOE acknowledges "the tremendous cost and time being taken to evaluate the suitability of Yucca Mountain as a mined geologic high-level waste repository."

Mixed-oxide (MOX) spent fuel from an plutonium disposition LWR would be significantly more attractive for diversion than commercial LWR spent fuel, particularly after the radiation field has decayed to lower levels. According to the 1993 DOE Plutonium Disposition Study (Ref. 20), a plutonium disposition LWR MOX spent fuel assembly would contain up to 30 kg of plutonium. This is enough plutonium to manufacture up to 4 weapons. For comparison, a typical commercial LWR spent fuel assembly would contain about 3.5 kg of plutonium of similar quality. A GT-MHR spent fuel element would contain less than 0.25 kg of much lower quality plutonium. In addition to increased diversion risks, the high plutonium content of plutonium disposition LWR MOX spent fuel would have a negative impact on the design of a spent fuel canister and repository loading strategies. Additional processing of MOX spent fuel may be required to lower the plutonium density.

Another issue associated with unprocessed LWR spent fuel as a permanent waste form is poor long-term containment provided by metal-clad fuel rods within metallic canisters. According to the Reference 15 performance assessment, a large fraction of LWR spent fuel would become

exposed within several hundred to several thousand years because of the expected failure of Zircaloy cladding and corrosion of metallic canisters, and the only remaining barrier for release to the accessible environment would then be the surrounding geologic media. The effectiveness of this barrier for long time periods is uncertain and could be compromised by unforeseen events, including climatic changes and increased seismic activity. In testimony before the House Commerce Subcommittee on Energy and Power on June 30, 1995, John Cantlon, Chairman of the Nuclear Waste Technical Review Board (NWTRB), stated that the NWTRB "has repeatedly urged the DOE to develop a robust, long-lived waste package that will work together with other engineered barriers and the geology at the site to provide long-term isolation of the radioactive waste from the accessible environment." Cantlon stated also that "the use of such waste packages can help improve confidence in the long-term performance of the repository and thus facilitate licensing of the facility." Other experts on disposal of high-level radioactive waste have stated (Ref. 21) that "any strategy of isolation should emphasize the near-field containment of radionuclides, a function primarily of waste form or 'waste package' performance" and that "strategies that rely solely on long travel times, dispersal, or dilution, implicitly presume release and movement of radionuclides." In a recent report (Ref. 22), the NAS concluded that the most harmful releases of radionuclides from a geologic repository could occur well after 10,000 years, which further underscores the need to provide effective near-field containment of radionuclides for geologic time periods. Other potential benefits of superior near-field containment are less required geological characterization of the candidate repository site and greater likelihood that a given site would be found acceptable.

Final waste form characteristics (and not just near-term diversion resistance) will determine the overall schedule for achieving effective disposition of plutonium. Plutonium disposition using deep-burn reactors like the GT-MHR could satisfy long-term safeguards requirements without relying on the availability of a geologic repository or the determination that the repository would provide the needed long-term safeguards. This is a very significant advantage for deep-burn reactors that has been overlooked during the DOE screening process. GT-MHR spent fuel would be a highly stable and highly diversion resistant waste form during potentially long-term storage and after permanent disposal. If future generations could respond to the DOE questionnaire, they would undoubtedly rate final waste form characteristics as the most important criterion for evaluating high-level radioactive waste forms, including those generated from disposition of surplus plutonium.

Final waste form characteristics and long-term environmental impacts should be given a high priority and careful evaluation when evaluating technologies for plutonium disposition. Advanced technologies that produce clearly superior permanent waste forms and have the potential to eliminate long-term, high-consequence environmental impact scenarios should be evaluated as part of the Programmatic EIS, particularly if the schedules for implementing these technologies are not significantly longer than those for more established technologies and if the potential for strong international collaboration exists. The GT-MHR would clearly meet these conditions.

16/01.05.00 cont.

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Use of Borosilicate Glass for Vitrification

The vitrification alternative proposed in the draft PEIS would involve manufacturing borosilicate glass logs containing plutonium and high-level waste. Recent evaluations have raised significant issues that may preclude borosilicate glass as a host phase for immobilization of plutonium. These issues include potentially poor long-term durability in a geologic repository and long term irradiation effects. These issues received considerable attention during a recent DOE Plutonium Stabilization and Immobilization Workshop in Washington, DC (December 12-14, 1995). Since weapons grade plutonium consists mostly of the fissile isotope plutonium-239, with a half-life of about 24,000 years, the time over which the waste remains highly radiotoxic would likely exceed the expected lifetime of the glass. Scientists at Argonne National Laboratory have been developing a more durable glass for plutonium immobilization (Ref. 23). 18/05.01.08

18/05.01.08 cont.

DOE should acknowledge the potential problems with borosilicate glass and evaluate alternative glass forms during preparation of the EIS.

Viability of Electrometallurgical Treatment

According to the draft Programmatic EIS, the DOE will consider electrometallurgical treatment as an option for plutonium disposition. Electrometallurgical treatment was derived from pyroprocessing technology developed for reprocessing liquid metal reactor spent fuel. In its 1995 report (Ref. 9), the NAS evaluated pyroprocessing as an option for plutonium disposition. The NAS determined that pryroprocessing has several disadvantages that "effectively rule it out as a serious competitor for the near-term plutonium disposition mission." The NAS raised concerns with regard to the maturity of the technology, the size of the facility required to complete the disposition mission, and suitability of the final waste form for permanent disposal. In light of this evaluation by the NAS, the DOE should provide stronger justification for continuing to evaluate electrometallurgical treatment as a viable option for plutonium disposition. 19/05.03.08

Coated-Particle Waste Form for Plutonium Immobilization

Coated particles were once considered by the DOE as an alternative waste form for immobilization of high-level waste, and research programs were conducted at Pacific Northwest Laboratory and Oak Ridge National Laboratory (ORNL) in the early 1980s (e.g., Refs. 10 through 12). The feasibility of coating high-level waste was established at ORNL, and coated particles were judged to have by far the best performance potential of the candidate alternative waste forms. DOE should evaluate the coated-particle waste form for plutonium immobilization as part of the EIS process. 20/14.00.00

Environmental Impacts of the CANDU Reactor Option

While the Programmatic EIS discusses a full spectrum of environmental impacts of using an existing light water reactor for plutonium disposition, several of the similar environmental impacts for use of existing CANDU reactors (such as those at the Ontario Hydro Bruce-A

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05 01 08 **Comment Number 18**

Alternative forms were evaluated before issuing the Draft PEIS. These results are reported in the document (available in DOE Public Reading Rooms): *Screening of Alternative Immobilization Candidates for Disposition of Surplus Fissile Materials*, February 9, 1996 (UCRL-ID 118819 [L-20790-1]).

05 03 08 **Comment Number 19**

Electrometallurgical Treatment was considered a reasonable alternative after completion of the screening process and scoping for the PEIS. The National Research Council recommended successful demonstration of the electrometallurgical treatment process prior to implementation. Upon making the decision on disposition technologies, DOE will demonstrate these technologies.

14 00 00 **Comment Number 20**

During the screening of alternatives for inclusion in the PEIS, various immobilization forms were considered. The decision was made to include immobilization in ceramic and glass forms. The specific ceramic form was not identified. Research and development (R&D) is both on-going and planned to support the disposition alternative(s), which would include pilot facilities for processes (such as ceramic coated particles) and materials, as necessary. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Nuclear Generating Station, located on Lake Huron about 300 km (186 miles) northeast of Detroit) are listed in the document as not applicable. Examples include normal radiological impacts, hazardous chemical impacts, and facility accidents. The Programmatic EIS limits its evaluation of the environmental impacts from these sources for all alternatives to a radius of 80 km (50 miles) from the site boundary. The basis for limiting the evaluation to this radius is not presented. It is noteworthy, however, that no such limit is placed upon the evaluation of the environmental impacts from these sources in other Programmatic Environmental Impact Statements such as the Programmatic EIS for Tritium Supply and Recycle.

In effect, DOE has assumed that the environmental impacts from these sources for the CANDU reactor option somehow stop at the U.S./Canadian border and do not affect U.S. citizens living near the plant. This is obviously unrealistic, and DOE should include a full assessment of the environmental impacts of the CANDU reactor option in the final Programmatic EIS. 21/06.05.08

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06 05 08 **Comment Number 21**

The environmental impacts in foreign nations are not addressed under NEPA. However, if the CANDU Reactor Alternative was selected, an assessment of environmental impacts would be accomplished pursuant to Canadian Federal and Provincial law. Further, the ROI used consistently for analysis of this PEIS for sites and technology, includes an 80-kilometer (km) (50-mile [mi]) radius. The distance from the U.S. border to the Bruce-A-Generating Station is greater than the distance for analysis.

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Relative Importance:	Theft / Diversion	Retrieval / Reuse	Technical Viability	ES&H	Cost	Time	Internat'l Influence	Public / Institutional	Additional Benefits
Very Important	124	78	104	101	35	64	57	42	49
Moderate	15	33	38	34	60	48	47	58	39
Less Important	7	23	8	10	42	32	38	40	40
Inappropriate	1	15	0	1	9	10	5	5	16

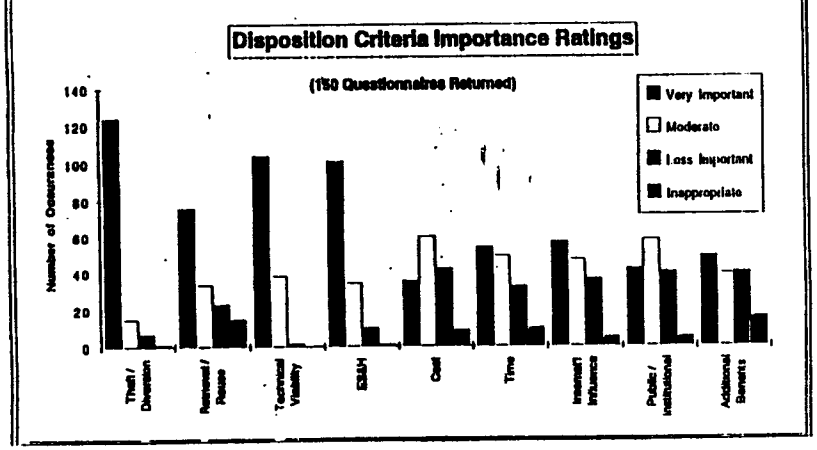

FIGURE 1 (FROM DOE/MD-0002)

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Rank:	Theft / Diversion	Retrieval / Reuse	Technical Viability	ES&H	Cost	Time	Internat'l Influence	Public / Institut'l	Additional Benefits		
1	34	13	12	29	3	7	8	7	8		
2	33	14	20	22	7	8	5	7	2		
3	21	22	27	16	8	6	3	5	9		
4	10	9	27	23	9	13	16	7	5		
5	10	9	20	7	16	16	11	12	17		
6	3	16	5	10	22	15	10	16	11		
7	6	11	6	9	14	23	21	23	6		
8	2	9	2	3	21	19	18	27	17		
9	0	15	0	1	18	11	17	15	41		

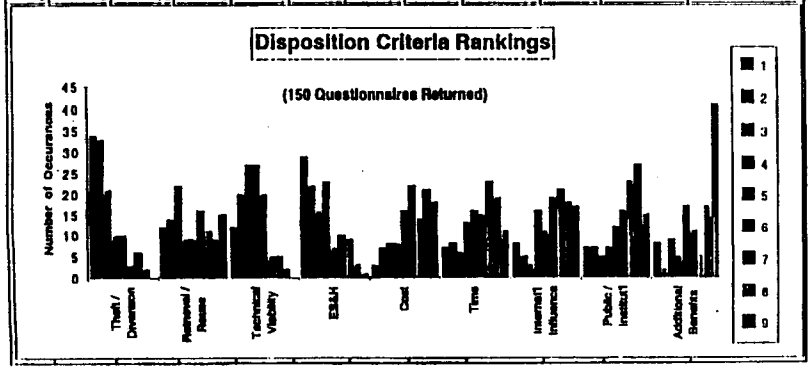

FIGURE 2 (FROM DOE/ND-0002)

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General Electric Company
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May 6, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 200026-5786.

Subject: Comments on the Draft Programmatic Environment Impact Statement for the Disposition of Weapons-Usable Fissile Materials, dated February 1996.

Please accept the attached comments related to the disposition of weapons usable plutonium.

Yours Truly

Edward Ehrlich

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Due to the close of the comment period on Tuesday May 7, transmittal of our comments to the DOE will be via by FAX to 1-800-820-5156

cc: Lynn Wallis
Steve Hucik

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EDWARD EHRLICH
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Storage and Disposition of Weapons-Usable Fissile Materials Draft
Programmatic Environmental Impact Statement
(February 1996)
DOE/EIS-0229-D

Comments

Volume/Section/Page	Comments	
Summary-Abstract/ compared to S-7	The summary abstract conclusion, that the disposition of weapons usable Pu is necessary, is in conflict with a no action alternative. Considering the continuing threat of diversion of Russia's weapons usable plutonium, a near-term bilateral, reliable Pu disposition program would appear to be a highly necessary activity and therefore a no action alternative which would neglect the "clear and present danger" situation, should be entirely unacceptable. The PEIS also fails to adequately address 1) the sense of urgency which should be evaluated by the reliable timeliness of each alternative and 2) the environmental risk which a nuclear threat due to diverted material would represent. Further delay in embarking on a practical disposition program and failure of the chosen alternatives to reliably fulfill the mission would enable and enhance that threat.	1/08.03.01 2/01.00.00
Summary S -5	The PEIS describes international cooperation as a PEIS criteria but fails to give appropriate credibility to the furthering of international cooperation which bilateral reactor based programs in both the U.S. and Russia would provide. It has been publicly suggested by DOE personnel that the disposition programs in each country could be different, however a vitrification program which would leave the weapons usable Pu unchanged and readily recoverable by the industrial infrastructures available in either the U.S. or Russia, cannot be credible to either side. Equivalent programs in the two countries for the large quantities of pit Plutonium must contain an element of irreversibility which only the LWR option offers.	3/01.03.00
	The PEIS fails to give appropriate credit under both its timeliness and cost criteria of the industrial reliability and predictability of the existing LWR option; especially as compared to 1) the uncertainties in the R&D required for other options, 2) the technical, cost, and schedule uncertainties inherent in the prototype stage of other options, and 3) in the reliability and cost uncertainties of the mission production stage of the other options being considered.	4/08.03.01

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08 03 01 **Comment Number 1**

Analyses of the No Action Alternative are required by NEPA to serve as a baseline. As stated in Chapter 1 of the PEIS, the purpose of the Proposed Action is to provide safe, secure, and cost-effective storage for the nonsurplus weapons-usable fissile materials and for surplus Pu pending disposition, since the disposition process would take time. The intent is to conduct the disposition process until all surplus Pu materials are taken care of.

01 00 00 **Comment Number 2**

Timeliness is one of the criteria used in the screening process for selecting reasonable alternatives to be analyzed in the PEIS. The endpoint for each disposition alternative is to convert the surplus Pu into a proliferation-resistant form that meets the Spent Fuel Standard, as described in the PEIS.

01 03 00 **Comment Number 3**

As described in the PEIS, the endpoint for all disposition alternatives is to convert the surplus Pu into a proliferation-resistant form that meets the Spent Fuel Standard. Vitrification of Pu can meet this Standard since the Pu would be as unattractive and inaccessible as that in spent nuclear fuel. The United States and Russia currently have a joint program to assess the feasibility of all the reasonable disposition alternatives, including the use of Pu in LWRs.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

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EDWARD EHRLICH
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Summary/Reactor Category/S-15	The statement "a dedicated facility would have to be built at a U.S. site to implement the reactor alternative" (MOX fuel fabrication facility) is considered somewhat misleading. MOX fabrication capabilities exist in Europe and could support the reactor alternative. The PEIS explains European capabilities in later sections and details the need for a U.S. capability. However, this paragraph is considered incorrect as written. It may be prudent for policy reasons to proceed with a MOX facility in the U.S. to assure a reliable, proliferation independent MOX fuel supply for a U.S. LWR program, but the decision to build MOX facility in the U.S. is more a political decision than one fully necessitated by the technology, logistics or the available infrastructure.	5/06.01.09
Summary/Existing Light Water Reactor Alternative/S-15	The first paragraph in this section states that a minimum of four (4) BWRs would be required for a Pu throughput of 2-3 t/yr. With optimized fuel and fuel cycle designs recently divulged to the DOE, this throughput can be achieved with two (2) existing BWRs utilizing full MOX cores or with three (3) existing BWRs utilizing a high Pu throughput (no burnable poisons in the MOX fuel rods) design. The PEIS timeliness and technological viability criteria should also consider that BWRs can operate with up to a full MOX core configuration without changes to the plant design, equipment, systems, or fuel bundle mechanical configuration. The capability for operation with MOX is achieved entirely through the design of the fuel pellet and core nuclear design. Systems operations and core and fuel bundle mechanical designs all remain unchanged. MOX cores for BWRs can also be designed within the operating envelope of the current UO_2 fuel design licensing criteria which sustains the existing margin to the licensing basis design limits for current fuel bundle designs. These considerations enable licensing of MOX fuel designs for BWRs and licensing of BWR plants for operation with MOX fuel to be implemented as straightforward, low technical risk activities. This approach has been the basis for MOX fuel designs and MOX fuel operation in BWRs since the onset of GE's Pu disposition evaluations. Modifications of mechanical, chemical, and control systems of pressurized water reactors (PWRs) were required in order to transition from UO_2 fuel to even the nominal 1/3 MOX core operating schemes being used in France. Where more challenging MOX operating cycles are being considered, PWR plants will require even further modifications and changes to reactor control and operating systems. DOE should NOT confuse the PWR requirement for control rod additions and soluble boron reactivity control systems changes as being applicable to BWRs as there are no such requirements for BWRs.	6/01.05.00 7/06.02.09

F-021

06 01 09 **Comment Number 5**

Europe is moving toward a balance between the capacity to fabricate MOX fuel and the capacity to utilize MOX fuel in reactors. Additionally, Europe has excess separated Pu stores which they intend to use as MOX fuel as the fuel fabrication infrastructure and reactor infrastructure permits. Therefore, use of European reactors for consumption of U.S. Pu-source MOX fuel would merely displace the use of separated European Pu and result in no net reduction in world inventories of separated Pu. Hence, the statement that Europe has no excess MOX capacity. Additionally, facility utilization projections indicate that, while some excess MOX fuel fabrication capacity may exist in Europe for the next few years, current capacity is soon expected to be fully utilized for commercial MOX fabrication. Therefore, the United States may not be able to rely on the use of existing European MOX fabrication capacity for the entire disposition campaign. However, as a part of efforts to develop weapons-grade Pu MOX fuel, DOE is consulting with European Fuel Fabricators to benefit from their experience in MOX fuel fabrication and may have some MOX Lead Test Assemblies and/or initial core loads fabricated in Europe. Also, participation in the construction and operation of a MOX Fuel Fabrication Facility in the United States will be open to European fuel vendors.

01 05 00 **Comment Number 6**

The Technical Summary Report for disposition, made available to the public in July 1996, recognizes the fact that full MOX cores could be utilized for Pu disposition. The Final PEIS and Summary have been revised to incorporate this information.

06 02 09 **Comment Number 7**

The Technical Summary Report for disposition, made available to the public in July 1996, recognizes this information.

Summary/Attachment B/S-153	In the Existing Light Water Reactors Alternative (per single unit) column under Waste Management, it states that spent nuclear fuel generation would increase approximately 23 *t* for BWRs. If the BWR operating cycles and core management/outage philosophies are not changed with the introduction of MOX fuel, the amount of spent fuel generated should not increase.	8/09.11.08
Vol. I/1.2, 6th para./ 1-5	We consider the statement that the NAS has identified several disposition options to be misleading. The NAS report states that the "two most promising alternatives" are fabrication and use as fuel (spent fuel option) and vitrification. The third option, burial in deep boreholes, has been less thoroughly studied. Considering the delays and uncertainty surrounding the Yucca Mt. repository, the uncertainties associated with deep borehole burial might be even more unceitain and therefore the program schedule, cost, and technical risks of the deep borehole option would seem to make that option not a credible nor reliable near term option.	9/01.04.00
Vol. I/Table 2.4.5.1-1/2-123	The column "minimum 4 BWR" is incorrect (see similar comment above). The GE ABWR is not listed in the "Evolutionary Reactor Types". Information on the ABWR is provided in NEDO-32351 and the ABWR should be available as an evolutionary reactor option.	10/06.02.09
Vol. I/2.4.5.2, Facility Operations/2-126	Again, "four BWRs" should be changed to "three BWRs" for partial MOX cores or "two BWRs" for full MOX designs.	
Vol. I/Table 2.4.5.2-1/2-129	Given the same fuel cycles as for LEU fuel, MOX cores should not generate additional spent fuel assemblies (as compared to typical LEU cores).	
Vol. I/Table 2.5-2a/ 2-255	If core management philosophy is unchanged, spent nuclear fuel generation would NOT increase by the 23 *t* for BWRs. DOE's assertion does not appear justified.	8/09.11.08 cont.
Vol. II/4.3.5.2.10, 3rd para./4-692	DOE appears incorrect in concluding that the number of discharged fuel bundles is higher for a MOX core than the typical LEU core. This paragraph raises the concern of increased waste and storage requirements for MOX fueled reactors that can be considered neither accurate nor justified.	
Vol. II/4.3.5.5/4-769	This paragraph might infer that there are CANDU reactors within the United States.	11/16.00.00

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09 11 08 **Comment Number 8**

MOX fuel used in the Existing LWR would remain in the reactor until sufficient burnup is achieved to meet the Spent Fuel Standard. This would be shorter than conventional uranium fuel cycles which remain in the reactor to achieve full economic value. MOX fuel will be withdrawn before full burnup is achieved and therefore more spent fuel will be generated. This assumption was used in order to bound the impacts for spent fuel generation and storage. It also would dispose of the excess weapons-usable fissile materials as quickly as possible. If the core management philosophy is different from the assumption used in the PEIS, as noted by the commentor, the resultant environmental impacts would be less. The facility operations section of Chapter 2 of the Final PEIS for the Reactor Alternatives acknowledges that there would be a range in the amount of MOX throughput dependant upon the reactor types and fuel management.

01 04 00 **Comment Number 9**

Comment noted.

06 02 09 **Comment Number 10**

The PEIS has been changed to reflect that 3 to 5 LWRs would be required to accomplish the mission in approximately 25 years and starting up in 10 to 12 years. The Technical Summary Report issued by DOE in July 1996 provides more details.

16 00 00 **Comment Number 11**

Comment noted. Text was changed to improve clarity.

GENERAL ELECTRIC COMPANY, SAN JOSE, CA,
EDWARD EHRLICH
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Vol. III/H.4/H-7	The GE Advanced Boiling Water Reactor is designed for MOX fuels, and therefore should be included in this discussion. The PWR discussion in Section H.5 includes all three LWR options.	12/06.04.08
Vol. III/H.4.1/H-7	Dependent upon the DOE decision to pursue partial or full MOX cores, less than four (4) BWRs can accommodate this mission.	10/06.02.09 cont.
Vol. III/H.4.3/H-8	The figures referenced in the paragraphs on criticality and thermal are reversed.	13/16.00.00
Vol. III/App. N, 4th para./N-1	This is a confusing paragraph since BWR fuel designs also use burnable poison rods.	14/06.00.08

F-021

06 04 08 **Comment Number 12**

Section H.4 addresses the existing and partially completed LWRs and Section H.5 addresses the existing, partially completed, and evolutionary LWRs. The General Electric (GE) evolutionary LWR was not addressed in the PEIS but would give comparable results. Additional analyses on the spent nuclear fuel disposition would be completed if the Evolutionary LWR Alternative is selected.

16 00 00 **Comment Number 13**

The commentor is correct. The figures referenced in Appendix H were changed for the Final PEIS. A consistency check was performed on the Final PEIS as a part of the Quality Assurance Procedure.

06 00 08 **Comment Number 14**

The paragraph in Appendix N has been revised in the Final PEIS for clarity.

GEORGIA INSTITUTE OF TECHNOLOGY, NUCLEAR ENGINEERING PROGRAM, ATLANTA, GA, W. M. STACEY AND J. A. FAVORITE
PAGE 1 OF 3

A PROPOSAL FOR PLUTONIUM DISPOSITION*

W. M. STACEY
J. A. FAVORITE
NUCLEAR ENGINEERING PROGRAM
GEORGIA INSTITUTE OF TECHNOLOGY
APRIL, 1996

PROCESS WEAPONS-GRADE PLUTONIUM IN A VOLUMETRIC NEUTRON IRRADIATION FACILITY TO BUILD UP HIGHER ACTINIDES AND FISSION PRODUCTS SUFFICIENT TO DETER DIVERSION OR THEFT FOR WEAPONS PRODUCTION	1/14.00.00
STORE THE IRRADIATED PLUTONIUM FOR EVENTUAL USE AS A FUEL IN COMMERCIAL NUCLEAR REACTORS	2/08.03.01

* BASED ON A DESIGN STUDY PERFORMED BY A GEORGIA TECH NE&HP DESIGN TEAM AND PUBLISHED IN FUSION TECHNOLOGY, 27, 326, 1995.

M-133

14 00 00 **Comment Number 1**

A fusion-induced neutron flux would not be available until 2015 as described in the comment. This timeframe would not be consistent with the purpose of and need for disposition of Pu to reduce proliferation. In addition, this technology is immature compared to existing fission reactor technology. Several other new reactor technologies were eliminated for similar reasons, as described in Chapter 2 of the PEIS.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

GEORGIA INSTITUTE OF TECHNOLOGY, NUCLEAR ENGINEERING PROGRAM, ATLANTA, GA, W. M. STACEY AND J. A. FAVORITE

IRRADIATION OF WEAPONS GRADE Pu TO 115 Mwd/kg (11% ^{240}Pu) IS SUFFICIENT TO DETER THEFT.

A VOLUMETRIC NEUTRON SOURCE CAPABLE OF PRODUCING 10^{21} n/s AND A FAST NEUTRON FLUX OF $2x10^{15}$ n/cm^{2}s OVER AN IRRADIATION VOLUME OF ~60m^3 CAN PROCESS ~10 TONNES PER YEAR OF Pu.

A FUSION NEUTRON SOURCE, BASED ON THE TECHNOLOGY THAT IS BEING DEVELOPED FOR ITER AND THE FUSION PHYSICS THAT WILL BE DEMONSTRATED IN ITER (2008-2015), CAN PRODUCE A DISTRIBUTED NEUTRON SOURCE OF 10^{21} n/s.

1/14.00.00 cont.

A CONCEPT FOR A ~60m^3 IRRADIATION FACILITY HAS BEEN DEVELOPED, BASED ON EXISTING NUCLEAR FUEL TECHNOLOGY, LIQUID LITHIUM COOLING AND A REFRACTORY METAL STRUCTURAL MATERIAL.

THE IRRADIATION FACILITY WOULD BREED THE NEEDED FUSION FUEL (TRITIUM) AND PRODUCE 2700 MW ELECTRICAL POWER.

A FUSION-BASED IRRADIATION FACILITY FOR Pu PROCESSING COULD BE BROUGHT ON LINE IN 2015-25, OR EARLIER WITH AN ACCELERATED PROGRAM.

THE IRRADIATION FACILITY AND THE TEMPORARY STORAGE FACILITY FOR THE PROCESSED Pu WOULD BE ON A GOVERNMENT SITE.

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A TRANSMUTATION FACILITY FOR WEAPONS-GRADE PLUTONIUM DISPOSITION BASED ON A TOKAMAK FUSION NEUTRON SOURCE

KEYWORDS: *plutonium disposal, plutonium transmutation, fusion transmutation facility*

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Received September 23, 1994
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It is suggested that weapons-grade plutonium could be processed through a transmutation facility to build up sufficient actinide and fission product inventories to serve as a deterrent to diversion or theft during subsequent storage, pending eventual use as fuel in commercial nuclear reactors. A transmutation facility consisting of a tokamak fusion neutron source surrounded by fuel assemblies containing the weapons-grade plutonium in the form of PuO_2 pebbles in a lithium slurry is investigated. A design concept/operation scenario is developed for a facility that would be able to transmute the world's estimated surplus inventory of weapons-grade plutonium to 11% ^{240}Pu concentration in ~25 yr. The fusion neutron source would be based on plasma physics and plasma support technology being qualified in ongoing research and development (R&D) programs, and the plutonium fuel would be based on existing technology. A new R&D program would be required to qualify a refractory metal alloy structural material that would be needed to handle the high heat fluxes; otherwise, extensions of existing technologies and acceleration of existing R&D programs would seem to be adequate to qualify all required technologies. Such a facility might feasibly be deployed in 20 to 30 yr, or sooner with a crash program.

I. INTRODUCTION

It has been estimated that 100 to 260 tonnes of weapons-grade plutonium (>93% ^{239}Pu) exists in the form of nuclear warheads and in processing and storage systems.[1,2] An even larger quantity, ~1400 tonnes, of highly enriched weapons-grade uranium exists.[2] Under the conditions of the Strategic Arms Reduction Treaties I and II, ~90 tonnes of weapons-grade plutonium and 450 tonnes of highly enriched uranium in the United States and the former Soviet Union will become surplus to military needs as weapons are dismantled over the next decade.[2,3] There is a substantially larger civilian stockpile, ~780 tonnes, of reactor-grade (^{239}Pu admixed with large fractions of higher transuranics) plutonium[2] of which ~80% is in the form of spent fuel, although ~135 tonnes has been separated for reuse in fission reactors.[2]

The disposition of all of this plutonium and highly enriched uranium is a pressing international concern. The security of approximately one-half of the weapons-grade plutonium and uranium that was in the custody of the former Soviet Union is of particular concern; some 25 tonnes cannot be accounted for.[2] The threat of some of this material falling into the hands of unauthorized parties (terrorists groups or irresponsible governments) is quite palpable. Even if the security is improved substantially, these large stockpiles of highly enriched, weapons-grade materials would remain a tempting target for diversion or theft. For the uranium,

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GERRELLS, ELSWORTH, SAN JOSE, CA
PAGE 1 OF 8

May 7, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786.

Dear Sirs:

My comments on the February 1996 Draft Programmatic Environment Impact Statement for the Disposition of Weapons-Usable Fissile Materials are attached.

Yours Truly,

Elsie Gerrells

Elsworth Gerrells
1145 Holy Ann Place
San Jose, CA 95120

F-038

Comments on DRAFT Programmatic Environmental Impact Statement for the Storage and Disposition of Weapons Useable Fissile Materials

(Comments apply to the storage and disposition of excess weapons plutonium.)

Timeliness, Reliability, Costs -Risk Effectiveness

The PEIS fails to take into account the potential costs and environmental impact of the most significant risk factor associated with the plutonium disposition program. That is the risk and impact of the divergence or theft of that weapons useable material from the Russian stockpile. 1/01.06.00

Programs underway to establish a better inventory and more reliable physical security over the Russian weapon materials are potentially piecemeal and band-aid activities with uncertain results.

At an April 8,1996 CSIS forum in Washington DC chaired by Dr. James Schlesinger, some key findings with respect to the threat of nuclear material in Russia included:

- threat is escalating,
- desperate, corrupt insiders are a serious threat
- military controls lessening
- finances are short
- trafficking trend is upward
- the threat outpacing security improvements, even with U.S. financial help
- smuggling routes are numerous, shifting through the Caucasus, Europe, Central Asia
- Russian organized crime is involved now - a dangerous mix of power, greed, corrupt officials/military
- countermeasures are expensive - a need to secure at the source
- protection at source paramount, but post-theft measures needed also
- neutralization is worst option - when conducted abroad, political and safety risks abound, capabilities limited.

Recommendations by the task force included:

- sustained funding and long term vision
- institutional measures
- bilateral safeguards (for material removed from warheads)
- the U.S. needs development of an indigenous safeguards culture in the former Soviet Union - not brought in from Los Alamos and put there

At the forum, Mr. Graham Allison urged that focus should be the "loose nukes" (the bomb-making nuclear materials). He concluded we are living on borrowed time.

F-038

01 06 00 Comment Number 1

The purpose of the Proposed Action is, in part, to establish the technical and program infrastructure that will enable the United States to take unilateral action or negotiate reciprocal actions with other nations for the disposition of surplus weapons-usable Pu. This PEIS addresses the environmental impacts of the reasonable alternatives for DOE's Proposed Action. Analyses of the cost, schedule, technical, and Nonproliferation Policy impacts are described in separate documents to support DOE's ROD. The documents related to technical, cost, and schedule analyses were made available for public review beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the analysis of the Nonproliferation Policy as it relates to the Proposed Action and alternatives.

Comments on DRAFT Programmatic Environmental Impact Statement for the Storage and Disposition of Weapons Useable Fissile Materials

(Comments apply to the storage and disposition of excess weapons plutonium.)

Timeliness, Reliability, Costs -Risk Effectiveness

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- Russian organized crime is involved now - a dangerous mix of power, greed, corrupt officials/military
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At the forum, Mr. Graham Allison urged that focus should be the "loose nukes" (the bomb-making nuclear materials). He concluded we are living on borrowed time.

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Record of Decision. Therefore these cost differentials between options under consideration should be meaningless when compared to the cost of the proliferation and threat risk. In that context, the overriding cost-benefit analysis clearly makes the most effective, reliable and timely solution available the desirable option. An overriding cost-benefit advantage of the light water reactor option is its assurance that the threat to national security could be reliably and effectively addressed in the short time frame intended, and the light water reactor option should therefore merit DOE support, and given those same considerations, other widespread public and political support. 2/08.03.01

Recognizing this, the National Academy of Sciences urged that costs should not be a major factor in getting on with the Pu disposition program and that a timely and reliable response should be primary.

The environmental impact of a clandestine nuclear device even if only hidden or if exploded in a U.S. city, would have an overwhelming environmental impact compared to some of the trivial issues being studied and elevated to equal consideration in the PEIS. Even a credible threat of a nuclear device by a sub-national terrorist group could cause serious social dislocation.

Timeliness, reliability, and cost-risk effectiveness do not appear to be valued in DOE's PEIS evaluation. Since early 1994 and again since then, the National Academy of Sciences has strongly urged the DOE to expedite the disposition activity. They recognize the "clear and present danger" of divergence or "breakout" of Russian nuclear material. | 3/08.03.00

DOE's actions to-date do not reflect the sense of urgency or timeliness in implementing a meaningful disposition program as recommended by the National Academy. Since 1993, resources have been directed to studies, and then more studies, and time and money have been expended on consideration of options with little real potential or technical value and with high technical, cost, and schedule risks. The PEIS and ROD originally advertised by DOE as intended for expedited completion in mid-1996, has been underfunded and most likely, intentionally delayed until after the presidential elections. Even now, resources are being committed or used by DOE on prototype technical activities which could have little real impact on accelerating a meaningful disposition effort but which appear to be undertaken to facilitate the opportunity to make grand but bogus claims of progress, solely to further political purposes in an election year. The PEIS spends years and millions of dollars considering endangered wildlife species and the minute distinctions of potential economic discrimination between the various options. DOE would be better to consider the impact of the delay and underfunding that has occurred in the disposition program on the economic discrimination that would befall all the citizens of any major population center targeted by a terrorist nuclear device, and also the risk that the citizens of that target location could become another endangered species. | 4/01.00.00 | 5/08.00.00

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08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 00 **Comment Number 3**

The time required to implement and complete the Proposed Action under each of the alternatives is included in this PEIS. A detailed schedule, reliability, and cost information have been included in a separate Technical Summary Report. Information on environmental impacts in this PEIS along with technical, cost and schedule information in the Technical Summary Reports, and other information will be provided to the decisionmaker.

01 00 00 **Comment Number 4**

The schedule analysis, along with the cost, technical, and Nonproliferation Policy analyses on the Proposed Action and reasonable alternatives, is presented in separate documents to support the DOE's ROD. The documents related to technical, cost, and schedule analyses were available for public review beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996. The ROD is expected in late 1996.

08 00 00 **Comment Number 5**

Comment noted.

DOE's technical staff clearly and very early identified a dual track approach of (1) converting the bulk of the excess weapons useable Pu materials to mixed oxide fuel and dispositioning it in existing LWRs, and 2) developing some form of vitrification technology for encapsulating smaller quantities of low level Pu from waste steams and scrape Pu that are not suitable for LWR fuel. These are the best available mix of technology and industrially reliable capabilities.

DOE funding should be directed toward accelerating the LWR option which addresses the bulk and weapons useable material while also sustaining a lower level of vitrification activities to address the smaller quantity and less-useable, and therefore less threatening, Pu wastes. 6/08.03.01

Consideration of Vitrification as a single solution for all U.S. excess material does not represent a credible or reliable and unrecoverable option. There are serious environmental and nuclear criticality uncertainties associated with the vitrification of large quantities of fissionable material. 7/08.03.01

There are also so may developmental uncertainties and production reliability concerns with all vitrification options such that the risk of it never providing a reliable bulk conversion option are very great. The vitrification options are considered experimental even by those who advocate their development. There is significant risk in the cost and schedule and successful resolution of technical issues even in an R&D phase in bringing those options to a prototype state. The costs, schedule and program risks are even greater when the prototype technology needs to be expanded and relied upon for the production disposition mission. If the eventually industrial reliability might be only 35-60 % , would it be viable ? Can DOE truly expect to estimate what the O&M costs of production are for a vitrification program ? 8/05.01.08

Furthermore, DOE's own scientists at LANL have published that recovery of Pu from vitrified forms is a simple chemical process and easily achievable. This makes vitrification less of a barrier than the LWR spent fuel option and also must have less credibility for encouraging a reciprocal bilateral program with Russia for that same reason. Therefore, the bulk of the weapons usable material should be dispositioned by the LWR option which is the only option that achieves an isotopic change of weapons usage forms of plutonium and increases the undesirable Pu 240 content and reduces overall the amount of Pu by about 1/3 in a once through cycle. 6/08.03.01 cont.

Proliferation and Technology Issues

At a guest lecture tour through the U.S. in April '96 by a noted expert on Plutonium, Prof. Wolfgang Stoll of Germany; Professor Stoll offered a foreign view of U.S. non-proliferation tactics.

Prof. Stoll offered that the U.S. is undermining its ability to achieve a timely disposition program for weapons usable materials if it rejects MOX fuel technology as a means of

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08 03 01 Comment Number 6

The Department of Energy acknowledges the commentor's support for the implementation of both the Reactor and Immobilization Alternatives. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 7

The Department of Energy acknowledges the commentor's opposition to the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

05 01 08 Comment Number 8

Further information on the technical viability, schedule, and costs of the Immobilization Alternatives is provided in the Technical Summary Report and related Immobilization Alternative Summary Reports published in July 1996.

dispositioning weapons materials. There is reluctance by some to proceed with disposition of weapons material through burning of MOX because of misinformed expectation by anti-nuclear idealists that if the U.S. does not use the technology, then it will also not be used by others for commercial purposes. Prof. Stoll assured his American audience that other nations are already far ahead of the U.S. in MOX fuel technology, commercial use, and experience with it, and that they will continue to pursue and use that technology to meet their spent fuel disposal and long term energy independence commitments and plans in safeguarded and proliferation resistant programs.

In fact, by not participating in MOX technology, the U.S. is abandoning it's technological leadership to others and will cease to have a voice or influence over the non-proliferation considerations of those programs. The U.S. expectations were characterized as naive, as the U.S. very mistakenly expects the rest of the world to unfailingly march to the beat of our drum. It was suggested that, instead, the U.S. would have much more influence and control over MOX technology by being the technology leader in that discipline, and where the U.S. might be able to turn technical support on or off to control the use of the technology in appropriately safeguarded and non-proliferation committed programs.

In subsequent discussions, it was noted that facilities and production processes for MOX fuel that would be used in a U.S. disposition program could be designed so it would be highly impractical to consider the use of those same facilities for the highly irradiated recycled Pu that would be considered if a commercial MOX program were intended. Furthermore, the facility could be designed for convenient decontamination from low exposure weapons grade Pu and built-in decommission considerations could be designed in so that could be readily achieved upon termination of the disposition program. It is also relevant to explain to the political opponents of LWR disposition that the U.S. disposition program is going to be limited program with only a few plants participating into order to achieve rapid and reliable disposition of weapons for a strategic non-proliferation goal and it is in no way oriented to promote the commercial use of MOX. There are "professional " protest lobbies (Greenpeace for one) that would decry any and all DOE disposition options and especially the LWR option; while others recognize the facility of the LWR option and decry the environment risks of geological disposal of vitrification products. Yet they offer no alternate solution to the environmental threat of doing nothing and the role they play in further delaying meaningful disposition.

Involved locales and common sense public good

Some professional environmental protesters would have the DOE abandon consideration of all near term options and spend additional decades in R&D on "still unidentified, ultimate disposition methods" which, of course, must have no potential for environmental impact. Pursuing a longer term solution for the much less threatening proliferation risk from reactor grade plutonium, instead of focusing on the near term

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security issues stemming from weapons grade plutonium, could result in the proverbial "locking of the barn door after the horses are stolen".

Few activities, if any, undertaken in modern industrial society have no risk. Society chooses to drive automobiles despite 50,000 traffic fatalities yearly. The risks of no action and action too long delayed are much greater than those highly improbable risks that some would demand we avoid in arriving at a record of decision and getting on with the program as expediently as practical. 9/08.03.01

When the general public and their political representatives are given these facts through public meetings and other information initiatives which the Department of Energy should be undertaking, and when they are made aware that the use of MOX fuel in reactors to convert weapons usable materials to spent fuel is a quick, reasonable and practical solution to the threat of diversion and otherwise relatively easy reuse that might be achieved with other options, the LWR option should win broad public and political acceptance.

Public responses at PEIS public scoping meetings in 1995 and this year's draft PEIS comment meeting have clearly demonstrated broad community support in those locales that are candidates for Pu disposition activities. There have been significant expressions of state and local level political and public support. The candidate communities are knowledgeable of the real nature of the plutonium hazard, (not the hyped hysterics that some portray) have favorable experience with plutonium activities, are comfortable with the real issues of plutonium handling and processing activities which will be common to all disposition options, and are confident in the ability of well-managed organizations to conduct the program safely and in an environmentally sound way. Particular locations which have had poor experiences with DOE facilities, or those with a well-established culture of opposition by special interests to DOE and nuclear-related operations are clearly not being considered as sites for program activities and should therefore not be a factor. A key, therefore, to achieving an accurate and meaningful public consensus lies in appropriately identifying and obtaining a consensus of those local and regional stakeholders who are truly affected. 10/08.02.00

Because U.S. national security is potentially affected by a lack of action as much as by specific actions taken in addressing this excess weapons material threat, special interests and/or bias and ideological critics who would seek to block the program with protests in the name of having "a higher vision " than the rest of us, or even by legal challenges, despite it otherwise being a broad-based acceptable solution, are doing a gross disservice to our county. The overwhelming public interest clearly lies in implementing an effective and timely solution. A solution which has broad public and political consensus, which is being hampered by a limited special interest challenge, has a strong argument for passing over those objections, especially when they are clearly politically motivated, largely procedural, filled with slanted and inflammatory "scare tactic rhetoric" or otherwise without substantive merit, considering the all the risks and options.

F-038

08 03 01 **Comment Number 9**

The Department of Energy acknowledges the commentor's opposition to the No Action Alternative. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 02 00 **Comment Number 10**

Comment noted. However, the storage and disposition of weapons-usable Pu is an issue of national interest. NEPA requires full public participation, and all comments receive equal consideration.

DOE disposition actions must remain focused on the nature and potential of the immediate threat of divergence of weapons useable materials and the timeliness and reliability of the response and solution to the threat offered by the proposed options, and not on "micro" issues of cost, support or non-support of nuclear power, value or use of the Pu material, and local or regional economic or political interests. | 11/01.03.00

The LWR option would seem to be the only credible option for the U.S. to offer the Russians to enter into a bilateral program. Anything that does less, does nothing to reduce the threat of diversion of Russian material which will remain at risk until converted into a form not readily useable in weapons. | 12/01.03.00

F-038

01 03 00 **Comment Number 11**

Comment noted.

01 03 00 **Comment Number 12**

Comment noted. All Reactor Alternatives analyzed in the PEIS are viable options that would serve the same purpose the commentor described.

GILBERT, KIM
PAGE 1 OF 1

May 29, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

To whom it may concern;

I am writing to express my concern about the U.S. Department of Energy consideration of processing plutonium at Hanford. Hanford should be cleaned up, not expanded.

Already, nuclear waste is leaking into the Columbia River and the billions of dollars that have been spent on cleaning it up have been wasted on bureaucracy rather than actually cleaning it up. 1/08.03.01

This is a very dangerous area and we seriously protest any discussion or ideas of using the area further!

Sincerely,

Kim Gilbert

M-246

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Hanford. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

3902 Loblolly Trail
Martinez, Georgia 30907
May 1, 1996

U. S. Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
Washington, D.C. 20026-3786

Dear Sir:

I attended the public meeting for the EIS for the Storage and Disposition of Weapons Materials held in North Augusta, SC, on April 31, 1996. Of the three options discussed, storing the materials and then disposing of them as fuel for commercial reactors appears to me to be clearly the preferred and most desirable disposal method. Since some commercial electric utilities are interested in using the materials as fuels, the materials should then be treated as an asset and not as junk or waste as is the apparent assumption used when considering the vitrification or bore hole disposal methods. Considerable sums of taxpayers money have been spent refining these materials. It seems ludicrous to me to spent additional money disposing of the materials without even attempting to recover any asset value that the material now has. 1/08.03.01

Of the three disposal methods, I would consider the bore hole method as being the least desirable. All to often technologies believed to be inherently safe have been found with time to have unwanted attributes. It would seem to me that if after burying these materials in deep holes and an undesirable condition is found after time, recovery of the materials may be close to impossible and very costly at the least. 2/08.03.01

Again, I wish to express my opinion that disposal of the material as fuels for commercial electric power reactors is a much preferred alternative over disposing of the materials as waste.

Joseph M. Gilkison

M-114

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

GOERGEN, CHARLES R., AIKEN, SC
PAGE 1 OF 1

May 6, 1996

Storage and Disposition of Weapons-Usable Fissile Materials Draft PEIS Public Comment
Charles R. Goergen
510 Boardman Road
Aiken, SC 29803

I am providing this comment to support the a mixture of options for disposition of weapons-usable fissile materials, specifically plutonium. These are based on the following premises:

- Plutonium should be considered a national asset rather than a liability.
- The disposition should not be disposal.
- The plutonium should be used for maximum realization of its energy value.
- There need not be a rush to achieve ultimate disposition of the plutonium.

The long-term disposition of plutonium should be production of energy. The reactor design should maximize the output of usable energy rather than a short term irradiation to transform some material and isotopically dilute the rest. This need not be achieved in the next decade or two. Research and design could be carried out at a pace that current budgetary limits support. As an analogy, the United States has many crude oil wells that are capped because they are currently uneconomical to pump. However, the will come a time in the future that cheap foreign oil is not available and it will be tapped. Until that time comes for plutonium I support a long term storage alternative. 1/08.03.01

Stabilization of plutonium solutions, scrap and residues per the Defense Nuclear Facilities Safety Board (DNFSB) 94-1 Implementation Plan and the Plutonium Vulnerability Management Plan should be vigorously pursued to achieve a form that meets the Criteria for Safe Storage of Plutonium Metals and Oxide. The current inventory of excess plutonium "pits" removed from nuclear weapons when packaged in the AT-400A package will achieve the long term storage standard. The storage standard form is intended to last a minimum of 50 years. This can give the U.S. an adequate period of time to develop the best reactor disposition alternative in a cost-effective manner.

The U.S. should consolidate its excess plutonium storage to a single site under full International Atomic Energy Agency (IAEA) safeguards per the intent of the Non-Proliferation Treaty. If we expect the IAEA to ensure inspected countries are not diverting material, it should be trusted to safeguard American materials. International inspections should be the method by which Americans assure the world that this material will not be reused in weapons. A new storage facility should be built that incorporates the latest and best in monitoring and surveillance techniques. The facility should be expandable in modular fashion to accommodate and facilitate any international agreements for the U.S. to safeguard other countries' inventories. It should be able to be used as a blueprint for building duplicates in other countries. Application and demonstration of exemplary safeguards until eventual disposition use has the highest likelihood of being emulated by foreign governments. 2/08.03.01

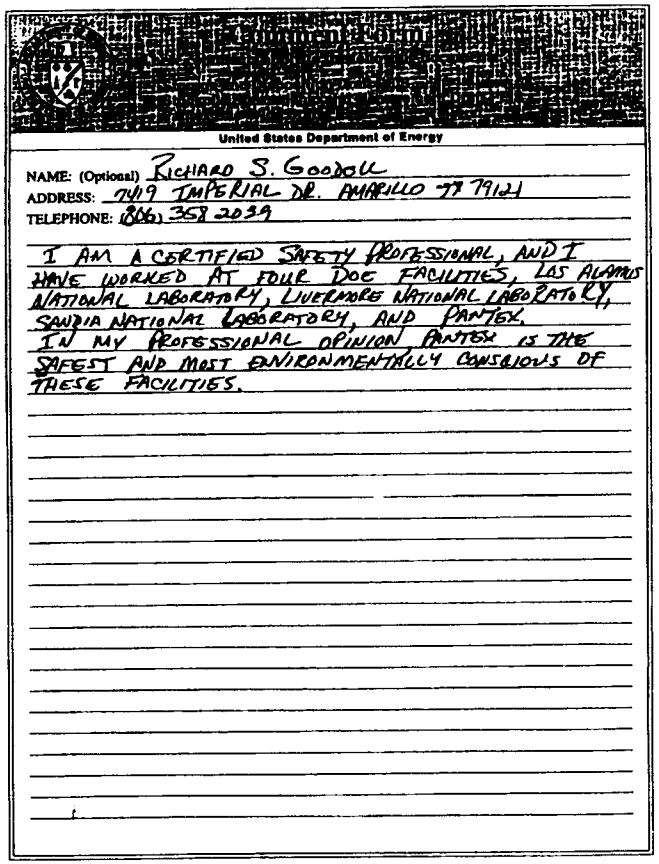
F-020

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for new facilities for long-term storage of weapons-usable fissile materials. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



United States Department of Energy

NAME: (Optional) RICHARD S. GOODELL
ADDRESS: 7419 IMPERIAL DR. AMARILLO TX 79121
TELEPHONE: (806) 358 2039

I AM A CERTIFIED SAFETY PROFESSIONAL, AND I HAVE WORKED AT FOUR DOE FACILITIES, LAS ALAMOS NATIONAL LABORATORY, LIVERMORE NATIONAL LABORATORY, SANDIA NATIONAL LABORATORY, AND PANTEX. IN MY PROFESSIONAL OPINION PANTEX IS THE SAFEST AND MOST ENVIRONMENTALLY CONSCIOUS OF THESE FACILITIES.

1/08.03.01

TX-044

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

GOODWIN, MARIAN, BLACKFOOT, ID
PAGE 1 OF 1

Comment ID: P0006
Date Received: April 18, 1996
Name: Marian Goodwin
Address: 455 South Street
Blackfoot, ID 83221

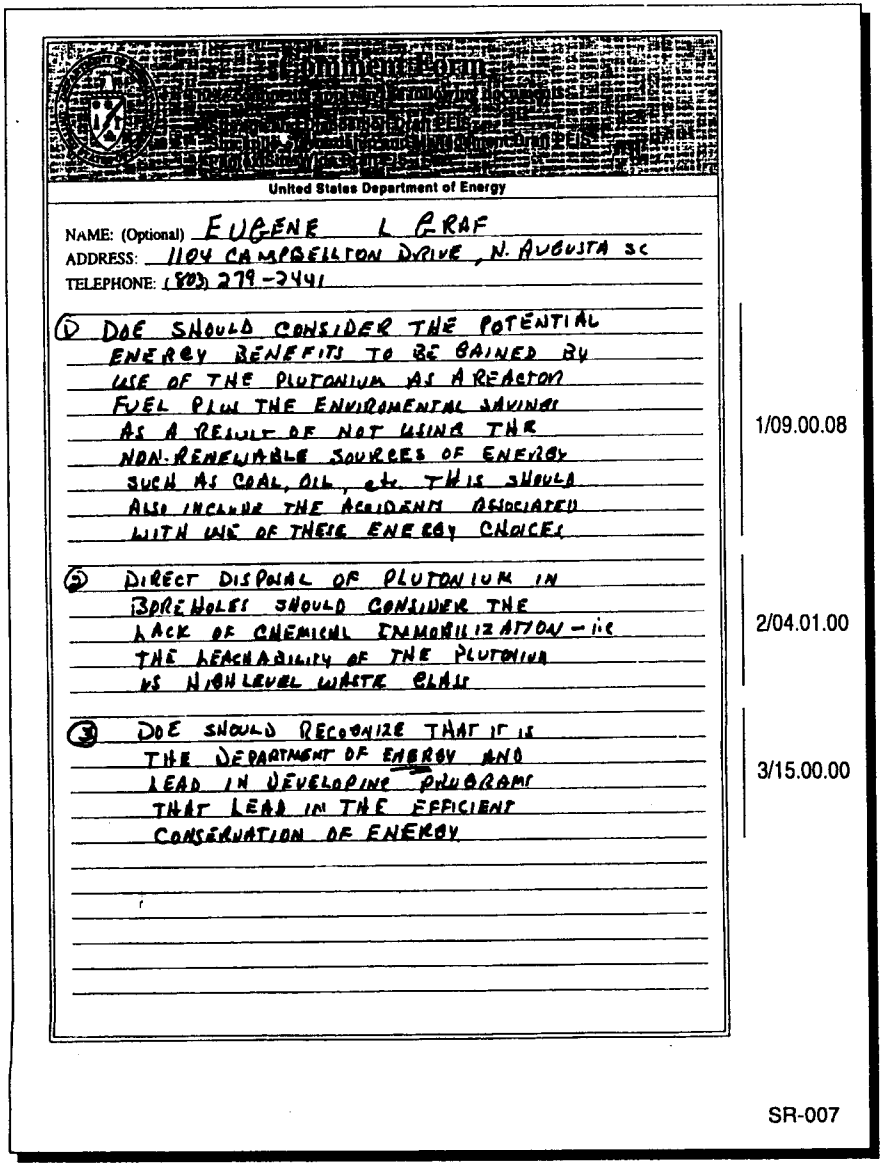
Transcription:

I just want to say that I'm in full support of the INEL and would like to see programs implemented out there to keep the thing going. And I'd also like to say that I'd like to apply for a job when there's an opening. I have a degree in waste management and biology and I can be reached at 208-785-8616 (day) and 208-684-3569 (after 3:30pm). Anyway, I just want to say I'm in support of the INEL. Thank you. | 1/08.03.01

P-006

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for additional missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



Comment Form

United States Department of Energy

NAME: (Optional) EUGENE L GRAF
ADDRESS: 1104 CAMPBELLTON DRIVE, N. AUGUSTA SC
TELEPHONE: (803) 279-2441

(1) DOE SHOULD CONSIDER THE POTENTIAL ENERGY BENEFITS TO BE GAINED BY USE OF THE PLUTONIUM AS A REACTOR FUEL PLUS THE ENVIRONMENTAL SAVINGS AS A RESULT OF NOT USING THE NON-RENEWABLE SOURCES OF ENERGY SUCH AS COAL, OIL, etc. THIS SHOULD ALSO INCLUDE THE ACCIDENTS ASSOCIATED WITH USE OF THESE ENERGY CHOICES

1/09.00.08

(2) DIRECT DISPOSAL OF PLUTONIUM IN BOREHOLES SHOULD CONSIDER THE LACK OF CHEMICAL IMMOBILIZATION - i.e. THE LEACHABILITY OF THE PLUTONIUM VS HIGH LEVEL WASTE GLASS

2/04.01.00

(3) DOE SHOULD RECOGNIZE THAT IT IS THE DEPARTMENT OF ENERGY AND LEAD IN DEVELOPING PROGRAMS THAT LEAD IN THE EFFICIENT CONSERVATION OF ENERGY

3/15.00.00

SR-007

09 00 08 **Comment Number 1**

Based on comments received, several sections of the Final PEIS include additional analyses. These sections (in Section 4.9) include Impacts on Uranium Mining and Nuclear Fuel Cycle Industries, Avoided Environmental Impacts of Using MOX Fuel Instead of Traditional Low-Enriched Uranium Fuel in Nuclear Power Plants, and Avoided Environmental Impacts of Using Nuclear Power Plants Instead of Fossil Fuel Power Plants. The Avoided Environmental Impacts of Using MOX Fuel Instead of Traditional Low-Enriched Uranium Fuel in Nuclear Power Plants section in the Draft PEIS includes the health impacts avoided to the public and workers for the mining and milling industries. Other avoided impacts to air quality and waste generated were added to the Final PEIS.

04 01 00 **Comment Number 2**

Comment noted.

15 00 00 **Comment Number 3**

Comment noted.

GRAMSTORFF, JEANNE B., FARNSWORTH, TX
PAGE 1 OF 1

Box 250
Farnsworth, TX 79033
April 22, 1996

Department of Energy
1000 Independence Avenue, S. W.
Washington, D. C. 20585
Dear Sirs:

I oppose the use of the Pantex Plant near Amarillo, Texas, for a permanent nuclear waste facility, particularly the processing of plutonium at this site. 1/08.03.01

The Pantex Plant has already contaminated perch water under and near its facility, and endangers neighbors who use the Ogallala ground water for irrigation. Drawing water from the area, as ground water wells do for the water in Amarillo, and for irrigation, draws water to those wells from the area. It will not be long before contaminated water shows up in Amarillo's water supply. We cannot afford to add the dangers of plutonium and permanent nuclear waste storage to this already present danger. The Ogallala is the only water available to the entire Texas Panhandle. When it is contaminated, the area will have to be abandoned. We cannot afford another Rocky Flats pollution disaster in this area. 2/09.04.04

Sincerely,

Jeanne B. Gramstorff

Jeanne B. Gramstorff

M-238

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 04 04 **Comment Number 2**

Waste/hazardous material treatment/handling operations are regulated to minimize the potential for releases of hazardous substances to the soil or surface water which could then migrate to the groundwater.

GREENPEACE

PRELIMINARY COMMENTS ON PLUTONIUM DISPOSITION PEIS
April 18, 1996
Greenpeace International

The task of what to do with weapons plutonium produced during the Cold War is a formidable one. We recognize that the process of making and implementing a "disposition" option could likely be an arduous one, with disagreements along the way, but it is clear that the process must lead to one main goal: a world more secure from the threat of continuing proliferation of stockpiles of weapons-usable plutonium.

The plutonium dilemma that now confronts us in the US is yet another legacy of misguided Cold War policies; we must not allow steps which have been made away from the threats of the nuclear arms race to be reversed. In only one way it is good that we are currently faced with the problem of what to do with the plutonium removed from nuclear weapons: the process of disarmament as required under the Nuclear Nonproliferation Treaty (NPT) has finally begun.

START III and Beyond

Given the growing demand by the international community that NPT disarmament obligations be met, the stockpile of plutonium removed from weapons will only grow. The U.S. now faces the challenge to show that it can meet its treaty commitments and quickly move far beyond the high level of nuclear weapons negotiated under the START II agreement. Deep cuts and then elimination of nuclear weapons will lead to a stockpile of so-called surplus plutonium of almost 100 tonnes. 1/01.03.00

The decisions made about what to do with this dangerous material must be made with deliberate and thoughtful analysis. But it appears that the Department of Energy has begun an Environmental Impact Statement process which is lacking in both analysis and depth. DOE must return to the drawing board and newly prepare this document with full consideration given to the global proliferation implications of the disposition decision.

Proliferation Impacts Ignored

While it is of utmost importance to irreversibly remove the plutonium from weapons, what is done with the material will have far-reaching international proliferation impacts. Although it is widely agreed that the meeting of a "high-level waste standard" 2/01.06.00

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DC-002

01 03 00 Comment Number 1

Although Strategic Arms Reduction Talks (START) II protocol nuclear-weapons levels are beyond the scope of this PEIS, global proliferation concerns and the need to encourage reciprocal actions by Russia are integral parts of various sections of the PEIS, including the purpose and need and the Preferred Alternative. Furthermore, proliferation implications for the various alternatives and variants are evaluated in DOE's nonproliferation analysis, which was issued for public review in October 1996. DOE's ROD will be based on the nonproliferation analysis, as well as the environmental analyses, technical and economic studies, national policy considerations, and public input.

01 06 00 Comment Number 2

As explained in the response to Comment Number 1, global and domestic nonproliferation is considered in various parts of the PEIS. The purpose of the Proposed Action is, in part, to establish the technical and program infrastructure that will enable the United States to take unilateral action, or negotiate reciprocal actions, with other nations for the disposition of surplus weapons-usable Pu. This PEIS addresses the environmental impacts of the reasonable alternatives for DOE's Proposed Action. Analyses of the cost, schedule, technical, and nonproliferation policy impacts are described in separate documents, and will be considered in DOE's decision. The *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Materials Storage and Plutonium Disposition Alternatives* was made available for public review in October 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the nonproliferation analysis as it relates to the PEIS alternatives and variants.

The analysis of the nonproliferation impacts examines, among other things, the risk of theft, risk of reversal, and arms reduction impacts for the various disposition alternatives.

GREENPEACE, WASHINGTON, DC
PAGE 2 OF 7

is a goal to be strived for, it appears that the DOE has set out on a course which largely disregards both domestic and international proliferation impacts of the plutonium disposition decision.

In reading the Draft Programmatic Environmental Impact Statement, it is striking to realize that there is almost no discussion of the proliferation impact of the decision. It's almost as if the DOE has forgotten or ignored that decisions taken here will have affects far beyond our borders. As it is recognized that the National Environmental Policy Act (NEPA) must consider proliferation impacts, DOE must simply redo this document and correct its grave error of omission. In coming to a decision after such an analysis is done, DOE must choose an option which minimizes both domestic and international proliferation impacts. We feel that such a choice can also be the most environmentally sound. 2/01.06.00 cont.

"Direct Use" Material

Nowhere in the EIS is there an in-depth discussion of the dangerous nature of MOX. Unlike conventional uranium fuel, MOX is regarded by the International Atomic Energy Agency (IAEA) as well as the US Government of requiring protection due to the ease with which the weapons plutonium can be separated from the fuel. The IAEA deems MOX as being of "direct use" in nuclear weapons and the US requires military escort during transport. 3/13.00.00

As a result of the military nature of the material, reactor operators in the US or Canada using MOX would effectively become nuclear weapons storage sites. To incorporate allegedly civilian facilities into the military complex raises serious questions about theft or diversion of the material from the reactors and during transport. The public will be quite hesitant to embrace the idea that their local reactor has become a storage site for nuclear weapons materials. 4/01.04.00

MOX = Reprocessing

It appears that nowhere in the document has DOE recognized the intimate relationship between the reprocessing industry and the use of plutonium fuel (mixed oxide fuel, MOX) in nuclear reactors. Every country which uses MOX fuel is either engaged in reprocessing or has close links with the reprocessing industry. Yet, in the EIS DOE has a total memory lapse, both failing to analyze the international interconnectedness of MOX, reprocessing, and plutonium use and stockpiling as well as failing to analyze potential impacts on a potential domestic plutonium industry. 5/01.06.00

Given the dismal failure of breeder reactors, plutonium reprocessors now present MOX as the justification for

2

DC-002

13 00 00 Comment Number 3

As discussed in the *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Materials Storage and Plutonium Disposition Alternatives*, appropriate safeguards and security would be used for the various steps of the MOX process. The safeguards and security for pit disassembly/conversion and MOX fuel fabrication would likely be similar to safeguards for the weapons-usable fissile materials. Furthermore, the facilities would be inspectable by IAEA. The DOE safe secure trailer (SST) system will be utilized for the transportation of the fresh MOX fuel which includes armed nuclear materials couriers. Once irradiated, the spent MOX fuel would meet the spent fuel standard and be disposed of in a geologic repository.

01 04 00 Comment Number 4

The Reactor Alternatives would utilize a once-through fuel cycle. Spent fuel would be disposed of with other commercial reactor spent fuel. Pu would arrive at the reactor in the form of fresh fuel which could not be used in weapons without extensive reprocessing to extract the Pu. Necessary safeguards and security at the reactors would be provided. The facilities would be inspectable by IAEA, as appropriate. The nuclear reactors would not become nuclear weapons storage sites.

01 06 00 Comment Number 5

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel and the commentor's concerns about reprocessing. The President's Nonproliferation Policy says the United States will not recycle Pu. Burning weapons Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel. Thus, foreign reprocessing would not be encouraged by the Reactor Alternatives. Section 2.4.5.1 of the Final PEIS has been expanded to clarify that reprocessing would not be part of the Reactor Alternatives. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

reprocessing. What was once an imaginary dream to "complete the nuclear fuel cycle" has now boiled down to a business in search of customers. The European reprocessing companies British Nuclear Fuels (BNFL) and COGEMA are currently building up massive stockpiles of plutonium and are attempting to gain new reprocessing and MOX clients around world. Belgonucleaire is attempting to sell its MOX services to any willing client. Russia and Japan are similarly engaged in reprocessing and plutonium stockpiling with a goal to use both MOX and breeder reactors. Yet DOE has turned a blind eye to this international repr essing-MOX connection. 5/01.06.00 cont.

Likewise, the likely connection in the US between a MOX industry created by use of weapons-grade plutonium and a future plutonium economy is ignored in the EIS. The history of interest in MOX in the US, as in other countries, is also tied to the reprocessing industry, as reflected by the GESMO process and the failed West Valley, Morris and Barnwell reprocessing experiments. But in spite of the past connection in the US between MOX and reprocessing, the EIS does not stop to reflect on what the future might hold if the US pursues MOX.

MOX Contradicts US Nonproliferation Policy

In September 1993, President Clinton issued a nonproliferation policy which stated that "The United States does not encourage the civil use of plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes. The United States, however, will maintain its existing commitments regarding the use of plutonium incivil nuclear programs in Western Europe and Japan." The policy also stated that the US would "seek to eliminate where possible the accumulation of stockpiles...of plutonium" and "explore means to limit the stockpiling of plutonium for civil nuclear programs." 2/01.06.00 cont.

If implemented, a decision to use MOX will violate this policy in many ways. First, any use of MOX in the US will go far beyond encouragement of the civil use of plutonium. Second, use of MOX will be an active encouragement to reprocessors in Europe, Japan, Russia (and potentially in other countries) which have inextricably woven together the reprocessing and MOX industries. Third, any agreements reached with European MOX fabricators to either provide MOX fabrication service in Europe or to assist in MOX fabrication in the US will constitute a new (not existing) commitment which will heartily be welcomed as boost to reprocessing/MOX. 6/01.06.00 5/01.06.00 cont.

The EIS has failed to evaluate the potential violations of President Clinton's nonproliferation policy or how the policy is anticipated to be changed in the case a MOX-use decision is made. 2/01.06.00 cont.

DC-002

01 06 00 Comment Number 6

The Reactor Alternatives, which would use MOX fuel, would not contradict the U.S. Nonproliferation Policy. As explained in the PEIS, the alternatives would pertain only to surplus weapons-usable Pu, such as from dismantled weapons, and would not use or encourage the use of MOX fuel based on other sources.

GREENPEACE, WASHINGTON, DC
PAGE 4 OF 7

MOX Fabrication Facility

It is extremely unclear what would become of a MOX facility in the US once the weapons grade plutonium stockpile had been fabricated into fuel. Given the expense of such a facility and the environmental impacts which would loom after its operation, it would seem that DOE would discuss the fate of the facility once its mission was over. But it does not seem that the decontamination and decommissioning of any MOX plant is included in the EIS. By lack of such a discussion, it is implied that another mission might await such a facility once the weapon-grade stockpile was depleted. Thus, the construction of a MOX plant might serve to stimulate commercial reprocessing as part of the infrastructure to support use of the plutonium would already be in place. 7/01.06.00

By choosing a mix of disposition options including MOX, the incentive to use a MOX fabrication facility for a second plutonium fuel fabrication mission might actually increase. A two or multi-option decision would mean that less plutonium was available for MOX, thus leading to increased cost per unit. With this increased cost, the impetus to continue use of the facility with commercial weapons-usable feedstock in an attempt to recoup cost or justify the facility's construction could actually increase.

Given that the main European reprocessors could be in on operation of any US MOX facility, that a primary DOE contractor (Westinghouse Savannah River Company) at one of the leading sites for a MOX facility (Savannah River Site) has actually prepared a study as to the feasibility of commercial reprocessing, and that a section dealing with "conditioning" (reprocessing) has been included in the Nuclear Waste Policy Act of 1996, we consider that the warning signs of hidden reprocessing agendas are clear. 8/01.06.00

"Expressions of Interest"

Under the plutonium disposition EIS process, no reason can be found for the December 1995 solicitation of "Expressions of Interest" from utilities and nuclear companies for their interest in MOX. The request for EOIs was simply an expediency of the moment apart from the formal EIS process. 9/08.00.00

As has been done in the EIS, the DOE did not outline in the solicitation to the utilities the proliferation risks of MOX use in the US. And the utilities have similarly chosen to also either ignore or obfuscate the connections. Utilities responding to the solicitation have presented their goals as noble - wanting to help with weapons-grade plutonium disposition - yet their real interests clearly are pecuniary in nature. Compensation, not public service, is the motivational factor.

4

DC-002

01 06 00 Comment Number 7

A MOX fuel fabrication facility would be constructed, or the existing facility modified for MOX fuel fabrication, only for the purpose of converting weapons-usable Pu into MOX fuel to be burned in a reactor. The Pu would be consumed in a reactor using a once-through fuel cycle, then disposed of as spent nuclear fuel. No reprocessing would be involved in surplus Pu disposition, consistent with the President's Nonproliferation Policy. After completion of the materials disposition mission, the facility would either go through decontamination and decommissioning (D&D) or be converted to another mission, not involving MOX fuel fabrication or reprocessing. D&D costs are considered in the Disposition Technical Summary Report and will be included in the decisionmaking process. Furthermore, DOE will evaluate environmental impacts for decontamination and decommissioning in subsequent tiered NEPA reviews.

01 06 00 Comment Number 8

The President's Nonproliferation Policy says the United States will not recycle Pu. Burning weapons Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel. There is no "hidden reprocessing agenda."

The Westinghouse Savannah River company report referred to by the commentor was prepared to respond to a request by Congressman C. Norwood (GA). DOE did not consider the report a significant issue since this Nation's policy of not reprocessing commercial spent fuel is long standing and there is no Administration support and little Congressional interest in revisiting the issue.

08 00 00 Comment Number 9

The request for "Expression of Interest" was made to answer the question: If the Existing LWR Alternative was selected for the disposition of Pu, would there be any utilities interested in implementing the decision and under what

But while the EOIs have become an integral part of the discussion about plutonium disposition they remain apart from the EIS process. Given that DOE sought the "expressions" outside of the EIS process raises serious questions as to the legitimacy of the EIS and decision-making process itself. If the EOI process is serious and is part of the decision-making process, the reactor or facility of each and every respondee should be incorporated officially in the EIS as DOE is in practice conducting a review of the viability of the proposals as they relate to the EIS. Just as DOE sites were covered in the EIS, the private facilities now involved in the process must be brought into the EIS or the entire EIS process should begin again. 9/08.00.00 cont.

An egregious example of monetary interest at work can be seen by the offer of TEAM CANDU, led by AECL Technologies and Ontario Hydro Nuclear. This proposal is to transport MOX fabricated in Canada or Europe to the Bruce A reactor complex on Lake Huron. The idea has been presented as being acceptable to Canadians but the formal process of government approval has not begun and the public debate in Canada over this idea has only just started. That public debate is likely to be quite contentious given that weapons-grade plutonium would roll on Canada's highways and the resulting plutonium-laden spent fuel will be left in Canada. 10/01.03.00

Ontario Hydro has not been forthcoming in stating that the Bruce A reactors are in need of retubing which has been estimated to cost $300 million each. The Bruce 2 reactor was taken out of service in 1995 in order to avoid this costly expense and other major repairs and the other Bruce A reactors are scheduled for retubing beginning in the year 2000. But given the expense of the overhaul and difficulty of justifying such an outlay in an increasingly competitive electricity market, it is possible that Ontario Hydro will have to close the reactors.

Why are the financial problems of Ontario Hydro not mentioned in the Expression of Interest? Is there a desire on their part to justify the expense of retubing by pursuing the MOX mission. And will US taxpayers end up underwriting these expenses? DOE and TEAM CANDU must come forward and reveal the true condition of the reactors at Bruce A and what the anticipated repair costs are. 11/01.03.00

Similarly, if reactor problems such as being experienced by Ontario Hydro exist with the US utilities expressing interest, the EIS must fully reveal and evaluate them.

Lack of Documentation

DOE contends that it does not have to publicly release information concerning the costs of the various options until 12/08.00.00

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general conditions? The request for "Expression of Interest" in the use of existing reactors for the disposition of Pu was only one of a series of actions taken by DOE to obtain technical, cost, schedule, and policy information. That information, along with the PEIS, will be presented to the decisionmaker in order to help ensure a well-informed decision. The *Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition* (DOE/MD-0003) provides an explanation for the issuing of this request for "Expression of Interest." Should a Reactor Alternative be selected at the ROD, DOE would issue a Request for Proposal to interested parties to solicit MOX fuel fabrication facility design and construction proposals and/or proposals for burning the MOX fuel in reactors.

The disposition sites used in the PEIS for analysis are considered representative, and a combination of sites was used. Tiered NEPA reviews, as appropriate, will examine specific locations, as stated in the PEIS; specific reactor location(s) will depend, in part, on market conditions and contract negotiations. The explanation of representative sites in Section 2.1.4 of the PEIS has been expanded to provide further clarification of the approach used for the sites for the analysis of environmental consequences.

01 03 00 Comment Number 10

Should the CANDU Reactor Alternative be chosen for Pu disposition, further negotiations between the U.S. and Canadian Federal and Provincial Governments will be required before implementation, as well as business negotiations with reactor owners. In addition, according to the Canadian Government (see letter sent by the Canadian Embassy in Washington, DC, dated June 6, 1996, reproduced in this CRD) implementation would be subject to Canadian Federal and Provincial regulations, and an appropriate level of analysis by the licensee of health, safety and environmental impacts would be required before issuance of an operation license and before any decision on burning Pu in a CANDU reactor could be implemented.

01 03 00 Comment Number 11

The Department of Energy (U.S. taxpayers) will not be underwriting the expense of retubing any reactor. Selection of a specific reactor(s) would be

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just before a Record of Decision is made. We contend that both as a matter of record for the Draft PEIS as well as in compliance with a sound openness policy that such documentation must be released as soon as it is available and long before the EIS comment period closes.

As the DOE repeatedly states in the EIS that "cost-effectiveness" will be a part of the disposition decision, no tools have been provided to aid in the public in the determination of the costs of the various options. All cost and economic evaluations must no longer be kept secret and be allowed to be reviewed as part of the EIS process. 12/08.00.00 cont.

It does not appear that reference or citation is made in the EIS to important documents which must be made available to the public during the Draft EIS comment period. For example, a document prepared by AECL Technologies on the CANDU reactor option is not mentioned in the EIS. And documents pertaining to work being done between Oak Ridge National Laboratory (ORNL) and Belgonucleaire in MOX performance are not mentioned in the EIS. 13/08.00.00

Immobilization

It appears to us that the guiding hand in any decision must be that of nonproliferation linked with environmental protection. Given the risks associated with an endorsement of MOX and the plutonium economy, we believe that immobilization is the only viable disposition option. 14/08.03.01

Given a need for further research into immobilization techniques, we therefore request that DOE provide more money in FY 1997 to expand research into the various options. Given that the prime mission of the Defense Waste Processing Facility is to vitrify high-level waste and not to be used for plutonium vitrification research, we endorse the idea of a pilot vitrification plant to study the feasibility of this option. 15/05.01.06

Requests

Given the seriousness of the issue at hand and the need for a careful analysis by the public of the options presented, we hereby make the following requests:

1) That all documents pertaining to cost of the various disposition options be immediately placed in the DOE public document rooms or be publicly released as soon as they are finished and be made a part of the Draft EIS record. 16/08.01.00

2) That all documents pertaining to research into MOX use and immobilization be placed immediately in the public document rooms and be made part of the Draft PEIS record.

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through responses to Requests for Proposals and follow-on business and contract negotiations.

08 00 00 Comment Number 12

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in October 1996. These analyses, along with the environmental analysis and public input, will be integrated into DOE's decisionmaking process.

08 00 00 Comment Number 13

Based upon this comment, the index of reference materials in the DOE Public Reading Rooms was improved. Further references in the Final PEIS were checked for completeness. The documents referred to by the commentor were not cited in the PEIS. However, the AECL Technologies, Inc., *Plutonium Consumption Program, CANDU Reactor Project*, July 31, 1994 is cited in the *FMDP CANDU PEIS Data Report* which is a cited reference in the PEIS. The work between Oak Ridge National Laboratory (ORNL) and Belgonucleaire was not relied upon for the PEIS.

08 03 01 Comment Number 14

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

05 01 06 Comment Number 15

Research and development is both on-going and planned to support the disposition alternative(s). If immobilization is selected in the ROD, DOE may propose pilot facilities. Currently the can-in-canister variant of the Immobilization Alternative is being researched at the SRS Defense Waste

3) That detailed budget figures for Fiscal Years 1996 and 1997 for MOX, storage and immobilization research be made available and that all documents produced in conjunction with such research be publicly released as soon as they are available and be made part of the Draft PEIS record.

4) That the public comment period be extended until such time as pertinent economic and technical documents are made available.

16/08.01.00 cont.

Given the fact that the "Expressions of Interest" in MOX use have de facto become a part of the EIS process and that documentation associated with such expressions was not publicly available until approximately March 29, further justification exists for an extension of the comment period.

Thank you for the opportunity to submit these comments. We will submit more comments and documentation at a later date.

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Processing Facility (DWPF). Based on public comments, Appendix O has been added to the PEIS to describe this variant.

08 01 00 Comment Number 16

The Technical Summary Reports, which contain cost information for both storage and disposition, were made available to the public (and have been placed in the DOE Public Reading Rooms) in July 1996 and will be included in the decisionmaking process. Documents related to research concerning MOX fuel, storage and immobilization which are cited in the PEIS, are available in the DOE Public Reading Rooms and are part of the PEIS record.

Budget figures and research documents may be made available upon appropriate request. However, the budget is not part of the NEPA process and the budget figures are not included in the PEIS record. Research documents that are cited and relied upon in the PEIS are available in the DOE Public Reading Rooms and are part of the PEIS record.

The Expression of Interest is not part of the NEPA Process. (See response to Comment Number 9).

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TOM CLEMENTS
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GREENPEACE

April 9, 1996

Re: Draft PEIS on Plutonium Disposition

To Whom it Concerns:

I am hereby submitting the following Greenpeace document to be included in the record for the "Storage and Disposition of Weapons-Usable Fissile Materials" PEIS. The document was originally prepared for the G7 summit in Moscow on April 19 & 20, 1996.

As any decision by the U.S. Department of Energy to use mixed oxide fuel (MOX) will have grave international proliferation implications, the final PEIS must thoroughly review those implications. Internationally, the MOX industry is inextricably linked to the reprocessing industry and serves as a stimulus to further reprocessing and associated plutonium stockpiling. The PEIS must address the impact that any U.S. MOX use will have on international plutonium reprocessing and subsequent stockpiling and use as fuel. Use in the U.S. of MOX will likely serve as a global plutonium proliferation stimulus and thus the international MOX and reprocessing implications must be analyzed in the final PEIS. 1/01.06.00

While we will submit additional documents, the attached document will serve as a background on the proliferation implications of the MOX option.

Sincerely,

Tom Clements

Tom Clements
Greenpeace International
Plutonium Campaign

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01 06 00 Comment Number 1

Comment noted. The President's Nonproliferation Policy says that the United States will not recycle Pu. Burning weapons Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel. This would not be a subsidization of the nuclear industry, nor provide any further stimulus for international Pu processing.

The Department of Energy has prepared and released for public comment a report on the nonproliferation analysis of the disposition alternatives, including the Reactor Alternative using MOX fuel. A series of public meetings were held on the scope and content of the report, and to receive comments on the report. The results of this nonproliferation analysis will be included in the decisionmaking process, along with the environmental, technical, cost and schedule analyses, and other public comments.

Reprocessing of MOX fuel in foreign countries is beyond the scope of, and not encouraged by, this PEIS. The purpose of this PEIS is disposition of surplus U.S. origin weapons-usable Pu, and storage of U.S. origin weapons-usable fissile materials. The Greenpeace document referred to by the commentor is included in this CRD and is part of the Administrative Record for the PEIS.

CHERNOBYL
10 YEARS AFTER...

GREENPEACE

March 1996

PLUTONIUM AND THE NUCLEAR SAFETY SUMMIT: OUT OF CONTROL !

INTRODUCTION

The threat posed by weapons-usable fissile materials is one of the central topics for the Nuclear Safety Summit to be held in Moscow, April 19-20th, 1996 - and for good reason. Approximately 100,000 nuclear weapons worth of fissile materials (plutonium and Highly Enriched Uranium - HEU) has been produced over the past fifty years as a result of the nuclear arms race and the commercial nuclear industry's promotion of weapons-usable materials as fuels for nuclear energy.

It is therefore to be welcomed that the G7 and Russia recognise that the threat posed by these materials requires action at the highest level. However, as this paper seeks to demonstrate, the political, economic and strategic interests of most of the G7 and Russia means that no real effort to reduce the threat posed by plutonium and other fissile materials will be launched by the Nuclear Safety Summit.

Greenpeace believes that so long as these interests determine the policies of the governments concerned, plutonium stockpiles will continue to grow, as will the global threat. Rather than statements of concern, the problem needs to be dealt with directly. What is required is an international commitment for the negotiation of a comprehensive international convention that would ban all plutonium production and use - the so-called Fissile Material Convention. This would prohibit all further reprocessing of plutonium, no use of plutonium Mixed Oxide Fuel (MOX), inclusive of a ban on MOX as a weapons plutonium disposition option, and the eventual removal from national control of all stocks of weapons-usable fissile materials.

PLUTONIUM DEMAND AND SUPPLY

For the purpose of this paper, all the plutonium referred to is separated (reprocessed) weapons-usable material. Thus, although it is important to state clearly the amount of plutonium in military inventories from material in commercial programmes, the distinction is in fact artificial.

Global plutonium stockpiles at the end of 1993 were in the region of 375 tonnes, of which 255 tonnes is contained within the military stockpiles of the nuclear weapon states - Russia, the United States, France, the United Kingdom, and China. The remaining stocks, around 120 tonnes, is so-called civilian plutonium, produced by commercial nuclear reactors, and reprocessed principally in the United Kingdom and France. However, whereas military plutonium production has almost ceased completely, commercial plutonium stocks are continuing to rise. In 1995, more than 20 tonnes of plutonium was produced at reprocessing plants in the UK, Russia, France and Japan. By the year 2000, so-called civilian stocks of plutonium will be nearly equal to current military stocks.

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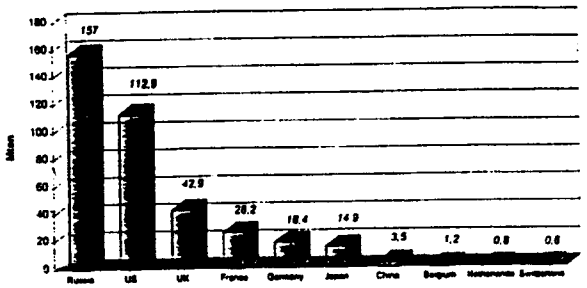
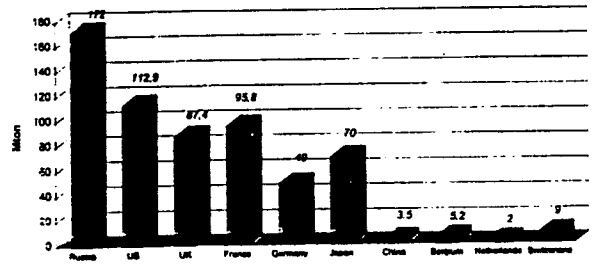
Table 1: Plutonium stocks 1993



All figures are for December 31st. 1993, unless otherwise stated.

Table 2: Plutonium stocks 2003



The figures are inclusive of plutonium loaded into MOX fuel, either loaded or stored for use in FBR and Thermal reactors. For all figures there's at least a ten percent uncertainty margin with the exception of the figure for the US.

Most of the plutonium listed in the non-nuclear weapon states, refers to ownership, in most cases the plutonium is currently stockpiled at three sites: Sellfield (UK), la Hague (France) and Ozersk (Russia). It should be noted however that all of the plutonium under contract at these sites is eventually to be returned to the country of origin.

References:

Russia	+/- 20%, Albright, et al. Figures are at December 31, 1993 SIPRI Yearbook 1995
US	DOE, February 6th 1996. Albright, World Inventory of Plutonium and Highly Enriched Uranium, SIPRI, 1993
UK	+/- 20%, Albright, 1995 based upon March 1994 UK government.
France	+/-30%, figures for Dec. 31, 1993. Albright, World Inventory of Plutonium and Highly Enriched Uranium, SIPRI, 1993 Cuyama, June 1, 1995; SIPRI Yearbook 1995
Other Countries	Albright, World Inventory of Plutonium and Highly Enriched Uranium, SIPRI, 1993 Cuyama, June 1, 1995, SIPRI Yearbook 1995

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The reason that global stocks of civilian plutonium are growing so rapidly is due to policies that were adopted during the 1960's and 1970's by many of the G7 nations. During this period the nuclear industry argued that in the near future uranium resources would become scarce, with a direct effect on both the economics and the ability to operate uranium fuelled reactors. Thus large resources were committed to the research and development of Fast Breeder Reactors (FBRs). These reactors were supposed to produce power, while also creating more plutonium than was used originally as a fuel. The fuel for the reactors would initially come from reprocessed plutonium produced in Light Water Reactors, requiring the construction of large-scale reprocessing facilities. However, the FBR reactors that were built, with few exceptions, have failed to operate successfully. France was to have six of these reactors on-line by 1985 - instead two are operating at low-power, and with no plans for new reactors; the former Soviet Union was to have 12, instead three operate, but with constant technical problems. The UK, U.S. and Germany have closed their FBR reactors.

Despite the collapse of the FBR experiment, by the late-1970's, electrical utilities had already signed large commercial contracts for the reprocessing of their nuclear reactor spent fuel with the UK and France. Thus, at the same time that FBR programmes were being abandoned or dramatically scaled back, construction of large-scale reprocessing plants, financed by Japanese, German, UK, French, Swiss, Belgium and Dutch utilities was proceeding.

Having committed billions of dollars for the construction of reprocessing plants, and confronted with large stocks of plutonium, utilities in these same countries (with the exception of the Netherlands) have laterally opted to use the plutonium as fuel in their Light Water and Boiling Water Reactors. However, plutonium use in these reactors is limited by significant political, nuclear safety, economic and environmental factors.

Therefore, while the utilities and governments in these countries seek to attempt to move ahead with larger plutonium use programmes, global stockpiles continue to grow. In 1996, it is estimated that more than 20,000kg of plutonium will be reprocessed in Russia, France, the UK, and Japan. To put this figure in perspective, it is equivalent to more than 7% of the total amount of plutonium produced during 50 years of the Cold war. In 1997 this will rise towards 10%. Clearly, these are the reasons why the G7 and Russia would rather not discuss the real plutonium problem in April 1996.

WORLD REVIEW - SUMMARY

Although the number of large scale (over 100 tonnes heavy metal per year THM/y) commercial reprocessing facilities remains relatively small at nine, reprocessing contracts at some of these facilities mean that many more countries for the first time will soon have significant stockpiles of weapons-usable plutonium.

The main obstacles however with MOX use in LWR's are: that MOX fuel costs are between 3 and 13 times more expensive than uranium fuel; significant technical, safety, environmental and public health problems are introduced due to the fuel fabrication, feactor use and waste storage of MOX fuel; and, the development of a MOX fuel cycle (including reprocessing plants, fuel fabrication facilities, nuclear reactors and waste storage facilities) is a major proliferation concern due to the extensive handling and transport of weapons-usable plutonium.

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As can be seen from Table one, most plutonium in 1993 was contained within the nuclear weapon states, though Japan and Germany already had significant stocks. The largest share of the total is contained within the nuclear weapon arsenals. A proportion of this material is being removed from nuclear warheads as disarmament agreements are implemented, and which certain governments and the nuclear industry are arguing should be used as MOX fuel in reactors. It is possible that the G7 and Russia will make this recommendation at the Nuclear Safety Summit.

FRANCE

France operates two large scale light water reactor (PWR/LWR) oxide reprocessing facilities, at La Hague in northern France, UP-3 and UP-2 800. Annual plutonium production capacity is between 12-13 tonnes. This production is split between domestic plutonium from French reactors operated, and foreign clients - Japan, Germany, Belgium and the Netherlands and Switzerland - In addition, a 400 THM/y Magnox-fuel plant UP1 also operates at La Hague, separating up to 1 tonne each year. This facility is due to close in 1997/98.

As a result of the collapse of commercial Fast Breeder Reactor programmes, the demand side for French plutonium has radically altered over the past ten years. Confronted with growing stockpiles of plutonium the French utility, Electricite de France (EdF) has opted for the use of mixed plutonium/uranium oxide (MOX) fuel in PWRs. Although the reactors are not designed for MOX use, EdF has been licensed for sixteen 900 Mwe PWRs to use MOX. As of March 1st 1995, only seven of these reactors were using MOX.

The MOX that is used in these reactors is fabricated at the 15tHM/y Cadarache facility. In August 1994, the large-scale MOX plant MELLOX began operation. This 120 tonnes per year facility, once fully operational will produce fuel primarily for EdF, but there is also a possibility that contracts with Japanese utilities will be signed in the next few years. To use all the MOX produced at MELLOX, EdF have stated that it intends to increase the number of reactors licensed for MOX use by an additional twelve, bringing the total to twenty-eight reactors. Total plutonium consumption of both MOX facilities, is expected to be over 10 tonnes each year.

Despite the optimistic assessment of the French nuclear industry, EdF still expects to have a surplus of more than thirty-eight tonnes of plutonium by the year 2000. It is could be significantly more.

UNITED KINGDOM

There is no domestic demand for plutonium in the UK, apart from that required in nuclear weapons. Three reprocessing facilities operate in the UK - the 7 tHM/y Dounreay FBR plant, the Sellafield 1500 tHM/y B205 Magnox facility and the 700 tHM/y THORP oxide facility. The most significant for this study is the THORP facility, which after many years of technical and construction delay, was completed in late 1992. Due to domestic political opposition, the plant was only given permission to operate in March 1994.

Contracts with THORP are split between domestic and overseas. Over half THORP's first ten years capacity consists of contracts for Germany, Japan, Italy, the Netherlands, Spain and Switzerland.

By the year 2003/4, THORP will have separated as much as 47 tonnes of plutonium, 41 tonnes of which will be for overseas clients. Although there is no domestic demand for plutonium fuel, the operators of THORP, the state-owned British Nuclear Fuels (BNF) hope to supply plutonium fuel, MOX, to their clients. Consequently, construction at the Sellafield site is being focused on completion of the Sellafield MOX Plant (SMP), with expectations that at least some of the 120 tHM/y capacity will be available by late 1997/1998. The SMP is based upon German technology from Siemens. Contracts between Germany and the UK were agreed during 1995, and a small Japanese contract was secured in January 1996. Future large contracts with Japan, are uncertain, given recent developments in Japan (see below).

JAPAN

Japan has the most ambitious plutonium programme in the world, and is one of the few countries still publicly committed to the commercial development of the FBR. However, their programme like all others world-wide, has been seriously effected by political, environmental, economic and technical problems. Although the US$6 billion Monju prototype FBR began operation in April 1994, like all FBRs before it, the operators experienced significant technical problems. These peaked in December 8th. 1995, when the reactor suffered a major release of liquid sodium coolant from the secondary circuit. Fortunately, there was no injury or major release of radioactivity. However, the political implications for the entire Japanese plutonium programme are still unfolding. The reactor that the operators believed could not suffer an accident, has shattered public and political confidence in the ability of Japanese industry to safely manage plutonium.

Though plans for construction of the follow-on demonstration FBR has already been delayed until the first decade of the next century, that could now be extended further. Operation of the large-scale Rokkasho-mura reprocessing facility which will separate as much as 6-7 tonnes of plutonium annually, will now not begin until around 2004/5. Due to strong opposition to the transport of 1.7 tonnes of plutonium oxide on board the Akatsuki-maru in 1992 from France to Japan, utilities are now believed to be considering transportation of plutonium MOX fuel from Europe, in the belief that it will not generate significant opposition. The combination of all these factors, has led to a de facto Japanese plutonium storage policy at the La Hague, and THORP sites, with stocks growing annually.

As can be seen by comparing Tables one and two, Japan's plutonium stock could grow from 15 tonnes in 1993 to 70 tonnes by 2003. This will depend upon completion of Japanese utilities first decade reprocessing contracts with the UK and France. Since both BNFL and Cogema gain financially through expensive plutonium storage costs, it is likely that most contracted Japanese spent fuel will be reprocessed by 2003/4.

How much of this is transported back to Japan, and how much is stockpiled in Europe remains unclear. It is unlikely that Monju will operate much before 2000, leaving one other FBR (Joyo) in operation (plus limited demand from the Fugen Advanced Thermal Reactor). In addition, though utilities in Japan, similar to those in France and Germany, have opted for MOX use in LWR's, the Monju accident has directly effected the timing and scale of MOX use in these reactors. Plans for two rising to twelve reactors fuelled with MOX will not be realised by early next century, having now foundered on the fall-out from Monju. Most recently statements from 3 regional prefecture Governors, opposing the licensing of MOX use in reactors unless certain conditions are met. It is *quite possible that no MOX use in LWR's will begin before 2000.*

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Clearly, supply greatly exceeds demand. Unless Japan delays or cancels reprocessing contracts, and cancels its own domestic reprocessing plant, it will have a total stock of around 110-113 tonnes from around 2010. Even in the optimistic demand projections of the Japanese government, as much as 85 tonnes of this will be surplus to requirements.

GERMANY

German reprocessing contracts with La Hague and THORP over the next ten years will increase the country's stock to 49 tonnes of plutonium. Choices made in the 1970's to enter these contracts were based upon a number of factors, including: providing plutonium for a commercial FBR programme, waste management, and apparently attractive prices from the reprocessing companies.

The miscalculations in the volume of plutonium stocks returning to Germany and the lack of domestic demand for FBR led to the adoption of MOX for LWR's and BWR's. However, a number of factors have evolved that have led to much less MOX use than anticipated, and consequently an imbalance between large scale plutonium reprocessing and the capacity to fabricate and use MOX has been created. Since 1991, Germany has had no available domestic MOX capacity, since operation of a Siemens plant at Hanau was suspended. That facility has now been abandoned. The larger uncompleted MOX facility at Hanau, which cost almost 1 billion dollars, was abandoned in December 1995. As of March 1st 1995, eleven reactors in Germany were licensed to use MOX, but only five did so. Growing plutonium stockpiles at La Hague of over 12 tonnes in January 1996, will soon be added to by operation of THORP at Sellafield.

BELGIUM

Belgium currently has contracts for reprocessing with Cogema's La Hague plant, which will yield over 5 tonnes by the year 2003. Once again Belgium's plutonium programme is an example of over-supply, with annual demand not expected to be greater than 0.3 tonnes in the period 1996/7-2000. Consequently, this will give Belgium an excess stockpile of more almost 4 tonnes by the year 2003. It will take a further 13 years to consume this plutonium in Belgium reactors.

RUSSIA

Commercial reprocessing is centred at the Radiochemical Combine Mayak site at Chelyabinsk-40, now renamed Ozersk. A 600 tHM/y reprocessing plant, RT-1, has operated since 1976, when it was converted from military production. Throughput of VVER-440 reactor fuel in practise has been around 190 tonnes on average, with recent reports suggesting a decline to 100 THM/y, this has yielded a total of around 27 tonnes by the end of 1994. There is almost no domestic demand for this plutonium. The Russian FBR programme is centred around BN-600 at Beloyarskya but this operates with HEU fuel not plutonium MOX. Plans for construction and operation of three BN-800 FBR's operating on plutonium MOX remain unrealised. In addition to the Chelyabinsk site, there are plans to complete the unfinished reprocessing facility a Krasnoyarsk-26. Construction of this facility was halted in the mid-1980's due to local opposition and financial restrictions from central government. The facility if it is ever built, is intended to reprocess 1500 THM/y of fuel from Russian VVER-1000, as well as

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overseas clients. Discussions have been held with utilities from a range of countries, including: the Republic of Korea, Switzerland, Ukraine, and Taiwan.

A more immediate problem for those concerned about commercial plutonium use is an option under consideration by the Ministry of Atomic Energy, for converting dismantled nuclear warhead plutonium into MOX fuel. Despite all the acknowledged problems with MOX, Minatom appears to favour this option over any other. Currently a study is underway that if implemented would lead to the construction of a small 20 THM/y MOX plant at Chelyabinsk, based upon Siemens technology. Russia has some specific problems due to the nature of its reactors. Only 22 of Russia's largest reactors are theoretically capable of handling MOX, eleven of these are of the RBMK type - thus using MOX would compound their already dangerous operating characteristics.

SWITZERLAND

By the year 2003/4, Switzerland will have acquired a stock of 9 tonnes of plutonium, through contracts at La Hague and Sellafield. Despite initial plans for MOX in all five of its reactors by the year 1998, doubts amongst utilities over the economic penalties of plutonium fuel use have contributed to expected delay's in MOX utilization. Currently, MOX supplied from Belgium, the UK and France, is used in two small PWR's.

SPAIN

Spain has contracts for 169 THM of spent fuel with the THORP facility. This will yield approximately one metric tonne of plutonium for return to Spain. There are however no plans for plutonium use in Spain's reactors. It should be noted that Spain's Vandellos magnox reactor had its spent fuel reprocessed in France, but not returned to Spain. It is believed that plutonium from this reactor entered the French military programme.

NETHERLANDS

The Netherlands has contracts with both the La Hague and THORP facilities, that once completed will yield about 2 metric tonnes of plutonium. As with Spain, there are no current plans for the use of this material, including in which location it will be stored.

PLUTONIUM MOX - REACTOR SAFETY AND PROLIFERATION CONSEQUENCES

It has been reported that the Nuclear Safety Summit will endorse the burning of plutonium from dismantled nuclear warheads in reactors - the MOX option. For a number of reasons this route poses a threat of greater nuclear proliferation, increased safety risks for reactors, additional health hazards for workers, and more problems for radioactive waste storage.

Perhaps the greatest obstacle to the MOX route for plutonium management is an economic, and therefore political, one. Global MOX production capacity by the year 2000 will be less than 350 tonnes each year. Although this is significant in terms of increasing the amount MOX in the world, all of this capacity is dedicated to fabricating MOX from commercial reprocessing - and even then it cannot deal with most of the commercial plutonium stocks. To convert plutonium from nuclear warheads on anything other than an experimental basis will require the construction of new large MOX facilities. On the basis that 100 tonnes of plutonium from warheads is to be converted to MOX. (50 tonnes each from Russia and the United States) it will require one 120 tHM/y plant to operate at full capacity for 27 years. Currently there is no

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industrial scale MOX production capacity in Russia, and Site-300 at Ozersk, if ever built, will have an annual plutonium throughput of around 400kg. This facility would have to operate for over 100 years to convert 50 tonnes of Russia's plutonium stock. The United States Department of Energy is currently considering the options for the disposition of its stockpile of military plutonium. No MOX facility currently operates in the United States. Environmental opposition to plans in both the United States and Russia could prevent any large-scale move to MOX use.

Reactor Safety Implications

If the Nuclear Safety Summit does endorse MOX for military plutonium, it will further highlight the irrelevance of the Summit for improving the safety of nuclear reactors. The reason for this is that the very reactors that would be used to burn the MOX fuel in Russia, are some of the most dangerous reactors operating and using plutonium fuel reduces further the weak safety margins of these plants. The preferred reactors in Russia for MOX use, from a nuclear physics perspective, are the six VVER-440s, of which 4 are the 230 series. Even the IAEA classifies these as being extremely unsafe, and it is unlikely that even MINATOM would consider introducing plutonium fuel into these reactors. Other options also have potentially severe consequences. For VVER-1000's, the problem of reduced pressure vessel size has been countered by moving to a three year fuel cycle. Introducing MOX into these reactors would eliminate the safety benefits of this, thus increasing the probability of a positive temperature coefficient, leading to a power excursion and severe accident. The only other option would be to move ahead with the construction of the BN-800 series of FBR's in Russia. Though this may MINATOM's preferred path, not only are there no funds for these, but safe reliable operation of such reactors has not been demonstrated.

It would indeed be a supreme irony if leaders from the G7 and Russia, meeting for the first time on exclusively nuclear matters, endorsed an option that would dramatically reduce the safety of some of the most dangerous reactors in the world.

Proliferation and Security

Any commitment to increase MOX production and use in reactors, will lead to an increased risk of nuclear proliferation. The plutonium contained within the MOX will either be weapons-grade or blended-down reactor grade. However, whatever its grade it will remain weapons-usable. It is worth mentioning that it has yet to be demonstrated by the International Atomic Energy Agency (IAEA) that it is possible to adequately safeguard plutonium MOX facilities. As fabrication plants for MOX pose a proliferation threat so to does the transport of the MOX to reactor sites. For example, during 1995 the option to have plutonium from Russia shipped to the Hanau MOX facility in Germany, was promoted by the German Foreign Ministry and Siemens (the builder of the uncompleted MOX plant). Highlighting the logistical problems of such an option, it was reported that a transport plan drafted by Siemens envisaged 70 transports every year, involving 4-5 tonnes of plutonium, for ten years. The transport methods considered included by rail through eastern and central Europe, by sea through the Baltic, and by air. Fortunately, the Hanau option was abandoned in December 1995.

In addition, countries now expanding their MOX use programmes are now confronted with the security problem posed by the storage of large quantities of plutonium MOX at reactor sites. Stockpiling plutonium MOX fabricated from dismantled nuclear warhead material raises very serious security concerns. This further raises the spectre of

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draconian measures applied by government agencies seeking to protect stockpiles of such material.

The consequences of producing hundreds of tonnes of weapons-usable MOX, will increase the probability that material will be diverted or stolen. After the past two years when nuclear smuggling, both real and imagined, has focused international attention in the threats posed by nuclear materials, it makes no sense to increase the diversion pathways for plutonium.

CONCLUSION

The unique dangers posed by weapons-usable fissile materials should not be underestimated. No excuses are therefore required when no simple solution is available for dealing with these materials. However, to pretend that the problem only exists in Russia, or that commercial plutonium is somehow a legitimate industrial process, highlights that the G7 and Russia have yet to come to terms with the unique threat posed by these materials. After all, it is these very nations within the group of G7 and Russia that have produced the problem, either as a direct result of the nuclear arms race, or of commercial nuclear programmes. The international community should therefore treat with extreme caution any solution offered by these same states at the Moscow Nuclear Safety Summit.

This summary paper has sought to highlight the fundamental contradiction of the G7 nations and Russia, when as expected they endorse the MOX option for dealing with weapons-usable plutonium. While plutonium production for explicitly military purposes has almost ceased, production for commercial purposes is rapidly expanding. No distinction can be made between these two types of plutonium - it is all weapons usable. The G7 and Russia by ignoring this reality will expose the lack of real political will to overcome the powerful interests of the global nuclear industry.

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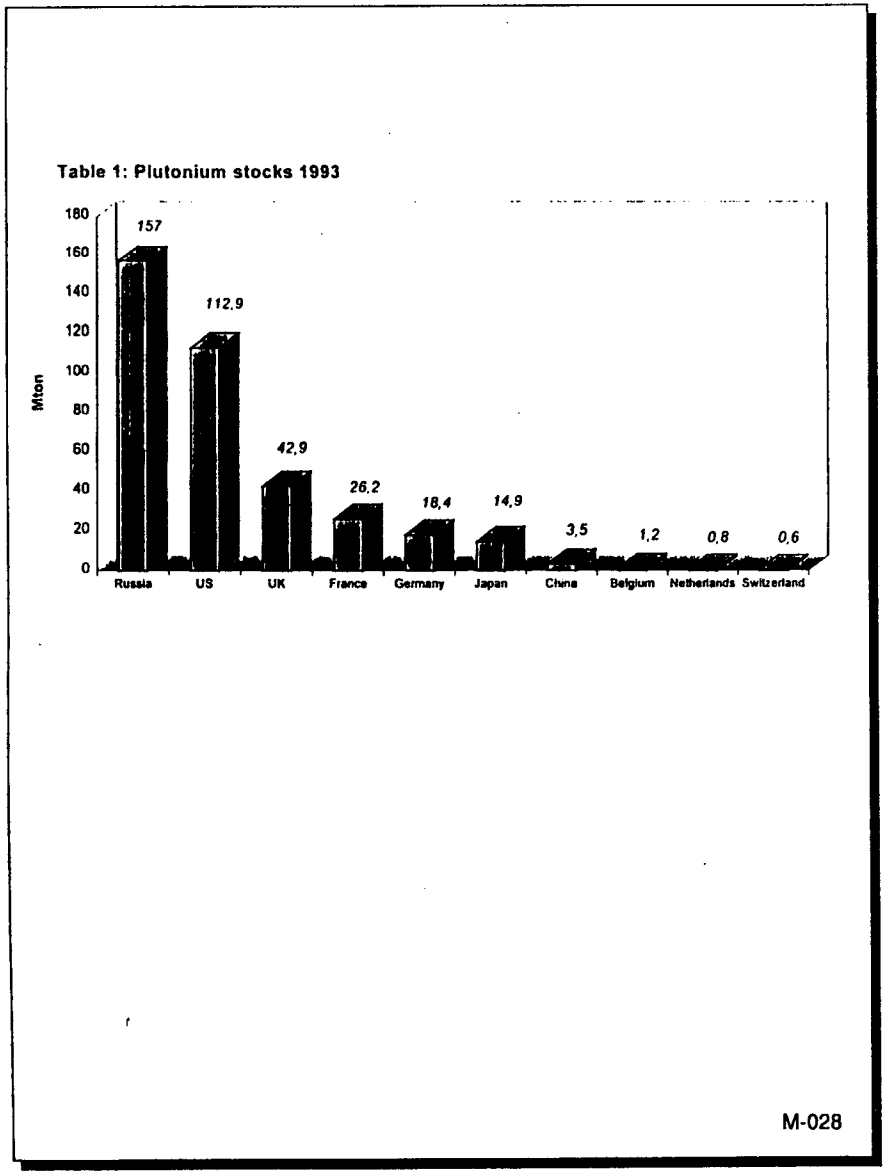
GREENPEACE, WASHINGTON, DC,
TOM CLEMENTS
PAGE 11 OF 13



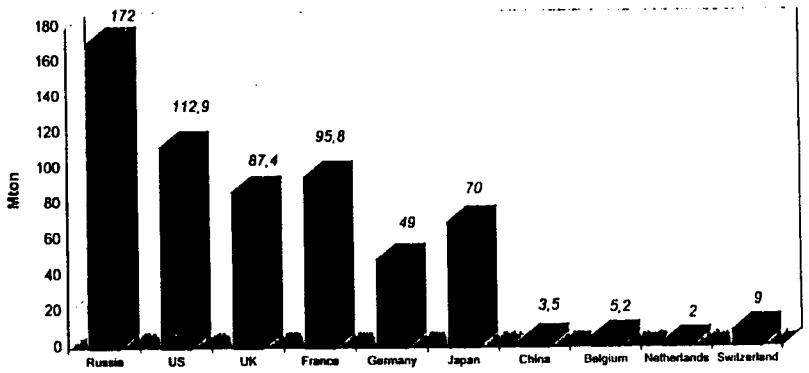


Table 2: Plutonium stocks 2003
Mton
180
160
140
120
100
80
60
40
20
0
172
112,9
87,4
95,8
49
70
3,5
5,2
2
9
Russia
US
UK
France
Germany
Japan
China
Belgium
Netherlands
Switzerland

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GREENPEACE, WASHINGTON, DC,
TOM CLEMENTS
PAGE 13 OF 13

The figures are inclusive of plutonium loaded into MOX fuel, either loaded or stored for use in FBR and Thermal reactors. For all figures there's at least a ten percent uncertainty margin with the exception of the figure for the US.

Most of the plutonium listed in the non-nuclear weapon states, refers to ownership, in most cases the plutonium is currently stockpiled at three sites: Sellfield (UK), la Hague (France) and Ozersk (Russia). It should be noted however that all of the plutonium under contract at these sites is eventually to be returned to the country of origin.

References:

Russia	+/- 20%, Albright, et al. Figures are at December 31, 1993. SIPRI Yearbook 1995.
US	DOE. February 6th 1996: Albright, World Inventory of Plutonium and Highly Enriched Uranium. SIPRI, 1993.
UK	+/- 20%, Albright, 1995. based upon March 1994 UK government.
France	+/-30%, figures for Dec. 31, 1993. Albright. World Inventory of Plutonium and Highly Enriched Uranium. SIPRI. 1993. Cogema. June 1. 1995; SIPRI Yearbook 1995.
China	figure for Dec.31. 1993. Albright. 1995.
Other Countries	Albright. World Inventory of Plutonium and Highly Enriched Uranium. SIPRI. 1993. Cogema. June 1. 1995; SIPRI Yearbook 1995.

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GREENPEACE

May 31, 1996

DOE-Office of Fissile Materials Disposition
c/o SAIC-PEIS
P.O. Box 23786
Washington, DC 20026-3786

To Whom it Concerns:

Attached are documents which I request be included as comments on the Storage and Disposition of Weapons-Usable Fissile Materials - Draft Programmatic Environmental Impact Statement:

1. The Problems of Disposing of Military Plutonium as MOX Fuel

2. MOX: A Background Briefing

3. The Use of Mixed Oxide Fuel Rods Containing Plutonium in Light Water reactors

4. MOX or The Plutonium Aberration

5. Industrial and Strategic Aspects of the Plutonium Fuel Cycle in France

6. various new articles on MOX

1/15.00.00

Thank you very much.

Sincerely,

Tom Clements

Tom Clements
Greenpeace International
Plutonium Campaign
tel. 202-319-2506
fax 202-462-4507

1436 U Street NW • Washington, DC 20009 • Tel (202) 462-1177 • Fax (202) 462-4507 • Tlx 89 2359

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M-250

15 00 00 **Comment Number 1**

Comment noted. The documents referred to are included in the PEIS Administrative Record. Further, this research information was analyzed for comments specific to this PEIS, and is available to the decisionmaker. No comments specific to the PEIS were identified in these documents.

GREG LAIR, INC., CANYON, TX,
GREG LAIR
PAGE 1 OF 2

April 22, 1996

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, DC 20026

RE: Pantex

To Whom It May Concern:

Greg Lair, Inc., of Canyon, Texas, supports the selection of Pantex for weapons assembly and disassembly activities. We strongly endorse the continuation of high explosives (HE) functions at Pantex, and oppose any plan to move these functions to the national laboratories. Since Pantex is the most cost-effective Department of Energy (DOE) facility and enjoys the strongest local support, we endorse the addition of other environmentally sound stewardship and management functions at Pantex. Furthermore, we believe that Pantex should be chosen as the location for fissile materials storage and disposition functions. 1/08.03.01

Pantex must retain HE capabilities to process the inventories already on-site from dismantling. Millions of tax payers dollars have been spent recently at the site to ensure that all the functions are safe and efficient. It is the only cost-effective choice available. Moreover, it would be highly advantageous to have all HE functions situated on the site to upgrape existing weapons systems; In the event of weapons production, on-site HE functions will be a necessity. High Explosives functions must remain at Pantex.

Since Pantex is the most cost-effectuve DOE facility and enjoys the strongest locall support, it is appropriate to consider Pantex as an alternative site for all future defense-related facilities to complement activities at the national laboratories. The location of additional defense-related activities at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost to the tax payer. The Department of Energy must view accurate budgetary comparisons between Pantex and other sites. Life-Cycle analysis would assist in these comparisons to ensure the inclusion of all capital, transportaion, training, remediation, and all costs. 2/07.02.00

GREG LAIR, INC.
CANYON E-WAY & BUFFALO STADIUM RD. • P.O. BOX 510 • CANYON, TEXAS 79015 • 806-655-2583

M-050

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support of Pantex. Decisions pursuant to potential future missions for storage and disposition at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

07 02 00 **Comment Number 2**

Cost data, along with technical and schedule data, were provided for public comment in a Technical Summary Report in late July 1996.

GREG LAIR, INC., CANYON, TX,
GREG LAIR
PAGE 2 OF 2

April 22, 1996

Greg Lair, Inc.
P.O. BOx 510
Canyon, TX 79015

Page -2-

We believe that Pantex should be chosen as the location for plutonium storage. It seems that Pantex is the only facility that has handled assembly and disassembly operations in a safe and efficient manner. If cost savings are considered, Pantex is the only choice for plutonium storage. The facility is already storing plutonium on-site, and has strived significantly to ensure not only safety but environmentally sound practices as well. Not only has the facility made recent upgrades to storage facilities, storage container usage and reconfigurement, and security enhancement, Pantex could also upgrade facilities for any and all storage options being considered by the DOE using processes already in place with minimal cost and difficulty. It makes little sense to re-create storage facilities at another site and then unnecessarily transport large amounts of plutonium across the country from Pantex. The cost and possible consequences of this decision would be enormous. Pantex also should be designated the preferred site for any disposition options and related function. It makes sense to site deposition where storage already exists. Furthermore, it is not feasible, from any perspective, to site strategic storage at one site and surplus at another. Pantex has the necessary safety, security, and surveillance capabilities to accommodate an expanded role with minimal costs, and it is the production site closest to Los Alamos, the planned fabrication site.

1/08.03.01
cont.

Based upon the above reasons and for the continued benefit of the entire community, Greg Lair, Inc. urges the Department of Energy to designate Pantex as the preferred alternative site for all existing and new stockpile management and stewardship functions as well as consolidation of all plutonium storage and disposition and any related functions.

Sincerely yours,

Greg Lair

GL/sm

M-050

HANFORD ACTION OF OREGON, PORTLAND, OR, TERRY HAMMOND
PAGE 1 OF 2

Terry Hammond
Hanford Action of Oregon
4545 NE 78th
Portland OR 97218

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

May 10, 1996

Re: Comment on Plutonium Disposition

Dear DOE:

Since attending the recent DOE meeting in Portland, Oregon, concerning plutonium disposition, I have just been informed of certain business support for the reactor alternative. I wish to record my determined opposition to this choice. 1/08.03.01

1. After decades of denial, the U.S. government is just now beginning to admit to the perils of nuclear radiation and the deaths it causes. Thousands of babies are being killed, thousands of adults are developing horrible radiation-caused diseases, farm animals are suffering disgusting mutations and infertility. With uranium mining, processing, weapons testing and deployment, and energy reactors, the nuclear establishment is conducting random genocide on the human population, while permanently destroying the possibility for healthy life on the planet. This practice must stop. Do not encourage the perpetuation of the nuclear establishment. In the tradition of the Nuremberg trials after W.W.II, consider your decisions a matter of personal accountability. 2/15.00.00

2. There is still no plan for permanent disposition of the mounting tons of nuclear waste in this country. Rather than contribute to the problem by creating more waste with the reactor alternative (as your PEIS indicates it will), some definite line of action must be created that allows us to feel we are moving in the right direction, and which provides a model for the rest of the world. You must stop the forward momentum of the nuclear establishment. 3/01.06.00

3. With childish disregard for the hazardous mess produced by their activities, both the military and energy sectors of the nuclear establishment have never included adequate management of nuclear wastes in their operating budgets. Recent news reports indicate that funds set aside to dismantle reactors are nowhere near enough to cover projected costs. Once again, the U.S. taxpayer is expected to pickup the extra bill, prodded by dire concerns for health and safety. The skyrocketing direct costs don't even include all the costs for generating reports and holding meetings associated with dangerous nuclear-

M-210

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

15 00 00 **Comment Number 2**

Comment noted.

01 06 00 **Comment Number 3**

Comment noted. DOE has the responsibility to find a path forward for surplus Pu disposition to support the President's Nonproliferation Policy. All the alternatives would take the Pu to an end state that produces some nuclear wastes. It is the intention of DOE to minimize waste production in the facilities that will be used for Pu disposition.

HANFORD ACTION OF OREGON, PORTLAND, OR, TERRY HAMMOND
PAGE 2 OF 2

waste disposition. The economic side of the nuclear nightmare is already way out of control. You must get a handle on what we have now without encouraging the kinds of facilities that are generating enormous expense directed at the innocent American taxpayer.

4. It would be nice if DOE could direct its reports to energy sources that don't need to talk about death and illness, catastrophic accidents and evacuation. The public anger and distrust of the U.S. government is increasing. The DOE, like its predecessors in the nuclear establishment, has a contemptible reputation, with a history of deceit, denial, cover-up and coercion. We appreciate recent efforts to bring some sunshine into your activities. Please help us regain confidence in DOE, while tackling a huge problem that concerns all of us. We need you. Be a leader in changing course and dismantling the deadly nuclear establishment.

3/01.06.00 cont.

Thank you for your consideration on this matter.

Sincerely,

Terry Hammond
Hanford Action of Oregon

M-210

Storage and Disposition of Weapons-Usable Fissile Materials Final PEIS

HANFORD ADVISORY BOARD, PORTLAND, OR,
MERILYN B. REEVES
PAGE 1 OF 11

HANFORD ADVISORY BOARD

A Site Specific Advisory Board, Chartered under the Federal Advisory Committee Act

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US Environmental Protection Agency
Washington Dept of Ecology

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Washington Health Department

David Nulton
Director, NEPA Compliance and Outreach
Office of Fissile Materials Disposition
Department of Energy
PO Box 23786
Washington, DC 20026-3786

Sent by Facsimile to 1-800-820-5156 and by US Mail

May 3, 1996

Dear Mr. Nulton:

Re: Storage and Disposition of Excess Weapons Useable Plutonium and Special Nuclear Materials (SNM) (HAB Advice #46)

The draft Plutonium Programmatic Environmental Impact Statement (PEIS) indirectly considers Hanford as a potential site for certain activities within the scope of the plutonium safe storage and disposition program by the virtue of the site's current capability and plutonium possession. The Hanford Advisory Board is opposed to the piecemeal approach to nuclear material storage and disposition like that taken in the PEIS on plutonium disposition. We have on three previous occasions adopted advice to USDOE urging an integrated public discussion on these issues. (Board Advice #13, 34 and 38) We have a commitment from USDOE leadership to initiate such a process. Therefore, a ROD on the narrow choices presented in this EIS is premature pending the National Equity Dialogue. The Board is opposed to the use of the bore hole option at Hanford. At this time, the Board has not expressed a preference for one of the other disposal options. However, the Board does have a number of values/issues which relate to a plutonium (Pu) and spent nuclear material (SNM) program. Many of these values/issues have been previously provided to you as advice or recommendations for other Hanford programs. These values are:

1/08.02.00

2/08.03.01

1. Any plutonium or SNM storage or disposal program must be compatible and integrated with the TPA commitments and milestones and should not affect the rate or funding of cleanup. The program would have the safe disposition of Hanford plutonium as a priority.

3/11.00.01

Contact: Confluence Northwest, Facilitation Team
800 NW Sixth Avenue, Suite 342, Portland OR 97209-3715
Phone (503) 243-2683 Fax (503) 243-3683

F-030

08 02 00 Comment Number 1

The Department of Energy acknowledges the commentor's support for coordination and increased understanding of decisions to be made concerning the storage and disposition of weapons-usable fissile materials. However, the National Dialogue Project is beyond the scope of this PEIS.

08 03 01 Comment Number 2

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

11 00 01 Comment Number 3

Comment noted. DOE's Fissile Materials Disposition Program is an integrated effort that will require the participation of a number of DOE sites that have weapons material experience. DOE acknowledges the commentor's concern about the potential effect that selection of Hanford for new missions could have on the Hanford cleanup program. It is DOE's intent that the implementation of Fissile Materials Disposition Program decisions will have little or no impact to ongoing cleanup programs. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input. The decision process will also give consideration to existing agreements between DOE, the State of Washington, and the Environmental Protection Agency (EPA).

2.	Any plutonium program assigned to Hanford must be fully funded from new funding sources. This funding should include appropriate site infrastructure and overhead costs. Funding should fully cover the cost of treatment, storage and disposal of any new waste streams.	4/07.00.00
3.	The acceptance of plutonium at Hanford should not delay, defer, or negatively impact Hanford cleanup.	5/11.00.01
4.	Appropriate local and regional public information and involvement programs must be conducted by the agencies to ensure that the public is fully informed of the risks, hazards and impacts of such a program. This would be part of the national dialogue on all nuclear materials (noted above) prior to assignment of nuclear materials to a specific site.	6/08.02.00
5.	Any permit or plan approval for new Hanford programs/activities must be fully integrated and must comply with all State of Washington public health and safety rules and regulations.	7/08.03.00
6.	Equity impacts must be addressed in the assignment of new nuclear materials (including plutonium) to Hanford.	8/01.00.00
7.	The transportation of plutonium and special nuclear materials to Hanford storage will require careful planning of routes and consideration of weather emergencies to minimize the likelihood of an accident. Emergency preparedness for minimizing the impacts from an accident will require financial support from DOE for state, tribal, and local involvement, including adequate equipment and training. When materials are shipped, timely notification should be provided to transportation agencies.	9/10.01.00
8.	The choice of disposal options re: Pu will be a determinant for sites such as Hanford. Prior to the choice of a disposal option, complete characterization of the material and the impacts of short and long-term disposition technologies must be reviewed by the public and regulatory agencies.	10/08.02.00
9.	Acceptable processing techniques including waste processing must be developed as an integrated part of any new Hanford storage and disposal program. Permanent disposal of waste plutonium at Hanford is not acceptable.	11/09.11.01

F-030

07 00 00 **Comment Number 4**

Funding for all alternatives will be through the Government's budget process. It is not a part of the environmental analysis.

11 00 01 **Comment Number 5**

The Department of Energy will not begin implementation of the Proposed Action at any site without having given full consideration to the environmental, cost, schedule and policy analyses, public comments, and agreements with various states regarding the clean-up activities on the sites. Therefore, implementation of the Proposed Action is not expected to cause adverse impacts to ongoing programs at the selected site(s).

08 02 00 **Comment Number 6**

The Department of Energy uses a wide variety of methods to communicate with the public on these important issues. These methods include public meetings, as part of the NEPA process, and meetings outside of the process, such as the Plutonium Round Table. Numerous fact sheets and displays are made available at the meetings as well as by mail. All of this information is available on the Program's electronic bulletin board.

08 03 00 **Comment Number 7**

It is recognized that the decision to locate any of the alternatives at a site would require coordination with State and local officials on a variety of areas including the mission of the site.

01 00 00 **Comment Number 8**

Comment noted. Equity will be considered in DOE's decisionmaking process along with all other factors.

HANFORD ADVISORY BOARD, PORTLAND, OR,
MERILYN B. REEVES
PAGE 3 OF 11

10. A "systems" analysis approach should be utilized to select the most effective method for processing and interim storage. This analysis should adequately address public and worker health and safety and environmental issues. | 12/08.03.00

11. If a plutonium disposition mission is assigned to Hanford, every effort should be made to use existing workforce, facilities, technologies, and other resources. | 13/09.00.01

Finally, we note that this PEIS does not address cumulative impacts of nuclear material movement and disposition as required by NEPA. | 14/08.00.00

The Health, Safety and Waste Management Committee of the HAB looks forward to further discussions and working with you on this issue. The Board looks forward to your written response, as called for in our charter.

Very truly yours,

Merilyn B. Reeves, Chair
Hanford Advisory Board

attachments: Board Advice #13, 34 and 38

cc: Thomas Grumbly, DOE
John Wagoner, DOE
Alice Murphy, DOE
Chuck Clarke, EPA
Mary Riveland, Ecology
Cindy Kelly, Designated Federal Official
Linda Lingle, Site Representative
Jim Mecca, DOE (by fax)
The Oregon and Washington Congressional Delegations

F-030

10 01 00 Comment Number 9

Logistical planning and meteorological surveillance are standard concerns which normally receive a great deal of attention during transportation operations such as this; transfer of materials to Hanford would hold no exceptions. Emergency preparedness personnel (that is, Emergency Response Teams) will be supplied with the necessary equipment and training commensurate with Department of Transportation (DOT), DOE, and NRC regulations. Sufficient funding for these concerns will be available to satisfactorily ensure that potential contingencies be dealt with in an effective and timely manner. DOE provides liaison with appropriate agencies for special nuclear material shipments. However, due to their classified nature, specific information on times and dates cannot be provided.

08 02 00 Comment Number 10

Before and after decisions are made on a disposition technology or technologies, DOE will conduct studies and technical demonstrations to fully understand the full impact of disposition actions. This information will be made available to the public, as appropriate.

09 11 01 Comment Number 11

The conceptual designs for the storage and disposition facilities have, as part of their design, waste management facilities that would treat and package all waste generated into forms that enable long-term storage and/or disposal in accordance with RCRA and other applicable Federal and State statutes and DOE Orders. As noted in Section 4.1.10 of the PEIS, waste management activities that would support the long-term storage or disposition of weapons-usable fissile materials were assumed to be per current site practice. Thus, only low-level waste (LLW) and possibly some solid nonhazardous waste was assumed to be disposed of onsite. Any future waste management facilities that may be required to support the long-term storage or disposition of weapons-usable material would be coordinated with any decisions in the waste-type-specific RODs resulting from the Waste Management PEIS and respective site-specific NEPA documentation.

HANFORD ADVISORY BOARD

Chuck Clarke, Regional Administrator
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, WA 98101

Mary Riveland, Director
Washington Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

John Wagoner, Manager
Department of Energy, Richland Operations
PO Box 550 (A7-50)
Richland, WA 99352

February 8, 1995

RE: Off-site Mixed Waste Acceptance

Dear Messrs. Clarke and Wagoner, and Ms. Riveland:

The following advice was adopted by the Hanford Advisory Board on February 3, 1995.

The State of Washington and U.S. EPA should not allow the U.S. Department of Energy or U.S. Department of Defense to transfer to the Hanford site any "Mixed (hazardous and radioactive) Waste" unless the following criteria are met:

1. A general condition of permit and plan approval and subsequent off-site waste acceptance in Washington State should be on-going substantive compliance with Washington Dangerous Waste laws and the terms, conditions, and schedules of permits, consent orders and clean-up agreements (e.g. the Tri-Party Agreement) between the DOE and the State.

2. Acceptance of off-site waste must be contingent on existing facility capacity and on availability of funding to handle processing and storage needs, while having a neutral or positive impact on Hanford clean-up.

3. In all instances where DOE proposed to treat off-site wastes at Hanford, a written reciprocal agreement should be required between the State of Washington, the state of origin of the off-site waste and the Department of Energy.

15/15.00.00

Page 1

HAB Consensus Advice #13
Subject: Off-site Mixed Waste Acceptance (Health, Safety & Waste Management Committee)
Adopted: February 3, 1995, Letter to Tri-Parties

Contact: Confluence Northwest, Facilitation Team
800 NW Sixth Avenue, Suite 242, Portland OR 97209-3715 Phone (503) 243-2643 Fax (503) 243-2643

F-030

08 03 00 Comment Number 12

Comment noted.

09 00 01 Comment Number 13

Comment noted and will be taken into consideration when DOE is ready to select sites to implement Pu disposition technologies.

08 00 00 Comment Number 14

The Department of Energy has determined that, based on historical trends and regulatory constraints, impacts associated with transportation of nuclear materials are unlikely and not otherwise significant. Therefore, no cumulative analysis of transportation impacts is performed. The cumulative impacts analysis is located in Section 4.7 of the PEIS.

15 00 00 Comment Number 15

The PEIS analyzes the storage of nonsurplus weapons-usable fissile materials and surplus Pu pending disposition. All materials are assumed to have been stabilized and packaged according to recommendations made by the Defense Nuclear Facilities Safety Board (DNFSB) prior to storage, and are not considered waste until disposition actions have been completed.

HANFORD ADVISORY BOARD, PORTLAND, OR, MERILYN B. REEVES
PAGE 5 OF 11

4. In deciding whether to approve storage, technical, economic and equity concerns should be addressed. Prolonged storage of off-site wastes prior to treatment, or of post-treatment residuals, generally should not be approved.

5. No pretreatment storage should be allowed at the receiving site unless it has been approved in the written reciprocal agreement between the shipping and receiving states.

6. Plans and schedules to treat off-site wastes should be approved only in instances where there is a binding legal obligation on the part of DOE for primary and secondary off-site storage facilities designed to receive post-treatment residuals before wastes are allowed to be shipped to Hanford. Plans and schedules should specify that generally no residuals will be stored or disposed of at Hanford . In the event of substantial noncompliance with Washington Dangerous Waste Law requirements, or failure to have off-site facilities available for return of post-treatment residuals, off-site waste will not be accepted at Hanford. Lacking specific agreement between the state, DOE and state of origin, waste residuals should be returned to the site of origin or other compliant facilities to be specified in plans and schedules.

15/15.00.00 cont.

7 When reviewing requests from other sites/states to accept mixed wastes for treatment at Hanford, the sending sites's treatment plan should be scrutinized to determining whether there has been thorough consideration of on site treatment and pre-shipment storage. Off-site wastes should not be accepted for treatment where such analysis is lacking or not compelling, unless it is otherwise approved in the reciprocal agreement between the sending and receiving states.

8. Receipt of any off-site wastes for treatment should require submission by shipping state of a schedule for shipment, treatment, and post-treatment residuals management, and prior written approval by the State of Washington.

9. Transport of off-site waste to Hanford for treatment will require careful planning of routes and consideration of weather emergencies to minimize the likelihood of an accident. Emergency preparedness for minimizing the impacts from an accident will require financial support from DOE to state, tribal and local involvement, including adequate equipment and training. When materials are shipped, timely notification should be provided to transportation agencies.

10. Cumulative impacts (e.g. of other wastes types) must be analyzed and considered in decisions concerning the movement and treatment of DOE mixed wastes. DOE

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must fully disclose all projected waste types and quantities that maybe shipped to Hanford prior to any consideration by Washington of TSD permits for mixed wastes generated at other facilities. This information must be part of the PEIS and Draft Site Treatment Plan public comment/public participation process, and of an inter-regional and inter-site advisory board dialogue, prior to development of final Site Treatment Plans and any agreement by Washington State to accept off-site wastes.

11. Hanford off-site waste acceptance criteria must include provision for inspection and payment of appropriate permit fees to cover all state costs, including inspection of pre-shipping procedures. Existing Mixed Waste facilities at Hanford must be in substantial compliance with the Tri-Party Agreement milestones, other orders or agreements and RCRA or state law requirements in order for permits to be issued or amended to allow off-site Mixed Wastes to be treated, stored or disposed of at Hanford.

15/15.00.00 cont.

The Board and its Health, Safety & Waste Management Committee will consider both additional information that has not been presented to date as well as agencies' responses to this advice. Based on that additional information and agency responses, it is expected that the Board will offer additional advice and recommendations to the U.S. Department of Energy, USEPA and the Department of Ecology.

The Board would like the State of Washington to explore options to control other materials (including low level waste, plutonium or transuranic (TRU) contaminated waste) intended for transport by DOE to Hanford for storage, treatment and/or disposition.

Very truly yours,

Merilyn B. Reeves, Chair
Hanford Advisory Board

cc: Thomas Grumbly, Department of Energy

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HANFORD ADVISORY BOARD, PORTLAND, OR, MERILYN B. REEVES PAGE 7 OF 11

HANFORD ADVISORY BOARD

A Site Specific Advisory Board, Chartered under the Federal Advisory Committee Act

Thomas Grumbly
Assistant Secretary for Environmental Management
Department of Energy
1000 Independence Avenue SW
Washington D.C. 20585

November 3, 1995

Re: Waste Management PEIS and Public Involvement, HAB Consensus Advice #34

Dear Mr.Grumbly:

At its November 2-3 meeting, the Hanford Advisory Board adopted the following advice relating to the Waste Management PEIS and public involvement.

Advice

The Hanford Advisory Board is concerned by USDOE Headquarters' inadequate planning and decisions for public involvement and information for the Waste Management PEIS. Publicity to promote public involvement has not met the standard expected. There is a need for timely and meaningful disclosure to the public in the Northwest of all relevant waste and nuclear materials movement actions, impacts and alternatives for the Waste Management Programmatic EIS.

This Board expressed strong reservations about USDOE's plans to hold one single multisite videoteleconference hearing for public comment from 6 cities. Those concerns were not heeded nor mitigated.

The Board is upset that DOE-HQ refused to place any notice advertising in major newspapers for 5 of the 6 cities where the hearing will be held, other than in the legal notices.

Northwest stakeholders and the Hanford Advisory Board have urged USDOE to disclose, and integrate impact and alternative analyses into one public document and process, all wastes and nuclear materials which USDOE is considering treating, storing and disposing at Hanford and throughout the complex. You personally committed at the Plutonium Roundtable in Seattle to such integration and disclosure. We remain concerned that such an integrated approach disclosing all interrelated and cumulative impacts should be available in time for public input to this major WM Programmatic EIS.

16/08.00.00

Therefore, the HAB urges USDOE to utilize an independently facilitated inter-site

HAB Consensus Advice #34
Subject: Waste Management PEIS and Public Involvement
Adopted: November 2-3, 1995

Contact: Confluence Northwest, Facilitation Team
800 NW Sixth Avenue, Suite 142, Portland OR 97209-3715
Phone (503) 243-1663 Fax (503) 243-1643

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08 00 00 **Comment Number 16**

This comment is outside the scope of the PEIS and, therefore, has been referred to EM for response.

stakeholder planning process to: cooperatively develop a meaningful integrated public participation process on the Department's proposed actions to ship for storage, treatment or disposal of DOE's nuclear and hazardous wastes and nuclear materials. The HAB requests DOE to keep the WMPEIS comment period open to implement any process resulting from the November 29th intersite meeting.

16/08.00.00 cont.

The Board looks forward to your written response, as called for in our charter.

Very truly yours,

Merilyn B. Reeves, Chair
Hanford Advisory Board

cc: Chuck Clarke, EPA
Mary Riveland, Ecology
John D. Wagoner, Manager
Cindy Kelly, Designated Federal Official
Linda Lingle, Site Representative
The Oregon and Washington Congressional Delegations

HAB Consensus Advice #34
Subject: Waste Management PEIS and Public Involvement
Adopted: November 2-3, 1995

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HANFORD ADVISORY BOARD, PORTLAND, OR, MERILYN B. REEVES PAGE 9 OF 11

HANFORD ADVISORY BOARD

A Site Specific Advisory Board, Chartered under the Federal Advisory Committee Act

Advising:
US Dept of Energy
US Environmental Protection Agency
Washington Dept of Ecology

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Marilyn Reeves

VICE CHAIR
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Gordon Rogers

Regional Environmental Groups/Citizens
Greg Delbridge
Paige Knight
Gerald Pollet
Todd Martin
Elizabeth Yeshel

State of Oregon
Shirley Clinch
Michael Graybeal

Ex-Officio
Confederated Tribes of the Umatilla Reservation
Washington Health Department
Yakama Indian Nation

Thomas P. Grumbly
Assistant Secretary for Environmental Management
Department of Energy
1000 Independence Avenue SW
Washington DC 20585

December 8, 1995

RE: Draft Waste Management Programmatic Environmental Impact Statement (DOE/EIS-0200-D)

Dear Mr. Grumbly:

The Hanford Advisory Board believes the following advice reflects the criteria DOE, EPA, WDOE, should use in selecting and negotiating alternatives. This advice is identical to HAB consensus advice #13 on "Off Site Mixed Waste Acceptance" adopted on February 3, 1995, and forms the basis for this additional advice and recommendations

The State of Washington and U.S. EPA should not allow the U.S. Department of Energy or U.S. Department of Defense to transfer to the Hanford site any hazardous and radioactive waste unless the following criteria are met:

1. A general condition of permit and plan approval and subsequent off-site waste acceptance in Washington State should be on-going substantive compliance with Washington Dangerous Waste laws and the terms, conditions, and schedules of permits, consent orders and clean-up agreements (e.g. the Tri-Party Agreement) between the DOE and the State.

2. Acceptance of off-site waste must be contingent on existing facility capacity and on availability of funding to handle processing and storage needs, while having a neutral or positive impact on Hanford clean-up.

3. In all instances where DOE proposed to treat off-site wastes at Hanford, a written reciprocal agreement should be required between the State of Washington, the state of origin of the off-site waste and the Department of Energy.

4. Technical, economic and equity concerns should be addressed in deciding whether to approve storage. Prolonged storage of off-site wastes prior to treatment, or of post-treatment residuals, generally should not be approved

HAB Consensus Advice #38
Subject: Draft Waste Mgmt Programmatic EIS (DOE/EIS-0200-D)
Adopted: December 7-8, 1995

This advice represents HAB consensus for this specific topic. It should not be taken out of context to extrapolate Board agreement on other subjects matters

Contact: Confluence Northwest, Facilitation Team
800 NW Sixth Avenue, Suite 342, Portland OR 97209-3715
Phone (503) 243-2661 Fax (503) 243-3681

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5. No pretreatment storage should be allowed at the receiving site unless it has been approved in the written reciprocal agreement between the shipping and receiving states.

6. Plans and schedules to treat off-site wastes should be approved only in instances where there is a binding legal obligation on the part of DOE for primary and secondary off-site storage facilities designed to receive post-treatment residuals before wastes are allowed to be shipped to Hanford. Plans and schedules should specify that generally no residuals will be stored or disposed of at Hanford. In the event of substantial noncompliance with Washington Dangerous Waste Law requirements, or failure to have off-site facilities available for return of post-treatment residuals, off-site waste will not be accepted at Hanford. Lacking specific agreement between the state, DOE and state of origin, waste residuals should be returned to the site of origin or other compliant facilities to be specified in plans and schedules.

7. When reviewing requests from other sites/states to accept wastes for treatment at Hanford, the sending site's treatment plan should be scrutinized to determine whether there has been thorough consideration of on site treatment and pre-shipment storage. Off-site wastes should not be accepted for treatment where such analysis is lacking or not compelling, unless it is otherwise approved in the reciprocal agreement between the sending and receiving states.

8. Receipt of any off-site wastes for treatment should require submission by shipping state of a schedule for shipment, treatment, and post-treatment residuals management, and prior written approval by the State of Washington.

9. Transport of off-site waste to Hanford for treatment will require careful planning of routes and consideration of weather emergencies to minimize the likelihood of an accident. Emergency preparedness for minimizing the impacts from an accident will require financial support from DOE to state, tribal and local involvement, including adequate equipment and training. When materials are shipped, timely notification should be provided to transportation agencies.

10. Cumulative impacts (e.g. of other wastes types) must be analyzed and considered in decisions concerning the movement and treatment of DOE wastes. DOE must fully disclose all projected waste types and quantities that may be shipped to Hanford prior to any consideration by Washington of TSD permits for wastes generated at other facilities. This information must be part of the PEIS and Draft Site Treatment Plan public comment/public participation process, and of an inter-regional and inter-site advisory board dialogue, prior to development of final Site Treatment Plans and any agreement by Washington State to accept off-site wastes.

11. Hanford off-site waste acceptance criteria must include provision for inspection and payment of appropriate permit fees to cover all state costs, including inspection of pre-

HANFORD ADVISORY BOARD, PORTLAND, OR, MERILYN B. REEVES PAGE 11 OF 11

shipping procedures. Existing Waste facilities at Hanford must be in substantial compliance with the Tri-Party Agreement milestones, other orders or agreements and RCRA or state law requirements in order for permits to be issued or amended to allow off-site wastes to be treated, stored or disposed of at Hanford.

The HAB is concerned that the WMPEIS has used the Baseline Environmental Management Report (BEMR) as its source for estimated waste volumes. We urge USDOE to work with individual sites to verify and validate these estimates, as well as other identified assumptions.

USDOE should develop an effective decision-making process to integrate those EISs dealing with waste storage, treatment and disposal from USDOE's facilities. This process must be designed in a way that will earn the agreement of the affected states and Indian nations, and the support of SSABs and other affected stakeholders; this process must also contain a strong public involvement element. Please refer to HAB Advice #34, requesting an integrated public participation process. The SSABs can play a key role in public involvement, but it must be augmented by a broader outreach program. USDOE should work with stakeholders to ensure that their values are factored into alternatives being considered in the WMPEIS. We have attached two documents ("The Future for Hanford: Uses & Cleanup" from the Future Site Uses Working Group and the Final Report of the Hanford Tank Waste Task Force) which identify the values of Hanford stakeholders.

The Hanford Advisory Board urges the Washington State Department of Ecology and the U.S. Environmental Protection Agency be fully involved in decisions that would impact the Hanford site, particularly in decisions that could compete with or detract from the site's cleanup mission and the resources it requires.

We look forward to your written response as is called for in our charter.

Very truly yours,

Merilyn B Reeves

Merilyn B. Reeves, Chair
Hanford Advisory Board

cc: Chuck Clarke, U.S. Environmental Protection Agency, Region 10
Cindy Kelly, Designated Federal Official
Linda Lingle, Site Representative
Mary Riveland, Washington Department of Ecology
John Wagoner, Department of Energy - Richland Operations
The Oregon and Washington Congressional Delegations

HAB Comment Advice #38
Subject: Draft Waste Mgnt Programmatic EIS (DOE/EIS-0200-D)
Adopted: December 7-8, 1995

Page 2
This advice represents HAB comments for this specific topic. It should not be taken out of context to extrapolate Board agreement on other subjects matters.

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Hanford Communities

Richland • Kennewick • Pasco • West Richland • Benton City • Benton County

P. O. Box 190, Richland, WA 99352
Telephone (509) 943-7348 Fax (509) 943-5666

April 28, 1996

Mr. Jim Hummer
Science Applications International Corp.
3250 Port of Benton Boulevard
Richland WA 99352

Dear Mr. Hummer:

This letter is to ask your help in our review of the draft Programmatic Environmental Impact Statement (PEIS) just released by the Department of Energy on long-term storage and disposal of weapons-usable plutonium surplus to the nation's defense needs. Because the PEIS covers a wide range of issues from transportation safety to environmental and socioeconomic impacts, the Hanford Communities will coordinate a review of the document and recommend a response to member jurisdictions.

Hanford is one of six DOE sites listed in the PEIS as candidates for long-term storage of weapons-usable plutonium. Rather than listing potential disposal sites, the PEIS suggests alternate technologies. Hanford is particularly well situated to support two of those listed -- vitrification and incorporation of plutonium into mixed oxide fuel (MOX) for use in nuclear reactors. 1/08.03.01

We believe our community's response to the PEIS should be carefully developed. It is our responsibility -- not that of "distant stakeholders" -- to appraise the health and safety, transportation, and socioeconomic impacts of weapons usable plutonium mission for Hanford. If properly understood by the public, disposal of weapons-usable plutonium could be embraced as a respectable and noble mission for Hanford. If this issue is not well understood and is strongly opposed by the general public, plutonium transport and long-term storage could have a very negative impact on the Tri-Cities region.

We need to determine whether this community should accept additional plutonium and, if so, under what circumstances. To accomplish this, we have asked a group of 20 individuals to work with us to review the draft PEIS and help us develop a position paper. We would sincerely appreciate your participation in this process. We anticipate that your involvement would include reviewing the draft PEIS working with our consultant to define and shape the issues to be addressed in the white paper and, if you are interested, participating in an issue briefing to convey this information to the community. Pam Brown of my staff will be contacting you to ask if you will be willing to help us on this project.

Sincerely,

Joseph C. King
Richland City Manager and Chairman of
Hanford Communities Administrative Board

Independent Communities With Common Interests

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08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for new missions at Hanford. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

HANFORD COMMUNITIES, RICHLAND, WA, JOSEPH C. KING PAGE 2 OF 7

James H. Hummer
188 CANYON STREET • RICHLAND WA 99352 • (509) 627-0176

May 2, 1996

Mr. Craig Williamson
Richland Fire & Emergency Services
1000 George Washington Way
Richland, WA 99352

Dear Mr. Williamson:

Subject: Review of DOE/EIS-0229-D, *Storage and Disposition of Weapons-Useable Fissile Materials Draft Programmatic Environmental Impact Statement*

Following is a compilation of comments from the EIS review for transportation issues. To better the review I solicited support from personal acquaintances from the Westinghouse Hanford Company (WHC) Transportation and Packaging Function. Their participation, and my own, is personal and does not represent the views of either WHC or Science Applications International Corporation (SAIC). Reviewers include me and:

Mr. W. F. (Bill) Irvine	Manager, Transportation and Packaging
Mr. J. G. (Greg) Field	Manager, Packaging Engineering
Ms. J. R. (Janet) Green	Engineer, Transportation Risk Assessment
Mr. J. H. (Jim) Portsmouth	Manager, Traffic Management

Overall, we found nothing we would characterize as a showstopper. Safety in transportation of radioactive materials has an excellent track record. However, transportation is an issue because it is visible and may involve (by proximity) persons that would otherwise be miles away from the material. For these, and other reasons, the Department of Energy has an extensive program of public liaison and communication to inform and solicit comments from the public on transportation issues. They also administer training on all aspects of radioactive and other hazardous material transportation and conduct emergency response training and accident recovery exercises. Other programs include self assessment of traffic management and radioactive and hazardous material packaging and transportation operations and third-party evaluation of commercial carriers. The DOE Office of Transportation, Emergency Management, and Analytical Services manages these programs (EM-76). They have not, but should, review this EIS. These programs help the DOE retain its track record in radioactive and hazardous materials transportation. The EIS does not, but should, explicit the benefits of these programs.

Westinghouse Hanford Company is an active participant in several of these programs, particularly training and motor carrier evaluation. As the normal follow-up to WHC's carrier registration, four inspectors from the Department of Transportation (DOT) conducted a

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formal review the week of March 7, 1994, to verify compliance with the federal regulations. They spent the entire week conducting random vehicle inspections, document reviews and personnel interviews in various departments and facilities across the site.

The review included all shipping documents for hazardous materials and wastes leaving the site during the previous year, driver qualification files, vehicle maintenance and inspection records, procedures and policies, hazardous materials employee training records, driver substance abuse testing results, medical files, and liability insurance and hazardous materials registration documentation. The review team found only four discrepancies, which they characterized as minor.

WHC received a "Satisfactory" rating, the highest granted by DOT, and was described in the exit briefing as the best transportation operation in the DOE complex. This may be another advantage that Hanford has concerning this scope of work.

Specific Comments:

The EIS assessment seems thorough, given that the numbers would withstand more rigorous scrutiny. There is concern that the packaging certifications (pedigrees) are not clearly explained; i.e., not all packagings possess the Nuclear Regulatory Commission endorsement. The other overall concern is that the relative risk bases are not presented clearly. 2/10.00.00

Alternatives in chapter 2 do not address material transportation adequately or consistently. For example, Section 2.4.1, *Pit Disassembly/Conversion Facility*, states that originator will have ultimate responsibility for safe transfer and shippers, transporters, and receivers are responsible for complying with applicable regulations. This is always the case, whether DOE is involved or not so it really says very little about what DOE does, or will do, to safely transport the materials. In Section 2.4.5.2, *Existing Light Water Reactor Alternative*, transportation addresses five types of radioactive material shipments including low-level waste, fresh MOX fuel, and spent fuel. Section 2.4.5.4, *Evolutionary Light Water Reactor Alternative*, discusses low-level waste, mixed low-level waste, hazardous waste, nonhazardous waste, transuranic waste, and spent fuel yet transportation is summed up as "Intersite transfers would be made by rail, truck transport, or pipeline as appropriate." All these sections should address all the applicable transportation streams and what special requirements apply such as security or special routing. 3/10.00.00

There are several references to a DOT Specification 6M in Section 4.4, *Intersite Transportation of Fissile Materials*, and Appendix G, *Intersite Transportation*, as a DOT specification 6M Type B packaging, a DOT approved 6M Type B packaging (using 2R inner containers), a 6M, a 6M-2R, and a model 6M. In addition there is a statement that "A typical 6M, Type B packaging approved for use by DOE is covered by Certificate of Compliance Number 9869, dated January 5, 1994." This infers NRC certification in 4/10.00.00

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10 00 00 Comment Number 2

The analysis for the storage and disposition alternatives evaluates the potential risks for transporting shippable forms of fissile materials (that is, Pu and HEU) that have been stabilized and packaged for shipment at the originating site. All packaging processes (and certifications) meet DOT and DOE requirements. NRC certification criteria is applied to all Type B packagings, as required by the DOT regulations. Section 4.4.2.2 of the PEIS presents information on packaging criteria established and enforced by Federal agencies. A thorough explanation of risk basis is presented within Sections G.1.1 and G.1.2 for truck/rail and port transit modes, respectively.

10 00 00 Comment Number 3

The transportation issues raised require site-specific knowledge in order to describe the transportation streams and the special requirements which apply to each transportation scenario (security, special routing). Transportation of radioactive material from an existing LWR site and evolutionary LWR site may include several modes of transportation (truck, rail, and barge) depending on the location of the site. Specific transportation streams and special requirements will be addressed if these alternatives are selected for further consideration. Appendix G presents additional information on transportation of radioactive materials and types of packaging specific to the material to be transported.

10 00 00 Comment Number 4

The PEIS uses the terminology "6M Type B package" to designate both the generic package type identified in the DOT specification and the specific variation of the package type used by DOE. The specific package type used by DOE is denoted as the 6M-2R, consisting of the 6M Type B package using 2R inner containers.

All aspects of the transportation of radioactive materials within the United States are regulated at the Federal level by the DOT. The Federal regulations are implemented by both NRC licenses and DOE for the transportation of

HANFORD COMMUNITIES, RICHLAND, WA,
JOSEPH C. KING
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comparison to a DOT specification packaging. The inconsistent terminology and the careless use of "Rad, Type B packaging" can be very misleading. One is an apple (DOT specification packaging), the other an orange (NRC certified packaging). As described, the EIS could lead to unnecessary criticism or debate about the validity of the risk analysis. The DOT specification packaging is not subject to the test sequence on page G-7. There is some controversy, mainly among the regulators (DOT and NRC) and DOE, regarding the DOT specification packaging. The EIS needs to identify clearly which packaging is which. — 4/10.00.00 cont

Section 4.4.2.2, *Packaging*, does not adequately describe the safety basis of the DOT-6M packaging, an old grand fathered DOT Specification packaging container, as shipped in the SST, particularly when compared with the safety basis of a state-of-the-art NRC certified spent fuel cask or the BUSS Cask. The public is probably not aware of the various systems that authorize Type B packages: DOT Specification (old), DOT Certificate of Competent Authority, NRC Certificate of Compliance, and DOE Weapons Program authorizations which include operational considerations. They need to be defined and considered in the risk analysis. — 5/10.00.00

The correct designator for some of these containers would be Type BF versus Type B.

Potential fatalities need to be defined better in Section 4. It is not clear that the potential fatalities reported represent an integrated risk of cancer fatalities from accident and non-accident radiological hazards and non-radiological risks associated with increased automobile emissions and highway fatalities. The numbers in this section would be more meaningful if they reported the radiological and non-radiological results separately. — 6/10.02.00

The section also infers that RADTRAN calculates the non-radiological risk, which it does not.

Page 4-772: The first sentence states "materials would be transported by SST or commercial equivalent truck." There is no commercially available equipment like the SST. — 7/10.00.00

Page 4-773: The second sentence states "For relatively low-level radioactive materials, DOT Specification Type A packaging are used." Strong tight containers are also allowed for low specific activity radioactive material shipments. — 8/10.00.00

Page 4-780: Given more time to digest the information provided, these items may become more clear. For the "Deep Borehole" emplacement alternative, it is not clear why shipments would follow immobilization and come from lag storage. The shipping volumes of 5.5 tons per year seem slow, when the immobilized pellets could be shipped at a rate of 551 tons per year. Why the large difference in shipping volume capacity? — 9/10.00.00

Page 4-781: The fifth paragraph mentions shipping one rail cask at a time for a total of sixty-four shipments per year. Is this in regular train service or "special train?" There is a — 10/10.00.00

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radioactive materials. Package designs meeting the Type B package performance criteria are considered by NRC and DOE to provide adequate protection of the public and operating personnel in the event of a transportation accident. The NRC has no regulatory authority regarding DOE transport of radioactive materials, although DOE does use NRC criteria for the certification of Type B packaging, including the 6M-2R.

The approval process followed by DOE regarding Type B packaging and transportation of radioactive materials is established by DOE Orders. Package design, testing, and safety information must be prepared for shipping packages proposed for use within the DOE complex. Review and approval of this information results in DOE's issuance of a Certificate of Compliance for the package and its use. In the case of the 6M Type B package, although the package meets DOT specification, the DOE approval process provides additional requirements prior to the package's use within the DOE complex.

10 00 00 Comment Number 5

A discussion of the safety basis of certified nuclear packaging is beyond the scope of the PEIS. The transport index (TI), which is a regulatory characteristic of a package, was estimated to be the maximum allowed by regulatory requirements and used in the transportation risk analysis. A discussion of transport packaging is presented in Appendix G.

10 02 00 Comment Number 6

The human health risks from the transportation of radioactive materials between sites includes both radiological and nonradiological impacts to the public and workers. The categories of calculated risk include nonradiological accident impacts to the public and workers, nonradiological normal operation impacts to the public (air pollution), radiological accident impacts to the public, and radiological normal operation impacts to the public and workers. The risk to the public from radiological accidents is an order of magnitude less than either nonradiological accidents or radiological exposures during normal operations.

Richland Fire & Emergency Services
Page 4
May 2, 1996

big difference in cost associated with the two options. 10/10.00.00 cont

Page 4-783: Risk numbers are difficult to understand and follow. For example, it seems that the deference in level of risk between processing in the U.S. versus processing in Europe, as depicted in Table 4.4.3.3-4, would be much greater than shown. 11/10.02.00

Appendix G: The risk associated with the transportation of the materials would be better understood if it were broken into radiological and non-radiological categories. The radiological risks would also be more meaningful if they reported them for both accident and normal modes. Summing all risks results in numbers that are only useful to compare the alternatives being considered in this EIS. One cannot easily compare them with the other reports, which do not use this method. 6/10.02.00 cont.

Not enough information was given about the RADTRAN input values used. For instance, the following values should be included and referenced: release fractions (RFAC, HERSOL, RESP), atmospheric dispersion values (for truck and rail, and oncoming highway traffic statistics. 12/10.02.00

NUREG-0170 severity categories were used for all truck shipments. This may not be appropriate for the 6M shipments or for the 55-gallon drum shipments. 13/10.02.00

Page G-3: Second paragraph, second sentence states that the 6M packages would be placed on Cargo Restraint Transporters (CRT) to facilitate loading and securing in the SST. At one time, we were told at Hanford to return our CRT's. Are they still being used on the SST's? Just a question. They worked well. 14/10.00.00

Page G-3: The second sentence in the third paragraph mentions transferring the CRT's from an SST to a standard ISO container. Standard ISO containers do not have the floor tie down capability associated with the CRT's and available in the SST. The CRT's have wheels, and a proper tie down pattern would have to be developed for ocean transport in ISO containers. 15/10.00.00

In addition, I have reviewed the other material you sent me and offer the following comments for your use.

Both Gordon Rogers and Rob Davis state their belief that transportation is a fully developed technology and with proper coordination and route selection, risk can be minimized. agree with this conclusion. The DOE will likely prepare a plan for a long term shipping campaign such as this, conduct emergency response training along the routes, and perform several other extra-regulatory activities to ensure safety in transportation.

Robert M. Jefferson commented that there seemed to be a complete lack of concern for criticality safety. They do not analyze criticality safety in the EIS. However, several

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10 00 00 Comment Number 7

If commercial trucks were to be utilized, additional requirements (physical and administrative) would be applied to provide equally effective safety and security measures as provided by SST.

10 00 00 Comment Number 8

The commentor is correct that strong, tight packagings can be used for low-level radioactive materials of less than Type A quantities. The text in Section 4.4.2.2 of the Final PEIS was changed to concur.

10 00 00 Comment Number 9

The Deep Borehole Alternative discusses the disposition of surplus weapons-usable Pu in two forms: (1) direct emplacement of Pu without immobilization and (2) Pu-loaded, ceramic-coated pellets. The amount of Pu to be transported for direct emplacement is estimated to not exceed 5 t (5.5 tons) per year. The amount of Pu-loaded, ceramic-coated pellets to be transported for emplacement is estimated to be 500 t (551 tons) per year. The Pu-loaded, ceramic-coated pellets contain 1-percent Pu. Therefore, the amount of Pu-loaded, ceramic-coated pellets would be 100 times as great as the amount of Pu for direct emplacement, or approximately 500 t (551 tons) per year.

10 00 00 Comment Number 10

Although shipments may be consolidated into "dedicated trains" of more than one car, the risk analysis has considered regular train services for these shipments. Several court decisions have shown there is no safety basis for the use of "special trains" for high-level nuclear materials. DOT, DOE, and NRC have provided no such direction that special trains will be used for radioactive materials.

HANFORD COMMUNITIES, RICHLAND, WA,
JOSEPH C. KING
PAGE 6 OF 7

aspects of the Department of Transportation and Nuclear Regulatory regulations deal with criticality safety as to packaging design requirements, content limitations, and transport vehicle loading. A letter comment states that the Transport Index (TI) is based on criticality considerations for fissile materials. Criticality safety is an important subject that the governing regulations address.

Sincerely,

J H Hummer

cc: J. G. Field
J. H. Green
W. F. Irvine
C. H. Klimill
J. H. Portsmouth

F-044

10 02 00 Comment Number 11

The values given in Table 4.4.3.3–4 of the PEIS represent the "Total Potential Fatalities" associated with the transportation of Pu oxide, uranium oxide, and MOX, for the Reactor Alternative category. The quantities presented are a result of direct risk calculations which yield results in "numbers of human fatalities." In regard to accumulating the risks associated with a given transportation process, the maximum risk impacts from the transport of Pu oxide, uranium oxide, and MOX fuel under the Reactor Alternatives may be summed directly from Table 4.4.3.3–4. According to results calculated by the "industry-wide accepted" RADTRAN code, the highest number of total potential fatalities from the transportation of materials from lag storage to fuel fabrication and then to a reactor site is 4.16 for MOX fuel fabrication in the United States. In Europe, the number of potential fatalities for a similar procedural operation would be 4.62. The difference between 4.62 and 4.16 fatalities is essentially negligible. Risk differences between the two "regional" alternatives (that is, the United States vs. Europe) are very small for all stages involved.

10 02 00 Comment Number 12

Appendix G of this PEIS discusses the pertinent methodology and associated parameters utilized in the transportation modeling via the RADTRAN code. The scope of this document does not require scientific detail regarding input parameters to exceed that of a programmatic level.

10 02 00 Comment Number 13

This PEIS evaluated the potential for highway accidents and radioactive releases from the 6M shipments during transport in terms of eight accident severity categories identified in NUREG-0170 and implemented through analysis by the RADTRAN 4.0 computer code. The accident categories ranged from the least severe and most frequent accident (Category I) to the most severe and least frequent accident (Category VIII). NUREG-0170 characterizes package response to these accident categories in terms of release fractions based on the package type, transportation mode, and accident category. DOE considers the accident category information presented in NUREG-0170 to adequately cover the transport mode and package types addressed in the PEIS.

10 00 00 **Comment Number 14**

The Cargo Restraint Transporters (CRTs) are still being used on the SST.

10 00 00 **Comment Number 15**

Transportation component design specific to this situation is beyond the scope of this PEIS. If design changes are necessary for International Standards Organization (ISO) transport to occur, proper modifications would be expedited to meet the necessary criteria.

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Hanford Communities

Richland • Kennewick • Pasco • West Richland • Benton City • Benton County

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May 8, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
c/o SAIC PEIS
Washington, D C. 20026-3786

Ref: Draft Programmatic EIS - Weapons Usable Fissile Materials Disposition - February 1996

To Whom it May Concern:

The Hanford Communities, individually through their respective elected bodies and collectively as a group, provide summary comments and recommendations as noted below relative to the referenced EIS. We appreciate the opportunity to provide input into this vital Department of Energy project and accordingly have taken extraordinary measures to ensure a thorough technical and citizen review.

We asked community leaders and technical experts to serve as a volunteer advisory group to the Hanford Communities for this draft PEIS. The 30+ persons participating in this capacity divided into seven focus groups: transportation, health and safety, MOX fuel and Pu conversion, reactor burn options, vitrification disposition, socioeconomic issues and national security issues. Their comments complement and go into greater depth than the Hanford Communities' comments and are summarized in Attachment 1. Please review and carefully consider both sets of comments.

While time constraints did not permit public meetings or televised citizen forums during the limited comment period, we intend to hold one or more public meetings or media forums to fully inform the public of this response and gain additional citizen input. We will promptly notify DOE if there are any substantive changes to this transmittal as a result of this additional input.

We strongly support the reactor burn option as the preferred Pu disposition alternative. We believe this option has the best chance of becoming the disposition model internationally because it permits recovery of a significant fraction of the valuable "fuel" value while fully complying with one of the accepted proliferation-resistant disposal alternatives. We believe Hanford offers the best and most compelling cost and schedule advantage with the least environmental, health, safety and proliferation risks for either the reactor burn or the vitrification disposition mode. With Hanford's and Washington Public Power Supply System's existing facilities and infrastructure, and the planned privatization of Hanford's tank waste vitrification program (Figure 1), large savings in capital and operating funds are possible relative to other sites. 1/08.03.01

SUMMARY COMMENTS AND RECOMMENDATIONS

- Excess weapons-usable fissile materials must be promptly safeguarded and disposed of in the U.S. and internationally to prevent nuclear weapons proliferation. Time is of the essence since there is a clear and present danger of illicit use of bomb-grade plutonium and high enriched uranium in the world today. Accordingly we recommend DOE select the preferred disposition alternative and the Pu conversion and disposition sites that best achieve rapid, cost effective, integrated use of already existing DOE facilities; widespread acceptance by the international nuclear weapons community; and minimization of disposition implementation time, new capital requirements and environmental, transportation, safeguards, security, worker and public health and safety, and proliferation risks. 2/08.03.01

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08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for new missions at Hanford. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the disposition of surplus Pu in existing facilities to the extent practical. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

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- Hanford should be included in the draft EIS as a potential Pu processing and disposition site -- the PEIS currently only considers Hanford as a "long term storage" site, and specifically, the
  - Fuels and Materials Examination Facility should be considered as a potential site for MOX fuel fabrication, Pu conversion and/or small scale Pu vitrification, and the
  - Fast Flux Test Facility reactor should be considered as a viable plutonium "burner" reactor

3/01.04.00

- We oppose any consideration of Hanford as a "long-term Pu storage only" facility. Temporary plutonium storage is acceptable as part of an expeditious, substantive Pu disposition option.

4/08.03.01

- Hanford is unique in that a large, operating, commercial nuclear-electric power station (WNP-2); a plutonium oxide fuel burning test reactor (FFTF); a commercial low-level waste disposal site; a nearly complete plutonium oxide (MOX) fuel fabrication facility; another large, but partially completed, nuclear-electric power station (WNP-1); a soon-to-be-developed vitrification plant; plus all the site infrastructure co-exist within DOE's Hanford site boundaries. These collocated or "clustered" facilities (Fig. 1) should be given preferential consideration in this EIS and Record of Decision and in all assessments of environmental impacts, schedules, capital requirements, life-cycle costs, health, safety, safeguards, security, transportation and proliferation risks.

3/01.04.00 cont.

- Mitigating transportation issues is a high priority. New or expanded Pu storage site(s) should not be determined until after the plutonium conversion site(s), and preferably, after the preferred plutonium disposition method(s) and the plutonium disposition site(s) are finally selected.

5/01.00.00

- We oppose using Canadian CANDU or any other foreign reactors to dispose of U.S. generated weapons grade plutonium. This is neither appropriate nor responsible international U.S. policy.

6/08.03.01

In conclusion, we do not believe the Department of Energy can adequately address or minimize the environmental impacts and associated health, safety, safeguards, security, transportation, schedule and cost impacts of the proposed PEIS until it evaluates its Pu conversion and disposition options relative to the synergistic use of existing, collocated, cost effective facilities in the DOE complex.

2/08.03.01 cont.

We urge you to formally and thoroughly examine the potential benefits of disposing of plutonium as depicted in the attached simplified schematic (Figure 1). We believe implementing this strategy will literally save DOE billions of dollars and shorten the time to initiate Pu disposition by at least 4 to 8 years. The schematic depicts a collocated plutonium disposition "system" involving compatible, already existing Hanford facilities plus new, already scheduled tank waste vitrification facilities. The plutonium conversion step indicated in the schematic could be at Hanford or elsewhere.

3/01.04.00 cont.

We look forward to working with the Department of Energy to refine and improve upon the ideas and concepts provided in this memo. It is essential that DOE's former weapon's complex sites cooperate to find the best, safest, most timely and cost-effective solution to the plutonium disposition problem. Excessive plutonium disposition costs will likely have a negative impact on the entire EM budget and hence adversely affect all sites. It is essential that the on-going Hanford cleanup program not be adversely impacted by the plutonium conversion and disposition program.

7/11.00.01

We urge you to incorporate our plutonium disposition comments and recommendations by whatever means are necessary under NEPA into a final or re-issued PEIS and into the Record of Decision.

Very truly yours,

Larry Haler, Chair
Hanford Communities Governing Board

Attachments: as stated

cc: Mr. T. P. Grumbly, DOE-HQ
Mr. J. David Nulton, DOE-HQ

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01 04 00 Comment Number 3

The PEIS considers six DOE sites for long-term storage of Pu. The ROD will choose an approach and site for long-term storage and a technology(ies) for disposition. The same six DOE sites were evaluated with regard to the disposition options addressed in the PEIS. Additional site-specific NEPA analysis may be required before a disposition decision can be implemented. Hanford is among the six sites considered for disposition.

Liquid metal reactors were not included as alternatives for Pu disposition in the PEIS due to the longer time and greater cost required to complete their construction. The FFTF, on the other hand, is an existing reactor and could be used for Pu burning. However, the limited capacity of the FFTF would limit the rate at which Pu could be dispositioned and require a much longer timeframe for disposition than that which could be achieved with the reactor options addressed in the PEIS.

The Department of Energy is in fact considering the FFTF, pursuant to the ROD for the TSR PEIS. The ROD (December 1995, 60 FR 63878) for the TSR PEIS addressed the FFTF for tritium production as follows:

> A private group has recently suggested that it purchase the FFTF from DOE and that DOE then contract with the private group to make tritium at that facility. In the [Tritium Supply and Recycling Final] PEIS, the use of FFTF was considered and dismissed as a long-term tritium supply option because the amount of tritium that it could produce would only meet a percentage of the steady state tritium requirements, and it was not reasonable to rely on operating the facility far beyond the end of its design life. However, DOE will evaluate the presentation made by the private group to determine whether the operation of the FFTF might be able to play any role in meeting future tritium requirements. If any changes are warranted to this ROD following that review, or further NEPA documentation is required, DOE will take appropriate action.

The Secretary of Energy has requested a review by the JASONS Panel (eminent academic scholars and scientists) as part of the evaluation of tritium production with the FFTF. Should the outcome of this evaluation lead to a DOE proposal to restart the FFTF for tritium production, additional environmental analyses would be performed, as appropriate. If the FFTF were to be restarted, a substantial portion of the surplus Pu that would be used

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The Hanford Communities Governing Board and Administrative Board Unanimously Approved the Attached Letter Response to the Department of Energy's "Storage and Disposition of Weapons-Usable Fissile Materials" Draft Programmatic Environmental Impact Statement During Its Meeting May 3, 1996

By Signature Below, We the Cities and the County Comprising the Hanford Communities, During Our Regular City Council or County Commissioner Meetings on May 6 or May 7, 1996 Voted Affirmatively to Send the Same Letter in Response to the Department of Energy's Draft Programmatic Environmental Impact Statement

Max Benitz, Jr. , Chair — 5-6-96 — date
Board of Benton County Commissioners

J. E. Fluckiger, Mayor — 5-7-96 — date
City of Benton City

Jim Beaver, Mayor — 5-7-96 — date
City of Kennewick

Charles Kilbury, Mayor — 5/6/96 — date
City of Pasco

Larry Haler, Mayor — 5/6/96 — date
City of Richland

Jerry Peltier, Mayor — 5-6-96 — date
City of West Richland

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for MOX fuel could be used to fabricate the FFTF driver fuel, thereby achieving the Spent Fuel Standard for Pu disposition through irradiation in the FFTF. Further description of the FFTF has been added to Appendix N of the PEIS.

The FMEF is considered for use as a long-term storage facility for Pu, and the impacts are included in Section 4.2.1 of the PEIS. For the production of MOX fuel a generic facility was considered for all six DOE sites. At Hanford this MOX fuel fabrication facility would be located in the 200-Area adjacent to 200 East. The utilization of the FMEF would be a variant for MOX fuel fabrication at Hanford, which is bounded by the environmental analysis for the MOX fuel fabrication facility located in the 200-Area. Table 2.4–1 of the PEIS provides a brief description of variants to disposition alternatives analyzed which includes "Modification/completion of existing facilities for MOX fabrication." The storage options for Hanford also include the construction of a new facility. Utilization of the FMEF for the Upgrade Alternative would not preclude its use to also support Pu disposition activities for either Reactor or Immobilization Alternatives.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's opposition to continuing or long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 00 00 **Comment Number 5**

Comment noted.

08 03 01 **Comment Number 6**

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy

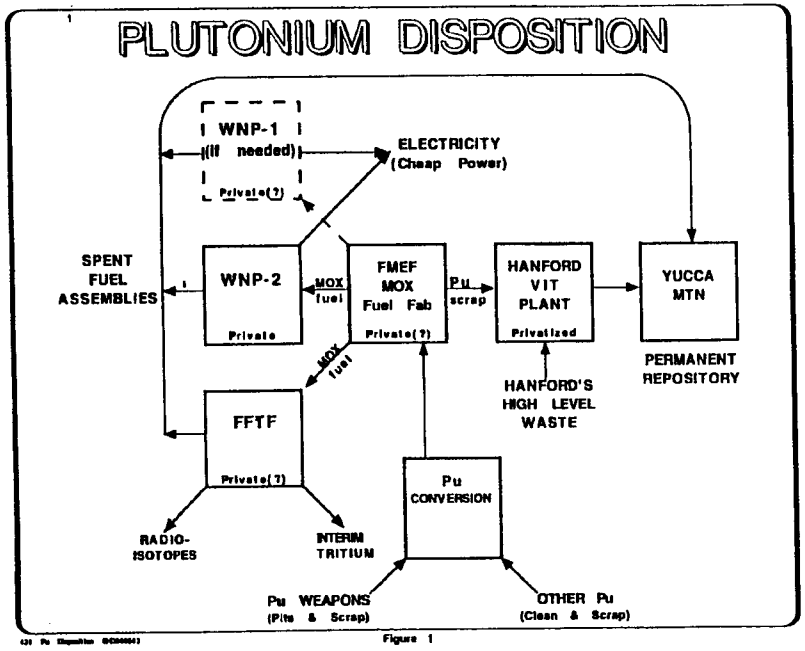

Figure 1

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considerations, and public input. This will include an appropriate level of analysis by Canada before any decision on burning Pu in a CANDU reactor is implemented.

11 00 01 **Comment Number 7**

Comment noted. DOE's Fissile Materials Disposition Program is an integrated effort that will require the participation of a number of DOE sites that have weapons material experience. DOE acknowledges the commentor's concern about the potential effect that selection of Hanford for new missions could have on the Hanford cleanup program. It is DOE's intent that the implementation of Fissile Materials Disposition Program decisions will have little or no impact to ongoing clean up programs. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input. The decision process will also give consideration to existing agreements between DOE, the State of Washington, and the EPA.

Attachment #1: Detailed Comments from the Hanford Communities "Citizens Advisory Committee" on the Plutonium Disposition PEIS

The Hanford Communities Advisory Committee[1] represents more than 500 years of experience dealing with billion dollar projects, community interests, and government programs similar to that outlined in this draft programmatic EIS.

Excess weapons-usable plutonium in any form other than a safeguarded "spent fuel standard" represents a clear and present danger to the world's society. The risks of devastating consequences are magnified by the time to reach consensus in today's complex national and international political environment. The "do nothing" option in this PEIS is not acceptable. Time is of the essence. Prompt, decisive United States leadership to demonstrate a cost-effective, near-term path forward that high proliferation-risk countries of the world will adopt, is critical. 8/08.03.01

In view of the short time permitted for review of the massive amount of detail (~2600 pages), each of seven subcommittees of the Advisory Committee was asked to primarily look for critical or serious issues, gaps, incorrect facts, conclusions or assumptions that could substantially distort the public's view. Also each subcommittee was asked to avoid trying to redo or reinvent the massive amount of valuable detail in the PEIS.

A. Health and Safety

This subcommittee was asked to address the feasibility and appropriateness of the statement in the PEIS relating to public and occupational health and safety within a fifty mile radius of the site. This was to be done in consideration of two possible uses for plutonium disposition at the site: 1) reactor burning of plutonium and 2) vitrifying plutonium together with high level waste into borosilicate glass logs.

A1. The first concern, if there is a concern, is that the summary report does not address the methodology used, so it is really not totally possible to evaluate how good the numbers or the doses are. 9/09.09.08

A2. The PEIS also stated that occupational and environmental radiological and chemical {doses} will be within accepted limits. The judgment of this committee is that there are sufficient unknowns, certainly with respect to the chemical hazards, that such a statement is difficult to substantiate. The other hazards, such as ergonomic, occupational in general, were not addressed. The only issue was latent cancer due to radiation within the two plutonium disposition alternatives. 10/09.09.08

[1] The list of invited Advisory Committee participants is attached. Some of those invited could not participate because of potential conflicts of interest, some participated on an ex-officio basis only, and some had only minor involvement because of illness or travel schedules. The majority of those invited did participate, providing valuable contributions to this Attachment.

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08 03 01 Comment Number 8

The Department of Energy acknowledges the commentor's opposition to continuing or long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 09 08 Comment Number 9

The PEIS Summary presents the Proposed Actions and their potential environmental impacts. It does not include a description of the assessment methodologies used for each environmental resource including human health risk assessment. A description of assessment methodologies used for each environmental resource is presented in the Methodology Report, Chapter 4, and the Appendices of the PEIS.

09 09 08 Comment Number 10

Detailed information regarding hazardous chemicals used in the Proposed Action, and their health impacts to workers and the general public, is described in Chapter 4 and Appendix M of the PEIS. This information includes the chemical emissions from the proposed facilities, the toxicity of the emitted chemicals, the predicted chemical concentrations in the environment, and health impacts to workers and the general public. The methodology used for the chemical hazards assessment is also documented in the Methodology Report, Chapter 4, and Appendix M of this PEIS.

A3. Was an ALARA evaluation done? If so, it is not documented or referred to in the PEIS. | 11/09.09.08

A4. The PEIS summary was written before NCRP report 121 was issued. The PEIS summary does not appear to be consistent with the philosophy or guidelines in NCRP 121, which deals with collective dose. This philosophy and guideline, if applied to this analysis, would basically ignore the radiological risks to the general public as the risk of a fatal cancer is less than one. | 12/09.09.08

A5. Based on the guidance provided to the Hanford Communities' subcommittees, we must accept the methodology that is the determinate of risk. On this basis, the radiological risk for cancer latency would appear to be insignificant.

A6. Perhaps more basic is the lack of specificity of what type of hazards, aside from radiation, might be involved, i.e., what types of chemicals, what would be shipping alternatives and what to do about long term release likelihood. Our conclusions are: a) to accept the calculations and risk estimates as done by DOE that the risk of latency for long term cancer causation is basically very small to insignificant, and b) to question the chemical hazards and transportation hazards that have not been fully addressed. (editor comment: note transportation issues in Section E below) | 13/09.10.08 | 12/09.09.08 cont. | 13/09.10.08 cont.

B. Pu Conversion and Mixed Oxide Fuel Fabrication

B1. The Fuels, Materials, and Examination Facility (FMEF) was improperly considered in the PEIS as only a potential storage area. This facility, originally built to manufacture and handle MOX fuel elements, should be considered as the best potential site for MOX fabrication in the United States.

B2. The FMEF capabilities and attributes are understated. The FMEF is a versatile and expandable facility. It was designed to be expanded to the east. All site infrastructure requirements, e.g., electrical capacity, cooling, sewer, security system, etc., are readily available to support an expansion.

B3. The FMEF in its current configuration can house a limited Pu metal-to-oxide conversion and a mixed-oxide (MOX) fuel fabrication line supporting Fast Flux Test Facility (FFTF) plutonium burn. In addition, one of the several large post-irradiation exam (PIE) hot cells can be used to demonstrate vitrification of off-specification or scrap local plutonium. All three of these programs could be implemented within five years, given the advanced completion state of the facilities and knowledge of the processes. | 3/01.04.00 cont.

B4. If an aggressive reactor burn program develops utilizing local light water reactors (LWR), FMEF's expansion capabilities would permit the addition of an adjacent fuel fabrication facility capable of fueling both FFTF and local LWRs. This would provide space within the existing FMEF building to retrofit large-scale Pu metal-to-oxide conversion, plutonium scrap cleanup and limited plutonium

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09 09 08 Comment Number 11

It has been stated in this PEIS that it is DOE's position to keep the health risk for workers and public ALARA although there is no elaboration of how to implement the ALARA practice for each proposed alternative. The ALARA analysis and practice are the refinement of the design and operation. It needs more detailed information about the facility design, which is not available at this stage.

09 09 08 Comment Number 12

As stated in this comment, the PEIS was written before National Commission of Radiological Protection (NCRP) Report 121 was issued. To meet NEPA requirements, the latent cancer fatalities to the population are reported in this PEIS as they are calculated, even if the results are very small or insignificant. To help understand the radiation health risk and latent cancer fatalities, an explanation of these terms is included in Appendix M of the PEIS.

09 10 08 Comment Number 13

The detailed information about hazardous chemicals from the Proposed Alternatives and their health impacts to workers and the general public is described in Chapter 4 and Appendix M of this PEIS. The information contained in this PEIS includes the chemical emissions from the proposed facilities, toxicity of the emitted chemicals, the predicted chemical concentrations in the environment, and their health impacts to workers and the general public. The methodology used for the chemical hazards assessment is documented in the Methodology Report, Chapter 4, and Appendix M of this PEIS. The transportation of hazardous and non-hazardous material is presented in Appendix G.

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vitrification. Expertise and equipment from other countries to expedite early MOX fuel fabrication could be used as appropriate. | 3/01.04.00 cont.

B5. While the PEIS bounds environmental impacts in an extreme fashion, it doesn't represent a realistic fiscal approach nor a rapid deployment approach to a very real plutonium proliferation problem. The PEIS's lack of recognition and understatement relative to a group of facilities that exist and are environmentally adequate and appropriate to economically begin this project make the value of the document questionable. The PEIS must bound, but it must also incorporate realistic solutions. | 14/01.04.00

B6. The current federal government fiscal policy and environment do not correspond to the extreme facility requirements and description in the PEIS. There is a need to take every advantage of facilities and capabilities currently available and pursue a modular approach to the solution. The need for plutonium disposition is too great to have the program collapse upon itself due to inflated need assumptions and criteria. | 15/01.00.00

B7. While land is in plentiful supply at Hanford, the land requirements indicated for facilities necessary to perform disposition activities such as pit disassembly, plutonium conversion, immobilization, and MOX fuel fabrication seem to be significantly overstated. These land use requirements do not seem to be consistent with facilities that have previously accommodated these type of operations. In addition, potential utilization of existing facilities at DOE Sites for these disposition activities would result in considerably less land use than indicated. | 16/01.04.00

B8. It appears that insufficient consideration has been provided in the PEIS to facilities that are already constructed and operational or are partially complete and could be made operational at minimum cost. Facilities such as these, at which most of the costs of siting, design, construction, public safety evaluations, security systems and processes, and public acceptance have already been provided, should be given top priority in these considerations. | 2/08.03.01 cont.

B9. All waste streams that may be generated as a result of the implementation of the selected disposition alternative need to be thoroughly evaluated. Acceptable plans and processes to properly dispose of these waste streams must be solidly in place prior to putting the alternative into production. Further, synergism, not conflict, with vital on-going cleanup missions is possible. | 17/09.11.08

C. Reactor Burn Disposition Option

C1. We strongly recommend the most effective, permanent and fail-proof means of disposing of surplus weapon's materials, i.e., convert it to reactor fuel and irradiate it to the spent fuel standard. The excess plutonium represents hundreds of millions of dollars, if used in the form of reactor fuel that should be used to provide needed electrical power, cancer killing radioisotopes and tritium for | 1/08.03.01 cont.

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01 04 00 **Comment Number 14**

Comment noted.

01 00 00 **Comment Number 15**

Existing facilities have been considered in this PEIS to the extent practicable. For example, in the storage action, one of the three alternatives is Upgrade at Multiple Sites, which uses existing facilities. In the disposition action, existing reactors in the United States and Canada are included as alternatives as well as an existing vitrification facility at DOE's SRS.

01 04 00 **Comment Number 16**

The Department of Energy believes that the land use requirements identified for pit disassembly and conversion, immobilization, and MOX fuel fabrication are correct. If these requirements exceed what is eventually needed, the smaller requirement will be bounded by the environmental analysis.

09 11 08 **Comment Number 17**

The conceptual designs for the Consolidation and Collocation storage alternatives and the disposition alternatives have, as part of their design, waste management facilities that would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with RCRA and other applicable Federal and State statutes, and DOE Orders. For the Upgrade Storage Alternatives, site-specific waste management facilities were determined to be adequate. As the designs mature, process waste assessments which include individual waste stream characterization will be completed. No waste stream will be generated that cannot be treated and packaged into a form that enables long-term storage and/or disposal.

national defense. We believe the United States should move rapidly to lead the world in the safe and efficient disposal of excess weapons-usable fissile materials using the disposition method to which most other nuclear power countries are committed. 18/01.03.00

C2. No consideration was given to liquid metal reactor concepts for Pu disposition, although LMRs, especially FFTF, are specifically designed for flexibility in fuel use, and are particularly well suited to operate with mixed oxide (MOX). FFTF, the newest reactor in the DOE complex, has more than a 20-year remaining life and can "burn" significant quantities of plutonium, especially if highly enriched MOX fuel is used. FFTF should be included as a disposition option in the final PEIS.

C3. Hanford represents a unique and effective solution to the Pu disposition problem:

- Virtually the entire disposition cycle can be accomplished on a single site (Hanford), which has much of the security, public health and safety considerations and facilities already in place to commence the task.

- There is unprecedented local public acceptance of a Hanford Pu disposition mission. Unanimous endorsement was obtained from every elected city council member (Richland, Kennewick, Pasco, West Richland and Benton City) and county commissioner (Benton County) and from the Hanford Communities governing and administrative boards. Please note the endorsements attached to the cover letter. 3/01.04.00 cont.

- The FMEF is a facility effectively ready to accept plutonium and uranium oxides and convert them to MOX fuel for FFTF irradiation.

- The FMEF can readily accommodate the introduction of LWR MOX fuel fabrication equipment. (Unused state-of-the-art MOX fuel fabrication equipment is available from Siemens. Siemens also represents a local source of expertise to support the installation and operation of this equipment. Sandvik Special Metals represents a local source of high quality, reactor grade tubing for LWR fuel fabrication).

- WNP-2 is a modern BWR that can annually consume approximately 0.5 tons of weapons grade plutonium as MOX fuel.

- FFTF can use about 3/4 tons of plutonium per year as fuel to produce medical radioisotopes and/or tritium.

- WNP-1, if completed, could consume close to 1 ton of plutonium per year in the form of MOX fuel.

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01 03 00 **Comment Number 18**

Comment noted.

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- The weapons grade plutonium on-site plus any received from off-site should not need to be transported more than a few miles and never off the Hanford reservation until it has been converted to a spent fuel standard.

C4. Using weapons usable fissile material to generate electricity in a once-through cycle in existing light water reactors (LWRs) is the most technologically assured option. The PEIS should clearly define the burnup range for the spent fuel standard. Without this range, costs and benefits cannot be reasonably calculated. — 19/08.03.01, 20/01.02.00

C5. Prior to selecting LWRs as one of the preferred alternatives, specifics like ownership and management of the facility (i.e., control of operations), re-licensing, costs, taxes, waste management, new fuel, security, spent fuel and spent fuel disposal charges, if any, should be considered and described. — 19/08.03.01 cont.

C6. The CANDU Reactor alternative is inconsistent with the criteria on 1) demonstrated technical viability, 2) fostering progress and cooperation with other nuclear weapons states and 3) environmental safety and health compliance. Placing U.S. weapons usable plutonium in the hands of a foreign government for disposition does not make sense for long term law, security and environmental, health and safety enforcement. (Recently, protests to this option have developed within Canada). — 21/06.05.08, 22/01.03.00

C7. Selection of the partially completed reactor alternative can provide major cost savings to the United States taxpayer and benefits to future generations. All of the screening criteria are met with this reactor alternative. A number of partially completed reactor sites are available for consideration. The PEIS should reference WNP-1 in its PEIS or remove all references to the TVA plant. The PEIS selects TVA's Bellefonte Nuclear Plant as the benchmark for reasons that even more strongly would justify selecting WNP-1. WNP-1 is on DOE land, less than five miles from the FMEF (the FMEF and WNP-1 share a common sewage treatment facility). DOE's Bonneville Power Administration is formally attached to the site, both financially and through electrical distribution. Prior to selecting a benchmark, a number of factors need to be considered, e.g., continuous preservation program, ASME pedigree maintenance, design documentation and security integrity, NRC inspections results, etc. — 23/06.03.08, 24/01.04.00

C8. Facility and operations "clustering" should be included in the PEIS. One of the current and highly successful business strategies is the concept of "clustering" semi-independent or synergistic businesses. Clustered businesses share overhead (infrastructure) costs and leverage a wide variety of inputs and outputs and resources. Five screening criteria can be directly and substantively influenced using the "cluster" approach: cost-effectiveness, timeliness, ES&H compliance, public and institutional acceptance, and additional benefits. Clusters are more economical because they reduce transportation, provide internal incentives for product and schedule, lower security risk, add regional employment stability and — 25/01.04.00

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08 03 01 **Comment Number 19**

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 02 00 **Comment Number 20**

The technical, cost, and schedule analyses of the various alternatives are presented in a separate document to support DOE's ROD. This document was made available to the public for review beginning in late July 1996.

06 05 08 **Comment Number 21**

The following points are given in response to your comments:

a) The CANDU reactor has never been tested with industrial quantities of MOX fuel. However, the Canadians are performing limited testing of MOX fuel in test reactors. It is believed that CANDU reactors can utilize MOX fuel. The Technical Summary Report provides more information on CANDU technology.

b) Contrary to the comment, one of the strengths of the CANDU Reactor Alternative is the prospect of having a joint U.S.-Russian Pu disposition campaign in Canada.

c) In terms of ES&H compliance, the implementation of the CANDU Reactor Alternative would be performed in full compliance with both the U.S. and Canadian ES&H regulations, as applicable.

01 03 00 **Comment Number 22**

Should the CANDU Reactor Alternative be selected for disposition of Pu, agreement with the Canadian Government would be reached on the Pu disposition process, including safeguards and security requirements which call for facility inspection by the IAEA, as appropriate, and environmental analyses conducted with public involvement.

share environmental impacts. Synergism with on-going cleanup commitments would be expected. | 25/01.04.00 cont.

C9. Security or resistance to theft and diversion by unauthorized parties can be enhanced by "clustering". The PEIS should acknowledge that security (and public health and safety) is significantly enhanced when the transportation of weapons grade materials outside a federally secured site is reduced or eliminated. | 26/13.00.00

D. Combined Fuel and Reactor Subcommittees' Comments

The comments from these two combined subcommittees deal with recommendations or changes to the screening criteria. The screening criteria represent the foundational base of the PEIS. Recommended changes to the criteria are shown in bolded italics.

D1. Screening Criteria for Long-Term Storage Option

a. Environmental, Safety and Health (ES&H) Compliance: High standards of public and worker health and safety and environmental protection must be met ***nationally and internationally*** and significant additional ES&H burdens should not be created. ***Combinations of facilities and use of existing nuclear sites should be used to avoid "new" environmental burdens.*** | 27/01.05.00

b. Cost-Effectiveness: Long-term storage should be accomplished in a cost-effective manner and should be compatible with reasonable disposition alternatives. ***Potential for capital cost escalation shall be considered in the decision process. Proven technologies will minimize capital costs and are the least likely to escalate due to unknowns.*** | 28/01.05.00

c. Foster Progress and Cooperation with Russia and Other Countries: A facility ***(all facilities)*** must accommodate international inspection for surplus materials in unclassified shapes and must establish appropriate standards for storage and protection of international nuclear material inventories. ***Technologies used shall consider the applicability to other countries, for example, the selected alternative should be consistent with Russia's national priorities and be within their means to afford and safely implement.*** | 29/01.05.00

d. Public and Institutional Acceptance: An alternative should be able to muster a broad and sustainable consensus on the manner in which long term storage is accomplished. ***The long term storage alternative should be integrated with the existing site mission and provide assurance that proven means of public involvement exist for mission oversight from start to finish.*** | 30/01.05.00

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06 03 08 **Comment Number 23**

Comment noted.

01 04 00 **Comment Number 24**

The PEIS uses the Bellefonte Nuclear Plant as the basis for analysis of a partially completed reactor. If the Partially Completed Reactor Alternative is stated in the ROD, a competitive process would be used to select an actual reactor facility for implementation. This process would consider economics, existing infrastructure, and related factors.

01 04 00 **Comment Number 25**

The Department of Energy, as part of the ROD, will consider the benefits of grouping various facilities at DOE sites in order to take advantage of existing infrastructure, technical expertise, and related factors.

13 00 00 **Comment Number 26**

Comment noted. DOE will consider this information in its analyses and decisionmaking process.

01 05 00 **Comment Number 27**

The commentor's recommended inclusion is already an existing part of the criteria. A detailed description of all the screening criteria appears in Section 2.2 of the *Summary Report of the Screening Process*, March 1995.

01 05 00 **Comment Number 28**

The commentor's concern has been taken into consideration in the cost, schedule, and technical impact analysis which is presented in a separate document made available to the public for review beginning in late July 1996.

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D2. Screening Criteria for Disposition Options

a. Resistance to Theft and Diversion by Unauthorized Parties: Each step in the disposition process must be capable of providing for comprehensive protection and control of weapons-usable fissile materials. ***The comprehensive protection and control approach must demonstrate integration with the previous and following step.*** — 31/01.05.00

b. Technical Viability: There should be a high degree of confidence that the alternative will be technically successful, ***with reliance on proven technology that can be economically supported and is available to former Soviet Union countries and other nuclear weapons states.***

c. Environmental, Safety and Health (ES&H) Compliance: High standards of public and worker health and safety and environmental protection must be met and significant additional ES&H burdens should not be created. ***The selected disposition alternative should take advantage of existing ES&H burdens to minimize total impact. New PEIS ES&H burdens should be integrated with existing federal and commercial ES&H burdens to avoid doubling the burden in the same exclusion zones.*** — 32/01.05.00

e. Cost-Effectiveness: Disposition should be accomplished in a cost-effective manner and be compatible with reasonable long term storage alternatives. ***Disposition should capitalize on existing federal facilities and proven technologies to enhance cost effectiveness. Cost effectiveness shall consider internationally compatible technologies to foster international progress and cooperation. Selected alternatives should include the total life-cycle cost concept and be cost projected through the period estimated to complete the mission.*** — 33/01.05.00

f. Timeliness: There is an urgent need to begin Pu disposition and to minimize the time period that surplus fissile materials remain in weapons-usable form. ***Each step in the process should be fully integrated into an overall project time table that includes steady state operation and D&D. Incentives and market competition shall be used to assure timeliness.*** — 34/01.05.00

g. Public and Institutional Acceptance: An alternative should be able to muster a broad and sustainable consensus on the manner in which disposition is accomplished. ***The nationally and internationally accepted disposition alternative must be integrated with local/regional acceptance of the selected site(s). In addition to local/regional acceptance, decisions about plutonium disposition need to be based on objective analyses of cost, time, and risk. The selected site should have a functional public oversight board with broad regional representation and strong local municipality support.*** — 31/01.05.00 cont.

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01 05 00 Comment Number 29

To the extent practicable, the commentor's recommendation was incorporated into the Nonproliferation Policy impact analysis presented in a separate document which was made available to the public for review in October 1996.

01 05 00 Comment Number 30

The Department of Energy has an ongoing effort in program integration in which public involvement is an important element.

01 05 00 Comment Number 31

Comment noted.

01 05 00 Comment Number 32

Comment noted.

01 05 00 Comment Number 33

Comment noted.

01 05 00 Comment Number 34

The commentor's concern has been taken into consideration in the cost, schedule, and technical impact analysis which is presented in a separate document made available to the public for review beginning in late July 1996.

h. Additional Benefits: The ability to leverage government investments for disposition of surplus materials to contribute to other national or international initiatives should be considered. ***The highest consideration should be given to prior unused or partially used government investments (facilities and/or infrastructure), especially those that are clustered, that could be leveraged to effect rapid, safe and cost effective plutonium disposition and to contribute to other national or international initiatives.*** 32/01.05.00 cont.

i. ***Waste Package and Byproduct Program Integration: The selected alternative shall consider all waste forms and their effective disposition, including provisions for D&D.*** 35/01.05.00

j. ***Local Public and Private Business Sector Involvement: The selected alternative shall use, to the maximum extent practicable, local private and public businesses, best commercial practices and incentives to best accomplish the mission.*** 32/01.05.00 cont.

E. Socioeconomic Issues

Since a number of the recommendations from the Advisory Committee support using already existing Hanford and/or local facilities, there were few new socioeconomic issues to consider. For example the Advisory Committee virtually discarded the "green field" strategy used in the PEIS, e.g., the construction of new facilities on geographically dispersed sites. Not disposing of weapons grade plutonium is believed to have far greater socioeconomic consequences than using existing Hanford assets and capabilities to responsibly and quickly demonstrate a workable international plutonium disposition model. 36/09.08.01

F. Transportation Issues

The group looking at transportation issues did not find anything in the PEIS that would be characterized as a "showstopper". Instead, a number of items of lesser consequences were discussed and are reported here for the purpose of addressing these in the final EIS. On the positive side, transportation of radioactive materials in this country has an excellent track record with few major accidents and no fatalities from release of material in accidents. This subcommittee concluded that transportation is a fully developed technology and with proper coordination and route selection, risk can be minimized. Hanford Site capabilities, as well as those of the surrounding communities, coupled with the new Hazardous Materials Management and Emergency Response (HAMMER) training facility, provide a unique combination of resources in support of on-site/off-site emergency preparedness.

However, because transportation often puts unwanted radioactive or hazardous materials in unwanted places, this topic will remain important relative to plutonium disposition. It is clear that the PEIS can take the position that there is convincing | 37/10.00.00

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01 05 00 **Comment Number 35**

"Waste minimization" and "known and manageable waste forms" were included in the screening criteria, as described in the *Summary Report of the Screening Process*.

09 08 01 **Comment Number 36**

The Department of Energy acknowledges the commentor's support for the utilization of existing facilities at Hanford for the storage and disposition of weapons-usable fissile materials. Decisions on storage and disposition will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

10 00 00 **Comment Number 37**

The PEIS transportation analysis includes the movement of material required for disposition at more than one location. If the common activity facilities (for example, pit disassembly facility) are located at the same site as the disposition activity facilities (for example, ceramic immobilization facility), then there would be a reduction in the transportation risk. The current analysis is bounding for activities at multiple sites.

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evidence that "clustering" of some or all of the various steps in locations, such as Hanford, with short relative inter-facility distances will result in lower fatalities due to a non-radiological caused accident. It is also clear, consistent with other commenters, that the PEIS is deficient in not calculating the transportation burden reduction by integrating the various transportation steps for different disposition and storage alternatives. | 37/10.00.00 cont. 38/10.00.00

F1. The packaging certifications (pedigrees) are not clearly explained, i.e., not all packagings possess the NRC endorsement. | 39/10.00.00

F2. Relative transportation risk bases are not clearly presented. | 40/10.00.00

F3. Alternatives in Chapter 2 do not address material transportation adequately or consistently. For example, in Section 2.4.1, Pit Disassembly/Conversion Facility; Section 2.4.5.2, Existing Light Water Reactor Alternative; and Section 2.4.5.4, Evolutionary Light Water Reactor Alternative, all should address all the applicable transportation streams and what special requirements apply such as security or special routing. | 41/10.00.00

F4. There are several examples of confusing references to DOT specification packaging versus NRC certified packaging. Some of these occur in Section 4.4, Intersite Transportation of Fissile Materials, and in Appendix G, Intersite Transportation "6M, 6M Type B, 6M-2R, Model 6M". The EIS needs to identify clearly which packaging is which. | 42/10.00.00

F5. Section 4.4.2.2, Packaging, does not adequately describe the safety basis of the DOT-6M packaging (an old grandfathered DOT Specification packaging container as shipped in the SST), particularly when compared with the safety basis of a state-of-the-art NRC certified spent fuel cask or the BUSS Cask. Many are not aware of the various systems that authorize Type B packages: DOT Specification (old), DOT Certificate of Competent Authority, NRC Certificate of Compliance, and DOE Weapons Program authorizations. They need to be defined and considered in the risk analysis. | 43/10.00.00

F6. "Potential fatalities" should be clearly defined in Section 4. | 44/10.02.00

F7. Section 4 infers that RADTRAN calculates the non-radiological risk, which it does not. | 45/10.02.00

F8. Page 4-772: The first sentence states "materials would be transported by SST or commercial equivalent truck." There is no commercially available equipment like the SST. | 46/10.00.00

F9. Page 4-773: The second sentence states "For relatively low-level radioactive materials DOT Specification Type A packaging are used". It should be pointed | 47/10.00.00

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10 00 00 Comment Number 38

The transportation of materials for storage and disposition have been separated to allow for separate decisions. The summation of the results is conservative since it does not consider the integration of the two actions. All steps (for example, pit disassembly or MOX fuel fabrication) have been included in the transportation analysis for disposition.

10 00 00 Comment Number 39

The analysis for the storage and disposition alternatives evaluates the potential risks for transporting shippable forms of fissile materials (that is, Pu and HEU) that have been stabilized and packaged for shipment at the originating site. All packaging processes (and certifications) meet DOT and DOE requirements. NRC certification criteria is applied to all Type B packagings, as required by the DOT regulations. Section 4.4.2.2 of the PEIS presents information on packaging criteria established and enforced by Federal agencies. A thorough explanation of risk basis is presented within Sections G.1.1 and G.1.2 for truck/rail and port transit modes, respectively.

10 00 00 Comment Number 40

The human health risks of material transportations associated with the proposed Pu storage and disposition alternatives are evaluated and presented in Section 4.4 of this PEIS. The more detailed description of the methodology and supporting data for the analysis is presented in Appendix G. Transportation of radioactive materials between sites includes health risks for both normal operations and accident conditions to the public and workers.

10 00 00 Comment Number 41

The transportation issues raised require site-specific knowledge in order to describe the transportation streams and the special requirements which apply to each transportation scenario (security, special routing). Transportation of radioactive material from an existing LWR site and evolutionary LWR site may include several modes of transportation (truck, rail, barge, etc.) depending on the location of the site. Specific transportation streams and

out that strong tight containers are also allowed for low specific activity radioactive material shipments.	47/10.00.00 cont.
F10. Page 4-780: For the Deep Borehole emplacement alternative, it is not clear why shipments would follow immobilization and come from lag storage. Also, why the large difference in shipping volume capacity? For example, the shipping volumes of 5.5 tons per year seem low, when the immobilized pellets could be shipped at a rate of 551 tons per year.	48/10.00.00
F11. Page 4-781: The fifth paragraph mentions shipping one rail cask at a time for a total of sixty-four shipments per year. No mention is made of whether these shipments are by special train or regular train service. There is a big difference in cost associated with the two options.	49/10.00.00
F12. Page 4-783: Risk numbers are difficult to understand and follow. It seems that the difference in level of risk between processing in the United States versus processing in Europe, as depicted in Table 4.4.3.3-4 would be much greater than shown.	50/10.02.00
F13. Appendix G: The risk associated with the transportation of the materials would be better understood if it were broken into radiological and non-radiological categories. The radiological risks would also be more meaningful if they were reported for both accident and normal modes. One cannot easily compare the "summed all risks" numbers in this PEIS with other reports that do not use this method.	51/10.02.00
F14. Not enough information was given about the RADTRAN input values used. For instance, the following values should be included and referenced: release fractions (RFAC, HERSOL, RBSP), atmospheric dispersion values (for truck, rail, and oncoming highway traffic statistics).	52/10.02.00
F15. NUREG-0170 severity categories were used for all truck shipments. This may not be appropriate for the 6M shipments or for the 55-gallon drum shipments.	53/10.02.00
F16. Page G-3: Second paragraph, second sentence states that the 6M packages would be placed on Cargo Restraint Transporters (CRT) to facilitate loading and securing in the SST. What's the status on the CRT's? Several sites were told to return them. Are CRT's still being used on the SST's?	54/10.00.00
F17. Page G-3: The second sentence in the third paragraph mentions transferring the CRT's from an SST to a standard ISO container. Standard ISO containers do not have the floor tie down capability associated with the CRT's and available in the SST. A proper tie down pattern would have to be developed for ocean transport in ISO containers.	55/10.00.00

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special requirements will be addressed if these alternatives are selected for further consideration. Appendix G presents additional information on transportation of radioactive materials and types of packaging specific to the material to be transported.

10 00 00 Comment Number 42

The PEIS uses the terminology "6M Type B package" to designate both the generic package type identified in the DOT specification and the specific variation of the package type used by DOE. The specific package type used by DOE is denoted as the 6M-2R, consisting of the 6M Type B package using 2R inner containers.

All aspects of the transportation of radioactive materials within the United States are regulated at the Federal level by the DOT. The Federal regulations are implemented by both NRC licenses and DOE for the transportation of radioactive materials. Package designs meeting the Type B package performance criteria are considered by NRC and DOE to provide adequate protection of the public and operating personnel in the event of a transportation accident. The NRC has no regulatory authority regarding DOE transport of radioactive materials, although DOE does use NRC criteria for the certification of Type B packaging, including the 6M-2R.

The approval process followed by DOE regarding Type B packaging and transportation of radioactive materials is established by DOE Orders. Package design, testing, and safety information must be prepared for shipping packages proposed for use within the DOE complex. Review and approval of this information results in DOE's issuance of a Certificate of Compliance for the package and its use. In the case of the 6M Type B package, although the package meets DOT specification, the DOE approval process provides additional requirements prior to the package's use within the DOE complex.

10 00 00 Comment Number 43

A discussion of the safety basis of certified nuclear packaging is beyond the scope of the PEIS. The TI, which is a regulatory characteristic of a package, was estimated to be the maximum allowed by regulatory requirements and

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F18. The PEIS transportation burden does not include the risks for intermediate level and low level waste associated with each step of the process. | 56/10.02.00

F19. No analysis of possible criticality incidents under accident conditions is provided. | 57/10.02.00

F20. The PEIS does not adequately analyze both the regulations (NRC, DOT and DOE) and the history of interpretation of those regulations, which form the basis for defining a transportation system for plutonium. | 58/10.00.00

F21. There are no references to the safeguards requirements for shipping Pu, even though these are extensive. It appears on page 4-771 that it is intended to utilize the SST for all shipments of Pu. Yet, on page 4-780, in the penultimate paragraph, it indicates that ceramic pellets containing 1% Pu might be shipped by commercial carrier. This is confusing. | 59/10.00.00

F22. Some of the analysis appears based on RADTRAN without any conscious evaluation of the results. For example, Page G-3 states that "transits to ports are typically through low population density areas." Ports are almost universally located in cities where the population density is the highest. | 60/10.02.00

G. Vitrification Disposition Option

Evidence continues to build that vitrification is a viable alternative or a supplemental alternative to reactor burn as a means of disposing of plutonium. Vitrification supplements reactor burn by serving as a potential disposal means for contaminated plutonium and plutonium scraps otherwise unsuitable for manufacture into MOX fuel assemblies. | 61/08.03.01

Incorporating several weight percent plutonium in a vitrified glass appears to be feasible. Criticality concerns about plutonium pooling in a vitrified melt are being dispelled with experimental data. In addition, neutron absorbers could be added to the matrix if deemed necessary. | 62/05.01.08

Durability of the glass product is a function of the type of glass limited by the maximum temperature of the melter. The borosilicate glass proposed in the PEIS can be processed at about 1050°C. Higher temperature melts can be achieved with less boron and more silicon, e.g., at about 1300 to 1500°C.

Small melter vitrification technology developed at Hanford over the past several decades and demonstrated in the 324 Building can be used as the basis for implementing a scaled-up version in a suitable Hanford facility. The planned TWRS high level tank waste vitrification project provides an opportunity for high radiation field "immobilization" techniques to be used for higher throughputs. In summary, all of the vitrification technology necessary to deal with a variety of vitrification alternatives resides at Hanford ready for implementation. | 63/05.01.01

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used in the transportation risk analysis. A discussion of transport packaging is presented in Appendix G.

10 02 00 Comment Number 44

Potential fatalities are a conservative estimate of those fatalities that would result from both radiological and nonradiological risks from normal operations and accident conditions for a Proposed Action. A definition has been added to the Glossary (Chapter 7, *Glossary*) of the Final PEIS.

10 02 00 Comment Number 45

RADTRAN calculated only the radiological risk due to materials transportation. Nonradiological risk is calculated as described in Section G.1.1. Section 4.4.1 was clarified to state that RADTRAN only calculated the radiological risk.

10 00 00 Comment Number 46

If commercial trucks were utilized, additional requirements (physical and administrative) would be applied to provide equally effective safety and security measures as provided by SST.

10 00 00 Comment Number 47

The commentor is correct that strong, tight packagings can be used for low-level radioactive materials of less than Type A quantities. The text in Section 4.4.2.2 was changed to concur.

10 00 00 Comment Number 48

The Deep Borehole Alternative discusses the disposition of surplus weapons-usable Pu in two forms: (1) direct emplacement of Pu without immobilization and (2) Pu-loaded, ceramic-coated pellets. The amount of Pu to be transported for direct emplacement is estimated to not exceed 5 t (5.5 tons) per year. The amount of Pu-loaded, ceramic-coated pellets to be transported for emplacement is estimated to be 500 t (551 tons) per year. The Pu-loaded,

G1. Page 2-109: Under facility operations, it should be clarified whether the 25 kg per operating day throughput is for Pu only or for the immobilized waste form. This same comment applies to the ceramic waste form.	64/05.01.08 65/05.02.08
G2. Page 2-110: Under waste management, what are "criteria" pollutants?	66/05.01.08
G3. Use of Cs-137 or high level waste as a deterrent -- Anything that requires massive shielding will probably increase the cost of operations by a factor of 100. Any significant gamma emitter will decay away in less than 300 years and will be of no long term value.	67/05.01.08
National Security	
This subcommittee of the Advisory Committee had nothing new to add to the PEIS. Other participants of the Advisory Committee agreed with the screening criterion in the PEIS that "there is an urgent need to begin Pu disposition and to minimize the time period that surplus fissile materials remain in weapons-usable form."	68/01.00.00

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ceramic-coated pellets contain 1 percent Pu. Therefore, the amount of Pu-loaded, ceramic-coated pellets would be 100 times as great as the amount of Pu for direct emplacement, or approximately 500 t (551 tons) per year.

10 00 00 Comment Number 49

Although shipments may be consolidated into "dedicated trains" of more than one car, the risk analysis has considered regular train services for these shipments. Several court decisions have shown there is no safety basis for the use of "special trains" for high-level nuclear materials. DOT, DOE, and NRC have provided no such direction that special trains will be used for radioactive materials.

10 02 00 Comment Number 50

The values given in Table 4.4.3.3–4 of the PEIS represent the "Total Potential Fatalities" associated with the transportation of Pu oxide, uranium oxide, and MOX, for the Reactor Alternative category. The quantities presented are a result of direct risk calculations which yield results in "numbers of human fatalities." In regard to accumulating the risks associated with a given transportation process, the maximum risk impacts from the transport of Pu oxide, uranium oxide, and MOX fuel under the Reactor Alternatives may be summed directly from Table 4.4.3.3–4. According to results calculated by the "industry-wide accepted" RADTRAN code, the highest number of total potential fatalities from the transportation of materials from lag storage to fuel fabrication and then to a reactor site is 4.16 for MOX fuel fabrication in the United States. In Europe, the number of potential fatalities for a similar procedural operation would be 4.62. The difference between 4.62 and 4.16 fatalities is essentially negligible. Risk differences between the two "regional" alternatives (that is, the United States vs. Europe) are very small for all stages involved.

10 02 00 Comment Number 51

The human health risks from the transportation of radioactive materials between sites include both radiological and nonradiological impacts to the

Hanford Communities Advisory Committee

Review of Plutonium Disposition
Draft Environmental Impact Statement

Invited Participants*

Mr. Jack Baker
Mr. Walt Blair
Mr. Joe Burn
Dr. John Calcagni
Dr. Tom T. Claudson**
Mr. Rob Davis
Mr. Laurin R. Dodd
Dr. Ersel Evans**
Mr. Greg Field
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Mr. Bill Irvine
Mr. Bob Jefferson
Mr. Ron Kathren
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Mr. Gene Wirth
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Ms. Pam Brown, Hanford Analyst
Dr. Ray Robinson, Project Consultant

*Some of those invited could not participate because of potential conflicts of interest, some participated on an ex-officio basis only, and some had only minor involvement because of illness or travel schedules. The majority of those invited did participate providing valuable contributions.
**Sub-committee Chairs

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public and workers. The categories of calculated risk include nonradiological accident impacts to the public and workers, nonradiological normal operation impacts to the public (air pollution), radiological accidents to the public, and radiological normal operation impacts to the public and workers. The risk to the public for radiological accidents is an order of magnitude less than either nonradiological accidents or radiological exposures during normal operations.

10 02 00 Comment Number 52

Appendix G of the PEIS discusses the pertinent methodology and associated parameters utilized in the transportation modeling via the RADTRAN code. The scope of this document does not require scientific detail regarding input parameters to exceed that of a programmatic level.

10 02 00 Comment Number 53

This PEIS evaluated the potential for highway accidents and radioactive releases from the 6M shipments during transport in terms of eight accident severity categories identified in NUREG-0170 and implemented through analysis by the RADTRAN 4.0 computer code. The accident categories ranged from the least severe and most frequent accident (Category I) to the most severe and least frequent accident (Category VIII). NUREG-0170 characterizes package response to these accident categories in terms of release fractions based on the package type, transportation mode, and accident category. DOE considers the accident category information presented in NUREG-0170 to adequately cover the transport mode and package types addressed in the PEIS.

10 00 00 Comment Number 54

The CRTs are still being used on the SST.

HANFORD ADVISORY BOARD

A Site Specific Advisory Board, Chartered under the Federal Advisory Committee Act

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Sent by Facsimile to 1-800-820-5156 and by US Mail

May 3, 1996

Dear Mr. Nulton:

Re: Storage and Disposition of Excess Weapons Useable Plutonium and Special Nuclear Materials (SNM) (HAB Advice #46)

The draft Plutonium Programmatic Environmental Impact Statement (PEIS) indirectly considers Hanford as a potential site for certain activities within the scope of the plutonium safe storage and disposition program by the virtue of the site's current capability and plutonium possession. The Hanford Advisory Board is opposed to the piecemeal approach to nuclear material storage and disposition like that taken in the PEIS on plutonium disposition. We have on three previous occasions adopted advice to USDOE urging an integrated public discussion on these issues. (Board Advice #13, 34 and 38) We have a commitment from USDOE leadership to initiate such a process. Therefore, a ROD on the narrow choices presented in this EIS is premature pending the National Equity Dialogue. The Board is opposed to the use of the bore hole option at Hanford. At this time, the Board has not expressed a preference for one of the other disposal options. However, the Board does have a number of values/issues which relate to a plutonium (Pu) and spent nuclear material (SNM) program. Many of these values/issues have been previously provided to you as advice or recommendations for other Hanford programs. These values are:

69/08.02.00

70/08.03.01

1. Any plutonium or SNM storage or disposal program must be compatible and integrated with the TPA commitments and milestones and should not affect the rate or funding of cleanup. The program would have the safe disposition of Hanford plutonium as a priority.

7/11.00.01 cont.

Contact: Confluence Northwest, Facilitation Team
800 NW Sixth Avenue, Suite 342, Portland OR 97209-3715 Phone (503) 243-2663 Fax (503) 243-3683

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10 00 00 Comment Number 55

Transportation component design specific to this situation is beyond the scope of this PEIS. If design changes are necessary for ISO transport to occur, proper modifications would be expedited to meet the necessary criteria.

10 02 00 Comment Number 56

The number of shipments of LLW and TRU waste is stated in the waste management section for each storage and disposition alternative. The radioactive wastes included in the transportation analysis is shown in Table 4.4.2.2–1. Transportation of the wastes is included for each storage and disposition option as stated in Section 4.4.3.

10 02 00 Comment Number 57

The form and limited quantities of material shipped and the design of the packaging system prohibit criticality. Controls are implemented by following DOT regulations for the TI.

10 00 00 Comment Number 58

The comment was given consideration for the Final PEIS but only current regulations are stated in the document. A list of Federal and State regulations is included in Appendix J.

10 00 00 Comment Number 59

The mode (SST, commercial truck, rail) for shipping materials under each alternative is identified in Table 4.4.2.2–1. The safe secure transport of special nuclear materials is described in the new Section G.6. Transport of immobilized Pu-loaded ceramic coated pellets (1 percent) could be by either SST or appropriate commercial truck. The decision would be made in siting studies if either of the Deep Borehole Categories is selected.

10 02 00 Comment Number 60

RADTRAN analysis considers population densities as explained in Section G.1. Because of the radioactive nature of the material being shipped, the

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2.	Any plutonium program assigned to Hanford must be fully funded from new funding sources. This funding should include appropriate site infrastructure and overhead costs. Funding should fully cover the cost of treatment, storage and disposal of any new waste streams.	72/07.00.00
3.	The acceptance of plutonium at Hanford should not delay, defer, or negatively impact Hanford cleanup.	73/11.00.01
4.	Appropriate local and regional public information and involvement programs must be conducted by the agencies to ensure that the public is fully informed of the risks, hazards and impacts of such a program. This would be part of the national dialogue on all nuclear materials (noted above) prior to assignment of nuclear materials to a specific site.	74/08.02.00
5.	Any permit or plan approval for new Hanford programs/activities must be fully integrated and must comply with all State of Washington public health and safety rules and regulations.	75/08.03.00
6.	Equity impacts must be addressed in the assignment of new nuclear materials (including plutonium) to Hanford.	76/01.00.00
7.	The transportation of plutonium and special nuclear materials to Hanford storage will require careful planning of routes and consideration of weather emergencies to minimize the likelihood of an accident. Emergency preparedness for minimizing the impacts from an accident will require financial support from DOE for state, tribal, and local involvement, including adequate equipment and training. When materials are shipped, timely notification should be provided to transportation agencies.	77/10.01.00
8.	The choice of disposal options re: Pu will be a determinant for sites such as Hanford. Prior to the choice of a disposal option, complete characterization of the material and the impacts of short and long-term disposition technologies must be reviewed by the public and regulatory agencies.	78/08.02.00
9.	Acceptable processing techniques including waste processing must be developed as an integrated part of any new Hanford storage and disposal program. Permanent disposal of waste plutonium at Hanford is not acceptable.	79/09.11.01

HAB Consensus Advice #46 Page 2
Subject: Storage and Disposition of Excess Weapons Useable Plutonium and Special Nuclear Materials (SNM)
Adopted: May 2-3, 1996

M-234

Military Ocean Terminal, Sunny Point, North Carolina, was used for analysis in the PEIS. Sunny Point is a remote, controlled-access port for military ammunition shipments and would likely be the shipping point.

08 03 01 **Comment Number 61**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

05 01 08 **Comment Number 62**

Comment noted.

05 01 01 **Comment Number 63**

Comment noted.

05 01 08 **Comment Number 64**

Clarification was made in Section 2.4.4.1 of the Final PEIS.

05 02 08 **Comment Number 65**

Clarification was made in Section 2.4.4.2 of the Final PEIS.

05 01 08 **Comment Number 66**

Criteria pollutants are defined in the *Clean Air Act* (CAA) in a listing of chemical pollutants for which certain concentration levels are not to be exceeded without monitoring and possible mitigation.

05 01 08 **Comment Number 67**

Comment noted. The Spent Fuel Standard involves a radiation barrier that decays over time.

10. A "systems" analysis approach should be utilized to select the most effective method for processing and interim storage. This analysis should adequately address public and worker health and safety and environmental issues. | 80/08.03.00

11. If a plutonium disposition mission is assigned to Hanford, every effort should be made to use existing workforce, facilities, technologies, and other resources. | 81/09.00.01

Finally, we note that this PEIS does not address cumulative impacts of nuclear material movement and disposition as required by NEPA. | 82/08.00.00

The Health, Safety and Waste Management Committee of the HAB looks forward to further discussions and working with you on this issue. The Board looks forward to your written response, as called for in our charter.

Very truly yours,

Merilyn B. Reeves, Chair
Hanford Advisory Board

attachments: Board Advice #13, 34 and 38

cc: Thomas Grumbly, DOE
John Wagoner, DOE
Alice Murphy, DOE
Chuck Clarke, EPA
Mary Riveland, Ecology
Cindy Kelly, Designated Federal Official
Linda Lingle, Site Representative
Jim Mecca, DOE (by fax)
The Oregon and Washington Congressional Delegations

HAB Consensus Advice #46 Page 3
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M-234

01 00 00 Comment Number 68

Comment noted.

08 02 00 Comment Number 69

The Department of Energy acknowledges the commentor's support for coordination and increased understanding of decisions to be made on the storage and disposition of weapons-usable fissile materials. However, the National Dialogue Project is beyond the scope of this PEIS.

08 03 01 Comment Number 70

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 00 Comment Number 71

The Department of Energy acknowledges the commentor's concern about the potential effect that the selection of Hanford for new missions could have on the Hanford clean-up program. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input. The decision process will also give consideration to existing agreement between DOE, the State of Washington, and the EPA.

07 00 00 Comment Number 72

Funding for all alternatives will be through the budget process, and is not a part of the NEPA process.

11 00 01 Comment Number 73

The Department of Energy will not begin implementation of the Proposed Action at any site without having given full consideration to the

environmental, cost, schedule, and policy analyses, public comments, and agreements with various states regarding the clean-up activities on the sites. Therefore, implementation of the Proposed Action is not expected to cause adverse impacts to ongoing programs at the selected site(s).

08 02 00 Comment Number 74

The Department of Energy uses a wide variety of methods to communicate with the public on these important issues. These methods include public meetings, as part of the NEPA process, and meetings outside of the process such as the Plutonium Round Table. Numerous fact sheets and displays are made available at the meetings as well as by mail. All of this information is available on the Program's electronic bulletin board. A video produced by the Oregon Department of Energy was underwritten by DOE.

08 03 00 Comment Number 75

It is recognized that the decision to locate any of the alternatives at a site would require coordination with State and local officials on a variety of areas including the mission of the site.

01 00 00 Comment Number 76

Comment noted. Equity will be considered in DOE's decisionmaking process, along with all other factors.

10 01 00 Comment Number 77

Logistical planning and meteorological surveillance are standard concerns which normally receive a great deal of attention during transportation operations such as this; transfer of materials to Hanford will hold no exceptions. Emergency preparedness personnel (that is, Emergency Response Teams) will be supplied with the necessary equipment and training commensurate with DOT, DOE, and NRC regulations. Sufficient funding for these concerns will be available to satisfactorily ensure that potential contingencies be dealt with in an effective and timely manner. DOE provides

liaison with appropriate agencies for special nuclear material shipments. However, due to their classified nature, specific information on times and dates cannot be provided.

08 02 00 **Comment Number 78**

Before and after decisions are made on a disposition technology or technologies, DOE will conduct studies and technical demonstrations to fully understand the impact of disposition actions. This information will be made available to the public, to the extent possible.

09 11 01 **Comment Number 79**

The conceptual designs for the storage and disposition facilities have, as part of their design, waste management facilities that would treat and package all waste generated into forms that enable long-term storage and/or disposal in accordance with RCRA and other applicable Federal and State statutes and DOE Orders. As noted in Section 4.1.10 of the PEIS, waste management activities that would support the long-term storage or disposition of weapons-usable fissile materials were assumed to be in accordance with current site practice. Thus, only LLW and possibly some solid nonhazardous waste was assumed to be disposed of onsite. Any future waste management facilities that may be required to support the long-term storage or disposition of weapons-usable material would be coordinated with any decisions in the waste-type-specific RODs resulting from the Waste Management PEIS and respective site-specific NEPA documentation.

08 03 00 **Comment Number 80**

Comment noted.

09 00 01 **Comment Number 81**

Comment noted and will be taken into consideration when DOE is ready to select sites to implement Pu disposition.

08 00 00 **Comment Number 82**

The Department of Energy has determined that, based on historical trends and regulatory constraints, impacts associated with transportation of nuclear materials are unlikely and not otherwise significant. Therefore, no cumulative effects analysis of transportation impacts were performed. The cumulative impact analysis is located in Section 4.7 of the PEIS.

HANFORD WATCH, PORTLAND, OR,
LYNN SIMS
PAGE 1 OF 1

May 6, 1996

USDOE
Office of Fissile Materials Disposition
Washington, DC 20026-3786

Dear Mr. Nulton,

We respectfully request an extension of the deadline for public comment on the Storage and Disposition of Weapon-Usable Fissile Material Draft PEIS because we have not had sufficient time to collect and review all available documents from public reading rooms, which we will need to revise and extend remarks. 1/08.01.00

The great dimension of the implications of this project in the economic, research, environmental and social sectors indicate that we should move very carefully concerning this decision making. Please grant an extension for the comment period.

Thank you,

Lynn Sims

Lynn Sims, Hanford Watch
3959 NE 42nd
Portland, OR 97213
503-287-6329

F-009

08 01 00 **Comment Number 1**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

HANFORD WATCH, PORTLAND, OR,
PAIGE KNIGHT
PAGE 1 OF 2

Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement Comment

The people of Oregon have been and will continue to be impacted by the activities and hazardous wastes at the Hanford Nuclear Reservation. Air and groundwater contamination generated from the Hanford site in Washington are a serious concern to Oregonians because we share a long border, the valuable and irreplaceable Columbia River, a vital part of our environment.

Hanford has already done its part in nuclear production and the people in this region have already paid a terrible price due to the legacy of the volumes of chemical and radioactive wastes produced there.

Chemical and radioactive wastes at Hanford pose severe, very long lived toxic risks. Although the mission at the site has shifted from production to cleanup, critical budget cuts and the problem of inadequate technologies have left the many monitoring, containment and precise cleanup plans yet to be assured or formulated.

Now we face the possibility that Hanford may become involved in activities related to the storage and disposition of warheads and weapons-usable fissile materials under the reactor disposition alternative offered in the current DPEIS. That the DPEIS considers the MOX option at all is inconsistent with any plan to reduce high level nuclear wastes in this country. 1/09.00.01

The option would also signal to the world that plutonium is a valuable resource and should be endorsed as a commodity to be traded and used in new and continuing nuclear enterprises.

Specifically, we are concerned about:
*the enormous expenses to the public, both economic and environmental

*the transport and handling risks of fissile materials

*the risks involved in fuel fabrication

*the public apprehension concerning the risks and true costs of nuclear power plant operation

*the creation of even more waste

*the dilemma of the lack of technology, funds or an acceptable licensed site for the permanent repository for these long lived toxic wastes

Therefore, we the undersigned strongly oppose the consideration of Hanford as a site, or the WPPSS plants for any operations pertaining to the reactor disposition alternative. 2/08.03.01

F-062

09 00 01 Comment Number 1

The construction and operation of a nuclear power reactor would generate economic benefits in the form of new jobs and income generated in the region where the proposed reactors would be located. The reactor would serve to eliminate the surplus Pu, meeting the purpose and need of this PEIS. Additionally, the reactor would generate electricity for commercial and residential use.

Table 4.4.3.3–4, presents total potential fatalities (including both radiological and nonradiological risks) associated with the transportation and handling of fissile materials used in the production of MOX fuel. These materials include surplus Pu, which would be transported from the lag storage sites, and uranium oxide, each of which would be transported to a foreign or domestic MOX fuel fabrication site. Risks associated with the transport and handling of the fabricated MOX fuel to a reactor site are also included in this table.

The risks to public and occupational health and safety related to MOX fuel fabrication are described in Section 4.3.5.1.9 of this PEIS. They are summarized in Table 2.5–3. The health risks from the operation of a MOX fuel fabrication facility are also analyzed in the PEIS which indicates that the operation of a nuclear reactor would not pose significant health risks to the surrounding population.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to new missions at Hanford. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

HANFORD WATCH, PORTLAND, OR,
PAIGE KNIGHT
PAGE 2 OF 2

In addition to objecting to burning MOX in reactors at Hanford, we also oppose using the Fast Flux Test Facility (FFTF), or any other facility at the site for tritium production for the US weapons arsenal. The proposed tritium production is not consistent with USDOE's mission. FFTF is slated for closure in the carefully negotiated TriParty Agreement. Please ensure the mission at Hanford is "cleanup". Do not allow the mission to revert to "military production". 3/14.00.00

Because it is apparent that a sound technological solution to the disposition problem does not exist, we urge you to aggressively fund development efforts aimed at achieving a real long-term solution to the plutonium problem. 4/14.00.00

Hanford Action of Oregon, Robin Klein
25-6 NW 23rd Pl.#406
Portland OR 97210
PH: 503-235-2924 FAX: 503-736-0097

Hanford Watch, Paige Knight
2285 SE Cypress
Portland OR 97214
503-232-0848 FAX: 503-287-6329

Don't Waste Oregon Council, Lloyd Marbet
19142 SE Bakers Ferry Rd.
Boring, OR 97009
PH: 503-637-3549 FAX: 503-637-6130

Columbia River United, Greg DeBruler
P.O. Box 667
Bingen, WA 98605
509-493-3950

Citizens Interested in Bull Run, Frank Gearhart
P.O. Box 3426
Gresham, OR 97030
PH: 503-665-4777 FAX: 503-669-9429

Northwest Environmental Advocates, Eugene Rosalie
133 SW 2nd
Portland, OR 97204
295-0490

Paige Knight (l.s)
c.1.ar.

F-062

14 00 00 Comment Number 3

Comment noted.

14 00 00 Comment Number 4

Comment noted. During the remainder of fiscal year 1996 and into fiscal year 1997 DOE plans to continue to expand a range of small-scale tests and demonstrations of Pu disposition technologies to fill gaps in our technical knowledge, remove uncertainties in the viability of certain technologies, and to demonstrate the practical usefulness of some of the technologies that might be employed for disposition of surplus weapons-usable Pu.

HANNUM, WILLIAM H., NAPERVILLE, IL
PAGE 1 OF 1

213 Arlington Avenue
Naperville, IL 60565
5 June 1996

Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
Washington, D. C. 20026-3786

Subject: Comments on Draft Environmental Impact Statement: DOE/EIS-0229-D; Storage and Disposition of Weapons-Usable Fissile Materials

Gentlemen:

The subject draft appears to have been carefully and exhaustively prepared. Those who managed and carried out this effort are to be commended.

I have two comments which I feel deserve attention. These comments are my own, have been prepared on my own time, and do not necessarily represent the view of my employer:

- In evaluating the reactor alternatives, it appears that no credit has been given for the environmental insult avoidance associated with the power generated by the nuclear plants. Since coal is the dominant fuel for electricity generation, and by all projections (including those of DOE) will continue to be the dominant fuel for electricity generation, credit should be given for the reduction in coal burning equivalent to that required to produce the electricity generated by the plutonium burning nuclear plants. 1/09.08.08

- Among the "Disposition Options Considered But Eliminated From Further Consideration," two reactor options (the modular helium reactor and the integral fast reactor) are qualified as follows: *If [this concept] is developed and successfully operated for other missions, it will be considered for Pu disposition as well.* Given the projected world energy growth, the commitment of many countries to further nuclear development (whether nuclear power is developed and deployed in the U.S. or not), and the involvement of other nations in these two technologies, it must be considered that one or both of these technologies will be developed and successfully deployed for other missions. Therefore, these options must be fully evaluated. 2/01.05.00

William H. Hannum

M-263

09 08 08 Comment Number 1

Based on comments received, several sections of the Final PEIS include additional analyses. These sections (in Section 4.9) include Impacts on Uranium Mining and Nuclear Fuel Cycle Industries, Avoided Environmental Impacts of Using MOX Fuel Instead of Traditional Low-Enriched Uranium Fuel in Nuclear Power Plants, and Avoided Environmental Impacts of Using Nuclear Power Plants Instead of Fossil Fuel Power Plants. The Avoided Environmental Impacts of Using MOX Fuel Instead of Traditional Low-Enriched Uranium Fuel in Nuclear Power Plants section in the Draft PEIS includes the health impacts avoided to the public and workers for the mining and milling industries. Other avoided impacts to air quality and waste generated were added to the Final PEIS.

01 05 00 Comment Number 2

The termination of the Integral Fast Reactor project was decided by DOE and Congress in 1994 and is beyond the scope of the PEIS.

Comment ID: P0029
Date Received: April 18, 1996
Name: Steven Hanson
Address: 306 East 4 South
Rexburg, ID
Phone: 208-356-8613

Transcription:

My opinion of the use of plutonium and storage and basically research and investigation into that is favorable. I think it should be done. I think that as we try and find a solution for radioactive materials that we have to deal with it, and I would be in favor of storage both in Idaho and processing, because I feel that it's one of the best ways that we can do to handle this material and use it productively. I my personal feeling of nuclear power is also very good. I would expect to use it effectively and I think that there's a lot of scare tactics that are driving people away because they don't understand it. So, my opinion is favorable. I think we ought to do it. I don't think we have much choice, because the fossil fuels are just not going to last that long. So I'm positive for nuclear power and storage and processing here in Idaho. Thank you.

1/08.03.01

P-029

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for additional missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

HARLEY, MARY LOU, BRIDGETOWN, NS
PAGE 1 OF 2

R.R. #4
Bridgetown, N.S.
B0S 1C0
May 12, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786 Washington, D.C.
U.S.A 20026-3786

RE: Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

While some members of the Canadian government have been promoting the idea of bringing the plutonium from the planned arms reduction program into Canada in the form of MOX fuel, this idea has not been debated at any House or public level. 1/01.03.00

During the recent public hearings on the concept of geological disposal of nuclear fuel wastes, several groups reported concern that the possibility of using MOX fuel fabricated from weapons plutonium in Canadian CANDU reactors had been spotted in American documents (most notably the "Management and Disposition of Excess Weapons Plutonium Reactor-Related Options" by NAS). At these hearings, government officials brushed the issue aside saying it was not yet a "fait accompli". Within a week of the end of Phase I of these hearings, the government was promoting this idea. As well as the concept of importing weapons plutonium into Canada in the form of MOX fuel, the ethics of the process by which this idea is being promoted has been called into question.

The United States is capable of handling the excess weapons plutonium to meet the spent fuel standard and you have the primary responsibility for coping with the weapons-grade plutonium.
1.The U.S. light-water reactors are capable of using MOX fuel containing weapons plutonium and have been recommended for this option by the National Academy of Sciences.
2. The weapons-grade plutonium could be embedded in glass logs of suitable specifications in the U.S. and managed in the same way as planned for U.S. defense high-level wastes. 1/01.03.00 cont.

Canadians should not be expected to bear the burden of security, safety and health risks associated with the transportation, storage and use of MOX fuel or the potential hazards and costs of the management of the resultant high-level nuclear waste. You are aware that the use of weapons plutonium as MOX fuel does not get rid of the plutonium. The objective of the MOX fuel approach is to contaminate the weapons-grade plutonium with other isotopes of plutonium and other radioactive material so that the excess weapons plutonium would be no more accessible that the plutonium in commercial spent fuel. Use of MOX fuel would result in significantly higher plutonium in the spent fuel compared to the present waste going into the nuclear fuel waste management

M-207

01 03 00 Comment Number 1

Comment noted. The CANDU Reactor Alternative is one of the reasonable alternatives analyzed in the PEIS. Should this alternative be selected for implementation of the Proposed Action, agreement with the Canadian Government would be reached on the Pu disposition process, including appropriate environmental analysis with public involvement.

program in Canada. Once through the fuel cycle the spent MOX fuel would be Canada's management problem, at least until it was aged more than a decade; possibly it would be permanently our problem, for hundreds of thousands of generations into the future. 1/01.03.00 cont.

Conversion of the weapons plutonium into spent MOX fuel may make it less accessible for bomb production, but the plutonium is still there, still posing a proliferation risk only requiring more care and expense, still releasing radiation, still toxic, still posing a health risk to the planet. 2/08.03.01

The "spent fuel standard" to make weapons plutonium no more accessible for weapons use than the plutonium in commercial spent fuel has not been promoted because it provides safety but because to go beyond this spent fuel standard is not considered justified unless the accessibility of the global stock of plutonium in spent fuel is similarly reduced. However, the level of purity of the plutonium which makes it attractive for weapons, also makes it more amenable to directed intervention designed toward rapid reduction of radioactivity over time frames accelerated over those of the natural half-life decay processes. In the haste to handle the security risk, do not lose sight of the health risk posed by this material; ask of any approach what the consequences will be with respect to reducing the toxicity of the material. 3/01.00.00

With respect to the weapons uranium, please take a balanced view. It would be irresponsible to make it more toxic by putting it into the nuclear fuel stream. Please consider management by a means that will not involve converting a portion of it into plutonium and other radioactive materials of higher toxicity than the original uranium. 4/15.00.00

If this spent fuel standard approach for dealing with weapons plutonium is the best interim step, it is the U.S.A. that should be taking that step. You have the capability and the responsibility. There is no justification for Canada to become involved in importing weapons plutonium in the form of MOX fuel. 1/01.03.00 cont.

Sincerely,

Mary Lou Harley

Mary Lou Harley, PH.D.

M-207

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

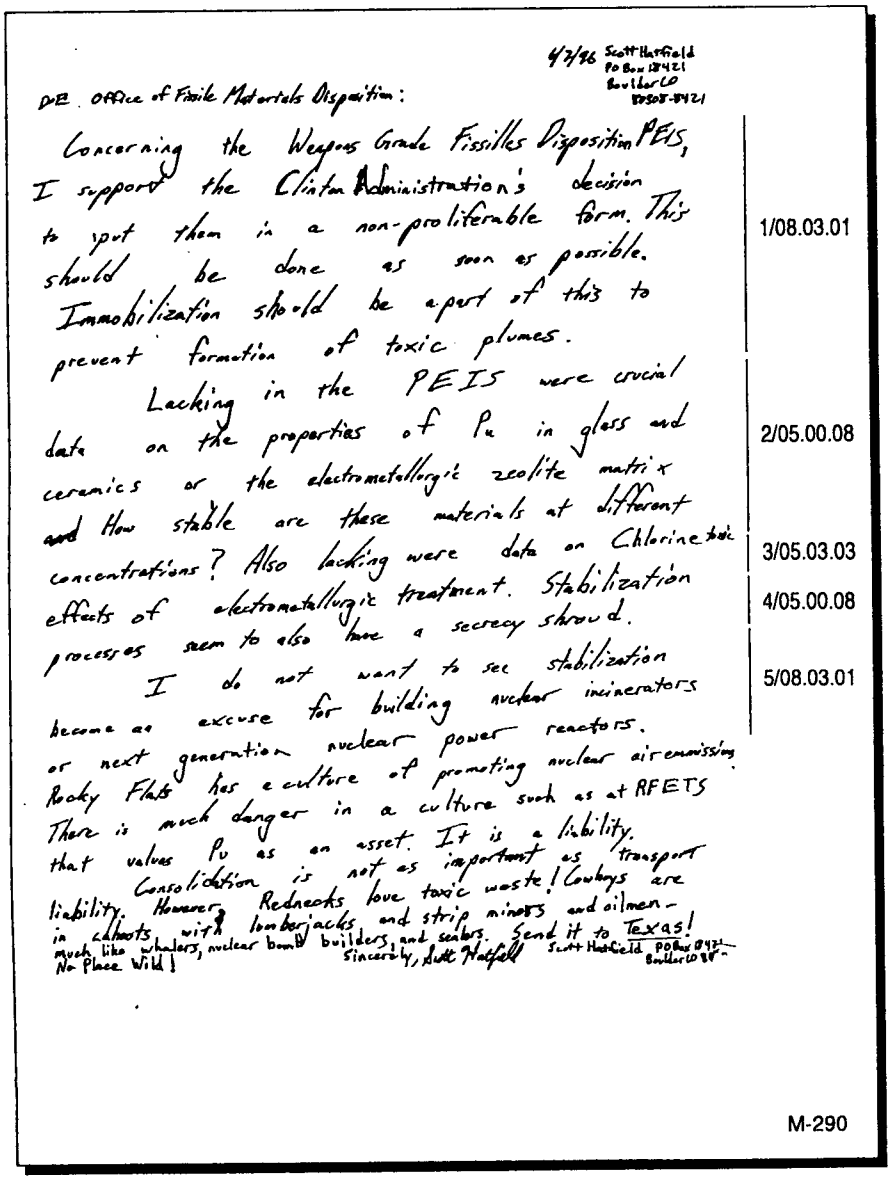
01 00 00 **Comment Number 3**

Comment noted.

15 00 00 **Comment Number 4**

The HEU covered in this PEIS refers to those materials that are not surplus to national defense needs. Therefore, the path forward for these materials would be storage only.

HATFIELD, SCOTT, BOULDER, CO
PAGE 1 OF 1



4/7/96 Scott Hatfield PO Box 18421 Boulder CO 80308-8421

DOE Office of Fissile Materials Disposition:

Concerning the Weapons Grade Fissiles Disposition PEIS, I support the Clinton Administration's decision to put them in a non-proliferable form. This should be done as soon as possible. Immobilization should be apart of this to prevent formation of toxic plumes. 1/08.03.01

Lacking in the PEIS were crucial data on the properties of Pu in glass and ceramics or the electrometallurgic zeolite matrix and How stable are these materials at different concentrations? Also lacking were data on Chlorine toxic effects of electrometallurgic treatment. Stabilization processes seem to also have a secrecy shroud. 2/05.00.08 3/05.03.03 4/05.00.08

I do not want to see stabilization become an excuse for building nuclear incinerators or next generation nuclear power reactors. Rocky Flats has a culture of promoting nuclear air emissions. There is much danger in a culture such as at RFETS that values Pu as an asset. It is a liability. Consolidation is not as important as transport liability. However, Rednecks love toxic waste! Cowboys are in cahoots with lumberjacks and strip miners and oilmen - much like whalers, nuclear bomb builders, and seabrs. Send it to Texas! No Place Wild! 5/08.03.01

Sincerely, Scott Hatfield

Scott Hatfield PO Box 8421 Boulder CO 80308-8421

M-290

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

05 00 08 **Comment Number 2**

All proposed immobilized waste forms have been analyzed to support the comparison of the technical performance related to long-term releases and behavior to other forms currently being evaluated for disposal in an NWPA geologic repository (for example, commercial and DOE-owned spent nuclear fuel and HLW). The results of these analyses are reported in the *Report on Evaluation of Plutonium Waste Forms for Repository Disposal*, Rev. 1, TRW Environmental Safety Systems Inc., March 29, 1996.

05 03 03 **Comment Number 3**

While this level of detail is lacking in the PEIS, further technical information on disposition alternatives is provided in the Technical Summary Report and related alternative summary reports published beginning in July 1996.

05 00 08 **Comment Number 4**

Further information on the technical viability of alternatives was provided in the Technical Summary Report and related alternative summary reports made available for public review in July 1996.

08 03 01 **Comment Number 5**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

HEALTH PROFESSIONALS FOR GLOBAL SURVIVAL, MONTREAL, QC, ERIC NOTEBAERT
PAGE 1 OF 2

PROFESSIONNELS DE LA SANTÉ POUR LA SURVIE MONDIALE

HEALTH PROFESSIONALS FOR GLOBAL SURVIVAL

autrefois Professionnels de la Santé pour la Responsabilité Nucléaire / formerly Health Professionals for Nuclear Responsibility
515, av. des Pins ouest, Montréal, QC H2W 1S4 • Téléphone : (514) 987-9709

Montreal, May the 6th, 1996.

U.S. DEPARTMENT OF ENERGY,
OFFICE OF FISSILE MATERIALS DISPOSITION
P.O. BOX 23786
WASHINGTON, D.C. 20026 - 3786
U.S.A.

Re: STORAGE AND DISPOSITION OF WEAPONS - USABLE FISSILE MATERIALS, DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT.

To whom it may concern,

The Government of Canada via Prime Minister Jean Chrétien announced during the recent G-7 meeting (April 19-20, 1996) that it considers importing in Canada Plutonium fuel for the Candu reactors of the Bruce " A " Nuclear Generating Station on Lake Huron. This plutonium from dismantled U.S. and Russian nuclear bombs would be contained in " mixed oxide " (MOX) fuel.

Our organization, which has been for many years involved in nuclear issues and studies, military or civilian, is deeply concerned with this proposal that we consider totally irresponsible, for many reasons:

1. The Government of Canada has no mandate from the population to make such a proposal with potential serious consequences, and ought to make formal consultations with the all the groups interested in the subject in Canada.

2. This makes Canada a dumping ground for foreign military radioactive waste.

3. It creates huge security problems during the transportation and handling of plutonium (an accidental self-sustained nuclear chain reaction can happen

1/08.03.01

PRIX NOBEL DE LA PAIX NOBEL PEACE PRIZE

PSSM est le chapitre québécois de l'Association des médecins pour la survie mondiale (Canada)
HPGS is the Québec chapter of Physicians for global survival (Canada)

M-175

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. This will include an appropriate level of analysis by Canada before any decision on burning Pu in a CANDU reactor is implemented.

HEALTH PROFESSIONALS FOR GLOBAL SURVIVAL, MONTREAL, QC, ERIC NOTEBAERT
PAGE 2 OF 2

PROFESSIONNELS DE LA SANTÉ POUR LA SURVIE MONDIALE
HEALTH PROFESSIONALS FOR GLOBAL SURVIVAL

autrefois Professionnels de la Santé pour la Responsabilité Nucléaire / formerly Health Professionals for Nuclear Responsibility
515, av. des Pins ouest, Montréal, QC H2W 1S4 • Téléphone : (514) 987-9709

with disastrous consequences).

4. It creates security problems in order to prevent theft of plutonium.

5. The cost linked to the " retubing " of the Candu reactors is very high (about $ 300 million per reactor), and those reactors may well not be able to function for the planned 25 years period, because they are aging.

6. And finally, it violates the spirit of Canada's non-proliferation stance, which is to isolate the Canadian nuclear industry from the military weapons programs of other countries, in making Ontario Hydro a commercial recipient of military fissile material

1/08.03.01 cont.

For all these reasons, we strongly oppose the idea of importing in Canada the plutonium from dismantled U.S., or Russian nuclear bombs.

Sincerely yours,

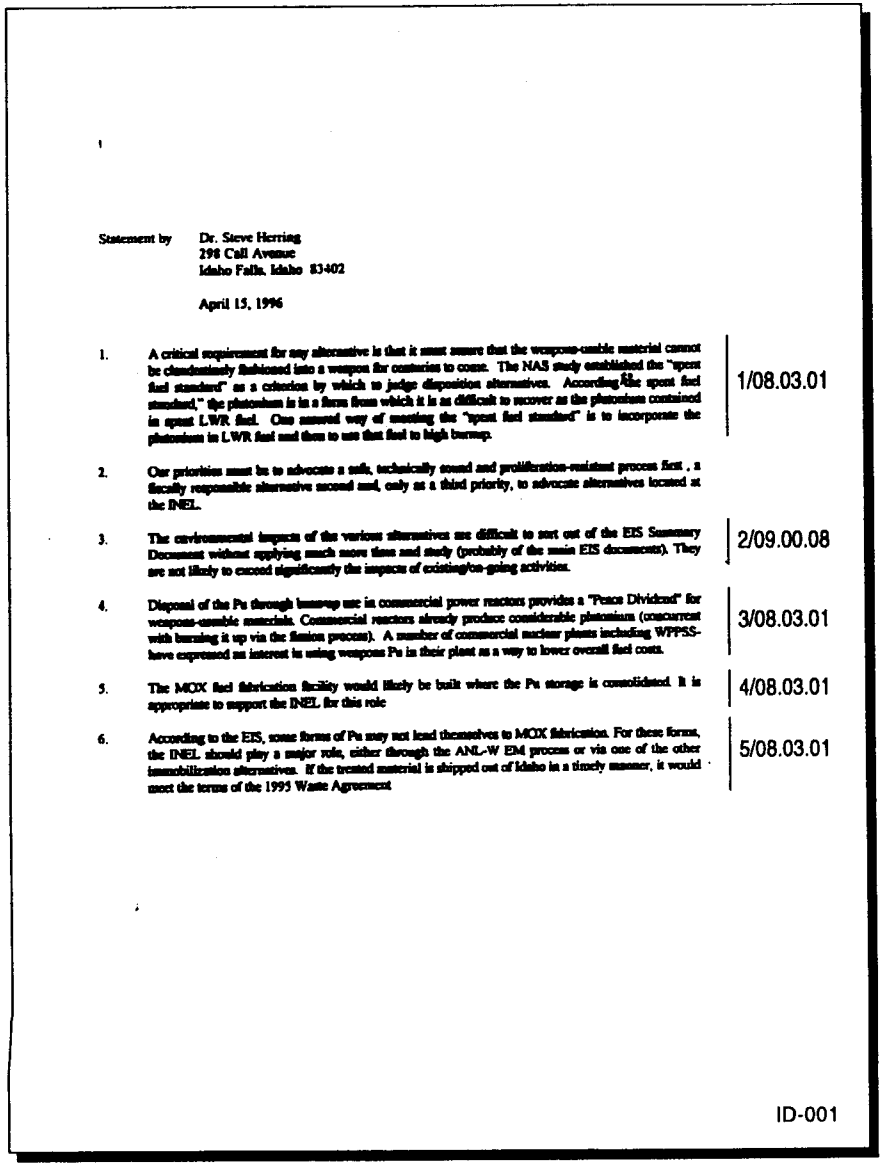
Dr Eric Notebaert, President.

c.c. The Right Honourable Jean Chrétien
Prime Minisrter of Canada.

PRIX NOBEL DE LA PAIX NOBEL PEACE PRIZE

PSSM est le chapitre québécois de l'Association des médecins pour la survie mondiale (Canada)
HPGS is the Québec chapter of Physicians for global survival (Canada)

M-175



Statement by Dr. Steve Herring
298 Call Avenue
Idaho Falls, Idaho 83402

April 15, 1996

1. A critical requirement for any alternative is that it must assure that the weapons-usable material cannot be clandestinely fashioned into a weapon for centuries to come. The NAS study established the "spent fuel standard" as a criterion by which to judge disposition alternatives. According the spent fuel standard," the plutonium is in a form from which it is as difficult to recover as the plutonium contained in spent LWR fuel. One assured way of meeting the "spent fuel standard" is to incorporate the plutonium in LWR fuel and then to use that fuel to high burnup. 1/08.03.01

2. Our priorities must be to advocate a safe, technically sound and proliferation-resistant process first , a fiscally responsible alternative second and, only as a third priority, to advocate alternatives located at the INEL.

3. The environmental impacts of the various alternatives are difficult to sort out of the EIS Summary Document without applying much more time and study (probably of the main EIS documents). They are not likely to exceed significantly the impacts of existing/on-going activities. 2/09.00.08

4. Disposal of the Pu through burnup use in commercial power reactors provides a "Peace Dividend" for weapons-usable materials. Commercial reactors already produce considerable plutonium (concurrent with burning it up via the fission process). A number of commercial nuclear plants including WPPSS-have expressed an interest in using weapons Pu in their plant as a way to lower overall fuel costs. 3/08.03.01

5. The MOX fuel fabrication facility would likely be built where the Pu storage is consolidated. It is appropriate to support the INEL for this role 4/08.03.01

6. According to the EIS, some forms of Pu may not lend themselves to MOX fabrication. For these forms, the INEL should play a major role, either through the ANL-W EM process or via one of the other immobilization alternatives. If the treated material is shipped out of Idaho in a timely manner, it would meet the terms of the 1995 Waste Agreement 5/08.03.01

ID-001

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 00 08 Comment Number 2

Based on comments received, the Summary of the Draft PEIS was revised. The text in the Summary was revised to clarify the comparison of impacts and to delete the reference to "adverse" impacts.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 4

The Department of Energy acknowledges the commentor's support for construction of the MOX fuel fabrication facility at INEL. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, existing agreements, and public input.

08 03 01 Comment Number 5

The Department of Energy acknowledges the commentor's support for the Electrometallurgical Treatment Alternative and other Immobilization Alternatives at INEL. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, existing agreements, and public input.

HERRING, STEVE, IDAHO FALLS, ID
PAGE 1 OF 1

Dr. Steve Herring
298 Call Avenue
Idaho Falls, Idaho 83402-3040

May 6, 1996

DOE-Office of Fissile Materials Disposition
c/o SAIC-PEIS
P. O. Box 23786
Washington, DC 20026-3786

I attended the hearing held in Idaho Falls and have since studied the draft PEIS in more detail. I would like to add the following comments:

1. A critical requirement for any alternative is that it must assure that the weapons-usable material cannot be clandestinely fashioned into a weapon for centuries to come. The NAS study established the "spent fuel standard" as a criterion by which to judge disposition alternatives. According the spent fuel standard," the plutonium is in a form from which it is as difficult to recover as the plutonium contained in spent LWR fuel. One assured way of meeting the "spent fuel standard" is to incorporate the plutonium in LWR fuel and then to use that fuel to high burnup. | 1/08.03.01

2. Disposal of the Pu through burn-up use in commercial power reactors provides a "Peace Dividend" for weapons-useable materials. Commercial reactors already produce considerable plutonium (concurrent with burning it up via the fission process). A number of commercial nuclear plants including WPPSS-2 have expressed an interest in using weapons Pu in their plant as a way to lower overall fuel costs.

3. All of the long term storage options seem to be acceptable from the standpoint of safety and environmental impact; however, the option for the Collocation of the Plutonium and Highly Enriched Uranium receives my support as the most favorable alternative. I also believe that any of the Long Term Storage sites proposed could be designed to be acceptable. | 2/08.03.01

4. According to the EIS, some forms of Pu may not lend themselves to MOX fabrication. For these forms, the INEL should play a major role, probably through the ANL-W Electrometallurgical process. | 3/08.03.01

5 The environmental impacts of the various alternatives are difficult to sort out of the EIS Summary Document. These impacts are not likely to significantly exceed the impacts of existing/on-going activities | 4/09.00.08

I thank you for the opportunity to comment on this draft Programmatic Environmental Impact Statement.

Sincerely yours,

J. Stephen Herring

M-194

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Reactor Alternatives. Decisions on storage and disposition of weapon-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the Collocation Alternative. DOE agrees that all long-term storage options are accepted from the standpoint of safety and environmental impacts. Decisions on storage alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's support for the Electrometallurgical Treatment Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, existing agreements, and public input.

09 00 08 Comment Number 4

Based on comments received, the Summary of the Draft PEIS was revised. Text in the Summary was revised to clarify the comparison of impacts and to delete the reference to "adverse" impacts.

HILL, LEO JAMES, FALLS CHURCH, VA
PAGE 1 OF 1

Leo James Hill
3030 Sleepy Hollow Road
Falls Church, Virginia 22042-3142
1-703-237-7507

26 March 1996

Written Comments on DOE/EIS-0229-D

Reference 2.4.3 "doubtful that potential proliferation... or host country could recover... without detection." | 1/01.06.00

Reference figure 2.4.3.1-2
Security

'Geostationary satellites with laser monitoring of sealed downhole with constant reporting to centralized ground command center. Insuring expedient intervention to any attempted breach of secured area. | 2/13.00.00

Reference 2.4.3.1 "earthquakes"

Leading edge technology now used for seismic studies of earthquake safe areas, balanced rocks, has the capability of measuring how many hundreds of thousands of years an area of basalt or bedrock has been stable. Newly discovered ionization and weathering measurement capabilities can accurately determine the stability of an area. | 3/04.01.00

M-004

01 06 00 **Comment Number 1**

Comment noted.

13 00 00 **Comment Number 2**

The security aspects of the storage and disposition alternatives will be developed further in detailed designs for the selected alternative(s).

04 01 00 **Comment Number 3**

Comment noted.

HIND, KURT
PAGE 1 OF 1

Comment ID: P0022
Date Received: April 18, 1996
Name: Kurt Hind
Address: none given
Phone: 208-526-2212

Transcription:

I currently work at the site. My work phone number is 208-526-2212. I would welcome the bringing of weapons-grade plutonium here for the jobs. I believe that we can store it safely. That it will be safe here, and I would welcome, like I said before, the adventation of jobs and a more stable economy here. Thank you. | 1/08.03.01

P-022

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for additional missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

April 20, 1996
Marlette, Michigan 48453

To: U.S. Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
Washington, D.C. 20026-3786

Prime Minister Chretien
House of Commons
Ottawa ON K1A 0A6
CANADA

From: Ward J. Hodge
6150 Mayville Road
Marlette, Michigan 48453

Gentlemen: One Planet-- One Letter, One problem:

This is about a political and an economic pendulum that has swung too far to one side. The big news story of 1996 will be that citizens on the North American continent will share many of the same economic, social, and environmental concerns for the future.

As an economist, I find little to cheer about from either our state or our nation's capitol today. Far right ideologies are replacing rational thought. Unprecedented firestorms of anti-regulatory legislation have turned traditional economic theories upside-down. Established regulatory lines between government agencies and our corporations are being rapidly erased.

Subversive agendas are promoting the privatization of public facilities and glorifying competition in our public utilities. Where is the concern on the part of our government officials for the future sustainability of the human race? Please respond to this letter with your plans to address the new wave of citizen anti-nuclear sentiment on your horizon. You are in a unique position to help stop the continued proliferation of nuclear waste on this planet.

I have recently received a draft copy of a news release regarding the sale of USA surplus plutonium to Canada. From one viewpoint, it is immaterial what this will be used for. The news release, from the Nuclear Awareness Project in Uxbridge, Ontario tells about the possible production of mixed oxide (MOX) fuel for use in two of the Bruce "A" nuclear reactors, "A proposal put forward by Ontario Hydro and Atomic Energy of Canada Limited (AECL) through AECL's U.S. Subsidiary, AECL Technologies."

This AECL Technologies proposal is, "Based on the assumption that (the) Bruce reactors will be retubed 'because there is a demand for electricity'". I believe this is a faulty assumption fueled by corporate agenda needs to continue a government supported planet-wide nuclear power base that is not sustainable.

M-048

Page 2 - U.S. Department of Energy/Ward Hodge

If I read the reports correctly, This exchange of considerable Canadian money for surplus U.S. Plutonium will mean trucking monthly shipments of approximately 2 metric tons per year to Canada for 25 years. No where do I read that there is a guarantee that this is a safe way to dispose of 50 metric tons of nuclear poison.

The trucks moving this waste will travel within a short distance of where I am presently living-- across the Blue Water bridge at Port Huron into Sarnia Canada. To me, This seems an outrageous crapshoot and a waste of Canadian financial resources.

According to the Nuclear Awareness Project (NAP) draft, The AECL Technologies proposal boasts that a provisional Environmental Assessment could likely be avoided by treating the MOX fuel "Mission" as being exempt under the Environmental assessment exemption granted to Bruce "A" reactors in 1976.

(Haven't we learned anything in the past twenty tears?) Also according to the NAP draft, "The original plutonium is not actually eliminated and additional plutonium is created within the fuel bundles in the process."

As this is being written, USA President Clinton is involved with other world leaders and Russia's Yeltsin to agree on a nuclear test ban sometime in the future. In today's news, Our President uses superlatives to describe what this will mean in our future.

April 1, this year, Canada's GLOBE AND MAIL reported that, "Senior government sources confirmed that Prime Minister Chretien supports (this) MOX fuel proposal, including importing Russian MOX fuel for use at the Bruce reactors... Chretien is apparently planning to endorse the whole scheme at the April 19-20 1996 Nuclear Safety & Security Summit of world leaders in Moscow."

Sir, It is no secret that we must do things differently in the next century if we want a sustainable future. First nation Americans continue to look ahead seven generations, while most of the ancestors of European emigrants in North America consider themselves lucky if they can look ahead to their next pay check, or their next election. Is that the kind of progress that we want here?

Albert Einstein is quoted in Chapter three of a new book about W. Edwards Deming, "THINKING ABOUT QUALITY -- Progress, Wisdom, and the Deming Philosophy."

> "The significant problems we face canot be solved at the same level of thinking we were at when we created them"

Before any further action is taken on either side of our mutual border, all government and corporate officials involved should consider the implications of the following:

M-048

Page 2 U.S. Department of Energy/Ward Hodge

1) In a January 1996 WAR AND PEACE DIGEST article headlined, "Physicist Chernousenko speaks Out on Horrors of Chernobyl", We read that a "Cover-up (was) lifted during U.S. Speaking Tour.

> "Vladimir Chernousenko,the heroic Ukranian Nuclear physicist who supervised the "clean up" of Chernobyl, reveals the true magnitude of the disaster. Like a voice crying in the wilderness, he is now committed to alerting the world of the fatal dangers of nuclear power. This may be his final effort. A victim of radiation poisoning resulting from the Chernobyl accident, Chernousenko is now dying of cancer."

2) Harvey Wasserman, senior Adviser for Greenpeace, has written a message in the latest Mother Jones magazine headlined, "Slaying The Nuclear Dragon." According to Wasserman, "A combination of strong activism, and bad economics has halted the building of nuclear reactors in the U.S. and Europe... Asia is a different story." (Is development so dear and life so cheap in China and India that nuclear power is the only option there?)

3) In the January/February, 1996 WORLD WATCH Magazine Christopher Flavin has written about the next Energy Revolution entitled, "POWER SHOCK". He says that we may soon witness the most dramatic changes in a world energy economy in a hundred years. He writes that, "Once technological change gathers momentum, it can move at Lightning speed." He includes solar electrical power and fuel cells in his analysis. "In a new joint venture called EnergyWorks, Bechtel Enterprises, Inc., and PacifiCorp, a giant utility... will pursue projects around the world based on wind turbines, biomass, industrial energy efficiency, and other technologies that most large energy firms have spurned as puny..."

Sir, I speak against any further development of nuclear power, both in this hemisphere and anywhere else on this planet until we have solved the problem of disposing this life-threatening waste, some of which can be with us for at least a quarter of million years. That, in itself is too long to even comprehend in a rational manner considering the frailty of life here, and the speed at which we are presently destroying our natural resources and our eco-systems. 1/08.03.01

On this continent we are neglecting our future because we are in denial about our present, and have forgotten much of our past. On both sides of our border, government officials working with multi-national lobbyists, must stop measuring human progress in terms of dollars gained and natural resources destroyed. If Canada is doing this, as suggested, to help nuclear disarmanent efforts of the USA and Russia, I believe it to be folly of the worst sort that will not reflect well on this administration or your department.

Sincerely,

Ward J. Hodge

M-048

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

7021 Sand Pt. Wy NE
Seattle Wash 9845
April 30, 1996

Re Plutonium Forum
Comment for the Storage + Disposition of Weapons-Usable Fissile Materials Draft Programmatic EIS

To Whom It May Concern:

My recommendation for the storage of this waste is that it always remain above ground and remain at whatever geographic location it is currently located. 1/08.03.01

To bury/move this waste would be highly dangerous. 2/08.03.01

As long as the United States produces nuclear energy + nuclear weapons, we will need to continue funding personnel to monitor this dangerous waste.

Thank you for considering my comments. Sincerely,
Paula Holden

M-220

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for long-term storage of fissile materials. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Comment ID: P0038
Date Received: May 1, 1996
Name: Linda Hyatt
Address: Dallas, TX

Transcription:

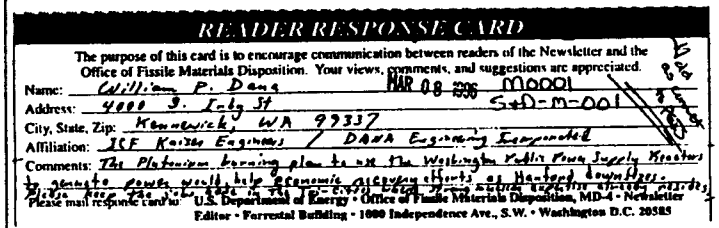
I wish to express my support for jobs and development in the Panhandle that don't endanger workers. I have family members that live there, and I also am concerned about the natural resources in Texas, and especially our agricultural products. Thus, I am opposed to any plutonium processing in the Texas Panhandle. Also to bringing plutonium to Pantex from other sites, and I am opposed to any long-term storage of plutonium over the aquifer in that area. Thank you very much. 1/08.03.01

P-038

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

ICF KAISER ENGINEERS/DANA ENGINEERING INCORPORATED, KENNEWICK, WA, WILLIAM P. DANA
PAGE 1 OF 1



READER RESPONSE CARD

The purpose of this card is to encourage communication between readers of the Newsletter and the Office of Fissile Materials Disposition. Your views, comments, and suggestions are appreciated.

Name: William P. Dana MAR 08 1996 M0001

Address: 4000 S. Ely St S+D-M-001

City, State, Zip: Kennewick, WA 99337

Affiliation: ICF Kaiser Engineers / DANA Engineering Incorporated

Comments: The Plutonium burning plan to use the Washington Public Power Supply Reactors to generate power would help economic recovery efforts at Hanford downwinders. Please keep the site open in the Tri-Cities area. Thank you.

Please mail response card to: U.S. Department of Energy • Office of Fissile Materials Disposition, MD-4 • Newsletter Editor • Forrestal Building • 1000 Independence Ave., S.W. • Washington D.C. 20585

1/09.08.01

M-001

09 08 01 **Comment Number 1**

The primary purpose of the Fissile Materials Disposition Program is to store and dispose of surplus weapons-usable fissile materials in a manner that achieves both national security and ES&H objectives. Selection of a Preferred Alternative was based on numerous factors including socioeconomics. While the creation of jobs is a benefit of the program, it is not the only factor used to determine the alternative or the location for implementing a Federal action.

IES UTILITIES, CEDAR RAPIDS, IA, WALTER NODEEN
PAGE 1 OF 1

Comment ID: P0040
Date Received: May 8, 1996
Name: Walter Nodeen
Principal Engineer of Nuclear Fuel
Organization: IES Utilities
Address: Cedar Rapids, Iowa

Transcription:

We operate the Duane Arnold Energy Center Nuclear Power Station which is a BWR. I just wanted to register our comments on the PEIS and say that we are much in favor of going ahead with the plutonium disposition that uses the plutonium for reactor fuel. In fact, we hope to be one of the reactors that is able to utilize that fuel. We think that is the best process and best policy to follow for several reasons. It saves the energy content of the plutonium instead of just wasting it by throwing it away. That appears to us to be the best way to go. Thank you. 1/08.03.01

P-040

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

JOBE, LOWELL A., IDAHO FALLS, ID
PAGE 1 OF 1

14469 N. 55th E.
Idaho Falls. ID 83401
May 7. 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington. D.C. 20026-3786

re: Storage & Disposition of Weapons-Usable Fissile Materials DPEIS

Gentlemen:

As a retired Systems Engineer and having worked in the water and waste treatment industry. 20 years at the INEL CPP plant. taught chemical engineering. and developed a Process Technology program at EITC. my judgement of the DPEIS document is that it does not consider the real final solution to the destruction of weapons-usable fissile materials. The only probable answer to this problem that I have seen is the IFR (Integral Fast Reactor) developed at ANL because it is the only option I know of for providing a closed-loop system to destroy Pu and other actinides by recycling them back to a fast reactor. using an electrometallurgical process to separate fissile materials from fission products. The recycled fissile materials are so radioactive and the Pu so impure as to be non-proliferable. The by-product stream contains a lower volume of radioactive fission products and other materials than the original fuel elements. with a lower heat load for final disposition. The side advantage of providing additional power. using a passively safe reactor that can't undergo devastating environmental consequences of Chernobyl or TMI are powerful reasons to consider the IFR for this and for the even more extensive Pu/SNF problem coming up in the near future. 1/14.00.00

To merely convert this fissile material into a form for burial either as glass or ceramic logs or as SNF from a LWR does not render it permanently free from proliferation at some future date. The President's Non-Proliferation Policy is inconsistent in stopping all Pu processing in the U.S. while supporting it in western Europe and Japan; also in seeking to eliminate accumulation of HEU and Pu. yet stopping further development of newer. safer nuclear power reactors such as the IFR. which would reduce HEU and Pu inventories. The IFR appears to me to be the only currently valid way to meet the President's Non-Proliferation Policy. Yet I find no mention of the rest of the 37 alternatives for Pu disposition referred to on p. S-6 of the Summary document. nor in Vol.I. as referred to in its Foreward. Western Europe. Russia and Japan have given no indication of backing down from their use of Pu or the PUREX method of reprocessing. which produce Pu for nuclear weapons. 1/14.00.00 cont.

Thus. I place little credence in this Draft PEIS for solving the real problem of destroying Pu. let alone maximizing power generated from this resource and enviromental protection from the by-products. To not do so is immoral. illogical. and is a symptom of the worst of our throw-away culture; total systems thinking is required for the best interests of the U.S. and the world.

For what could possibly be used from this DPEIS as a reasonable alternative. I consider the ANL Electrometallurgical Alternative as being the most cost effective of any alternative. since it requires the least area. equipment. personnel of any; it showed up as best in the comparative tables on most items. The equipment and information might be usable if the U.S. wakes up to its real responsibilities; let science & engineering make the decisions. 2/08.03.01

Respectfully submitted:

Lowell A. Jobe

M-186

14 00 00 Comment Number 1

During the screening of alternatives for inclusion in the PEIS, a Reactor-Burning concept was evaluated involving a variation of the Integral Fast Reactor concept. However, this concept, which would use a reactor fuel cycle design still under development, would be more costly and less timely than other mature reactor options. The development program was recently terminated by the Administration and Congressional action. Since Pu disposition can be accomplished using existing technologies, there is no justification for developing this advanced technology for Pu disposition.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the Electrometallurgical Treatment Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, existing agreements, and public input.

Comment ID: P0026
Date Received: April 18, 1996
Name: Rob Johnston
Address:

Transcription:

I want to comment on the plutonium disposal. I prefer that they use it in light water reactor and use the energy up as available. It's a smart way to do it. It's economically supported through scientific research, and I think it's a waste of taxpayer's dollars to just dispose of it. Thank you. | 1/08.03.01

P-026

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

JOLLEY, MICHAEL F., CHUBBUCK, ID
PAGE 1 OF 1

Michael F. Jolley
5423 Yellowstone Ave.
Chubbuck, Idaho 83202

Secretary Hazel O'Leary
U.S. Department Of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-2786

9 April 1996

Dear Secretary O'Leary:
In response the call for public comments about the disposition of the United States Fissile materials, I wish to add my opinion for the record.
I strongly believe that all fissile material should be used for the production of electricity for the United States. This should be done, in similar fashion, as the proposed Idaho project. I understand that this would result in the production of more nuclear waste. However, I believe strongly that the research over the past few decades at the Idaho National Engineering lab has provided a safe way to deal with nuclear waste.
Furthermore, this proposal would reduce the need for hydroelectric power production. Specifically, the Pacific Northwest would benefit with greater Salmon and Steelhead runs.
Respectfully,

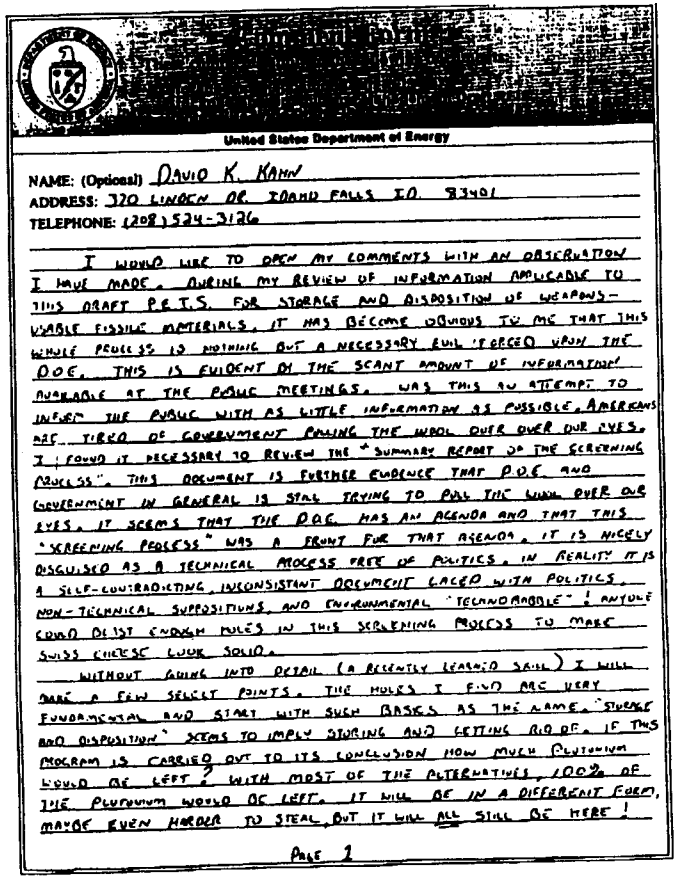
Michael F. Jolley

1/08.03.01

F-004

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



United States Department of Energy

NAME: (Optional) DAVID K. KAHN
ADDRESS: 320 LINDEN DR. IDAHO FALLS ID 83401
TELEPHONE: (208) 524-3126

I WOULD LIKE TO OPEN MY COMMENTS WITH AN OBSERVATION I HAVE MADE. DURING MY REVIEW OF INFORMATION APPLICABLE TO THIS DRAFT P.E.I.S. FOR STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS, IT HAS BECOME OBVIOUS TO ME THAT THIS WHOLE PROCESS IS NOTHING BUT A NECESSARY EVIL IMPOSED UPON THE DOE. THIS IS EVIDENT IN THE SCANT AMOUNT OF INFORMATION AVAILABLE AT THE PUBLIC MEETINGS. WAS THIS AN ATTEMPT TO INFORM THE PUBLIC WITH AS LITTLE INFORMATION AS POSSIBLE. AMERICANS ARE TIRED OF GOVERNMENT PULLING THE WOOL OVER OUR EYES. I FOUND IT NECESSARY TO REVIEW THE "SUMMARY REPORT OF THE SCREENING PROCESS". THIS DOCUMENT IS FURTHER EVIDENCE THAT D.O.E. AND GOVERNMENT IN GENERAL IS STILL TRYING TO PULL THE WOOL OVER OUR EYES. IT SEEMS THAT THE DOE HAS AN AGENDA AND THAT THIS "SCREENING PROCESS" WAS A FRONT FOR THAT AGENDA. IT IS NICELY DISGUISED AS A TECHNICAL PROCESS FREE OF POLITICS. IN REALITY IT IS A SELF-CONTRADICTING, INCONSISTANT DOCUMENT LACED WITH POLITICS, NON-TECHNICAL SUPPOSITIONS, AND ENVIRONMENTAL "TECHNOBABBLE"! ANYONE COULD DEDUCT ENOUGH HOLES IN THIS SCREENING PROCESS TO MAKE SWISS CHEESE LOOK SOLID.

WITHOUT GOING INTO DETAIL (A RECENTLY LEARNED SKILL) I WILL MAKE A FEW SELECT POINTS. THE HOLES I FIND ARE VERY FUNDAMENTAL AND START WITH SUCH BASICS AS THE NAME. "STORAGE AND DISPOSITION" SEEMS TO IMPLY STORING AND GETTING RID OF. IF THIS PROGRAM IS CARRIED OUT TO ITS CONCLUSION HOW MUCH PLUTONIUM WOULD BE LEFT? WITH MOST OF THE ALTERNATIVES, 100% OF THE PLUTONIUM WOULD BE LEFT. IT WILL BE IN A DIFFERENT FORM, MAYBE EVEN HARDER TO STEAL, BUT IT WILL ALL STILL BE HERE!

PAGE 1

F-052

1/08.02.00

2/01.05.00

3/01.02.00

08 02 00 **Comment Number 1**

The Department of Energy uses a wide variety of methods to communicate with the public on these important issues. These methods include public meetings, as part of the NEPA process, and meetings outside of the process, such as the Plutonium Round Table. Numerous fact sheets and displays are made available at the meetings as well as by mail. All of this information is available on the Program's electronic bulletin board.

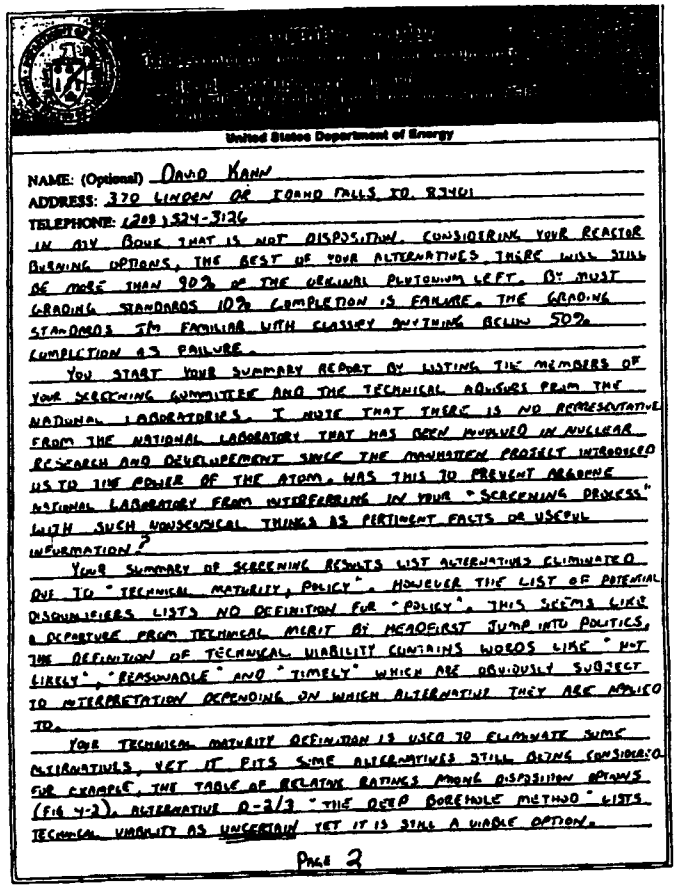
01 05 00 **Comment Number 2**

Comment noted.

01 02 00 **Comment Number 3**

The purpose of the Proposed Action for Pu disposition is to convert Pu into proliferation-resistant forms that meet the Spent Fuel Standard (options for long-term disposition of Pu should seek to meet a standard that makes Pu as inaccessible for weapons use as the much larger and growing quantity of Pu that is found in spent nuclear fuel from commercial power reactors, as suggested by the NAS), thereby fulfilling the President's Nonproliferation Policy. The disposition alternatives would convert 100 percent of the material into a proliferation-resistant form.

KAHN, DAVID K., IDAHO FALLS, ID
PAGE 2 OF 4



United States Department of Energy

NAME: (Optional) DAVID KAHN
ADDRESS: 370 LINDEN DR IDAHO FALLS ID. 83401
TELEPHONE: (208) 524-3136

IN MY BOOK THAT IS NOT DISPOSITION. CONSIDERING YOUR REACTOR BURNING OPTIONS, THE BEST OF YOUR ALTERNATIVES THERE WILL STILL BE MORE THAN 90% OF THE ORIGINAL PLUTONIUM LEFT. BY MUST GRADING STANDARDS 10% COMPLETION IS FAILURE. THE GRADING STANDARDS I'M FAMILIAR WITH CLASSIFY ANYTHING BELOW 50% COMPLETION AS FAILURE.

YOU START YOUR SUMMARY REPORT BY LISTING THE MEMBERS OF YOUR SCREENING COMMITTEE AND THE TECHNICAL ADVISORS FROM THE NATIONAL LABORATORIES. I NOTE THAT THERE IS NO REPRESENTATIVE FROM THE NATIONAL LABORATORY THAT HAS BEEN INVOLVED IN NUCLEAR RESEARCH AND DEVELOPMENT SINCE THE MANHATTEN PROJECT INTRODUCED US TO THE POWER OF THE ATOM. WAS THIS TO PREVENT ARGONNE NATIONAL LABORATORY FROM INTERFERRING IN YOUR "SCREENING PROCESS" WITH SUCH NONSENSICAL THINGS AS PERTINENT FACTS OR USEFUL INFORMATION?

YOUR SUMMARY OF SCREENING RESULTS LIST ALTERNATIVES ELIMINATED DUE TO "TECHNICAL MATURITY, POLICY". HOWEVER THE LIST OF POTENTIAL DISQUALIFIERS LISTS NO DEFINITION FOR "POLICY". THIS SEEMS LIKE A DEPARTURE FROM TECHNICAL MERIT BY MEANS FIRST JUMP INTO POLITICS. THE DEFINITION OF TECHNICAL VIABILITY CONTAINS WORDS LIKE "NOT LIKELY", "REASONABLE" AND "TIMELY" WHICH ARE OBVIOUSLY SUBJECT TO INTERPRETATION DEPENDING ON WHICH ALTERNATIVE THEY ARE APPLIED TO.

YOUR TECHNICAL MATURITY DEFINITION IS USED TO ELIMINATE SOME ALTERNATIVES, YET IT PITS SOME ALTERNATIVES STILL BEING CONSIDERED FOR EXAMPLE, THE TABLE OF RELATIVE RATINGS AMONG DISPOSITION OPTIONS (FIG 4-2). ALTERNATIVE D-2/3 "THE DEEP BOREHOLE METHOD" LISTS TECHNICAL VIABILITY AS UNCERTAIN YET IT IS STILL A VIABLE OPTION.

PAGE 2

F-052

3/01.02.00 cont.

4/01.05.00

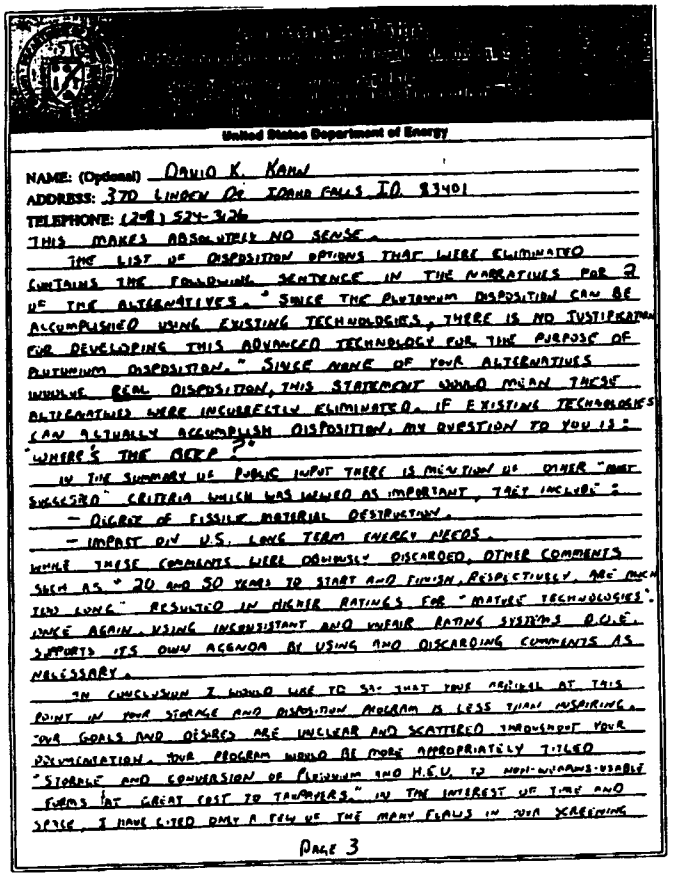
5/01.05.00

01 05 00 Comment Number 4

The screening process provided a reasonable basis for evaluating options for further consideration in a report that was made available in March 1995.

01 05 00 Comment Number 5

In considering the technical maturity of an option for Pu disposition, DOE looked at the risks and uncertainties associated with the development and implementation of the option, the time and cost required to minimize risks and uncertainties, and how these factors affect DOE's ability to accomplish the disposition mission. Though the borehole category may not be as developed and mature as the reactor and immobilization categories, it does provide a category of technology alternatives for Pu disposition different from the other two. The borehole category gives three different technology paths for consideration of disposition alternatives, of which one or more could be selected to fulfill the PEIS purpose and need.



United States Department of Energy

NAME: (Optional) DAVID K. KAHN
ADDRESS: 370 LINCOLN DR IDAHO FALLS ID 83401
TELEPHONE: (208) 524-3126

THIS MAKES ABSOLUTELY NO SENSE.

THE LIST OF DISPOSITION OPTIONS THAT WERE ELIMINATED CONTAINS THE FOLLOWING SENTENCE IN THE NARRATIVES FOR 2 OF THE ALTERNATIVES. "SINCE THE PLUTONIUM DISPOSITION CAN BE ACCOMPLISHED USING EXISTING TECHNOLOGIES, THERE IS NO JUSTIFICATION FOR DEVELOPING THIS ADVANCED TECHNOLOGY FOR THE PURPOSE OF PLUTONIUM DISPOSITION." SINCE NONE OF YOUR ALTERNATIVES INCLUDE REAL DISPOSITION, THIS STATEMENT WOULD MEAN THESE ALTERNATIVES WERE INCORRECTLY ELIMINATED. IF EXISTING TECHNOLOGIES CAN ACTUALLY ACCOMPLISH DISPOSITION, MY QUESTION TO YOU IS: "WHERE'S THE BEEF?"

IN THE SUMMARY OF PUBLIC INPUT THERE IS MENTION OF OTHER "MOST SUGGESTED" CRITERIA WHICH WAS VIEWED AS IMPORTANT, THEY INCLUDE:

- DEGREE OF FISSILE MATERIAL DESTRUCTION.
- IMPACT ON U.S. LONG TERM ENERGY NEEDS.

WHILE THESE COMMENTS WERE OBVIOUSLY DISCARDED, OTHER COMMENTS SUCH AS "20 AND 50 YEARS TO START AND FINISH, RESPECTIVELY, ARE MUCH TOO LONG" RESULTED IN HIGHER RATINGS FOR "MATURE TECHNOLOGIES". ONCE AGAIN, USING INCONSISTANT AND UNFAIR RATING SYSTEMS DOE SUPPORTS ITS OWN AGENDA BY USING AND DISCARDING COMMENTS AS NECESSARY.

IN CONCLUSION I WOULD LIKE TO SAY THAT YOUR APPROACH AT THIS POINT IN YOUR STORAGE AND DISPOSITION PROGRAM IS LESS THAN INSPIRING. YOUR GOALS AND DESIRES ARE UNCLEAR AND SCATTERED THROUGHOUT YOUR DOCUMENTATION. YOUR PROGRAM WOULD BE MORE APPROPRIATELY TITLED "STORAGE AND CONVERSION OF PLUTONIUM AND H.E.U. TO NON-WEAPONS-USABLE FORMS AT GREAT COST TO TAXPAYERS." IN THE INTEREST OF TIME AND SPACE, I HAVE LISTED ONLY A FEW OF THE MANY FLAWS IN YOUR SCREENING

PAGE 3

6/01.04.00

7/01.05.00

8/01.00.00

F-052

01 04 00 Comment Number 6

The purpose of the Proposed Action is to convert Pu into a proliferation-resistant form that meets the Spend Fuel Standard in a prompt manner. Destruction of Pu is not a necessary requirement for meeting the purpose of the Proposed Action.

01 05 00 Comment Number 7

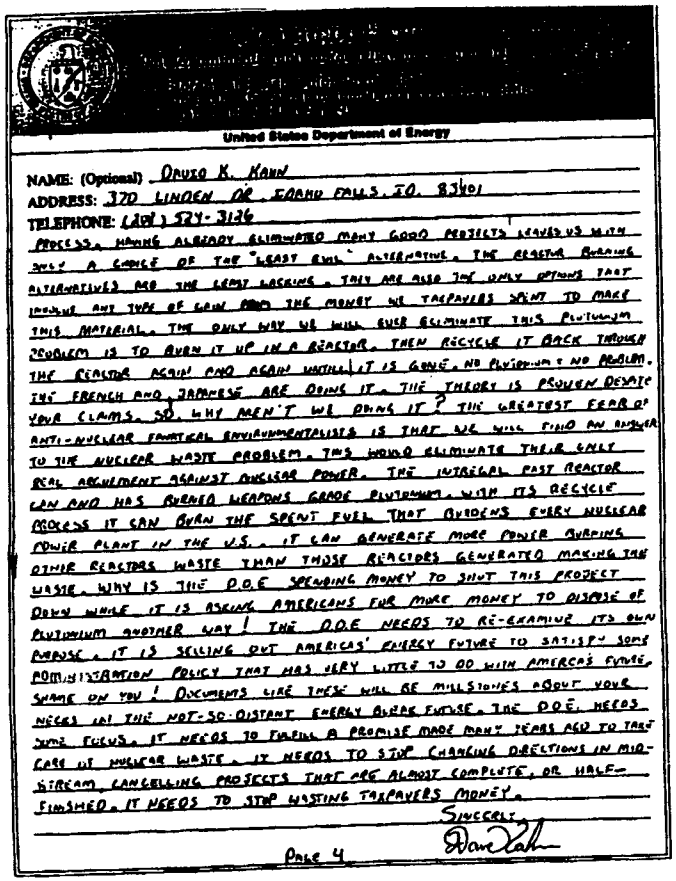
The Department of Energy developed screening criteria which were used as a basis for narrowing technology options for disposition. This criteria were provided to the general public for comment and discussed at the scoping meetings. The criteria were changed as a result of public comment. Other factors were considered in the screening process, but were not included as "criteria."

The degree of fissile materials destruction and impact on U.S. energy needs were among the factors considered. However, in some cases, such as vitrification, these factors were outweighed by other benefits.

The technologies selected for evaluation in the PEIS will be capable of starting disposition in 8 to 10 years and finishing in 16 to 20 years (that is, in much less time than 20 to 50 years). Less mature technologies would take much longer due to the greater degree of R&D required. Therefore, more time would be required to start disposition.

01 00 00 Comment Number 8

Comment noted.



United States Department of Energy

NAME: (Optional) DAVID K. KAHN
ADDRESS: 370 LINDEN DR. IDAHO FALLS, ID. 83401
TELEPHONE: (208) 529-3126

PROCESS, HAVING ALREADY ELIMINATED MANY GOOD PROJECTS LEAVES US WITH ONLY A COUPLE OF THE "LEAST EVIL" ALTERNATIVE. THE REACTOR BURNING ALTERNATIVES ARE THE LEAST LACKING. THEY ARE ALSO THE ONLY OPTIONS THAT INSURE ANY TYPE OF RETURN FROM THE MONEY WE TAXPAYERS SPENT TO MAKE THIS MATERIAL. THE ONLY WAY WE WILL EVER ELIMINATE THIS PLUTONIUM PROBLEM IS TO BURN IT UP IN A REACTOR. THEN RECYCLE IT BACK THROUGH THE REACTOR AGAIN AND AGAIN UNTIL IT IS GONE. NO PLUTONIUM = NO PROBLEM. THE FRENCH AND JAPANESE ARE DOING IT. THE THEORY IS PROVEN DESPITE YOUR CLAIMS. SO, WHY AREN'T WE DOING IT? THE GREATEST FEAR OF ANTI-NUCLEAR FANATICAL ENVIRONMENTALISTS IS THAT WE WILL FIND AN ANSWER TO THE NUCLEAR WASTE PROBLEM. THIS WOULD ELIMINATE THEIR ONLY REAL ARGUMENT AGAINST NUCLEAR POWER. THE INTEGRAL FAST REACTOR CAN AND HAS BURNED WEAPONS GRADE PLUTONIUM. WITH ITS RECYCLE PROCESS IT CAN BURN THE SPENT FUEL THAT BURDENS EVERY NUCLEAR POWER PLANT IN THE U.S.. IT CAN GENERATE MORE POWER DURING OTHER REACTORS WASTE THAN THOSE REACTORS GENERATED MAKING THE WASTE. WHY IS THE D.O.E SPENDING MONEY TO SHUT THIS PROJECT DOWN WHILE IT IS ASKING AMERICANS FOR MORE MONEY TO DISPOSE OF PLUTONIUM ANOTHER WAY! THE D.O.E NEEDS TO RE-EXAMINE ITS OWN PURPOSE. IT IS SELLING OUT AMERICAS' ENERGY FUTURE TO SATISFY SOME ADMINISTRATION POLICY THAT HAS VERY LITTLE TO DO WITH AMERICAS FUTURE. SHAME ON YOU! DOCUMENTS LIKE THESE WILL BE MILLSTONES ABOUT YOUR NECKS IN THE NOT-SO-DISTANT ENERGY AWARE FUTURE. THE D.O.E. NEEDS SOME FOCUS. IT NEEDS TO FULFILL A PROMISE MADE MANY YEARS AGO TO TAKE CARE OF NUCLEAR WASTE. IT NEEDS TO STOP CHANGING DIRECTIONS IN MID-STREAM, CANCELLING PROJECTS THAT ARE ALMOST COMPLETE, OR HALF-FINISHED. IT NEEDS TO STOP WASTING TAXPAYERS MONEY.

SINCERELY,
Dan Kahn

PAGE 4

F-052

9/01.04.00

10/01.04.00

01 04 00 **Comment Number 9**

Comment noted.

01 04 00 **Comment Number 10**

Comment noted.

Comment ID: P0016
Date Received: April 18, 1996
Name: Mike Keesler
Address: 4320 East 540 N
Rigby, ID 83442
Phone: 208-745-8552

Transcription:

It seems as though we had a perfect solution or dealing with this with these warheads and the weapons grade plutonium when we had the IFR project going. I mean burning it through those reactors would definitely take care of it. It would fuel the reactors for many many years to come and provide us with an almost free source of power by doing that, but it seems that they didn't think about it. Anyway, they could still revive the project or burn them in other reactors, I guess, if that's what it takes, but that seems the most viable alternative to getting rid of this waste or the byproducts from the nuclear weapons. Thank you. 1/08.03.01

P-016

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

KEEVAN, MARCIA, AMARILLO, TX
PAGE 1 OF 5

Marcia Keevan
Amarillo, Texas

This opportunity to comment on the future of the nuclear weapons complex is a democratic process, and I like democracy. But, do we, after four years of valid attempts to instill the secrecy surrounding the contaminated facilities of the Cold War effort, do we feel have enough information to give you of the D.O.E. an informed consent? Are all of the important damage reports in the public domain, or are many vital documents concerning soil, air, and groundwater contamination still being suppressed?

We do not feel a position we are not permitted to face. I call on the D.O.E., Mason & Hanger, the unions, the D.O.D., the City of Amarillo and the State of Texas to correct once and for all, the unethical situation that prohibits documents such as the Zone 12 Ground-water Assessment (which was prepared by Argonne Nat. Lab) from being easily available to the general public as well as to civic leaders.

How can you ask a community to look forward when we are not even permitted an honest look back in time? When we cannot even view an accurate picture of the present situation? The contamination history of the Pantex Plant, as well as the implications for our present and future well-being, is not the type of information that should be withheld. We own the contamination. The citizens of America pay the D.O.E.'s bills. It is not "un-American" to expect the government to account for its actions. Rather, it is (accounting) exactly what a democratic government must do

1/08.02.00

TX-060

08 02 00 **Comment Number 1**

All of the documents used to prepare this PEIS have been made available to the public. Copies of the reference documents have been placed in DOE Public Reading Rooms near each of the potentially affected sites.

What a very sad day this is. This is a day in which some of our leaders have demonstrated that we aren't (mature) enough to handle the truth. Some identify the act of requiring government to to account with the act of yelling "fire" in a crowded theater. Such a comparison is both untrue and un-American.

Are my fellow citizens to become an unruly, riotous lot if we discover that some in our leadership have not had our best interests at heart? Are we too immature, after 200 years of democracy, to handle the truth about mistakes we have allowed the government to make? Will you, of the D.O.E., respect our comments and opinions knowing that we are submitting these based on only partial truths?

This political in-fighting must stop. The facts need to see the light of day, the public needs to hear them. Some of the hidden information is depressing - OH WELL! Some of the hidden information involves deception - UNFORTUNATE. Some of the hidden info shakes our fragile perceptions of validity - THAT'S LIFE, FOLKS!

Improving the condition of the human spirit is still a noble pursuit, and any contributions we can make towards such is worth it.

TX-060

let us not underestimate our democracy. Our nation fought a long, bitter, Cold War, and yet, have we honored the American casualties of that war? The sacrifice made by unknowing men, women, children, and even children yet to come? Failure to recognize such sacrifice made for such a long, costly war is unpatriotic. The continuing attempts to try to diminish the damage done by Cold War contamination serves only to dishonor the dead and and still dying casualties in our nation. Whether we are in or out of uniform, a life is a life, and lives sacrificed in war deserve recognition, not scorn.

Pantex is directly on a geological fault. This fault has been active during this century. Earthquakes strong enough to crack a farm building have occured. 2/09.05.04

Pantex, the Superfund Site, is currently operating under no permit with the State of Texas. Records show that Pantex is monitored for some 160 different contaminants. Why? 3/09.04.04

TX-060

09 05 04 **Comment Number 2**

Section 3.5.5 of the Final PEIS provides a description of the seismic condition of the Pantex area and notes that the area is relatively free from earthquakes. It also notes that little or no damage could occur as a result of an earthquake. Appropriate seismic criteria will be used for any facility upgrades or new facility designs.

09 04 04 **Comment Number 3**

Activities conducted under the Superfund Program do not require permits; however, Pantex does have appropriate permits and all administrative requirements associated with the applicable permits must be adhered to.

A full suite of contaminants is monitored to understand the nature and extent of the contamination in order to fully protect human health and the environment.

(next page, first paragraph, then this)

I call on the D.O.E and the State of Texas to establish a standard for multiple contaminants in water, rather than measuring contaminant by contaminant. I do not wish to have a glass of drinking water with 20-100 tiny teeny contaminants, all of which individually fall below "safe" drinking water standards

TX-060

Pantex did not know that such contamination would spread to the groundwater.

The use of Rhentain-90 to test ~~containment~~ containment at the firing sites is an un-acceptable, unpleasant fact. Please tell us more about this, as well as the other open air experiments conducted at the site. DU particles from the test explosions at the firing sites spread into the air, land, and water on and off site. DU is toxic and radioactive. While I thank-you for starting to clean it up, once again, I must say, tell us more!

In closing, I regret that our local business leaders used your hearings to toast our United States President and Honorable Sec of Energy. I appreciate all efforts to make a historically negligent, dangerous industry safer and more ~~accountable~~ accountable.

TX-060

Comment ID: P0030
Date Received: 04/25/96
Name: W. H. Keisimeyer, M.D.
Organization: Augusta Hypertension
Address: 1021 15th Street, Suite 2
Augusta, GA 30901
Phone: 706-722-4688

Transcription:

My comment on this question of how can we safety store and dispose of plutonium dismantled from nuclear weapons is that the plutonium would be processed in a safe fashion so that it can be loaded on rockets and sent to the sun for ultimate recycling of it to where it originated and I am recommending that this be considered to be done in a central location such as Savannah River Site in South Carolina so as to have not only an environmental impact but also have a positive effect on downsizing from defense cutbacks, in other words, this would be processed for the entire planet at SRS. It would be shipped from other countries into this location and it could be processed in pellets that would be suitable for launching from rockets and furthermore if necessary it would be worth the consideration of launching these loads from a remote area, an uncivilized area, similar to those areas in the South Pacific that were sites of tests such as Bikini Atoll, and this would avoid the concern over rocket explosions or launch explosions and contamination of the local environment. I can be reached here if you have any further questions. Thank you and have a pleasant day.

1/01.04.00

P-030

01 04 00 Comment Number 1

The Space Disposition Option was eliminated during a technology screening process that preceded the PEIS. There were several reasons for eliminating this option, including safety, cost, and environmental concerns.

KELLEY, DAVID K., AMARILLO, TX
PAGE 1 OF 1

1/08.03.01

2/08.03.01
3/15.00.00

PC-228

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

Comment noted.

15 00 00 **Comment Number 3**

Comment noted.

Stephen L. Kimberley M.D.
Medical - Legal Consultation
85286 Ridgetop Drive
Eugene, Oregon 97405
(541) 342-6298

DOE
Department of Fissile Materials Disposition
PO Box 23786
Washington, D.C. 20026-3786

Dear Sirs,

I am writing you in urgent regard to the situation at Hanford Nuclear Reserve. In my opinion as a scientist and physician the situation there represents the greatest threat to biological life on the planet. You do not need to be a scientist to understand that millions of tons of active and eminently explosive nuclear waste stored haphazardly on the banks of one of the largest rivers in the world is a situation that is primed for disaster. I am speaking of the type of disaster that would change life on earth as we know it forever.

I realize that those in your office have been working diligently on this problem for decades and it is not a situation that you personally created. However I am asking you to bear with me as I point out the direction of the only viable solution. I am not some radical that is protesting a nearly impossible situation but rather a scientist trying to shed light on a political and environmental issue of greatest import. Any attempts to control this problem by containment will be obviously temporary. To bury this waste miles beneath the earth could be more harmful than helpful. The only viable method of solution is to neutralize this waste using microorganisms. This technology is rapidly evolving and if it were stimulated and fostered the neutralization process could be started soon. 1/08.03.01

Please focus on this area of waste neutralization using microorganism technology. Your funds will be much better spent and the public and politicians will be far happier and more accepting of this solution than of those which call for feeble containment at the expense of future generations. Please contact me if you would like to discuss this further. I suggest you work with existing bioremediation companies and researchers for direction. 2/14.00.00

With Sincere Thanks,

Stephen L. Kimberley M.D.

cc: Ron Wyden US Senate

M-044

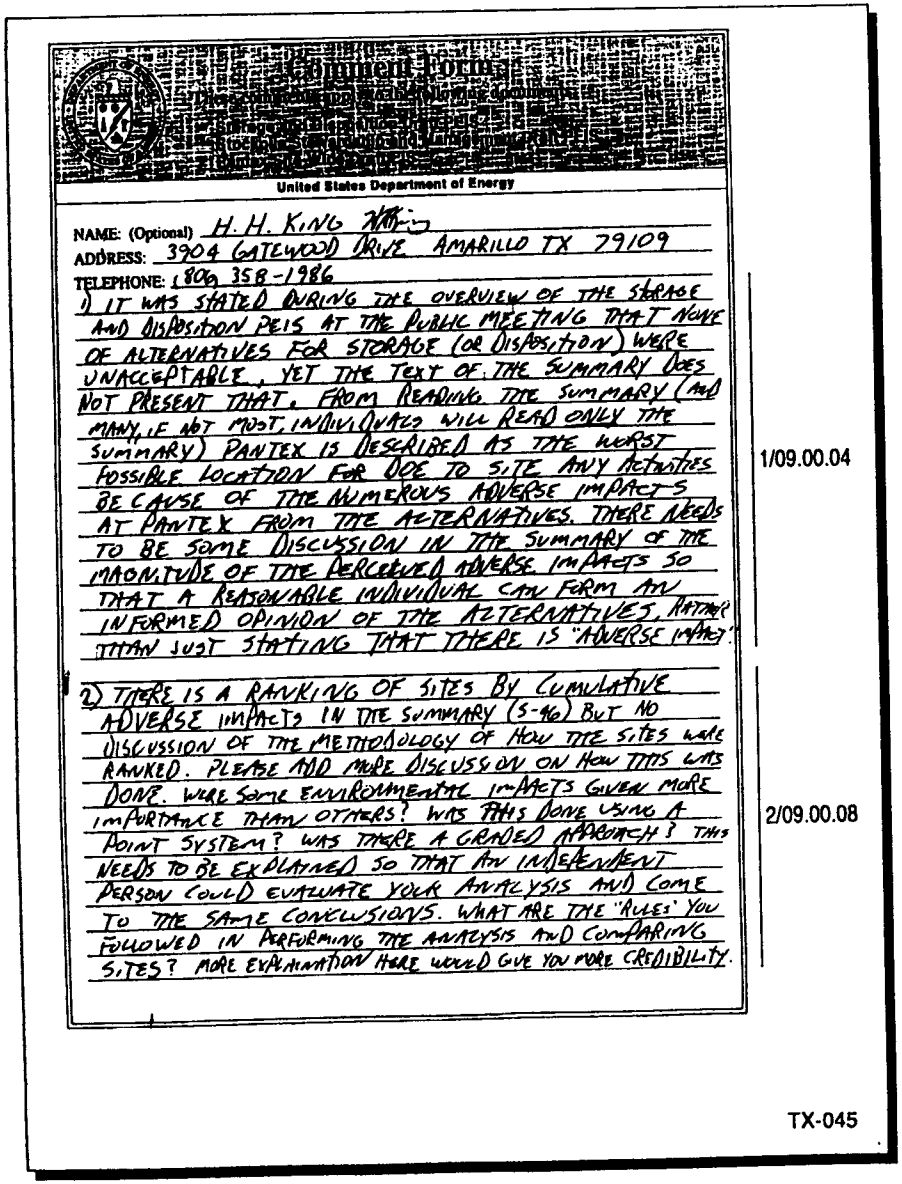
08 03 01 **Comment Number 1**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

14 00 00 **Comment Number 2**

The purpose of the Proposed Action is to convert the surplus weapons-usable Pu into a form that meets the Spent Fuel Standard for proliferation resistance. Existing proven waste forms are sufficient to meet the needs of the Proposed Action. Development of new waste forms is beyond the scope of this PEIS.

KING, H. H., AMARILLO, TX
PAGE 1 OF 1



Comment Form

United States Department of Energy

NAME: (Optional) H. H. KING
ADDRESS: 3904 GATEWOOD DRIVE AMARILLO TX 79109
TELEPHONE: (806) 358-1986

1) IT WAS STATED DURING THE OVERVIEW OF THE STORAGE AND DISPOSITION PEIS AT THE PUBLIC MEETING THAT NONE OF ALTERNATIVES FOR STORAGE (OR DISPOSITION) WERE UNACCEPTABLE. YET THE TEXT OF THE SUMMARY DOES NOT PRESENT THAT. FROM READING THE SUMMARY (AND MANY, IF NOT MOST, INDIVIDUALS WILL READ ONLY THE SUMMARY) PANTEX IS DESCRIBED AS THE WORST POSSIBLE LOCATION FOR DOE TO SITE ANY ACTIVITIES BECAUSE OF THE NUMEROUS ADVERSE IMPACTS AT PANTEX FROM THE ALTERNATIVES. THERE NEEDS TO BE SOME DISCUSSION IN THE SUMMARY OF THE MAGNITUDE OF THE PERCEIVED ADVERSE IMPACTS SO THAT A REASONABLE INDIVIDUAL CAN FORM AN INFORMED OPINION OF THE ALTERNATIVES, RATHER THAN JUST STATING THAT THERE IS "ADVERSE IMPACT"

1/09.00.04

2) THERE IS A RANKING OF SITES BY CUMULATIVE ADVERSE IMPACTS IN THE SUMMARY (S-46) BUT NO DISCUSSION OF THE METHODOLOGY OF HOW THE SITES WERE RANKED. PLEASE ADD MORE DISCUSSION ON HOW THIS WAS DONE. WERE SOME ENVIRONMENTAL IMPACTS GIVEN MORE IMPORTANCE THAN OTHERS? WAS THIS DONE USING A POINT SYSTEM? WAS THERE A GRADED APPROACH? THIS NEEDS TO BE EXPLAINED SO THAT AN INDEPENDENT PERSON COULD EVALUATE YOUR ANALYSIS AND COME TO THE SAME CONCLUSIONS. WHAT ARE THE "RULES" YOU FOLLOWED IN PERFORMING THE ANALYSIS AND COMPARING SITES? MORE EXPLANATION HERE WOULD GIVE YOU MORE CREDIBILITY.

2/09.00.08

TX-045

09 00 04 **Comment Number 1**

Based on comments received, the Summary was revised. There was no intention to portray Pantex, the Pantex region, or the Texas Panhandle region in a negative fashion. Each DOE site was analyzed and studied in the same manner and presented in the Draft PEIS accurately per these analyses and studies. All revisions made to the PEIS text are included in the Summary of the Final PEIS.

09 00 08 **Comment Number 2**

The Department of Energy did not intend to give the perception that the sites were ranked. Based on comments received, the Summary of the Draft PEIS was revised. All revisions made appear in the Summary of the Final PEIS.

April 29, 1996
304 Manor Drive
Sautee, GA 30571

U.S. Department of Energy
Office of Fissile Materials Disposition
Washington, D.C. 20026-3786

Statement for the record: Weapons Usable Fissile Material PEIS

I am unable to attend the April 30 PEIS on the disposition of weapon grade Plutonium in Augusta and wish this written statement to be interested into the record in my absence.

First, I oppose any plan to dispose of Plutonium by turning it into MOX fuel. In other words, I oppose burning Pu in a reactor. I oppose reprocessing of any kind because of it sends the wrong message internationally. | 1/08.03.01 | 2/01.00.00

The U.S. is the leader of the free world. We should not deviate from our commitment not to reprocess commercially. I want to point out that this commitment was made by President Jimmy Carter who was trained in nuclear technology, served aboard a nuclear submarine, and was in a better position than any world leader to understand the implications of reprocessing.

Second, I protest the PEIS system itself as it pertains to this decision. By holding these hearings at DOE sites around the country in cities where the public has a strong economic interest in perpetuating DOE related jobs, the outcome is biased. While I applaud the DOE's efforts to establish and support a Citizens Advisory Board and thereby encourage public input, I question its effectiveness in reaching the general public. | 3/08.02.00

I attended the CAB forum in August on April 25 but feel it was slanted toward a preconceived outcome. I also protest the relatively short time allowed for written comment following the PEIS. Seven days (deadline May 7th) is not enough time for the general public to absorb the information and express their concerns. | 4/08.01.00

I am aware of the urgency in this matter, but I am convinced that we must secure all fissile material as best we can without being rushed into long-term solutions that can possibly lead to even greater problems in the future. If we burn fissile Pu in reactors, we have no guarantee that the process will stop there and that we will not continue to depend on MOX as a source of energy.

Our biggest long-term problem is what to do with radioactive waste from reactors in the U.S. and around the world. This problem was not even addressed at the CAB meeting on April 25. I asked this question and so did others I spoke to, but we had to ask in writing and the panel choose not to answer. The MOX option only exacerbates this problem and is a primary reason why it must be opposed. | 5/15.00.00

Sincerely,

Joan O. King

Joan O. King

M-200

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 00 00 **Comment Number 2**

The specific purpose of DOE's PEIS effort is to evaluate alternatives for the disposition of surplus weapons-usable Pu that would render the Pu as inaccessible and unattractive for reuse in nuclear weapons as the much larger and growing quantity of Pu that exists in spent nuclear fuel from commercial power reactors. This condition is referred to as the Spent Fuel Standard. If an alternative using MOX fuel in reactors is selected, the surplus Pu would eventually be contained in spent fuel and, by definition, the Spent Fuel Standard would be achieved.

While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of Pu from that spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort. The fact that the PEIS evaluates disposition of surplus weapons Pu through use in MOX fuel, but does not further evaluate reprocessing of the spent fuel, does not foreclose policy or technology options, nor does it prejudice future decisions regarding the management or disposition of the spent fuel.

08 02 00 **Comment Number 3**

Comment noted.

08 01 00 **Comment Number 4**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

15 00 00 **Comment Number 5**

Comment noted.

Comment ID: P0033
Date Received: May 1, 1996
Name: Joan King
Address: 304 Manor Drive
Sautee, GA 30571
Phone: 706-878-3459

Transcription:

I am concerned about several things. 1) I can not get to Augusta for the PEIS hearing on the disposal of plutonium, but I am opposed to anything that would jeopardize our position against producing plutonium. That means I don't want to see MOX fuel option used. Glassify it if possible. But, I'm also concerned that there isn't enough time for the information to get out. If May 7 is the deadline for written comments, this is not allowing enough time. I know it must be very difficult to get all of this in, but you are asking the public to be informed about something that is tremendously complicated. I would like to see a special panel address this; do it publicly; give the public enough time to become educated and to know what the issues are. This is not something that can be settled in Augusta or near any of the nuclear plants where people are already predisposed towards certain options. I hope somebody will get back to me on this. I will write written comments. Thank you. Bye.

1/08.03.01
2/08.03.01
3/08.01.00
4/08.01.00

P-033

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 01 00 **Comment Number 3**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

08 01 00 **Comment Number 4**

Comment noted.

=== COVER PAGE ===

TO: U.S. DEPARTMENT OF ENERGY, OFFICE OF FISSILE MATERIALS DISPOSITION
FAX: 202-586-~~3786~~ 2710
WASHINGTON, D.C. 20026-3786 U.S.A.

FROM: S (ZIGGY) KLEINAU
FAX: 519-795-7725
TEL: 519-795-7725

3+1 PAGE(S) TO FOLLOW

COMMENT:

PLEASE BE KIND ENOUGH TO TAKE THE OPPOSITION TO THE IMPORT OF WEAPONS-GRADE PLUTONIUM, EVEN IN THE SMALLEST AMOUNT, OF THE FOLLOWING 35 PERSONS LIVING IN THE VICINITY OF THE BRUCE 'A' REACTORS INTO CONSIDERATION WHEN CONTEMPLATING A METHOD OF DISPOSAL FOR NUCLEAR WAR HEADS.

1/08.03.01

AN ACKNOWLEDGEMENT OF OUR SUBMISSION (PETITION) WOULD BE MUCH APPRECIATED AND SHOULD BE DIRECTED TO:

S. K. KLEINAU
R.R. #1, LION'S HEAD/ONTARIO, CANADA
N0H 1W0

Thank you very much indeed,

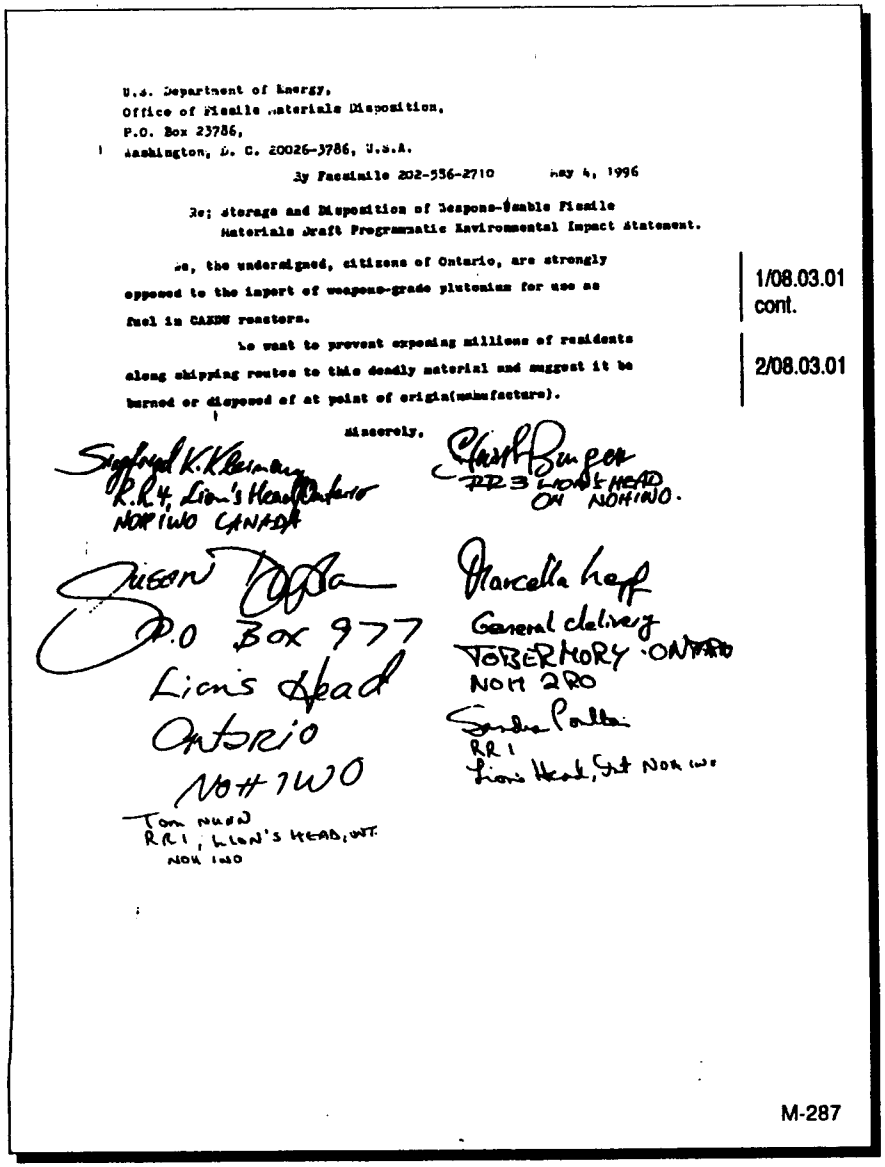
P.S. ORIGINALS WILL FOLLOW BY MAIL. Sigfried Kleinau.

M-287

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. This will include an appropriate level of analysis by Canada before any decision on burning Pu in a CANDU reactor is implemented.

KLEINAU, S. K., ET AL., KEMBLE, ON
PAGE 2 OF 8



U.S. Department of Energy,
Office of Fissile Materials Disposition,
P.O. Box 23786,
Washington, D. C. 20026-3786, U.S.A.

By Facsimile 202-586-2710 May 4, 1996

Re; Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

We, the undersigned, citizens of Ontario, are strongly opposed to the import of weapons-grade plutonium for use as fuel in CANDU reactors. 1/08.03.01 cont.

We want to prevent exposing millions of residents along shipping routes to this deadly material and suggest it be burned or disposed of at point of origin(manufacture). 2/08.03.01

Sincerely,

Siegfried K. Kleinau
R.R.4, Lion's Head, Ontario
N0H 1W0 CANADA

Christ Burger
RR3 LION'S HEAD
ON N0H 1W0.

Susan [illegible]
P.O Box 977
Lion's Head
Ontario
N0H 1W0

Marcella Lapp
General delivery
TOBERMORY ONTARIO
N0H 2R0

Sandra Poulton
RR1
Lion's Head, Ont N0H 1W0

Tom Nunn
RR1, LION'S HEAD, ONT.
N0H 1W0

M-287

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

U.S. Department of Energy,
Office of Fissile Materials Disposition,
P.O. Box 23786,
Washington, D. C. 20026-3786, U.S.A.

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Sincerely,

Dr. Cathy Stanley
RR1 Kemble, ON
N0H 1S0

HANS ALBARDA
RR1 KEMBLE ONT
N0H1S0

Robert Hall
Lions Head
Ont

June Fraser
Lion's Head ON N0H 1X0

Tonya Osborne Lions Head ONT N0H 1W0

Justin Osborne " " " " "

Ryan Higgs Lions Head ont

M-287

KLEINAU, S. K., ET AL., KEMBLE, ON
PAGE 4 OF 8

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Sincerely,

WAYNE STRAUGHAN
R1 LONDESBORO NOM2HO
ONT

[illegible]
R1 Dungannon Ont.
NOM1RO

[illegible]
RR#1 Mitchell ONT
NOK 1HO

[illegible]
RR6 Cardinal Ont.
N7R 5Y3.

[illegible]
RR5 FLEMERTON
NOC1E0-[illegible]

[illegible]
RR1 New Dundee ONT.
NOB 2E0

[illegible]
RR1 Lucknow
Ont NOC 2HO

[illegible]
RR#3, Clifford
NOG 1MO

[illegible] Carroll
RR#2
Meaford Ont
N4L 1W6

[illegible]
[illegible]
[illegible]
L7N 2W6

VITOLD KREUTZER
RR#2 PROTON STATION
NOC 1LO

[illegible] RR1
[illegible] NOH 2C5

Bernice Ellis-Whitney
RR 3 Elmwood Ont
NOG 1SO

HEATHER DUNLOP
RR#1 ELMWOOD, ONT NOG 1SO

DAVID MARGETTS
[illegible]
RR 3 CHESLEY ONT
NOG 1LO

M-287

KLEINAU, S. K., ET AL., KEMBLE, ON
PAGE 5 OF 8

U.S. Department of Energy,
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Sincerely,

[illegible]
P.O. Box 957
Lion's Head, Ontario
N0H 1W0

Tony McQuail
RR#1 Luckuow, ON
N0G 2H0

SANDRA-JEAN OHRT
642 CASTLEGUARD CR.
BURLINGTON, ONT. L7N 2W6
Sandra-Jean Ohrt

ERIC [illegible]
RR1
SEBRINGVILLE, Ont.
N0K 1X0

Russ Ohrt
642 Castleguard Cr.
Burlington ON
L7N 2W6

JIM KUELLMER
61 BEACHVIEW CR
TORONTO M4E 2H6

M-287

KLEINAU, S. K., ET AL., KEMBLE, ON
PAGE 6 OF 8

U.S. Department of Energy,
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Sincerely,

PAUL M L. BRUER RR6 WIARTON ON N0H 2T0
[signature]
Carol Ruland
Carol Ruland RR3 Lions Head N0H 1W0
John Dunfield 450 MAIN ST. W LISTOWEL ONT N4W1A6
T. L. Hummel Bx 116 Collingwood ON L9Y 3Z4
[signature] Box 374 Merrickville, Ont. K0G-1N0
Mike Nickerson
Paul Benvenuti 1-55 Crooks St Ham. Ont. L8R 2Z7
Caroline Cameron RR#7 Antigonish, N.S B2G 2L4
N. Ahmed 96 [illegible] L8S 4A5
Kathy Cox 55 Melbourne St. W. Lindsay, Ont. K9V 2S7
[signature] 17 Major St, Kitchener, Ont N2H 4R1
Irene Kock Box 448 Uxbridge ON L9P 1M8

M-287

KLEINAU, S. K., ET AL., KEMBLE, ON
PAGE 7 OF 8

U.S. Department of Energy,
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We want to prevent exposing millions of residents along shipping routes to this deadly material and suggest it be burned or disposed of at point of origin(manufacture).

Sincerely,

Stefan Ochman 200 Colvillete Trail B.C. V5E 6R1
Eddy Kulla 1544 King St. West (Bsmt) Toronto, Ont M6K- 1J6.
Eva Schroeder 76 Armstrong St. Ottawa Ont. K1Y 2V7
Cathie Pym C. Pym 385 Torrance St. Burlington, Ont. L7R 2R7
Janet Pym Janet Pym 385 Torrance St. Burl., Ont. L7R 2R7
JEFF PYM Jeff Pym 385 TORRANCE ST. BURLINGTON, ON L7R 2R7
Bernd Keebs 86 Sott St. Ayr N0B-1E0
Christopher Golding 24 Queen St Guelph RR#4 Lions Head.
Edith Tompkins 705-430 William St, London, Ont. N6B 3E2.
Mirandla Keeper 63-Main St Lions Head N0H 1W0
Norman Alcock Miller Lake, Ont.
Elena Bladon Box 4 Lion's Head, Ont. N0H1W0
Roger T Bladon RR#1 MAR. ONT. N0H 1X0
Hendrik Reiner
Faye Bulchart RR2 Lions Head. Ont. N0H1W0

M-287

KLEINAU, S. K., ET AL., KEMBLE, ON
PAGE 8 OF 8

U.S. Department of Energy,
Office of Fissile Materials Disposition,
P.O. Box 23786,
Washington, D. C. 20026-3786, U.S.A.

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We want to prevent exposing millions of residents along shipping routes to this deadly material and suggest it be burned or disposed of at point of origin(manufacture).

Sincerely,

Ruth Tompkins P.O. Box 193. Lion's Head. Ontario N0H 1W0
Rick Rom RR#1 Lions Head, ont. N0H 1W0
Carol Coupland RR#2 Rhone Head Ont N0H 1W0
Margaret C Wheeler Box 96 Wallacetown N0L 2M0.

M-287

KLINE, CONNIE, WILLOUGHBY HILLS, OH
PAGE 1 OF 1

Date Received: 06/12/96
Comment ID: P0052
Name: Connie Kline
Address: 38531 Dodds Landing Drive
Willoughby Hills, Ohio 44094

Transcription:

Yes, my name is Connie Kline. Phone and fax are (216) 946-9012. Another dedicated fax line is (216) 663-4177. I have very little information on this proposed DOE plan to use fissile materials apparently in commercial reactors. I would like if possible, if there is something fairly short, that could be faxed to either of those numbers that I gave or, my address is 38531 Dodds Landing Drive, Willoughby Hills, Ohio 44094. As it stands now, what I have read about the Programmatic Environmental Impact Statement regarding this fissile material being used in commercial reactors, I am opposed to it based on what I have read so far. But I certainly would be very interested in receiving either by fax or by mail some additional information as I have been able to get my hands on very little information about this. Thank you. 1/08.03.01 2/08.02.00

P-052

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 02 00 **Comment Number 2**

The Department of Energy uses a wide variety of methods to communicate with the public on these important issues. These methods include public meetings, as part of the NEPA process, and meetings outside of the process, such as the Plutonium Round Table. Numerous fact sheets and displays are made available at the meetings as well as by mail. All of this information is available on the Program's electronic bulletin board.

STACY KNIGHT

I strongly support the continuation of the high explosive function at the Pantex facility. I oppose any effort to move these functions to the national labs. Pantex is the most cost effective DOE facility and has an excellent track record in doing the high explosive functions.

- I believe that Pantex should be chosen as the location for fissile materials storage and disposition functions. Pantex already stores surplus plutonium and has a safety and security record that is unmatched in the DOE complex. When given fair budget consideration, strong local support and national security interest, Pantex is the ideal choice for this function of fissile materials storage and disposition. 1/08.03.01

QUESTIONS:

- Please explain why the Lawrence Livermore National Laboratory and the Los Alamos National Laboratory stockpile management budgets show projected increases from 1996 to 2004, since the U.S. has terminated development of nuclear weapons.

- Are these projected increases in the stockpile management at the two labs based on transferring of missions to them which have previously been done at the production plants?

TX-047

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

KOEBERL, DWIGHT D., SEATTLE, WA
PAGE 1 OF 1

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): Dwight D. Koeberl
Address (optional): 2029 NW 72nd St
Seattle, WA 98117

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. **Materials Immobilization/Vitrification** - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

This option seems preferable, because it allows disposal of plutonium in an unusable form. Disposal in a form not suitable for weapons use is the best option. | 1/08.03.01

2. **Deep borehole disposal** - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

Only preferable if immobilized first. | 1/08.03.01 cont.

3. **Reactor Options** - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

Very objectionable because of the wastes generated. | 2/08.03.01

4. **Storage Options** - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

The material should be made inappropriate for use in bombs. | 3/01.02.00

M-223

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 02 00 Comment Number 3

The Department of Energy's proposed storage action includes nonsurplus weapons-usable fissile materials to support national defense and surplus Pu pending disposition. The surplus Pu would ultimately be converted into a form that would make it difficult to extract and reuse to make weapons.

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): Michael Korth
Address (optional): 586 Scenic Dr
West Richland Wa

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

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1. **Materials Immobilization/Vitrification** - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

OK

2. **Deep borehole disposal** - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

Not attractive option - expensive to observe over a long 250 K years

1/08.03.01

3. **Reactor Options** - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

The Japanese are very hostile with nuclear But it must be done at cost to meet the plan for 25 K lbs.

2/08.03.01

4. **Storage Options** - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

OK

M-230

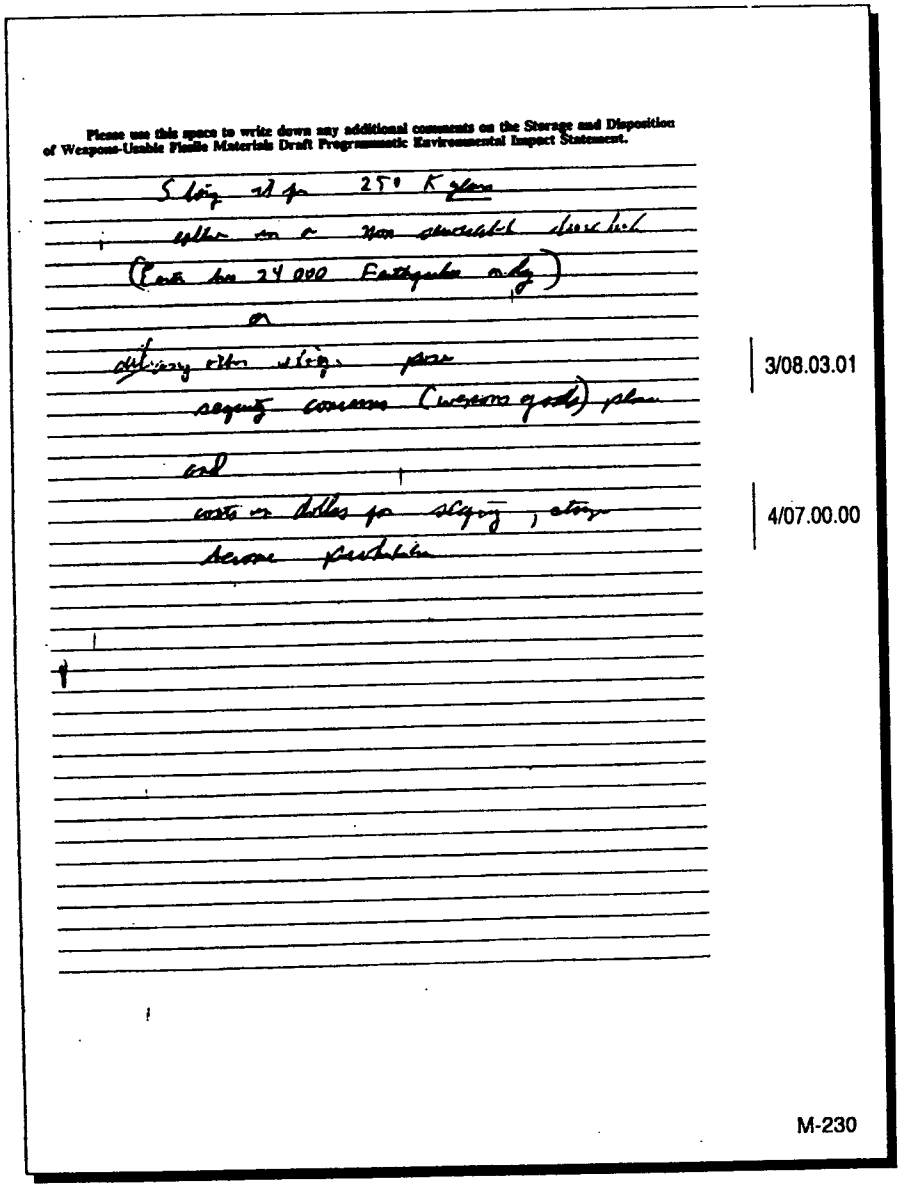
08 03 01 Comment Number 1

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

KORTH, MICHAEL, WEST RICHLAND, WA
PAGE 2 OF 2



Please use this space to write down any additional comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

Storing it for 250 K years
either in a non [illegible] [illegible]
(Earth has 24 000 Earthquakes only)
or
[illegible] other storage [illegible] 3/08.03.01
security concerns (weapons goals) [illegible]
and
costs in dollars for [illegible], storage 4/07.00.00
become prohibitive

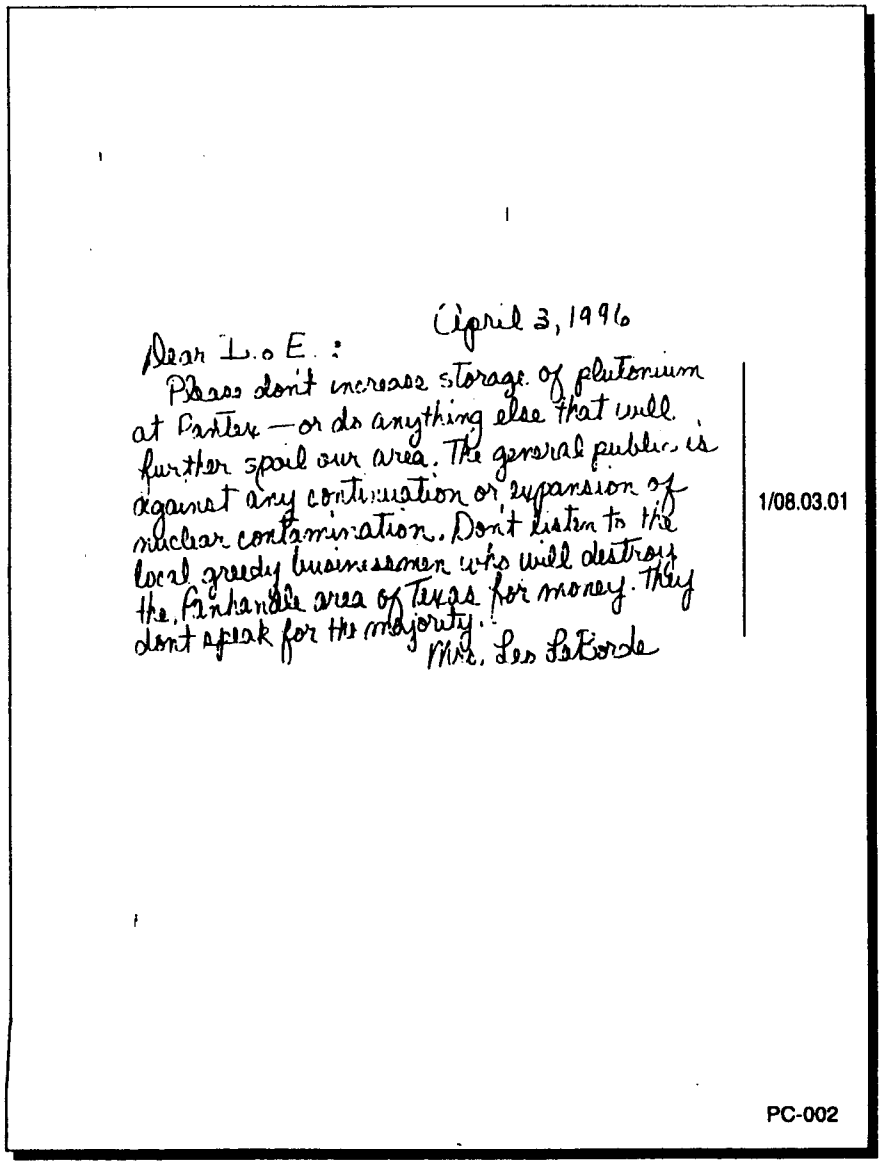
M-230

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

07 00 00 **Comment Number 4**

Cost data, along with technical and schedule data, was provided in a Technical Summary Report for storage in late July 1996.



April 3, 1996

Dear D.O.E.:

Please don't increase storage of plutonium at Pantex — or do anything else that will further spoil our area. The general public is against any continuation or expansion of nuclear contamination. Don't listen to the local greedy businessmen who will destroy the Panhandle area of Texas for money. They don't speak for the majority.

Mrs. Leo LaBorde

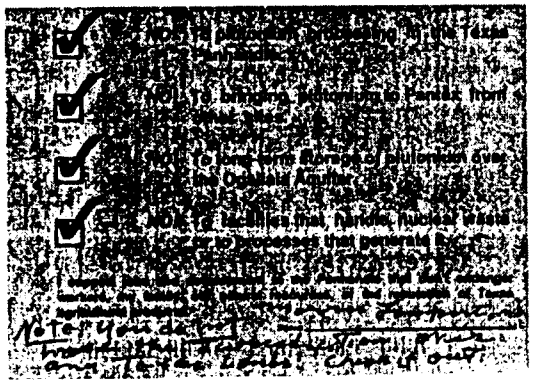
1/08.03.01

PC-002

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

LAMPERT, MORRIS
PAGE 1 OF 1



1/08.03.01

2/08.03.01

3/09.01.04

PC-182

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

Comment noted.

09 01 04 **Comment Number 3**

Pantex was originally built for the U.S. Army during the early days of World War II with the mission of producing conventional munitions. After the war, the facilities were deactivated and lay vacant until 1949 when Texas Technological College (now Texas Tech University) purchased the site for $1.00. In 1951, the AEC (predecessor of DOE) asked the Army to reclaim the main plant and surrounding land under the recapture clause of the sale agreement, and the land area was subsequently transferred to the AEC.

Pantex operational activities are presently situated within 6,030 ha (14,900 acres) of land, of which approximately 3,683 ha (9,100 acres) are owned by the Federal Government and the remaining 2,347 ha (5,800 acres) are leased from Texas Tech University primarily to provide a safety and security buffer zone. All owned and leased buildings on the site are administered, managed, and controlled by DOE. DOE owns an additional remote tract of 436 ha (1,077 acres) of undeveloped land at Pantex Lake located approximately 4 km (2.5 mi) northeast of the main plant site. This property is held by DOE to retain the water rights. Total Pantex land area equals 6,466 ha (15,977 acres). The potential location of all storage and disposition alternatives at Pantex would be situated on land area owned by the Federal Government.

June 6, 1996

U.S. Department of Energy
Office of Fissile Materials
Forrestal Building
1000 Independence Ave., S.W.
Washington, D.C. 20585

Dear Department of Energy,

Thank-you for allowing me to comment on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Environmental Impact Statement.

My preferred alternative for Long-Term Storage is: 1/08.03.01

Consolidate all Pu Material at One Site Using Upgraded and/or New Facility; HEU Remains at ORR.

My preferred alternative for Plutonium Disposition is: 2/08.03.01

Immobilization by Electrometallurgical Treatment.

Thank-you once again.

Sincerely,

Colleen Lancaster

801 Davis DR
Brentwood, TN 37027

F-048

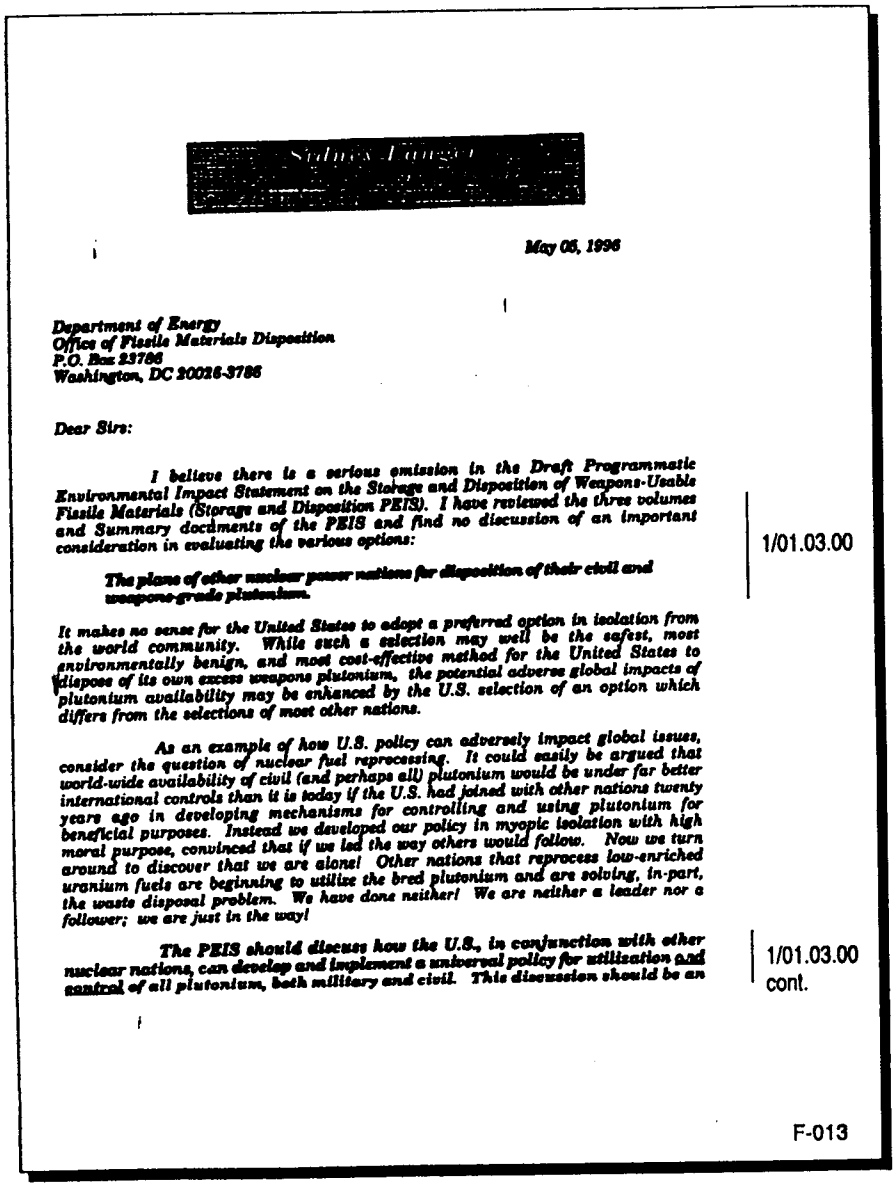
08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Consolidation Alternative. Decisions on the storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the Electrometallurgical Treatment Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, existing agreements, and public input.

LANGER, SIDNEY, SAN DIEGO, CA
PAGE 1 OF 2



[redacted]

May 05, 1996

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

Dear Sirs:

I believe there is a serious omission in the Draft Programmatic Environmental Impact Statement on the Storage and Disposition of Weapons-Usable Fissile Materials (Storage and Disposition PEIS). I have reviewed the three volumes and Summary documents of the PEIS and find no discussion of an important consideration in evaluating the various options: 1/01.03.00

The plans of other nuclear power nations for disposition of their civil and weapons-grade plutonium.

It makes no sense for the United States to adopt a preferred option in isolation from the world community. While such a selection may well be the safest, most environmentally benign, and most cost-effective method for the United States to dispose of its own excess weapons plutonium, the potential adverse global impacts of plutonium availability may be enhanced by the U.S. selection of an option which differs from the selections of most other nations.

As an example of how U.S. policy can adversely impact global issues, consider the question of nuclear fuel reprocessing. It could easily be argued that world-wide availability of civil (and perhaps all) plutonium would be under far better international controls than it is today if the U.S. had joined with other nations twenty years ago in developing mechanisms for controlling and using plutonium for beneficial purposes. Instead we developed our policy in myopic isolation with high moral purpose, convinced that if we led the way others would follow. Now we turn around to discover that we are alone! Other nations that reprocess low-enriched uranium fuels are beginning to utilize the bred plutonium and are solving, in-part, the waste disposal problem. We have done neither! We are neither a leader nor a follower; we are just in the way!

The PEIS should discuss how the U.S., in conjunction with other nuclear nations, can develop and implement a universal policy for utilization and control of all plutonium, both military and civil. This discussion should be an 1/01.03.00 cont.

F-013

01 03 00 Comment Number 1

The PEIS analyzes the environmental impacts for storage of weapons-usable Pu and HEU from the U.S. weapons stockpile, disposition of Pu declared surplus to national defense needs. U.S. civilian materials and the materials of other nations, whether civilian or military, are not within the scope of the PEIS. The PEIS is not a U.S. or international policy-making document. However, by completing environmental analyses and related cost, schedule, technical, and nonproliferation analyses that will be used to reach a ROD, the United States will be in a position to implement Pu disposition efforts multilaterally or bilaterally through negotiations, or unilaterally as an example to Russia and other nations.

integral part of the discussions in Chapter I. An adverse impact that needs to be considered is whether a U.S. policy, developed again in isolation, would increase the future global availability of plutonium for nefarious purposes. It appears to me that such a primary decision is a prerequisite to consideration of the technical proposals for disposition.

1/01.03.00 cont.

Thank you for the opportunity to comment on the Draft PEIS,

Sincerely yours,

Sidney Langer

F-013

Plutonium Disposition EIS. General Comments

by W.F. Lawless

The disposition of plutonium is a complex decision for all Americans because of the uncertainties derived from plutonium's very long 24,000 year half-life. Other factors add to this complexity:

1. The uncertain threat of global warming from the burning of hydrocarbon fuels (e.g., coal, natural gas, gasoline, fuel oil, etc.).

2. The uncertainty of environmental effects from wind, solar, and hydroelectric power.

3. The uncertainty of the proliferation of weapons material from commercial reactors that generate electricity with plutonium fuels in Russia, Japan, and Europe.

To moderate the threats from proliferation, the U.S. has decided to dispose of its approximately 50 MT of excess weapons grade plutonium in one of three forms: in deep bore holes, contaminating it with fission products, and burning it up in reactors. The first option is an unattractive safeguard against proliferation, the second option recovers no energy, and the last option recovers a minor amount of energy as it passes once-through commercial reactors. The last two options comply with the spent fuel standard, i.e., they are as resistant to proliferation as the 1000 MT of spent fuel now scheduled for disposal at Yucca Mountain. But there are uncertainties with the spent fuel standard.

4. The uncertainty of safeguarding the plutonium after the fission products have decayed; the uncertainty of heat damage to Yucca Mountain during the first few hundred years; and the

SR-008

uncertainty from the radiotoxicity of plutonium and from the possibility of criticality events during the next 1,000,000 years at Yucca Mountain .

In contrast to the spent fuel standard, however, the SRS vitrified high level waste will be dangerous only during the time required for the decay of its fission products.

Mindful of the above facts, the options in the EIS overlook an environmentally better option. Before U-235 is used to produce electricity in the U.S., it is diluted with U-238, but U-238 exposed to U-235 creates plutonium. Thus, plutonium is a key ingredient of spent fuel. Even in the plutonium-disposition option three noted above, plutonium will be diluted with U-238 to create more plutonium as it burns up (NAS, p. 143n). Because of the uncertainties, DOE should include a fourth option.

5. The fourth option is to demonstrate the recovery and extraction of plutonium from excess weapons material and from spent mox fuel made from the excess weapons plutonium, to dilute it with non-fertile material instead of U-238 (e.g., Th-232 would generate fissile U-233; an aluminum or silicone mixture would not generate a fissile end-product), and to burn the plutonium in commercial reactors. The end result would be an environmentally safer standard for disposal at Yucca Mountain that could become known as the vitrified high-level waste standard. It would not only remove the threat of plutonium from the biosphere, but it would also reduce environmental threats (e.g., global warming, the mining of uranium, or the heat stresses at Yucca Mountain), recover the maximum amount of energy available from plutonium, and not generate new plutonium. 1/14.00.00

SR-008

14 00 00 Comment Number 1

Comment noted. Reprocessing is not an option, as stated in the President's Nonproliferation and Export Control Policy.

While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of Pu from that spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort. The PEIS evaluates disposition of surplus weapons Pu through MOX fuel but does not propose or further evaluate reprocessing of the spent fuel. The PEIS does not prejudice future decisions regarding the management or disposition of the spent fuel.

Specific Comments

1. Even if free, plutonium fuel relative to uranium fuel in a LWR is expensive (NAS, 1994, p. 24-5) and will require a subsidy (p. 164). Pu fuels are more economic for new advanced reactor concepts (for LMR's, see pp. 182, 186; for ALMR's, see p. 185). Fuel costs will be offset by the recovery of energy, utility repository subsidies, and the reduction of safeguard concerns (in WSRC, 1996).

2. A. Makhijani: "The United States is the only leading country that has wisely rejected the use of civilian plutonium because of its proliferation dangers and its high costs. It is therefore the only country that is in a position to exercise the leadership to persuade other countries to forgo civilian plutonium production, at least for the time being, and to put all separated plutonium into non-weapons-usable form." (Report, 1995, p. 15)

M. Lawrence: "Plutonium can be made into power reactor fuel and burned up in a reactor. Ample experience exists in the fabrication and use of mixed oxide fuels containing plutonium. While the economics of using mixed fuels are not considered favorable, at least by the U.S. and especially in the near term, several countries use or plan to recycle plutonium as a matter of strategic national policy." (Report, 1995, p. 31)

N. Egorov, Russia Federation on Atomic Energy: "I would say that we, in both countries, have paid too high a price sometime ago to generate and create that material and that is why we must choose the most efficient way of disposition of this material. That is why the general position of the Russian Federation in terms of plutonium disposition is that we should use, in the longer-term, that material as a component of the mixed oxide fuel for commercial power plants." (Report, 1995)

SR-008

Currently, seventeen European and two Japanese commercial reactors burn plutonium MOX fuels (NAS, 1994, p. 186). By the year 2000, more are planned for Europe, Japan, and Russia.

3. U-235/U-233 plus U-238 produces plutonium (NAS, 1994, p. 205). Non-fertile fuels do not contain U-238 (NAS, p. 156).

4. Plutonium stocks, from the burning of U-235/U-238 in commercial reactor fuels, are increasing at about 60-70 MT per year (NAS, 1994, p. 28).

5. Low quality weapons grade (WG) plutonium and reactor grade (RG) plutonium are both explosive (NAS, 1994, p. 32-33).

6. Plutonium is difficult to handle because it is radioactive and toxic (NAS, 1994, p. 68).

7. Americium content is higher in RG rather than WG plutonium (NAS, 1994, p. 121-2).

8. Spent fuel rods destined for the repository are contaminated with fission products and plutonium. This spent fuel standard is safe from proliferation for the first few hundred years, however, as the fission products decay, proliferation risks increase proportionately (NAS, 1994, p. 151; p. 191; the spent fuel standard is described on p. 143).

9. "Options for near-total elimination of plutonium may have a role to play in the longer-term effort to reduce the risks posed by global plutonium stocks." (NAS, 1994, p. 143)

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10. "Institutional issues in managing plutonium disposition may be more complex and difficult to resolve than the technical ones. The process must be carefully managed to provide adequate safeguards, security, transparency, and protection for environment, safety, and health; to obtain public and institutional approval, including licenses; and to allow adequate participation in the decision making by all affected parties, including the U.S. and Russian publics and the international community." (NAS, 1994, p. 144)

11. "...as long as civilian plutonium exists and continues to accumulate, options that went further than the spent fuel standard and sought to eliminate the excess weapons plutonium entirely would provide little additional security, unless the same were done with the much larger amount of civilian plutonium." (NAS, 1994, p. 148; p. 155)

12. U.S. policy under President Clinton: "On September 27, 1993, the Clinton administration announced a nonproliferation initiative that makes clear that, while the United States will not interfere with reprocessing in Japan and Europe, "the United States does not encourage the civil use of plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes."" (NAS, 1994, p. 149)

13. Greater than 100 years may be necessary to destroy existing plutonium stocks (NAS, 1996, p. 209-219). The Academy does not recommend plutonium fuels (NAS, p. 221), but does recommend additional research on their use (NAS, p. 222), including high plutonium loadings to reduce the production of plutonium (NAS, p. 211). The NRC's Separations Technology and Transmutation Systems (STATS) is studying the burning of all actinides (NAS, p. 210).

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14. The estimate by SRS to reprocess 40,000 MTHM of commercial spent fuel at SRS and dispose of the remains in a repository is about $8.6 billion versus $11.3 billion for dry disposal in the repository; the total costs for spent fuel, excess weapon materials, and spent Naval fuels is $15.5 billion to reprocess and dispose versus $28.8 billion to only dispose (WSRC, 1996). By comparison, T. Pigford estimates a cost of about $100 billion to reprocess 630 MTHM (telephone call, April 1, 1996; he figured $800-$2,000 per kg of heavy metal to reprocess, $1,200 per kg to fabricate, and $400 per kg to recover energy; see also the Academy "STATS" report). Including reprocessing and fabrication fuel costs, Eichholz (1985) estimated that u-235/plutonium fuels were competitive with coal and oil-fired utilities in 1981 (p. 627).

15. The age of the facilities at SRS, and the radioactive releases from them, have been raised as issues if spent fuels are to be reprocessed at SRS. The separations canyons at SRS are more than 40 years old, however, their equipment has been upgraded and is functional.

These issues regarding the canyons can be related to other man-made structures. The Eiffel Tower, the Douglas DC-3 aircraft, and the Empire State Building are all older than the SRS canyons. Technology is not necessarily dated by its age; the Titanic, which sunk on its maiden voyage, is a good example. When the Empire State Building opened in 1931, the life-span of the average American was around 47. In 1988, according to the U.S. Bureau of the Census, the average life-span of Americans had increased to about 75. During this period, at the rate of about 2 million visitors annually, 75 million visitors had toured the Empire State Building. If each visitor toured the Empire State Building within about one hour, because some tall concrete buildings are radioactive at about 5 µrads per hour (Eichholz, 1985, p. 108), the collective annual radioactive dose from the Empire State Building would be much greater than the dose to the population exposed to reprocessing releases from SRS.

SR-008

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SR-008

LEAGUE OF WOMEN VOTERS, COLUMBIA, SC, MARY T. KELLY
PAGE 1 OF 2

June 6, 1996

FROM: Mary T. Kelly, Natural Resources Specialist
League of Women Voters of South Carolina
4018 Sandwood Drive
Columbia, S.C. 29206
(803) 782-8410

TO: Department of Energy
Office of Fissile Materials Disposition
c/o SAIC-PEIS
P.O. Box 23786
Washington, D.C. 20026-3786

RE: Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement dated February 1996

The League of Women Voters of South Carolina appreciates the opportunity to comment on this EIS. As residents of the state that is home to the Savannah River Site we have a major stake in the outcome of the decisions you are trying to formulate. We also appreciate the extension of the time for commenting on this most important EIS and for the efforts that have been made to educate the public on the issues involved. However, we regret that important educational efforts such as the Plutonium Forum held in N. Augusta were not done in a more timely manner and did not stress rather than minimize - aside from bomb making potential - the dangers inherent in plutonium. To mention just one point, never once was the term criticality used or defined. 1/08.02.00

In general we endorse the recommendations of the National Academy of Science although with serious reservations about the use of MOX fuel and the openness to possible deep bore hole disposal. Deep bore holes at SRS should only be done, if at all, based on new geologic studies and attention to possible earthquakes. 2/08.03.01

LWVSC joins with the League of Women Voters of Hilton Head Island and Dr. David Jordan in pointing out the serious dangers of inhalation from plutonium oxide and the problems inherent in creating new wastes during the process of fuel manufacture. Reprocessing the spent fuel rods would magnify the waste burden. As you well know, water soluble reprocessing waste has been a major danger and source of contamination at both Hanford and at SRS. It is only beginning to be addressed through use of the Defense Waste Processing Facility at SRS. Total confidence in the operation of that facility has yet to be achieved. 3/09.11.08

M-264

08 02 00 **Comment Number 1**

Comment noted.

08 03 01 **Comment Number 2**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 11 08 **Comment Number 3**

The potential human health impacts from the proposed Pu storage and disposition alternatives are evaluated and presented in this PEIS for facility normal operation and anticipated accidents. The analysis considered all major potential exposure pathways including the inhalation of Pu oxide emitted from the facilities.

The manufacture or MOX fuel assemblies would create TRU and a minimal amount of mixed TRU wastes as described in Section 4.3.5.1.10. This waste would be treated and packaged in either a facility constructed with the MOX fuel fabrication plant or in an expanded central facility. The waste would be staged in storage facilities until it would be shipped to a Waste Isolation Pilot Plant (WIPP) for disposal, depending on whether DOE decides to operate the WIPP. While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of Pu from that spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort.

LEAGUE OF WOMEN VOTERS, COLUMBIA, SC,
MARY T. KELLY
PAGE 2 OF 2

We would like to stress the following points:

•The MOX fuel option - This was made to sound simple at the N. Augusta forum when in fact it is not. The down side of this needs to be clearly laid out for the public to understand. It should not be driven by utility or jobs pressure.. To quote Dr. Jordan's statement " ...burning MOX fuel looks like a pork-barrel program for electric utilities." As pointed out in the NAS report, with the passage of time, spent fuel rods cool radioactively and can be more safely handled by a future generation of rogue nations or terrorists bent on recovering plutonium. 4/06.00.08

•The Department of Energy should stop the hard sell in promoting programs on the basis of jobs creation, a potent weapon in getting the people and political structure of South Carolina to accept things that may not be in their or the nation's best interest. Your decisions should be based on hard scientific evaluations, in the overall interests of national security and the goal of non-proliferation.. It is particularly disturbing to read in THE STATE of June 6 that Secretary Grumbley himself told a group of South Carolina and Georgia lawmakers that if all the projected missions came to South Carolina, employment could grow to 19,000 by the year 20002. As you are well aware the Yucca Mountain site has run into major citizen opposition. It is highly likely that other states will have similar reservations about accepting proposed new missions. Sad to say, major, major decisions re our nuclear future are viewed by too many politicians and SRS workers and contractors as just one more form of economic development. 5/01.06.00

We wish you well as you wrestle with these necessary decisions which we agree, need to be made and implemented expeditiously. However, we hope that in so doing clean up and environmental remediation do not take a back seat. 6/11.00.06

M-264

06 00 08 **Comment Number 4**

Whereas it is true that the radioactivity does decay with time, the process is relatively slow, progressing with an approximately 30-yr half-life. If terrorists, or others could get access to the Pu in spent fuel, recovery of that Pu from spent fuel is a non-trivial challenge, even after the radiation field has decayed somewhat. Pu in spent fuel is not directly weapons-usable. To make it weapons-usable requires extracting the Pu from the spent fuel which is expensive and technologically complex. Once the surplus Pu is rendered to the Spent Fuel Standard it is no more attractive or useful than the Pu in already existing quantities of spent fuel.

01 06 00 **Comment Number 5**

The purpose of the Proposed Action is, in part, to establish the technical and program infrastructure that will enable the United States to take unilateral action or negotiate reciprocal actions with other nations for the disposition of surplus weapons-usable Pu. This PEIS addresses the environmental impacts of the reasonable alternatives for DOE's Proposed Action. Analyses of the cost, schedule, technical, and Nonproliferation Policy impacts are described in separate documents to support DOE's ROD. The documents related to technical, cost, and schedule analyses were made available for public review beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the analysis of the Nonproliferation Policy as it relates to the Proposed Action and alternatives.

11 00 06 **Comment Number 6**

Comment noted. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

LEAGUE OF WOMEN VOTERS, HILTON HEAD ISLAND, SC, PATRICIA TOUSIGNANT
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LEAGUE OF WOMEN VOTERS

HILTON HEAD ISLAND, S.C.

FROM: Patricia Tousignant, President
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Office of Fissile Materials Disposition
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P.O. Box 23786
Washington, D.C. 20026-3786

RE: Weapons-Grade Plutonium Disposal
Plutonium Disposition Educational Forum
April 25, 1996
North Augusta Community Center, SC

Attached is a statement and newspaper article prepared by Dr. David Jordan for the League of Women Voters of Hilton Head Island, SC on the Disposal of Weapons-Grade Plutonium. Dr. Jordan attended this Forum as our representative and prepared the following comments after studying the Fissile Materials Disposition Overview materials. The League of Women Voters submit this paper as our statement on this vital and sensitive issue. Dr. Jordan is a Chemistry Professor during the summer months at Potsdam College of the State of New York and resides the balance of the year in Hilton Head Island, South Carolina. His addresses and phone numbers are:

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SRS-CAB members
Sen. Holly Cork-SC
Sen. McKinley Washington-SC
Rep. Billy Keyserlinn-SC
Rep. Scott Richardson-SC
Rep. James Hodges-SC

Congressmen: Spence
Clyburn
Spratt
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Graham
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Union of Concerned Scientists
LWV-US
LWV-GA
LWV-SC
Elliott Close / Sr. Cons.

M-244

WEAPONS-GRADE PLUTONIUM DISPOSAL
Store it or Convert it to an Unattractive Hazardous Material through Using it as Fuel?

Government agencies and organizations such as the National Academy of Science have considered over thirty options for managing excess weapons-grade plutonium, arising from the dismantling of nuclear warheads. The Plutonium Disposition Educational Forum held in North Augusta on April 25 discussed two of these options.

Very pure metallic plutonium (Pu), containing a high percentage of the 239-isotope, for use in a bomb is a finely machined sphere roughly the size of a billiard ball. Some panelists emphasized the point that Pu-239 was not much of a health hazard, because it emits only alpha particles, which cannot penetrate far into tissue. Furthermore, the emission rate of these particles is slow, since particle emission by half of the plutonium atoms takes approximately 25,000 years. External contact with plutonium limits the radiation effects to the body surface.

However, health hazards become greater if the Pu metal is converted to its oxide, for the oxide can form dust particles, which may enter lung cavities. Plutonium oxide in the lungs increases ones risk for the development of lung cancer, because the emitted alpha particles will continually affect the closely surrounding tissue. The risk of a cancer is a function of the dose of plutonium inhaled.

Never mentioned at the forum is the fact that nitrate salts, which are produced during reprocessing of plutonium metal or the oxide, are water-soluble, so if by accident or storage tank corrosion these salts enter the public water supply, concentration of plutonium at other parts within the body is possible. At the end of 1994, the Savannah River Site was storing 126,300 cubic meters of highly radioactive solutions derived from reprocessing. Only in 1996 has treatment of these solutions begun. In 1960 the Savannah River site had a leak of 100 gallons of high-level radioactive waste into the ground water. The storage tanks at Hanford, Washington, a facility similar to the Savannah River Site have been leaking continuously since 1956, and have released over 750,000 gallons of liquid waste into the ground; it has been detected in test wells.

M-244

Reportedly there is a warehouse in Russia where twelve-thousand thermos bottles of Pu materials are stored; the contents of just three would be sufficient to make a bomb. The security supervision of this Pu is eroding. Sufficient Pu-239 to construct a bomb could be smuggled out hidden in a worker's clothing. Forum speakers conveyed a sense of urgency that international agreements for the strict control of plutonium materials should be arranged soon.

The Department of Energy has narrowed the disposal options to three: 1) usage as a fuel in nuclear reactors. 2) placement into deep dry boreholes or mines (geologic disposal), and 3) immobilization in glass or ceramic with secure storage. The latter two could be combined. Forum speakers generally voiced opinions consistent with what one would expect from the companies or agencies that they represented": otide reprocessors and nuclear power plant service employees favored the first option. There was wide agreement that there will be a large monetary cost for disposal of plutonium, no matter what the method.

The fuel option uses plutonium oxide mixed with uranium oxide (called a MOX fuel) in a nuclear reactor. Nuclear power plants now fission uranium oxide, and if properly modified, could fission MOX to generate electricity. Using plutonium oxide alone would be rather hazardous because it is more difficult to keep the fission process under control than it is with MOX or uranium oxide alone.

The majority of panelists supported the MOX fuel option and argued that in the foreseeable future there will be an insatiable need for energy, which nuclear fuel can partly supply, thus preserving petroleum for other purposes. The Russians, in fact, regard their plutonium stocks as a "National Treasure", and will not readily dispose of it. Storing weapons-grade plutonium in this country in a way which would make it easily retrievable would not seem to the Russians and others to be good-faith disposal, and the overriding concern is to quickly come to agreements to stop the proliferation. Very importantly, spent reactor fuel is so much more radioactive and hazardous than unspent fuel that only nations with highly sophisticated technology will be able to process it for further disposition, thereby eliminating the threat of its acquisition by rogue parties.

LEAGUE OF WOMEN VOTERS, HILTON HEAD ISLAND, SC, PATRICIA TOUSIGNANT
PAGE 4 OF 5

On the other hand, immobilization advocates argue that MOX fuel is cheaply available (as is solar energy) but expensive to utilize. A MOX industry will perpetuate the supply of Pu because it can be reprocessed, and it is the continued vulnerability to theft and wider dispersal of this supply that is the issue of greatest concern. There are few reactors in the US (more in Europe) that are presently suitable to burn MOX. Modification of existing reactors will require substantial capital investment.

Although immobilization of wastes is not yet a highly developed technology, glass is durable and environmentally acceptable and glass technology is well established. Geologic disposition is stalled partly due to political opposition and the tedious pace of federal governmental action. It seems that these methods could be available much earlier if an appropriate sense of urgency existed.
If immobilization ensures that highly-radioactive wastes are included in the glass encasements, nations, individuals or terrorist organizations lacking sophisticated technology would not be able to reprocess the materials without subjecting themselves to severe health effects. Immobilization preserves the material for future use, while minimizing the creation of new wastes. Even with the fuel option, not all of the potential fuel is of suitable quality for burning; a disposal program for this will be required anyway. Inventories of material, openly published and verifiable, would alleviate suspicions, permit careful monitoring and promote international agreements. 1/08.03.01

According to one speaker, "urgency is the name of the game" to prevent the dangers of a return to weapons production or the consequences of weapons-grade plutonium reaching the hands of terrorists.

It seems to this observer that although there are valid arguments for each of these possible methods of disposal, sustaining the plutonium cycle with the present technology by reprocessing and burning MOX fuel looks like a pork-barrel program for electric utilities, compounds the risks of nuclear proliferation, and certainly leads to even greater waste disposal and clean-up costs. To be able to urge other nations to place decreased reliance upon plutonium and to allay their suspicions regarding the United State's intended use of our plutonium, we must store it so that it is not readily recoverable, openly publish our inventory of stored nuclear wastes, and freely allow others to verify the disposition of these materials. 2/08.03.01

1/08.03.01 cont.

M-244

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the immobilization disposition technologies. Immobilization disposition would place the material in a form which is not readily recoverable, and would permit verification of the disposition of the materials.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Society is not presently managing these materials and wastes well. If in the not-too-distant future the nuclear energy in these stored materials becomes essential for society, the waste-treatment technology and security procedures may have improved and be comparable with those of a still-evolving reactor technology. In twenty-five thousand years, the plutonium will still have half of the energy value that it has now.

A thorough discussion of this issue may be found in the 1994 report of the National Academy of Sciences: *Management and Disposition of Excess Weapons*.

David Jordan

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LEVENTHAL, PAUL, ET AL.
PAGE 1 OF 7

June 7, 1996

Mr. Greg Rudy
Acting Director
Office of Fissile Materials Disposition
U.S. Department of Energy
1000 Independence Ave. SW
Washington, DC 20585

Dear Mr. Rudy:

We are writing to provide our comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement ("DPEIS"). Despite the substantial effort that went into preparation of the draft analysis, there are a number of important issues that were given inadequate attention or no attention at all. These defects, as discussed below, must be corrected if the final PEIS is to meet the requirements of the National Environmental Policy Act and the Department of Energy's (DOE) implementing regulations (10 C.F.R. 1021).

Nonproliferation and Cost Analyses Must Be Included in the DPEIS and Integrated Into the NEPA Decision-Making Process

DOE is still preparing a cost analysis and a non-proliferation analysis of disposition options. At the April 18 public hearing on the DPEIS, you stated that those analyses eventually would be made available to the public when completed, but not prior to the end of the comment period, then scheduled for May 7. (At the urging of several public-interest groups, including some of those signing this letter, the comment period was extended to June 7, but not to 45 days after the cost and nonproliferation analyses are made publicly available, as requested.)

DOE claims that these analyses are not required for inclusion in the PEIS, which focuses on environmental issues. This is an inappropriately narrow view of the scope of programmatic environmental impact statements. As spelled out in the letter to Secretary O'Leary of April 5 requesting the delay, previous EIS's have included detailed nonproliferation analyses, even making non-proliferation a primary decision criterion. Cost analyses have been included as decision factors in a number of EISs, as well. The plutonium disposition DPEIS explicitly cites "non-proliferation," "security," and "cost-effectiveness" as among the screening criteria used in the disposition PEIS process to rule out certain disposition alternatives. Certainly the cost and non-proliferation analyses used to support these decisions must be incorporated into the PEIS itself. 1/08.00.00

It is our position, therefore, that the public comment period should remain open until 45 days after all relevant support documents, including the cost and non-proliferation analyses, are made publicly available. Therefore, these analyses, together with public 2/08.02.00

M-289

08 00 00 Comment Number 1

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the Fall of 1996. Each of these analyses along with the environmental analysis and public input will be integrated into DOE's decisionmaking process.

08 02 00 Comment Number 2

At the request of several organizations and individuals, the public comment period for the PEIS was extended to a total of 92 days. The technical, cost, and schedule analyses were made available to the public for review beginning in July 1996. The nonproliferation analysis was made available to the public for review beginning in October 1996. These analyses, along with consideration of public comments on these analyses and the Final PEIS are fully integrated in DOE's decisionmaking process.

comments on them, must be fully integrated in the Department's decision-making process under NEPA. | 2/08.02.00 cont.

Issues That Must Be Included in the Nonproliferation Analysis

The National Academy of Sciences' (NAS) 1994 study[1] of weapons-plutonium disposition proposed three proliferation risk factors for use in comparing plutonium-disposition options: risk of theft, risk of reversal, and impact on arms reduction. These are important criteria that should guide DOE's analysis, but the DPEIS does not specifically address them. These risks must be fully evaluated in the non-proliferation analysis and be made part of the DPEIS. | 3/01.06.00

Analysis of the risk of theft and diversion must include a thorough examination of difficulties encountered with plutonium accountancy at mixed-oxide (MOX) fuel fabrication plants. In particular, the 70-kilogram plutonium discrepancy at the Plutonium Fuel Production Facility (PFPF) in Japan is now the subject of an extensive clean-out inspection by the International Atomic Energy Agency (IAEA). The discrepancy results from excessive hold-up of plutonium in the process line of this purportedly a state-of-the-art MOX fuel fabrication facility, and raises serious questions as to whether MOX disposition options can be adequately safeguarded. Nor does the lack of knowledge by the IAEA of the results of in-process materials accounting at MOX fabrication plants within Euratom provide any basis for assuming that these plants are subject to effective safeguards either. | 4/01.06.00

Analysis of the risk of reversal must address the comparative difficulty of retrieving plutonium from final waste forms. Appendix H of the DPEIS, "High-Level Waste Forms Comparative Analysis," fails to examine these issues. A detailed comparative analysis of plutonium retrievability from spent MOX fuel and immobilized glass and ceramic waste forms must be included along with the factors already addressed, such as regulatory issues, criticality, thermal load, radiation, and releases. | 5/01.06.00

Analysis of risks to arms control and nonproliferation must include a thorough assessment of the international repercussions of a U.S. decision on disposition technology. The DPEIS implicitly acknowledges the importance of what the NAS study called the "fuel cycle policy signal" when it posits that one of the goals of the disposition process is "to strengthen national and international arms control efforts by providing a storage and disposition model for the international community." But the DPEIS does not explicitly consider the fuel cycle policy signal that the MOX option would send relative to alternative immobilization options. | 6/01.06.00

[1] Committee on International Security and Arms Control, National Academy of Sciences, Management and Disposition of Excess Weapons Plutonium, 1994.

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01 06 00 Comment Number 3

The purpose of the Proposed Action is, in part, to establish the technical and program infrastructure that will enable the United States to take unilateral action or negotiate reciprocal actions with other nations for the disposition of surplus weapons-usable Pu. This PEIS addresses the environmental impacts of the reasonable alternatives for DOE's Proposed Action. Analyses of the cost, schedule, technical, and nonproliferation policy impacts are described in separate documents and will be considered in DOE's decision. The documents related to technical, cost, and schedule analyses were made available for public review beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the analysis of the nonproliferation analyses, *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Materials Storage and Plutonium Disposition Alternatives*, as it relates to the Proposed Action and alternatives.

The analysis of the nonproliferation impacts examines, among other things, the risk of theft, risk of reversal, and arms reduction impacts for the various Reactor Alternatives using MOX fuel and Immobilization Alternatives.

01 06 00 Comment Number 4

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations (including the nonproliferation analyses), and public input. The nonproliferation analyses, *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Materials Storage and Plutonium Disposition Alternatives*, examines the potential diversion risk using MOX fuel fabrication, safeguards, "hold-up" material, and accountability to the IAEA and international community, among other things. These nonproliferation analyses have been made available for public comment and will be considered in the decisionmaking process.

01 06 00 Comment Number 5

One of the goals of materials disposition is to make the Pu as inaccessible and unattractive for weapons use as the residual Pu contained in commercial

In its September 27, 1993 non-proliferation policy statement, the Clinton administration declared that "the United States does not encourage the civil use of plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes." The possibility that the MOX option would have an adverse affect on U.S. non-proliferation policy by stimulating the use of MOX in civil nuclear power programs and thereby encouraging plutonium reprocessing and recycling must be addressed in the DPEIS's analysis. 7/01.06.00

Cost Analysis Must Include Subsidies to Nuclear Utilities and Be Integrated into the NEPA[1] Decision-Making Process

Like the non-proliferation analysis, the cost analysis of plutonium disposition options now being prepared by Oak Ridge National Laboratory must be integrated into the NEPA decision-making process. That analysis must include all costs of the various disposition options, including subsidies being demanded by nuclear electrical utilities that have expressed interest in using weapons-plutonium MOX fuel. Given recent regulatory changes and the severe diseconomics of nuclear electricity generated at some facilities, these utilities face strong competition from non-nuclear electrical generators. An industry technical analysis fully anticipates that some utilities will insist upon not simply compensation for direct costs related to warhead plutonium disposition in their reactors, but subsidization of the electricity these reactors produce to guarantee that it is economically competitive with electricity from alternative non-nuclear sources, a subsidy that could cost U.S. taxpayers billions of dollars over the life of the plutonium-disposition program.[2]. These costs must be carefully calculated in advance, so that they can be taken into account in the decision on disposition alternatives. 1/08.00.00 cont.

Pyroprocessing Immobilization Alternative Must Be Fairly Assessed

The DPEIS (Section 2.4.3.3) posits "electrometallurgical treatment" as one of the immobilization options. This technology, also known as "pyroprocessing," was developed by Argonne National Laboratory as part of the Integral Fast Reactor (IFR) Program, which DOE has since cancelled, largely on non-proliferation grounds.

Because it involves reprocessing technology, pyroprocessing poses a proliferation risk and undercuts U.S. non-proliferation policy aimed at discouraging reprocessing. Nor is it a sensible technical alternative; both a recent National Academy of Sciences study and an 8/01.04.00

[2] One study calculates that such a subsidy may run as high as six cents per kilowatt-hour, depending upon the utility and plants, equivalent to billions of dollars. GE Nuclear Energy, Study of Plutonium Disposition Using Existing GE Advanced Boiling Water Reactors, NEDO-32361, Prepared for the U.S. Department of Energy, June 1, 1994, p. 1.2-4.

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nuclear spent fuel (that is, the Spent Fuel Standard). The Pu contained in spent MOX fuel or in an immobilized glass or ceramic form is deemed to meet the Spent Fuel Standard. The proliferation resistance of the final MOX spent fuel and immobilized forms is compared for the various alternatives and variations in DOE's nonproliferation study, *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives*, which was made available for public review in October 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the analysis of the Nonproliferation Policy as it relates to the Proposed Action and alternatives. The proliferation analysis, along with the PEIS, public comments, cost, schedule, and technical analyses will be part of the decisionmaking process to support the ROD.

01 06 00 Comment Number 6

Converting surplus Pu into MOX fuel is not the end state. The end state is to use the MOX fuel in a reactor so that it meets the Spent Fuel Standard for proliferation resistance after irradiation. While the Pu is in the MOX fuel form, it would be subject to high standards of safeguard and security.

While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of Pu from that spent fuel is not being proposed by DOE and is beyond the scope of the fundamental nonproliferation purpose of the disposition effort. The fact that the PEIS evaluates disposition of surplus weapons Pu through use in MOX fuel, but does not further propose or evaluate reprocessing of the spent fuel, does not suggest or propose reprocessing for the management or disposition of the spent fuel.

The President's Nonproliferation Policy does not prohibit the use of MOX fuel, but rather restricts the separation of Pu for civilian use. Fabricating MOX fuel from surplus weapons-usable Pu and using that fuel in a once-through fuel cycle would meet the Purpose and Need of the PEIS for Pu disposition and would not violate the President's policy.

internal DOE report[3] reject it as a viable weapons-plutonium disposition alternative. DOE has ignored these considerations in its analysis. They must be included in the Final PEIS analysis, which, accordingly, must reject electrometallurgical treatment as an option for plutonium disposition. 8/01.04.00 cont.

Safety and Health Impacts of Disposition Options Must Be Consistently and Accurately Assessed

A major objective of the DPEIS should be to present a thorough evaluation of the occupational and public health risks of different weapons-plutonium disposition options. Disposition options then should be ranked according to the risks they pose, and this ranking should play an important role in the eventual choice of disposition option.

The DPEIS, however, fails to accomplish this objective. Its methodology for evaluating and comparing the safety risks of different disposition options is logically inconsistent and confusing. These inconsistencies serve to exaggerate the risks of the immobilization options relative to the reactor-based options. They must be corrected in the final version to provide a fair presentation of the evaluation and ranking of the safety risks of immobilization and reactor-based disposition options. 9/09.09.08

Such a presentation would show that the health and safety impacts of the immobilization options will be substantially lower than those associated with the reactor options. However, the DPEIS is structured to minimize the significance of this fact.

What follows is a partial listing of the deficiencies we have identified:

- The DPEIS overestimates the safety and health impacts of the immobilization options by explicitly including only the absolute impacts of options requiring new facilities, and not the incremental impacts associated with existing facility process variants, such as can-in-canister at the Defense Waste Processing Facility (DWPF). On the other hand, the DPEIS does explicitly evaluate the incremental impacts of the existing Light Water Reactor (LWR) MOX option with respect to normal (as distinguished from accidental) emissions. This leads to an inconsistent comparison of the two options. 10/09.09.08

- The accident analysis of the LWR option is based entirely on an irrelevant case, an evolutionary LWR fueled with low-enriched uranium, which does not account for the numerous unresolved safety issues associated with the use of full-core, weapons-grade 11/09.09.08

[3] "Comments on the Electrometallurgical Process," attachment to letter to Bill Danker, MD-1, from Leonard Gray, Task Leader, Fissile Materials Immobilization Task [sic], Fissile Materials Disposition Project, August 30, 1995; Gregory R. Choppin, et al., An Evaluation of the Electrometallurgical Approach for Treatment of Excess Weapons Plutonium, National Research Council, 1996.

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01 06 00 Comment Number 7

The President's Nonproliferation Policy says the United States will not recycle Pu. Burning weapons-usable Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel.

01 04 00 Comment Number 8

The Department of Energy acknowledges the commentor's opposition to the Electrometallurgical Treatment Alternative. Information and assessments on Electrometallurgical Treatment will be taken into account in the decision process. Separate technical, schedule, and cost analyses on the disposition options, including the Electrometallurgical Treatment Alternative, were issued by DOE beginning in late July 1996; the nonproliferation analysis of the disposition options, including electrometallurgical treatment, was issued for public comment in October 1996. The Electrometallurgical Treatment Alternative is analyzed in the PEIS because it is a "reasonable" alternative, and as such, must be analyzed under NEPA. Section 2.4.4.3 of the PEIS has been revised to note the NAS concerns regarding the use of electrometallurgical treatment for Pu disposition. Further, Electrometallurgical Treatment Alternative is not included in the Preferred Alternative.

09 09 08 Comment Number 9

Potential human health impacts from Proposed Actions are analyzed and documented in this PEIS as required by NEPA. To inform the public and decisionmakers, all latent cancer risks associated with the alternatives are presented in the PEIS regardless of their risk magnitude. The ranking or decisionmaking analysis of the alternatives will be based on various factors including human health impacts. DOE's intent in the PEIS is to provide an unbiased environmental analysis of all alternatives. However, the Reactor Alternatives generally do have more available information than other disposition alternatives because of industry experience.

MOX fuel in existing LWRs or CANDUs. As a result, the important issue of how accident impacts may increase if MOX is substituted for LEU in existing reactors is not addressed. This is a crucial point because the *incremental* accident risks resulting from this substitution may actually exceed the *absolute* risks of an evolutionary LWR accident as cited in the DPEIS. | 11/09.09.08 cont.

• A DPEIS reference document[4] lists LWR accidents with higher frequency *and* greater consequences than the most severe LWR accident sequence evaluated in the DPEIS; | 12/09.09.08

• The geographical range of the safety analysis is unjustifiably limited: the choice of an 80-km threshold for consideration of public health impacts leads to absurd conclusions, such as the notion that an accident in a Canadian CANDU reactor would have no environmental impact in the US; | 13/09.09.08

• The absence of discussion of economic and other external factors severely impairs the credibility of the safety analysis, especially as it applies to the MOX option. | 14/09.09.08

Transportation Safety and Security Issues Must Be Addressed

The DPEIS does not discuss the security arrangements for sea shipments of plutonium or MOX reactor fuel, which would be necessary if warhead-plutonium MOX fuel were fabricated in Europe. These arrangements may be included in the classified appendix on transportation.[5] If so, some aspects of these arrangements should be made a part of the public record and subject to independent evaluation. Further, there is no discussion of transportation security arrangements with the government of Canada if CANDU reactors were used. These matters require clarification. The DPEIS needs to state publicly what level of security will be required for shipments of plutonium and MOX. This can be done without providing explicit details regarding armament, routing and scheduling that might prove useful to a potential adversary. | 15/10.00.00

Appendix G compares transportation impacts for the different disposition alternatives. The analysis understates the environmental hazards of transporting radioactive material by embracing the Type B transport standards and assigning a low probability to an accident that could result in a breach of the Type B cask. The appendix ignores recent | 16/10.02.00

[4] Fissile Material Disposition Project, Lawrence Livermore National Laboratory, Evolutionary/Advanced Light Water Reactor Data Report, UCRL-ID-123411, February 9, 1996, Table 8-5, p. 8-14.

[5] This classified appendix is mentioned on page 4-783 of the DPEIS, but a citation is not given and no further information is provided.

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09 09 08 Comment Number 10

The human health impacts for both the existing condition (No Action) and the Proposed Actions are evaluated and presented for all Proposed Alternatives in the PEIS, including the Existing LWR Alternative (The health impacts from potential accidents for the three Reactor Alternatives using MOX fuel are also analyzed.) The incremental impacts are those impacts from Proposed Actions over existing conditions at the same site. For example, the incremental impacts of using the partially completed LWR would be represented by the total impacts because the LWR was not operated before. Whereas, the incremental impacts of using the existing LWRs would be represented by the differences between using the proposed MOX fuel and the current uranium dioxide (UO_2) fuel. Section 4.3.5.2.9 of the Final PEIS has been modified to show the incremental and total impacts.

Appendix O was added to the Final PEIS to provide a description of the immobilization variants utilizing the can-in-canister approach at SRS. The DWPF (an existing facility) is included in this description. The preferred alternative in the Final PEIS includes the immobilization alternative in new or modified existing facilities. Further tiered NEPA analysis will be provided, as appropriate, for the alternatives selected in the ROD. Table 2.4–1 of the PEIS also included possible variants, many of which utilize existing facilities.

09 09 08 Comment Number 11

The human health impacts for both the existing condition (No Action) and the Proposed Action are evaluated and presented for all alternatives in the PEIS, including the Existing LWR Alternative. (The health impacts from potential accidents for all three Reactor Alternatives using MOX fuels are presented in the Final PEIS.) Incremental impacts are those impacts from the Proposed Actions over the existing conditions at the same site. For normal operations, both incremental impacts and total impacts are presented in the PEIS for each disposition alternative. While incremental impacts may appear lower for existing alternatives, the total impacts do not cause misleading impressions. Also, an inclusion of potential avoided environmental impacts from a Proposed Action is appropriate to the NEPA process. The avoided environmental impacts are presented when the potential environmental

expert reports that challenge the adequacy of the Type B standards,[6] as well as ongoing initiatives within the IAEA and the International Maritime Organization (IMO) to re-evaluate these standards in the context of historical data about accident conditions. Instead, the DPEIS relies on earlier reports to assert the adequacy of Type B containers. The DPEIS' analysis is cursory and outdated, and must be revised to take into account the most recent studies and the ongoing IAEA and IMO re-evaluations of these casks.

16/10.02.00 cont.

We believe that all of the above issues must be thoroughly addressed for the PEIS to conform with NEPA requirements and provide an adequate basis for the Secretary's decision on long-term disposition of weapons-usable fissile materials.

If you would like further detail on the above points, please contact Steven Dolley of the Nuclear Control Institute at 202-822-8444.

Sincerely,

Paul Leventhal
Nuclear Control Institute

Christopher Paine
Natural Resources Defense Council

Daryl Kimball
Physicians for Social Responsibility

Jennifer Weeks
Union of Concerned Scientists

[6] Illinois Institute of Technology Research Institute (IITRI), "Definition of Bounding Physical Tests Representative of Transport Accidents—Air and Marine," IITRI KO6019, November 1983; ECO Engineering, Inc., Annapolis, MD., "A Review of the Proposed Marine Transportation of Reprocessed Plutonium from Europe to Japan," March 1992; Edwin S. Lyman, Princeton University School of Engineering/Applied Sciences, "Safety Issues in the Sea Transport of Vitrified High-Level Radioactive Wastes to Japan," December 1994.

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impacts from the Proposed Action are less than the impacts from the existing condition.

09 09 08 Comment Number 12

The accident impacts for existing and partially completed LWRs were taken from existing documents for a set of representative facilities. Accident impacts presented in the PEIS were the average impacts of the representative facilities. However, the Final PEIS includes quantitative health risk analyses for the evolutionary, existing, and partially completed LWRs using MOX fuel for both normal operations and potential accidents.

09 09 08 Comment Number 13

Like any other EIS, a realistic impact area has to be defined to conduct radiological impact assessment. Federal guidance defines two major impact regions. NUREG-0654 defines 16 km (10 mi) as the plume exposure region and 80 km (50 mi) as the ingestion exposure region for the nuclear facility accident emergency planning zone. While populations at greater distances may receive some exposure from an accidental release of radioactive material into the environment, this exposure would be considerably less than the exposure to the population within the 80 km (50 mi) region. Also, extending the assessment to further distances would introduce greater analytical uncertainties to the calculated impacts.

It is acknowledged that if the source term was very large then the boundaries chosen could be extended. Nevertheless, NUREG guidance is an appropriate and reasonable choice for NEPA analysis.

09 09 08 Comment Number 14

Technical, cost, and schedule analyses were made available to the public beginning in July 1996. The nonproliferation analysis was made available to the public in beginning in October 1996. Input from each of these analyses will be integrated in the DOE's decisionmaking process.

Tom Clements
Greenpeace International

Fred Miller
Nuclear Waste
Citizens Coalition

Bill Magavern
Public Citizen

Kathryn Crandall
Women Strike for Peace

Michael Mariotte
Nuclear Information Resource
Service

cc: Dave Nulton

M-289

10 00 00 Comment Number 15

The PEIS analysis assumes that transport of Pu by ship would be done by dedicated British Nuclear Fuel, Limited, or COGEMA ships from military seaports in the United States to seaports in Great Britain or France. The transport would meet applicable IAEA requirements and the International Maritime Organization (IMO) code. While in temporary storage at the seaports and during transport on the ship, appropriate escort security measures would be implemented. Section G.1.2.5 provides a description of the transportation effects on the global commons and includes the results of an environmental assessment of the sea shipment of Pu, *Environmental Assessment of the Import of Russian Plutonium-238*, referenced in the PEIS as DOE 1993x. Technical and licensing issues related to the MOX fuel fabrication have been considered by DOE in the technical evaluations of the storage and disposition alternatives, which were issued in late July 1996. It is anticipated that MOX fuel fabricated in Europe would not be used in a reactor in Canada.

10 02 00 Comment Number 16

Type B packagings are currently certified safe for transporting radioactive materials. The comments were given consideration for the PEIS, but the analysis used is for currently certified packagings. If the safety certification for the packaging is withdrawn, then new analyses would be required.

LEWIS, MARVIN, PHILADELPHIA, PA
PAGE 1 OF 1

Date Received: 06/12/96
Comment ID: P0051
Name: Marvin Lewis
Address: 3133 Fairfield Street
Philadelphia, Pennsylvania 19136

Transcription:

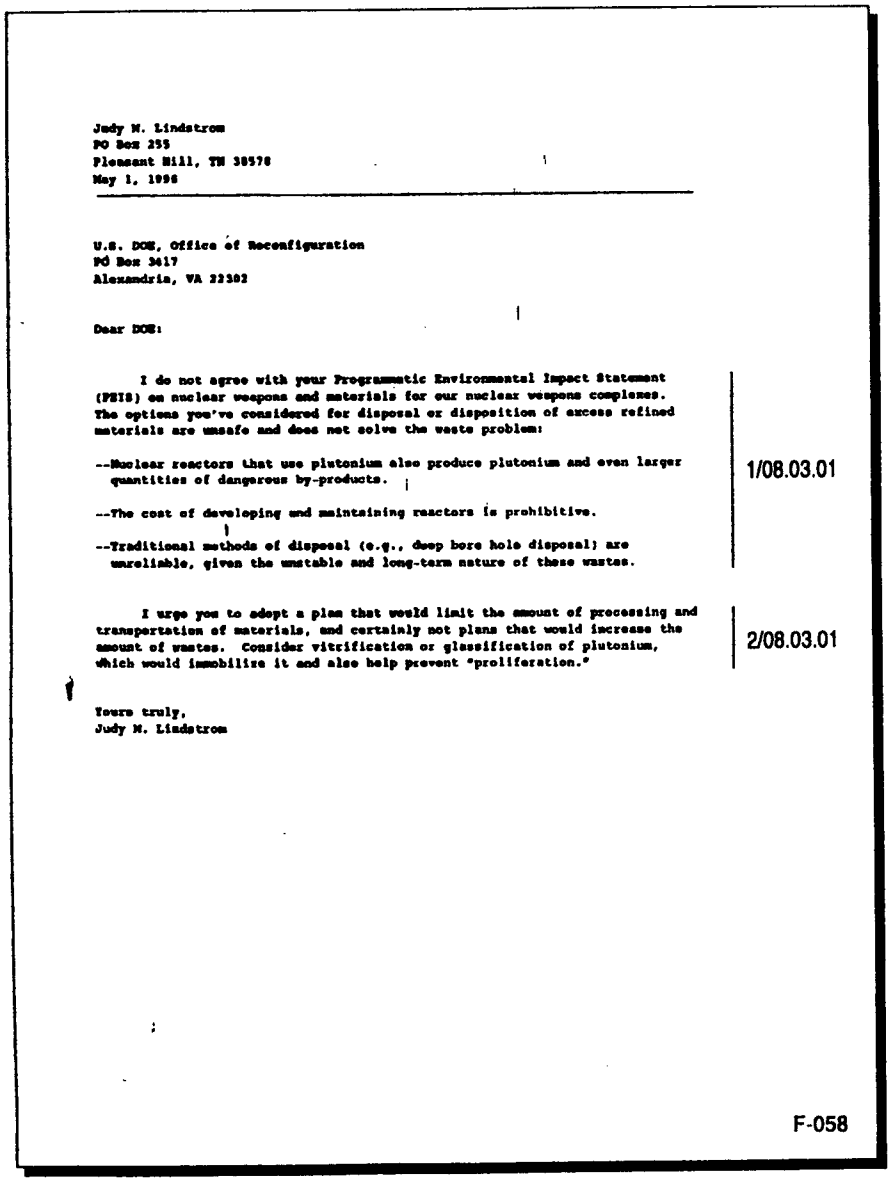
My name is Marvin (M-a-r-v-i-n) Lewis (L-e-w-i-s), 3133 Fairfield Street, Philadelphia, PA 19136 Area Code (215)676-1291. I appreciate that the comment line is still open. I hope that there has been an extension for comments on the supremely dangerous and very problematical programmatic PEIS. But to go on with my comments, yes, there is plutonium produced in commercial nuclear reactors. However, to start with MOX, mixed oxide fuel, is a matter of danger, great danger. This was gone over back in the -- when it was first proposed commercially, many years ago in GESMO, General Environmental Statement on Mixed Oxide Fuel. The very comments I made in GESMO and all the comments in GESMO should be incorporated as a minimum, into this PEIS. Many, many issues were raised that have been lost from memory both institutional and personal. And I've also lost a lot of the paperwork which is almost impossible to find -- except in the NRC Reading Room. This is a dangerous, impossible suggestion that we go to mixed oxide fuel. Many reactors are in areas of high population. Any, any plutonium releases would be disastrous. I really ask that whomever thought this one up, rethink it and stop it. Respectfully submitted, Marvin Lewis. 1/08.03.01

P-051

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

LINDSTROM, JUDY M., PLEASANT HILL, TN
PAGE 1 OF 1



Judy M. Lindstrom
PO Box 255
Pleasant Hill, TN 38578
May 1, 1996

U.S. DOE, Office of Reconfiguration
PO Box 3617
Alexandria, VA 22302

Dear DOE:

I do not agree with your Programmatic Environmental Impact Statement (PEIS) on nuclear weapons and materials for our nuclear weapons complexes. The options you've considered for disposal or disposition of excess refined materials are unsafe and does not solve the waste problem:

--Nuclear reactors that use plutonium also produce plutonium and even larger quantities of dangerous by-products. 1/08.03.01

--The cost of developing and maintaining reactors is prohibitive.

--Traditional methods of disposal (e.g., deep bore hole disposal) are unreliable, given the unstable and long-term nature of these wastes.

I urge you to adopt a plan that would limit the amount of processing and transportation of materials, and certainly not plans that would increase the amount of wastes. Consider vitrification or glassification of plutonium, which would immobilize it and also help prevent "proliferation." 2/08.03.01

Yours truly,
Judy M. Lindstrom

F-058

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Date Received: 04/03/96
Comment ID: P0002
Name: Valerine Litt
Address: Oak Ridge, Tennessee

Transcription:

My name is Valerine Litt. I want that stuff at Oak Ridge out of there. I read an article that the cancer rate within a 100 mile radius was higher than any other place in the nation. I have lost six members of my family to cancer in the last 20 years. I now have one brother that has been free of throat cancer for five years after two major surgeries and 32 radiation treatments. I myself had cancer of the uterus 20 years ago. Why not put it somewhere else? I went to Oak Ridge when I was fifteen years old when you had to go through a gate where there was guards where this radiation stuff and the war material and all of that there. We have had it long enough in this area. Get it out. Now.

1/08.03.01

P-002

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at ORR. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

LOCKE, JOHN W. AND JOYCE C., AMARILLO, TX
PAGE 1 OF 1

6202 Yale
Amarillo, Texas 79109-6727
April 27, 1996

Department of Energy
1000 Ihdependence Avenue, S. W.
Washington, D. C. 20585

Re: Pantex - No Plutonium

Dear Ms. O'Leary:

We are against the long-term storage and disposition of plutonium and highly enriched uranium at the Pantex Plant located at Amarillo, Texas.

We feel the storage of radioactive material at Pantex endangers the Oglalala Aquifer which is the "blood" that nourishes our nations's farm land. 1/08.03.01

I was exposed to rhdioactive material in Operation Crossroads (Bikini, 1946) and have since learned that NO amount of radiation is safe.

Please do not make Pantex a nuclear long-term storage facility.

Sincerely,

John W. Locke

Joyce C. Locke

M-201

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Waste/hazardous material treatment/handling operations are regulated to minimize the potential for releases of hazardous substances to the soil or surface water that could then migrate to the groundwater. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

LOS ALAMOS NATIONAL LABORATORY, LOS ALAMOS, NM,
KEN BOWER
PAGE 1 OF 1

Forwarded message:
> From httpd Thu Nov 16 14:16:51 1995
> Date: Thu, 16 Nov 1995 14:16:50 -0500
> From: HTTPD Daemon <httpd>
> Message-Id: <199511161916.AA00853@fedix.fie.com>
> Reply-To: doemd1
> Subject: COMMENT Form - incoming
> Apparently-To: doemd1-demo@fedix.fie.com
>
> ** To be properly posted to the correct forum area the
> ** reply to this message MUST be mailed to >> doemd1@fedix.fie.com << !
>
> **
> ** This message was generated by the submission of a From Comment
> ** on the Fissile Materials Electronic BBS. Reply to this message
> ** with the text of this message included in the reply. All "Replied"
> ** are publicly available on the Electronic BBS
>
> ** This is information generated at the time of submission and is
> ** used to track individual comments. It should not be changed!
> #To = doemd1-demo@fedix.fie.com
> #serial_no = 131
> #MailTitle = COMMENT Form - incoming
>
> ** The following information is DATA from the comment form. The
> ** "ctype" is the Author's Request for a Public or Private comment.
> ** If you do not want this message to be publicly posted to the BBS
> ** do nothing or reply to the author directly.
> #name = Ken Bower
> #title = Staff Member
> #company = Los Alamos National Laboratory
> #addr1 = A117
> #addr2 =
> #city = Los Alamos
> #state = New Mexico
> #zip = 87545
> #phone = 505-665-2578
> #fax = 505-665-4411
> #email = kebower@lanl.gov
> #subject = internet access to PEIS
>
> ** The following is the text of the Author's Comment.
> #BEGIN comment =
> Making the PEIS available on-line is extraordinarily valuable. Thank you.
> #END comment

1/08.02.00

E-001

08 02 00 **Comment Number 1**

Comment noted.

LOSEY, DAVID C., AIKEN, SC
PAGE 1 OF 1

David C. Losey
1628 Citation Drive
Aiken, South Carolina 29803-8224

May 7, 1996

Mr. J. David Nulton, Director
DOE - Office of Fissile Materials Disposition
c/o SAIC - PEIS
P. O. Box 23786
Washington, DC 20026-3786

Dear Mr. Nulton:

I'd like to offer these comments on the EIS for *Storage and Disposition of Weapons-Usable Fissile Materials*.

The spent fuel standard provides a fundamental basis for much of the proposed action in the EIS. This basis may be flawed without a disposition path for the spent fuel. We shouldn't assume that at some future time we'll merely bury the spent fuel. There is a growing awareness that burying wastes in the earth is a poor option.

Relying on the spent fuel standard needs to be preceded by DOE taking responsibility for closing the spent fuel cycle. It is important to have the disposition path opened before converting the excess weapons plutonium to spend fuel. The benefits gained by making the plutonium unattractive through activation could be grossly outweighed later by difficultly in handling the material. 1/01.02.00

Please consider having the entire plutonium disposition plan in place before activating or mixing the plutonium with radioactive contamination.

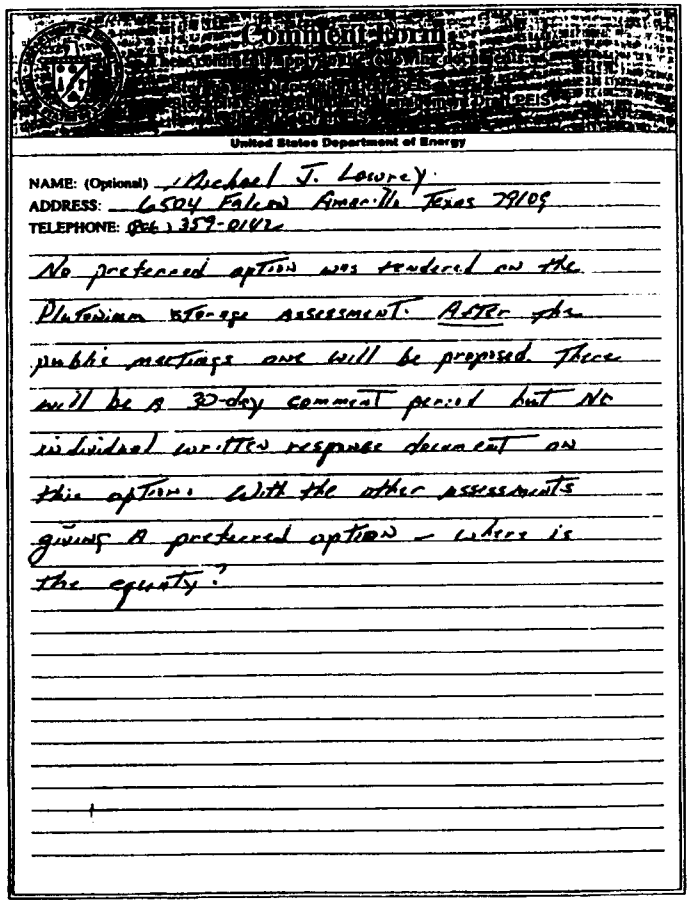
Thank you for the opportunity to comment on this program.

Sincerely,
David C Losey
David Losey

M-190

01 02 00 **Comment Number 1**

The ultimate disposition path, an NWPA geologic repository, for the spent fuel would be the same as any spent fuel from nuclear reactors in the United States. Design of the MOX fuel containing weapons-usable Pu is done such that the spent fuel would meet the performance criteria for disposal in an NWPA geologic repository.


Comment Form
United States Department of Energy

NAME: (Optional) Michael J. Lowrey
ADDRESS: 6504 Falcon Amarillo Texas 79109
TELEPHONE: (806) 359-0142

No preferred option was tendered on the Plutonium Disposition Assessment. After the public meetings one will be proposed. There will be a 30-day comment period but No individual written response document on this options. With the other assessments giving A preferred option - where is the equity?

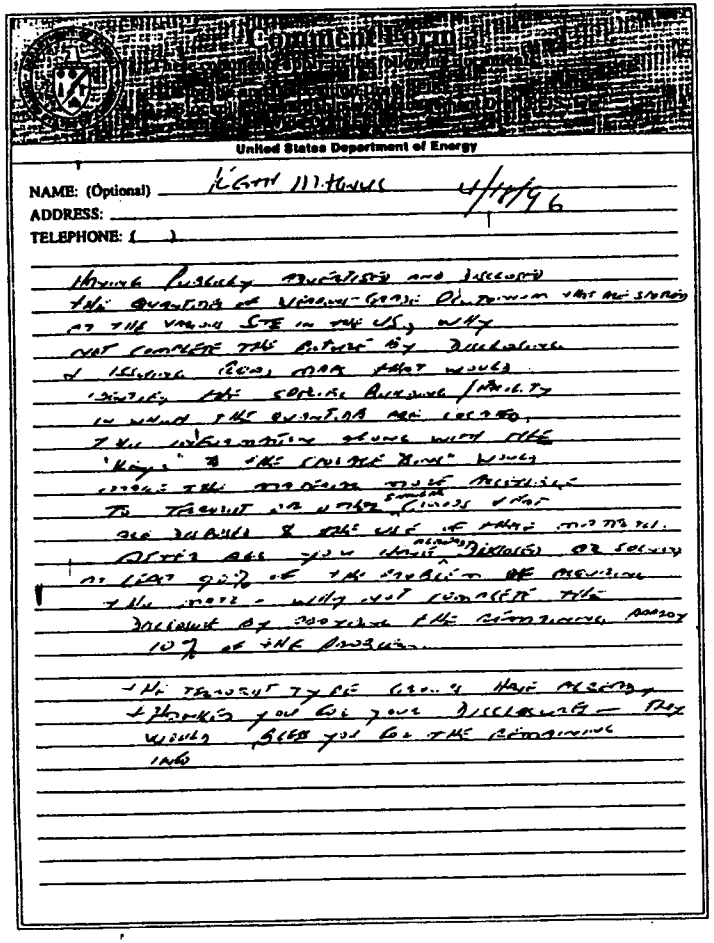
1/08.00.00

TX-052

08 00 00 **Comment Number 1**

A Preferred Alternative was not identified in the Draft PEIS for two reasons. First, DOE wanted to obtain public input on the alternatives before identifying a Preferred Alternative. Second, DOE wanted to develop additional information on technical, cost, schedule, and policy consideration independent of the NEPA analyses. The results of the technical, cost, and schedule analyses were issued by DOE in July 1996 and the results of the nonproliferation study were issued in October 1996. This information will be used in determining the ROD.

MAGNUS, KEITH, WASHINGTON, DC
PAGE 1 OF 1


Comment Form

United States Department of Energy

NAME: (Optional) Keith Magnus 4/18/96
ADDRESS:
TELEPHONE: ( )

Having publicly advertised and disclosed the quantities of weapons-grade plutonium that are stored at the various STE in the US, why not complete the picture by disclosing & issuing road maps that would identify the specific building/facility in which the quantities are located. The information along with the "keys" to the storage "rooms" would make the material more accessible to terrorist or other smaller groups that are disposed & the use of these materials. After all you have already disclosed or solving at least 90% of the problem of acquiring the mats - why not complete the disclosure by providing the remaining approx 10% of the problem.

The terrorist type groups have already thanked you for your disclosures - they would bless you for the remaining info

1/15.00.00

DC-003

15 00 00 **Comment Number 1**

The Secretary's February 6, 1996, Openness Initiative announced the locations and quantities of surplus weapons-usable fissile materials. This announcement was to provide the general public with information which DOE could use in reviewing the proposed departmental actions and provide informed input to the decisionmaking process. This announcement was made with full consideration of national security.

MANNING, SAM P., SPARTANBURG, SC
PAGE 1 OF 1

Comment ID: P0036
Date Received: May 1, 1996
Name: Sam P. Manning
Address: P.O. Box 355
Spottenburg, SC 29304
Phone: 803-582-5220

Transcription:

I had expected to be at the North Augusta Community Center meeting on April 30, however, I am in the hospital at present, and unable to come due to a heart problem. I therefore, respectfully request that a copy of the storage and disposition of weapons-usable fissile materials draft PEIS be sent to me [address]. Also please send me a copy of the stockpile stewardship and management draft PEIS. I also respectfully request an opportunity to file a statement in the next ten days, as I'm in the hospital and have been unable to prepare the report like I had requested to. I am concerned in reference to the amount of nuclear storage that may be placed on the shoulders of the State of South Carolina, as I think it's too much and presents a danger not only to South Carolina, but to North Carolina and Alabama based on the amount. I thank you, and I hope to get a message in later, but I'd be most grateful if you'd mail me that material, and also give me permission to file a statement within the next ten days. I thank you so much. 1/08.01.00 2/08.03.01

I had planned and expected to be in Augusta tomorrow afternoon to make a presentation. I regret at present I am in the hospital. I request permission to file a ten page to file a statement in the next ten days expressing my concerns in regards to the burden of nuclear radioactive waste that South Carolina has to carry. I fear that we are building up a situation that may be dangerous for the State and for the Nation due to the concentration of nuclear waste and nuclear weapons in this area. I regret that I cannot be present for the hearing on Tuesday, as I stated, I respectfully request permission to file a statement in regards to all three matters and I think, I'm hoping it will be the issues that will be raised will be raised by or considered by the leading scientists in the Nation. I thank you.

I had expected to be in Augusta on Tuesday the 29th correction on Tuesday the 30th, but I am in the hospital. I would appreciate it though if you would carry these comments, and I hope to be able to submit a more formal statement. I reference to the storage of nuclear weapons, It is my understanding that they should be stored in an area where there are very few people and that is very dry. The Savannah River Site has 500,000 people living within 100 miles of the facility. It also adjoins the Savannah River for 22 miles. The Savannah River Site at present has over 505 of the county's high level radioactive waste. It should be removed to a drier area. It should not be increased. I thank you.

P-036

08 01 00 Comment Number 1

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to new missions at SRS. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

CALL-IN COMMENTS ON DOE'S PEIS

MR. MANNING: Sam P. Manning, Attorney at Law, Spartanburg, South Carolina. My address is Post Office Box 355, Spartanburg, SC. I am calling to express concern in reference to the possible location of additional nuclear weapons and waste in South Carolina. I would have attended the hearings at North Augusta on April 30th, but was in the hospital due to a heart problem of blockage of the main artery.

I will state my concern and ask that it be included in the record in regards to such matters, and I would ask -- I base my comments on this knowledge, which I believe is uncontradictable, that South Carolina at the present, based on official Government Department of Energy records, South Carolina has within its borders more high-level radioactive waste than any other State. South Carolina also, since World War II, has had this tragic problem develop. According to the National Centers for Disease Control in Atlanta, South Carolina has a higher percentage of birth defects, and of the worst birth defects, than any other State. This is when a baby is born with its brain outside the skull or when the baby has spinabifida. It is my hope that they can get thorough and complete scientific studies to try to ascertain what creates this problem.

Approximately two years ago, an official statement from the Savannah River Site made this statement, that "radiation can cause cancer, and radiation can cause birth defects," but for purposes of an environmental statement, "incidences of cancer will only be counted where the person had died, and birth defects in this or future generations will not be counted or considered."

South Carolina is a brave and wonderful State. We must have a greater emphasis on science and research, and we have to be careful in our State that our citizenry and future children are not destroyed.

I would ask that the studies dealing with the storage and disposition of weapons, fissionable materials, that the Savannah River Site not be considered as a depositary for such. I would also respectfully request to inspect the

1/08.03.01

P-045

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at SRS. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Stockpile Stewardship and Management, that Savannah River Site not be considered. South Carolina already carries a great share of the environmental burden for the Nation. Scientific studies have stated that in respect to radioactive waste problems, that they should be stored in an area that has a minimum of population and does not have a great deal of water. The Savannah River Site adjoins the Savannah River for 22 miles. It has a substantial population within 50 miles of the boundary, and for the protection of the southeastern United States and Savannah River, the emphasis and the push must be on making this area safe for the Nation. With 360,000 liters of plutonium solution, the percent of possible of nuclear chain reaction, it would be foolhardy to increase the burden. The Nation is already looking, apparently with favor, on storing 17,000 aluminum-clad fuel rods at Savannah River from 41 foreign countries. It is in the interest of not only South --

[Recorded MAY 17 at 5:42 p.m.].

P-045

MANNING, SAM P., SPARTANBURG, SC
PAGE 1 OF 1

CALL-IN COMMENTS ON DOE'S PEIS

MR. MANNING: This is Sam P. Manning, Attorney at Law.

I am calling now to add this to the earlier comment that I made. I have been in the hospital due to a heart blockage question, but I would like for my statements to be included in the environmental impact statement or the study. I was unable to attend the North Augusta Community Center program, which was April 30th, and I would like these comments to be included.

In reference to continuing the operation of the Pantex plant and associated storage and development of nuclear weapons, I would ask that the Savannah River Site not be considered for such. South Carolina at present, based on Department of Energy records, has more than 50 percent of the country's high-level radioactive waste. We also have the highest incidence of [inaudible] birth defects. Savannah River two years ago made the statement that radiation can cause cancer, and that radiation can cause birth defects, that they would only count cancer when somebody has died, and they would not count the birth defects in this or future generations. 1/08.03.01

What the emphasis must be on at Savannah River is adequate and full research for the protection of the general public. They have there at present 360,000 liters of plutonium solution that, according to a DOE study, presents a possible criticality event. For the protection of the southeastern area of the country -- not only the Carolinas, but Georgia and the Nation -- increased emphasis must be given on safety. Also, we must protect the young people of tomorrow.

I thank you. It is a privilege to be able to make this statement. Thank you.

[Recorded May 17 at 5:52 p.m.]

P-046

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at SRS. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

DOE-Office of Fissile Materials Disposition
c/o SAIC-PEIS
P.O. Box 23786
Washington, D.C. 20026-2786

To Whom It May Concern:

We the undersigned protest the storage of nuclear waste, plutonium and uranium in the state of Nevada. | 1/08.03.01

Lisa K Mare
Christine M. Brooks
Sheila Barlow
Rachael Juige

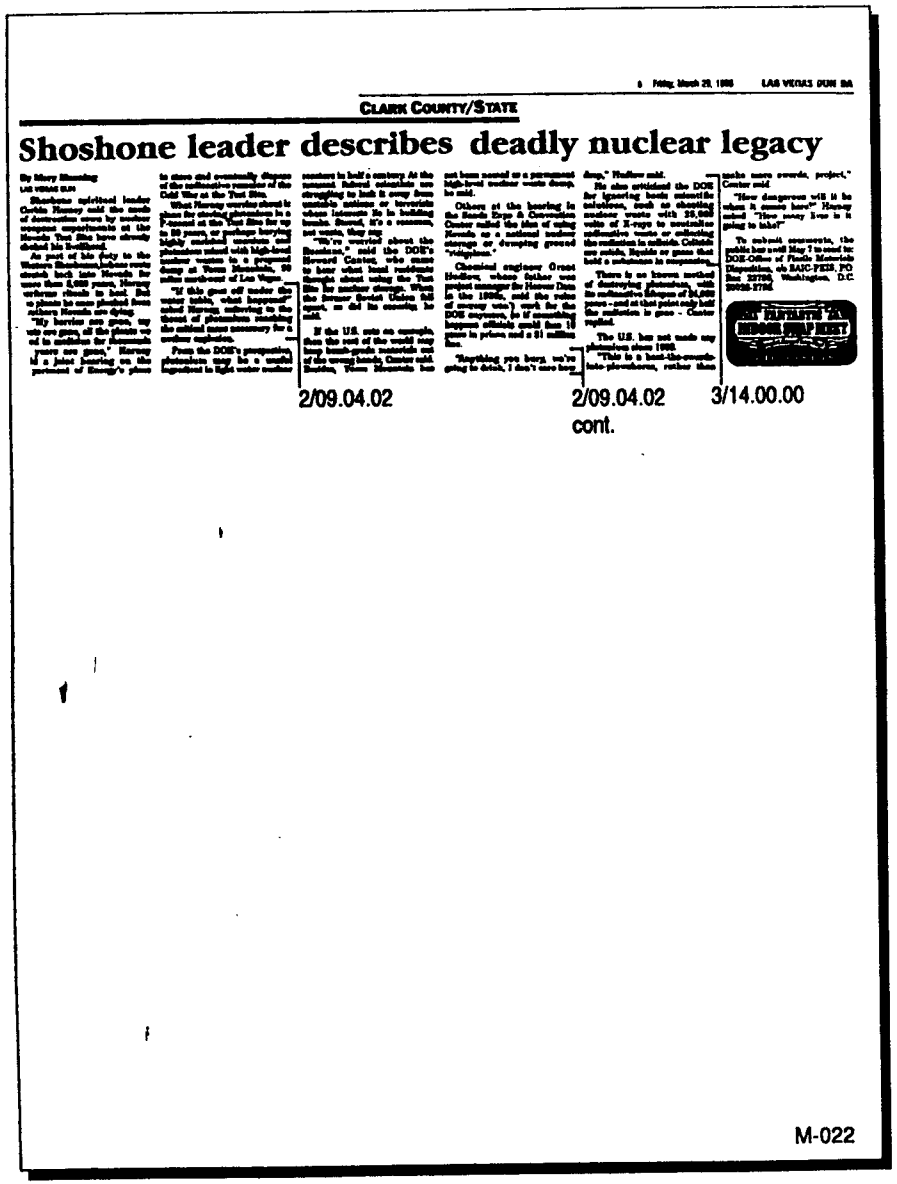
I left this letter and the enclosed story on a clipboard in the lunchroom for one shift and five out of eight people signed it. We are all residents of Nevada.

Thank you for listening to our opinion.
R.J.

M-022

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at NTS. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



CLARK COUNTY/STATE

Shoshone leader describes deadly nuclear legacy

2/09.04.02 2/09.04.02 cont. 3/14.00.00

M-022

09 04 02 Comment Number 2

As discussed in Sections 2.4.3 and 4.3.3.1.4 of the Draft PEIS, extensive precautions would be taken to ensure that criticality of the Pu emplaced into the deep borehole would not occur. There would be a site-specific study, formulation of appropriate regulations, detailed engineering studies, and computer modeling before the deep borehole facility would become operational. Section 4.3.3.1.4 of the Draft PEIS describes the environmental impacts for a deep borehole on a programmatic level so that a comparison can be done between the disposition technologies.

14 00 00 Comment Number 3

The Department of Energy applied results of a screening process along with public input to identify a range of reasonable alternatives for analysis in the Draft PEIS, and utilized technical reports and analyses from national laboratories and the industry to develop a final list of alternatives. Details were published in a separate report, ***Summary Report of the Screening Process to Determine Reasonable Alternatives for Long-Term Storage and Disposition of Weapons-Usable Fissile Materials*** (DOE, March 1995).

MARENGO APPLIANCES, MARYSVILLE, MI,
PAUL MARENGO
PAGE 1 OF 1

MARENGO APPLIANCES
[illegible] Simpson Road
FORT GRATIOT, MI [illegible]
FAX 810 982-0465

DEPARTMENT OF ENERGY
FAX 202-586-3710

I wish to vigorously protest the transport of plutonium, under the euphemism Mixed Oxide, from Hanford cross-country and through Port Huron, Mich. to Bruce CANDU in Kincardine Ont.

As you so well know plutonium is the world's most potent, hazardous material on the world.

Please do not expose Americans, Canadians, and the eco-system to such a dangerous, almost immortal hazard.

1/08.03.01

1/08.03.01 cont.

Paul Marengo
1990 Pine Rd, Apt #106
Marysville, Mich.
48040

F-068

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. This will include an appropriate level of analysis by Canada before any decision on burning Pu in a CANDU reactor is implemented.

MAYSON, W. PENLAND, JR., AUGUSTA, GA
PAGE 1 OF 2

DOE Public Meeting on
Draft Environmental Impact Statements
April 30,1996

There are three draft environmental impact statements on which the DOE is soliciting public comments. These three documents cover plutonium storage and management:

* The Pantex EIS considers SRS as an alternative for storage of up to 20,000 plutonium pits, most of which are currently stored at Pantex.
* The Stockpile Stewardship and Management EIS evaluates SRS as an alternative for plutonium recovery and remanufacturing of plutonium pits to maintain the nuclear stockpile.
* The Disposition of Weapons Usable Fissile Materials EIS considers alternatives for consolidating plutonium storage and technologies for disposing of surplus plutonium.

SRS is under consideration for a major role in each of these programs. Following are some points that relate to these issues:

(1) A key part of any decision concerning these programs is the attitude of the neighboring communities.

SRS's neighbors in Georgia and South Carolina have supported SRS operations since the location was named 46 years ago as a weapons material production plant. Over these years, operators of SRS have been prudent, responsible, and world-class in technical ability. This community naturally welcomes additional missions of this type and jobs and money coming in, especially after so much has left the last few years. We also know and trust the people at SRS. Because of the support SRS enjoys, we urge DOE to choose SRS as the site for the future needs discussed in these EIS's.

(2) In many cases SRS has the facilities and capability already in place for certain of the EIS alternatives, and additions needed could be installed very cost-effectively by DOE.

Storage of nuclear materials, for example, is commonplace activity at SRS, and SRS officials report that they are already planning a modular storage facility, which could be easily modified for additional capacity. The storage unit is budgeted at $150 million, and additional storage capacity would roughly double that number.

(3) If it is determined that the national interest requires a large scale effort to reconstitute the plutonium pits now in the stockpile, a large percentage of which are decades old and potentially unreliable, SRS has the expertise and many of the facilities to perform that job

1/08.03.01

SR-010

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for SRS. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

cost-effectively.

The capital investment of that option is about $350 million, much of which would return to he community in the form of purchases and construction wages.

(4) Excess plutonium must be managed properly. Storage is an option, but there is also the possibility of obtaining energy benefit from plutonium by making mixed oxide fuels for use in nuclear reactors. SRS is a logical place for fuel manufacture because of the existing plutonium handling facilities and expertise onsite. This would represent construction and related expenditures of about $350,000.

At the same time, SRS is essentially the center of applied vitrification technology in this country, and would be the ideal location for vitrifying plutonium as an anti-proliferation action. Capital costs would be about $500 million.

1/08.03.01 cont.

(5) It must be remembered that SRS has the only active large-scale plutonium processing facility in the nation.

(6) SRS not only has the capability to perform each of these missions safely and effectively, but in fact, is the only site that which can perform all of the missions.

SRS has the technology, infrastructure support, and facilities to immediately implement the NEPA decisions. Only SRS retains large-scale functioning plutonium capability. Only SRS has experience at startup and operation of nuclear facilities with today's standards of operation. Only SRS can provide the Department the capability to merge all of its plutonium functions at a single site with billions of dollars of savings which will result from this approach.

W. Penland Mayson, Jr.
3028 Bransford Rd.
Augusta, Ga. 30909

SR-010

MCFARLAND, LEWIS L., PORTLAND, OR
PAGE 1 OF 1

Lewis L. McFarland
5885 Southwest Sixtythird Avenue
Portland, Oregon 97221
(503) 245-8170

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

RE: MOX Reactors at Hanford

Ladies and Gentlemen,

I just read a review of WPSS plan to put together a consortium of 5 utilities to run 10 reactors at taxpayers expense that would use MOX. As a citizen of the Northwest, a taxpayer and a holder of a degree in math-physics I am opposed to any such plan. The world does not need more nuclear waste to get rid of. These reactors are expensive and have proven to be quite unsafe. 1/08.03.01

Sincerely,

Lewis L. McFarland

copy: Elizabeth Furse
US Congress

M-247

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Comment ID: P0019
Date Received: April 18, 1996
Name: Scott Miller
Address: Boise [ID]

Transcription:

I'm commenting on the Department of Energy's material. I'm glad they have an 800 number to comment on. I feel the state of Idaho is 1 million people strong. It's a weak state because of the population. Anything the Department of Defense or Department of Energy wants to do in the state is fine as long as there's regulations and groups that are informative of what's going on in the state. Please ask people what they think, especially the State of Idaho. It's a beautiful state and I hate to see it ruined.

1/08.02.00

P-019

08 02 00 **Comment Number 1**

Comment noted.

Loring E. Mills
132 Eareckson Lane
Stevensville, MD 21666
Tel: (410) 643-1244

April 25, 1996

U. S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

Subject: Comments on Storage and Disposition of Weapons-Usable Fissile Materials, Draft Programmatic Environmental Impact Statement (PEIS), February 1996

Gentlemen;

The Federal decision on storage and/or disposition of weapons-usable fissile materials will have an environmental impact on **Global Climate Change**. Global climate change is the primary national and international environmental concern of the 21st Century. Surprisingly, the Draft PEIS **does not effectively evaluate and compare the important items that contribute to global climate change**. The PEIS should be modified and supplemented to include a comparison of the storage and disposition alternatives as they impact global climate change.

Two primary measurable and deterministic items that are very useful measures for the contribution of any action with regard to global climate change are: **1- net energy consumption and 2- net carbon dioxide releases.** Calculations can be made, with deterministic values, for both of these items.

1/01.00.00

Attachment A: and Attachment B: of the PEIS Summary provide what is referred to as a Comparison of Environmental Impacts for each of the No-Action, Long-Term Storage and Disposition Alternatives. The twelve distinct environmental impact measures do not identify specifically the deterministic items that reveal the impact on global climate change. While the Department may believe it has included such environmental impacts within the listed measures, it is not apparent, nor does it distinctly identified the overall environmental impact related to this major environmental concern of the upcoming century. **Clearly, a distinct and specific recognition of environmental impact on global climate change is essential to provide a complete environmental evaluation and comparison of each comprehensive alternative for such an important Federal action.**

A deterministic assessment of the important items of net energy consumption and net carbon dioxide releases, that relate directly to global climate change, is not provided with these comments. However, a brief outline and relative indication of impact is provided on page 4 as an

1

M-055

01 00 00 Comment Number 1

The effluents and releases from facilities described in the reasonable alternatives section in the PEIS do not include emissions that would substantially contribute to a global climate change.

attachment for reference purposes. All alternatives and process steps, other than disposition through nuclear power plant systems, are net energy consumers and will result in additional carbon dioxide releases, adversely impacting global climate change. It can be argued that the use of weapons-usable materials in all four of the reactor fuel alternatives will result in a substantial net energy production, rather than consumption, and a corresponding reduction in carbon dioxide releases. Perhaps in the cases of Existing LWRs and CANDU reactors the weapons-usable material would simply replace uranium fuel and while there is a net energy production, there would not be a decrease in carbon dioxide releases. On the other hand, since the Department's energy forecast models gradually phase out nuclear energy production when existing nuclear energy units have completed there economic life, if the Partially Completed LWRs and Evolutionary LWRs alternatives were used to consume the weapons-usable material, clearly there would be a substantial net energy production and a significant reduction in carbon dioxide releases. The Department should proceed with a detailed determination of these items and include separate environmental impact measures related to global climate change.

The Environmental Impact Tables in Attachments A and B of the Summary provide isolated impacts for individual functions and do not provide a combined set of functions that are required for specific alternatives, along with the net environmental impact of each complete alternative. As an example, to perform disposition through Vitrification, it requires Pit Disassembly/Conversion, Plutonium Conversion, Vitrification, Final Disposal and the environmental impacts of the energy production facilities supplying energy for these functions. The EIS does not combine these functions into a set of environmental impacts for a system that would be required for disposition by vitrification. Such a combined total environmental impact should be identified for each complete alternative in addition to the individual functions. Similarly, disposition through the use of Evolutionary LWR should include the combined environmental impacts of Pit Disassembly/Conversion, Plutonium Conversion, MOX fuel fabrication, Evolutionary LWR and Spent Fuel Disposition. The net combined impacts are essential to properly assess and compare the alternatives. Each complete alternative should be identified with its combined net environmental impacts for the life cycle of the task. 2/09.00.08 2/09.00.08 cont.

A more complete discussion is needed within the PEIS to effectively describe the weapons-usable fissile materials High-Enriched Uranium and Plutonium are unique material in several ways. The PEIS should provide a full listing of the physical, chemical, radiological and potential energy attributes of each material along with a discussion on the potential impacts of each attribute. Specifically, the heavy metal characteristics and related potential toxic aspects should be discussed. A complete discussion of the radiological characteristics and potential radiological impacts along with the known means of shielding and personal protection should be included. In addition, the equivalent potential energy content of these materials should be identified and discussed. Since the primary means of using the potential energy values within these materials is through the production of electricity, the measure could be established as equivalent mega-watt hours, or equivalent barrels of petroleum, or tons of coal that would be required to produce the same amount of electricity that can be produced with the potential energy of these materials. These attributes and characteristics should be included in a basic discussion of the weapons-usable fissile materials within the PEIS. 3/09.09.08

2

M-055

09 00 08 Comment Number 2

Attachments A and B of the Draft PEIS have been deleted for the Final PEIS Summary, but still appear as tables in Section 2.5 of the Final PEIS. In response to the comments received, the Summary has also been revised to include impact analysis results for combined alternative functions.

09 09 08 Comment Number 3

The general discussion of the radiation mechanism and radiation human health effects are included in Section M.2. The major human health effect from radiation would be an induction of cancer fatalities, which is a common effect for any radionuclide. Therefore, inclusion of detailed discussions of each specific radioactive material is not necessary. For hazardous chemicals, since each chemical may cause different ill-health effects, complete information on the toxicity profiles of the hazardous chemicals involved in the Fissile Materials Disposition Program is described in the Section M.3.

MILLS, LORING E., STEVENSVILLE, MD
PAGE 3 OF 4

An issue of concern with regard to the alternatives of using partially completed and evolutionary LWR systems to consume the plutonium, is whether there is a need for additional electricity production capacity. Clearly, new production capacity will be required for the national system within the time period of disposition. Every year since 1975, the demand for electricity within the U.S. has increased, abet at a slower rate than prior to 1973. Also, the average age of existing electricity production facilities is increasing nearly one year for each year of time. Many of the existing facilities are becoming worn out and need to be replaced soon. Without question, new electricity production facilities are needed and will be built within the next ten years. Thus, the completion of partially completed LWRs and/or the construction of evolutionary LWRs are reasonable alternatives for the necessary additional electricity production capability. They would displace new facilities using fossil fuels and result in a significant reduction in CO_2 releases--affecting global climate. 4/08.03.01

Thank you for the opportunity to provide comments on the Draft PEIS for this important Federal action.

Sincerely,

Loring E. Mills

M-055

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Attachment to Comments by Loring E. Mills on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement - Dated February 1996

Brief Outline and Comparison Of Environmental Impact Measures For Plutonium Disposition Alternatives Affecting Global Climate Change Net Energy Consumption and Net Carbon Dioxide Releases

	Net Energy Consumption*	Net Carbon Dioxide Release*
Pit Disassembly/ Conversion	MWh and Fossil Fuels Consumed	Net CO_2 Release
Pu Conversion Fac.	MWh and Fossil Fuel Consumed	Net CO_2 Release
Direct Disposition	MWh and Fossil Fuel Consumed	Net CO_2 Release
Ceramic Immobilization/ Borehole	MWh and Fossil Fuel Consumed	Net CO_2 Release
Borehole Complex	MWh and Fossil Fuel Consumed	Net CO_2 Release
Vitrification	MWh and Fossil Fuel Consumed	Net CO_2 Release
Ceramic Immobilization	MWh and Fossil Fuel Consumed	Net CO_2 Release
Electrometallurgical Treat	MWh and Fossil Fuel Consumed	Net CO_2 Release
MOX Fuel Fabrication	MWh and Fossil Fuel Consumed	Net CO_2 Release
Existing LWR	MWh Produced & Fossil Fuel Consumed	No Change (replaces U fuel)
Partial Completed LWR	MWh Produced & Fossil Fuel Consumed	Significant Reduction in Net CO_2 Release
Evolutionary LWR	MWh Produced & Fossil Fuel Consumed	Significant Reduction in Net CO_2 Release
CANDU Reactor	MWh Produced & Fossil; Fuel Consumed	No Change (replaces U fuel)

* Values should include the construction of facilities and the total life cycle amount involved with the consumption of all surplus weapons-usable materials

4

M-055

MILLS-REKDAL, SHEILA, ET AL.
PAGE 1 OF 3

April 22, 1996

To the United States Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

In a democracy the voice of all people should be listened to and considered in decision-making when policies so greatly effect grassroots America. Being concerned with the preservation of rural America, I am seriously troubled by the Programmatic Environmental Impact Statement prepared for the Department of Energy regarding Storage and Disposition of Weapons-Usable Fissile Materials.

Although I recognize the need to ensure safe, secure, long-term storage and disposition of the significant quantities of surplus fissile materials, which include plutonium (Pu) and highly enriched uranium (HEU), I believe this document fails to address very critical human issues. life issues. 1/09.00.04

In reviewing the alternatives for the possible future of Pantex, it becomes very evident that all of the nation's weapons-usable plutonium not in active warheads would be stored at Pantex - 20,000 pits, plus much of the plutonium now at Rocky Flats Plant, Colorado; Hanford, Washington; Los Alamos, New Mexico; Savannah River, South Carolina; and the Idaho National Engineering Laboratory.

Before 1989, plutonium pits were never stored at Pantex. However, with the closing of Rocky Flats, Pantex is the interim storage site for at least 12,000 pits. Now this document proposes not only storing plutonium pits, but other more undesirable forms of plutonium.

Once stored at Pantex, this site is being considered for a plutonium pit disassembly/conversion facility to cut the pits and process them into metal or oxide; a plutonium conversion facility to process other types of Pu; a facility to mix plutonium with uranium to make mixed oxide fuel (MOX); nuclear power reactors to use the MOX fuel, plus storage of the spent fuel from the reactors, as well as storage of all the mixed waste generated from all these processes. It is processing of plutonium which has contributed to the national environmental degradation which saddles our nation with a $300 billion dollar cleanup problem.

This document states there would be few negative effects from doing any and all of these activities at Pantex. What the document fails to address is the impact on the good reputation of our agricultural products. Agriculture is the one industry which has consistently sustained the Panhandle for decades.

The food chain begins here in the prime agricultural farmland of the Texas Panhandle. The meat products and cereal grains produced here are shipped throughout the world; 25% of the Nation's beef is produced and processed here. The quality and wholesomeness of these products would be placed in jeopardy with the siting of these processes at Pantex. Without production agriculture this part of Texas would cease to exist. When one of every four people is employed in an agriculture related job, the loss to this High Plains trade area of these jobs would create untold problems.

A second issue the document fails to address is the location of Pantex above the Ogallala aquifer, the source of groundwater for the plains of Texas and seven other Midwestern food producing states. With high explosives, chemicals, solvents, and radionuclides, Pantex has contaminated the first ground layer of water bearing sands above the Ogallala aquifer. With the downward migration of the recharging waters, how long will it be before the Ogallala itself will be contaminated? 1/09.00.04 cont.

Water and agriculture are the real wealth of the Texas Panhandle. Without them there would be no "Texas Panhandle." We cannot stand by and allow these resources to be compromised in any way. Food is the most important commodity we have - it must be protected. Ogallala aquifer over a vast area of our

Not all alternatives for siting these processes at other sites were analyzed in this document. Before choosing a preferred alternative, other options need to be considered. The siting of these missions at Pantex seems shortsighted and ill-conceived. The environmental impact in conjunction with these processes has the potential to devastate this food producing region. 2/08.03.01

The Panhandle is too valuable to be used as a plutonium storage, processing and waste facility.

Sincerely,

Sheila Mills-Rekdal
Randy Rekdal
Andrew Rekdal

Ellen D Mills

M-078

09 00 04 Comment Number 1

Radiological and chemical releases resulting from the Proposed Actions for normal operations would be within Federal and State regulatory limits. Therefore, the quality of agriculture in the Panhandle would not be affected, and agriculture-related employment in the Panhandle region would remain unaffected.

Also, current and future operations at Pantex are not expected to affect the water quality of the Ogallala Aquifer. However, since this aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge), and since Pantex operations contribute to the depletion of the Ogallala Aquifer, impacts to the aquifer were analyzed in the PEIS.

Current and future operations at Pantex are not expected to impact the soil used for agriculture and farming in the Pantex region. All activities will be limited to Pantex and any impacts to the surrounding areas are within Federal, State, and local regulatory limits.

The PEIS includes analyses on the radiological and chemical impacts to workers and the public from both normal operations and accidents. These analyses also address the effects to local plant and animal resources as well as the effects on prime farmland.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

4/29/96

To Whom it May Concern:

Question: Who derived the most monetary profit from Rocky Flats?

Question: Who is paying for clean up?

Basic premise learned from parents: You make a mess you clean it up, even if it means no dinner.

That is why it is so very important that this decision be made with the utmost caution and foresight. Projects of this magnitude have no place in the small ball park of political favoritism, cronyism, or any other "ism". This is too deadly a subject to be used as a political football.

This is not just a question of "not in my back yard." It is a question of "where can this facility be located that it will have the least impact on the environment - socially, ecologically, ~~economically~~. It seems the Manzano Site at Kirtland AFB would be a much safer site - security wise as well as it is not in an agricultural zone of the same proportion. It

(over)

3/01.04.00

M-078

01 04 00 **Comment Number 3**

Combined storage of pits and non-pit Pu at the Manzano WSA was originally eliminated as a reasonable alternative in the Draft PEIS. After considering separate storage of pits from non-pit Pu, the option to store these pits at the Manzano WSA no longer appears unreasonable. The Manzano WSA was evaluated in the Pantex EIS and Section 2.1.3 of the Final PEIS. The Final PEIS was revised to clarify the consideration of the Manzano WSA for combined storage, and a description of the WSA was included in Appendix P.

appears to have been a storage facility with capability to store 30,000 pits. It would certainly seem more practical than Larsen county.

I sincerely hope reason pervails in this matter & that political money Grubbing is side tracked for the practical plutonium train to find it's home station.

Sincerely,
We are the
Caretakers of this
Planet!

3/01.04.00 cont.

M-078

MINER, RUTH ALLAN AND MENDELSON, EMANUEL S., PHILADELPHIA, PA
PAGE 1 OF 1

48 W. Highland Avenue
Phiuladelphia, PA 19118-3310
June 7, 1996

U.S.Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

Fax 1-800-820-5156

We vigorously oppose any and all steps to continue the production of nuclear fuel and object strenuously to the mixed oxide method of blending plutonium and uranium--the MOX process--for use in commercial reactors. This process not only involves building reprocessing facilities and altering existing reactors at public expense but will increase volumes and radioactivity of the waste produced. 1/08.03.01 2/08.03.01

The U.S. Government, primarily responsible for the spread of nuclear materials worldwide, is now reaping the whirlwind. It is time to set another example: Stop producing radioactive waste in every way possible before another fatal holocaust occurs that can destroy us all. We hold the U.S. Government responsible for contemptuous treatment of human life. It is time to turn in a new direction.

Stop processing radioactive materials for military and energy use and stop producing nuclear waste.

Ruth Allan Miner

Ruth Allan Miner

Emanuel S. Mendelson

Emanuel S. Mendelson

F-064

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

MONTEREY INSTITUTE OF INTERNATIONAL STUDIES, MONTEREY, CA, TARIQ RAUF
PAGE 1 OF 7

Date: Wed, 1 May 1996

Subject: FORUM Form - incoming

serial_no = 165
MailTitle = FORUM Form - incoming

name = Tariq Rauf
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ctype = public
subject = WPu Disposition

** The following is the text of the Author's Comment.

MEGATONS TO MEGAWATTS:
ELECTRICITY FROM THE COLD WAR'S LEGACY

by

Tariq Rauf

The world's seven most advanced industrial countries -- the Group of Seven (G-7) -- will be meeting at the Moscow Summit on Nuclear Safety and Security, on 19-20 April, together with Russia to discuss the safety of Soviet-designed nuclear power reactors a nd the safe disposal of nuclear materials from dismantled nuclear warheads.

The Problem

With the end of the Cold War and the collapse of the former Soviet Union, far reaching nuclear disarmament agreements are resulting in the dismantling of thousands of nuclear warheads. By the turn of the century some 30,000 atomic bombs will have been dis mantled, yielding hundreds of metric tonnes of weapon-grade fissile (or nuclear) materials -- highly enriched uranium (HEU) and

E-007

plutonium. Ironically, the fissile materials from dismantled warheads will still continue to threaten humanity through the dang ers of nuclear terrorism, theft, accidents, or re-use in new warheads. This is particularly true in Russia, where centralized control and physical security of nuclear materials remain woefully low and former Communists and nationalists are rising in popul arity.

While both HEU and plutonium can be utilized to make nuclear warheads, there are two important differences between them. The first is that HEU can be diluted with other isotopes of uranium to yield low-enriched uranium (LEU), which cannot sustain the fast -neutron chain reaction required for a nuclear explosion. LEU is the fuel for most of world's nuclear power reactors, but heavy water reactors such as the Canadian (deuterium-uranium) or CANDU reactors use natural uranium. Re-enriching LEU to weapon-grade or HEU requires complex enrichment technology, which is both costly and not easily accessible. Plutonium, in contrast, cannot be diluted with other isotopes of plutonium to render it unusable for weapons. It must either be burnt in nuclear reactors, or p laced in long-term storage -- an unproved technology -- with all the attendant risks of theft or accident (particularly in Russia).

Recognizing the risks of poorly guarded weapon-grade nuclear materials in Russia, the United States is buying 500 tonnes of weapons-grade uranium from dismantled Russian warheads and is using the uranium after dilution as fuel in its commercial power reac tors. The danger from Russian weapon-grade plutonium still remains to be addressed.

Disposition Options for Weapons Plutonium

Expert studies commissioned in the United States recommend four principal options for short- to medium-term management of excess weapons plutonium: none of these options eliminate the danger, all they can achieve is to reduce the risks. Moreover, these op tions do not reduce the inventory of excess weapons plutonium.

Plutonium disposition options need to:
minimize the time that plutonium is stored in forms readily usable for nuclear weapons;
preserve safeguards and security during the disposal process, while maintaining the same high level of security and accounting applied to nuclear weapons in storage, i.e. the "stored weapons standard";
render plutonium into a form which is as difficult to recover for making nuclear weapons as is contained-plutonium in spent fuel from nuclear reactors, i.e. the "spent fuel standard"; and
meet the highest standards for public and worker safety, as well as environmental protection.

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Several options can be considered for achieving these objectives. Exotic options such as sending the plutonium into the Sun (for incineration) or into deep space aboard rockets, or using surplus nuclear warheads to destroy asteroids in space (on projected collision paths with Earth), or underground nuclear explosions to also incinerate other hazardous materials (including chemical weapons), or sub-seabed disposal, or dilution in the open ocean, or disposal in the Earth's magma, can all be ruled out as eit her they do not meet the basic requirements of human and environmental safety or are inimical to existing arms control processes. Workable options include:

fabrication and use as mixed-oxide (MOX) fuel, without reprocessing, in existing or modified nuclear power reactors;
vitrification, that is combining the plutonium with high-level radioactive wastes as these are melted into large glass logs for long-term underground storage; and geologic disposition or burial in deep boreholes -- the last two options require fu rther study.

1/08.03.01

These options are currently under consideration in the United States and Russia. The principal concern is to prevent accidents and the misuse of plutonium in an unstable Russia, and to find ways acceptable to Russia for safely and securely disposing of th is material. Until recently, Russia regarded the plutonium as having an economic value and thus was not amenable to plutonium disposition. However, after visiting Canada last October, Russia's minister for atomic energy, Viktor Mikhailov, is now consideri ng ways of dealing with excess weapons plutonium including Canadian assistance.

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08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the disposition alternatives. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Reactor Burn up of Plutonium

Plutonium after it has been mixed with depleted uranium can be used in commercial power reactors, in the form of mixed-oxide (MOX) fuel. Many of the world's existing light-water reactors (LWRs) could use MOX fuel, but because of their particular design t hey can be refuelled only after costly and sometimes lengthy shutdowns. Given the poor safety culture and weak nuclear security in Russia, it would not be desirable to encourage plutonium storage or use in Russia given the high risks of accidents and thef t. Japan and Western Europe also would not be suitable on a number of grounds, including lack of political acceptability (as far as both the US and Russia are concerned) and for non-proliferation reasons because of their plutonium reprocessing programs. T his leaves Canada as the only potential candidate acceptable to both Russia and the US to assist in plutonium disposition.

Canadian CANDU Reactors

Canada's (deuterium-uranium) CANDU reactors offer the best technical possibility for the mission of eliminating weapons plutonium, because the reactor design inherently allows for the handling of full-MOX cores and would involve no change from the usual p hysics of the reactor. CANDU reactors are refuelled on-line, that is, they do not have to be shut-down for refuelling as do LWRs. Further, CANDUs use a "once-through" fuel cycle which, in principle, would make them an efficient burner of MOX derived from weapons plutonium; and the fissile content would be burned down to a lower level than in a LWR, with the extraction of more energy per kilogram of plutonium. CANDU fuel is produced in smaller and simpler units than those typical of LWRs, thus potentially reducing the cost of fuel fabrication, which is a substantial fraction of the total cost of MOX use. CANDU reactors have the best safety record in the world -- there are 21 CANDUs operational in Canada. Recently, a CANDU reactor, operated by Ontario
Hydro , s
et a world record for continuous operation and electricity production. Atomic Energy of Canada Limited (AECL), the designer and builder of CANDU reactors is experienced in dealing with MOX fuels and is in a position to supply technical expertise in suppor t of plutonium burn up in CANDUs. The CANDU option meets all of the criteria for safe and effective plutonium disposition.

Two of the current standard design CANDU reactors could transform 50 metric tonnes of Russian weapons plutonium into spent fuel in 25 years. Another two CANDU reactors would be needed to burn up a matching 50 tonnes of excess US weapons plutonium. The Bru ce Nuclear Power Plant in Ontario, located on Lake Huron north-east of Detroit, has eight operational power reactors, of which two or four could be used to burn excess weapons plutonium, as soon as MOX from

2/08.03.01

E-007

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for the CANDU Reactor Alternative. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

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MONTEREY, CA, TARIQ RAUF
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excess weapons plutonium becomes available. MOX fuel burned in Canadian CANDUs would be fabricated as fuel either at a suitable facility in the US, or in Russia, before being transported to Canada. A new fuel bundle design, under consideration, could reduce the number of MOX fuel bundles by nearly 50 percent, thus making for a significant economic and transportation advantage.

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Transportation

Existing modes of road and rail transportation could be used to bring MOX fuel bundles into Canada from the US. In effect, the "safe, secure transports" (SST) routinely used to ship containers of special nuclear materials within Canada and the US could be used for MOX. Shipments of MOX fuel bundles in special containers from Russia could be done safely and efficiently by either commercial or military transport aircraft.

Environment, Health, and Safety

Instead of mining and refining some 6,000 tonnes of uranium per year, the use of MOX would consume 2 tonnes of weapons plutonium together with some 250 tonnes of depleted uranium waste. The amount of spent fuel produced would decrease by about 10% over t he use of natural uranium. While plutonium products cause anxiety about health and safety considerations, it is often forgotten that very much greater quantities of permanently toxic elements such as arsenic, cadmium, and lead are stored and disposed of with much less concern. While plutonium compounds are both fissile and toxic and must be stored and handled with care, epidemiological studies have not demonstrated adverse health effects in humans.

Canada's Role

Though Canada was a member of the war-time Manhattan Project to develop an atomic bomb, it was also the first country to voluntarily give up its expertise and capability to develop nuclear weapons and since then it has consistently and actively contribute d to preventing the spread of nuclear weapons and reducing the nuclear danger.

The potential use of Canadian CANDU reactors to help in the safe and efficient disposition of one the Cold War's most enduring legacies -- long-lived weapon-usable fissionable materials -- offers a unique opportunity to make a significant contribution to making the world a safer place by converting megatons to megawatts.

[Tariq Rauf (a specialist in Canadian and international security) is currently Director of the International Organizations and Nonprolifcration Project at the Monterey Institute of International Studies in California.]

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Monterey: 31 March 1996 Tel: (408) 647-3504
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END comment

E-007

April 30, 1996

David Montgomery
(206) 342-1349 work
(360) 793-3583
35825 164th St SE.
Sultan, WA 98294

DISPOSAL OF U S PLUTONIUM

The Clinton adminstration has put 50% of all our plutonium under the inspection control International Atomic Energy Agency (an agency of the U.N.). The Department of Energy is now taking input on what to do with this plutonium A meeting will be held in Seattle on Tuesday April 30,1995 (flyer included) that is sponsored by the Department of Energy. Department of ecology and various disarmament groups like Physicians for Social Responsibility to get citizens input on various plans for this plutonium.

There are several problems with this plan.

1) We are the only nuclear power that is disposing of it's plutonium from nuclear weapons. This critical material produced at great cost over the cold war may be needed again when the communist win the presidential elections in Russia this June. This option of reassemblying nuclear weapons should be available to the next President. 1/01.06.00

2) The current operation of the U.N. inspection of U.S. nuclear materials, I believe is illegal. President Clinton has justified these inspections based an Article VI of the Non-Proliferation Treaty, which calls for negotiations to achieve universal nuclear disarmament. We have forgotten that when President Nixon submitted the Non-Proliferation Treaty to the U.S. Senate he stated it would prohibit the International Atomic Energy Agency from any inspections dealing with our national security. The treaty has not been modified to allow these inspections. 2/01.06.00

David R Montgomery

M-215

01 06 00 Comment Number 1

The United States is not likely to proceed significantly with Pu disposition unless Russia takes reciprocal action simultaneously. Both the United States and Russia have inventories of Pu, surplus to defense needs. The United States is retaining necessary quantities of Pu under the Stockpile Stewardship and Management Program to guarantee that future defense needs of the Nation are assured.

01 06 00 Comment Number 2

Comment noted. IAEA considerations are not a part of the environmental analysis. However, IAEA is considered in the technical and nonproliferation analysis and will be integrated in DOE's decisionmaking process.

telligence and deep sense of compassion made an indelible impression on all who knew him.

Mrs. Nixon joins me in extending deepest sympathy to his wife and family.

NOTE: Mr. McGill died on February 4 in Atlanta, Ga., of a heart attack at the age of 70. Since 1942 he had been editor, and since 1960 publisher, of the Atlanta Constitution. In 1958 he won the Pulitzer Prize for editorial writing.

29 Message to the Senate Requesting Advice and Consent to Ratification of the Treaty on Non-Proliferation of Nuclear Weapons. *February* 5, 1969

To the Senate of the United States:

After receiving the advice of the National Security Council, I have decided that it will serve the national interest to proceed with the ratification of the Treaty on Non-Proliferation of Nuclear Weapons. Accordingly, I request that the Senate act promptly to consider the Treaty and give its advice and consent to ratification.

I have always supported the goal of halting the spread of nuclear weapons. I opposed ratification of the Treaty last fall in the immediate aftermath of the Soviet invasion of Czechoslovakia. My request at this time in no sense alters my condemnation of that Soviet action.

I believe that ratification of the Treaty at this time would advance this Administration's policy of negotiation rather than confrontation with the USSR.

I believe that the Treaty can be an important step in our endeavor to curb the spread of nuclear weapons and that it advances the purposes of our Atoms for Peace program which I have supported since its inception during President Eisenhower's Administration.

In submitting this request I wish to endorse the commitment made by the previous Administration that the United States will, when safeguards are applied under the Treaty, permit the International Atomic Energy Agency to apply its safeguards to all nuclear activities in the United States, exclusive of those activities with direct national security significance.

I also reiterate our willingness to join with all Treaty parties to take appropriate measures to insure that potential benefits from peaceful applications of nuclear explosions will be made available to non-nuclear-weapon parties to the Treaty.

Consonant with my purpose to "strengthen the structure of peace," therefore, I urge the Senate's prompt consideration and positive action on this Treaty.

RICHARD NIXON

The White House
February 5, 1969

I am Jim Murphy and I have been an Amarillo resident since 1977. I am active in a variety of community organizations and am on a number of boards including a local public school board.

I am here tonight to respectfully express an emphatic "No!" to any expansion or added roles at Pantex that include plutonium processing or nuclear waste storage. Although such expansion or new "missions" may have some positive economic benefits for the area, there would be economic risks as well. 1/08.03.01

At any rate, it is apparently necessary to occasionally reiterate that there are some things that money can't buy and some things in life that are more important than economic bottom lines.

I count amongst these things a safe and clean environment for our traditional agricultural and cattle-raising industries and ways of life, a clean aquifer and a safe and healthy environment for our children and grand children. Plutonium processing and/or nuclear waste storage are hostile and unfriendly to those environments and ways of life and not worth whatever the price may be.

The tantalizing apple of prosperity beckons; but when it is the fruit of the plutonium tree, we best look elsewhere.

Jim Murphy
6711 Columbia Ln.
Amarillo, TX 79109

4-22-96

TX-056

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

MURRAY, ALEXANDER P., GAITHERSBURG, MD
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24305 Clematis Drive,
Gaithersburg, MD 20882,
May 3, 1996.

DOE - Office of Fissile Materials Disposition,
c/o SAIC PEIS,
P.O. Box 23786,
Washington, DC 20026-3786.

Re: DOE/EIS-0229-D, Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement, dated February, 1996.

Dear Sir/Madam:

Thank-you for the opportunity to comment upon the subject environmental impact statement. The PEIS covers an important area that DOE needs to address with a reasonable alternative (or alternatives) in a timely manner with cost effective means. My comments follow:

1. The alternatives are of different categories and need to be clarified and explained better. For example, the long-term storage alternatives are site variations, while the disposition alternatives include disposal, wasteform, and reuse variations. The draft EIS should try and follow the classic categories of storage, reuse/recycle, and disposal. These should be displayed graphically and show endpoints (e.g., plutonium disposal site, Federal repository). There may also be other subcategories based on plutonium/HEU form and facilities (e.g., igloo, bunker, vault). The analyses also should accommodate the fact that reactor alternatives are reuse options producing a valuable resource; usually EIS's include the value of the resource (avoid latent fatalities, say by avoidance of emissions and consumption of other resources) or use a difference type analysis. Ideally, this should be summarized in a table in the Summary. — 1/01.00.00

2. The proposed action is stated to consist of long-term storage and disposition (i.e., the two main categories of alternatives). This is contradictory and confusing. While DOE often defers the specific preferred/proposed action to the final EIS, the proposed action is usually more definitive than the two principal categories of alternatives. DOE needs to pick one or the other, and the text should be modified to reflect that choice. — 2/01.00.00

3. The draft does not adequately discuss the type of plutonium. This includes physical (e.g., pit, classified shape, unclassified shape, billet, powder) and chemical (e.g., metal, — 3/01.04.00

M-150

01 00 00 Comment Number 1

Comment noted. The Final PEIS text format is the same as that suggested, and information requested is already in the text (Chapter 2). As described in Appendix H of the Final PEIS, DOE is still evaluating the suitability of a repository site. An expanded discussion of avoided environmental impacts has been included in Section 4.9 of the Final PEIS.

01 00 00 Comment Number 2

Separating storage from disposition would not effectively meet the purpose of and need for the Proposed Action. Planning for storage of the surplus Pu pending disposition is closely related to that for the disposition activities and would be affected by the technology(ies) selected to implement the Proposed Action. DOE is confident that a decision can be made on disposition technologies at this time, and is continuing to expand a range of small scale tests and demonstrations of some Pu disposition technologies to remove uncertainties in viability.

01 04 00 Comment Number 3

Most of the Pu addressed in the PEIS is in either a metal or oxide form. Some of the Pu metal is in a classified pit form. The form, shape, and location of the Pu materials does not have a major bearing on the technologies chosen for disposition or the siting of those technologies. Although some of the Pu has chemical or isotopic constituents that would make it unsuitable for use in MOX fuel, it is a relatively small amount of the total Pu inventory. The immobilization technologies could be used for disposition of all forms of Pu.

oxide, ceramic, glass, impurities) forms. This is important because it can affect the viability of certain alternatives vis-a-vis others, and should be discussed better. 3/01.04.00 cont.

4. The EIS appears partial against the reactor and MOX option by including old data and omitting actual operating results. Presented reactor and fuel characteristics in the EIS appear to be from the 1970's and are completely out of date. The EIS presents cases that would imply lower throughputs and longer completion times with a reactor MOX option as compared to the other options. This is an artifact of the writers' assumptions and contradicts actual experience (i.e., the writers assumed 2-4 reactors, but Europe currently has some 20 reactors licensed and burning MOX, and the United States currently has some 100 plus reactors running, with several utilities willing to investigate MOX cycles with the government). The text includes several misleading and/or incorrect statements:
   - For MOX use, you don't convert the reactor, you change the fuel. The text should also mention 30% versus 100% MOX use (the latter is essentially the uncompleted LWR alternative).
   - The evolutionary/advanced LWR designs plan to use LEU fuel like current reactors. Use of MOX constitutes the same option as for current reactors, although a new reactor of any type can be tailored for MOX use. 4/06.01.08
   - The use of terms like "pay a premium for such MOX fuel" should be explained and referenced - European experience indicates comparable or slightly lower costs with MOX usage.
   - The text should also explain the scheme assumed - 30% vs. 100% load etc. (the text implies 100% is used for all of the reactor options).

   Furthermore, the reactor-MOX alternative is the only option with an analogue operating on an industrial scale, under full IAEA safeguards and external regulatory practices. The correct facts on the reactor-MOX option need to be included in the EIS so that the public and the policy-makers are informed with current, accurate information and practices.

5. The experience of the Europeans and other countries with plutonium disposition is essentially neglected by the EIS. The EIS incorrectly states that Europe (Euratom facilities) has no "excess" MOX capacity. Europe has selected the reactor-MOX option for civilian plutonium, and is recommending the same route for excess weapons-usable fissile materials. To date, some 400 tonnes of MOX fuel, containing some 20 tonnes of plutonium, have been manufactured and irradiated in reactors. Over twenty commercial nuclear reactors in Europe are currently licensed and using MOX fuel. Europe currently has an operating MOX fabrication capacity of over 100 te/yr as MOX (about 6-7 te/yr as plutonium). The Europeans have built two new facilities (Melox and SMP) which are increasing the MOX capacity to close to over 300 te/yr. Both facilities have 5/06.01.08

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06 01 08 Comment Number 4

Comment noted. The Final PEIS was revised to reflect comments received.

06 01 08 Comment Number 5

Comment noted.

MURRAY, ALEXANDER P., GAITHERSBURG, MD
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space for an additional line of some 50-60 te/yr each and have offered this space (for a fee of course) for disposition of excess weapons-usable fissile materials via MOX fabrication and burning in power reactors. Capacity does not appear to be a limiting factor, and the report should reflect this. All of these facts need to be included in the EIS, perhaps as a separate section. The EIS should also discuss the use of the European experience in the U.S., such as by construction of a Melox or an SMP in our country, or use of European-MOX experience in licensing reactors. — 5/06.01.08 cont.

6. Furthermore, the reactor-MOX option produces a benefit (electricity and less resource usage), isotopically modifies the plutonium so it is essentially useless for weapons, and renders it self-protecting (the ANS has issued a white paper making these points and supporting the reactor-MOX approach). It also destroys a significant percentage (50% plus) of the original plutonium. None of the other alternatives has these benefits. This discussion is not included in the text, but should be included in the final EIS. — 6/06.01.08

7. Some form of "stabilization" is needed for long-term storage; this is only briefly mentioned in the text. It is unlikely that fifty-year storage of pits will be "acceptable" to the public, to the IAEA, and to arms control treaties. "Stabilization" will probably constitute the greatest fraction of the storage impacts. Stabilization for storage may also be a subset of stabilization for disposition. This needs to be discussed in the text. — 7/02.00.08

8. The draft suffers from the "build new things" syndrome, particularly for the consolidation alternative. Existing facilities do not seem to receive equal consideration. I would speculate that there is probably adequate room in FMEP for all of the material (I note that FMEF is heavily shielded and should not require any additional shielding). There are also other facilities within DOE that are not even mentioned. These include DAF, E-MAD, and R-MAD at NTS, and the TAN and ICPP areas at INEL. The Barnwell plant adjacent to the SRS also has large vaults and cells suitable for plutonium/HEU storage and/or processing. These should be mentioned (they are viable facilities for operations that would be required under this EIS). The EIS should also distinguish between facilities that are suitable but need equipment and new facilities - 75-80% of the time and costs are associated with the building, not the equipment. — 8/01.02.00

9. Information on LANL and LLNL facilities is not included, but is stated to be added to the final EIS. Usually, sites not mentioned in the draft do not show up in the final EIS. — 9/01.04.00

10. It seems reasonable to exclude U-233 from this EIS. However, the stated reasons appear to refer to nonpurified and irradiated U-233, not to pure U-233, and could also be applied — 10/01.04.00

M-150

06 01 08 **Comment Number 6**

Comment noted.

02 00 08 **Comment Number 7**

A basic assumption for this environmental analysis is that the materials are already in a stabilized form before they are received for storage. Actions taken for materials stabilization are covered by analyses under the Environmental Management Program.

01 02 00 **Comment Number 8**

The Department of Energy looked at many of the facilities you mentioned in assessing the Upgrade at Multiple Sites Alternative. These facilities must meet the selection criteria which include cost-effectiveness, timeliness, and technical viability, and the facilities would not be used for other missions. For example, the FMEF is included as a reasonable alternative at Hanford.

01 04 00 **Comment Number 9**

One and one-half tons of Pu material located at LANL was designated as surplus. None of the Pu material located at LLNL has been designated as surplus. Although LANL is not a candidate site for either long-term storage or disposition of surplus Pu, it is analyzed in the Final PEIS under the No Action Alternative since this material would remain at LANL. The Draft PEIS mentions that the LANL No Action Alternative for storage would be addressed in the Final PEIS.

01 04 00 **Comment Number 10**

The Department of Energy continues to maintain the same position presented in the Draft PEIS. Since uranium-233 (U-233) disposition is not ready for a decision, DOE is not currently proposing to take action on the disposition of surplus U-233, which will continue to be stored at current locations.

to plutonium. (The handling properties of purified, unirradiated U-233 are similar to HEU.) The rationale should be explained better. | 10/01.04.00 cont.

11. In the EIS, the HLW repository should be referred to as the Federal repository (for spent fuel and HLW - its main function is actually for commercial SNF). Also, there should be a statement and reference for the CANDU MOX SNF staying in Canada after discharge. | 11/12.00.00

12. It is unclear why the immobilization alternative has a 5 te/yr (plutonium) capacity, while the MOX plant/reactor alternative is around 2-3 te/yr (the Melox and SMP each have a capacity of 120 te/yr MOX - about 6 te/yr plutonium per plant). Capacity and schedule would appear to favor reactor MOX use. These points should be discussed, and, at a minimum, the capacity of MOX should at least equal that of the other alternatives for consistency. | 12/01.02.00

13. The EIS should elaborate upon statements such as "... no waste forms are currently licensed for disposal in an HLW repository." This is half true because the repository is not licensed. However, vitrified wasteforms are generally recognized by the regulators as being acceptable - the EPA has even determined that vitrification constitutes BDAT for HLW. These points should be brought out. | 13/09.11.08

14. The site and facility sizes seem huge for the operations involved - these need to be explained and the bases presented. The basis for the one mile buffer zone needs explanation. The MOX sites in Europe do not require 2,200 acres, and the disparity needs explanation. | 14/09.01.08

15. The EIS appears to be naive on spent nuclear fuel management. For example:
- Dry storage technologies already exist - they don't require development.
- Cooling time in the pool varies with fuel history and dry cask design; 5 years (not 10 years) is typical, and this should be pointed out in the text.
- The additional SNF assemblies due to MOX is puzzling, and should be explained. The European experience indicates that the irradiation times and quantities for MOX assemblies should be the same as for LEU assemblies.
- Typical fuel cycles are 18-24 months, not 12-18 months. | 15/06.00.08

16. There should be a check for consistency and the use of the same bases throughout the document (e.g., time, disposition rate etc.) | 16/16.00.00

M-150

12 00 00 Comment Number 11

It is true that commercial spent nuclear fuel constitutes the majority of the waste for disposal in a geologic repository. Since this analysis assumes a hypothetical operating repository, DOE elected to refer to it as a HLW repository. Disposal options for CANDU spent nuclear fuel are discussed in Section 2.4.5.5 of the PEIS.

01 02 00 Comment Number 12

The assumptions for throughput of the various facilities are based on the lifecycle of the entire alternative, not just how fast the facility can process the materials. Analyses of the cost, schedule, and technical aspects of the various alternatives are presented in a separate document available for public review beginning in late July 1996.

09 11 08 Comment Number 13

A sentence has been added to Section H.1 of the Final PEIS to acknowledge the fact that the EPA did announce in a *Federal Register* notice in June 1990 that vitrification constitutes the best demonstrated technology available for HLW.

09 01 08 Comment Number 14

Land area requirements during operation for disposition alternatives appear to be much greater than for storage alternatives. This is attributed to the site-specific nature of the storage alternatives which incorporate the infrastructure and environmental features of the DOE analysis site versus the greenfield condition of most disposition alternatives. Additionally, the need for buffer zones would increase the total land area requirement. Since all storage alternatives would be situated on a DOE site, buffer zones are already established. The greenfield requirement for a 1.6-km (1-mi) buffer zone area would be reduced at some DOE storage sites where existing site conditions preclude compliance. Additional buffer zone areas, as part of the operations total land area requirement, would not be added to the storage alternatives.

MURRAY, ALEXANDER P., GAITHERSBURG, MD
PAGE 5 OF 5

17. The impacts need to be verified and their consistency checked. For example, the reactor-MOX options are shown as having a high power consumption, which is incorrect because there is a large, positve power production (if you will, "negative consumption"). Some other impacts of reactor-MOX alternatives also appear anomalous (e.g., land use, LCFs). Again, a difference-type analysis focusing just on the MOX effect would be beneficial and correct. — 17/06.01.08

I notice that a 60 day comment period has been allotted for this EIS. This seems unrealistically short for an EIS of this importance and inconsistent with other recent EISs, which typically allow 90 or 120 days for comments. If possible, it would be beneficial if an additional 30 days could be allowed for public comment. — 18/08.01.00

The EIS has the beginnings of a good document and the comments should help the writers complete it. I greatly appreciate the opportunity to comment on this EIS, and please feel free to contact me if you have any questions.

Sincerely,
Alex Murray
Alexander P. Murray.

M-150

Buffer zones relate to such issues as providing sufficient access around building exteriors to accommodate emergency vehicles, as well as open space for security patrols. Distances from facilities to the site boundaries and between facilities are based on technical, safety, and security considerations. The buffer zone is not necessarily used exclusively as open space. Some support facilities (for example, sanitary landfills or stormwater management ponds) may be located in the buffer zone. The need for buffer zones would be determined during site-specific reviews that would follow this PEIS. Siting criteria would generally follow DOE Order 430.1, *Life Cycle-Asset Management.*

As a greenfield site, the MOX Fuel Fabrication Facility Alternative would require approximately 890 ha (2,200 acres) during operation to accommodate the facility and at least a 1.6-km (1-mi) buffer zone. However, the operating facility (that is, MOX Fuel Fabrication Facility, support facilities, roads, and parking lots) would only disturb approximately 81 ha (200 acres).

06 00 08 **Comment Number 15**

Corrections/changes have been made to Chapter 2, Sections 4.3.5.2.10 and 4.3.5.3.10 of the PEIS.

16 00 00 **Comment Number 16**

A consistency check was performed on the Final PEIS as a part of the Quality Assurance Procedure.

06 01 08 **Comment Number 17**

Comment noted.

08 01 00 **Comment Number 18**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

COMMENT FORM
These comments apply to the Storage and Disposition Draft PEIS

NAME: Joy Myers
ADDRESS: HC 62 Box 41, Dubois, ID 83423
TELEPHONE: (208) 374-5359

As the criteria against which to judge potential alternatives were based on the President's nonproliferation policy, it appears to me that nonproliferation aspects should be addressed in the Storage and Disposition Draft PEIS specifically as they relate to each alternative. Page S-5 of the Summary states: "The criteria include nonproliferation; security; environment, safety, and health; timeliness and technological viability; cost-effectiveness; international cooperation; and peaceful beneficial reuse whenever possible." Analysis of the alternatives addresses only a few of these criteria. 1/01.06.00

For instance, the Long-term Storage Alternatives all appear to violate the stated criteria. Leaving surplus fissile material in its present form and in long-term storage sets a poor example for both nonproliferation efforts and international cooperation. Would the United States be content if the former Soviet Union agreed to merely place its surplus fissile material into long-term storage? Is this really any different than stockpiling? While it is presumable that consolidation and/or collocation would help address the security criterion, such analysis is missing from the PEIS. A discussion of the cost-effectiveness of upgrading or constructing long-term storage facilities without actually eliminating surplus fissile material is also missing. No where is the preference for peaceful beneficial reuse mentioned. 2/01.04.00 3/07.01.00 4/01.05.00

Under the Disposition Alternatives, much of the above paragraph also applies to the Deep Borehole Direct Disposition Alternative. Assumedly, security considerations may be improved, but this approach is in reality merely another version of long-term storage. By using a generic site for analysis, the PEIS ignores the problems inherent in attempting to locate and open such a facility anywhere in the United States. Are areas which meet the deep borehole standards even available? Such practical and political considerations need, at least, a mention. The Deep Borehole Immobilized Disposition Alternative is an improvement, but it also neglects to consider the peaceful beneficial reuse criterion in addition to the problem of attempting to site such a waste facility. 5/04.03.00 6/04.02.00

Based on the environmental, safety and health information contained in the PEIS, the Electrometallugical Treatment Alternative is clearly preferable in the immobilization category. Impacts on waste management at the INEL appear to be small; and, according to Governor Batt's statement, surplus fissile material would be acceptable under the conditions of the Idaho Agreement if it were shipped to the INEL for treatment. The ability of this process to produce LEU from HEU has the potential for meeting both the nonproliferation standard as well as the beneficial reuse standard. In addition, the process could have the capability of immobilizing the forms of PU not suitable for MOX fabrication. 7/08.03.01

F-005

01 06 00 Comment Number 1

The purpose of the Proposed Action is, in part, to establish the technical and program infrastructure that will enable the United States to take unilateral action or negotiate reciprocal actions with other nations for the disposition of surplus weapons-usable Pu. This PEIS addresses the environmental impacts of the reasonable alternatives for DOE's Proposed Action. Analyses of the cost, schedule, technical, and Nonproliferation Policy impacts are described in separate documents to support DOE's ROD. The documents related to technical, cost, and schedule analyses were made available for public review beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the analysis of the Nonproliferation Policy as it relates to the Proposed Action and alternatives.

01 04 00 Comment Number 2

The intent of DOE's Proposed Action is to provide storage for the nonsurplus weapons-usable fissile materials and for surplus Pu materials pending disposition, since the disposition action would take time. The impacts of the Proposed Action and reasonable alternatives on implementation of the President's Nonproliferation Policy are analyzed in a separate document in support of the ROD.

07 01 00 Comment Number 3

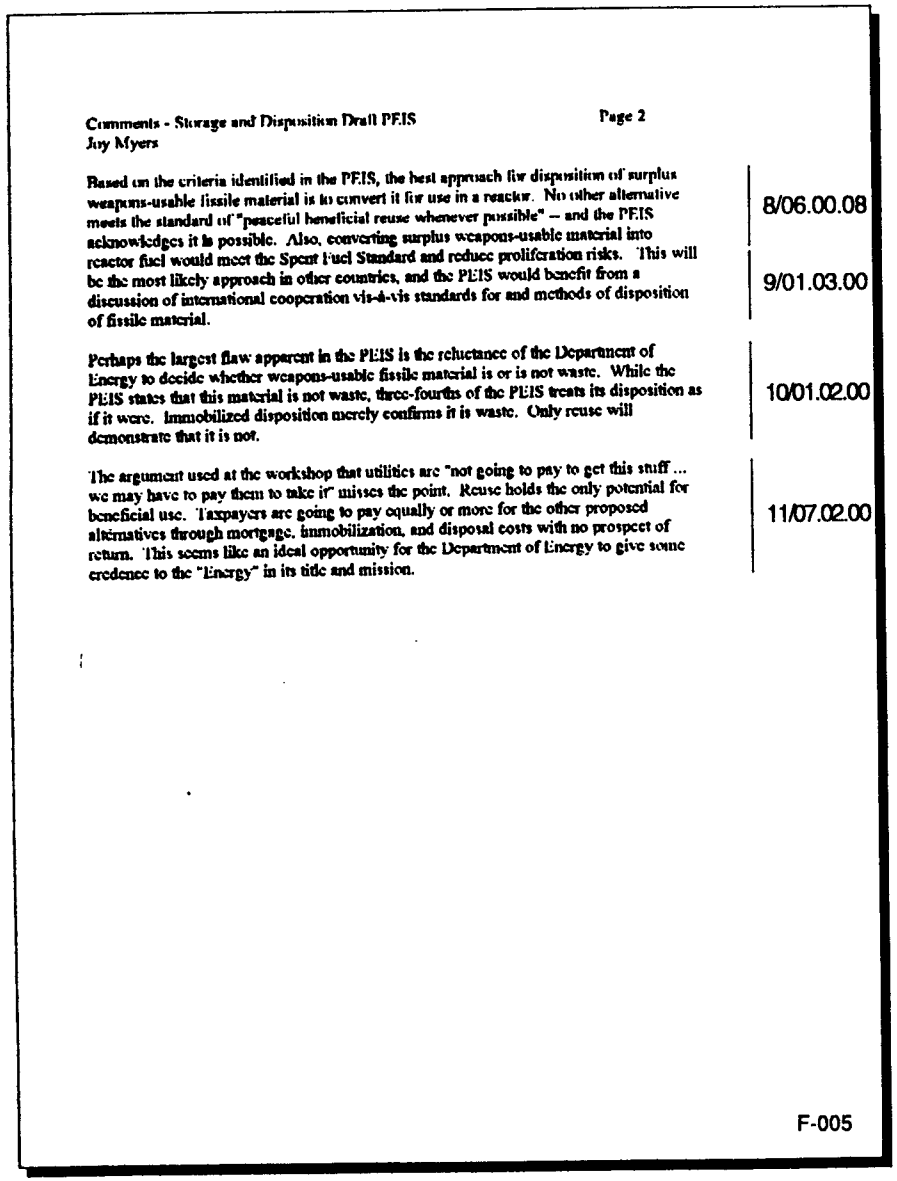
Cost data, along with technical and schedule data, was provided in Technical Summary Reports of both storage and disposition beginning in late July 1996.

01 05 00 Comment Number 4

Additional benefits were included in the criteria for the screening process which led to the alternatives which were analyzed in the PEIS.

04 03 00 Comment Number 5

As noted in Chapter 2 of the PEIS, identification of a suitable site for a deep borehole is beyond the scope of this PEIS. Regarding suitable geology,



Comments - Storage and Disposition Draft PEIS Page 2
Joy Myers

Based on the criteria identified in the PEIS, the best approach for disposition of surplus weapons-usable fissile material is to convert it for use in a reactor. No other alternative meets the standard of "peaceful beneficial reuse whenever possible" -- and the PEIS acknowledges it is possible. Also, converting surplus weapons-usable material into reactor fuel would meet the Spent Fuel Standard and reduce proliferation risks. This will be the most likely approach in other countries, and the PEIS would benefit from a discussion of international cooperation vis-á-vis standards for and methods of disposition of fissile material. 8/06.00.08 9/01.03.00

Perhaps the largest flaw apparent in the PEIS is the reluctance of the Department of Energy to decide whether weapons-usable fissile material is or is not waste. While the PEIS states that this material is not waste, three-fourths of the PEIS treats its disposition as if it were. Immobilized disposition merely confirms it is waste. Only reuse will demonstrate that it is not. 10/01.02.00

The argument used at the workshop that utilities are "not going to pay to get this stuff ... we may have to pay them to take it" misses the point. Reuse holds the only potential for beneficial use. Taxpayers are going to pay equally or more for the other proposed alternatives through mortgage, immobilization, and disposal costs with no prospect of return. This seems like an ideal opportunity for the Department of Energy to give some credence to the "Energy" in its title and mission. 11/07.02.00

F-005

Section 3.9.5 notes potential host rock media for a deep borehole site in the contiguous United States.

04 02 00 Comment Number 6

While the Borehole Alternative offers no potentially beneficial use of this material, this lack of access makes it difficult to divert to weapons use.

08 03 01 Comment Number 7

The Department of Energy acknowledges the commentor's support for the Electrometallurgical Treatment Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, existing agreements, and public input.

06 00 08 Comment Number 8

Comment noted.

01 03 00 Comment Number 9

The PEIS focuses on the environmental impacts of each alternative. DOE's decision process will be based on the results of the Final PEIS, together with information from technical and economic studies, national policy objectives, and public input. This process will provide the United States with the basis and flexibility to implement Pu disposition efforts multilaterally, bilaterally through negotiations, or unilaterally as an example to Russia and other nations.

01 02 00 Comment Number 10

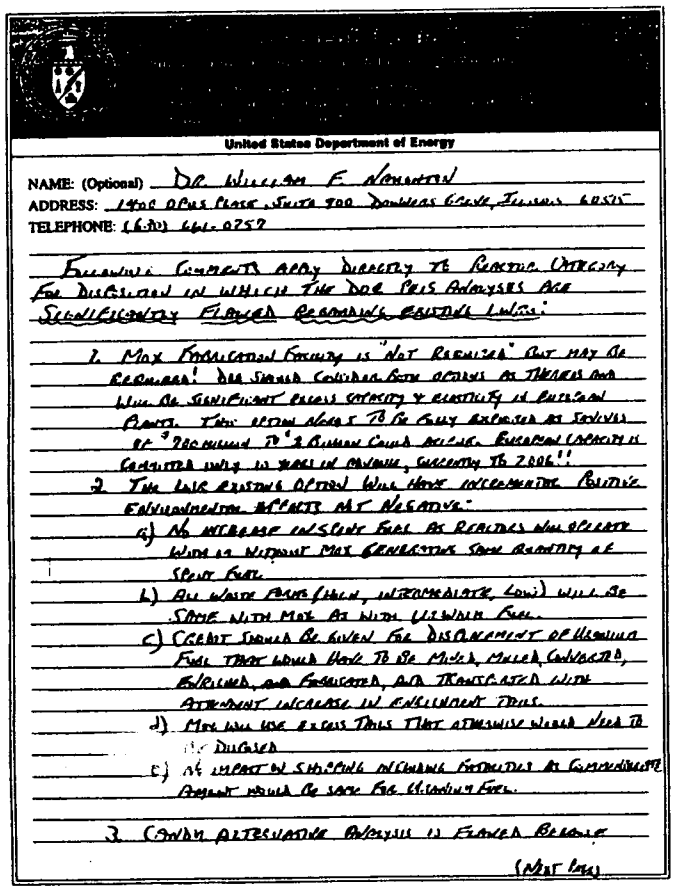
The AEA materials (including special nuclear materials such as weapons-usable fissile materials) are excluded from the definition of solid waste under RCRA and its implementing regulations, as stated in the *Solid Waste Disposal Act*, Section 1004. Furthermore, Section 1006 states that RCRA does not apply to any materials that are subject to the AEA.

All reasonable alternatives for surplus Pu disposition analyzed in the PEIS would generate wastes. The environmental impacts of the various wastes are discussed in Section 4.3 and Appendix E.

07 02 00 Comment Number 11

Cost data, along with technical and schedule data, were provided in a Technical Summary Report for disposition beginning in late July 1996. This report included consideration for reactor fuel cost offsets that could be realized by using MOX fuel in existing reactors as a discussion of possible revenues that could be realized from the sale of electricity or steam from a new or partially completed reactor using MOX fuel and net life cycle costs.

NAUGHTON, WILLIAM F., DOWNERS GROVE, IL
PAGE 1 OF 2



United States Department of Energy

NAME: (Optional) Dr. William F. Naughton
ADDRESS: 1400 Opus Place, Suite 900 Downers Grove, Illinois 60515
TELEPHONE: (630) 661-0757

Following comments apply directly to Reactor Category for disposition in which the DOE PEIS analyses are significantly flawed regarding existing LWRs:

1. Mox fabrication facility is "not required" but may be required! DOE should consider both options as thereof and will be significant excess capacity & elasticity in European plants. This option needs to be fully exposed as savings of $700 million to $1 billion could accrue. European capacity is committed only 10 years in advance, currently to 2006!! 1/06.01.09
2. The LWR existing option will have incremental positive environmental effects not negative:
   a) No increase in spent fuel as reactors will operate with or without Mox generating same quantity of spent fuel.
   b) All waste forms (high, intermediate, low) will be same with Mox as with Uranium fuel. 2/06.02.09
   c) Credit should be given for displacement of Uranium fuel that would have to be mined, milled, converted, enriched, and fabricated, and transported with attendant increase in enrichment tails.
   d) Mox will use excess tails that otherwise would need to be disposed
   e) No impact on shipping including fatalities as commensurate amount would be same for Uranium fuel.
3. Candu alternative analysis is flawed because 3/06.05.09

(Next page)

DC-004

06 01 09 Comment Number 1

Europe is moving toward a balance between the capacity to fabricate MOX fuel and the capacity to utilize MOX fuel in reactors. Additionally, Europe has excess separated Pu stores which they intend to use as MOX fuel as the fuel fabrication infrastructure and reactor infrastructure permits. Therefore, use of European reactors for consumption of U.S. Pu-source MOX fuel would merely displace the use of separated European Pu and result in no net reduction in world inventories of separated Pu. Hence, the statement that Europe has no excess MOX capacity. Additionally, facility utilization projections indicate that, while some excess MOX fuel fabrication capacity may exist in Europe for the next few years, current capacity is soon expected to be fully utilized for commercial MOX fabrication. Therefore, the United States may not be able to rely on the use of existing European MOX fabrication capacity for the entire disposition campaign. However, as a part of efforts to develop weapons-grade Pu MOX fuel, DOE is consulting with European Fuel Fabricators to benefit from their experience in MOX fuel fabrication and may have some MOX Lead Test Assemblies and/or initial core loads fabricated in Europe. Also, participation in the construction and operation of a MOX Fuel Fabrication Facility in the United States will be open to European fuel vendors.

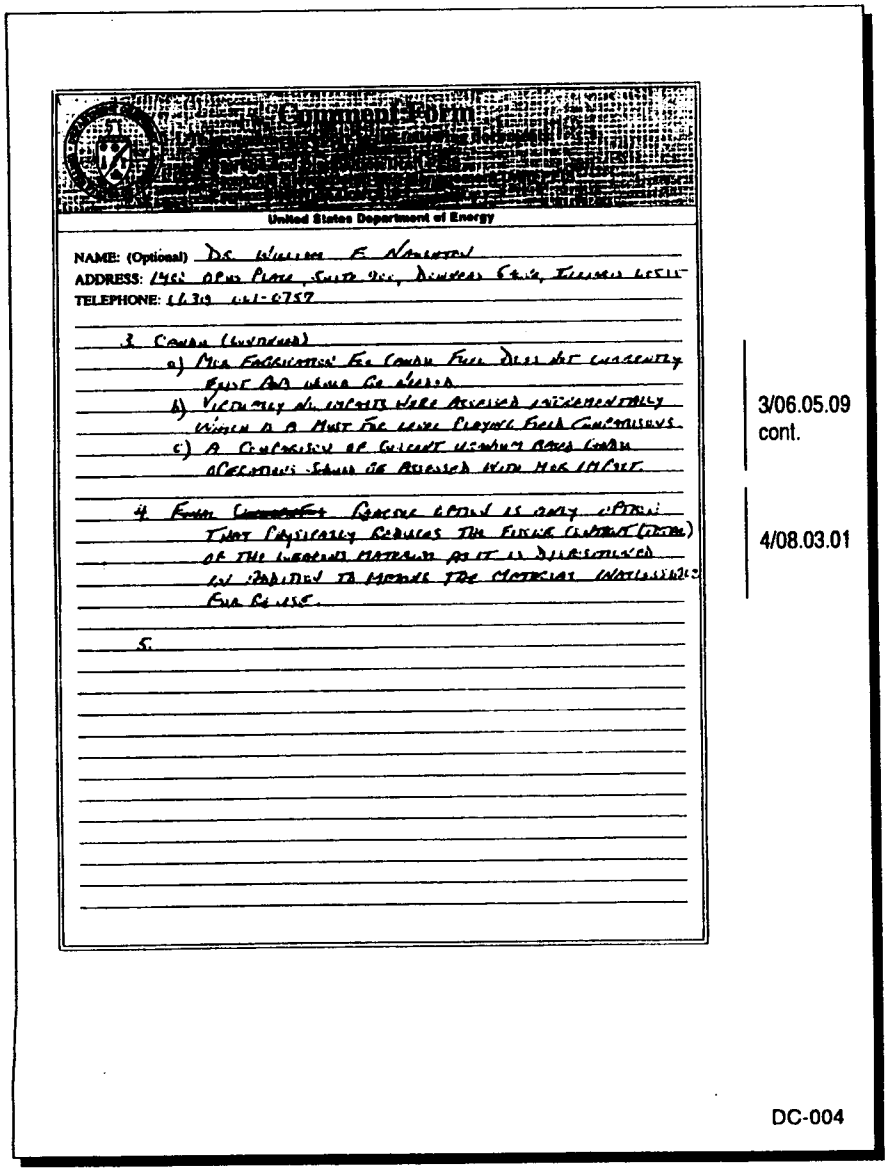
06 02 09 Comment Number 2

The avoided impacts are considered in Section 4.9 of the PEIS.

06 05 09 Comment Number 3

If the CANDU Reactor Alternative is selected, a complete assessment of reactor environmental impacts in Canada would be performed, pursuant to Canadian Federal and Provincial law.

NAUGHTON, WILLIAM F., DOWNERS GROVE, IL
PAGE 2 OF 2



Comment Form

United States Department of Energy

NAME: (Optional) Dr. William F. Naughton
ADDRESS: 1450 Opus Place, Suite 900, Downers Grove, Illinois 60515
TELEPHONE: 630 [illegible]-0757

3. Candu (continued)
a) Mox Fabrication for Candu Fuel Does not currently exist and would be needed.
b) Virtually no impacts were assessed incrementally which is a must for level playing field comparisons.
c) A comparison of current uranium based Candu operations should be assessed with mox impact.

3/06.05.09 cont.

4. Final ~~[illegible]~~ Reactor option is only option that physically reduces the fissile content (total) of the weapons material as it is dissociated in addition to making the material inaccessible for reuse.

4/08.03.01

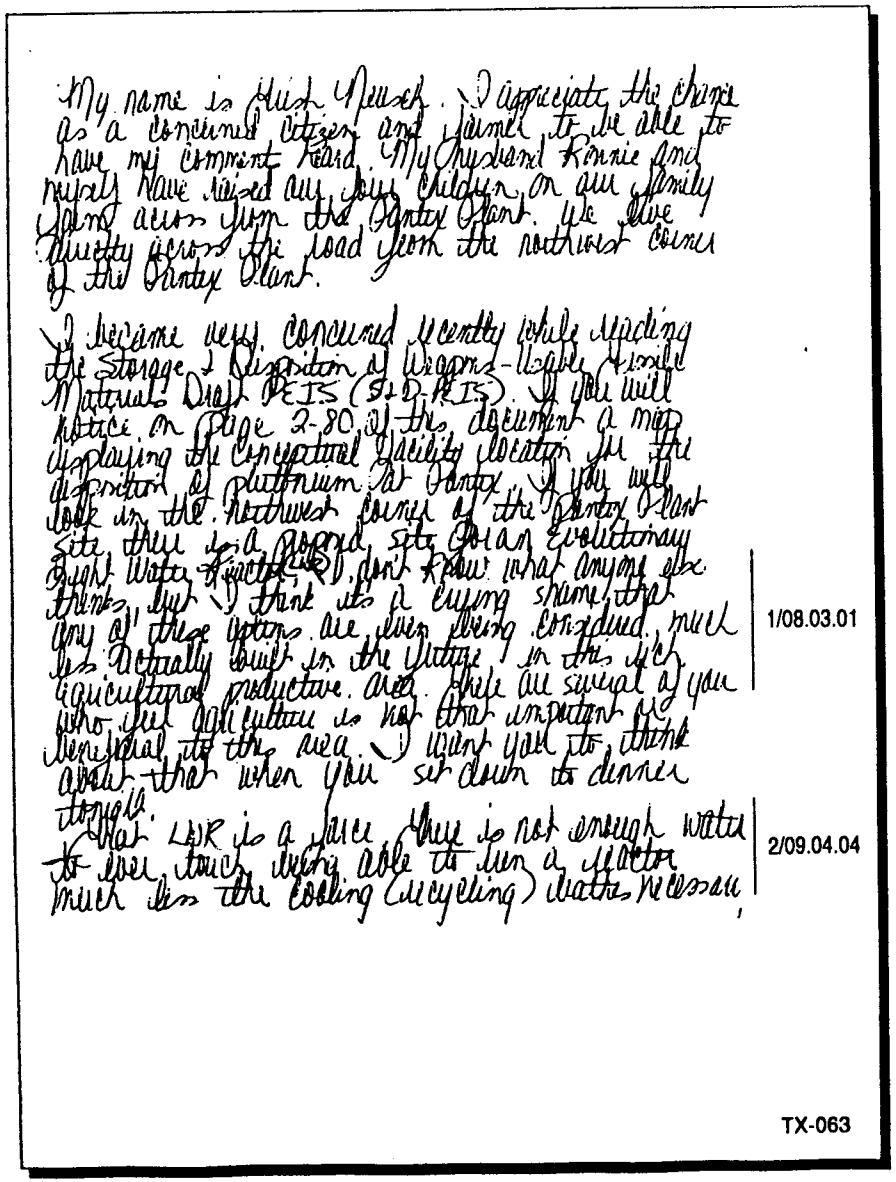
5.

DC-004

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

NEUSCH, TRISH, PANHANDLE, TX
PAGE 1 OF 3



My name is Trish Neusch. I appreciate the chance as a concerned citizen and farmer to be able to have my comment heard. My husband Ronnie and myself have raised our four children on our family farm across from the Pantex Plant. We live directly across the road from the northwest corner of the Pantex Plant.

I became very concerned recently while reading the Storage & Disposition of Weapons-Usable Fissile Materials Draft PEIS (S&D-PEIS). If you will notice on page 2-80 of this document a map displaying the conceptual facility location for the disposition of plutonium at Pantex. If you will look in the northwest corner of the Pantex Plant site, there is a proposed site for an Evolutionary Light Water Reactor (LWR). I don't know what anyone else thinks, but I think it's a crying shame that any of these options are even being considered, much less actually built in the future in this rich agricultural productive area. There are several of you who feel agriculture is not that important or beneficial to this area. I want you to think about that when you sit down to dinner tonight. 1/08.03.01

That LWR is a farce. There is not enough water to ever touch being able to run a reactor much less the cooling (recycling) baths necessary. 2/09.04.04

TX-063

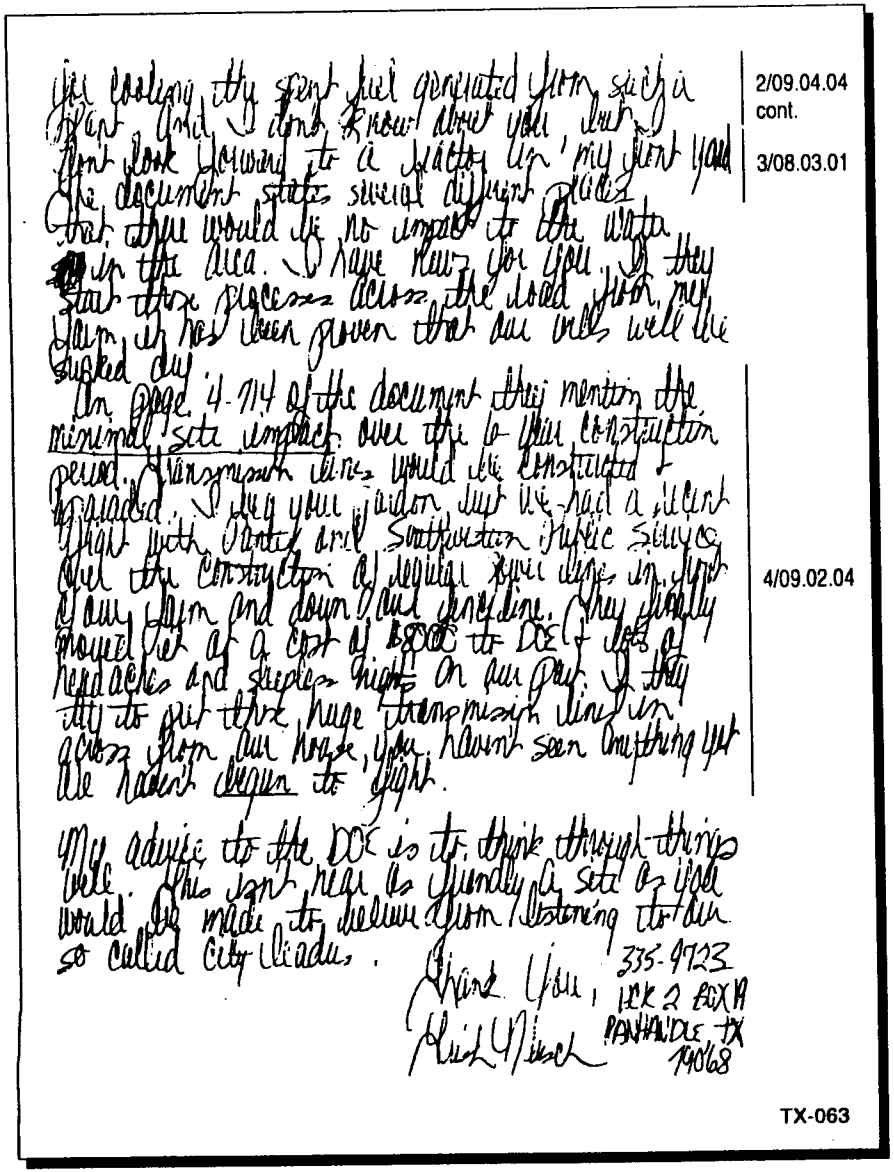
08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 04 04 **Comment Number 2**

It is possible that treated wastewater from the City of Amarillo could be used to supply the evolutionary LWR (Section 4.3.5.4.4). Cost issues are not within the scope of this PEIS. In this case, there would be no additional impacts over the No Action Alternative to groundwater resources. Environmental impacts from siting an Evolutionary LWR at Pantex would be evaluated in future site-specific reviews, as required, if this technology is chosen as a disposition alternative.

NEUSCH, TRISH, PANHANDLE, TX
PAGE 2 OF 3



for cooling the spent fuel generated from such a plant. And I don't know about you, but I don't look forward to a reactor in my front yard. The document states several different places that there would be no impact to the water in the area. I have news for you. If they start those processes across the road from my farm, it has been proven that our wells will be sucked dry. 2/09.04.04 cont. 3/08.03.01

On page 4-114 of the document they mention the minimal site impact over the 6 year construction period. Transmission lines would be constructed & upgraded. I beg your pardon but we had a recent fight with Pantex and Southwestern Public Service over the construction of regular power lines in front of our farm and down our fenceline. They finally moved it at a cost of $8000 to DOE & lots of headaches and sleepless nights on our part. If they try to put those huge transmission lines in across from our house, you haven't seen anything yet we haven't begun to fight. 4/09.02.04

My advice to the DOE is to think through things well. This isn't near as friendly a site as you would be made to believe from listening to our so called City leaders.

Thank You,
Trish Neusch

335-9723
HCR 2 BOX 19
PANHANDLE, TX
79068

TX-063

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 02 04 **Comment Number 4**

Construction and operation of all storage alternatives at Pantex would not affect site infrastructure. Construction of all disposition alternatives would not affect infrastructure at Pantex, except for the evolutionary LWR. The evolutionary LWR at Pantex would require additional peak electrical load during construction. New and upgraded transmission lines would be put in place for increased and redistributed electrical load as part of the construction phase. Adequate electrical energy would be available from the regional power grid. The sub-regional electric power pool from which Pantex draws its power is the West Central Power Pool. Should the Evolutionary LWR Alternative be selected, the need for and location of any new or upgraded electrical lines would be determined in site-specific, tiered NEPA documentation, as required.

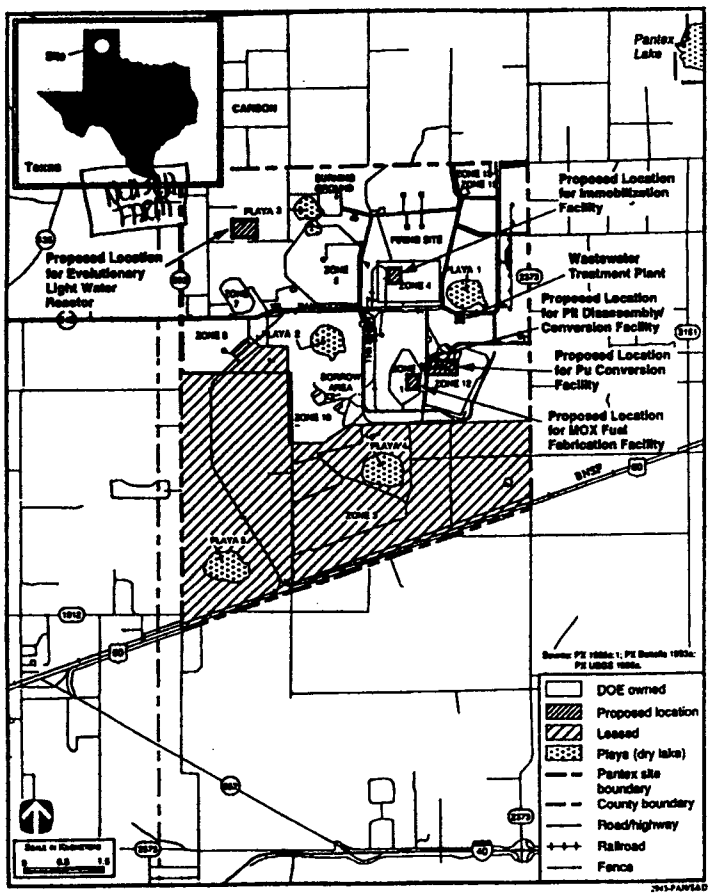


Figure 2.4-4. Conceptual Facility Location for the Disposition of Plutonium at Pantex Plant.

2-80

TX-063

NEVADA NUCLEAR WASTE TASK FORCE, INCORPORATED

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Las Vegas, NV 89102
702-248-1127
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April 2, 1996

David Nulton
DOE
Office of Fissile Material Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

COMMENTS ON THE DRAFT PEIS FOR STORAGE AND DISPOSITION OF FISSILE MATERIALS

As with several of the Environmental Impact Statements now underway, critical comment on alternatives is of questionable value because the Department of Energy's stated intention is to select a "hybrid alternative." To do a complete evaluation of any proposed action, the commenter must have complete and clearly defined details, and know that the action, as stated, is a viable option. At a public meeting, held to discuss this document, workshop participants were told that none of the proposed actions was a "preferred alternative" and that the final Record of Decision could include elements chosen from several alternatives. Such a plan puts public participants at a serious disadvantage and weakens the effectiveness of their involvement. The result is declining or further fortified distrust toward the federal agency and its decisions - especially in matters where public health and safety are, or should be the highest priority. 1/08.03.01

The alternatives in the DPEIS are in two categories - long-term storage and plutonium disposition.

Long-Term Storage

Long-term storage is defined as fifty years. At the public meeting in Las Vegas the "no action" and upgrade alternatives were discussed in a facilitated workshop. The DOE presenter said, in response to questions, that the "no action" proposal would leave plutonium where it is and not include improvements and repairs necessary to bring facilities into a safe condition. Knowing that the existing facilities have deficiencies and problems that threaten the health and safety of workers and nearby communities, this alternative is unacceptable and could be considered a "straw man." 2/01.04.00

M-010

08 03 01 Comment Number 1

Between the issuance of the Draft and the Final PEIS, DOE has obtained information from a variety of sources, including the public. Public input was used to determine the Preferred Alternative and will be considered in DOE's decisionmaking process. DOE also conducted cost, schedule, and nonproliferation studies and reviewed various studies with the public before determining the Preferred Alternative.

01 04 00 Comment Number 2

Under the No Action Alternative, environmental and safety upgrades and maintenance at existing storage facilities would be done, as required, to ensure safe operation for the balance of the facility's useful life. The No Action Alternative is required pursuant to Council on Environmental Quality (CEQ) Regulations implementing NEPA.

NEVADA NUCLEAR WASTE TASK FORCE, INC., LAS VEGAS, NV,
JUDY TREICHEL
PAGE 2 OF 3

The second alternative - upgrade existing facilities - would clearly be the preference of this commenter, except that the DOE presenter said that it would include partial consolidation. "Partial consolidation" is a vague term and lends itself to the "hybrid decision" that would not be a subject to thorough evaluation by the public. | 3/08.02.00

Neither of the two consolidation alternatives should be selected. There is no proven, safe method for long-term nuclear material storage. Every site is now, and will be, experimental with unforeseen situations and trial and error style responses. Consolidation, therefore does not ensure safety or environmental protection. It also has a transportation component that increases risks to a far greater number of people. | 4/02.03.08 | 5/10.00.00

Plutonium Disposition
Three technology alternatives are discussed for Plutonium Disposition. Two of them are not disposal technologies. Immobilization and reactor use are simply a change in the waste form. Currently, it is assumed that the resulting forms suggested will go to a repository for disposal. Because the existence or availability of a repository is not certain (and perhaps not likely), these two alternatives are incorrectly defined. | 6/11.01.08

The third choice - deep borehole - is another possible "straw man." It is a concept with no proven merit and there is no site with any chance of public approval. | 7/04.00.00

Clearly, the only option worth considering is long-term storage alone - it is the reality of the situation. Meanwhile alternatives for disposal should continue to be researched. Given the status of the knowledge about alternatives, a disposal decision is premature. | 8/02.00.08 | 9/08.03.00

The preparation of an EIS is not simply a troublesome box to be checked off in the federal process. Likewise, the key element of it - public participation is not an unimportant detail. Of all the entities, (or in DOE jargon - "stakeholders") involved, the public is the only lasting one. While federal agencies come and go and congressional decisions change continually, the public remains. The citizens pay the costs, live with the risks and ultimately will be either adequately protected or the victims of irreversible consequences | 10/08.02.00

Submitted by,

Judy Treichel
Executive Director

M-010

08 02 00 **Comment Number 3**

The PEIS provides specific information on the partial consolidation portion by analyzing the impacts of moving all of the surplus material from RFETS and LANL to one or more of the six sites being analyzed. Therefore, if all of the materials were sent to more than one site, environmental impacts at any of the sites receiving material would be less.

02 03 08 **Comment Number 4**

Comment noted.

10 00 00 **Comment Number 5**

The human health risks of material transportations associated with the proposed Pu storage and disposition alternatives are evaluated and presented in Section 4.4 of this PEIS. The more detailed description of the methodology and supporting data for the analysis is presented in Appendix G. Transportation of radioactive materials between sites includes health risks for both normal operations and accident conditions to the public and workers.

11 01 08 **Comment Number 6**

Comment noted. However, the goal is to convert the material into a form that meets the Spent Fuel Standard, which is not dependent on the availability of a repository.

04 00 00 **Comment Number 7**

Since no sites have been selected for a deep borehole and there are no existing deep boreholes utilized for waste disposal, DOE chose to analyze a generic borehole site for environmental impacts. The other disposition technologies require facilities which are similar to existing facilities in the United States. Therefore, DOE chose to pick representative sites for the other disposition alternatives.

02 00 08 **Comment Number 8**

Comment noted.

08 03 00 **Comment Number 9**

The Department of Energy is following a schedule that allows the careful consideration of all relevant information, such as this PEIS, technical and economic studies, and commentors' input. Then good, sustainable decisions can be made.

08 02 00 **Comment Number 10**

Comment noted. DOE is committed to full implementation of NEPA that includes public participation at all levels. All comments submitted receive full consideration.

NEWMAN, R. I., FRIPP ISLAND, SC
PAGE 1 OF 7

R.I. Newman
388 Wahoo Drive
Fripp Island, SC 29920
(803) 838-4789

May 6, 1996

U. S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

Dear Persons:

Thank you for the opportunity to comment on your "Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement" (hereafter "PEIS").

The subject addressed in the PEIS must rank as among the most important, long- and short-term-affecting actions considered by the Department of Energy (DOE) in decades. It could have very significant impacts on near-term (two decades) budgets for R&D on unproven processes (with unpredictable delays and cost over-runs, based on earlier DOE projects), possible catastrophic energy crises in future years, perpetuation of significant CO_2 contamination of our atmosphere (in violation of international commitments), weakening of our national security, near- and long-term avoidable gross increase in energy costs (impacting most on some minorities and other low-income populations).

It should also complete the National Environmental Policy Act (NEPA) uncompleted review of the effect of using mixed oxide fuel (MOX) in reactors, along with reprocessing, on which(illegal?) actions were taken by Presidents Carter and Clinton in what appeared to be violation of the congressional mandate requiring such review in advance of any action having a potential major impact on the environment (the proliferation aspects of the Generic Environmental Statement on Mixed Oxide Fuel were abandoned by the NRC after Mr. Carter's unilateral executive order).

I have two major objections to the PEIS as issued for public comment.

The first problem is the lack of information on matters decreed by Congress to be included in any environmentas study as mandated by NEPA.

The second problem has to do with the subject of minimizing the possibility of proliferation of weapons-usable plutonium in the U.S..

As to the first concern, the statement of policy in NEPA

M-162

requires several actions pertinent to my concerns: Title I, SEc.101,(a) "...fulfill the social,economic, and other requirements of present and future generations of Americans."; Title I, Sec.101, (b), (1), "fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;"; Title I, SEc.101, (b), (6), "enhance the quality of renewable resources and approach the maximum attaining recycling of depletable resources."; Title I, SEc. 102,(C), (iv), "The relationship between local short-term uses of man's environment and the maintenance of long-term productivity; Title I, Sec. 102, (C), (v), "any irreversilbe and irretrievable commitments of resources which would be involved in the proposed action should it be implemented."; Title I, Sec. 102, (F) "Recognize the worldwide and long range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing decline in the quality of mankind's world environment." (Emphasis added)

My concerns, which prompt these comments are several. They include: 1. we seem to be more and more dependent on foreign sources for our fossil-fueled energy systems--gasoline ("borrowing" oil from our "strategic reserve"); 2. there is a finite limit to the,now vast, fossil fuel reserves; 3, we have only one proven, available, economic ally competetive alternative to fossil fuel--nuclear; 4. while once the leader in nuclear technology, we are year by year losing those engineers with competence in designing safe nuclear fuel cycle facilities; 5. our nation's leaders seem to be oblivious to the relationship between readily available and dependable sources of energy and our national security; 6. loss of a supply of low-cost, readily available energy will not only impact our security, but will have a disastrous effect on our disadvantaged, low-income people with their iuavoidable need for heat for their homes and gas for their cars. | 1/08.03.01

A decision now to take an action which would intend to make a useful,and available energy scurce as irretrievable as possible and perpetuate the myth that we should not recycle partly used nuclear fuel would be tantamount to sounding the death-knell and driving the last nail in the coffin for the imminent demise of nuclear power, only to be brought back to life (inevitably) at great cost and only with the help of those foreign countries to whom we were once the leader.

The PEIS should look aheada as directed by NEPA at least fifty years at the impact on "future generations". | 2/08.00.00

The PEIS should also look outside their blindered view of the "complete, uncompleted reactors" and "build advanced reactor" concepts. In the future, our country will need more large-scale supplies of electric power. The only two | 1/08.03.01 cont.

M-162

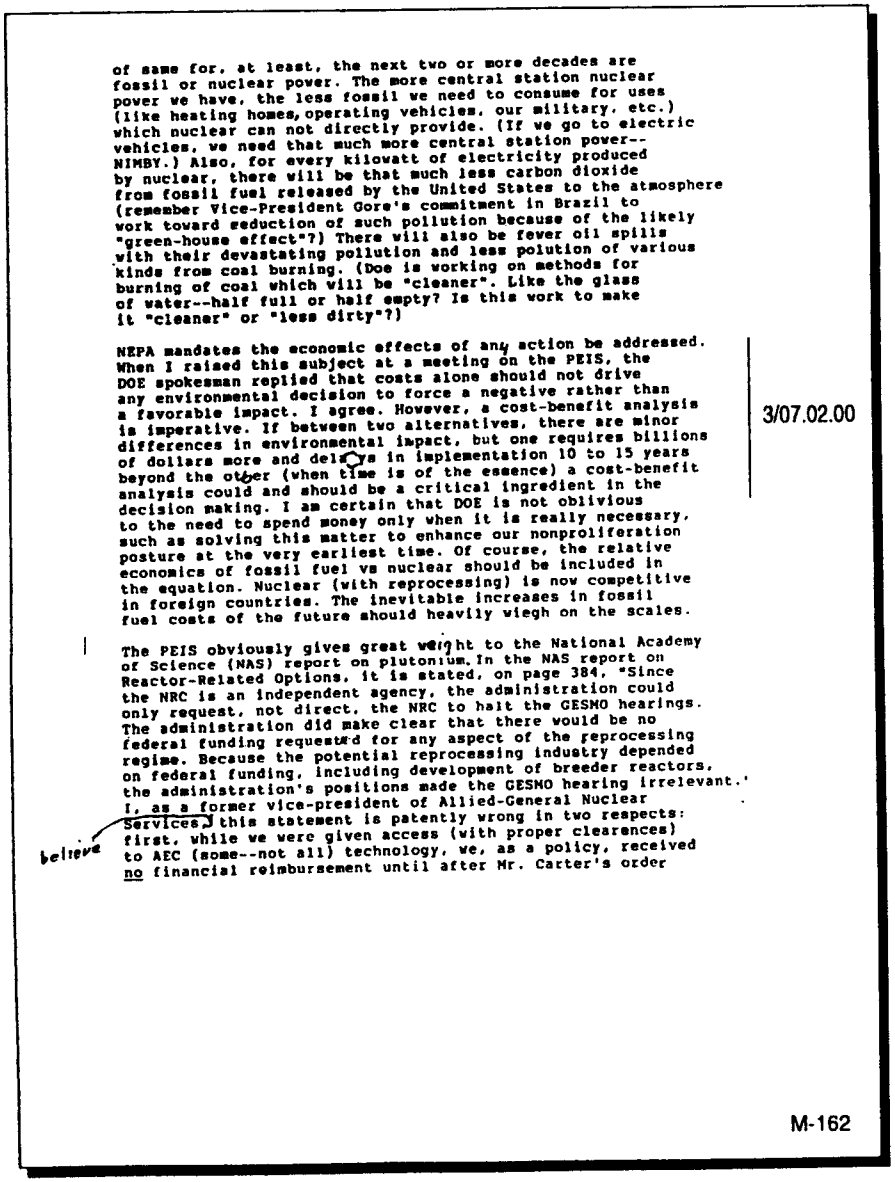
08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 00 00 **Comment Number 2**

The PEIS analyzes the impacts on the environment for the period required to accomplish the Proposed Action under each of the alternatives (up to 50 years after the ROD for storage, and within 25 years after the ROD for disposition). Such an analysis cannot go much beyond that timeframe without becoming "remote or speculative."

The PEIS takes into account future generations in that its purpose is to reduce surplus Pu stockpiles, potential proliferation, and other potential environmental impacts. The PEIS considers long-term consequences of irreversible/irretrievable commitment of resources (Section 4.11).



of same for, at least, the next two or more decades are fossil or nuclear power. The more central station nuclear power we have, the less fossil we need to consume for uses (like heating homes, operating vehicles, our military, etc.) which nuclear can not directly provide. (If we go to electric vehicles, we need that much more central station power--NIMBY.) Also, for every kilowatt of electricity produced by nuclear, there will be that much less carbon dioxide from fossil fuel released by the United States to the atmosphere (remember Vice-President Gore's commitment in Brazil to work toward reduction of such pollution because of the likely "green-house effect"?) There will also be fewer oil spills with their devastating pollution and less polution of various kinds from coal burning. (Doe is working on methods for burning of coal which will be "cleaner". Like the glass of water--half full or half empty? Is this work to make it "cleaner" or "less dirty"?)

NEPA mandates the economic effects of any action be addressed. When I raised this subject at a meeting on the PEIS, the DOE spokesman replied that costs alone should not drive any environmental decision to force a negative rather than a favorable impact. I agree. However, a cost-benefit analysis is imperative. If between two alternatives, there are minor differences in environmental impact, but one requires billions of dollars more and delays in implementation 10 to 15 years beyond the other (when time is of the essence) a cost-benefit analysis could and should be a critical ingredient in the decision making. I am certain that DOE is not oblivious to the need to spend money only when it is really necessary, such as solving this matter to enhance our nonproliferation posture at the very earliest time. Of course, the relative economics of fossil fuel vs nuclear should be included in the equation. Nuclear (with reprocessing) is now competitive in foreign countries. The inevitable increases in fossil fuel costs of the future should heavily wiegh on the scales.

3/07.02.00

The PEIS obviously gives great weight to the National Academy of Science (NAS) report on plutonium. In the NAS report on Reactor-Related Options, it is stated, on page 384, "Since the NRC is an independent agency, the administration could only request, not direct, the NRC to halt the GESMO hearings. The administration did make clear that there would be no federal funding requested for any aspect of the reprocessing regime. Because the potential reprocessing industry depended on federal funding, including development of breeder reactors, the administration's positions made the GESMO hearing irrelevant." I, as a former vice-president of Allied-General Nuclear Services, believe this statement is patently wrong in two respects: first, while we were given access (with proper clearances) to AEC (some--not all) technology, we, as a policy, received no financial reimbursement until after Mr. Carter's order

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07 02 00 **Comment Number 3**

Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in late July 1996. These documents were available for public review beginning in late July 1996.

then only for projects DOE considered important to them. Second, reprocessing does not rely on the breeder but both the light water reactor (financially) and the breeder (for its fuel) need reprocessing.

An adequate cost-benefit analysis, including the cost of R&D and the benefit of power generation must look at the time required for R&D, even that (as with DWPF) performed during pre-operational "testing". While timing itself is not a directly pertinent factor in a cost-benefit study, it should be highlighted as there is unanimity that the urgency of implementation non-proliferation actions is great. On page S-3 of the PEIS is the statement, "The purpose of the proposed action is to implement the President's Nonproliferation and Export Control Policy in a safe, reliable, cost-effective, technically feasible and timely manner." (Emphasis added)

I believe there is another flaw in the PEIS. With nuclear operations, two different studies are required in government as well as industry. One is the PEIS, which is now being discussed. The other is a Safety Analysis Report (SAR). They serve two entirely different purposes. The SAR, as its name implies, is intended to analyze, in minute detail, the expected safety of the proposed operation. For this reason, the NRC requires that air and water-borne releases from both normal and accident conditions be looked at "conservatively". This requires that margins be added to any consequence number to assure that, in real life, said consequence will have a lower actual adverse impact on the public and workers than estimated (a margin of safety). I do not have a copy of the guidances issued by the President's Council on Environmental Quality, but, as I recall, the Council said that an environmental impact statement, as a tool for comparing alternatives, should express environmental consequences in realistic, or best estimate numbers, rather than conservative numbers. On page 4-19 of the PEIS, for example, it is stated, "Studies of human populations exposed to low doses are inadequate to demonstrate the actual level of risk. There is scientific uncertainty about cancer risk at the low-dose region below the range of epidemiological observation and the possibility of no risk or even health benefits cannot be excluded. Because the health risk estimators are multiplied by conservatively calculated radiological doses to predict fatal cancer risks, the fatal cancer values presented in this PEIS are expected to be overstated." 4/09.09.08

Finally, on the NEPA considerations, NEPA addresses "any irreversible and irretrievable commitments of resources". The PEIS defines actions which are designed to make a valuable energy resource as difficult as possible to recover in the future. Yet, on page F-33 is the statement, "Existing rulings designate spent nuclear fuel as a recoverable resource...." 5/09.00.08

M-162

09 09 08 Comment Number 4

Since many of the potential actions under the various alternatives are still in the preliminary development stage, the actual information for these alternatives is not yet available. When no actual information is available, estimations must be made to predict environmental impacts. Because of uncertainties in these estimations, conservative assumptions are made to show the maximum potential environmental impacts. Where actual information is available, it is used in the PEIS.

09 00 08 Comment Number 5

Appendix F, "Air Quality and Noise," does not address spent nuclear fuel as a recoverable resource, and the Draft PEIS does not include page F–33, the page number is apparently misstated. However, Section 4.11 of the PEIS addresses "Irreversible and Irretrievable Commitments of Resources" and acknowledges that disposing of Pu represents an irretrievable commitment of a potential energy source.

NEWMAN, R. I., FRIPP ISLAND, SC
PAGE 5 OF 7

My second concern, non-proliferation, is important as it is driving this PEIS with, I believe, false, short-sighted premises.

The only certain, long-termeway to make weapons-usable plutonium unavailable for weapons manufacture is to burn it up!

The PEIS alternatives have, at least, two major shortcomings: They leave most of the plutonium available to future generations for power only at a high cost of money and probably radiation exposure to those who must, out of desperation for energy, retrieve it. Also, they ignore the availability of high levels of security measures needed, world-wide, in the interim period during which the PEIS actions are debated,researched, pilot-planted, constructed, and implemented.

Another false premise is that the declarations by Presidents Carter and Clinton are cast in concrete (or vitrified). Any decision, be it by Congress, the Supreme Court, or the President can be, and often is,revisited. The orders of the two presidents are now ripe for review!

The excuse (or reason--call it what you may) for abandoning reprocessing (recycling) was to set an example to other countries. That was the purported basis of stopping a private effort to develop an economic gas centrifuge for uranium enrichment in the mid '60's. the stoppage didn't work. Centrifuges are now in use around the world (including the U.S. and Russia.

Further, if reprocessing is such a potentially proliferation-possibe activity, why does the U.S.stand by when it is now being done in France, England, Russia,etc.? The U.S. was one of the principal architects of the international Atomic Energy Agency (IAEA), the principal purpose of which was to minimize the threat of proliferation. If reprocessing is such a threat, why doesn't the U.S. insist that the IAEA stop it world-wide? 6/01.06.00

Maybe we should look a short way into the future.

Looking at what DOE is proposing in the PEIS, there are three phases. First is the decision, R&D, debate, construction,check-out,debate,and start-up. Second is the operation,possibly making the plutonium irretrievable. The third is then, "OOps, we're running out of fossil fuel--what do we do now?" 7/01.06.00

The first phase, depending on which way we go, could take 5-10 years. (Look at the high level waste disposal program.)

The second phase could take 10-20 years.

M-162

01 06 00 **Comment Number 6**

Comment noted. The President's Nonproliferation Policy states that the United States does not encourage the civil use of Pu and, accordingly, does not itself engage in Pu reprocessing for either nuclear power or nuclear explosive purposes. The United States, however, will maintain its existing commitments regarding the use of Pu in civil nuclear programs in Western Europe and Japan.

The policy also states that the United States will make every effort to secure the indefinite extension of the Nonproliferation Treaty. The United States will seek to ensure that the IAEA has the resources needed to implement its vital safeguard responsibilities, and will work to strengthen the IAEA's ability to detect clandestine nuclear activities.

01 06 00 **Comment Number 7**

Comment noted.

During this 15-40 years, we still have weapons-usable plutonium on our hands (and other countries are still recovering it!). During this time, we must have a high level of physical security!

A publication I just received gave me encouragement on security. It was the program of an upcoming meeting of the Institute of Nuclear Materials Management (INMM). At their upcoming four-day meeting there will be some 285 papers presented on safeguards on materials from uranium hexafluoride through MOX fuel fabrication plants to high and low level waste. Of these, at least 180 relate to the safeguarding of plutonium. Authors are from around the world. Gratifyingly, about 100 pepers were authored by employees of DOE or DOE contractors, often in collaboration with representatives of foreign countries.

The subject of physical security is most certainly getting a high priority. If we can protect our weapons-grade plutonium and the French and English theirs, why can we not protect our weapons-usable plutonium recycled from power reactors?

Let's look at reprocessing.

There is no evidence I have seen or heard that our head-in-the-sand has had any influence on anybody. Reprocessing conserves fossil fuel and uses other natural resources for the benefit of future generations. Nuclear, with reprocessing, significantly reduces atmospheric carbon diaxide polution, oil spills, etc. The realistic environmental impact of nuclear power and reprocessing is minimal. If security can help protect us in the next quarter of a century or more, why the proliferation concern on reprocessing? Abandonment of reprocessing for the coming decades will rob us of the great expertise on reprocessing plant design and operation we developed over the past 50 years.

6/01.06.00 cont.

he PEIS should be rewritten for many reasons(many of which I have not addressed) to comply with the mandates of NEPA and the CEQ and to give the true picture on reprocessing and other PEIS-related matters to the American public.

The above is not to fault the DOE. It is simply doing what the boss ordered, (Marching to the drummer's beat.) However, as scientists and public servants, it has ,at least, an equal obligation to state the facts, fully and openly.

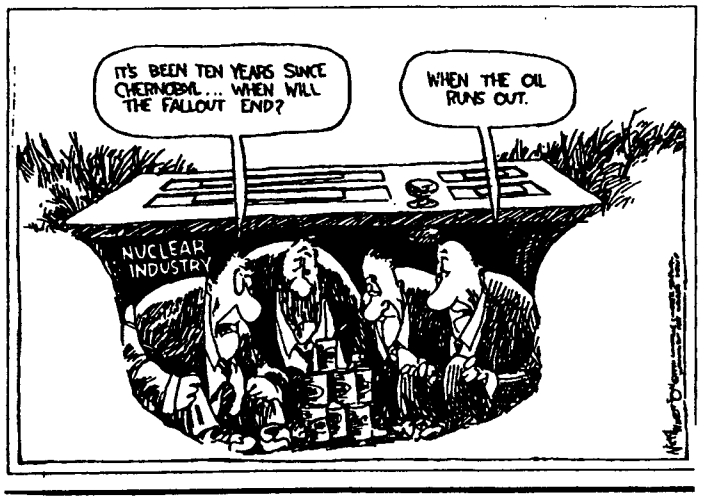
Emphatically yours,

R. I. Newman

M-162

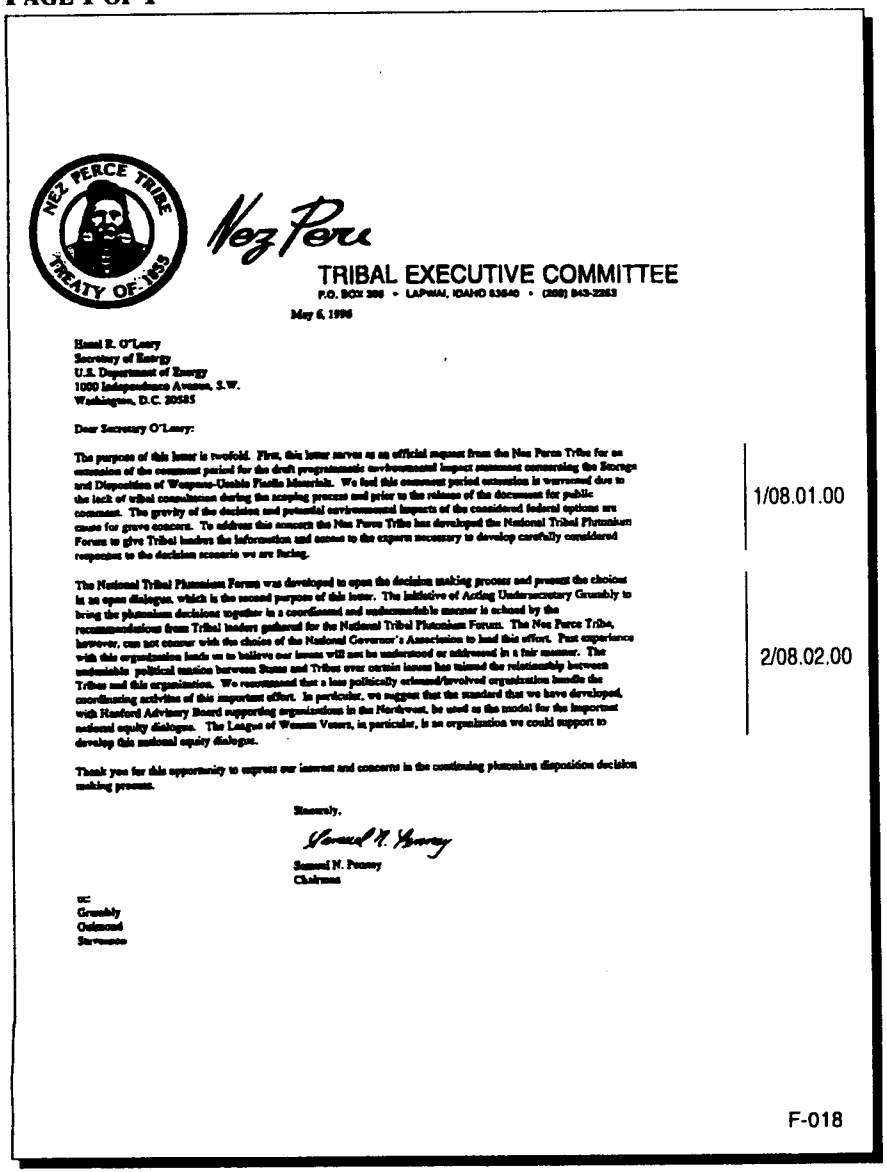
Gazette
5/6/96

OPINION



M-162

NEZ PERCE TRIBE, LAPWAI, ID,
SAMUEL N. PENNEY
PAGE 1 OF 1



NEZ PERCE TRIBE
TREATY OF 1855

Nez Perce

TRIBAL EXECUTIVE COMMITTEE
P.O. BOX 305 • LAPWAI, IDAHO 83540 • (208) 843-2253

May 6, 1996

Hazel R. O'Leary
Secretary of Energy
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Dear Secretary O'Leary:

The purpose of this letter is twofold. First, this letter serves as an official request from the Nez Perce Tribe for an extension of the comment period for the draft programmatic environmental impact statement concerning the Storage and Disposition of Weapons-Usable Fissile Materials. We feel this comment period extension is warranted due to the lack of tribal consultation during the scoping process and prior to the release of the document for public comment. The gravity of the decision and potential environmental impacts of the considered federal options are cause for grave concern. To address this concern the Nez Perce Tribe has developed the National Tribal Plutonium Forum to give Tribal leaders the information and access to the experts necessary to develop carefully considered responses to the decision scenario we are facing.

1/08.01.00

The National Tribal Plutonium Forum was developed to open the decision making process and present the choices in an open dialogue, which is the second purpose of this letter. The initiative of Acting Undersecretary Grumbly to bring the plutonium decisions together in a coordinated and understandable manner is echoed by the recommendations from Tribal leaders gathered for the National Tribal Plutonium Forum. The Nez Perce Tribe, however, can not concur with the choice of the National Governor's Association to lead this effort. Past experience with this organization leads us to believe our issues will not be understood or addressed in a fair manner. The undeniable political tension between States and Tribes over certain issues has tainted the relationship between Tribes and this organization. We recommend that a less politically oriented/involved organization handle the coordinating activities of this important effort. In particular, we suggest that the standard that we have developed, with Hanford Advisory Board supporting organizations in the Northwest, be used as the model for the important national equity dialogue. The League of Women Voters, in particular, is an organization we could support to develop this national equity dialogue.

2/08.02.00

Thank you for this opportunity to express our interest and concerns in the continuing plutonium disposition decision making process.

Sincerely,

Samuel N. Penney

Samuel N. Penney
Chairman

cc:
Grumbly
Olmstead
Stevenson

F-018

08 01 00 Comment Number 1

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

08 02 00 Comment Number 2

The Department of Energy acknowledges the commentor's support for coordination and increased understanding on the decisions to be made on the storage and disposition of weapons-usable fissile materials. However, the National Dialogue Project is beyond the scope of this PEIS.

NO NAME SUBMITTED
PAGE 1 OF 1

Date: Tue, 23 Apr 1996

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** The following is the text of the Author's Comment.

With regard to this PEIS, the SSMPEIS and the Pantex EIS:

1. Why, in identifying impacts, does DOE not identify significance of impacts, particularly "adverse" impacts?

2. During scoping for these documents agriculture and groundwater were identified as important issues to stakeholders. The documents do not identify any significant impacts to either. Because they were identified as issues, DOE should explicitly state there are no problems if that is its conclusion. Please take a position on the important issues!
END comment

1/09.00.08

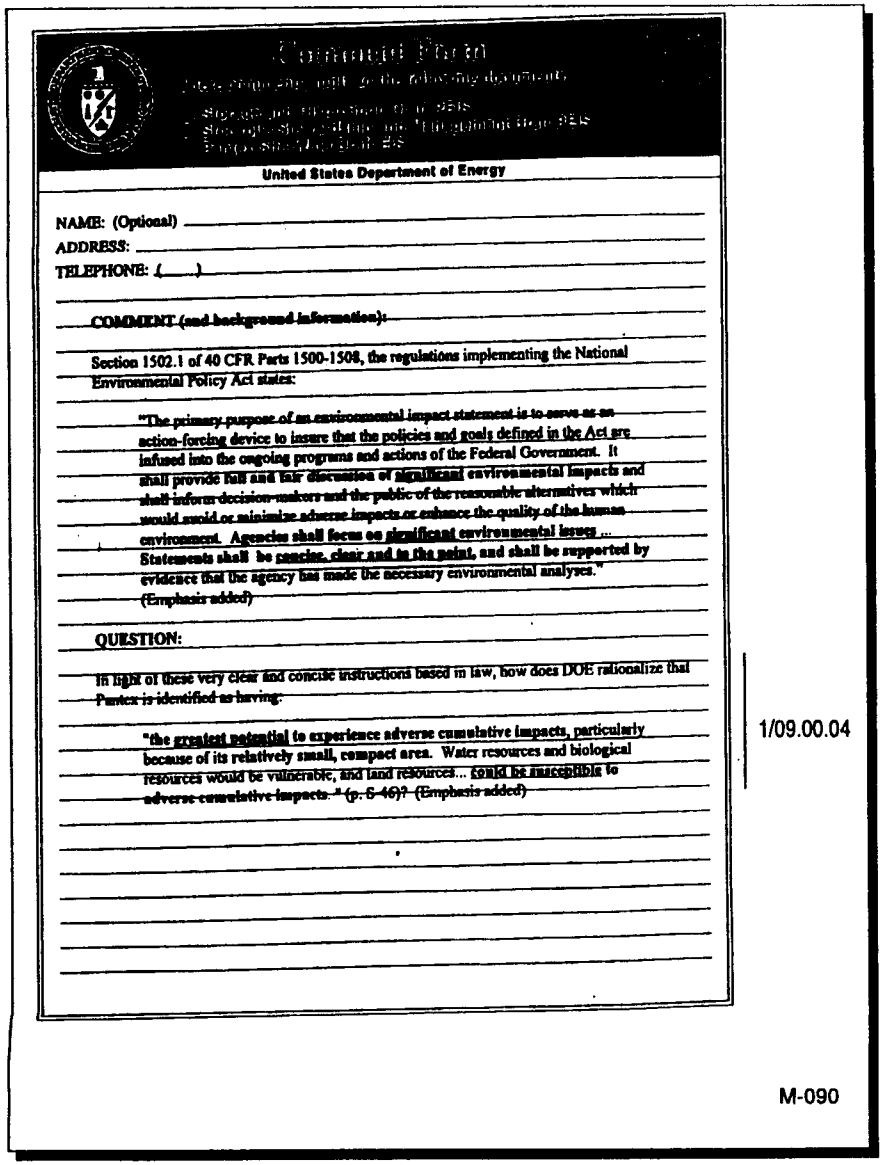
** The folloing is the space reserved for an Offical Reply. If you
** do not wish to reply to this comment then do not change it.
** If you wish to leave a comment then enter it here in the REPLY
** area
Begin Reply
(*** insert reply here ***)
End Reply

E-004

09 00 08 Comment Number 1

Based on comments received, reference to "adverse" impacts has been deleted from the Draft PEIS and Summary in order to describe impacts less subjectively. This is the same reason "significance" of impacts is not used. Environmental impact descriptions in the Final PEIS and Summary have been expanded and revised, and are generally described in quantifiable and semi-quantifiable terms.

In the PEIS, ground water is discussed under water resources in terms of impacts on both quantity and quality. Agriculture is evaluated in terms of land resources and human health risks from the ingestion of crops and animal products. For the construction and normal operation of the various proposed storage and disposition actions, including the Preferred Alternative, no major problems to ground water and agriculture were identified in the impact analyses conducted for the Final PEIS. Discussion on potential environmental impacts is presented in Chapter 4 of the Final PEIS. Those revisions made in the Final PEIS are also reflected in the Summary.



Comment Form

United States Department of Energy

NAME: (Optional) _____

ADDRESS: _____

TELEPHONE: (____) _____

COMMENT (and background information):

Section 1502.1 of 40 CFR Parts 1500-1508, the regulations implementing the National Environmental Policy Act states:

"The primary purpose of an environmental impact statement is to serve as an action-forcing device to insure that the policies and goals defined in the Act are infused into the ongoing programs and actions of the Federal Government. It shall provide full and fair discussion of significant environmental impacts and shall inform decision-makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment. Agencies shall focus on significant environmental issues ... Statements shall be concise, clear and to the point, and shall be supported by evidence that the agency has made the necessary environmental analyses." (Emphasis added)

QUESTION:

In light of these very clear and concise instructions based in law, how does DOE rationalize that Pantex is identified as having:

"the greatest potential to experience adverse cumulative impacts, particularly because of its relatively small, compact area. Water resources and biological resources would be vulnerable, and land resources... could be susceptible to adverse cumulative impacts." (p. 6-46)? (Emphasis added)

1/09.00.04

M-090

09 00 04 Comment Number 1

Based on comments received, the Summary was revised. There was no intention to portray Pantex, the Pantex region, or the Texas Panhandle region in a negative fashion. Each DOE site was analyzed and studied in the same manner and presented in the Draft PEIS accurately per these analyses and studies. All revisions made to the PEIS text are included in the Summary of the Final PEIS.

DRAFT S&DPEIS

COMMENT (and background information):

In the Summary (p. S-46), it is stated that "When the other DOE programs previously identified in this section are considered, the rank order of DOE sites in terms of their descending potential for cumulative impacts changes to SRS, INEL, Pantex, NTS, Hanford and ORR." A similar statement appears on p. S-47.

2/09.00.04

QUESTION:

What does this statement mean? It is obscure and demands an explanation that is concise, clear, to the point, and supported by evidence.

M-090

09 00 04 **Comment Number 2**

The Department of Energy did not intend to give the perception that the sites were ranked. The language in the Summary has been revised to better reflect the impact analysis in Section 4.7. The Final PEIS provides the necessary information to describe the impacts for the resources analyzed. It is up to the decisionmaker to determine which impacts are discriminators among sites.

DRAFT S&DPEIS

COMMENT (and background information):

In the Summary it is stated (p. S-20) that "Potential adverse impacts to waste management would occur at Pantex, ORR (all three options), and SRS, because the construction of sanitary, utility, and process wastewater treatment systems to treat nonhazardous liquid wastes may be required."

3/09.11.08

QUESTION:

How can the construction of facilities and systems to treat waste have the potential to adversely impact the *management* of waste? Is this a significant environmental impact as intended by §1502.1 of the NEPA regulations?

M-090

09 11 08 **Comment Number 3**

The conceptual design for the consolidated and collocated storage facilities and the disposition facilities have, as part of their design, waste management facilities that would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with RCRA and other applicable Federal and State statutes and DOE Orders. The impacts of having to construct the waste management facilities are captured in other resource areas such as land use and air quality. The text referring to "potential adverse impacts" to waste management has been deleted.

DRAFT S&DPEIS

COMMENT (and background information):

The oft-repeated phrase appears in the Summary:

> **"Potential adverse intersite transportation impacts related to all DOE sites could occur because of the increased risk of traffic accident fatalities."**

4/10.00.00

QUESTION:

Is there no risk to human health associated with intersite transportation of radioactive material? Has a dose risk assessment been made?

M-090

10 00 00 Comment Number 4

The human health risks of material transportations associated with the proposed Pu storage and disposition alternatives are evaluated and presented in Section 4.4 of this PEIS. The more detailed description of the methodology and supporting data for the analysis is presented in the Appendix G. Transportation of radioactive materials between sites includes health risks for both normal operations and accident conditions to the public and workers.

DRAFT S&DPEIS

COMMENT (and background information):

The Summary discusses three plutonium disposition categories (deep borehole, immobilization and reactor) consisting of nine alternatives, and ultimate high-level waste disposition.

QUESTIONS:

a. If the immobilization alternatives and reactor alternatives (except CANDU) result in the same ultimate disposition, viz., a high-level waste (HLW) repository, what is the cost/benefit of the reactor alternatives? | 5/07.02.00

b. Doesn't *a HLW repository* mean the DOE's High-Level Nuclear Waste Repository at Yucca Mt., Nevada? | 6/12.01.00

c. What would constitute ultimate disposition in the case of the CANDU reactor alternative? Would the Canadians be allowed to send the resultant high-level nuclear waste back to the U.S.? | 7/06.05.08

M-090

07 02 00 **Comment Number 5**

Cost data, along with technical and schedule data, were provided in a Technical Summary Report for disposition in late July 1996.

12 01 00 **Comment Number 6**

The PEIS does not assume the use of Yucca Mountain as a HLW repository for disposal of MOX spent nuclear fuel and/or immobilized materials. However, since Congress directed Yucca Mountain to be the only site considered for evaluation (site characterization) for the disposition of spent nuclear fuel and HLW, data developed to date at this site has been used to evaluate the potential for disposing of Pu wastes.

06 05 08 **Comment Number 7**

No. The spent fuel would be retained within the Canadian spent fuel program.

DRAFT S&DPEIS

COMMENT:

In the Summary, under "Phaseout" (page S-21), it is stated that:

> "For all DOE sites, with the exception of Pantex, phaseout would have a potential for adverse impacts to cultural resources if any of the structures eligible for National Register of Historic Places (NRHP) listing would not be maintained," and "None of the affected structures in Zone 12 at Pantex are considered eligible for NRHP listing."

8/09.07.04

This is *not* an accurate statement! Several of the structures in Zone 12 are potentially eligible for NRHP listing under the Cold War context. Pantex Plant is working with the State Historical Preservation Office (SHPO) and the Advisory Council on Historic Preservation regarding the subject of "Cold War" structure NRHP listings.

It is anticipated that several of the Zone 12 structures will be listed. The draft S&DPEIS text should be corrected.

M-090

09 07 04 **Comment Number 8**

The Summary was corrected to be consistent with Section 3.5.7 which says that Zone 12 does include a number of structures potentially eligible for the NRHP.

DRAFT S&DPEIS

COMMENT (and background information):

In Volume III (pp. M-131 through M-155), the chemicals used are as follows:

Hanford reports 3 chemicals, none with slope factors
NTS reports NO chemicals
INEL reports 28 chemicals, 12 with slope factors
Pantex reports 25 chemicals, 6 with slope factors
ORR reports 10 chemicals, none with slope factors
SRS reports 15 chemicals, 5 with slope factors
Rocky Flats reports 10 chemicals, 3 with slope factors.

9/09.10.08

These reported chemical usages present an erroneous comparison, as all sites under consideration will use similar chemicals. For example, benzene is a combustion product of both diesel fuel and gasoline, and would be common to all sites.

QUESTION:

Was the manner by which the information was requested not specific enough to insure accurate reporting or are the records at some sites incomplete? Please correct.

M-090

09 10 08 Comment Number 9

The data calls sent to each site contained the same information and requests. Under the No Action Alternative, the emissions data is from existing site facilities. Since each site has different existing facilities and operations, the chemicals emitted from these facilities are expected to be different. The cancer risk slope factors depend solely on the nature of the chemicals. For proposed new actions, the emissions data would be very similar among the sites. For detailed information on the emission data on each site, please refer to the respective data reports cited in the PEIS.

NO NAME SUBMITTED
PAGE 1 OF 2

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): See back
Address (optional): _____

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. **Materials Immobilization/Vitrification** - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

See other side

2. **Deep borehole disposal** - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

See other side

3. **Reactor Options** - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

See other side

4. **Storage Options** - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

See other side

M-192

Please use this space to write down any additional comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

There must be a way to Take Plutonium in small quantity, like 1 milligram and To cause its existence To cease.

To Cease by heat, cold, chemicals, Lasteria — or if nothing else works To cease by placing The Plutonium unit infront of a full-sized portrait photo of an x-mother-in-law!

1/14.00.00

M-192

14 00 00 **Comment Number 1**

Comment noted.

NO NAME SUBMITTED
PAGE 1 OF 1

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): _____
Address (optional): _____

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. **Materials Immobilization/Vitrification** - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

I think this is the best long term solution | 1/08.03.01

2. **Deep borehole disposal** - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

Unacceptable | 2/08.03.01

3. **Reactor Options** - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

This seems to be the best near term solution. | 3/08.03.01

4. **Storage Options** - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

We need to get on with it

M-227

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): _____
Address (optional): _____

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

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The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. **Materials Immobilization/Vitrification** - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

I support this concept | 1/08.03.01

2. **Deep borehole disposal** - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

No | 2/08.03.01

3. **Reactor Options** - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials

I might support this proposal if there were more safeguards. | 3/08.03.01

4. **Storage Options** - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

I would support this in the short term. | 4/08.03.01

M-229

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for the storage of fissile materials. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

NO NAME SUBMITTED
PAGE 1 OF 2

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): _____
Address (optional): _____

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The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. **Materials Immobilization/Vitrification** - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

2. **Deep borehole disposal** - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

QUESTION THE SEISMOLOGICAL STABILITY OF CERTAIN AREAS & YUCCA MTN. -- ANY BOREHOLE DISPOSAL SHOULD INVOLVE IMMOBILIZATION. | 1/09.05.08 | 2/08.03.01

3. **Reactor Options** - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

DON'T SUPPORT MOX FUEL. | 3/08.03.01

4. **Storage Options** - USDOE would continue existing storage practices for weapons usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites

"NO ACTION" IS THE WORST OPTION! | 4/08.03.01

M-231

09 05 08 **Comment Number 1**

No actual sites for the Deep Borehole Alternative currently exist or have been proposed. Therefore, a generic site was evaluated in the PEIS. DOE's decision on surplus Pu disposition for the borehole technology encompasses only the selection of a strategy and does not involve the selection of a borehole disposition site. Should either of the Deep Borehole Alternatives be selected, a siting study would be conducted in coordination with a site-specific discussion of environmental conditions and impacts in additional documents.

08 03 01 **Comment Number 2**

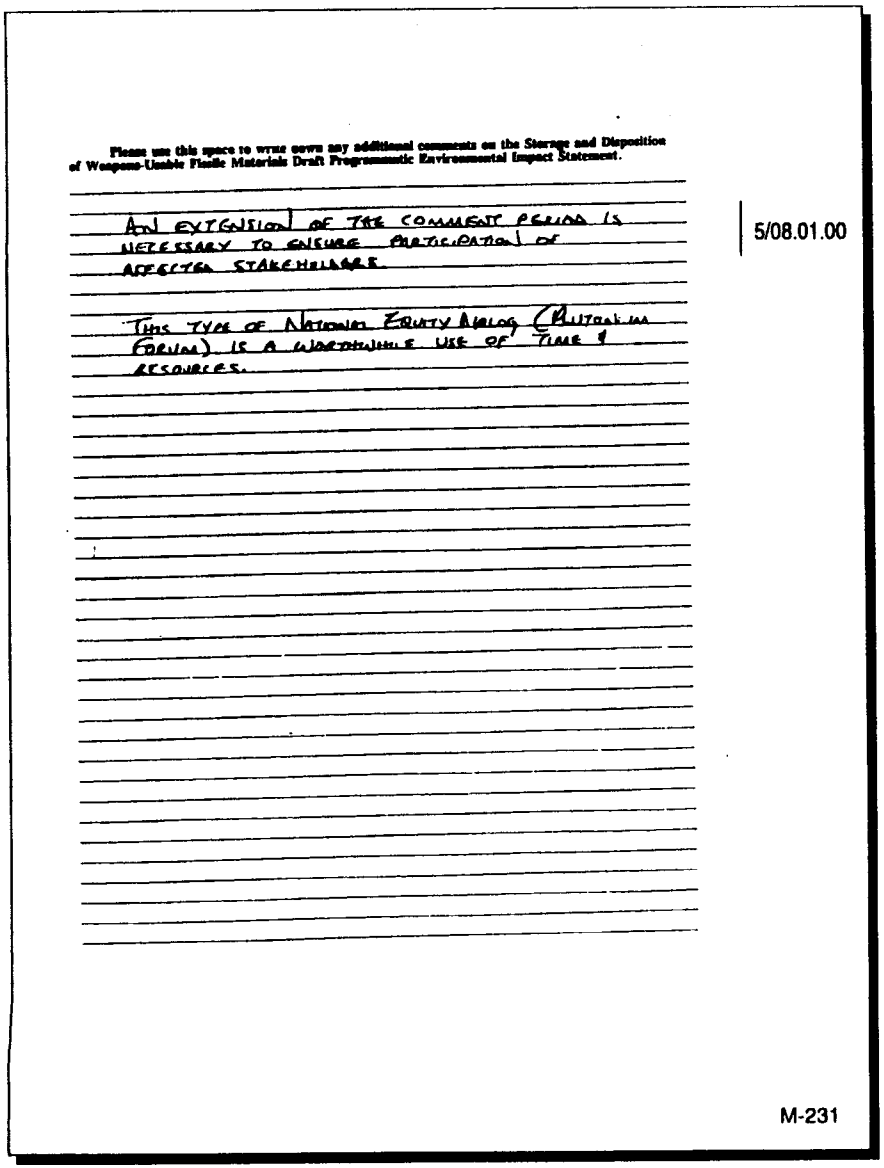
The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's opposition to continuing or long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



Please use this space to write down any additional comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

AN EXTENSION OF THE COMMENT PERIOD IS NECESSARY TO ENSURE PARTICIPATION OF AFFECTED STAKEHOLDERS.

5/08.01.00

THIS TYPE OF NATIONAL POLICY DEBATE (PLUTONIUM FORUM) IS A WORTHWHILE USE OF TIME & RESOURCES.

M-231

08 01 00 **Comment Number 5**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

NO NAME SUBMITTED
PAGE 1 OF 1

Comment ID: P0011
Date Received: April 18, 1996
Name: none given
Address:

Transcription:

I would like to vote yes for the project. Thank you. | 1/08.03.01

P-011

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for long-term storage and disposition of weapons-usable fissile materials. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Comment ID: P0025
Date Received: April 18, 1996
Name: none given
Address:

Transcription:

I prefer not to give my name, but I would like to comment on the plutonium disposal. I prefer that they burn the plutonium in a appropriate reactor, and use it up that way and make it profitable where we've put so much money into it already. It would also provide jobs in operating these reactors. Thank you. | 1/08.03.01

P-025

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

NO NAME SUBMITTED
PAGE 1 OF 1

Date Received: 06/14/96
Comment ID P0053
Name: None given
Address: No address given.

Transcription:

I have a comment and a question. The question is first. It's on the Storage and Disposition-- has to do with the borehole alternative, and the other alternative that uses the repository In size, how does the repository compare with the size of a single borehole? That's my question. And the comment: according to the Openness Initiative, there appears to be about fifty (50) tons of surplus plutonium. The borehole alternative talked about four (4) or so holes. If you divide fifty (50) by four (4), I'll even give you five (5) holes, that's like 10 tons of pure plutonium in a single hole -- not a single repository, but a single hole -- just a few feet in diameter. Why would this not pose a problem, like for criticality and for other environmental impacts? 1/04.00.00 2/04.01.00

Thank you for considering my comment and my question.

P-053

04 00 00 Comment Number 1

Section 3.9.1 of the Draft PEIS cites a range of 2,000 to 20,000 ha (4,942 to 49,420 acres) of land to accommodate the borehole site and buffer zone. While the high-level repository has yet to be sited, the environmental assessment of the current candidate site indicates that a total of 10,000 ha (24,710 acres) would be controlled for repository uses.

04 01 00 Comment Number 2

As noted in the PEIS Data Input Reports for the Borehole Alternatives, analyses to date have not identified any disqualifiers and have supported the continuation of them as reasonable disposition alternatives. More detailed analyses would accompany further phases of implementation that would include additional criticality analysis, if selected.

Date Received: 06/14/96
Comment ID: P0054
Name: None given.
Address: No address given.

Transcription:

My question is: How is the Department saving money in the engineered design of plutonium storage facilities? Its seems like the upgrade facilities are being designed uniquely. and I base this on the different numbers with no common ratios in the appendices. So if it's true that we're having unique designs for the different upgrade facilities, we're spending four times the architectural engineering design funds than is necessary. What is the Department doing to minimize expenses by maximizing the use of common plutonium storage facility designs? Thank you for considering the role of the taxpayer, who is your ultimate stakeholder. 1/07.01.00

P-054

07 01 00 Comment Number 1

For the Upgrade Storage Alternative considered in the PEIS, DOE has attempted to minimize the costs of engineered design, construction, and operation by utilizing the same standards, criteria, and technical approach wherever possible for the facilities being considered. However, due to differences in existing storage facility configurations and equipment at the various DOE sites involved, the upgrades are necessarily different to be compatible with existing design and configuration.

NO NAME SUBMITTED
PAGE 1 OF 1

Date Received: 06/14/96
Comment ID: P0055
Name: None given.
Address: No address given.

Transcription

I have a question concerning the high level waste repository for the Storage and Disposition Environmental Impact Statement. I have read the Notice of Intent for the Yucca Mountain Environmental Impact Statement, and the Department of Energy's intent, according to that document, is not to put plutonium in the repository, other then what's in commercial spent fuel. I have read the Storage and Disposition Environmental Impact Statement, and it says that the Department's intent, if immobilization is chosen, is to put plutonium in the repository. So which document has the true Department of Energy intent, and which document is trying to hide something from the public? The two documents of course, are the Storage and Disposition Environmental Impact Statement and the Department of Energy Notice of Intent for the Yucca Mountain EIS. Thank you. Please be open and honest. Bye

1/12.00.00

P-055

12 00 00 **Comment Number 1**

The Notice of Intent (NOI) for the Repository EIS considered only commercial spent nuclear fuel, DHLW, and DOE-owned spent fuels. If the timing of the Repository EIS (and subsequent license application) does not permit inclusion of Pu forms resulting from a ROD on Pu Disposition, then supplemental NEPA compliance documentation will be required. The Office of Fissile Materials Disposition is working closely with the Office of Civilian Radioactive Waste Management to ensure coordination between these two efforts.

Date Received: 06/14/96
Comment ID: P0056
Name: None given.
Address: No address given.

Transcription:

I am concerned about the annual radioactive releases during normal operations of common facilities for plutonium disposition. I am referring to Table M 2.3.1-2 in the Storage and Disposition Environmental Impact Statement. Each of those three so-called common facilities have releases exceeding a hundred microcuries a year. And I understand that TA-55 in Los Alamos, which in about 15 years its actual emissions are only 1 microcurie per year. So we are talking that these facilities would emit over a hundred times more as a new facility. The Plutonium Finishing Plant at Hanford, which is a 40-plus year facility, has emissions in about this order of magnitude. So I guess my question is: If these common facilities are projected to emit PFP-like emissions now, what will their relations be towards the end of their useful life? Thank you very much.

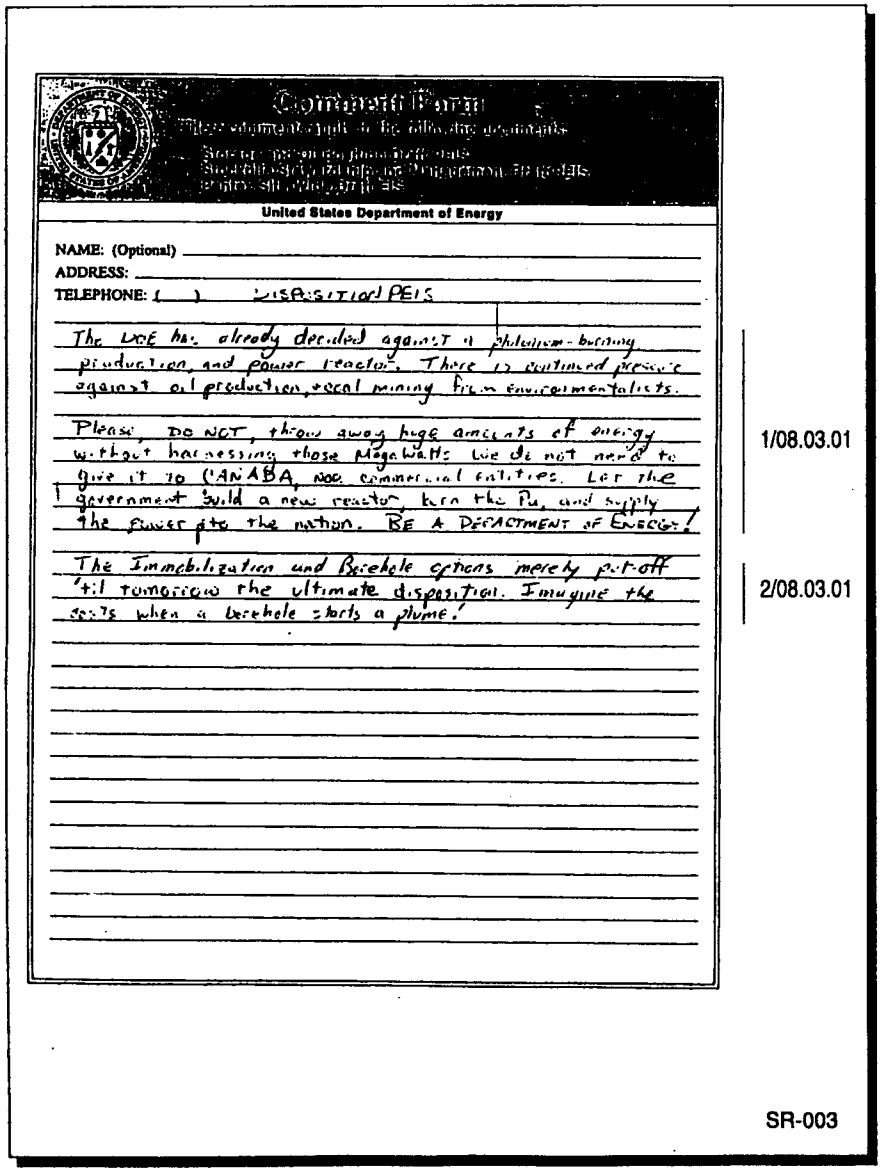
1/09.09.08

P-056

09 09 08 Comment Number 1

The radionuclide emissions from proposed Pu disposition facilities are estimated by evaluating the maximum potential human health effects from the Proposed Actions. The radionuclide emission estimates contained some degree of uncertainties. These uncertainties lead to the use of conservative radionuclide emission estimates. The radionuclide emissions during actual operation will be below the levels conservatively estimated in this PEIS. See the data reports as cited in the PEIS for the methods and assumptions used for the radionuclide release estimations.

NO NAME SUBMITTED
PAGE 1 OF 1



Comment Form

United States Department of Energy

NAME: (Optional) _____
ADDRESS: _____
TELEPHONE: ( ) DISPOSITION PEIS

The DOE has already decided against a plutonium-burning production and power reactor. There is continued pressure against oil production, coal mining from environmentalists.

Please, DO NOT, throw away huge amounts of energy without harnessing those megawatts we do not need to give it to CANADA, non commercial entities. Let the government build a new reactor, burn the Pu, and supply the power to the nation. BE A DEPARTMENT OF ENERGY!

The Immobilization and Borehole options merely put off 'til tomorrow the ultimate disposition. Imagine the costs when a borehole starts a plume!

SR-003

1/08.03.01

2/08.03.01

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to the Borehole and Immobilization Alternatives. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

FISSILE MATERIALS PEIS COMMENTS

- There does not seem to be any discussion about costing of alternatives. Does cost of each alternative play a role in choosing preferred alternative? When choosing a preferred alternative, it would be fiscally irresponsible without cost evaluation. — 1/08.00.00

- As Pantex dismantlement decreases, the number of buildings used for this purpose will decrease. Plans for each alternative on page S-12 specify modifying and/or building new facilities. Did these plans take into effect, that existing structures would become available for use, thus avoiding large new construction costs and minimizing impact on the environment. — 2/02.00.04

- On page S-18, under the No Action Alternative, (Page S-19 Upgrade Alternative, Consolidation Alternative (both options), page S-20 Expand-Use Alternative, Collocation Alternative, S-28 Disposition Alternative Pit Disassembly/Conversion Facility, S-30 Ceramic Immobilization Facility, S-31 Vitrification Alternative, S-33 MOX Fuel Fabrication Facility, S-35 Evolutionary LWRs Alternative) the summary states "Adverse impacts to water resources at Pantex would result from the continued local drawdown of the Ogallala Aquifer, but Pantex's contribution to this drawdown is expected to continue to decrease due to a decrease in other DOE activities at Pantex.
  - There does not appear to be an evaluation of decrease versus increase in the above statement and consideration of using reclaimed wastewater.
  - On page 3-159 of Volume I, it states that "an agreement between Pantex and the city of Amarillo is currently being negotiated to develop reclaimed wastewater ... The use of reclaimed wastewater could curtail the annual decline rate of the Ogallala Aquifer." There does not appear to be any evaluation or consideration given to reclaiming wastewater and reusing that water with respect to "adverse impact: Evaluation of recycling treatment water (Amarillo & Pantex agreement) — 3/09.04.04
  - Page S-64 Summary Comparison states that Pantex would use the least amount of water among candidate sites and 57% of water used would be discharged back to the playas and consequently the aquifer. No adverse impact is mentioned.
  - In other parts of the summary, water usage is mentioned as a percentage and thus skews the perception of impact. Since Pantex uses less water from the surrounding area than any of the other candidate sites, any increase in water usage would come out as a higher percentage given an equal increase at all sites. Even this is not true since other sites would use more water than Pantex for these options.
  - In the detailed description of Volume II, pages 4-190 through 4-192, water usage for the alternatives has a negligible impact on the aquifer as stated by "water requirements are small relative to the total water in aquifer storage", "total projected amount to be pumped in Carson County by an insignificant amount (0.0001-percent)", and ""there should be minimal

TX-050

08 00 00 **Comment Number 1**

The technical, cost, and schedule analyses of the various alternatives are presented in a separate document to support DOE's ROD. This document was made available to the public for review beginning in late July 1996.

02 00 04 **Comment Number 2**

As the mission for Pantex changes, DOE will continue to evaluate the possible re-use of existing facilities versus the need for new facilities. Existing facilities will be utilized, where possible, to avoid the cost and related impacts of building new facilities.

09 04 04 **Comment Number 3**

The actual quantities required for each alternative and the associated percent increases are provided in Chapter 4 of the PEIS and also in the table entitled "Potential Changes to Water Resources at Pantex Plant No Action (2005) and Storage Alternatives." Although Pantex is contributing to the depletion of the Ogallala Aquifer, as stated in Chapter 4, additional groundwater drawdowns attributed to the various long-term storage alternatives are expected to be slight, with minimal impacts to regional groundwater levels. The Summary was revised to emphasize that Pantex's water use from the Ogallala Aquifer is expected to decrease significantly by the year 2005, and that additional withdrawals attributed to the long-term storage alternatives should have only a minor impact on groundwater resources.

The possible use of reclaimed wastewater is not examined in detail in the PEIS because some data (such as cost-benefit analysis) have not been determined for implementing the pipeline specifically for any of the alternatives proposed in this PEIS. In general, several of the disposition alternatives are the only ones which require enough water to consider a project of the scale of constructing an approximately 32.2 km (20 mi) long pipeline to supply water to Pantex. Future tiered NEPA documents would be conducted, as required, to analyze the feasibility of providing Amarillo's treated wastewater to Pantex.

impacts to regional groundwater levels from this additional withdrawal. The total water withdrawal ... would be less than what is currently being withdrawn from the Ogallala Aquifer by Pantex." This does not create an "adverse impact". 3/09.04.04 cont.

- On page S-18, under the Upgrade Alternative, (S-19 Consolidation Alternative, S-20 Collocation Alternative, S-28 Disposition Alternative Pu Conversion Facility, S-31 Vitrification Alternative) the summary states "The Upgrade Alternative would have potential adverse impacts to air quality at Hanford (both options), INEL, Pantex, and SRS, since air pollutants concentrations would increase during construction and operations. Yet in the very next sentence, the summary states "Cultural and paleontological resources could be affected wherever there is ground disturbance due to construction ... except at ... and at Pantex, because no new ground disturbance would be involved.
  - what part of operations would adversely impact air quality at Pantex.
  - On Page S-72, which is approximately the same for all other alternatives, the summary states "During construction, site is expected to comply with ambient air standards and guidelines. During operation ... site is expected to comply with ambient air standards and guidelines." There is no adverse impact stated during Appendix A summary comparisons. The above is stated for all sites. Why are only specific sites mentioned above singled out for "adverse impact" If Pantex, as a candidate site, is expected to comply with all ambient air standards and guidelines then where is the "adverse impact" in that? 4/09.03.04
  - In volume II, the words "adverse impact" are never mentioned in regards to air quality. Volume II, pages 4-184 and 4-185, does mention "Increased PM10 and TSP concentrations may occur during the peak construction period, particularly during dry and wind conditions." Has an evaluation taken place to compare this small area of construction with the thousands of acres that are plowed annually in this area during dry and windy periods. The increase in PM10 and TSP directly attributable to Pantex would be negligible -- not an "adverse impact".

- On page S-19, under the Consolidation Alternative, the summary states "The potential for adverse impacts to land resources exists at ... Pantex, under the construction of a new facility north of Zone 11 and modification of existing facilities in Zone 12 South option, due to nonconformance with existing land-use plans, policies, or controls.
  - The Appendix A of the summary does not even mention this "adverse impact". The side-by-side comparison with the other sites is approximately equal. Why was Pantex singled out for "adverse impact"? 5/09.01.04
  - In Volume II, page 4-176, it states that "However, the master plan (*Pantex Site Development Plan*) designates Zone 11 for applied technology (PX DOE 1995g:8,11). Therefore, there would be potential adverse effects to land use." It is not anticipated that the Applied Technology Division will expand to use the land in question. This is not an adverse impact and is a

TX-050

09 03 04 Comment Number 4

The impacts to the air quality at Pantex due to operational activities are identified in the various sections of the PEIS dealing with air quality. As an example, Section 4.2.4.3 identifies the emission sources associated with operations to include boilers for space heating, diesel generators and testing of emergency diesel generators, exhaust and road dust from delivery and employee vehicles, and toxic/hazardous pollutant emissions from facility processes.

The Summary of the Draft PEIS, which presents information from Chapter 4 on environmental consequences, was revised to remove all subjective or qualitative comparisons among sites such as "adverse impacts."

09 01 04 Comment Number 5

Land-use planning is a dynamic process in which plans must be refined to reflect new information or needs. Although a potential action would be inconsistent with the current site development plan, Pantex could revise the plan in accordance with the proposal. The Proposed Action would be in compliance if the change is approved. The Final PEIS was revised to reflect this condition.

Zone 11, a potential location for the Consolidation Alternative at Pantex, was deleted in the Final PEIS.

very strict interpretation of a document written to describe existing land use. Changes can be made easily to the *Pantex Site Development Plan* to describe future land use that was not thought about at initial writing.

- In Volume II, page 4-176/177, it states for all alternatives that "alternative would be consistent with the city of Amarillo's land-use plans, policies, and controls. In Volume I, page 3-147, "Within the State of Texas, land-use planning occurs only at the municipal level. The City of Amarillo comprehensive plan has designated land for future growth." These two references indicate that any construction at Pantex does not create "a potential for adverse impact to land resources ... due to nonconformance with existing land-use plans, policies, or controls."
- In Volume II, page 1-856, it states "Nonetheless, future site development would be anticipated to be in conformance with the future land uses as designated by the Pantex Site Development Plan. As such, the various additive, aggregative land-use actions that would accumulate incrementally, although consuming land, would not change land use, or violate land-use plans, policies, or controls for the user. Proposed development would also be compatible with the industrial use visual character of the developed areas of Pantex." This is in direct opposition to the above "adverse impact" statement
- VERIFY what policies actually exist for Pantex and is there any nonconformance issues. CONFIRM impression of what is stated in PEIS and the *Pantex Site Development Plan.*

5/09.01.04 cont.

- On page S-19, under the Consolidation Alternative (S-20 Collocation Alternative, S-22 Disposition Alternative Pit Disassembly/Conversion Facility, S-31 Vitrification Alternative, S-33 MOX Fuel Fabrication Facility, S-35 Evolutionary LWRs Alternative), the summary states "At all of the DOE sites under consideration, cultural and paleontological resources have the potential to be affected wherever there is ground disturbance due to construction activities.
  - The side by side comparison in Appendix A states "Prehistoric and historic resources occur within the acreage that would be disturbed during construction." (Who chose these sites, adequately surveyed, use of other buildings, etc)
  - For Pantex, Appendix A also states "It is unlikely that paleontological resources occur within the acreage disturbed during construction." Thus not all DOE sites are the same in this area.

6/09.07.04

- On page S-19, under the Consolidation Alternative (page S-20 Collocation Alternative, S-28 Disposition Alternative Pit Disassembly/Conversion Facility, S-30 Ceramic Immobilization Facility, S-31 Vitrification Alternative, S-35 Evolutionary LWRs Alternative), the summary states "Waste management at Pantex (both options) and SRS has the potential for adverse impacts where implementation of this alternative may require construction of sanitary, utility, and process wastewater treatment systems to treat nonhazardous liquid wastes

7/09.11.04

TX-050

09 07 04 **Comment Number 6**

Paleontological resources are different from cultural (prehistoric, historic, and Native American) resources. At Pantex, paleontological resources are unlikely to be affected within areas of disturbance, while cultural resources (for example, historic resources) may be affected. The affected environment for these resources is discussed in more detail in Section 3.5.7 of the PEIS.

09 11 04 **Comment Number 7**

Based on comments received, the Summary of the Draft PEIS was revised to clarify the comparison of impacts and to delete reference to "adverse" impacts. All revisions made appear in the Summary of the Final PEIS.

- The summary is inconsistent from paragraph to paragraph on pages S-19 and S-20. The second paragraph as stated above mentions adverse impact at Pantex, but does not mention adverse impact for Pantex in last paragraph on S-19 or S-20 second paragraph, or last paragraph for Collocation Alternative page S-20 — 7/09.11.04 cont.
- The treatment of liquid nonhazardous wastes is the area of concern that may require construction of sanitary, utility, and process wastewater systems. Construction of additional facilities is not necessary due to the decrease of other activities (e.g. dismantlement) at Pantex and the existing facilities can accommodate this increase of liquid nonhazardous wastes. This is not an adverse impact. — 8/09.11.04

- On page S-19, under the Consolidation Alternative(Page S-20 Collocation Alternative, S-28 Disposition Alternative Pit Disassembly/Conversion Facility, S-30 Ceramic Immobilization Facility, S-31 Vitrification Alternative, S-35 Evolutionary LWRs Alternative), the summary states "Potential adverse intersite transportation impacts related to all DOE sites could occur because of the increased risk of traffic accident fatalities.
  - It could be concluded that the addition of one vehicle trip to Pantex causes an increased risk of traffic accident fatalities. However in Volume II, in all of the alternatives, page 4-203 through 4-206, all alternatives state for traffic conditions "There would be no significant traffic impact to the local road network" If there is no significant traffic impact, then why does the summary state otherwise" — 9/10.02.00

- On page S-19, under the Consolidation Alternative (Page S-20/21 Collocation Alternative), the summary states "The Consolidation Alternative would have adverse impacts to the following. ... biological resources at ... Pantex
  - But for construction of a MOX Fuel Fabrication Facility on page S-33, the summary states "At all DOE sites, except for Pantex, there would be the potential for adverse biological resource impacts because habitat disturbance and potential impacts to special status species during construction activities. For construction, there is either adverse impact or no adverse impact -- this example shows large inconsistencies in evaluations and conclusions drawn from basically the same data input. — 10/09.06.04

- On page S-20, under the Consolidation Alternative(S-35 Evolutionary LWRs Alternative), the summary states "..., biological resources would experience adverse impacts under the Consolidation Alternative at all DOE sites. This is due to habitat loss .... In addition, the potential exists for adverse impacts to either Federal- or State-listed threatened and endangered or special status species at ... Pantex (both options) .... There is also the potential for adverse impacts to wetlands at Pantex (both options)."
  - Page 3-166 in Volume I. "No critical habitat for threatened and endangered species as defined in the ESA (50 CFR 17.11; 50 CFR 17.12) exists on Pantex." — 11/09.06.04
  - Page 3-167 in Volume I. "There is little undisturbed habitat at Pantex that

TX-050

09 11 04 **Comment Number 8**

After discussion with Pantex representatives and review of the Pantex EIS (DOE/EIS-0225D), the impacts of liquid nonhazardous wastes have been reevaluated. The Final PEIS reflects that the existing wastewater treatment systems at Pantex are adequate to handle the increase for the Consolidation and Collocation Storage Alternatives.

10 02 00 **Comment Number 9**

The statement in the Summary on the potential adverse intersite transportation impacts concerns the human health impacts of moving radioactive material (Pu and uranium) to support the storage and disposition alternatives. This analysis concerns DOE material, is governed by Federal, State, local, and DOE regulations, and determines the number of fatalities due to movement of the material. The analysis is contained in Section 4.4 of the PEIS. The statements in the various socioeconomic sections concern local traffic conditions in regard to construction and operations workers that may be needed for the alternatives. This analysis concerns workers, is governed by traffic laws, and determines the effect of the local transportation network.

09 06 04 **Comment Number 10**

The proposed sites for the Consolidation Alternatives and the MOX Fuel Fabrication Facility were in different locations at Pantex and contained different habitat types (one being a previously disturbed area). Thus, the potential to disturb biological resources would also differ among these alternatives. The proposed site locations have changed and are reflected in the Final PEIS.

09 06 04 **Comment Number 11**

The Summary was revised to correctly reflect the analysis provided in Chapter 4. The official designation of critical habitat by the U.S. Fish and Wildlife Service (USFWS) does not determine the presence of, nor the possibility of, impacts to a threatened or endangered species. Regardless of the permanent or temporary nature of a species occurrence at Pantex, the potential impacts to those species attracted to the site are described. The word

would accommodate any of the threatened, endangered, and other special status species, other than the Texas horned lizard. Most of these species are attracted to the playas, which provide water and foraging habitat."

- The above two sentences taken together do not merit "an adverse impact" at Pantex.
- The summary side-by-side comparison states "Construction-related ground disturbance may increase the potential for sediment runoff to wetlands. During construction and operation, discharge of treated wastewater could cause increase open water areas in site playas which could lead to change in plant community composition. Discharges should increase aquatic habitat for amphibians." This is not adverse impact. Most of these playas are dry for most of the year. An increase of water would definitely help wetlands and provide improvement for the "water and foraging habitat."

11/09.06.04 cont.

- On page S-20, under the Collocation Alternative (Page S-29, Ceramic Immobilization Facility, S-35 Evolutionary LWRs Alternative), the summary states "Although the level of service on one or more local roads would decline during construction at INEL, Pantex, and ORR (all three options), the associated employment benefits would outweigh any short-term adverse local transportation impacts."
  - In Volume I, page 3-175, it is stated that Traffic conditions on all of these roads (FM 693, 293, 2373) are typically free flowing with low volumes of vehicles capable of traveling at speed limits without interference due to congestion. Building projects in past have had no effect on traffic conditions at the plant and would not be expected to have "adverse local transportation impacts" in the future. The traffic volume would not be that great even with construction crews.

12/10.00.00

- Inconsistency: Even though Pantex is included in sites used for analysis of Immobilization and Deep Borehole and Reactor categories (see second paragraph on page S-13), Page 22 (Page 32 MOX Fuel Fabrication Facility) states "Construction and operation of the pit disassembly facility would have no or negligible impacts to land resources, site infrastructure, air quality, noise, and geology and soils at any of the DOE sites used for analysis purposes."
  - This statement is not consistent with other alternatives and associated evaluations and conclusions. Additionally, the above paragraph is not consistent with following paragraphs in the same sections.

13/09.00.04

- On page S-28, under the Pu Conversion Facility paragraph, the summary states "Whereas the associated employment would have generally positive socioeconomic impacts at all of the DOE sites, the level of service on one or more local roads during the operations period would decline at INEL, Pantex, and ORR, leading to an adverse socioeconomic impact for the Pu conversion facility.
  - In Volume I, page 3-175, it is stated that Traffic conditions on all of these roads (FM 693, 293, 2373) are typically free flowing with low volumes of vehicles capable of traveling at speed limits without interference due to

12/10.00.00 cont.

TX-050

"adverse" has been deleted as a descriptor of impacts. There are no anticipated impacts for wetlands at Pantex

The side-by-side summary comparison noted is presented consistently throughout the document. Both increases and decreases in stormwater and wastewater discharges may affect the open water areas in the playas and could lead to changes in both the plant and biotic populations living within and utilizing the playa. Also, increases in stormwater, wastewater, and operational discharges may increase the potential for sediment and affect the open water area and water quality within the playa. The impacts due to water discharge to playas are described as an increase in aquatic habitat and an alteration of wetland habitat; whether the changes to wetlands are positive or negative would be determined in site-specific environmental documentation.

10 00 00 **Comment Number 12**

The local transportation model used indicates that there would be a decline in the level of service during construction of the collocation facility, ceramic immobilization facility, and evolutionary LWR at Pantex. The model indicates there would not be a decline in the level of service during operation of these facilities. The statements in the Summary concern the level of service decline during construction not operation. A description of the Average Annual Daily Traffic (AADT) is included in Section 4.1.8 of the PEIS. This model uses six levels of service described in Table 4.1.8–1. A drop of one level of service is considered an impact in the PEIS. Although building projects in the past have had no effect on traffic conditions, the AADT model was applied to all sites so that a comparison can be made between them.

09 00 04 **Comment Number 13**

Based on comments received, the Summary was revised. There was no intention to portray Pantex, the Pantex region, or the Texas Panhandle region in a negative fashion. Each DOE site was analyzed and studied in the same manner and presented in the PEIS per these analyses and studies. All revisions made to the PEIS text are included in the Summary of the Final PEIS.

congestion. Building projects in past have had no effect on traffic conditions at the plant and would not be expected to have "adverse local transportation impacts" in the future. The traffic volume would not be that great even with construction crews.

- In Volume II, page 4-203 through 4-206, all alternatives state for traffic conditions "There would be no significant traffic impact to the local road network". This a large inconsistency and does not deserve to be described as an "adverse impact" in the summary.

12/10.00.00 cont.

- On page S-29, under Ceramic Immobilization paragraph (S-31 Vitrification Alternative, S-32 MOX Fuel Fabrication Facility, S-35 Evolutionary LWRs Alternative), the summary states "The potential for adverse impacts would exist for land resources at Pantex, because use of the proposed site would not be in conformance with the *Pantex Site Development Plan*.

  - In Volume II, page 4-176, it states that "However, the master plan (*Pantex Site Development Plan*) designates Zone 11 for applied technology (PX DOE 1995g:8,11). Therefore, there would be potential adverse effects to land use." It is not anticipated that the Applied Technology Division will expand to use the land in question. This is not an adverse impact and is a very strict interpretation of a document written to describe existing land use. Changes can be made easily to the *Pantex Site Development Plan* to describe future land use that was not thought about at initial writing.

5/09.01.04 cont.

TX-050

NO NAME SUBMITTED
PAGE 1 OF 2

1. Go slow on disposal — 1/01.00.00

2. With our present President we do not know from one day to the next what he is going to do!
France is testing
China is testing etc.
It is foolish to be thinking of reducing the stockpile as it seem to be proposed. — 2/01.00.00

3 The environment damage that you may seem will affect this area. No consideration is given to all the chemicals that is poisoning the human body by allowing the chemical companies to put all their chemicals into our food supply which will harm all humanity in the U.S. — 3/15.00.00
a. which is worse "the pollutants" put out by Pantex that affects the local population. or
b. all the chemicals that go into our food which affects the whole nation
It will hurt the economy of this city to have another "pay roll" eliminated. the maize 4 plans under plans to dispose of, and those already gone are - the air Base. Bell Helicopter. Bell Helicopter. — 4/09.08.04

TX-051

01 00 00 **Comment Number 1**

Comment noted.

01 00 00 **Comment Number 2**

Comment noted.

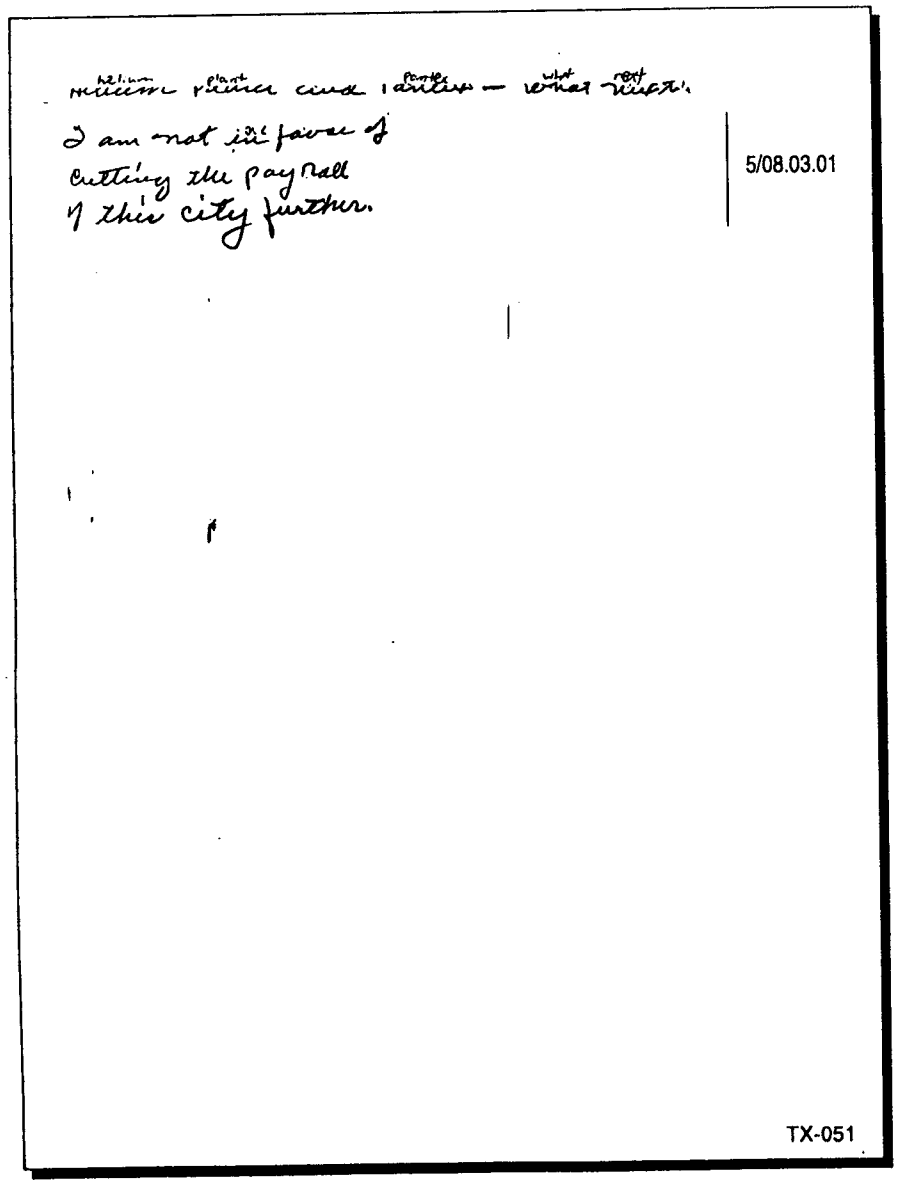
15 00 00 **Comment Number 3**

Comment noted. Regulating the food supply companies is the responsibility of the Food and Drug Administration.

09 08 04 **Comment Number 4**

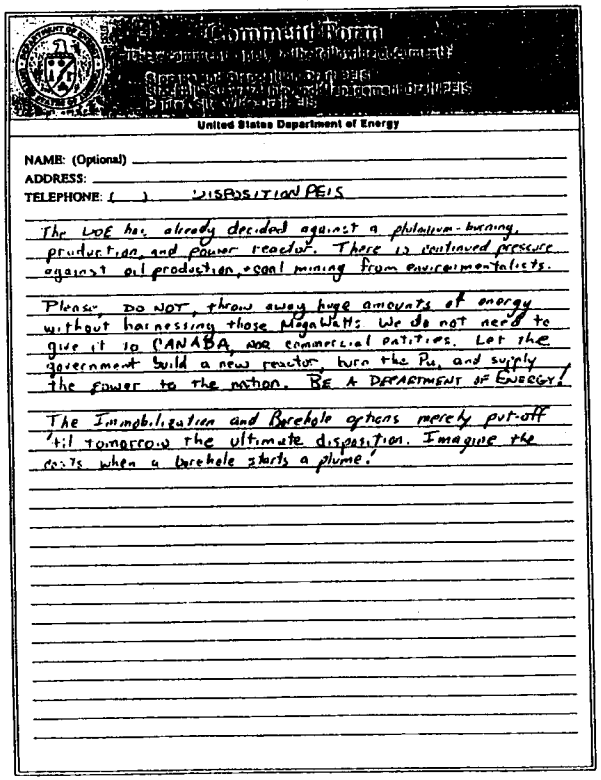
Phasing out existing storage facilities is the only activity associated with the PEIS alternatives that would eliminate jobs at Pantex. DOE estimates that only about five direct jobs would be lost due to the phaseout of the storage mission. Although any employment loss would be undesirable, the loss of five jobs would have no impact on the local or regional economy.

NO NAME SUBMITTED
PAGE 2 OF 2



08 03 01 **Comment Number 5**

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



Comment Form

United States Department of Energy

NAME: (Optional) _____

ADDRESS: _____

TELEPHONE: ( ) DISPOSITION PEIS

The DOE has already decided against a plutonium-burning, production, and power reactor. There is continued pressure against oil production, coal mining from environmentalists.

Please DO NOT throw away huge amounts of energy without harnessing those MegaWatts. We do not need to give it to CANADA, nor commercial entities. Let the government build a new reactor, burn the Pu, and supply the power to the nation. BE A DEPARTMENT OF ENERGY!

The Immobilization and Borehole options merely put-off 'til tomorrow the ultimate disposition. Imagine the costs when a borehole starts a plume.

1/08.03.01

2/08.03.01

TX-054

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to the Borehole and Immobilization Disposition Alternatives. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

NO NAME SUBMITTED, IDAHO FALLS, ID
PAGE 1 OF 1

Comment ID: P0024
Date Received: April 18, 1996
Name: none given
Address: Idaho Falls, ID

Transcription:

My comments are the DOE has promised to get all that mess out, out there at the site, get it out of here in, I don't no when, 2000 something. Now they plan on putting 2 ton of the most deadly, long-lived substance there is, and I'm definitely against it. I'm a citizen here in Idaho Falls, and there are a lot like me who don't speak up, who are lost in the clammer of all the people who want the jobs, but we live here too. Thank you. 1/08.03.01

P-024

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at INEL. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

J. Christopher Noah, Sr., Ph.D.
528 McKinne's Line
Evans, GA 30809
(706) 855-7223
fax (706) 869-0166

May 3, 1996

U. S. Department of Energy
Storage and Disposition Draft PEIS Office
P.O. Box 23786
Washington, DC 20026-5156

VIA FAX

Dear Sirs:

Thank you for the opportunity to present my views on the Storage and Disposition Draft EIS on April 30, 1996 in North Augusta, SC. As a follow up, I have additional points to be expressed. They are:

1. After years of study of the land use and environment of the Savannah River Site and the potential environmental impact this project may have; it is my conclusion that *SRS can accommodate a project of this magnitude without adversely affecting the environment.* Forty-five years of government control has actually enhanced the environment of SRS. This has been documented by the Savannah River Ecology Laboratory (University of Georgia) and the Savannah River Forest Station (USFS/USDA). However, there are indeed pockets of contamination that require attention. These can be controlled by institutional controls on future land uses.

1/08.03.01

2. *Many large-scale future missions can be accommodated by SRS.* Given the infrastructure, security, workforce competency, community support and land use, there is no reason why new missions such as this project cannot be located at SRS. This does not mean that development should be given carte blanche. Environmental controls, comprehensive planning and operational safeguards should be implemented. Having lived in Alaska during the construction of the Alyeska Pipeline, I saw first-hand how development and the environment could co-exist. However, this technological accomplishment did not come without a tremendous amount of work.

3. *This and the other projects discussed at the EIS meetings on April 30, should be considered in one planning document* (It does not have to be large). Besides being programmatically linked, future uses such as these should be judged in the aggregate. This would save time, resources and reduce confusion to the public and SRS employees.

2/11.00.08

M-167

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for SRS. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

11 00 08 **Comment Number 2**

Comment noted. DOE has an on-going effort in program integration.

NOAH, J. CHRISTOPHER, EVANS, GA
PAGE 2 OF 2

4. Most importantly, *careful land use planning should be undertaken prior to this or any other large scale projects.* Section 101 of NEPA generally states that planning should be undertaken and coordinated by the federal government. However, Section 102 specifically states that planning is very important and should be utilized. This was reiterated by "The Father of NEPA," Dr. Lynton Keith Caldwell, when he visited SRS on April 2. Land use planning studies concerning large federal facilities in other agencies, other DOE sites and SRS have yielded significant results - Most notably in environmental protection, consolidation of resources and savings to the public.

5. Finally, *there should be a concerted effort to open Yucca Mountain.* It is difficult to view this project in fair terms if no end-state of nuclear materials is identified. | 3/12.01.00

To provide a little background on myself, please see the attachment.

Thank you again for considering my comments.

Sincerely,

attachment

M-167

12 01 00 **Comment Number 3**

Comment noted.

Date Received: 06/12/96
Comment ID: P0050
Name: Karen Norris
Address: 1035 Adams Circle, Apt #112
Boulder, CO 80303

Transcription:

Hi, my name is Karen Norris and I live at 1035 Adams Circle, Apt #112 in Boulder, Colorado 80303. Anyway, I was going to make a written comment, and this guy with an Environmental Master's Degree and a Chemical Engineering Bachelor's Degree screwed me up because he didn't like the way I was thinking, and I know its like after the seventh. He didn't like that I wanted to ship it up off into outer space and have extra-terrestrial help. The extra-terrestrials are like a cure, and I wanted y'all to give up the information because our planet is so overloaded that it could -- the extra terrestrials are here because we could blow it up -- if our planet blew it would really screw theirs up and the chain reaction, and then the universe and well, he didn't like the space blast. And I don't like the National Academy of Sciences space blast either, because -- but you just gotta get a hold of E.T. I want to neutralize it or also I wanted to stabilize, vitrify it and throw it down the gol darn Nevada nuclear test hole. I'm sure I could get enough Indians to go along with that one, Native Americans, but he didn't like my thinking -- Scott Hatfield and he's from Boulder and so he wouldn't help me with my written comments. So why don't you just-- Anyway, I got a Rocky Flats belt buckle from the DOE -- this DOE guy one time. Well anyway, in 1989 John Kudurka, he was the head manager of waste disposal, anyway like for three years previous to 1989, I had to negotiate with his head manager at waste disposal, Rocky Flats for three years. He couldn't tell me about the accidents he saw and all this stuff, and I'd approve extra terrestrial -- he was going to do something about the accident. Anyway, in 1989 he finally came up with how the heck to nail Rocky Flats without a permit, no permit -- DOE, EPA, FBI cover-up. In 1989, they finally shut them down, and I called them up and I nailed them -- he told me how to do it. Anyway, he worked at Rocky Flats, maybe he still does I don't know, I haven't seen him for a lot of years now. Anyway after that, I got a got a gol darn belt buckle after I told this DOE guy everything I knew about Rocky Flats, and I got one of these belt buckles -- those trinkets that weren't supposed to be made there, and according to this DOE guy it was a Lawrence Livermore favor or something. It was a belt buckle that looked like an atom spinning around. Actually I think you all owe me a Lawrence Livermore favor. So lets neutralize it or let's do the extra-terrestrial space blast. You know the National Academy of Sciences space blast. Just get a hold of the E.T.s or I want to neutralize it or I want to then vitrify it and stabilize it, vitrify it, and throw it down the Nevada nuclear test hole, and I stopped nuclear testing. And our bring back POW-MIA from Vietnam. Anyway, I called the Pentagon, my political code name is Dolly. I'm not really a Dolly. Anyway, I got a gol darn Rocky Flats belt buckle, and you should just extend your comment period since the gol darn Environmental Master's Degree and Chemical Engineering Scott Hatfield didn't like my kind of thinking. Anyway -- its like, well, what's your thinking? Hey, well, tell-- I like the DOE because they're laying off all the people at Rocky Flats and forget the buy-out. What are you doing paying those people for trying to you know, create mass genocide? F--- the buy-out. Cut your budget, get rid of them. Anyway and I don't know, tell the head Navy lady that took over, since the head guy at Rocky Flats quit or

1/15.00.00

P-050

15 00 00 **Comment Number 1**

Comment noted.

something and she's you know like our -- tell Atlantis, I don't know. Let us know about the extra terrestrials even though, like... Well anyway, let me know about the extra terrestrials so they can possibly help. Try to neutralize it, you know, because I don't care how much it costs -- they wasted so much money already is the thing, and Germany is not a superpower, we can neutralize it. Anyway, or else I want to vitrify it, stabilized vitrification and throw it down the Nevada nuclear test hole. Plug that test hole up. There's no more nuclear testing. There's a total comprehensive underground nuclear test ban treaty with China and France and you know, get with it, you know. World peace. Thank you.

P-050

Comment ID: P0042
Date Received: May 8, 1996
Name: Karen North
Address: 1035 Adams Circle, Apt. #112
Boulder, CO 80303
Phone: (303) 443-7854

Transcription:

Call #1 - In honor of Project Phoenix and the Seti Institute and me as a citizen. We would like you to stabilize it and use vitrification and shove the glass logs directly down the Nevada Nuclear Test Site hole. Thank you. | 1/15.00.00

Call #2 - Actually, we would like you to stabilize it, use vitrification, and then shove it all down the Nevada Nuclear Test hole or Test Site. Actually, my dad is really working on a plan for the International Alliance of Atomic Veterans this year. But it's like top secret so I can't tell you. Actually, I think that the government [unintelligible] of an extra terrestrials. I'm a native American Indian, cover up too. I have never heard of people that tell the government to get off their land, and to give up ETS - extra terrestrials - and in honor of Project Phoenix and the Seti Institute, we'll all want the same. The Seti Institute is located in Mountainview, California. Anyway, I would like to wish the Department of Energy Good Luck. And I would really like to thank them for the major layoffs at Rocky Flats, and thank you Hazel O'Leary, because if we didn't bitch so much, nothing would happen. I don't know, you know. Actually, I like the layoffs coming up but then I heard - somebody I work with's brother works at Rocky Flats. They laid off so many people that they can't keep up with the barrels, which is OK cause they nailed them with barrels. I nailed Rocky Flats of leaking barrels of tech. I had to call a tech - Chemical Hazard - Solvent. You know, but it's like no permit. Yeah it's me, I'm not dead yet. Well anyway, tell Hazel O'Leary that I have basically - [hung up]

Call #3 - I happen to have one of those [unintelligible] that wasn't supposed to be made at Rocky Flats. It was given to me by the DOE. It looks like a belt buckle with atoms spinning around. I would like to have a meeting with the total Department of Energy on what to do with this Lawrence Livermoe favor. [unintelligible] Anyway, John Kazverco was the head manager of waste disposal in like 86-89 and he told me how to actually like he wasn't supposed to tell me this, because he had a contract signed with like whatever. Anyway, I like nailed Rocky Flats without a permit for leaking barrels of, I had to call it tech. Anyway betraying the Department of Energy and the EPA and the FBI cover-up, I'm not a grand jurer. I have a Rocky Flats belt buckle and I would like to negotiate. The belt buckle wasn't supposed to be made there. It's a Lawrence Livermore favor. Anyway, good negotiator, my boyfried has his Master's degree in environmental engineering and his Bachelor's in Chemical Engineering, and I also call up the United States Command Center, they know me. I am for Hazel O'Leary and the DOE is like laying off of the people. Rocky Flats is scared. How do I know like about the buyout, because I'm one of the best. Could you please tell the Energy Secretary to call me up 1-303-443-7854. My name is Karen North. Tell the DOE that we would like the - this is what we want - me and Project Phoenix and the Seti Institute which is in honor of the search for extra terrestrial

P-042

15 00 00 **Comment Number 1**

Comment noted.

intelligence. I could give you a couple of numbers to call. When the DOE asked me who I was and why I was there, this is not a joke. So why don't you research me, and find out about Project Phoenix and Seti.

Call #4 - I would like you all to stabize it and use vitrification and send those glass logs directly into the Nevada Nuclear Test Site to stop nuclear testing. The stupidity of the total Department of Energy and complete humiliation of knowing man on Earth. I mean - excuse me I'll try again - I'm Karen North from Boulder - and I really feel that - Acctually you know I call up the United States Command Center, United States Pentagon, I'm friends with Seti and Project Phoenix and actually I'm like - the Department of Energy are really you know dummies [unintelligible]. It's so hard to have to tell you how stupid you are.

P-042

Box 104, Uxbridge, Ontario, L9P 1M6
Tel/FAX 905-852-0571 nucaware@web.apc.org

FAX RECORD **Date:** Thursday, June 6, 1996

To: 202-586-2710
U.S. Department of Energy
Office of Fissile Materials Disposition

From: Irene Kock
Nuclear Awareness Project

Total pages (including cover): 8 pages + cover sheet

Comments: Comments re: Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Please note that attachments and original submission are being sent express post -- attachements are not included with this fax

If this fax is incomplete please call 905-852-0571 or 905-852-3044 for re-transmission

F-053

NUCLEAR AWARENESS PROJECT, UXBRIDGE, ON,
IRENE KOCK
PAGE 2 OF 9

Nuclear Awareness Project
Box 104, Uxbridge, Ontario L9P 1M6
Tel/Fax 905-852-0571 nucawnre@web.apc.org

June 6, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington D.C. 20026-3786 U.S.A.

BY FAX: 202-586-2710 (Original in the mail with attachments)

Re: Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS).

To whom it may concern,

Attached please find a submission from Nuclear Awareness Project on the topic of the proposed use of mixed-oxide (MOX) fuel, containing plutonium from dismantled U.S. nuclear warheads, at the Bruce "A" Nuclear Generating Station. Our submission is endorsed by the following environmental organizations: Concerned Citizens of Manitoba, Saskatchewan Inter-Church Uranium Committee, and FACTS - For A Clean Tonawanda Site (New York). The MOX-CANDU reactor proposal is noted in the Department of Energy (DoE) document *Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement* as one of the options under consideration by the DoE for plutonium disposition.

Nuclear Awareness Project is a non-profit environmental organization founded in 1983, dedicated to raising public awareness about nuclear issues and energy alternatives in Ontario, around the Great Lakes basin and across Canada. The group has over 300 members and supporters, and conducts research and public education programs, in addition to publishing a newsletter and operating a public resource centre.

We have reviewed the proposal *Plutonium Consumption Program - CANDU Reactor Project*, Final Report, July 1994, by AECL Technologies, as well as the relevant sections of the DoE PEIS. The attached submission outlines our views on a range of issues regarding this proposal. Nuclear Awareness Project does not support the importation of plutonium in any form into Canada. We urge the DoE to rule out the option of using CANDU reactors located in Canada for plutonium disposition purposes. We believe that a better alternative would be immobilization of the plutonium within the United States. 1/08.03.01 2/08.03.01

F-053

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. In addition, according to the Canadian Government (see letter sent by the Canadian Embassy in Washington, DC, dated June 6, 1996, reproduced in this CRD) an appropriate level of analysis by Canada would be required before any decision on burning Pu in a CANDU reactor is implemented. Before implementation, further negotiations between the United States and Canada will be required as this will include actions on the disposal of the spent fuel.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Sincerely,

Irene Kock

Irene Kock

attachments

c.c. Concerned Citizens of Manitoba
Dave Taylor
674 Riverwood Ave.
Winnipeg, Manitoba R3T 1K4

Inter-Church Uranium Committee
Philip Penna
P.O. Box 7724
Saskatoon, Saskatchewan S7H 4R4

FACTS - For A Clean Tonawanda Site
Jim Rauch
P.O. Box 566
Kenmore, New York 14217-0566

F-053

NUCLEAR AWARENESS PROJECT, UXBRIDGE, ON,
IRENE KOCK
PAGE 4 OF 9

Nuclear Awareness Project
Box 104, Uxbridge, Ontario L9P 1M6
Tel/Fax 905-852-0571 nucaware@web.apc.org

June 6, 1996

Submission to the U.S. Department of Energy Regarding the
Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Capacity Factors and Reliability of CANDU Reactors

The Atomic Energy of Canada Limited (AECL) proposal assumes that the four Bruce "A" Nuclear Generating Station reactors will be retubed regardless of whether or not the mixed-oxide (MOX) fuel scheme is implemented, and that these reactors will operate at an average capacity factor of 80% for a further 25 year period. These assumptions are inappropriate, given current debates about the future of the electricity sector in Ontario, and given operating experience at CANDU reactors.

The AECL Final Report *Plutonium Consumption Program - CANDU Reactor Project* notes:

> "It is assumed for the purposes of this study that the Bruce NGS A units will be retubed because there is a demand for electricity."[1]

Retubing is the rebuilding of a CANDU reactor core where all fuel channels are replaced at a cost now estimated by Ontario Hydro at about $350 million per reactor.[2] The DoE should note that the Bruce reactor 2 was shut down in 1995 to avoid this cost and other major repairs, primarily to steam generators. The other 3 reactors are scheduled for retubing starting in 2000, but could instead by shut down at that time. The Bruce "A" Station began operations between 1977 and 1979. It is unlikely that Ontario Hydro will be able to justify the expense of retubing its aging reactors when faced with increasing competition in the electricity sector.

3/01.03.00

The AECL Final Report also notes:

> "... it is assumed that during the 25 year mission time the average capacity factor of the units is 80%, which is generally consistent with Ontario Hydro's experience..."[3]

A review of capacity factors for CANDU reactors in Ontario shows that the 80% capacity factor target is not realistic. Bruce "A" is approaching 20 years of operation, and trends show that CANDU reactor performance deteriorates with age. The 1994 annual and the lifetime capacity factors for the Bruce "A" Station are shown in Table 1.

F-053

01 03 00 **Comment Number 3**

Should the CANDU Reactor Alternative be chosen for Pu disposition, further negotiations between the U.S. and Canadian Federal and Provincial Governments will be required before implementation, as well as business negotiations with reactor owners. These negotiations will include performing further environmental analyses, as appropriate.

Table 1: Annual and Lifetime Capacity Factors
for the Bruce "A" Nuclear Generating Station.[4]

Bruce "A" Reactor	Annual Capacity Factor for 1994	Lifetime Capacity Factor to Dec. 94
1	53.0	68.0
2	53.4	69.0
3	37.8	75.0
4	50.8	72.2

The Pickering "A" Station is a case in point, since the four Pickering "A" reactors were retubed between 1983 and 1993. Reactors 1 and 2 were retubed prior to 1990, and post-retubing performance averaged only 70% for the five year period from 1990 to 1994. See Table 2.

Table 2: Post-Retube Capacity Factors
for Pickering Reactors 1 and 2.[5]

YEAR	Pickering 1	Pickering 2
1990	67	65
1991	67	72
1992	65	91
1993	77	95
1994	19	88
5 year average capacity factor = 70%		

The degree of over-optimism and actual error in AECL's two assumptions about reactor rehabilitation and performance expectations brings into question the validity of all of the findings in the AECL Report.

Costs and Subsidies

The total gross cost for using plutonium fuel in CANDUs is estimated by AECL at over $2.2 billion (1993 U.S.$). This price does not include the cost of retubing the Bruce "A" reactors or improving security at the Bruce site. The price of plutonium fuel production and shipping is estimated at $70 million per year — about three to four times the cost of CANDU uranium fuel. It has been reported that Ontario Hydro representative John Luxat has said that the DoE will pay the difference between the cost of CANDU uranium fuel and mixed-oxide fuel, estimated at $54 million per year.[6] Yet the budget presented by AECL for this project doesn't mention any subsidies to Canada or

NUCLEAR AWARENESS PROJECT, UXBRIDGE, ON,
IRENE KOCK
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Ontario Hydro from the DoE. What is the DoE's policy on subsidizing utilities which use MOX fuel made from DoE plutonium? 3/01.03.00 cont.

If the DoE does not pay for retubing and security improvements at Bruce "A", then Ontario rate-payers will have to pay those costs, which could easily approach $1 billion to retube and rehabilitate 2 reactors and 'harden' the Bruce Nuclear Power Development against terrorist attacks. This is in addition to paying what it would cost to use CANDU uranium fuel, and the usual operation, maintenance and administration costs, as well as capital modification costs associated with the reactors. This is not a bargain for Ontario electricity rate-payers, as is being implied by Ontario Hydro — it is a burden. Other cheaper and safer energy supply and demand management options are readily available. The pressure to implement full cost accounting and integrated resource planning in decision making on electricity options will only increase as Ontario shifts into an era of increased competition in the electricity sector. It is likely that reactor rehabilitation will not be economical compared to these other options.

Spent Fuel Management and Burial

The end result of using plutonium fuel in CANDU reactors under this proposal is that foreign military radioactive waste would remain in Canada. From the environment community's point of view, accepting radioactive waste from a foreign country would set a dangerous precedent. The issue of high level radioactive waste burial in Canada is currently being reviewed by a Federal Environmental Assessment Panel.[7] The current proposal, put forward by AECL, involves burial of the wastes in the Canadian Shield. Many reviewers, including the Atomic Energy Control Board, Environment Canada and the Panel's own Scientific Review Group, found significant technical deficiencies in the AECL proposal, which took almost 15 years to prepare. Canadians are far from achieving consensus on the best management strategy for nuclear fuel wastes, and there has been no public consultation on the option of accepting foreign wastes for burial here. Therefore, the assumption in the DoE PEIS, that "Spent fuel generated by a CANDU reactor would be accommodated within the Canadian spent fuel program"[8] is unwarranted and premature. Nuclear Awareness Project certainly does not support the storage or burial of foreign radioactive wastes in Canada. 1/08.03.01 cont.

Canada's Non-Proliferation Policy

The use of plutonium fuel would violate the spirit of Canada's non-proliferation stance, which is intended to isolate the Canadian nuclear industry from the military nuclear weapons programs of other countries. This plutonium fuel scheme would integrate Canada into the nuclear weapons program of the United States through: 1) making Ontario Hydro a commercial recipient of military fissile material; 2) undertaking security measures within Canada for fissile plutonium of foreign origin; and 3) providing radioactive waste disposal for foreign decommissioned nuclear weapons. Nuclear Awareness Project supports the maintenance of a clear separation between Canadian nuclear programs and the military nuclear programs of foreign powers. 4/01.03.00

F-053

01 03 00 Comment Number 4

Once the Pu is converted to MOX fuel, it is no longer considered weapons-usable without extensive chemical processing and, therefore, would not involve the Canadian nuclear programs in the military nuclear programs of foreign powers.

Environment and Public Health Hazards

The operation of CANDU reactors in Ontario causes negative environmental and public health impacts due to routine emissions of radioactive pollution, especially tritium, which is found at levels far exceeding 'background' in the vicinity of all CANDU reactors. See the attached excerpt from Nuclear Awareness Project's Spring 1996 newsletter "Tritium Hits Port Elgin" for details of a recent incident at Bruce "A" (Attachment A). 3/01.03.00 cont.

The possibility of severe accidents at the Bruce "A" reactors cannot be ruled out, and the risk becomes greater as the reactors age. Such an accident would likely impact the entire Great Lakes basin. The enclosed excerpt from the *Nuclear Hazard Report 1991 - 1992*, addresses some of these reactor safety concerns in detail (Attachment B). A major concern is the risk that trade-offs are being made between safety and maintenance and capital costs, as outlined in section 3.1 of the *Nuclear Hazard Report*.

The AECL proposal is incomplete in a key area that concerns public safety. Plutonium fuel can become "critical" under certain conditions. Transportation and handling accidents could be disastrous for those exposed to radiation. The AECL proposal fails to provide details of the circumstances under which this may happen and how each situation might be prevented or mitigated. AECL simply notes that:

> "Accident scenarios with MOX fuel may be postulated which could lead to criticality concerns. These range from accidental immersion in light water during transportation... The complete range of such accidents would be analyzed as part of the licensing basis for MOX operation, however, based upon a review of some scenarios no difficulties are foreseen."[9]

To leave a full assessment of criticality risks to the licensing stage is unacceptable. The AECL proposal fails to address any accident conditions, only outlining some possible storage configurations to show how the fuel would behave under normal conditions.

There is no guarantee that the plutonium fuel scheme will undergo an environmental assessment at either the provincial or federal level. An exemption was granted to the Bruce "A" Station in 1976 under the Ontario Environmental Assessment Act, and the use of MOX fuel may come under this exemption. The undertaking would be regulated by the Atomic Energy Control Board, which may not require a public hearing under Canada's Environmental Assessment Act. Nuclear Awareness Project is concerned that every effort will be made by our governments at the provincial and federal level to avoid an environmental assessment on this proposal. We believe that it is unacceptable for the DoE to be considering the MOX - CANDU reactor scheme in the absence of a firm commitment from the government of Canada to conduct a comprehensive Environmental Assessment with full public hearings under the Canadian Environmental Assessment Act. 5/01.03.00

F-053

01 03 00 **Comment Number 5**

Should the CANDU Reactor Alternative be selected at the ROD, agreement with the Canadian Federal and Provincial Governments would be reached on the Pu disposition process, including appropriate environmental analysis with public involvement.

NUCLEAR AWARENESS PROJECT, UXBRIDGE, ON, IRENE KOCK
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Public Notification and Access to Information

Nuclear Awaroness Project was pleased to receive the U.S. Department of Energy's *Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement*, and have the opportunity to comment. However, it was only through a conversation with colleagues in the U.S. that we knew about this Environmental Assessment at all. To the best of our knowledge the DoE did not provide notification to the Canadian public about this review process. Certainly Ontario Hydro and AECL made no effort that we know of to inform the Canadian public of this opportunity to comment on their proposal. We hope you will give due consideration to our comments, even though the DoE is not accountable to Canadians. 6/01.03.00

Nuclear Awareness Project has been aware of the proposal to use mixed-oxide fuel containing weapons-grade plutonium in CANDU reactors since 1994, and began requesting a copy of the proposal that year. After over a year of run-around and unfulfilled promises by Ontario Hydro to provide the document, it was requested formally under Freedom of Information legislation. Ontario Hydro refused to release the report and instead, directed us to obtain a copy from the U.S. Department of Energy. The DoE eventually directed us to AECL Technologies Inc. in the U.S., and a "Controlled Copy" of *Plutonium Consumption Program - CANDU Reactor Project* was received in April 1996. Ontario Hydro and AECL have deliberately withheld vital information on the MOX fuel proposal as long as possible in order to stifle public debate. This is unacceptable behaviour from any corporation, let alone provincial and federal crown corporations.

Ontario Hydro has also been uncooperative in releasing information on other aspects of the proposal, such as public opinion polls. Nuclear Awareness Project requested a copy of the results of a public opinion poll conducted for Ontario Hydro on the plutonium fuel issue in 1995. The script of the poll was released, however, Hydro refused to reveal the results and analysis, under the Freedom of Information Act, noting: "The survey will be used in Federal Cabinet policy discussion. Release of the survey would interfere with a fair and unbiased Cabinet review of the issues". Hydro's reply also noted that: "... release of the survey could generate negative news coverage that would affect the economic interests of Ontario Hydro."[10]

Conclusion

Nuclear Awareness Project does not support the importation of plutonium fuel for use in the Bruce "A" Nuclear Generating Station for the following reasons:

- In order to use MOX fuel at two reactors, the Bruce "A" Nuclear Generating Station will require in the order of $1 Billion in repairs and security upgrades which would have to be paid by the electricity rate-payers of Ontario; 3/01.03.00 cont.
- the Bruce reactors are otherwise likely to be shut down early, saving capital repair costs, as well as operating, maintenance and administration costs — electricity can be supplied, or demand managed more cost effectively;

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01 03 00 Comment Number 6

The Department of Energy is committed to the NEPA process which includes consideration of all public comments. All comments are given equal consideration in the decisionmaking process.

- the use of MOX fuel would set a precedent for Canada to become a dumping ground for foreign military radioactive waste, an undesirable prospect for many Canadians;
- the use of MOX fuel would reverse Canada's longstanding non-proliferation policy of isolating itself from foreign nuclear weapons programs;
- the use of MOX fuel would create unprecedented security problems to prevent theft or diversion of plutonium;
- the use of MOX fuel would pose a public health and environment threat, since plutonium is one of the most carcinogenic substances known, and there is a risk of criticality accidents.

3/01.03.00 cont.

Therefore, Nuclear Awareness Project urges the Department of Energy to rule out the option of using CANDU reactors located in Canada for plutonium disposition purposes. We believe that a better alternative would be immobilization of the plutonium within the United States.

Endnotes

1. AECL Technologies Inc., *Plutonium Consumption Program - CANDU Reactor Project*, Final Report, July 1994, U.S. DoE Contract DE-AC03-94SF20218, p. 1-10.

2. Mittelstaedt, M., "Plague-ridden Bruce reactor shutting down after half life", *Globe & Mail*, August 31, 1995.

3. AECL Technologies Inc., p. 1-10.

4. *Nuclear Engineering International*, April 1996, p. 29.

5. Atomic Energy Control Board Staff Annual Reports on the Pickering Nuclear Generating Station.

6. Silver, R., "Ontario Hydro Nuclear Eyes Pu Burning as Way to Save Bruce-2", *Nucleonics Week*, December 22, 1994.

7. For more information contact the Nuclear Fuel Waste Environmental Assessment Panel, Canadian Environmental Assessment Agency (CEAA), 819-953-0179.

8. U.S. Department of Energy, *Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement*, Summary, February 1996, p. S-16.

9. AECL Technologies Inc, C-20.

10. Letter to Irene Kock, Nuclear Awareness Project, from S.M. Leng, Corporate Records and Freedom of Information Officer, Ontario Hydro, December 11, 1995.

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NUCLEAR AWARENESS PROJECT, UXBRIDGE, ON,
IRENE KOCK
PAGE 1 OF 5

Box 104, Uxbridge, Ontario, L9P 1M6
Tel/FAX 905-852-0571 nucaware@web.apc.org

FAX RECORD **Date:** Thursday, June 6, 1996

To: 202-586-2710
U.S. Department of Energy
Office of Fissile Materials Disposition

From: Irene Kock
Nuclear Awareness Project

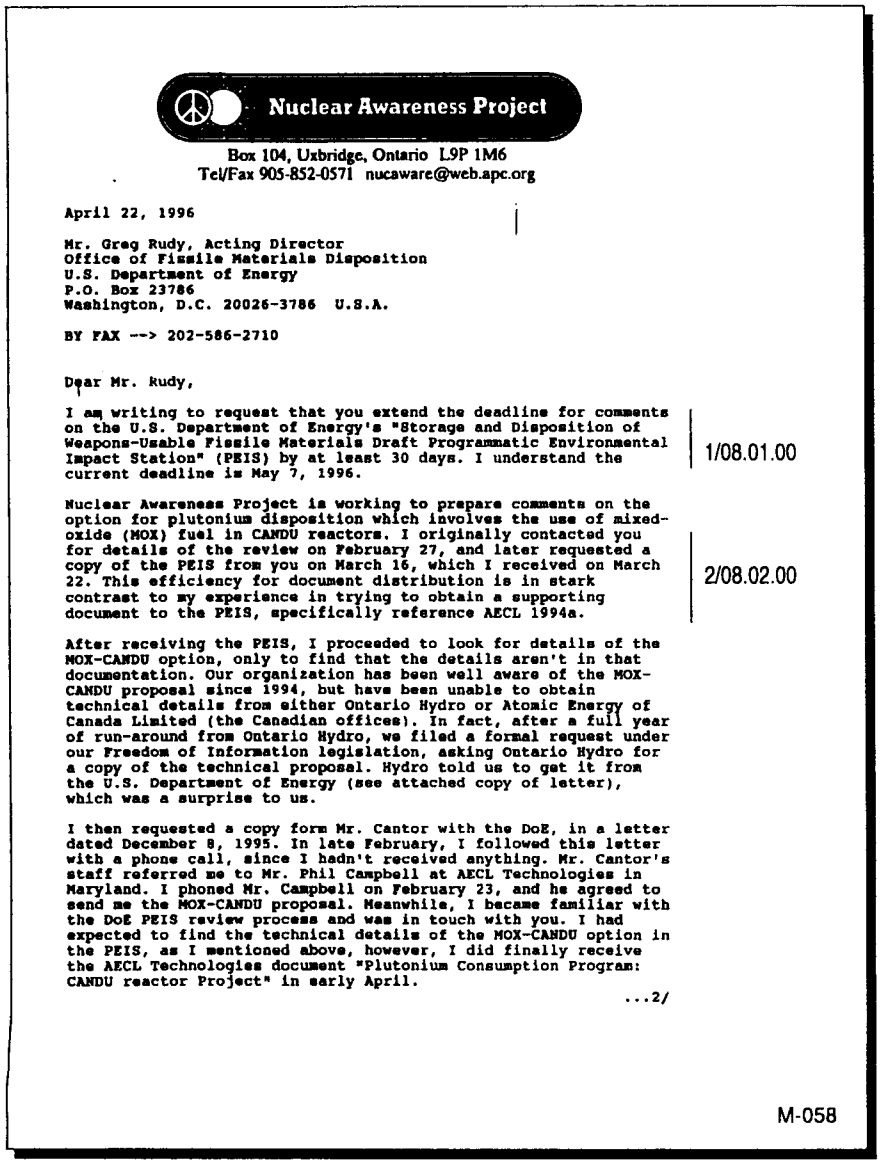
Total pages (including cover): 8 pages + cover sheet

Comments: Comments re: Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement

Please note that attachments and original submission are being sent express post -- attachements are not included with this fax

If this fax is incomplete please call 905-852-0571 or 905-852-3044 for re-transmission

M-058



Nuclear Awareness Project

Box 104, Uxbridge, Ontario L9P 1M6
Tel/Fax 905-852-0571 nucaware@web.apc.org

April 22, 1996

Mr. Greg Rudy, Acting Director
Office of Fissile Materials Disposition
U.S. Department of Energy
P.O. Box 23786
Washington, D.C. 20026-3786 U.S.A.

BY FAX --> 202-586-2710

Dear Mr. Rudy,

I am writing to request that you extend the deadline for comments on the U.S. Department of Energy's "Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Station" (PEIS) by at least 30 days. I understand the current deadline is May 7, 1996. 1/08.01.00

Nuclear Awareness Project is working to prepare comments on the option for plutonium disposition which involves the use of mixed-oxide (MOX) fuel in CANDU reactors. I originally contacted you for details of the review on February 27, and later requested a copy of the PEIS from you on March 16, which I received on March 22. This efficiency for document distribution is in stark contrast to my experience in trying to obtain a supporting document to the PEIS, specifically reference AECL 1994a. 2/08.02.00

After receiving the PEIS, I proceeded to look for details of the MOX-CANDU option, only to find that the details aren't in that documentation. Our organization has been well aware of the MOX-CANDU proposal since 1994, but have been unable to obtain technical details from either Ontario Hydro or Atomic Energy of Canada Limited (the Canadian offices). In fact, after a full year of run-around from Ontario Hydro, we filed a formal request under our Freedom of Information legislation, asking Ontario Hydro for a copy of the technical proposal. Hydro told us to get it from the U.S. Department of Energy (see attached copy of letter), which was a surprise to us.

I then requested a copy form Mr. Cantor with the DoE, in a letter dated December 8, 1995. In late February, I followed this letter with a phone call, since I hadn't received anything. Mr. Cantor's staff referred me to Mr. Phil Campbell at AECL Technologies in Maryland. I phoned Mr. Campbell on February 23, and he agreed to send me the MOX-CANDU proposal. Meanwhile, I became familiar with the DoE PEIS review process and was in touch with you. I had expected to find the technical details of the MOX-CANDU option in the PEIS, as I mentioned above, however, I did finally receive the AECL Technologies document "Plutonium Consumption Program: CANDU reactor Project" in early April.

...2/

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08 01 00 Comment Number 1

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

08 02 00 Comment Number 2

The Department of Energy uses a wide variety of methods to communicate with the public on these important issues. These methods include public meetings, as part of the NEPA process, and meetings outside of the process, such as the Plutonium Round Table. Numerous fact sheets and displays are made available at the meetings as well as by mail. All of this information is available on the Program's electronic bulletin board. All information was and will continue to be provided upon request as well as in the DOE Public Reading Rooms.

NUCLEAR AWARENESS PROJECT, UXBRIDGE, ON,
IRENE KOCK
PAGE 3 OF 5

All this background is just to point out to you the serious difficulty we have had in obtaining a document which forms the basis for the sections in the DoE PEIS on the MOX-CANDU option. I believe an extension of at least 30 days should be provided to make up the time lost due to complete documentation being unavailable. I look forward to your reply. | 2/08.02.00 cont. 1/08.01.00 cont.

Sincerely,

Irene Kock

Irene Kock

- 2 page letter attached (included with original in the mail)

M-058

ontario hydro

700 University Avenue Toronto Ontario M5G 1X6

Telephone: (416) 592-2736 Fax: (416) 592-5514

December 7, 1995

Nuclear Awareness Project
ATTN: Ms. Irene Kock
Box 2331
Oshawa, Ontario
L1H 7V6

Dear Ms. Kock:

Request for Access to Information
- Reference Number: 950062

I am responding to your access request received under the Freedom of Information and Protection of Privacy Act on November 10, 1995.

Access is denied to the following document:

- Plutonium Consumption Program - CANDU Reactor Projects

Access is denied to this record in accordance with section 22(a) of the Act, as this record has recently been published and is currently available to the public. You can request a copy from:

US Department of Energy
Fissile Materials Management
ATTN: Howard Cantor
Technical Director
Forrestal Hall
Washington, D.C.
USA

No other studies or reports exist that have been prepared by Ontario Hydro on the possible use of mixed-oxide fuel containing plutonium from dismantled nuclear warheads.

The person responsible for making the decision regarding access is L.E. Leonoff - Senior Vice-President, General Counsel and Secretary. You may request a review of this decision by contacting the Information and Privacy Commissioner within 30 days of receiving this response.

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Ms. Irene Kock -2- December 7, 1995

In the event that you wish to launch an appeal to the Information and Privacy Commissioner, please provide the Commissioner's Office with 1) the request reference number which Ontario Hydro assigned to your request; 2) a copy of the decision letter; and 3) a copy of the original request for information which you sent to us.

Sincerely,

S.M. Leng
Corporate Records and Freedom
of Information Officer
Corporate Records and Freedom
of Information Department
H18 A17

M. Gamble:MD

M-058

COMMENTS ON THE DEPARTMENT OF ENERGY'S
STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS
DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Nuclear Control Institute

June 7, 1996

EXECUTIVE SUMMARY

Non-Proliferation Issues

- The nonproliferation analysis is an integral element of the screening criteria and decisions made in preparing the DPEIS, and should therefore be made a formal part of the PEIS, rather than the subject of a separate process. | 1/01.06.00

- The Secretary of Energy should extend the public comment period until 45 days after all relevant support documents, including the cost and non-proliferation analyses, are made publicly available. | 2/08.01.00

- The 1994 NAS study on the disposition of excess weapon plutonium proposed three proliferation risk factors for use in comparing plutonium-disposition options: risk of theft; risk of reversal; and impact on arms reduction. These criteria should be incorporated into the PEIS's non-proliferation analysis. | 3/01.06.00

- Judged by each of these criteria, the option of irradiating weapons plutonium in nuclear reactors (the MOX option) poses far greater proliferation risks than the option of vitrifying plutonium with highly radioactive waste (the VHLW option).

- The MOX option presents a greater risk of diversion primarily because of the fuel-fabrication stage, a process that is difficult to safeguard effectively. Such uncertain verification could severely limit the trust nations place in an international nuclear arms-reductions and non-proliferation regime predicated upon recycling warhead plutonium as fuel for reactors. | 4/01.06.00

- The DPEIS fails to consider the "can-in-a-canister" vitrification option, now being developed at Savannah River and Livermore, despite the great promise it has shown. It must receive specific analysis and consideration in the PEIS. | 5/01.02.00

- The proliferation resistance of the final waste forms largely determines the potential reversibility of plutonium disposition, but the DPEIS fails to examine these issues. A detailed comparative analysis of plutonium retrievability from spent MOX fuel and immobilized glass and ceramic waste forms must be included. | 6/01.06.00

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01 06 00 **Comment Number 1**

Both the PEIS and the nonproliferation analysis document will be used, along with cost, schedule, and technical analyses in the decisionmaking process, to support the ROD.

08 01 00 **Comment Number 2**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days. The documents related to technical, cost, and schedule analyses were made available to the public beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996. These analyses will be considered along with the PEIS by the decisionmaker in reaching the ROD. The public had the opportunity to provide input on the studies before the ROD.

01 06 00 **Comment Number 3**

The purpose of the Proposed Action is, in part, to establish the technical and program infrastructure that will enable the United States to take unilateral action or negotiate reciprocal actions with other nations for the disposition of surplus weapons-usable Pu. This PEIS addresses the environmental impacts of the reasonable alternatives for DOE's Proposed Action. Analyses of the cost, schedule, technical, and nonproliferation policy impacts are described in separate documents and will be considered in DOE's decision. These documents were made available for public review beginning in late July and October 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the nonproliferation analysis, *Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Materials Storage and Plutonium Disposition Alternatives*, as it relates to the Proposed Action and alternatives.

The analysis of the nonproliferation impacts examines, among other things, the risk of theft, risk of reversal, and arms reduction impacts for the various Reactor Alternatives using MOX fuel and for the Immobilization Alternatives.

NUCLEAR CONTROL INSTITUTE, WASHINGTON, DC,
PAUL LEVENTHAL
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• Isotopic composition of the residual plutonium in the final waste forms is an inappropriate criterion by which to assess proliferation risks because it perpetuates a dangerous myth that reactor-grade plutonium cannot be used to make workable weapons. The ability to construct a weapon from reactor-grade plutonium was demonstrated decades ago. It is dangerous even to consider it an open question. Isotopic degradation does not pose a substantial barrier to re-militarization of warhead plutonium, and therefore does not constitute a compelling argument in favor of the MOX option---a conclusion shared by the 1995 NAS study.	7/01.06.00
• The MOX option would clearly encourage the civil use of plutonium. The U.S. Government would be engaging in MOX activities for the first time on a commercial scale, legitimizing the use of MOX in civil nuclear power programs. Such a sea change in U.S. policy would confuse and complicate U.S. non-proliferation diplomacy. It would send the wrong signal to Western Europe, Japan, and other non-nuclear-weapon states.	8/01.06.00
• The MOX option sends the wrong fuel cycle policy signal in three ways. First, the MOX option effectively declares that plutonium has an asset value, and that the energy contained within it should be viewed as a national asset. Second, the MOX option suggests that a plutonium fuel cycle can be effectively safeguarded, and the use of MOX for weapons plutonium disposition would surely be cited by plutonium advocates as a government "seal of approval" on the process. Third, the MOX option would be portrayed as giving credibility to the claim that plutonium recycle in light-water reactors (LWRs) is essential to nuclear waste management.	9/01.06.00
• While we strongly favor the immobilization options generally over the reactor options, we do not support all the immobilization options. We strongly oppose the electrometallurgical treatment alternative ("pyroprocessing"). This opposition is supported by the conclusions of studies by the National Academy of Sciences, and even DOE's own internal memo.	10/08.03.01
Transportation Security Issues	
• The selection of any reactor disposition option will increase transportation risks by adding two extra transportation steps to the disposition process. Weapons-grade plutonium will have to be transported from a plutonium conversion facility to a MOX fuel fabrication plant. MOX fuel would be sent from the fuel fabrication plant to a reactor site or sites.	11/10.00.00
• Transport risks would increase even more if a decision were made to fabricate MOX fuel in Europe, pending construction of a domestic fuel fabrication plant. This scenario would require trans-Atlantic sea shipments of weapons-grade plutonium and unirradiated MOX reactor fuel.	12/10.02.00
• Any of the immobilization options would require less transportation of weapons-usable materials and thereby reduce safety and security risks, a conclusion shared by the	13/08.03.01

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01 06 00 **Comment Number 4**

Appropriate safeguards and security considerations will be given to the MOX facility during the development of the design, or selection of an existing facility, and during the operation of the facility. These considerations will include the capability for material accountability and appropriate protection of the various forms of the material throughout the fuel fabrication process. As noted in the nonproliferation analysis, MOX fuel fabrication poses a potential security and diversion risk, which must be addressed with enhanced security.

01 02 00 **Comment Number 5**

The can-in-canister concept is included as a variant under the Vitrification Alternative for surplus Pu disposition. A more detailed discussion of this process appears in Section 2.4.4 and Appendix O of the Final PEIS as a result of comments received.

01 06 00 **Comment Number 6**

One of the goals of materials disposition is to make the Pu as inaccessible and unattractive for weapons use as the residual Pu contained in commercial nuclear spent fuel (that is, the Spent Fuel Standard). The Pu contained in spent MOX fuel or in an immobilized glass or ceramic form meets the Spent Fuel Standard. The proliferation resistance of the final MOX spent fuel and immobilized forms are compared for the various alternatives and variations in DOE's nonproliferation study, *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives*, which was made available for public review beginning in October 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the analysis of the Nonproliferation Policy as it relates to the disposition and storage and alternatives. The proliferation analyses, along with the PEIS, public comments, and cost, schedule, and technical analyses will be part of the decisionmaking process to support the ROD.

1995 NAS study. | 13/08.03.01 cont.

• There should be an explicit requirement for an armed military escort for U.S. sea shipments of weapons-grade plutonium and mixed-oxide reactor fuel fabricated from it. The DPEIS needs to state publicly what level of security will be required for shipments of plutonium and MOX. Anything less than an armed military escort should be unacceptable. | 14/13.00.00

• The DPEIS does not discuss the security arrangements for sea shipments of plutonium or MOX reactor fuel. Some aspects of these arrangements can and should be made a part of the public record and subject to independent evaluation.

Transportation Safety Issues

• No air shipments of plutonium or MOX should be allowed, given that a crashworthy air-shipment cask has not been developed for these materials. | 15/10.00.00

• The DPEIS understates the environmental hazards of transporting radioactive material by embracing the current international ("Type B") transport standards and assigning a low probability to an accident that could result in a breach of the cask. The DPEIS disregards recent expert reports that challenge the adequacy of the current international standards, as well as ongoing initiatives within the IAEA and the International Maritime Organization (IMO) to re-evaluate these standards in the context of historical data about accident conditions. The DPEIS's analysis is cursory and outdated, and must be revised to take into account the most recent studies and the ongoing IAEA and IMO re-evaluations of these casks. | 16/10.02.00

• Given the amounts of plutonium and MOX that could be transported for disposition, it would be prudent to test the shipping casks to failure and to evaluate the findings in the PEIS. | 17/10.00.00

Economic Issues

• Like the non-proliferation analysis, the cost analysis of plutonium disposition options now being prepared by Oak Ridge National Laboratory must be integrated into the NEPA decision-making process. | 18/08.00.00

• The cost analysis must include all costs of the various disposition options, including subsidies being demanded by nuclear electrical utilities that have expressed interest in using weapons-plutonium MOX fuel.

• Cost comparisons for the different plutonium disposition options should also reflect the cost of security requirements for sea shipments. | 19/07.02.00

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01 06 00 Comment Number 7

Although it may be possible to make a nuclear weapon from spent commercial reactor fuel, it can only be done with a great deal of difficulty by individuals with extensive experience in handling and processing nuclear materials. The disposition of weapons-usable Pu through the use of MOX fuel in LWRs creates a radiological barrier that makes the Pu as difficult to retrieve and reuse in weapons as Pu in spent commercial reactor fuel. The use of this technology approach would allow for the Pu to be disposed of in a geologic repository the same as commercial reactor fuel.

01 06 00 Comment Number 8

The President's Nonproliferation Policy says the United States will not recycle Pu. Burning weapons-usable Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel.

01 06 00 Comment Number 9

Converting surplus Pu into MOX fuel is not the end state. The end state is to use the MOX fuel in a reactor, so that after irradiation it meets the Spent Fuel Standard for proliferation resistance. While the Pu is in the MOX fuel form, it would be subject to high standards of safeguard and security.

While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of Pu from that spent fuel is not being proposed by DOE and is beyond the fundamental nonproliferation purpose of the disposition effort. The PEIS evaluates disposition of surplus weapons Pu through use in MOX fuel, but does not further propose or evaluate reprocessing of the spent fuel, and does not suggest or propose reprocessing for the management or disposition of the spent fuel.

Plutonium forms that are suitable for conversion to MOX fuel would have an energy value. However, the alternatives utilizing surplus weapons-usable Pu

I. Introduction

The Nuclear Control Institute ("NCI") is a non-profit policy research group that seeks to increase understanding in the U.S. and other countries of proliferation and terrorism risks associated with civilian uses of nuclear-weapon materials—plutonium and highly enriched uranium. NCI is concerned that certain plutonium-disposition options considered in the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement ("DPEIS")[1] contribute to those risks.

The Department of Energy (DOE) proposes that a disposition strategy be implemented for the 38.2 metric tons of U.S. weapon-usable plutonium that has been declared surplus, as well as any additional material designated as surplus in the future. This strategy will entail rendering such weapon-usable plutonium as inaccessible and unattractive for weapons use as the plutonium contained in spent nuclear fuel from commercial power reactors, a criterion known as the "spent fuel standard." The objectives of this approach are to strengthen the irreversibility of nuclear arms reductions and to reduce the risks of diversion or theft of the material.

NCI is concerned, however, that arms-reduction and non-proliferation objectives will be undercut if surplus plutonium is used as fuel in nuclear power reactors (the MOX option) rather than directly disposed of in waste (the vitrification option). We are also concerned with issues associated with environmental safety and health, transportation safety and security, economics, legal and regulatory matters, and fulfillment of DOE obligations under the National Environmental Policy Act (NEPA). All these concerns are elaborated in this set of comments, with the exception of environmental safety and health issues, which are addressed in a separate set of comments prepared by Dr. Edwin Lyman, scientific director of the Nuclear Control Institute.[2]

II. Non-Proliferation and Cost Analyses Must Be Included in DPEIS

Two key DOE analyses for use in consideration of plutonium disposition alternatives are not yet completed. DOE is still preparing a cost analysis and a non-proliferation analysis of disposition options. At the April 18 public hearing on the DPEIS, Greg Rudy, head of the Office of Fissile Material Disposition, stated that those analyses would eventually be made available to the public when completed, but not prior to the end of the comment period, then scheduled to end on May 7. At the request of NCI and several other

18/08.00.00 cont.

[1] Office of Fissile Materials Disposition, U.S. Department of Energy, Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement, DOE/EIS-0229-D, February 1996, Volumes I, II, III, and summary (hereafter referred to as "DPEIS").

[2] Dr. Edwin Lyman, "Public and Occupational Health and Safety Impacts of Plutonium Disposition Alternatives," Nuclear Control Institute, June 7, 1996.

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for fabrication of MOX fuel and burning in reactors are considered reasonable since converting the material to spent fuel meets the Spent Fuel Standard.

The Department of Energy is confident that the utilization of MOX fuel can be effectively safeguarded. Appropriate measures will be taken to provide this assurance. Further, the U.S. fuel cycle policy is unchanged. The Pu would be consumed in a reactor using a once-through fuel cycle, then disposed of as spent nuclear fuel. No reprocessing would be involved in surplus Pu disposition, consistent with the President's Nonproliferation Policy.

08 03 01 Comment Number 10

The Department of Energy acknowledges the commentor's opposition to the Electrometallurgical Treatment Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

10 00 00 Comment Number 11

The human health risks of material transportations associated with the proposed Pu storage and disposition alternatives are evaluated and presented in Section 4.4 of this PEIS. The more detailed description of the methodology and supporting data for the analysis is presented in the Appendix G. Transportation of radioactive materials between sites includes health risks for both normal operations and accident conditions to the public and workers.

10 02 00 Comment Number 12

According to results calculated by the RADTRAN code, the highest number of total potential fatalities from the transportation of materials from lag storage to fuel fabrication and then to a reactor site is 4.16 for MOX fuel fabrication in the United States. For MOX fuel fabrication in Europe, the number of potential fatalities for transportation would be 4.62. Risk differences between the two MOX fuel fabrication options (that is, the United States vs. Europe) are very small for transportation of all stages involved. The

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public-interest groups and stakeholders,[3] the comment period was extended until June 7, but DOE said that "while [DOE] does not intend to incorporate such [non-proliferation and cost] reports within the PEIS, they will be made available for public review this summer."[4] Mr. Rudy asserted that these analyses are not required for inclusion in the PEIS process which focuses on environmental issues.

18/08.00.00 cont.

This is an inappropriately narrow view of the scope of programmatic environmental impact statements. Previous EIS's, such as the spent fuel take-back PEIS, have included detailed nonproliferation analysis, even making non-proliferation a primary decision criterion.[5] Cost analysis has been included as a decision factor in some EIS's as well.[6] Indeed, even the draft plutonium disposition DPEIS explicitly cites "non-proliferation," "security," and "cost-effectiveness" as among the screening criteria used in the disposition

[3] Letter from Nuclear Control Institute, Greenpeace International, Nuclear Waste Citizens Coalition, Physicians for Social Responsibility, Institute for Science and International Security, and Nuclear Information Resource Service, to Energy Secretary Hazel O'Leary, April 29, 1996.

[4] Letter from Greg Rudy, Office of Fissile Materials Disposition, to Nuclear Control Institute, Nuclear Waste Citizens Coalition, Nuclear Information Resource Service, Greenpeace International, Institute for Science & International Security, and Physicians for Social Responsibility, May 6, 1996.

[5] Final Environmental Impact Statement: Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel, DOE/EIS-0218F, February 1996, Summary, pp. 51-59 (non-proliferation impacts of alternatives analyzed and compared); Draft F-Canyon Plutonium Solutions Environmental Impact Statement, DOE/EIS-0219D, August 1994, p. 2-13 ("security and nonproliferation" decision criterion "relates to how well each alternative supports national security objectives and nonproliferation"); Draft Environmental Impact Statement: Interim Management of Nuclear Materials, DOE/EIS-0220D, March 1995, p. 2-46 (decision criterion language identical to F-Canyon draft EIS); Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling, DOE/EIS-0161, Volume I, October 1995, p. S-8 (commercial irradiation services alternative ruled out of draft PEIS based on "nonproliferation concerns"; later incorporated into final PEIS based in part on "further consideration of nonproliferation issues"); Disposition of Surplus Highly Enriched Uranium Draft Environmental Impact Statement, DOE/EIS-0240-DS, October 1995, Summary, p. S-7 ("criteria against which to judge potential alternatives" based on President Clinton's 1993 nonproliferation policy and 1994 NAS report on plutonium disposition; "[t]hese criteria included [inter alia] nonproliferation; security ...".

[6] Spent Fuel Take-Back EIS, op. cit, pp. 62-63 (costs of alternatives analyzed and compared); Savannah River Site Waste Management: Draft Environmental Impact Statement, DOE/EIS-0217D, Volume I, January 1995, p. 2-78 ("A technology had to meet the following criteria to be deemed a potential technology ... (3) Its costs were comparable to other possible technologies"); Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs: Final Environmental Impact Statement, DOE/EIS-0203-F, Volume I, Summary, April 1995, p. 37 ("cost of implementation" a decision criterion, and comparative cost analysis integrated into PEIS); Draft Programmatic Environmental Impact Statement for Stockpile Stewardship and Management, DOE/EIS-0236, Volume I, February 1996, p. 3-1 ("planning assumptions and basis for analysis" in PEIS include "[m]aximize efficiency and minimize cost and waste consistent with programmatic needs"); Surplus HEU Disposition Draft EIS, op. cit, p. S-7 ("cost-effectiveness" among "criteria against which to judge potential alternatives").

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values given in Table 4.4.3.3–4 of the PEIS represent the "Total Potential Fatalities" associated with the transportation of Pu oxide, uranium oxide, and MOX fuel, for the Reactor Alternative category. The quantities presented are a result of direct risk calculations which yield results in "numbers of human fatalities." In regard to accumulating the risks associated with a given transportation process, the maximum risk impacts from the transport of Pu oxide, uranium oxide, and MOX fuel under the Reactor Alternatives may be summed directly from Table 4.4.3.3–4. Section G.1.2.5 provides a description of the transportation effects on the global commons.

08 03 01 **Comment Number 13**

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

13 00 00 **Comment Number 14**

The safeguards and security of storage of the weapons-usable fissile materials will continue to follow existing applicable regulations and requirements. Furthermore, the facilities would be inspectable by IAEA, as appropriate. Transportation impacts are discussed in Section 4.4 and Appendix G of the PEIS. Armed nuclear material couriers carefully selected and highly trained to operate tractor-trailers and communication systems would be used. These couriers would also be authorized by the AEA to carry firearms and make arrests in the performance of their duties. No military personnel are anticipated to be used in DOE's management of weapons-usable fissile materials in the United States. However, the same level of security, or higher as deemed necessary, would be provided for sea shipments as that of U.S. over-land shipments. During transport on the ship and while in temporary storage at the seaports, appropriate security escort measures would be implemented. Any sea transport would also meet applicable IAEA requirements and the International Maritime Organization code.

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PEIS process to rule out certain disposition alternatives.[7] Certainly the analyses used to support these cost and non-proliferation decisions should be incorporated into the PEIS itself. | 18/08.00.00 cont.

DOE's Office of Non-Proliferation and Arms Control, tasked with preparing the non-proliferation analyses, is developing a process whereby the public can comment on and participate in the development of that analysis.[8] The process will be modeled on the approach used in preparing the National Ignition Facility (NIF) non-proliferation analysis last year. While the opportunity for public input this approach will offer is beneficial and welcome, we also believe the nonproliferation analysis is an integral element of the screening criteria and decisions made in preparing the DPEIS, and should therefore be made a formal part of the PEIS. | 20/08.00.00

Moreover, we are not aware of any comparable public-input process for the economic analysis of disposition options being prepared by Oak Ridge National Laboratory. NEPA specifically requires that cost analyses, if prepared, be made a formal part of the EIS process. CEQ regulations, adopted by DOE for its implementation of NEPA,[9] provide that "[i]f a cost-benefit analysis relevant to the choice among environmentally different alternatives is being considered for the proposed action, it shall be incorporated by reference or appended to the statement as an aid in evaluating the environmental consequences. . . ."[10] [emphasis supplied] Courts have upheld this requirement, holding that "[t]he cost-benefit analysis of alternatives must be contained within the environmental impact statement standing alone, and not as complemented by the administrative record."[11] | 18/08.00.00 cont.

It is NCI's position, therefore, that the Secretary of Energy should extend the public comment period until 45 days after all relevant support documents, including the cost and non-proliferation analyses, are made publicly available. | 18/08.00.00 cont.

II. Non-Proliferation Issues

The absence of a non-proliferation analysis from the DPEIS is particularly egregious. First, the DPEIS itself states that "[t]he purpose of the proposed action is to implement the President's Nonproliferation and Export Control Policy in a safe, reliable, cost-effective, | 21/01.06.00

[7] DPEIS, Summary, p. S-5.

[8] Rudy letter, ibid.; Dave Airozo, "DOE Keeps Nonproliferation, Cost Analyses Out of Pu-Disposition PEIS," NuclearFuel, May 20, 1996, p. 12.

[9] 10 C.F.R. 1021.101; 10 C.F.R. 1021.103.

[10] 40 C.F.R. 1502.23 (emphasis added).

[11] National Wildlife Federation v. Marsh, 568 F.Supp. 985, 997 (D.D.C. 1983).

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10 00 00 Comment Number 15

Air transport is not proposed as an option under the alternatives discussed within this PEIS. Transport of nuclear materials is limited to either land or sea. Furthermore, there is no intent or strategy for air transport to ultimately become a viable option under any of the alternatives presented in the document, even if the "Safety Series 6" regulations, referenced to on page 20 of 47 of your comments (page 564 of this CRD), are subsequently approved.

10 02 00 Comment Number 16

Type B packagings are currently certified safe by DOE and NRC for transporting radioactive materials. The comments were given consideration for the PEIS, but the analysis used is for currently certified packagings. If the safety certification for the packaging is withdrawn, then new analyses would be required through the DOT, NRC, and IAEA as appropriate.

10 00 00 Comment Number 17

The testing of shipping casks is beyond the scope of the PEIS. The risk analysis performed for the PEIS used data from currently approved DOT, NRC, and DOE-certified shipping casks to determine impacts. When a specific alternative for disposition of Pu has been selected, any additional data with respect to the risks associated with shipping casks containing Pu and/or MOX fuel would be incorporated into the analysis.

08 00 00 Comment Number 18

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, was provided for public comment in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available to the public in the fall of 1996. Each of these analyses, which are separate from the NEPA process, will be integrated along with the environmental analysis and public input into DOE's decisionmaking process.

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technically feasible, and timely manner."[12] Second, as mentioned above, among the screening criteria used to select and exclude alternatives from the DPEIS were President Clinton's 1993 non-proliferation policy, as well as such factors as "non-proliferation" and "security."[13] 21/01.06.00 cont.

NCI is also concerned about the failure to coordinate decisions regarding disposition of military plutonium with U.S. policy toward civilian plutonium. A study by the U.S. National Academy of Sciences (NAS) on the disposition of plutonium from dismantled nuclear weapons emphasized that "further steps should be taken to reduce the proliferation risks posed by all of the world's plutonium stocks, military and civilian, separated and unseparated...."[14] A similar point was made in a Rand Corporation report which said: "It is critical that countries pay attention to the proliferation threat from the civilian side if they want to maximize the non-proliferation value of dismantling U.S. nuclear weapons and those of the FSRs (former Soviet republics). If countries ignore the civilian threat, they can compound the problem by making wrong choices in how to deal with military materials."[15] 22/01.04.00

To date, the U.S. Government has not drawn both elements of the plutonium problem, military and civilian, into a unified, coherent national plutonium policy. The strong interconnection between military and civilian aspects of U.S. HEU policy has been missing in the case of plutonium. The principal reasons for this include the reluctance of the United States to challenge Western Europe, Japan and Russia on their civilian plutonium programs, as well as resistance from nuclear industry representatives and government policymakers who insist that plutonium is a resource to be utilized, not a waste to be disposed of. These are largely political judgements that give short shrift to or ignore altogether the underlying security risks of encouraging civilian use of separated plutonium.

If current plans proceed, the world will have far more separated plutonium in civilian than in military programs[16]---a trend that can only work against effective disposition of military plutonium by the present nuclear-weapon states if civilian stockpiles

[12] DPEIS, Summary, p. S-3.

[13] DPEIS, Summary, p S-3

[14] Committee on International Security and Arms Control, National Academy of Sciences, Management and Disposition of Excess Weapons Plutonium, 1994 [NAS 1994], p 34.

[15] Brian Chow and Kenneth Solomon, Limiting the Spread of Weapon-Usable Fissile Materials, Rand Corporation Report, November 1993, p. xii.

[16] David Albright, Frans Berkhout, and William Walker, World Inventory of Plutonium and Highly Enriched Uranium 1992, 1993, p. 200 & p. 206. Albright et al. calculate that 257 metric tons of plutonium were in military inventories at the end of 1990. By 2010, they project that up to 546 metric tons of plutonium will have been separated from civilian spent fuel, and that up to 266 metric tons will remain as surplus.

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07 02 00 **Comment Number 19**

The costs associated with transporting the materials by sea, including related security, would be considered if the selected alternative(s) requires sea shipment. Cost data, along with technical and schedule data, was provided in a Technical Summary Report for disposition in the summer of 1996.

08 00 00 **Comment Number 20**

As noted by the commentor, DOE has prepared a nonproliferation analysis for the decisionmaker so that an informed decision can be made. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations and public input. The nonproliferation study is part of national policy considerations.

01 06 00 **Comment Number 21**

In addition to the environmental analysis of the storage and disposition alternatives identified in this PEIS, DOE conducted technical, schedule, cost and nonproliferation analyses to assure an adequate basis for a ROD. These analyses were published as separate documents and were made available to the public for review and comment.

The United States has placed some of its weapons-usable materials under IAEA safeguards and is continuing efforts to make more available to IAEA. DOE is also assisting Russia with efforts to build new storage facilities and to establish new control and accountability capabilities for existing storage facilities. Through these efforts, there is hope to encourage greater international commitment to IAEA inspections and, thereby, further ensure meeting nonproliferation goals.

01 04 00 **Comment Number 22**

European, Japanese, and Russian civilian nuclear policies are beyond the scope of this PEIS and DOE's Proposed Action; coordination of U.S. policy and related nonproliferation impacts concerning U.S. origin civilian and

of plutonium eclipse military stockpiles as projected. It is therefore imperative that U.S. warhead-plutonium disposal policy and non-proliferation objectives be closely coordinated. 22/01.04.00 cont.

The NAS study proposed three proliferation risk factors for use in comparing plutonium-disposition options: risk of theft; risk of reversal; and impact on arms reduction.[17] Judged by each of these criteria, the option of irradiating weapons plutonium in nuclear reactors (the MOX option) poses far greater proliferation risks than the option of vitrifying plutonium with highly radioactive waste (the VHLW option).

The MOX Option Poses a Greater Risk of Diversion and Theft 23/08.03.01

The MOX option presents a greater risk of diversion primarily because of the fuel-fabrication stage, a process that is difficult to safeguard effectively in view of plutonium's characteristic of sticking to the surfaces of processing equipment, and of the large, unavoidable uncertainties in the measurements of this "held-up" material. Fuel fabrication is susceptible to systematic diversion schemes by state operators of the plants, or by individual plant workers in collaboration with outside states or groups. This stage is avoided with the VHLW option, making it a proliferation risk unique to the MOX option. This issue is not considered in the DPEIS' analysis of MOX fuel fabrication.[18]

Recent experience suggests that the proliferation risk at this stage of disposition could be substantial. Difficulties at the Plutonium Fuel Processing Facility (PFPF) in Japan suggest that purportedly state-of-the-art MOX fabrication plants are difficult if not impossible to safeguard effectively. In May 1994, the Nuclear Control Institute disclosed that a major plutonium inventory discrepancy was been building up at the PFPF since the plant began operating in 1988.[19] The Japanese government and International Atomic Energy Agency (IAEA) claim that this plutonium, amounting to about 70 kilograms, or more than eight significant quantities (SQs), is not missing because it has been measured as being held up---that is, stuck to surfaces in the remote-handling equipment. Such measurements are taken by means of neutron coincidence counting and are subject to a wide range of uncertainty, perhaps as much as 30 percent in some instances.[20] To end the uncertainty, the IAEA recently requested that Japan cut open the glove boxes to remove and physically produce the held-up plutonium for the purpose of establishing the plant's inventory. This request was strongly resisted by the Japanese and will not be met promptly,

[17] NAS 1994, pp. 23-27.

[18] DPEIS, Section 4.3.5.1.

[19] "'Astounding' Discrepancy of 70 Kilograms of Plutonium Warrants Shutdown of Troubled Nuclear Fuel Plant in Japan," Nuclear Control Institute, May 9, 1994.

[20] Paul Leventhal, "IAEA Safeguards Shortcomings---A Critique," Nuclear Control Institute, September 12, 1994. For further discussion of the limitations of IAEA safeguards on plutonium, see Marvin Miller, "Are IAEA Safeguards on Plutonium Bulk-Handling Facilities Effective?," Nuclear Control Institute, August 1990.

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surplus "military" (weapons-usable) Pu is considered in the nonproliferation analysis that will be part of the decisionmaking process. As an example of this consistency and coordination, DOE is not proposing reprocessing of spent fuel generated by the use of MOX fuel consistent with U.S. policy against reprocessing of commercially generated spent fuel.

08 03 01 Comment Number 23

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations (including nonproliferation analyses), and public input. The nonproliferation analysis, *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Materials Storage and Plutonium Disposition Alternatives*, examines the potential diversion risk using the MOX fuel fabrication, safeguards, "hold-up" material, and accountability to the IAEA and international community, among other things. This nonproliferation analysis has been made available for public comment and will be considered in the decisionmaking process.

as the IAEA had originally asked.[21]

It will reportedly cost more than $100 million to clean out all the held-up plutonium and rebuild the PFPF, and even then PNC offers no guarantee that all the plutonium can ever be recovered or accounted for. As of October 1995, the clean-out was not scheduled to be completed until the end of the year,[22] and it is not clear that the work has been completed even now. MOX fabrication plants in Europe, which might be used to produce warhead-plutonium MOX fuel,[23] have not made sufficient disclosure of the design and operating history of their material control and accounting systems to permit any conclusion about the effectiveness of safeguards at these facilities. Because safeguards at these facilities are fully implemented by EURATOM, neither the United States nor the IAEA is in a position to verify independently material balances.

This controversy over the plutonium hold-up problem at MOX fuel fabrication plants holds valuable lessons for the warhead-plutonium disposition process. MOX disposal schemes have unacceptable uncertainties and risks built into them that will make it impossible to determine whether all warhead plutonium has been accounted for.

Such uncertainty could severely limit the trust nations could place in an international nuclear arms-reductions and non-proliferation regime predicated upon recycling warhead plutonium as fuel for reactors. Thus, the existing uncertainty over effectiveness of safeguards at MOX fabrication plants undercuts a primary goal of the disposition process, " . . . to provide visible evidence of irreversible disarmament."[24]

23/08.03.01 cont.

There are also risks of theft with the MOX option that arise during transportation and storage of plutonium and MOX fuel, which are discussed below (see "Transportation Issues").

In a vitrification disposition scheme, separated plutonium is vulnerable to diversion only prior to its placement in the melter. After that, it is mixed with molten glass and, in most proposals, either mixed with or emplaced in highly radioactive fission products, making it inaccessible for all practical purposes. Safeguards efforts for vitrification must concentrate on preparation of plutonium for the melter (e.g., conversion from metallic to oxide form). At least one vitrification technology, the GMODS system under development

24/05.01.08

[21] Mark Hibbs, "IAEA Gives Japan Till 1995 to Account for Holdup Inventory at PFPF Plant," NuclearFuel, October 10, 1994, pp. 12-13.

[22] Mark Hibbs, "Rebuild at PNC's PFPF Plant Will Cost Japan $100-million," NuclearFuel, October 9, 1995, pp. 11-12; "Pu Hold-Up at PFPF Still Controversial," Nuke Info Tokyo, November/December 1995, p. 3.

[23] DPEIS, Section 2.4.5.1, p. 2-119.

[24] DPEIS, Summary, p. S-4

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05 01 08 **Comment Number 24**

The Glass Material Oxidation/Dissolution System Alternative was eliminated from further consideration upon determining that the research and development required precluded it from being used for disposition within a decade from the ROD. Should this alternative become technologically viable, it may be considered by DOE in subsequent tiered NEPA documents. Other technologically viable vitrification alternatives and vitrification variants are considered and analyzed in this PEIS.

at Oak Ridge National Laboratory, is intended to allow plutonium to be added in unaltered metallic form, avoiding this stage entirely and eliminating this diversion vulnerability.[25] 24/05.01.08 cont.

One promising vitrification option that should be assessed in detail in the DPEIS, but is not,[26] is now being developed. In January, scientists at the Savannah River Site in South Carolina successfully demonstrated the "can-in-a-canister" approach, which mixes weapons plutonium and molten glass in small metal cans. After cooling, these cans are to be placed in larger steel canisters, which would then be filled with a mixture of molten glass and highly radioactive waste, thus immobilizing the plutonium and meeting the NAS' spent fuel standard for final disposal. The operation would take place at the Defense Waste Processing Facility at Savannah River which recently began filling these larger canisters to dispose of thousands of gallons of high-level waste remaining from plutonium production during the Cold War. 5/01.02.00 cont.

Both Westinghouse, the contractor operating the Savannah River Site, and the DOE Office of Fissile Material Disposition are very encouraged by the promising results thus far. According to Nicholas Kuehn, coordinator of the can-in-a-canister project at Savannah River, a "cold test" in January to demonstrate vitrification in cans with non-radioactive material, "exceeded our best expectation." As a result, Kuehn stated, can-in-a-canister is "certainly at the top of the list for immobilization options." A "hot test," in which actual plutonium will be vitrified in a can, will take place at Lawrence Livermore Laboratory later this year.[27] 25/05.00.06

The safeguards advantages of immobilization are noted in the NAS study. It concluded that fabrication of HLW waste logs would

> . . . be easier to safeguard than fabrication of MOX fuel bundles. Monitors would have to confirm only the single step of mixing the plutonium with the HLW. Once that step had taken place, the plutonium would be in an intensely radioactive mix and very difficult to divert. There would be no capability within the vitrification facility for re-separating the plutonium from the HLW.

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[25] C.W. Forsberg et al, Oak Ridge National Laboratory, "Direct Conversion of Spent Fuel to High-Level-Waste (HLW) Glass," Paper Presented to American Nuclear Society Conference, Salt Lake City, Utah, September 28, 1994.

[26] The DPEIS does not assess the "can-in-a-canister" approach in detail because it only analyzes the environmental consequences of a new, or "greenfield," vitrification plant. DPEIS, Section 4.3.4.1. Such an approach is inappropriate, because it skews the decision process toward MOX options by overestimating the environmental impacts of vitrification options that would use existing facilities (such as "can-in-a-canister" at DWPF) relative to MOX options. This point is elaborated in the environmental safety and health section of these comments.

[27] George Lobsenz, "Can In a Canister? DOE Considers Novel Plutonium Disposition Process," Energy Daily, May 31, 1996, p. 1.

05 00 06 **Comment Number 25**

Comment noted.

MOX fabrication, by contrast, requires many steps involving large-scale bulk handling of plutonium, with inherent accounting uncertainties, and at each step of the process the plutonium remains in a form from which it could be readily reseparated.[28]

The MOX Option Poses a Greater Risk of Reversal

The proliferation resistance of the final waste forms largely determines the potential reversibility of plutonium disposition. Appendix H of the DPEIS, "High-Level Waste Forms Comparative Analysis," fails to examine these issues. A detailed comparative analysis of plutonium retrievability from spent MOX fuel and immobilized glass and ceramic waste forms must be included along with the factors already addressed, such as regulatory issues, criticality, thermal load, radiation, and releases. 26/06.01.08

Reversibility is a function of three factors. The first is the amount of residual plutonium remaining in the final waste forms. The MOX option would leave modestly less plutonium in final waste than the VHLW option. However, it is misleading to speak of MOX "burning" of weapons plutonium as if all or even most of the plutonium is consumed during irradiation. In fact, irradiated weapons-plutonium MOX fuel would contain only about 30 percent less total plutonium than fresh MOX.[29]

The second factor is retrievability of the residual plutonium. Separation of plutonium from fresh MOX fuel is a straightforward chemical process. Reprocessing irradiated MOX fuel by means of PUREX employs proven technology that could recover substantial amounts of plutonium. Chemical separation of plutonium from VHLW is a similar chemical processes, roughly comparable in difficulty.[30]

The third factor is the isotopic composition of the residual plutonium in the final waste forms. Plutonium disposed of in VHLW remains weapons-grade, except for normal radioactive decay. Weapons plutonium in irradiated MOX fuel contains a considerably smaller proportion of fissile isotopes after irradiation than before. This factor, however, is not nearly as important from a non-proliferation perspective as some have argued. Many MOX proponents emphasize the degree to which the isotopics of the weapons plutonium would be altered by irradiation in a particular reactor technology—that is, the degree to

[28] NAS 1994, p. 192.

[29] Panel on Reactor-Related Options for the Disposition of Excess Weapons Plutonium, Committee on International Security and Arms Control, National Academy of Sciences, Management and Disposition of Excess Weapons Plutonium: Reactor-Related Options, 1995 [NAS 1995], Table 6-5, p. 270, indicates that a fresh weapons-plutonium MOX fuel element would contain 25 kilograms of plutonium. The same element, after irradiation to a burn-up of 40 megawatt-days per kilogram heavy metal, would contain 18 kilograms of plutonium.

[30] NAS 1995, p. 243

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06 01 08 **Comment Number 26**

Proliferation resistance is the primary objective of the Fissile Materials Disposition Program. To ensure each disposition alternative provides sufficient proliferation resistance, an independent team of safeguards and security experts is assessing the proliferation vulnerability of the various disposition alternatives. The purpose of this assessment is to identify potential weaknesses in the proliferation resistance and, thus, the effectiveness of the disposition alternatives to threats of material theft and/or retrieval and reuse.

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which the Pu-239 proportion can be reduced---as if this factor should be decisive in choosing among disposition technologies.

This is an inappropriate criterion by which to assess proliferation risks because it perpetuates a dangerous myth that reactor-grade plutonium cannot be used to make workable weapons. The ability to construct a weapon from reactor-grade plutonium was demonstrated decades ago. It is dangerous even to consider it an open question. Hans Blix, director-general of the IAEA, informed our Institute that there is "no debate" on this point in the Safeguards Department of the IAEA, and that the agency considers virtually all isotopes of plutonium, including high burn-up reactor-grade plutonium, to be usable in nuclear weapons.[31] In June 1994, U.S. Energy Secretary Hazel O'Leary declassified further details of a 1962 test of a nuclear device using reactor-grade plutonium, which successfully produced a nuclear yield.[32] 7/01.06.00 cont.

In a future breakout scenario, the United States (or Russia) could presumably draw on its nuclear test data and predictive capabilities to reconfigure weapons designs and reconstitute a large arsenal, even from plutonium isotopically degraded to reactor-grade by irradiation in MOX. Also, development of laser isotope separation, such as AVLIS, is likely eventually to permit the "mining" of the Pu-239 isotope from reactor-grade plutonium. If isotopic degradation were determined to have some utility from a non-proliferation perspective (for example, to establish parity with non-nuclear-weapon states storing high burn-up plutonium in the form of spent fuel), weapons plutonium could be mixed with reactor-grade plutonium, possibly from surplus stockpiles of separated civil plutonium in Great Britain or Russia, to dilute it isotopically prior to vitrification with HLW. 27/01.06.00

Our main point is, however, that isotopic degradation does not pose a substantial barrier to re-militarization of warhead plutonium, and therefore does not constitute a compelling argument in favor of the MOX option. It is important to note that the 1995 NAS study agreed with this conclusion. In its comparison of the MOX and VHLW options it found that "[t]he plutonium in the spent fuel assembly would be of lower isotopic quality for weapons purposes than the still weapons-grade plutonium in the glass log, but *since nuclear weapons could be made even with the spent fuel plutonium this difference is not* 28/08.03.00

[31] Letter from Hans Blix, Director-General of the IAEA, to Paul Leventhal, NCI, November 1, 1990; "Blix Says IAEA Does Not Dispute Utility of Reactor- Grade Pu for Weapons," Nuclear Fuel, November 12, 1990, p. 8. However, Blix made this statement only after the Nuclear Control Institute challenged assertions by IAEA officials earlier that year that reactor-grade plutonium was unsuitable for use in weapons.

[32] U.S. Department of Energy, Office of the Press Secretary, "Additional Information Concerning Nuclear Weapon Test of Reactor-Grade Plutonium," DOE Fact Sheet released as part of the Openness Initiative, June 27, 1994. The fact that the test occurred and produced a nuclear yield was declassified in 1977. Robert Gillette, "Impure Plutonium Used in '62 A-Test," Los Angeles Times, September 16, 1977, part 1, p. 3.

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01 06 00 **Comment Number 27**

Comment noted.

08 03 00 **Comment Number 28**

The proliferation resistance of each alternative is the subject of a separate study conducted by DOE's Office of Non-Proliferation and National Security. The results of this study will, along with the PEIS and other information, be presented to the decisionmaker so that good sustainable decisions can be made.

decisive."[33] [emphasis supplied] This point should be explicitly made explicitly in the final PEIS and record of decision. | 28/08.03.00 cont.

The MOX Option Poses a Threat to Arms Control and Non-Proliferation Efforts

In its non-proliferation policy statement, the Clinton administration declared that "the United States does not encourage the civil use of plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes."[34] Though it does not necessarily involve further reprocessing, the MOX option would clearly encourage the civil use of plutonium, which in a number of countries includes plans for reprocessing irradiated MOX fuel. The U.S. Government (or its duly authorized agents) would be engaging in MOX activities for the first time on a commercial scale, legitimizing the use of MOX in civil nuclear power programs. | 29/06.01.08

Such a sea change in U.S. policy would confuse and complicate U.S. non-proliferation diplomacy. It would send the wrong signal to Western Europe, Japan, and other non-nuclear-weapon state members of the Non-Proliferation Treaty (NPT). The NAS study conceptualized this issue as the "Fuel Cycle Policy Signal":

> [P]olicymakers will have to take into account the fact that choosing to use weapons plutonium in reactors would be perceived by some as representing generalized U.S. approval of separated plutonium fuel cycles, thereby compromising the ability of the U.S. government to oppose such fuel cycles elsewhere. Conversely, choosing to dispose of weapons plutonium without extracting any energy from it could be interpreted as reflecting a generalized U.S. government opposition to plutonium recycle. Either choice could have an impact on fuel cycle debates now underway in Japan, Europe, and Russia.[35]

The DPEIS implicitly acknowledges the importance of the fuel cycle policy signal when it posits that one of the goals of the disposition process is "to strengthen national and international arms control efforts by providing a storage and disposition model for the international community."[36] But the DPEIS does not cite the NAS finding or explicitly consider the fuel cycle policy signal that the MOX option would send relative to alternative immobilization options. | 30/01.06.00

[33] NAS 1995, p. 413.

[34] White House Fact Sheet. "Nonproliferation and Export Control Policy," September 27, 1993, p. 2.

[35] NAS 1994, p. 149.

[36] DPEIS, Summary, p. S-4.

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06 01 08 **Comment Number 29**

Converting surplus MOX fuel is not the end state. The end state is to use the MOX fuel in a reactor, so that after irradiation, it meets the Spent Fuel Standard for proliferation resistance. While the Pu is in the MOX fuel form, it would be subject to high standards of safeguards and security.

While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of Pu from that spent fuel is not being proposed by DOE and is contrary to the fundamental nonproliferation purpose of the disposition effort. The PEIS evaluates disposition of surplus weapons Pu through use in MOX fuel, but does not further propose or evaluate reprocessing of the spent fuel and does not suggest reprocessing for the management or disposition of the spent fuel.

01 06 00 **Comment Number 30**

The U.S. fuel cycle policy is unchanged. The Pu would be consumed in a reactor using a once-through fuel cycle, then disposed of as spent nuclear fuel. No reprocessing would be involved in surplus Pu disposition, consistent with the President's Nonproliferation Policy. The Nonproliferation Policy impact analysis for the alternatives described in the PEIS is presented in a separate document made available for public review in the October 1996.

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The MOX option sends the wrong fuel cycle policy signal in three ways. First, the MOX option effectively declares that plutonium has an asset value, and that the energy contained within it should be viewed as a "national asset" (as the U.S. DOE puts it)[37] or even "national heritage" (as the Russians put it).[38]

Second, the MOX option suggests that a plutonium fuel cycle can be effectively safeguarded, and the use of MOX for weapons plutonium disposition would surely be cited by plutonium advocates as a government "seal of approval" on the process.

Third, the MOX option would be portrayed as giving credibility to the claim that plutonium recycle in light-water reactors (LWRs) is essential to nuclear waste management. Despite the fact that both unaltered spent fuel and high-level waste derived from reprocessing produce comparable amounts of penetrating radiation and short-term thermal output,[39] reprocessing advocates have seized upon the separation and re-use of plutonium as the sine qua non of effective waste management.

Reprocessing proponents would seize upon the use of MOX in the disposition process as a U.S. government policy statement that plutonium can be effectively disposed of by means of fissioning it in MOX-fueled reactors. The MOX fuel used to irradiate weapons plutonium could be reprocessed, and the plutonium industry, particularly in Japan and Germany, would continue to press for this option as a means to "eliminate" completely plutonium over hundreds of years. If total plutonium elimination becomes the goal of a plutonium-recycling program, fast reactors—with all their poor economics, safety hazards, and proliferation risks— would become inevitable, because for technical reasons plutonium cannot be recycled more than two or three times in thermal reactors.[40] Even then the goal of total elimination would be futile, because most fast reactors are breeders that produce more plutonium than they consume. The U.S. warhead-plutonium disposition program should not in any way lend credence to such misguided efforts. 22/01.04.00 cont.

Thus, a general category of danger from the MOX option would be the perpetuation of overseas plutonium and breeder reactor programs. Russia's current position is to keep weapons plutonium in long-term storage pending its eventual use as fuel for LWRs and fast 31/01.06.00

[37] "Report Calls Plutonium a 'National Asset,'" Denver Post, July 29, 1993.

[38] Frank von Hippel, Federation of American Scientists' Fund, Cooperative Research Project on Arms Reduction: Sixth Annual Report, August 22, 1993, p. 3.

[39] U.S. Office of Technology Assessment, Managing the Nation's Commercial High-Level Radioactive Waste, March 1985, pp. 68-73.

[40] Report by the Working Party on Physics of Plutonium Recycling, NEA Nuclear Science Committee, Physics of Plutonium Recycling, Volume I: Issues and Perspectives, OECD Nuclear Energy Agency, 1995, pp. 115-116.

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01 06 00 **Comment Number 31**

The U.S. fuel cycle policy is unchanged. The Pu would be consumed in a reactor using a once-through fuel cycle, then disposed of as spent nuclear fuel. No reprocessing would be involved in surplus Pu disposition, consistent with the President's Nonproliferation Policy. The Nonproliferation Policy impact analysis for the alternatives described in the PEIS is presented in a separate document made available for public review in the fall of 1996. DOE feels that this will not provide any signal or support foreign reprocessing.

breeder reactors.[41] The U.S. would have little credible basis upon which to oppose Russia's plutonium fuel cycle plans if the U.S. were to select the MOX option and would also provide tacit support to European and Japanese plutonium programs. 31/01.06.00 cont.

A further danger is that the MOX option would undercut U.S. non-proliferation diplomacy directed at so-called "rogue states." With the U.S. actively pursuing the MOX option, it becomes far more difficult to deny nations of proliferation concern their "right" to civil use of plutonium as members of the NPT. North Korea claimed, albeit with little credibility, that its reprocessing plant at Yongbyon was intended to separate plutonium for use in MOX fuel for civilian nuclear power reactors. Though it agreed in October 1994 to abandon plans for indigenous reprocessing facilities, the ultimate disposition of plutonium contained in the remaining MAGNOX spent fuel and in future LWR spent fuel has yet to be determined. Overseas reprocessing has not been ruled out; nor has recycling of plutonium as MOX fuel in North Korea been specifically precluded. 32/01.04.00

At the third NPT PrepComm meeting, Iran threatened to withdraw from the NPT because, it charged, Iran and other NPT non-nuclear-weapon states were being denied nuclear technology that was their due under the terms of Article IV. India and Pakistan, though not NPT members, pursue plutonium programs that they justify as a legitimate part of their civil nuclear programs, and China anticipates reprocessing the spent fuel from its nuclear-power plants.

The only credible way to oppose the separation and use of plutonium as well as acquisition and use of HEU in nations of proliferation concern is to oppose it comprehensively—that is, to oppose such use in any nation for any purpose. This approach is effectively precluded if the U.S. insists upon retaining the right to use MOX fuel in civilian reactors, even if only for the purpose of weapons plutonium disposition. 33/08.03.01

Pyroprocessing Immobilization Alternative Must Be Rejected[42]

The DPEIS (Section 2.4.3.3) posits "electrometallurgical treatment" as one of the immobilization options. In this option, pyroprocessing technology developed by Argonne National Laboratory as part of the Integral Fast Reactor (IFR) Program, now cancelled, would be used to produce a zeolite waste form. Cesium-137 or high-level waste would be incorporated into the waste form to create a radiation barrier.[43]

While we strongly favor the immobilization options generally over the reactor 34/01.04.00

[41] Mark Hibbs, "G-7 Concessions Mark Triumph for Minatom's Strategic Aims," Nucleonics Week, April 25, 1996, p. 9.

[42] This section was prepared by Daniel Horner, deputy director of the Nuclear Control Institute.

[43] DPEIS, p. 2-114.

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01 04 00 **Comment Number 32**

Comment noted.

08 03 01 **Comment Number 33**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 04 00 **Comment Number 34**

The Department of Energy acknowledges the commentor's opposition to the Electrometallurgical Treatment Alternative. Information and assessments on electrometallurgical treatment will be taken into account in the decisionmaking process. Separate technical, schedule, and costs analyses on the disposition options, including electrometallurgical treatment, were issued by DOE beginning in late July 1996; the nonproliferation analysis of the disposition options, including electrometallurgical treatment, was issued for public comment in October 1996. The Electrometallurgical Treatment Alternative is analyzed in the PEIS because it is a "reasonable" alternative, and as such, must be analyzed under NEPA. Section 2.4.4.3 of the PEIS has been revised to note the NAS concerns regarding the use of electrometallurgical treatment for Pu disposition.

options, we do not support all the immobilization options. We strongly oppose the electrometallurgical treatment alternative ("pyroprocessing"). A recent NAS study noted the proliferation risks of proceeding with pyroprocessing: 34/01.04.00 cont.

> Developing technology that effectively extracts the plutonium from mixtures could facilitate decommissioning of former weapons manufacturing facilities and mitigate some of the problems found at these facilities, such as corroding fuel. However, such efficient technology also raises concerns about proliferation; what the United States might use to assist in the cleanup of a contaminated facility such as Rocky Flats could be used by another country to obtain plutonium for a weapons program.[44]

We cannot understand why this option was even included among the alternatives. The 1995 NAS study summarized its views on pyroprocessing as follows: 34/01.04.00 cont.

> The pyroprocessing approach, which would use technology developed as part of the U.S. Integral Fast Reactor program, would require substantial additional engineering development and construction of major new facilities (including what would amount to a sizable LWR fuel reprocessing plant to provide feed material), and it would provide a waste form that has not been characterized at all for long-term disposition and would probably be unsuitable for emplacement in Yucca Mountain. All this strikes our panel as a prescription for long delays and big investments in pursuit of highly uncertain prospects for solving a problem for which satisfactory approaches -- the current-reactor/spent fuel and borosilicate-glass/vitrification options -- are much closer at hand.[45]

These problems were not even addressed, let alone rebutted, in the DPEIS.

This summary analysis alone indicates that pyroprocessing should have been ruled out on the grounds of timeliness, technical maturity, ES&H, policy (because, like options R10, R11, and R13, it involves reprocessing), and cost-effectiveness. Indeed, one wonders what the purpose of the screening criteria is if an option can fail to meet so many of them and still be included among the options considered in the DPEIS. 34/01.04.00 cont.

Among the other critiques of pyroprocessing was an internal DOE memo, which analyzes and rejects each of the rationales for continuation of the pyroprocessing program, concluding that "[t]he promise of simplicity and being inexpensive just does not seem to be

[44] Gregory R. Choppin, et al., An Evaluation of the Electrometallurgical Approach for Treatment of Excess Weapons Plutonium, National Research Council, 1996 [Choppin], p. 27.

[45] NAS 1995, p. 412. A more detailed analysis appears on pp. 219-221.

born [sic] out in practice."[46] As indicated in this memorandum, the recent report by the National Academy of Sciences did highlight the serious potential problems from plutonium loading in the pyroprocessing waste form:

> Criticality concern related to the long-term post-closure repository performance of the GBZ [glass-bonded zeolite] waste form cannot be addressed readily, because the exact composition of the waste forms is still undetermined. The resulting technical concerns are exacerbated by the expected concentration of plutonium at the front of the loading columns during processing.[47]

The report also raised important questions about the waste forms with regard to radioactive decay effects, chemical stability, thermal stability, and long-term waste-from performance.[48]

With regard to the assessment of pyroprocessing in the 1994 and 1995 NAS plutonium-disposition studies, the report said:

> Given the great concern about the fate of weapons plutonium, the CISAC reports recommended against approaches that would require significantly more time to develop, or would entail significantly greater uncertainty, than alternatives that could be available in a shorter time with less uncertainty. That conclusion was based on an earlier version of the electrometallurgical approach. Although this committee has not examined costs, the committee believes that the uncertainty and timeliness for the present proposed electrometallurgical technique would not alter the conclusion of the earlier report.[49]

DOE clearly was aware of this recent study as it prepared the DPEIS, as the study is cited on page 2-114 of Volume I. But the footnote is rather remarkable. It says, "The National Academy of Sciences recently completed an evaluation and draft report on this subject. The results of this evaluation will be considered in the preparation of the Final Storage and Disposition PEIS." The study was completed and DOE was aware of it, but obviously chose not to incorporate into the analyses it conducted in preparing the DPEIS. It is difficult to avoid the conclusion that DOE ignored this study (as well as the other

34/01.04.00 cont.

[46] "Comments on the Electrometallurgical Process," attachment to letter to Bill Danker, MD-1, from Leonard Gray, Task Leader, Fissile Materials Immobilization Task, Fissile Materials Disposition Project, 30 August 1995.

[47] Choppin, p. 24.

[48] Choppin, pp. 6 and 22-26.

[49] Choppin, pp. 27-28.

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critiques cited above) so that it could include pyroprocessing as one the disposition options, notwithstanding the overwhelmingly negative assessments of it by independent experts. | 34/01.04.00 cont.

IV. Transportation Issues[10]

Transport Security Issues

This section addresses security and safety concerns related to the transport of plutonium and mixed-oxide fuels, as described in the DPEIS's evaluation of plutonium disposition options.

First, it must be noted that the selection of any reactor disposition option will increase transportation risks by adding two extra steps to the disposition process. Weapons-grade plutonium will have to be transported from a plutonium conversion facility to a MOX fuel fabrication plant. Mixed-oxide (MOX) reactor fuel would be sent from the fuel fabrication plant to a reactor site or sites. The DPEIS recognizes the security risks involved and states an SST will be used "to minimize potential for diversion."[11] The NAS study pointed out the single-site location of weapon-plutonium vitrification as a factor that would reduce the risk of theft relative to MOX options.[12]

Transport risks would increase even more if a decision were made to fabricate MOX fuel in Europe, pending construction of a domestic fuel fabrication plant. This scenario would require trans-Atlantic sea shipments of weapons-grade plutonium and unirradiated MOX reactor fuel. Although the DPEIS assumes construction of a U.S. MOX plant within six years, regulatory obstacles and public resistance could delay construction beyond the time a MOX plant would be needed. In that case, more frequent shipments to and from Europe would be necessary. Furthermore, if MOX were to be used to fuel a CANDU reactor, and were to come to a U.S. military or other port of entry, an additional transportation step would be required to send fresh MOX fuel to Canada. This last variation is not addressed in the DPEIS. | 35/10.00.00

Transportation risks could be minimized, however, by opting for direct disposal of surplus plutonium as waste. Any of the immobilization options would require less transportation of weapons-usable materials and thereby reduce safety and security risks. If conversion and vitrification were done at the Pantex site, it would eliminate the need to transport plutonium from the storage facility to an immobilization plant. | 36/10.00.00

At issue are shipments of large quantities of weapons-usable materials. If fuel | 35/10.00.00 cont.

[10] This section was prepared by Sharon Tanzer, vice president of the Nuclear Control Institute.

[11] DPEIS, p. 2-123.

[12] NAS 1995, p. 243.

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10 00 00 Comment Number 35

The PEIS analysis assumes that transport of Pu by ship would be done by dedicated British Nuclear Fuel, Limited, or COGEMA ships from military seaports in the United States to seaports in Great Britain or France. The transport would meet applicable IAEA requirements and the IMO code. While in temporary storage at the seaports and during transport on the ship, appropriate escort security measures would be implemented.

Section G.1.2.5 provides a description of the transportation effects on the global commons and includes the results of an environmental assessment of the sea shipment of Pu, *Environmental Assessment of the Import of Russian Plutonium-238,* referenced in the PEIS as DOE 1993x. Technical and licensing issues related to the MOX fuel fabrication have been considered by DOE in the technical evaluations of the storage and disposition alternatives, which were issued in late July 1996. It is anticipated that MOX fuel fabricated in Europe would not be used in a reactor in Canada.

10 00 00 Comment Number 36

The PEIS transportation analysis includes the movement of material required for disposition at more than one location. If the common activity facilities (for example, pit disassembly facility) are located at the same site as the disposition activity facilities (for example, ceramic immobilization facility) there would be a reduction in the transportation risk. The current analysis is bounding for activities at multiple sites.

fabrication were done in the United States, the DPEIS estimates the fabrication plant would receive 20 shipments of plutonium annually and send 174 shipments of reactor fuel bundles to a reactor site or sites.[53] If a European fuel-fabrication facility were used, there would be two sea shipments to Europe each year of two to four tons of weapons-grade plutonium and four sea shipments annually to the United States of fresh MOX fuel.[54]

Use of an existing European fuel-fabrication facility is described as an interim, short-term option because construction of a U.S. plant is projected to take six years.[55] But during this time, there could be a dozen sea shipments of plutonium to Europe and twice that number of shipments of MOX fuel to the United States. The U.S. has advised Japan repeatedly that Japan must provide an armed escort for Japanese shipments of reactor-grade plutonium in oxide or mixed-oxide form from France to Japan.[56] There needs to be an explicit requirement for a comparable armed escort for U.S. sea shipments of weapons-grade plutonium and mixed-oxide reactor fuel fabricated from it.

35/10.00.00 cont.

The transport of many "significant quantities" of weapons-materials raises security concerns that are directly relevant to selection of a disposition option. With respect to plutonium, the DPEIS commits to the use of Safe Secure Transport vehicles [SST] in the United States. However, the DPEIS is not clear on the arrangements for domestic transport of unirradiated MOX fuel.

On this point, the text is inconsistent and contradictory. Table 4.4.2.2.-1 indicates MOX fuel will be transported by "truck," with no mention of an SST. Elsewhere, use of an SST, an SST "container," or a certified commercial truck carrier" is described.[57] The report notes that "standard commercial practice" will be followed,[58] even though there is no commercial MOX industry in the U.S. And there is no discussion of security arrangements with the government of Canada—which presumably has no SSTs—if CANDU reactors were used. These matters require clarification.

37/10.00.00

[53] DPEIS, p. 4-782.

[54] DPEIS, p. G3.

[55] DPEIS, p. 2-123.

[56] Letter from Fred McGoldrick, Director, Office of Nuclear Non-Proliferation and Export Policy, U.S. Department of State, October 25, 1993, to Tom Clements, Greenpeace International Plutonium Campaign.

[57] DPEIS, pp. 4-771-4772. "Pu and HEU would be transported in truckload shipments by safe secure trailer (SST). The other materials would be transported by commercial truck . . . " DPEIS, Appendix G, Intersite Transportation, p. G-1. "'For the shipment of Pu oxide from lag storage to an overseas MOX fuel fabrication site and the return shipment of reactor fuel assemblies, (1) material must be transported by safe secure trailer (SST) to or from the selected U.S. port . . . " DPEIS, Appendix G, p. G-3.

[58] DPEIS, p. 4-782.

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10 00 00 Comment Number 37

Transportation from the MOX fuel fabrication site to a reactor site would be in accordance with DOE's SST system, to ensure the safe transport of this material. If the CANDU Reactor Alternative were selected at the ROD, transportation requirements would be coordinated with Canadian authorities for the safe secure transport of the MOX fuel. Sections 4.4.2 and G.1.1 of the Final PEIS have been clarified to correct the confusion for the utilization of SST, for fresh MOX fuel shipment.

The PEIS analysis assumes that transport of Pu by ship would be done by dedicated British Nuclear Fuel, Limited, or COGEMA ships from military seaports in the United States to seaports in Great Britain or France. The transport would meet applicable IAEA requirements and the IMO code. While in temporary storage at the seaports during transport on the ship, appropriate escort security measures would be implemented.

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The DPEIS does not discuss the security arrangements for sea shipments of plutonium or MOX reactor fuel. These arrangements are likely included in the classified appendix on transportation.[59] However, some aspects of these arrangements should be made a part of the public record and subject to independent evaluation. 37/10.00.00 cont.

There is ample precedent for public debate on these issues. The physical protection arrangements for sea shipment of plutonium have been discussed publicly at least since the 1984 sea shipment of 184 kilograms of plutonium from France to Japan. The need for a military escort was debated in the American and Japanese press prior to the *Akatsuki-maru* shipment in 1993. The Department of State has stated on more than one occasion that the U.S. would require an armed escort vessel for any future sea shipment of mixed-oxide fuel.[60]

The DPEIS needs to state publicly what level of security will be required for shipments of plutonium and MOX. This can be done without providing explicit details regarding armament, routing and scheduling that might prove useful to a potential adversary. Anything less than an armed military escort should be unacceptable, given U.S. insistence on an armed escort for any shipment of MOX fuel containing U.S.-origin reactor-grade plutonium from France to Japan. The United States should provide no less for shipments of U.S. weapons-grade plutonium. 14/13.00.00 cont.

Cost comparisons for the different plutonium disposition options should also reflect the cost of security requirements for sea shipments. U.S. naval vessels have been used in the past to protect plutonium shipments between France and Japan. This expense should be reflected in any cost evaluations of the different disposition alternatives. 19/07.02.00 cont.

The DPEIS rules out air transport of any nuclear materials.[61] This reflects the U.S. Government's correct rejection of the arguments made at the IAEA that MOX fuel is a "low-dispersible" material and therefore can be flown in a Type B cask. New Safety Series 6 regulations are expected to permit air shipment of MOX in a Type B cask, but the IAEA Board of Governors has not yet approved the new code. NCI has urged the Board to reject the new standards.[62] 15/10.00.00 cont.

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[59] DPEIS, p. 4-783.

[60] "Kansai Electric's Shipment Will Require Armed Escort Ship," July 23, 1993, press release from Plutonium Action Network - Kyoto. Also, letter from Fred McGoldrick, State Department, to Tom Clements, Greenpeace International, October 25, 1993.

[61] DPEIS, p. 4-772.

[62] Letter to Dr. Hans Blix, Director General, International Atomic Energy Agency, from Paul Leventhal, President, and Dr. Edwin Lyman, Scientific Director, Nuclear Control Institute, February 26, 1996; IAEA response from Morris Rosen, Deputy Director General, March 25, 1996. NCI response to Mr. Rosen is in preparation. NCI press release, "NCI Denounces as a Fraud a New IAEA Safety Standard for Air Shipments

Air transport was the preferred option in the late 1980s for the return of plutonium from France to Japan. Air transport reduces many of the security concerns associated with sea shipment. However, there is no crashworthy cask available for air shipment of plutonium or MOX fuels. Air shipment was rejected in favor of sea shipment after the Nuclear Control Institute raised Congressional concerns over the environmental consequences of an air crash involving plutonium shipment casks that could not withstand a high velocity crash.[63] No commercial cask is licensed for plutonium air transport in the United States.

Transport Safety Issues

Appendix G compares transportation impacts for the different disposition alternatives. The analysis understates the environmental hazards of transporting radioactive material by embracing the Type B transport standards and assigning a low probability to an accident that could result in a breach of the cask. The appendix disregards recent expert reports that challenge the adequacy of the Type B standards,[64] as well as ongoing initiatives within the IAEA and the International Maritime Organization (IMO) to re-evaluate these standards in the context of historical data about accident conditions. The DPEIS' analysis is cursory and outdated, and must be revised to take into account the most recent studies and the ongoing IAEA and IMO re-evaluations of these casks. 16/10.02.00 cont.

The DPEIS suffers from the following defects:

- The DPEIS finds no "significant accident risks apart from the remote possibility of a major fire" involved in the handling and short-term storage of plutonium and MOX containers in port facilities. There is no further analysis of the risk of a major fire.[65] 38/10.02.00

- The DPEIS dismisses the risk of a radioactive release were a container to be dropped during loading or offloading. The "yielding nature" of the port surface, it is claimed, would reduce the likelihood of a breach of the container. 39/10.02.00

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of Plutonium," March 1, 1996.

[63] The Murkowski Amendment, Section 5061 of the Omnibus Budget Reconciliation Act of 1987 was enacted following release of NCI's Special Report, "Air Transport of Plutonium Obtained by the Japanese from Nuclear Fuel Controlled by the United States," March 3, 1987.

[64] Illinois Institute of Technology Research Institute (IITRI), "Definition of Bounding Physical Tests Representative of Transport Accidents—Air and Marine," IITRI KO6019, November 1983; ECO Engineering, Inc., Annapolis, MD., "A Review of the Proposed Marine Transportation of Reprocessed Plutonium from Europe to Japan, March 1992: Edwin S. Lyman, Princeton University School of Engineering/Applied Sciences, "Safety Issues in the Sea Transport of Vitrified High-Level Radioactive Wastes to Japan," December 1994.

[65] DPEIS, p. G-3.

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10 02 00 Comment Number 38

Section G.1.2 of the PEIS describes port transit risk, which includes thermal (fire) conditions. Conservative port handling impacts based on the methodology described in Appendix G are presented in Table G.1–1. Pu and MOX fuel require the use of highly sophisticated Type B packagings that are specifically designed to prevent the release of contents under all credible transportation accident conditions (such as during handling in port). Appendix G has been modified to provide clarification for sea shipments and handling of Pu and MOX containers in port facilities.

10 02 00 Comment Number 39

Safety is in the packaging, which is specifically designed to prevent a release of radioactive material under all credible accident circumstances such as loading and unloading operations. Packaging is designed to withstand a drop test onto a flat, essentially unyielding surface. A yielding port surface could further reduce potential risk. The sequence of tests for ensuring the reliability of the 6M, Type B packaging is described in Section G.5 of the PEIS.

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The DPEIS reaffirms the ability of a type B package to survive a major shipboard fire. It repeats familiar arguments: the likelihood that a shipboard fire will occur in the same location as the cargo is relatively small; the duration of a shipboard fire does not necessarily mean any single package will be threatened; unless a package is "engulfed" by a fire, it does not matter whether the fire reaches sustained temperatures above the regulatory fire temperature of 800 degrees C., nor is the fire's duration likely to be a factor in maintaining the container's integrity.[66]

40/10.00.00

At the same time, the appendix concedes that "[H]owever unlikely, there is always a potential for maritime accidents during the ocean shipment of Pu and MOX fuel."[67] It cites an environmental assessment of the import of Russian plutonium 238 which found that "fire alone is not a credible means of causing a release." "The probability of a severe ship collision, followed by a fire, is on the order of 1.0×10^{-8} per port call.(DOE 1993x:A-3)"

Probability statistics are not the best tool to establish the adequacy of a transport standard. In a paper presented to the International Maritime Organization's Special Consultative Meeting, Dr. Edwin Lyman, NCI scientific director, used the example of elastomer cask seals to illustrate the weaknesses of the type B standards.[68] The lid seals prevent the escape of radioactive gases from the cask following an accident. They will fail after exposure of a few hours to temperatures of 250 - 300 degrees C. However, the Type B thermal test is low enough so that the failure threshold is not reached. Therefore, "transport casks with elastomer seals are able to be qualified as Type B packages . . . the current regulations do not require the cask designer to determine the conditions which *would* cause the seal to fail and ensure that a large safety margin is present."[69]

41/10.00.00

A 1992 report by ECO Engineering[70] also challenges the adequacy of Type B standards. The ECO report states, "Marine accidents involve significant forces and outcomes that appear to exceed the limits of the standards to which the casks are designed."[71] The report describes fire, collision, immersion and sabotage as events that could cause the casks to fail.

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[66] DPEIS, p. G-4.

[67] DPEIS, p. G-5.

[68] "Addressing Safety Issues in the Sea Transport of Radioactive Materials," by Edwin S. Lyman PhD, Scientific Director, Nuclear Control Institute, presented to the IMO Special Consultative Meeting, March 4-6, 1996, London, England.

[69] Lyman, ibid., p. 5

[70] "A Review of the Proposed Marine Transportation of Reprocessed Plutonium from Europe to Japan," ECO Engineering, March 30, 1992, prepared for Nuclear Control Institute and Greenpeace International.

[71] Ibid., p. 4.

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10 00 00 Comment Number 40

The potential for a maritime accident was estimated based on several existing studies and data. The probability of a maritime accident would be small on the order of 1.0×10^{-8}/yr to 1.0×10^{-7}/yr, not per port call. DOE has considered the commentor's comments, but DOE remains convinced that the probability numbers were correctly stated in the Draft PEIS and therefore are included in the Final PEIS.

10 00 00 Comment Number 41

Both Pu and MOX fuel would be transported in Type B packages that have been fully tested and certified for these materials, as required by Federal law. DOE, as a responsible shipper of hazardous materials, will comply with stringent Federal packaging requirements. It is noted that there is some controversy concerning the adequacy of the Type B packaging. However, these packages are currently certified as safe for transporting radioactive materials. If the safety certification for the packaging is withdrawn, then new analyses will be required. Acknowledgment of this controversy has been included in Appendix G of the Final PEIS.

The duration and intensity of shipboard fires, the enormity of the energy levels associated with ship collisions, and the extent of hydrostatic pressure of the ocean depths, to say nothing of the consequences of acts of terrorism, would appear to create exposure environments beyond the limits of the casks designed in accordance with IAEA standards.[72]

Sandia National Laboratories complained, in a rebuttal to the ECO report, that the accident conditions described in the ECO report exceed IAEA regulations. "Both U.S. and IAEA regulations make it clear that while the certification tests represent severe accident conditions, they do not represent maximum credible accident conditions,"[73] Sandia wrote. In its response, ECO wrote it "did not intend to impute such claims to the regulations. Rather ECO's intent was to point out the potential for severe accidents occurring that might breach containment of a Type B packaging."[74]

41/10.00.00 cont.

Given the amounts of plutonium and MOX that could be transported for disposition, it would be prudent to test the shipping casks to failure and to evaluate the findings in the PEIS.

V. Economic Issues

Like the non-proliferation analysis, the cost analysis of plutonium disposition options now being prepared by Oak Ridge National Laboratory must be integrated into the NEPA decision-making process. That analysis must include all costs of the various disposition options, including subsidies being demanded by nuclear electrical utilities that have expressed interest in using weapons-plutonium MOX fuel.

42/07.00.00

Given recent regulatory changes and the severe diseconomics of nuclear electricity generated at some facilities, these utilities face strong competition from non-nuclear electrical generators. An industry technical analysis fully anticipates that some utilities will insist upon not simply compensation for direct costs related to warhead plutonium disposition in their reactors, but subsidization of the electricity these reactors produce to guarantee that it is economically competitive with electricity from alternative non-nuclear sources, a subsidy that could cost U.S. taxpayers billions of dollars over the life of the

[72] Ibid., p. 10.

[73] "Safety of Shipments of Plutonium By Sea, U.S. Department of Energy, September 1993, Appendix B, "Review of the ECO Engineering, Inc. Report," by Sandia National Laboratories, p. 1.

[74] "Clarification for Appendix B of the Study: 'Safety of Shipments of Plutonium by Sea.' DOE/EM-0103, September 1993

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07 00 00 Comment Number 42

In the *Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition* potential fees to reactor owners for existing LWRs to use MOX fuel were noted. The exact fees were not included in the report since there is no firm basis on which to estimate these fees that would result from a business negotiation between the Government and the reactor owner. The technical analysis, along with the cost and schedule analyses, will be part of the decisionmaking process to support the ROD.

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plutonium-disposition program.[11] These costs must be carefully calculated in advance, so that they can be taken into account in the decision on disposition alternatives. | 42/07.00.00 cont.

Steven Dolley
Research Director
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[11] One study calculates that such a subsidy may run as high as six cents per kilowatt-hour, depending upon the utility and plants, equivalent to billions of dollars. GE Nuclear Energy, Study of Plutonium Disposition Using Existing GE Advanced Boiling Water Reactors, NEDO-32361, Prepared for the U.S. Department of Energy, June 1, 1994, p. 1.2-4.

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**COMMENTS ON THE DEPARTMENT OF ENERGY'S
STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS
DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT**

Public and Occupational Health and Safety Issues

Submitted by

Edwin S. Lyman, PhD
Scientific Director
Nuclear Control Institute

June 7, 1996

Strategies for stopping the spread and reversing the growth of nuclear arms

Paul L. Leventhal, *President* Peter A. Bradford David Cohen Denes A. Hayes Julian Koenig Sharon Tanzer Roger Richter Dr. Theodore B. Taylor
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Edwin S. Lyman, PhD
Scientific Director
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June 7, 1996

Comments on the Department of Energy's
Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Public and Occupational Health and Safety Impacts of
Plutonium Disposition Alternatives

Conversion of surplus weapons-usable plutonium (WU-Pu) to the spent fuel standard can provide a great benefit to disarmament and non-proliferation, especially if there is reciprocal action on the part of Russia. However, this significant benefit comes at a price. All disposition options under consideration in the DPEIS involve multi-year campaigns involving large-scale processing of WU-Pu and other extremely hazardous radionuclides. Furthermore, for the large fraction of surplus WU-Pu that is now in the form of weapons components, WU-Pu in relatively stable solid form must be converted to highly dispersible intermediate process streams and subjected to a number of energetic processes such as oxidation and treatment at high temperature. Because of the possibility of a catastrophic accident in a processing facility or during irradiation in a nuclear reactor, the implementation of disposition will be associated with a substantial increase in the risk of dispersal of a large quantity of WU-Pu.

43/09.09.08

For this reason, a major objective of the DPEIS should be the presentation of a thorough and consistent evaluation of the occupational and public health risks of different WU-Pu disposition options. Disposition options should be ranked according to the risks that they pose, and this ranking should play an important role in the final selection.

It has often been argued that environmental impacts need not be a decisive factor in choosing a WU-Pu disposition option because the risks of any option will be small compared to those incurred when the WU-Pu was produced. However, this argument in no way negates the desirability of strictly limiting further harm from the aftermath of the Cold War. If the opportunity now exists to carry out the disposition program in a way that minimizes health and safety impacts, common sense dictates that the lowest-impact option should be given the most serious consideration, assuming it is not disqualified by other factors such as deleterious non-proliferation impact or excessive cost or delay.

44/08.03.01

The DPEIS, however, fails to accomplish this objective. The methodology it uses for evaluating and comparing the safety risks of different disposition options is logically inconsistent and confusing. Furthermore, possibly as a consequence of the large number of different groups involved in its preparation, it contains contradictory factual information. The errors and questionable assumptions in the documents referenced by the DPEIS cast

45/09.09.08

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09 09 08 **Comment Number 43**

Potential human health impacts from Proposed Actions are analyzed and documented in this PEIS as required by NEPA. To inform the public and decisionmakers, all latent cancer risks associated with the alternatives are presented in the PEIS regardless of their risk magnitude. The ranking or decisionmaking analysis of the alternatives will be based on various factors including human health impacts. DOE's intent in the PEIS is to provide an unbiased environmental analysis of all alternatives. However, the Reactor Alternatives generally do have more available information than other disposition alternatives because of industry experience.

08 03 01 **Comment Number 44**

Comment noted.

09 09 08 **Comment Number 45**

Based on comments received from the public and other reviewers, revisions have been made to the PEIS to clarify information that was incorrect or unclear. These revisions appear in the Final PEIS.

considerable doubt on its quantitative accuracy. 45/09.09.08 cont.

The most problematic consequence of the inconsistencies plaguing the DPEIS analysis is an exaggeration of the risks of the immobilization options relative to the reactor-based options. This must be corrected in the final version in order to provide a fair presentation of the evaluation and ranking of the safety risks of the various options. 43/09.09.08 cont.

. Such a presentation would show that the health and safety impacts of the immobilization options will be substantially lower than those of the reactor options. However, as shown below, the DPEIS is structured to minimize the significance of this fact. Whether deliberate or not, this has the effect of biasing the whole document toward the reactor options.

1. Inconsistencies in the DPEIS health and safety methodology

a) Incompleteness of accident evaluation criteria

In Section M.5.1.1., it is stated that "the potential for facility accidents and the magnitudes of their consequences are important factors in the evaluation of ... storage and disposition alternatives," and that "the health risk issues are twofold." These two issues are identified as 1) whether accidents at any of the facilities pose unacceptable health risks to workers or the public, and 2) whether alternative locations for facilities can provide lesser public or worker health risks.

This list of issues to be considered in evaluating accident impacts of disposition is clearly incomplete. In particular, the question of whether alternative *disposition options at a given location*, rather than alternative *locations*, can provide "lesser public or worker health risks" does not seem to be regarded in the DPEIS as a worthy criterion for consideration. This is confirmed by the absence of a graph in the Summary comparing accident impacts of different options. But such a comparison is clearly legitimate and meaningful, and therefore essential. 46/09.09.08

Discounting the relevance of the comparative accident impacts of different disposition options biases the DPEIS analysis toward the reactor options. This is not completely clear from the data provided by the DPEIS itself. According to the DPEIS, the *maximum* risks of cancer fatalities to workers and the public resulting from accidents at a plutonium vitrification facility are two to three orders of magnitude below those resulting from accidents involving evolutionary LWRs (Ev-LWRS).[1] On the other hand, data in the DPEIS implies that the *expected* risks, computed by weighting the consequences of individual accident sequences with their expected probabilities, are comparable for the two 47/09.09.08

[1] Storage and Disposition DPEIS, Attachment B, Pg. S-150.

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09 09 08 Comment Number 46

The health impacts from accidents are very difficult to compare using bar graphs. The bar graphs distort the relative health impacts among the alternatives (for example, a normally small number appears large when compared with a very small number). Therefore, to avoid confusion, the comparison bar graphs were not used in the Final PEIS.

09 09 08 Comment Number 47

The health risk assessment from the potential accidents in this PEIS is analyzed to "envelope" the potential accident impacts ranging from high probability-low consequence to low probability-high consequence. Although it is believed that the health risk from all potential accidents would fall within this "envelope," it is difficult to identify all of potential individual accidents for all of the proposed facilities since most of the proposed alternative facilities are still in early development stages. The risks for the accidents are calculated based on the health effects from the set of the accidents analyzed for each alternative in the PEIS. Whether the set of accidents selected covers all potential accidents for the facility depends on the complexity of the facility and the maturity of the design. Therefore, it is not appropriate to compare the risks for the accidents between the alternatives. However, it can be used for comparing the facility accident impacts among different sites within an alternative since they use the same set of the accidents. The expected risk was not used for the summary comparison of the alternatives. The PEIS provides the consequences, probabilities, and risk of the utilization of MOX fuel for Pu disposition.

options. However, when the many problems with the DPEIS accident analysis are corrected, as detailed below, we expect that the immobilization options will prove to have significantly lower impacts than the reactor options with respect to all measures of accident severity, including "expected" risks. 47/09.09.08 cont.

The DPEIS downplays the significance of "discernible differences [in health and safety impacts] among alternatives" by stressing that although in some cases the potential accident risks of the immobilization options are indeed much lower than those of the reactor options, "the risks associated with implementing any of the alternatives is small,"[2] a statement provided without adequate justification. Particularly problematic is the use of generic probabilistic risk assessment (PRA) results to provide values for the absolute accident risks of different options. It is widely accepted that while PRAs are useful in understanding comparative risks, e.g. how modifications to a particular plant can improve safety, they are far less useful (and credible) in generating values of absolute risk. 48/09.09.08

The credibility of the absolute risk values cited in the DPEIS is further damaged by the numerous errors, omissions and inconsistencies contained in the analysis of reactor accidents (especially in existing LWRs), which could lead to an underestimation of the actual risks of using MOX by several orders of magnitude. Some of these are described in more detail below. 49/09.09.08

The DPEIS does not explain its risk methodology clearly. A section on "risk" purports to argue that the risks from accidents during plutonium disposition should be considered in the context of other, more common risks, such as death from accidental poisoning. However, even this discussion is misleading since it uses as an example a comparison of the *annual* risk from a plutonium storage accident (itself one of the smallest accident risks tabulated in the DPEIS) over the *lifetime* risks from these more common hazards, thereby overstating them by a factor of 70.[3] If, for instance, one considers the annual risk as a result of an accident at an Ev-LWR, the difference between the risks of the reactor disposition option and the "common risks" cited in the DPEIS are not as striking. The (lifetime) risk from accidental poisoning, according to the DPEIS, is 1/1000, so the annual risk is 1.4×10^{-5}; the expected risk from an Ev-LWR accident at the Oak Ridge plant is given as 1.2×10^{-4} (pg. M-366). If this value were adjusted to correct for the underestimation by several orders of magnitude of volatile and semi-volatile releases in a beyond-design-basis accident (see below), it becomes apparent that some of the activities listed in the DPEIS can have risks approaching the so-called "common" risks. 50/09.09.08

Although it can be useful to put the absolute risks of disposition activities into perspective, this should not be used to obscure the fact that the immobilization options provide minimum-risk alternatives for WU-Pu disposition. 43/09.09.08 cont.

[2] Storage and Disposition DPEIS, Section M.5.1.1.2, p. M-226.

[3] Storage and Disposition DPEIS, Section M.5.1.1.1, p. M-225.

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09 09 08 Comment Number 48

Both the human health consequences (potential cancer risk for the MEI of public and worker and latent cancer fatalities to the general public) from the postulated accidents and the frequency of the accident occurrence are evaluated and reported in the PEIS. The health effects from potential accidents in this PEIS are not based on the facility probabilistic risk assessment (PRA). At this programmatic level of NEPA review for disposition, specific disposition facilities are not being proposed so as to support a facility-specific PRA. Additional facility-specific analyses would be provided in subsequent tiered NEPA review.

09 09 08 Comment Number 49

In response to public comment, the accident analyses for existing LWRs has been modified in the Final PEIS.

09 09 08 Comment Number 50

Section M.5 of the PEIS contains evaluation methodologies and assumptions used in analyzing facility accidents. The discussion presents the risks in terms of the commonly used units ascribed to each risk. The information provided is not meant to imply that risks of a latent cancer fatality caused by DOE operations are trivial, but rather to show how they compare with other more familiar risks. Based on comments received from the public and other reviewers, revisions have been made to the PEIS to clarify information that was unclear. These revisions appear in the Final PEIS.

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b) Absence of explicit evaluation of can-in-canister immobilization options

Some of the WU-Pu disposition options under consideration in the DPEIS can be implemented in a variety of ways. In Volume I, Section 2.4, p. 2-76, the methodology that was used for determining which variant of a particular disposition option should be chosen for full evaluation in the DPEIS is discussed. In particular, it is stated that "bounding" variants were selected, e.g. those which were likely to have environmental impacts equal to or greater than all the other variants under consideration. This approach was used to explain why only the "greenfield" immobilization options that require a new, shielded immobilization plant were explicitly analyzed, rather than the options that "piggyback" on operations at existing facilities, such as the can-in-canister (CIC) approach at the Defense Waste Processing Facility (DWPF) at the Savannah River Site (SRS). The CIC approach will have lower environmental impacts than greenfield approaches because in the latter approach, only the incremental risks associated with WU-Pu immobilization would be charged to the disposition program. 51/05.00.08

This could be a legitimate approach, provided that it were consistently applied, which is not the case in the DPEIS. The DPEIS evaluates reactor options that require construction of new, evolutionary LWRs (Ev-LWRs) *and* those involving irradiation of MOX fuel in existing LWRs (Ex-LWRs) (except in the important category of accident impacts). This is apparently not judged in the DPEIS to be inconsistent with the approach used for immobilization options because it treats the reactor proposals as different "options," rather than variants of the same option. However, this is merely a semantic distinction. 52/05.00.08

Because only incremental impacts are considered in the Ex-LWR case, but not in any of the immobilization options, the reader can get the misleading impression that the Ex-LWR reactor option could have comparable or even lower normal radiological impacts than any of the immobilization options (e.g. Summary, Figs. S-17 and S-18; Attachment B, pgs. S-142 to S-145) and can even provide a net benefit (although this benefit disappears when the impacts of MOX fabrication are considered). The DPEIS even goes as far as to include a section on the incremental benefits of using MOX fuel in reducing the health impacts of the nuclear fuel cycle, a section which is completely irrelevant to the particular mission of WU-Pu disposition and is completely wrong as well (see below). 53/09.09.08

For consistent treatment of "incremental" radiological impacts, there should be a comparison of the Ex-LWR options with the CIC options. In these options, plutonium first would be immobilized in glass or ceramic, without the addition of cesium-137 for spiking purposes, and packed in small cans. These cans would then be placed in the DWPF canisters prior to filling with HLW glass. The incremental environmental impacts of this approach would be those associated with operation of the plutonium immobilization line only (assuming that the introduction of the small cans would not have a detrimental effect on DWPF operations, as results from cold testing of CIC at DWPF clearly indicate). 54/09.09.08

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05 00 08 **Comment Number 51**

Comment noted. Appendix O, *Can-In-Canister Variants*, was added to describe the variant of the Vitrification Alternative.

05 00 08 **Comment Number 52**

Comment noted.

09 09 08 **Comment Number 53**

The human health impacts are presented for both the existing condition (No Action) and the action alternatives in the PEIS, including the Existing LWR Alternative. (The health impacts from potential accidents for all three Reactor Alternatives using MOX fuels are presented in the Final PEIS.) Incremental impacts are those impacts from each alternative over the existing conditions. In response to public comment, Section 4.3.5.2.9 of the Final PEIS has been revised to show incremental and total impact. For normal operations and accidents, both incremental impacts and total impacts are presented in the PEIS for each reactor disposition alternative. Also, an inclusion of potential avoided environmental impacts is appropriate to the NEPA process; however, in response to public comments, this section has been revised.

09 09 08 **Comment Number 54**

The can-in-canister variant is one of a number of potential applications of the Vitrification Alternative. The environmental impacts of the can-in-canister variant, which uses the same facilities as the Vitrification Alternative, are bounded by the impacts of the vitrification analysis shown in the PEIS. Appendix O, *Can-In-Canister Variants*, was added to describe this variant of the Vitrification Alternative.

One can show, using figures given in the DPEIS, that the incremental normal radiological impacts of CIC options would be about two orders of magnitude smaller than those from a greenfield immobilization facility. This can be seen most easily by comparing the doses received by the public from normal operation of the ceramic immobilization facility in the deep borehole option, in which case no cesium-137 is used, and those from a greenfield ceramic immobilization facility, in which case cesium-137 is added directly to the ceramic during processing. From Tables M.2.9-3 and M.2.9-4 of the DPEIS, one sees that routine emissions of plutonium from ceramic immobilization facilities located at SRS account for about 4% and 2% of the total dose to the maximally exposed individual (MEI) and the committed effective population dose equivalent, respectively, the rest being due to Cs-137 emissions.

54/09.09.08 cont.

Similar reasoning can be applied to the accident analysis of greenfield immobilization facilities given in the DPEIS to extract the incremental risks associated with CIC. For example, the annual risk to the MEI from accidents at a greenfield vitrification facility at SRS is 1.1×10^{-10}, according to Table M.5.3.5.2-6. To obtain the incremental impacts of the CIC approach, one should only consider accidents resulting in releases of plutonium and subtract the doses due to Cs-137 releases. This approach yields an annual risk from CIC to the MEI at SRS of 1.6×10^{-12}, about a factor of one hundred smaller than the greenfield risk.

Because the CIC approach has significantly smaller radiological impacts than the greenfield immobilization, and because it is analogous to the Ex-LWR option, it should be treated as a distinct option and fully evaluated in the PEIS.

5/01.02.00 cont.

c) Absence of evaluation of incremental accident impacts of the existing LWR option

The DPEIS assumes that there are no incremental accident risks associated with the substitution of MOX for low-enriched uranium (LEU) in Ex-LWRs, which makes this option appear to be essentially zero-risk. This statement is simply not justifiable for a number of reasons which are discussed in detail below. In fact, the incremental accident risk of this option may well exceed the absolute risk of the Ev-LWR option.

49/09.09.08 cont.

d) Incorrect analysis of "avoided human health impacts" due to substitution of MOX for LEU

Volume II, Section 4.9 of the DPEIS is entirely wrong and should be corrected or deleted from the final version. In attempting to compare the risks of the MOX and LEU fuel cycles, the authors of the section seem to have forgotten that MOX fuel is about 95% uranium. Thus it is completely wrong to claim, as they do, that there are no health impacts associated with the uranium mining, milling and conversion stages in the MOX cycle. The stage of the cycle which is bypassed is uranium enrichment, which is well-known to have very low health impacts anyway.

55/09.09.08

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09 09 08 Comment Number 55

Depleted uranium (independent of the HEU disposition), which is currently in the DOE stockpile, is assumed to be used to blend Pu into MOX fuel. Since no new uranium mining, milling, conversion, or enrichment would be needed to produce MOX fuel, the impacts of these uranium fuel cycle steps would be avoided.

Although not explicitly stated, the authors may be assuming that depleted uranium stockpiles will be used to fabricate MOX fuel, in which case the associated mining and milling steps (but not conversion) will be avoided. This is a legitimate point, but by the same reasoning, one can also give credit to stockpiles of uranium that can be used in the LEU route, such as LEU obtained from the blend-down of surplus HEU. The relatively small amount of electricity that would be generated from MOX fuel fabricated from surplus warhead plutonium could easily be displaced by the LEU equivalent of about 30 tonnes of HEU. Thus one cannot consistently assign an incremental health benefit to the US MOX program. 56/09.09.08

e) Inappropriateness of 80-km limit for consideration of public health impact

The restriction of evaluation of public health impacts to within an 80-km radius of the facility in question leads to some peculiar inconsistencies in the comparison of immobilization and MOX options. For instance, according to the DPEIS the CANDU option appears to have no public health impacts on the U.S. population, other than those resulting from the small risk associated with the production and transport of MOX fuel within the U.S. Yet a quick look at a map reveals that a release of radiation from the Bruce A station in Ontario would most likely affect a large portion of the northeastern United States, although mostly at distances greater than 80 km. 57/09.09.08

Furthermore, the 80-km truncation conceals the fact that a large-scale reactor accident can have national and even global impact, whereas an accident at an immobilization facility would in all likelihood be much more limited in geographical range. This is because both the source term and the energy available for dispersion would be much smaller in the case of the immobilization facility. Thus truncating consideration of public health impacts at 80 km greatly overestimates the risks associated with immobilization compared with MOX.

2. Serious flaws in the safety analysis of reactor options

The health and safety analysis of the MOX options in the DPEIS contains such serious flaws that DOE should discard the analysis as written and start over, proceeding in a clear and logical manner. The use of MOX in LWRs or CANDUs -- in particular, full-core MOX utilizing weapons-grade plutonium as proposed in the DPEIS -- is a novel practice associated with numerous unsolved and potentially very serious safety risks. Experience with LWR MOX use in other countries, which is often cited by promoters of the MOX options, is of limited applicability to the planned US program because the foreign programs utilize plutonium with different isotopic contents, lower MOX core fractions, and fuel without integral burnable absorbers. In addition, experience to date with the use of MOX has revealed a number of significant safety issues which remain unresolved. The existing LWR (Ex-LWR) option, which is probably the MOX option most likely to be chosen, must be singled out for special concern. Yet the DPEIS contains no accident analysis specific to this option. 49/09.09.08 cont.

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09 09 08 Comment Number 56

The depleted uranium for the MOX fuels is already in DOE's stockpile and is independent of the DOE's HEU disposition program.

09 09 08 Comment Number 57

Like any other EIS, a realistic impact area has to be defined to conduct a radiological impact assessment. Federal guidance defines two major impact regions. NUREG-0654 defines 16 km (10 mi) as the plume exposure region and 80 km (50 mi) as the ingestion exposure region for the nuclear facility accident emergency planning zone. While populations at greater distances may receive some exposure from an accidental release of radioactive material into the environment, this exposure would be considerably less than the exposure to the population within the 80-km (50-mi) region. Also, extending the assessment to further distances would introduce greater analytical uncertainties to the calculated impacts.

It is acknowledged that, if the source term was very large, the boundaries chosen could be extended. Nevertheless, NUREG guidance is an appropriate and reasonable choice for NEPA analysis.

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The DPEIS dispenses with fundamental issues of MOX safety in one paragraph, in which it alludes to "separate studies" (which were mistakenly left unreferenced) that "indicate that the use of MOX fuel in a ... LWR does not increase the risk and consequences of accidents."[4] Most of these source documents turn out to be studies based entirely on reactor vendor analyses which purport to confirm the safety of using MOX in their reactors. However, at least one of the reactor vendors freely admitted to us that its in-house analyses were biased and unreliable.[5] Closer examination of these studies reveals that they in no way provide adequate justification for the above statement in the DPEIS. In fact, at least one of the references, the National Academy of Sciences study "Management and Disposition of Excess Weapons Plutonium: Reactor-Related Options," actually contradicts the statement, by estimating that the consequences of a severe accident could increase by 10-20% as a result of the substitution of MOX for LEU. Such an increase, far from being insignificant, could overwhelm the radiological impacts of any of the other disposition options. Furthermore, the discussion below indicates that the NAS may have underestimated the incremental consequences. 58/09.09.08

DOE may have judged that this shoddy and incomplete accident analysis was sufficient for the purposes of the DPEIS because, if the MOX option were chosen, safety issues would be dealt with later in the context of NRC review of the procedure. However, this defeats the purpose of the whole exercise, which is to inform decision-making with an accurate comparative assessment of risks. To conform to the spirit of NEPA, a deeper understanding of the potential risks involved with the use of MOX in LWRs in this country must be acquired prior to the public comment period and should not be deferred until after decisions are made. The NRC and independent experts should be brought in at the DPEIS stage to provide alternative perspectives on the outstanding safety issues. This would be a prudent course of action, since unanticipated safety questions that arise later in the process could serve to cause unacceptable delays in disposition. 59/08.03.00

The only DPEIS reactor alternative for which any information concerning accident impacts is provided is the Evolutionary LWR (Ev-LWR) option. In the Summary, the reader is informed that "comparable data are not available" for the existing (Ex-LWR) option. DOE may be assuming here that the accident impacts of the Ev-LWR option bound those of the Ex-LWR, since the full impact of an accident would have to be charged to plutonium disposition in the former case, whereas in the latter case, one only need consider incremental impacts, e.g. the difference in risk between an existing reactor fueled with MOX and the same reactor fueled with LEU. Since the DPEIS claims without justification that there is no difference in risk, it implies that the Ex-LWR is a zero-risk option. However, this logic is faulty and renders the accident analysis in the DPEIS unusable for decision-making purposes. 49/09.09.08 cont.

[4] DPEIS, Volume II, pg 4-690

[5] Personal communication with General Electric executive, September 1995.

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09 09 08 **Comment Number 58**

The impacts and risks associated with the use of MOX fuel in existing commercial LWRs and in evolutionary LWRs have been reanalyzed. The results, which have a quantitative basis, are presented in Sections 4.3.5.2.9, 4.3.5.4.9, and M.5.3.10 of the Final PEIS.

08 03 00 **Comment Number 59**

The Department of Energy acknowledges the commentor's concern about the accident analysis used in the PEIS for the Reactor Alternatives. The accident analysis is at a level of detail and specificity needed for a programmatic decision on the disposition of weapons-usable fissile materials. Additional analysis for three cases of accident release scenarios was added to Section 4.3.5.2.9 of the Final PEIS. Impacts for one case are shown in Table 4.3.5.2.9 of the Final PEIS. Further detailed, technology-specific accident analysis will be included in the subsequent tiered NEPA review.

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a) Inadequacy of the Ev-LWR accident analysis in general

Before addressing whether the risk values resulting from the LEU-fueled Ev-LWR accident analysis contained in the DPEIS are also valid for a MOX-fueled Ex-LWR, it should be pointed out that these values are inaccurate even for the case to which they are supposed to explicitly pertain. The Ev-LWR analysis included in the DPEIS greatly understates the potential risks of an accident involving a LEU-fueled LWR, even one of "evolutionary" design. The "evolutionary" designs, such as the GE ABWR, do not contain the advanced safety measures, such as those proposed for the European Power Reactor, which would nearly eliminate the risk of a catastrophic off-site release of radiation (e.g. a double containment structure), and thus are still vulnerable to such events. However, Ev-LWR vendors claim that the risk of such events will be greatly reduced relative to the current generation of Ex-LWRs.

49/09.09.08 cont.

The most severe Ev-LWR beyond design-basis accident included in the DPEIS is an anticipated transient without scram (ATWS), followed by loss of core cooling, core meltdown, and late containment failure. The frequency of this accident is listed as 1.7×10^{-7} per reactor-year. However, the associated radionuclide source term, which references the General Electric Advanced Boiling Water Reactor (ABWR) Safety Analysis Report and studies prepared by a consultant for another purpose, is much smaller than that which could conceivably result from a loss-of-containment accident.[6]

For instance, the postulated release of Cs-137 to the environment is 230 curies (Ci), which is seen to correspond to a release fraction of 1.8×10^{-3} when compared to the end-of-cycle Cs-137 Ev-LWR core inventory of 1.3×10^{7} Ci given in a source document (which itself reference ABWR safety analyses).[7] This release is substantially below the maximum possible release of cesium, which is semi-volatile and can be almost completely evolved from the core during a meltdown. It is now accepted that 20-40% of the cesium core inventory was released to the environment during the Chernobyl accident.

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In fact, if one looks at the entire ABWR severe accident spectrum, which does not appear in the DPEIS but is included in one of the source documents,[8] one sees that the Cs release fraction can be as great as 3.5×10^{-1} in a certain class of accidents known as Release Class (RC) 5, whereas a release of 2×10^{-3} in the DPEIS accident appears to corresponds to

[6] DPEIS, Volume III, Appendix M, Table M.5.3.8.1-2, p. M-361.

[7] LLNL 1996g, *op. cit.*, Table 8-1, p. 8-10. Although the Cs-137 value cited above is reasonable, one should note that this table is otherwise unreliable, with some entries clearly wrong (e.g. a core inventory of 5.4×10^{3} Ci, or 8.7 MT, of Pu-239, is given for a LEU-fueled Ev-LWR), and others inconsistent with values given in the DPEIS (for instance, a release of 4.4×10^{6} Ci of Kr-85 is postulated in the DPEIS, whereas the core inventory in Table 8-1 is only 1.2×10^{6} Ci). Inconsistency among the various source documents is a general feature of the DPEIS.

[8] LLNL 1996g, Table 8-5, p. 8-14.

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The impacts and risks associated with the use of MOX fuel in existing LWRs has been reanalyzed. The analysis is in accordance with DOE, Office of NEPA Oversight guidelines for the preparation of EISs (*Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements U.S. Department of Energy, Office of NEPA Oversight*, May 1993). The guidelines require an assessment of impacts due to potential severe accidents which have frequencies of occurrence in the range of 1.0×10^{-7}/yr to 1.0×10^{-6}/yr. The guidelines state that, as a practical matter, events with probabilities less than 1.0×10^{-7}/yr will rarely need to be examined. The analysis was based on the best available information at the time the Final PEIS was prepared. The results of the analysis, which have a quantitative basis and utilize the Melcor Accident Consequence Code System (MACCS) code, are presented in applicable sections of the Final PEIS. The analysis includes a determination of the sensitivity of americium, curium and Pu to the risk dominant accident doses for a commercial MOX fueled reactor and the results are described in the Final PEIS.

While cesium-137 (Cs-137) source terms from extraordinary reactor accidents (Reactor Class 5 accidents) may exceed release fractions analyzed in the PEIS, the beyond design basis accident selected for analysis (Reactor Class 2 accident) has a frequency of occurrence of 1.3×10^{-7}, which is consistent with NEPA guidelines. While Chernobyl accident releases of Cs-137 may have exceeded 20 to 40 percent of the cesium core inventory, such release fractions are not applicable to U.S. LWRs. The analysis of severe accidents (Reactor Class 5 accidents) is appropriate for PRAs or Safety Analysis Reports (SAR). Should the Reactor Alternative using MOX fuel be selected as the Preferred Alternative, subsequent tiered-NEPA documents or SARs will be prepared on site-specific bases.

The PEIS was modified in Section 5.3.11 to include a review of the radioisotopes discussed in the Sandia report. This report discussed using the MACCS code for curium and other transuranic radioisotopes. The contribution of americium (Am-241), curium (Cm-242 and Cm-244), and plutonium (Pu-238, Pu-239, Pu-240, and Pu-241) was added to the accident section of this PEIS.

a Release Class 2 event, which is said to occur with a frequency of 1.3×10^{-7}. There is a similar disparity in iodine release fractions between RC5 and RC2. RC2 is also characterized by zero release of other semi-volatiles (e.g. Te, Ru) and low-volatiles (e.g. Sr and Ba). While the RC5 release fraction is a factor of 20,000 greater than the one assumed in the DPEIS, the associated accident frequency is listed as 2.2×10^{-6}, which is only a factor of ten smaller. Thus the risk of the RC5 accident (e.g. probability times consequences) due to cesium emission is on the order of one thousand times greater than that of the DPEIS accident. Of the eight release classes listed, four have larger risks associated with them than RC2, the one included in the DPEIS. There is no legitimate basis for excluding these other accidents from consideration. However, their exclusion artificially underestimates the potential environmental impacts of reactor disposition relative to the immobilization options, leading to erroneous conclusions.

b) Inadequacy of the Ev-LWR accident as an upper bound for Ex-LWR accident impacts

60/09.09.08 cont.

There are two interrelated reasons why the Ev-LWR accident analysis in the DPEIS cannot be considered to be bounding or conservative with regard to the potential accident impacts of the MOX options.

First, it is based on analysis of an Ev-LWR fueled with LEU instead of MOX, and thus completely sidesteps the complex but crucial issue of whether and to what extent severe accident parameters, such as core damage frequencies (CDFs) and source terms, may differ for an Ev-LWR fueled with full-core MOX rather than LEU.[9]

Second, the Ev-LWR analysis contains numerous assumptions with regard to safety features which are specific to advanced reactor designs and simply do not apply to the MOX options based on use of existing LWRs (Ex-LWR) or CANDUs. For instance, advanced LWRs are assumed to have CDFs at least an order of magnitude smaller than those associated with LWRs operating today. Also, the source terms employed in the beyond design-basis accident analyses are based on assumptions about the likelihoods of various accident scenarios which are indisputably invalid for currently operating reactors (and may not even be valid for Ev-LWRs, which to date exist largely on paper).

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To assess whether the Ev-LWR case is bounding or not with respect to accident impacts, one must determine, in light of these two factors listed above, whether the incremental risks of substituting MOX for LEU in Ex-LWRs may actually exceed the absolute risk values for (LEU-fueled) Ev-LWR operation provided in the DPEIS. The best way to do this consistently would be to derive complementary cumulative distribution

[9] Although one of the main references for the DPEIS section on Ev-LWR safety is a document (Evolutionary/Advanced Light Water Reactor Data Report, UCRL-ID-123411, February 1996), which does contain some discussion of the differences between MOX and UO_2 source terms, this information is apparently not used in the DPEIS for the development of accident risk values. Instead, data from two other documents which refer exclusively to UO_2-fueled LWRs are used.

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The PEIS recognizes that there are uncertainties in the methodology for accident analysis as described in Section 4.1.9. There are additional uncertainties in the difference in reactor-grade versus weapons-grade MOX fuel. Although there is no experience in the United States for a full MOX core, DOE will consider a full MOX core only after evaluating lead test assemblies and/or a partial MOX core with weapons-grade material. This evaluation will reduce technical uncertainties between reactor-grade and weapons-grade MOX fuel. In addition, before a partial or full core can be utilized in a reactor, a reactor-specific safety analysis will be performed analyzing the use of weapons-grade MOX fuel.

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The human health impacts for both the existing condition (No Action) and the action alternatives are evaluated and presented in the PEIS, including the Existing LWR Alternative (The health impacts from potential accidents for the three Reactor Alternatives using MOX fuel are also analyzed.) The incremental impacts are those impacts from Proposed Actions over existing conditions at same site. For example, the incremental impacts of using the partially completed LWR would be represented by the total impacts because the LWR was not operated before. The incremental impacts of using the existing LWRs would be represented by the differences between using the proposed MOX fuel and the current UO_2 fuel.

functions (CCDFs) for all three options and compare them.

Determination of the incremental risks of the Ex-LWR option is bound to be an extremely difficult and uncertain exercise. However, it is central to the whole disposition question. The public will want to know if there is significant risk involved in introducing MOX into Ex-LWRs and whether there are safer alternatives. The DPEIS sheds no light on this question and therefore fails to accomplish its mission. 49/09.09.08 cont.

Rather than try to determine which alternatives are bounding and which are not, the PEIS should simply provide enough information to accurately carry out the following comparisons: the incremental risks of the CIC immobilization options vs. the incremental risks of the Ex-LWR option (evaluated in a technically justifiable manner), and the risks of the greenfield immobilization options vs. the risks of the greenfield reactor options. The absence of such comparisons in the DPEIS makes it extremely difficult for the reader to obtain a clear understanding of the relative environmental impacts of the reactor and immobilization options. 62/09.09.08

Below, we will discuss a number of issues which support the notion that the substitution of MOX for LEU in Ex-LWRs may increase both the consequences and the probabilities of severe accidents by significant factors.

i) Beyond design-basis accident consequences: the issue of low-volatile source terms

The question of whether the consequences of a beyond design-basis accident in an Ex-LWR (e.g. core meltdown and containment failure) would change significantly if the reactor were fueled with MOX instead of LEU depends on the relative radionuclide inventories of the two cores and the radiological impact of the differences. The primary distinction is that the in-core inventories of the transuranic actinides Pu, Am and Cm are all greater by substantial factors in MOX cores. The magnitude of these factors, which depends on the initial plutonium loading in the fuel, is approximately on the order of 3 for plutonium isotopes, 5 for americium isotopes and 4 for curium isotopes at the end-of-cycle. (For MOX fabricated with reactor-grade plutonium, the curium inventory is greater by an additional factor of 10). Neptunium inventories actually are smaller in MOX cores, but the difference is only about of a factor of two. Since these radionuclides are alpha-emitters with very high inhalation and ingestion radiotoxicities, and many have long half-lives, they can contribute significantly to the committed doses incurred following a reactor accident, especially via the ingestion and resuspension pathways, even if only a small fraction of the core inventory is released. 60/09.09.08 cont.

Using an argument dating at least as far back as GESMO, the Generic Environmental Impact Statement on the Use of Mixed-Oxide Fuel in Light-Water Reactors, DPEIS references claim that the increase in actinide inventories in a MOX core will not affect the consequences of an Ex-LWR accident because "plutonium and other insoluble

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The Department of Energy determined that the bounding analyses for each of the disposition alternatives is an appropriate level of detail to support a programmatic decision. Site-specific environmental analysis of disposition technologies will be performed, as appropriate, for the next tiered NEPA documents. In response to public comment, Appendix O has been added which discusses the can-in-canister variant.

fuel isotopes are not included in the releases to the environment."[10] Thus according to this logic, it does not matter whether the inventory of actinides is greater in a MOX core because they are low-volatile species and will not be released to the environment even if the containment fails. 60/09.09.08 cont.

This argument is, plainly speaking, incorrect. There are circumstances under which significant releases of low-volatile radionuclides can occur.

First of all, the best possible laboratory for loss-of-containment accidents, the Chernobyl event, has demonstrated that significant and wide-ranging dispersal of non-volatile radionuclides is possible in beyond-design-basis accidents. The recently issued OECD review of the Chernobyl source term has concluded that the release fraction for low-volatile core constituents, including the actinides, was approximately 3.5%. Moreover, non-volatile fuel fragments were discovered as far away as Greece, over one thousand kilometers away.[11]

The often-repeated argument that a Chernobyl-type accident cannot happen here does not mean that the dispersal behavior of the Chernobyl core does not have relevance for Western LWRs, should they be subject to beyond design-basis accidents with loss of containment (provided that the differences in core melt chemistry are taken into account). In fact, the NRC has acknowledged in the past that low-volatile releases as high as several percent of core inventory were possible in such accidents and incorporated this information into its state-of-the-art LWR probabilistic risk assessment (PRA), NUREG-1150.[12] 63/09.09.08

The DPEIS relies on vendor documents to support its claim that the release of low-volatile radionuclides would be insignificant in a beyond design-basis Ex-LWR accident. For example, the LWR PEIS Data Report quotes release fractions to the environment taken from a Westinghouse Hanford Company report. For low-volatile radionuclides, these values are all extremely small (the largest is 0.3%). The report then claims that these values are consistent with NRC's latest rulemaking on the issue of core-to-containment release fractions, NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants."[13] 64/09.09.08

[10] Oak Ridge National Laboratory, *FMDP LWR PEIS Data Report*, Rev. 3, ORNL/MD/LTR-42, December 1995, p. B-22.

[11] L. Devell *et al.* "The Chernobyl Reactor Accident Source Term: Development of a Consensus View," OECD/NEA, OECD/GD(96)12. November 1995.

[12] US Nuclear Regulatory Commission, NUREG-1150, 1987.

[13] U.S. Nuclear Regulatory Commission, "Accident Source Terms for Light-Water Nuclear Power Plants," NUREG-1465, February 1995.

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The human health impacts from the potential LWR accidents were analyzed and presented in this PEIS. The health impacts will be evaluated for full MOX cores of the existing, partially completed, and evolutionary LWRs, and results are documented in the Final PEIS. The Chernobyl reactor is intrinsically different from the LWRs designed and operated in the United States. The design (including containment system design) and operation of the nuclear power plants in the United States prevent the Chernobyl-type accident consequences to happen in the United States with a probability greater than 1.0×10^{-7}/yr. While a Chernobyl-type accident could result in higher radionuclide releases, the radioactive releases from the accidents analyzed in the PEIS reflect a beyond design basis accident within the probability of occurrence (1.0×10^{-7}) that is acceptable for NEPA purposes. Also, any probabilistic risk assessment for the Proposed Action is beyond the scope of this PEIS.

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NUREG-1465, *Accident Source Terms for Light-Water Nuclear Power Reactors*, was used in the LWR PEIS Data Report to support core-to-containment release fraction. Although NUREG-1465 has been questioned by the public, it represents the most recent guidance for release fractions. Public comment on this report is beyond the scope of this PEIS.

It is true that NUREG-1465 tends to support the use of low-volatile release fractions lower than those used in NUREG-1150 and closer to the ones used by industry. This is not a coincidence, since the industry played a large role in revising NUREG-1465 to their liking. As described below, a careful look at the history of NUREG-1465, its supporting documentation and its domain of applicability indicates that the low-volatile release fractions it recommends are not sufficiently conservative for use in accident analysis of Ex-LWRs. It is therefore not relevant to the use of MOX in Ex-LWRs and should not be referenced in the DPEIS in this context. (A separate question is whether it has any validity at all).

The release behavior of the low-volatile radionuclides to containment from the molten reactor core during a severe accident is highly complex and dependent on details of accident progression that are not well understood; consequently, predictions of low-volatile release fractions are characterized by uncertainties spanning at least four orders of magnitude.[14] This uncertainty has been exploited by the nuclear industry, which consistently chooses the lower bound of the range in its own assessments.

64/09.09.08 cont.

NRC originally issued a draft of NUREG-1465 in which the low-volatile release fractions were similar to those used in NUREG-1150, e.g. on the order of 2-3%. These values were strongly disputed by industry, which preferred release fractions hundreds of times lower, such as those proposed by EPRI (the Electric Power Research Institute) for use in assessments of Ev-LWRs.

Rather than try to establish a rational and conservative basis for source term estimation, NRC submitted to industry pressure and lowered the NUREG-1465 low-volatile release fractions by a factor of approximately 50. Was this change warranted? Not according to the Advisory Committee on Reactor Safeguards (ACRS), which wrote that "these adjustments need to be better justified or not be made."[15] However, the ACRS' recommendation was ignored

Industry comments on the draft of NUREG-1465 consisted of two main arguments as to why they believed its low-volatile release fractions were too high.[16] First, they alluded to recent research that "demonstrated" that low-volatile release fractions from melted fuel were indeed much smaller than those assumed in NUREG-1150. Second, they argued that the use of mean values of release fraction data was not appropriate for the low-

[14] H Nourbaksh, "Estimation of Radionuclide Release Characteristics Into Containment Under Severe Accident Conditions," U.S. Nuclear Regulatory Commission, NUREG/CR-5747, Nov 1993.

[15] US NRC Advisory Committee on Reactor Safeguards, letter to NRC Chairman Ivan Selin, September 20, 1994

[16] U.S Nuclear Regulatory Commission, "Proposed Issuance of Final NUREG-1465," SECY-94-300, December 15, 1994.

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volatile radionuclides, because the uncertainty distributions range over many orders of magnitude. In distributions of this type, the mean is unduly influenced by values at the extreme upper end of the range. The EPRI low-volatile release fractions were based on the median of the distribution, which was typically two to three orders of magnitude below the mean.

The evidence supporting the industry position was summarized in a document prepared for DOE's Advanced Light Water Reactor (ALWR) Program by a consulting firm, Los Alamos Technical Associates (LATA).[17] This report, which appears to have been accepted uncritically by NRC, is fundamentally flawed in at least one major respect and draws conclusions which are inconsistent with other NRC documents. The LATA report refers to a few experiments which observed small low-volatile release fractions, but notably omits discussion of one experiment in particular, the ST test series at the Annular Core Research Reactor (ACRR) at Sandia National Laboratories.[18] The ST test series were noteworthy for their observation of unexpectedly high release fractions for low-volatile elements, such as europium (RF = 6.4%).

The LATA report referred to the ST series in passing, without describing their results, but dismisses them as irrelevant because they were conducted in a reducing atmosphere, which he contends "represents a special case that may exist only locally for brief periods of time in an accident." It neglected to mention that the ST series was conducted explicitly to evaluate the impact of a reducing atmosphere on fission product release, an environment which was not adequately represented in the existing database. This information was necessary, according to the authors of the ST-1 report, because "there are ... regions of actual reactor cores that are expected to be in atmospheres of nearly pure hydrogen during severe accidents."[19]

In fact, one of the major sources of uncertainty in charting the progression of reactor accidents is the temporal and spatial variation in oxidation potential that may occur in a particular sequence. The ST series of experiments demonstrate that these uncertainties are closely related to uncertainties in low-volatile release fractions. This point, although undoubtedly known to NRC staff, does not seem to have been taken into account when uncritically revising downward the NUREG-1465 release fractions according to the erroneous industry contention that "all" recent data support such a revision.

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[17] D. Osetek, "Low Volatile Fission Product Release During Severe Reactor Accidents," Los Alamos Technical Associates, Inc, Albuquerque, NM, prepared for the U.S DOE Idaho Operations Office,DOE/ID-13177-2, October 1992.

[18] M. Allen *et al.* "Fission Product Release and Fuel Behavior of Irradiated Light Water Reactor Fuel Under Severe Accident Conditions: The ACRR ST-1 Experiment," NUREG/CR-5345, Sandia National Laboratories, November 1991

[19] *Ibid*

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The question of oxidation potential is especially important with regard to americium. The volatility of metallic americium is greater by several orders of magnitude than that of the oxide, whereas for the other actinides the difference between metal and oxide volatility is not as great.

A major uncertainty in prediction of the release fraction of low-volatile radionuclides is associated with the vulnerability of Ex-LWRs to a class of accidents known as high-pressure melt expulsion (HPME) events. These are events in which the reactor vessel fails at high pressure leading to ejection of the molten core into the containment at high velocity and significant aerosol formation. HPME provides a mechanism by which relatively large fractions of low-volatiles can be converted to aerosol form in the containment atmosphere and therefore be subject to release into the environment. They should be distinguished from events in which the bulk of the core remains essentially intact throughout the meltdown.

According to NRC, the mean values of low-volatile release fraction uncertainty distributions into containment associated with HPME events in PWRs can be as high as 7%. One should note that the median values of these distributions are only about one order of magnitude less than the mean values, as opposed to the distributions of low-volatile in-vessel release fractions, in which the median is two to three orders of magnitude below the mean. Thus the industry argument that the mean values of low-volatile release fraction distributions do not accurately characterize the distributions does not apply to the HPME case.

HPME is of particular concern because of its relationship to another phenomenon known as Direct Containment Heating (DCH), in which the high heat transfer rates from the fuel aerosol causes a rapid rise in containment temperature that could lead to containment overpressurization and failure. HPME events, which are associated with both large low-volatile releases to containment and large probabilities of containment failure, can therefore result in large releases of low-volatiles to the environment as well.

These effects underscore the point that realistic source terms can only be generated by thorough analysis of specific accident sequences. NUREG-1465 provides representative release fractions for generic loss-of-containment accidents. As other NRC documents have pointed out, for radionuclides with release fractions spanning several orders of magnitude, such as the low-volatile species, neither the mean nor any other single measure contains enough information to accurately characterize the distribution. Knowledge of the actual details of the distribution is required to assess the likelihood of significant low-volatile releases in a particular accident sequence for a particular plant. Generic conclusions, such as those which appear in the DPEIS, are completely meaningless.

Given that large uncertainties in the prediction of low-volatile release fractions still exist, how significant is this issue on the actual consequences of a severe accident involving a MOX-fueled Ex-LWR? According to the DPEIS, it is not significant at all, because

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"other radioisotopes that are released in an accident have more serious impacts on human health than the Pu used in the MOX fuel."[20] However, not only is this statement an oversimplification (e.g. the increase in transplutonium actinides is ignored), but it is also wrong. Because of the relative radiotoxicity and longevity of some of the actinides, they can have significant impacts on accident consequences. According to a study done at Sandia, which used the MACCS code to evaluate the relative importance of different radionuclides to the public health consequences of a severe LWR accident, it was found that the curium isotopes in particular were highly significant both for early and long-term exposures.[21] While the results obtained in that paper depend on the specific assumptions used in their model, they are useful to obtain a qualitative understanding of the importance of curium and the other actinides.

60/09.09.08 cont.

For instance, according to the results of the Sandia study, the ratio of the contribution of curium to cesium with respect to the total number of latent cancers resulting from an accident would be about 0.1, assuming Chernobyl release fractions of 0.4 for Cs and 0.035 for Cm, and core inventories characteristic of a LEU-fueled LWR. For a MOX-fueled LWR, the Cs inventory remains essentially the same, while the Cm inventory increases by a factor of approximately 4. This implies that the number of latent cancers due to the Cm release from a W-Pu MOX-fueled LWR would be about 40% of those due to Cs release. For plutonium isotopes, a similar calculation shows that the approximately three-fold increase in Pu release from a MOX-fueled reactor would result in a number of latent cancers about 80% of those due to Cs release. On the other hand, the decrease in Np would only translate into a few-percent decrease in the number of latent cancers. Because Cs release is the major contributor to latent cancers following an LEU-fueled LWR accident (typically 60% or greater), the Sandia result implies that the increased Cm and Pu releases from a severe accident affecting a W-Pu MOX-fueled LWR could result in a 50% increase in the total number of latent cancers as compared to an LEU-fueled LWR. (For R-Pu MOX, the increase would be significantly larger).

ii) Beyond design-basis accident probabilities

The DPEIS asserts that the substitution of MOX for LEU in LWRs would have no effect on the spectrum of accident probabilities. The document provides no evidence of this, nor does it even discuss a single safety-related issue associated with MOX use. Instead, it again refers the reader to vendor studies, which claim to demonstrate "substantial margins against limiting conditions" for transients involving MOX cores.

60/09.09.08 cont.

However, the situation is not nearly as straightforward as the DPEIS suggests.

[20] DPEIS, Vol 2, Sect 4.3.5.2.9, pg. 4-690.

[21] D. Alpert, D. Chanin and L. Ritchie, "Relative Importance of Individual Elements to Reactor Accident Consequences Assuming Equal Release Fractions," NUREG/CH-4467 (SANDIA85-2575), Sandia National Laboratories, Albuquerque, March 1986.

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There are significant outstanding safety issues associated with the utilization of MOX in LWRs, even with partial-core, reactor-grade MOX, which is the only case for which there is industrial-scale experience. In the case of full-core, weapons-grade MOX, for which there is no industrial experience, numerous additional technical uncertainties with serious implications for safety would arise. 60/09.09.08 cont.

GESMO, the Generic Environmental Impact Statement on the Use of Mixed-Oxide Fuel in Light-Water Reactors, contained a brief discussion of some of the safety issues associated with partial-core, reactor-grade MOX. However, the document is completely out-of-date and many of the reassuring predictions it made concerning the viability of MOX have not been borne out in practice. For instance GESMO claimed that the issues of plutonium segregation and greater fission gas release in MOX fuel would not be significant; however, today they are major stumbling blocks for the qualification of MOX fuel for high burnups. The increased fission gas release from MOX fuel elements has led the French safety authority, DSIN, to limit burnups of MOX fuel in PWRs to 33 MWd/kgHM, well below that now achieved with LEU fuel, which imposes an economic penalty on the use of MOX in France.[22] 65/06.01.08

The DPEIS must include, at a bare minimum, a discussion of these issues at the same level of detail as GESMO, fully updated and with a candid discussion of the remaining uncertainties associated with MOX use in LWRs in the context of W-Pu disposition.

Relative to an LEU core, a MOX core is characterized by the following features: more negative moderator temperature and void coefficients, smaller delayed neutron fraction and prompt neutron lifetime, reduced control rod worth and greater inhomogeneities in fuel microstructure. Each one of these changes separately can have an adverse effect on safety. In addition, one can posit scenarios in which these changes interact synergistically to greatly amplify their individual effects.

The overall deleterious interaction between these elements can be understood in the following way. The decrease in reactor period associated with the smaller delayed neutron fraction and prompt neutron lifetime is perhaps the most serious issue, since this can result in a significant reduction in the time available for an operator to respond to transients. Because of the relatively small percentage of Pu-241 it contains (which has a larger delayed neutron fraction than Pu-239 and Pu-240), this problem is more severe for weapons-grade plutonium than for reactor-grade, especially at the beginning of cycle, when there is a nearly three-fold reduction in delayed neutron fraction.

For transients associated with an increase in coolant temperature (undercooling transients), such as those initiated by the loss-of-heatsink accident (LOHA) in PWRs, this

[22] A. MacLachlan, "New French RIA Tests Suggest Better Resistance of High-Burnup Fuel," *Nuclear Fuel*, September 11,1995. p 1.

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Fabrication and use of MOX fuel using reactor-grade Pu is a mature, industrial scale technology in Europe with at least three vendors actively fabricating MOX fuel. There are some differences introduced by the use of weapons-grade Pu, which DOE is addressing as part of an ongoing weapons-grade MOX fuel development program and fuel qualification program. As a part of this, DOE is consulting with the European fuel vendors to benefit from their experience. The fuel qualification program would include in-reactor irradiation of fuel pellets and assemblies. A commercial reactor used to disposition Pu would have to be licensed by the NRC. Part of this licensing process would include an extensive, independent review of safety and performance issues associated with the use of MOX fuel.

In addition to issues associated with using MOX fuel versus LEU fuel, there are uncertainties in the different reactor types (BWR versus pressurized water reactor [PWR]), reactor vendors (Westinghouse versus Combustion Engineering), and reactor sites. In addition to reactor type, reactor vendor, and reactor sites, there are reactor-specific variations in the number of cooling loops, the emergency core cooling system, the type of control rods, reactor vessel neutron and thermal history, and the type of fuel loading pattern (for example, low leakage). A reactor-specific safety analysis will be done to determine the effects on the neutronic and mechanical characteristics of the reactor system, as well as the effects of reactor-specific characteristics on the accident analysis including pressurized thermal shock, loss of heat sink, and other accidents. The effects of extended burnup of the fuel will also be evaluated to determine the safety margin including the departure of nucleate boiling (DNB) ratio and other parameters over the life of the fuel assemblies.

decrease in stability may be compensated for by the greater negative temperature feedback associated with the greater magnitude of the moderator temperature coefficient.

However, because of the greater magnitude of the moderator temperature coefficient, the increase in core reactivity associated with a decrease in coolant temperature or increase in coolant density (overcooling or overpressure transients) will be more rapid for a MOX core than for an LEU core. In these events, the change in feedback behavior of a MOX core will aggravate, rather than compensate for, the reduced reactor period, so that the severity of overcooling/overpressure transients will increase. The reduced worth of control rods and soluble poisons also increases the risk that the transient will proceed without scram.

The third coupled safety issue is the intrinsic inhomogeneity of MOX fuel compared to LEU. Current methods of MOX fabrication, such as the MIMAS process in use at the MELOX plant in France, produce inhomogeneities in the fuel that lead to macroscopic clumping of plutonium at the periphery of the fuel rod during irradiation.[23] 66/06.01.08

This clumping phenomenon, which is very difficult to model accurately, can lead to formation of "hot spots" which can alter predictions concerning the local cladding temperature increase during reactivity insertions, such as overpressure transients in BWRs, and calculation of the departure from nucleate boiling (DNB) ratio. Additional uncertainties result from the lack of fabrication and irradiation experience with MOX fuel containing integral burnable absorbers (such as gadolinium), which would be required in MOX fuel for U.S. Ex-LWRs. The effect of gadolinium addition on the microstructure of MOX fuel both before and during irradiation is not known.

At least one of the vendor documents (the only one we have reviewed) cited indirectly by the DPEIS does not appear to address the issue of determining MOX-specific DNB ratios.[24] This renders its conclusions regarding the acceptability of MOX core response during transients untrustworthy. This point is underscored by the fact that the DPEIS, as well as the vendor references, assume that MOX fuel burnups will be significantly higher (e.g. 43 MWd/kgHM for PWRs) than those currently allowed in France. 65/06.01.08 cont.

The magnitude of the increase of overall risk of core damage and catastrophic release if MOX is substituted for LEU in an Ex-LWR is highly plant-specific, as is the relative contribution of various initiating events to core damage in LWRs. In order to get a sense of the issues involved is instructive to look at a few specific cases.

[23] A. MacLachlan, "French Working to Improve MOX Performance and Economics," *Nuclear Fuel*, November 6, 1995, p. 8.

[24] GE Nuclear Energy, "Study of Plutonium Disposition Using Existing GE Advanced Boiling Water Reactors," NEDO-32361, June 1, 1994.

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06 01 08 Comment Number 66

Comment noted. Extensive irradiation experience, including both test and commercial irradiation, has shown that the process described by the commentor produces adequate homogeneity.

The commentor's reference #23 from the November 6, 1995, *Nuclear Fuel* more accurately refers to microscopic Pu-rich regions present throughout the fuel matrix. The inhomogeneities are microscopic, and are much smaller than those that have been shown acceptable through Reactivity Insertion Accident (RIA) testing.

The accepted values for Pu particle size based on RIA testing are supported by M.D. Freshley, E.A. Aitken, D.C. Wadekamper, R.L. Johnson, and W.G. Lussie in *Nuclear Technology* 15(1972) 239 and by T. Abe, N. Nakae, K. Kodato, M. Matsumoto, and T. Inabe in *J. Nuclear Materials* 188(1992) 154.

PWRs: Perhaps the most troubling consequence of the use of MOX in PWRs is the fact that one of the classes of events which are more severe for MOX cores than LEU cores, the overcooling transients, is also the same class which has the potential to cause one of the most dangerous and poorly understood safety phenomena associated with PWR operation, pressurized thermal shock (PTS) failure of the reactor pressure vessel (RPV).[25]

PTS is a phenomenon in which the reactor vessel can undergo catastrophic failure if the vessel remains pressurized during (or repressurizes immediately following) a sudden and significant drop in reactor temperature. In the worst case, this event, can result in a simultaneous failure of all the barriers (the fuel cladding, the RPV itself, and the containment building) to release of radionuclides into the environment.[26] Early containment failure can occur as a result of missile attack from fragments of the exploding RPV or from direct containment heating (DCH) in accident sequences in which partial melting of the fuel occurs prior to RPV failure. Such events are also associated with significant releases of low-volatile radionuclides to the environment, as discussed in the previous section; thus the substitution of MOX for LEU in Ex-LWRs can result in an increase in both the probability and the consequences of this class of accidents.

65/06.01.08 cont.

PTS transients can result directly from a large variety of initiating events, including main steam line breaks, small-break LOCAs (e.g. Three Mile Island) and steam generator tube ruptures (SGTRs).[27] Other events, such as instrumentation malfunctions or turbine trip due to loss of offsite power (LOOP), can initiate sequences resulting in PTS as well.[28] In many of these sequences, the time available for initiation of operator action is an important parameter.[29] Since the reduced response time to overcooling transients associated with the substitution of MOX for LEU increases the risk of inadequate or incorrect operator action, the risk that one of these initiating events will progress to PTS increases as well.

The susceptibility of a reactor vessel to PTS increases with irradiation time as a result of fast neutron embrittlement of the reactor vessel; the PTS risk increases sharply with reactor age. The approach used by the NRC for limiting the risk of PTS in the aging fleet of U.S. PWRs has been to restrict the extent of RPV embrittlement permissible in operating reactors before plant-specific evaluation is required. This is done by comparing

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[25] U.S. Nuclear Regulatory Commission, "Reactor Pressure Vessel Status Report," NUREG-1511, December 1994.

[26] J. Collier and L. Davies, "Second Marshall Report Gives Grounds for Confidence," *Nuclear Engineering International*, May 1982, p. 30.

[27] NRC, NUREG-1511, *op cit.*, p. 4-2.

[28] U.S. Nuclear Regulatory Commission, "Pressurized Thermal Shock," SECY-82-465, November 1982.

[29] *Ibid*, p. 6-5.

PTS "reference temperatures" for base metal and welds, which provide a rough measure of the PTS susceptibility of the RPV with respect to the spectrum of identified overcooling transients, to "screening criteria" defined by NRC. Because of the large uncertainties characterizing initiation and progression of the PTS phenomenon, however, the actual level of risk of core damage and radionuclide release corresponding to the screening criteria, which were set in 1982 and have remained unchanged, is unclear.[30]

The NRC concluded in 1994 that only two U.S. PWRs would exceed the PTS screening criteria before the end of operating life. However, since that time NRC has apparently lost confidence in the adequacy and completeness of data it has received from operators in support of their compliance with the PTS rule. Reasons for this include new indications of greater uncertainties in the chemical composition of welds than was previously assumed and greater sensitivity of PTS reference temperature to variability of weld composition. Also, accurate analysis of PTS risk is seriously impaired by gaps in the data supplied by operators that result from withholding of information based on proprietary considerations.[31]

Because of the large uncertainties associated with the PTS phenomenon, the baseline PTS risk of Ex-PWRs is very difficult to assess accurately. The spectrum of initiators includes events of relatively high probability, such as SGTRs (approximately 0.005 per reactor-year) and small steam line breaks (0.02 per reactor-year), which have consequences that depend strongly on operator intervention and therefore would be more likely to progress to PTS in MOX cores than in LEU cores. This suggests that the overall risk of PTS may be substantially greater in MOX cores. Therefore, the PTS screening criteria now in use are not appropriate for MOX cores and will have to be reevaluated.

60/09.09.08 cont.

BWRs: In BWRs, the PTS risk is believed to be considerably smaller than that in PWRs. However, there are BWR-specific safety issues associated with MOX use as well. Probabilistic risk assessments such as NUREG-1150 have shown that core damage in typical BWRs is dominated by station blackout events. In this category is the turbine trip without bypass event, a loss-of-heatsink accident (LOHA) associated with overpressure transients and void collapse. This is one of the most limiting transients that can affect a BWR, and it is also one which is more severe for a MOX core, as discussed above. Thus the overall risk of core damage in BWRs will increase if MOX is substituted for LEU.

64/09.09.08 cont.

[30] Comments of David Okrent on SECY-82-465, member of NRC Advisory Committee on Reactor Safeguards, October 14, 1982.

[31] U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, NRC Generic Letter 92-01, Revision 1, Supplement 1: Reactor Vessel Structural Integrity, May 19, 1995.

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NUCLEAR CONTROL INSTITUTE, WASHINGTON, DC,
PAUL LEVENTHAL
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iii) The role of economics in safety assessment

An accurate assessment of the PTS risk associated with MOX use in Ex-PWRs is also closely related to reactor-specific economic issues, which are not addressed in the DPEIS. For instance, the risk may be reduced by annealing the reactor vessel, a procedure that is not anticipated to be very costly (about $20 million) but which nonetheless has been resisted to date by the PWRs identified as being of greatest PTS risk, such as the Palisades plant in Michigan. If DOE decides that the PTS risk should be mitigated by annealing the RPVs of Ex-PWRs chosen for Pu disposition, both the cost and the associated worker radiation exposure will probably have to be borne by the disposition program.

The degradation of steam generators (SG) in PWRs raises a similar issue. Some of the utilities which have responded to DOE's solicitation of Expressions of Interest have offered the use of PWRs which are known to be operating with severely degraded steam generators (Kewaunee). The operator of Kewaunee has opposed steam generator replacement (at a cost of approximately $100 million) on economic grounds. However, given the large contribution of SGTR events to overcooling and PTS transients, it would be unwise to pursue MOX disposition in these reactors without SG replacements. Again, the cost would probably have to be charged to disposition, since plants like Kewaunee are determined not to replace their steam generators. Charging the occupational exposure of SG replacement, typically about 150 person-rem, would increase the total incremental occupational exposure associated with the Ex-LWR MOX option of 27.2 person-rem per reactor listed in the DPEIS (Vol. II, Table 4.3.5.2.9-2, p. 4-690) by a factor of greater than five. 67/07.01.00

Another area in which safety and economics interact concerns the allowable MOX fuel burnup. Utilities are going to expect to be compensated for MOX-related issues that impair the reactor performance. Restriction of MOX burnups to well below LEU burnups, as is the case now in France, will have economic consequences and affect the cost of the MOX option. The calculus that will be used to balance the safety issues associated with high MOX burnups and the economic penalty is not addressed in the DPEIS. 68/01.04.00

3. Conclusions

The DPEIS does not contain sufficient information to consistently compare the occupational and public health and safety impacts of the immobilization and MOX options. To correct this problem, the final version should include:

- A full evaluation of the incremental health and safety impacts of the can-in-canister (CIC) immobilization options, both for routine operation and for accident conditions.

- A full evaluation of the incremental health and safety accident impacts of the existing LWR and CANDU MOX option, taking into account the specific properties of full-core,

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07 01 00 Comment Number 67

Comment noted. DOE is not proposing this mitigation at this stage. Should the Existing Reactor Alternative be selected in the ROD, and this mitigation be determined to be necessary, such costs and exposures will be evaluated in subsequent tiered NEPA analyses, and cost studies as appropriate.

The costs for operating life extensions (for example, steam generator replacements) would be borne by the reactor owner. Such actions would likely require their license review and related environmental analysis. Contract negotiations for the utilization of the MOX fuel for Pu disposition would be competitive between reactor owners, and DOE and would consider related technical, cost, and environmental issues.

01 04 00 Comment Number 68

Comment noted.

weapons-grade MOX fuel and potential differences in the probabilities and consequences of accidents relative to LEU fuel, as well as specific issues (e.g. pressure vessel embrittlement) pertaining to the physical condition and operating history of existing reactors which are candidates for the program.

- A revision of the accident impact analysis of the evolutionary LWR option, taking into account the specifics of MOX fuel as described above, and using a more realistic source term for loss-of-containment accidents.

In all parts of the analysis, outstanding uncertainties should be clearly identified and their magnitudes estimated.

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NEI

NUCLEAR ENERGY INSTITUTE

Marvin S. Fertel
VICE PRESIDENT
NUCLEAR ECONOMICS & FUEL SUPPLY

May 7, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
c/o SAIC-PEIS
P.O. Box 23786
Washington, D.C. 20026-3786

SUBJECT: Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement
(DOE/EIS-0229-D)

The Nuclear Energy Institute[1] (NEI) appreciates the opportunity to comment on the Department of Energy's (DOE) Draft Programmatic Environmental Impact Statement (PEIS) for the Storage and Disposition of Weapons-Usable Fissile Materials (DOE/EIS-0229-D). NEI supports the efforts of DOE in identifying appropriate actions for the storage of all weapons-usable fissile materials and for the disposition of weapons-usable fissile material declared surplus to national defense needs. NEI encourages DOE to pursue those actions necessary to ensure that these weapons-usable materials are in a safe, controlled, and inspectable storage condition as soon as possible. Given the importance of implementing safe, efficient, and economical actions to dispose expeditiously of surplus weapons-usable fissile materials, we encourage DOE to rely to the greatest extent possible on the technical analysis and recommendations of the National Academy of Sciences as outlined in its 1994 publication, Management and Disposition of Excess Weapons Plutonium. By taking appropriate actions in a timely manner, the United States

[1] The Nuclear Energy Institute is the organization responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry. NEI's purpose is to foster and encourage the continued safe utilization and development of nuclear energy to meet the nation's energy, environmental and economic goals. NEI represents over 250 companies and organizations worldwide, including electric utilities that own and operate nuclear power plants, nuclear plant equipment suppliers, engineering/construction firms, nuclear fuel cycle companies, and others in the nuclear energy industry.

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NUCLEAR ENERGY INSTITUTE, WASHINGTON, DC,
MARVIN S. FERTEL
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May 7, 1996
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can lead by example in eliminating what NAS called "a clear and present danger to national and international security."

In response to the requirements of the National Environmental Policy Act of 1969, as amended, this draft PEIS analyzes various long-term storage and disposition alternatives. For the disposition of surplus plutonium, nine action alternatives are identified and categorized as either deep borehole burial, immobilization of plutonium for disposal, or burn in reactors as mixed-oxide (MOX) fuel. NEI agrees with DOE in pursuing the "spent fuel standard" as the most appropriate standard for managing the risks associated with surplus weapons-grade plutonium. As NAS states "...none of the options for long-term disposition of excess weapons plutonium can be expected to substantially reduce the inventories of excess plutonium from nuclear weapons for a least a decade." Therefore, we urge you to concentrate your resources on alternatives that will bring results in the shortest timeframe possible at reasonable cost. 1/01.05.00

NEI cautions against the utilization of ICRP and NCRP models to attempt to estimate actual impacts of low levels of radiation exposure to the public and workers. These models were developed to be conservative and to accommodate uncertainties in knowledge of the health impacts at low radiation exposures. The proper use of these models is to assess potential risks associated with one policy option relative to other options, and as a result, to make informed risk management decisions. 2/09.09.08

NEI recognizes that more than one option for the disposition of excess-weapons plutonium will be needed to adequately address all surplus weapons-usable material. As DOE acknowledges, existing surplus plutonium comes in various forms, and some of these forms may not be suitable for conversion to MOX fuel. Therefore, the strategy for disposition of surplus weapons-usable plutonium may involve a combination of disposition alternatives. NEI supports the findings of NAS indicating that the two most promising alternatives for the purpose of meeting the spent fuel standard are the use of surplus plutonium as MOX fuel and the vitrification option. 3/08.03.01

NEI supports the disposition of surplus plutonium as MOX fuel in commercial reactors as the most viable method of attaining the spent fuel standard and therefore, significantly reducing the security risks of this weapons-usable material. Disposal of plutonium using the "MOX option" can be accomplished in a timely manner and lies within the bounds of existing technology. DOE must be aware, however, that the final decision to burn surplus weapons plutonium in commercial reactors rests with individual electric utility companies and as such, a predictable and reliable schedule for fuel supply will be critical to their decision-making process.

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01 05 00 **Comment Number 1**

Comment noted.

09 09 08 **Comment Number 2**

The human health effects response to low-level radiation exposure is still disputed in the scientific community. The International Commission of Radiological Protection (ICRP) and NCRP, two widely respected and accepted scientific organizations, support using the linear-non-threshold approach for estimating human health risks for low-level radiation exposure. Some suggest that this estimation is too conservative while others believe that radiation effects would be greater at low-level radiation exposures. However, the ICRP and NCRP approach is the most widely used method to estimate the radiation health risk and has long been employed by regulatory agencies in the United States. It was appropriate to use this method in the PEIS.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

NUCLEAR ENERGY INSTITUTE, WASHINGTON, DC, MARVIN S. FERTEL
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U.S. Department of Energy
May 7, 1996
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DOE must resolve a number of institutional issues, including the fact that the United States does not have a facility to fabricate MOX fuel, before it can expect reasonable participation from these companies. If MOX fuel is to be manufactured in the United States, reactor burning of weapons-usable plutonium will not begin for an additional five to ten years, which will be needed to build and license a MOX fabrication facility. The option of using excess European capacity to fabricate MOX fuel is not included in the draft PEIS, but may well be the most expeditious method of disposing of this material and should be evaluated as part of the PEIS. | 4/01.00.00

As stated previously, before any company will agree to burn weapons-usable plutonium in its reactors, it will require a firm commitment from the federal government that the material would be delivered as and when promised. Security of fuel supply is of utmost importance to electric utilities and without it, DOE cannot expect long-term utility participation in obtaining these all important national security goals. | 5/13.00.00

In closing, we wish to reiterate that the United States has an opportunity to demonstrate leadership to the rest of the world by implementing actions that will result in the near term disposal of surplus weapons plutonium. The world has accepted the validity of the spent fuel standard as a fully adequate non-proliferation deterrent. Aggressive implementation by the United States of the MOX and vitrification options to achieve the spent fuel standard and to dispose of surplus weapons-usable plutonium should be pursued expeditiously and achieved as soon as possible. Since there will be significant licensing and regulatory issues associated with the successful implementation of the MOX fuel option, we encourage DOE to develop an approach that maximizes industry involvement. | 6/01.06.00 | 7/06.06.08

Thank you for the opportunity to comment and we look forward to our continued participation in this activity.

Sincerely,

Patricia J. Hagg for MSF

Marvin S. Fertel

M-152

01 00 00 **Comment Number 4**

The use of European MOX fuel fabrication is an option analyzed under the Existing LWR Alternative (see Section 2.1.4, under the Reactor Category).

13 00 00 **Comment Number 5**

Comment noted.

01 06 00 **Comment Number 6**

Comment noted.

06 06 08 **Comment Number 7**

Comment noted. If the Reactor Alternative using MOX fuel is selected, negotiations with the appropriate reactor owners would include commitments for MOX fuel supply.

Nuclear Information and Resource Service

1424 16th St. NW, Suite 404, Washington, DC 20036; 202-328-0002; fax 202-462-2183; e-mail nirsnet@igc.apc.org web www.nirs.org

June 6, 1996

Greg Rudy, Acting Director
Office of Fissile Materials Disposition
U.S. Department of Energy
1000 Independence Avenue NW
Washington, DC 20585

Comment with regard to: Storage and Disposition of Weapons Usable Fissile Materials Draft Programmatic Environmental Impact Statement

Dear Mr. Rudy,

We are writing to supplement two other sets of comments to which Nuclear Information and Resource Service is a signatory. We would like to emphasize our support for the recall of the Draft Programmatic Environmental Statement on the grounds that it does not fairly or adequately assess all the options or impacts of the options given, and thus does not fulfill NEPA requirements. The purpose of these comments is to register areas that should be omitted and other areas that should be included in the revised Draft PEIS that considers the impact of mixed oxide fuel (MOX). 1/08.03.01

We wish to assert here that the MOX fuel option should be excluded from any consideration whatsoever. National nuclear policy should reflect the goals of the citizens of the United States. It is clear that the majority of American taxpayers do not support further nuclear development and do not support their tax dollars being used to subsidize an economically non-competitive, polluting, dangerous industry that is in part responsible for creating the very problem that the PEIS is designed to try and resolve. MOX fuel is not a "solution" to anything. 2/08.03.01

At a time when the national policy move towards deregulation and down-sizing should be allowing market forces for the first time to affect the profile of electric utility service, the creation of a MOX Fuel program would be a form of protectionism that would shield some utilities from some of the forces of competition. We are not necessarily advocating utility deregulation, but pointing out that this would constitute federal intervention on behalf of nuclear waste generators.

In addition, the "policy signal" sent to utilities would be a federally-approved open door for programs to extend MOX fuel use, including reprocessing, pyroprocessing, breeder type reactors and ultimately the need for a vastly expanded radioactive waste program to handle both so-called "low-level" and high-level wastes—not to mention the health consequences in increased medical 3/01.04.00

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08 03 01 **Comment Number 1**

Comment noted.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 04 00 **Comment Number 3**

The specific purpose of DOE's PEIS effort is to evaluate alternatives for the disposition of surplus weapons-usable Pu that would render the Pu as inaccessible and unattractive for reuse in nuclear weapons as the much larger and growing quantity of Pu that exists in spent nuclear fuel from commercial power reactors. This condition is referred to as the Spent Fuel Standard. If an alternative using MOX fuel in reactors is selected, the surplus Pu would eventually be contained in spent fuel and, by definition, the Spent Fuel Standard would be achieved.

While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, reprocessing and extraction of Pu from that spent fuel is not being proposed, and is beyond the fundamental nonproliferation purpose of the disposition effort. The PEIS evaluates disposition of surplus weapons Pu through use in MOX fuel, but does not propose reprocessing of the spent fuel, breeder reactors, or other potential programs involving MOX fuel. Nor does the PEIS prejudice future decisions regarding the management or disposition of the spent fuel.

NUCLEAR INFORMATION AND RESOURCE SERVICE, WASHINGTON, DC, MARY OLSON
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costs due to continued dispersal of hazardous agents in areas of population, food production and water sources. | 3/01.04.00 cont.

We call upon the Department to recognize that this set of eventualities has been again and again rejected by affected communities, national environmental and public interest organizations, and Congress. It is time that the Department invest its considerable expertise in figuring out how to devote more of its own budget to the development and deployment of non-nuclear energy options and the consideration of the non-reactor options for plutonium and other fissile materials. | 4/01.04.00

Without dropping our above stated contentions, we also note a number of specific problems in the Draft PEIS that makes it unsuitable even on its own, misguided terms.

The analysis must include the impact of the use of MOX fuel on implementation of the "Low-Level" Radioactive Waste Policy Act. Very specific projections of probable waste streams have been made for the projected disposal facilities, which could be drastically altered with MOX fuel use. The impact analysis must include an assessment of impact on groundwater since very persistent radionuclides are allowed in civilian shallow land burial and other relatively unconfined facilities. To what extent will use of MOX fuel add long-lived radionuclides and/or highly radioactive materials to commercial "low-level" waste sites? This should include a discussion of all sources of radiation affected by use of MOX fuel, including reprocessing, fuel fabrication, enrichment, and any other facilities. There should also be an assessment of the impact on the Department itself since the civilian "low-level" sites are to be ceded over to the Department after closure. Increases in the persistent radionuclide inventory could affect the liability issues associated with such sites, and issues such as the possibility of inadvertent criticality must be included. | 5/09.11.08 | 6/09.04.08 | 5/09.11.08 cont.

Similarly, it is imperative that the PEIS include a full analysis of the relative impacts of MOX fuel on all aspects of irradiated fuel management and disposition. This must include impacts of thermal loading on the fuel pool, dry cask storage, dry cask transport, and repository emplacement. In addition, all accident scenarios associated with fuel pools, cask loading and unloading, storage, transport and handling must be assessed for increased relative impacts, but also confounding factors that MOX fuel presents, particularly in the area of criticality and/or increased burn-up. (E.g. rate of hydrolysis of water moisture in an unevacuted dry cask and potential for hydrogen gas build-up and ignition.) | 7/06.01.08

The nature of a Programmatic Environmental Impact Statement is intended to encompass complex interlocking factors. A decision to supply existing utilities with a fuel source and subsidy has a number of economic and social consequences. As noted above, such a move by the Department is a "policy signal" to open the way for further nuclearization of the U.S. at a time when this is contrary to the will of the people. If this PEIS is going to include the option of MOX fuel, then there needs to be a full-blown, detailed assessment of the future impact on society from nuclear power expansion, particularly technologies using MOX fuel. | 8/06.01.08

Finally, with regard to the basis for assessing radiological impacts, the assessment given is inadequate. We reference a growing body of literature and data that substantiates that there is | 9/09.09.08

M-282

01 04 00 **Comment Number 4**

Comment noted.

09 11 08 **Comment Number 5**

The design of the MOX fuel fabrication facility is conceptual at this time and, therefore, estimates of LLW by radionuclide content and concentration would be speculative. The conceptual designs for the disposition facilities have, as part of their design, waste management facilities that would treat and package all waste generated into forms that enable long-term storage and/or disposal in accordance with RCRA and other applicable Federal and State regulations and DOE Orders. As the designs mature, process waste assessments, which include individual waste streams characterization, will be completed. All waste streams generated would be treated and packaged into a form that enables long-term storage and/or disposal.

09 04 08 **Comment Number 6**

The analyses presented in Chapter 4 include potential impacts to groundwater quality and groundwater availability.

06 01 08 **Comment Number 7**

Depending on the fuel design and reactor irradiation campaign selected, there could be differences between the behavior of the individual MOX fuel assemblies and the LEU fuel assemblies. If modifications to reactor systems are required, the modifications would be implemented as necessary to ensure comparable system performance between MOX fuel and LEU fuel.

Since issues such as accident scenarios associated with fuel pools, cask loading and unloading, and storage and transport are facility design-specific (for example, BWR or PWR, different capacity, different reactor suppliers), the discussions on such issues are beyond the scope of this PEIS. However, if this Reactor Alternative is selected, such issues will be analyzed in tiered NEPA documents, SARs, and other licensing documents.

radiological hazard and impact from low doses of radiation (*). We challenge the assertion that hormesis effects cannot be ruled out. Even if there is variability in human response to radiation exposure, it is completely inappropriate for a federal agency to support any policy that would selectively favor those individuals with a higher tolerance to radiation at the sacrifice of the rest of the population. It is absolutely required that radiological impact be assessed with regard to those who are most vulnerable in any population. Evidence of elevated effects of low-dose radiation lead us to challenge the assertion made in the draft PEIS that assuming a single point source at a specified number of feet is more conservative than doses from ongoing internal exposure.

9/09.09.08 cont.

We are calling upon you to be the leaders towards a sustainable future: avoid the long costly process of discovering too late that your "solution" only made the problem worse.

Sincerely,

Mary Olson
Nuclear Information & Resource Service
Radioactive Waste Project

* Partial list of references substantiating detrimental health effects from low doses of ionizing radiation. We submit these references and by association the text of these documents as part of our official comment of record.

BEIR V, Health Effects of Exposure to Low-Levels of Ionizing Radiation, National Academy Press, 1990.

Gardner, et al, 1990, "Results of Case-Control Study of Leukemia and Lymphoma Among Young People Near Sellafield Nuclear Plant in West Cumbria." BMJ, Vol 300, 17 February, 1990.

10/01.02.00

Gofman, John, 1990, "Radiation-Induced Cancer from Low-Dose Exposure: An Independent Analysis." C.N.R. Book Division, San Francisco.

Morris, M. and R. Knorr, 1990, "The Southeast Massachusetts Health Study 1978--1986" Report of the Massachusetts Department of Public Health, October 1990.

Wing, Stephen, et al, Mortality Among Workers at Oak Ridge National Laboratory." Journal of the American Medical Association, March 20, 1991--Vol. 265, No. 11 pp 1397-1402.

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06 01 08 **Comment Number 8**

Comment noted.

09 09 08 **Comment Number 9**

The human health effects response to low-level radiation exposure is still disputed in the scientific community. The ICRP and NCRP, two widely respected and accepted scientific organizations, support using the linear-non-threshold approach for estimating human health risks for low-level radiation exposure. Some suggest that this estimation is too conservative while others believe that radiation effects would be greater at low-level radiation exposures. However, the ICRP and NCRP approach is the most widely used method to estimate the radiation health risk and has long been employed by regulatory agencies in the United States. It is appropriate to use this method in the PEIS.

01 02 00 **Comment Number 10**

Comment noted. The BEIR V and *Journal of the American Medical Association* references were used in preparing this PEIS. The commentors' other listed references were not considered because they were not specific to a particular site being considered for any alternative, nor generally recognized authoritative references like the BEIR V.

O'NEILL, JOHN E., MADISON, IN
PAGE 1 OF 1

10-29-95

U.S. Dept. of Energy
Office of Fissle Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

REGARDING:

(a) Ltr. 10-19-95, Disposition of Surplus Highly Enriched Uranium EIS (HEU EIS)

COMMENT: EIS (HEU EIS) Regardless of the alternatives for disposition, storage will be required. In view of the Environmental opposition to locations, I wonder: Has former U. S. Army above ground storage areas been considered? Former Army Depot, Igloo S.D. had 801 above ground, isolated storage igloos with few people and large buffer zones.

(b) Fact Sheet, 10-17-95, Reading Room Locations. Storage and Disposition of Weapons-Usable Fissle Materials Programmatic EIS (PEIS) — 1/01.04.00

COMMENT: EIS (PEIS) Same as above.---Has former U.S. Army above ground storage areas been considered?

(c) Newsletter, Fall 1995, Vol 1, Management of Nuclear Weapons Materials, Management and Disposition of Excess Weapons Plutonium (a report) — 2/15.00.00

COMMENT: Newsletter (Excess Plutonium) Madison Indiana has a large electric power plant (Indiana Kentucky Electric (IKE) that is producing power for Plutonium manufacture at Portsmouth Ohio. Would you comment on the future need for the electric energy?

Sincerely,

John E. O'Neill

John E. O'Neill
1713 Oak Hill Dr.
Madison, IN 47250

PH: 812-273-1600

M-002

01 04 00 **Comment Number 1**

The Manzano Mountain Site was considered in the Final PEIS for pit storage and Appendix P was added. Other non-DOE sites (for example, aboveground military sites) were considered in the Screening Report and were eliminated because of cost effectivenesss, ES&H, and public/institutional acceptance concerns, with no overriding advantages compared to existing DOE sites already safeguarding nuclear materials.

15 00 00 **Comment Number 2**

This comment is beyond the scope of the PEIS. Planning for use of the electric energy is the responsibility of the generating utility company.

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7 JUne 1996

DOE-Office of Fissile Materials Disposition
P O Box 23786
Washington, DC 20026-3786

To whom it may concern:

Enclosed please find the comments of the Oak Ridge Environmental Peace Alliance regarding the Storage and Disposition PEIS. You will note that our comments are intended to identify areas of profound weakness in the current PEIS so that DOE can prepare a more adequate PEIS when redrafting the document as has been called for by a broad national coalition of groups concerned with fissile materials storage and disposition.

Thank you for your attention to our concerns.

Sincerely,

Ralph Hutchison

Ralph Hutchison, coordinator
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Comments on the
Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Oak Ridge Environmental Peace Alliance
May 7, 1996

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Introduction

The Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (Storage and Disposition PEIS) continues the Department of Energy's piecemeal approach to making decisions regarding the storage, processing and disposition of weapons-usable fissile materials. The Storage and Disposition PEIS addresses the long-term storage of highly enriched uranium and plutonium and further discusses disposition of plutonium but does not address the disposition of strategic highly enriched uranium.

The Department of Energy, faced with the need to make decisions about what to do with weapons-usable fissile materials, has now produced at least eight NEPA documents which look at pieces of the Department's challenge but are neither coherent nor comprehensive taken in their entirety. The Department's refusal to adopt a comprehensive and coherent NEPA strategy, as requested by grassroots citizens groups in a meeting with the Secretary of Energy in January of 1994, has led us to the current situation. It is even clearer now than it was in January, 1994, that the most responsible and efficient approach to making decisions regarding fissile materials would have been a comprehensive, integrated, coherent approach.

Instead the Department has prepared, is preparing, or has committed to prepare:

- an Environmental Assessment on the interim storage of plutonium pits at the Pantex Plant in Amarillo, Texas
- an Environmental Assessment on the interim storage of highly enriched uranium at the Y-12 Plant in Oak Ridge, Tennessee
- an Environmental Assessment on the downblending of highly enriched uranium purchased from the republic of Kazakhstan
- a Site-wide Environmental Impact Statement for the Pantex Plant in Amarillo, Texas
- an Environmental Impact Statement on the disposition of surplus highly enriched uranium
- a Site-wide Environmental Impact Statement for the Y-12 Plant in Oak Ridge, Tennessee
- a Programmatic Environmental Impact Statement for the Storage and Disposition of Weapons-Usable Fissile Materials
- a Programmatic Environmental Impact Statement on the stewardship and management of weapons and strategic weapons materials in the US stockpile

1/01.00.00

Even this coverage is not exhaustive; the Department of Energy has not yet prepared NEPA analysis for the disposition of highly enriched uranium which is currently considered strategic (with the exception of approximately 35 metric tons included in the

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01 00 00 Comment Number 1

Each of these documents is analyzed based on separate and distinct purposes and needs, and was determined by DOE not to be connected. Decisions related to each of these documents can be made independently without prejudicing the other decisions. Coordination of these analyses and decisions with each of the related DOE Programs is an integrated and ongoing process.

Disposition of HEU is the subject of a separate document, the HEU EIS. As stated in the HEU CRD on page 3–161, if more than 200 t (220 tons) of HEU is eventually declared surplus, additional NEPA analysis will probably be necessary, but DOE believes it has adequately bounded the surplus material for the foreseeable future.

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surplus highly enriched uranium EIS which has not yet been officially declared surplus), necessitating at some time in the future the preparation of yet another NEPA document.

The Department should, in this *Programmatic* EIS, discuss the disposition of highly enriched uranium as thoroughly as it does plutonium, considering the reasonable alternatives (which are fewer and more manageable) and avoiding the necessity of yet another environmental analysis when the next 50 metric tons of highly enriched uranium is declared surplus. 1/01.00.00 cont.

Overriding concerns of the Oak Ridge Environmental Peace Alliance

The Oak Ridge Environmental Peace Alliance believes that the current draft PEIS for the storage and disposition of weapons-usable fissile materials is fundamentally deficient and should be withdrawn, redrafted and reissued for comment when the Department has been able to address the concerns identified by the public. 2/08.03.01

The specific comments we offer here relate primarily to deficiencies in the current draft's consideration of the long-term storage of highly enriched uranium. They indicate areas in which the Department must either improve the rigor and quality of the PEIS, fill in gaps, or modify the PEIS to meet the minimum requirements of NEPA before it is reissued.

The disappeared years

In discussing the long-term storage of highly enriched uranium at Oak Ridge's Y-12 Plant, which is for economic, security and safety reasons the department's only reasonable option, the draft PEIS relies heavily on the Environmental Assessment for the Interim Storage of highly enriched uranium at Y-12, prepared by DOE in 1994. The Interim storage EA, prepared in 1994, considered storage of highly enriched uranium at Y-12 for up to 10 years.[1] This means DOE has NEPA coverage for the storage of highly enriched uranium until 2004.

In assessing the need for upgrades to the Y-12 facility, the PEIS relies on a data report, *Upgrading the Y-12 Plant for Long-Term HEU Storage*, which states "The long-term storage mission is assumed to begin in the year 2020, continuing for at least 50 years. [Y/ES-043/R2, p.2, §1.4]"

Assuming that DOE plans to conduct highly enriched uranium operations at the Y-12 Plant during the sixteen years between 2004 and 2020, NEPA coverage must be provided. Since NEPA coverage on storage of highly enriched uranium expires in 2004, DOE must address long-term storage beginning in 2004, not 2020, at the Y-12 Plant. 3/08.00.00

Length of long-term storage

In the HEU EIS currently in preparation, DOE analyzes the environmental impact of the disposition of 200 metric tons of surplus HEU. Of this 200 metric tons, one hundred sixty-five metric tons have already been declared surplus by the President. This gives DOE a 35 metric ton "buffer" to cover HEU which may be declared surplus in the future.

Beyond this 35 metric tons, DOE has no NEPA analysis addressing the disposition of HEU which is currently considered strategic but which will, at some time in the future, be declared surplus. Absent such analysis, and absent the plan for such analysis, DOE has

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08 03 01 **Comment Number 2**

As noted in presentations at the public meetings, DOE welcomes public input throughout the decisionmaking process, which includes the formal NEPA comment periods, scoping, and reviewing the Draft PEIS, as well as during the period of time after issuance of the Final PEIS leading up to the ROD. DOE believes that the Draft PEIS was adequate, and does not intend to issue another draft.

08 00 00 **Comment Number 3**

This PEIS analyzes the environmental impacts of long-term storage of HEU for a period of up to 50 years. The document uses a planning date of 2005 as the year in which all of the HEU would be in place at a selected site. The environmental analysis in this document, plus any tiered documents, will provide the "coverage" required for long-term storage to the year 2055.

no rationale for limiting its consideration of "long-term" HEU storage to fifty years. The number fifty has been selected arbitrarily and is not anchored to any point in reality—not the design life of buildings, not the expectation of completion of disposition, not a schedule of international disarmament, not the physical properties or the hazard-life of the materials being analyzed.

Analysis for fifty years is neither adequate nor appropriate. The half-lives of these materials indicate they will still be as dangerous in fifty years as they are today. The absence of a disposition plan and timetable indicates these material will, in fifty years, be sitting where they are placed as a result of decisions made in this Storage and Disposition PEIS. It makes far more sense, and is more honest to the communities which are being asked to host these materials, for the Department to look truly long-term—perhaps up to 500 years—and to establish review periods at 10 year intervals. Unless DOE can provide some assurance, or even reasonably suggest, that Y-12 will not store HEU past the year 2054, the Storage and Disposition PEIS must analyze longer storage scenarios as reasonable alternatives in the "long-term storage" section of the PEIS. 4/01.04.00

The Limitations of the Y-12 Interim Storage EA

During the preparation of the Y-12 Interim Storage EA in 1994, documents released to the public, including DOE's own 1993 Safety Survey, raised significant questions about the structural reliability and safety of seven of the eight facilities being used for highly enriched uranium processing and storage at Oak Ridge. The state of Tennessee, commenting on the EA, joined with the Oak Ridge Environmental Peace Alliance in recognizing the significance of these concerns.[2] The concerns are summarized below (Appendix A). In issuing the Finding of No Significant Impact for the Interim Storage EA, DOE also acknowledged the legitimacy of these concerns and committed to the preparation of a highly enriched uranium vulnerability study (now ongoing) and a Y-12 Site-wide EIS (not yet initiated).[3]

The Storage and Disposition PEIS employs language suggesting that long-term storage at Oak Ridge would merely mean extending the findings of the Y-12 Interim Storage EA beyond the current 10 year limitation, perhaps with building upgrades outlined in the PEIS Data Report [Y/ES-043/R2]. The Storage and Disposition PEIS may not rely on the Interim storage EA for anything other than its very specific and limited intent. It says DOE can store highly enriched uranium at Y-12 for ten years. All parties agreeing to the Interim Storage EA realize that there is inherent in that agreement a level of risk—that a significant earthquake or severe tornado could damage and destroy buildings in which highly enriched uranium is stored. The agreement of the public to the FONSI for the Interim Storage EA was based on a desire to allow dismantlement to proceed unhindered while DOE performed more rigorous analysis in the vulnerability assessment and the Y-12 EIS. It did not certify that buildings were reliable and safe for ten years or that everyone agreed they were. DOE abuses the public trust and violates its own standards for material control and accountability if it presents the Y-12 Interim Storage EA as the foundation for a decision to store HEU long-term in current facilities. 5/11.00.05

It is not true that the Department's stated purpose for safe and secure long-term storage of highly enriched uranium can be met with minor modifications to current buildings at Y-12. It is also not true that "upgrade in place" is the only reasonable alternative which should be considered in the Storage and Disposition PEIS for the long-term storage of highly enriched uranium. In some very important senses, it is not a reasonable alternative at all. 6/02.05.05

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01 04 00 Comment Number 4

Fifty years was used as the timeframe for long-term storage for the environmental analysis because it is a reasonable facility lifecycle. To increase this to 100 years or more would lead to a highly speculative environmental analysis, which would be contrary to the intent of NEPA. For disposition of surplus Pu, to meet the Nation's goals in support of its nonproliferation policies, DOE determined that "clear and present danger" demands that disposition be initiated promptly.

11 00 05 Comment Number 5

This PEIS analyzes the long-term storage of nonsurplus HEU, and the surplus HEU that cannot go from current storage to disposition within 10 years (the time limit for the *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Level at the Y–12 Plant, Oak Ridge, Tennessee* [Y–12 EA]). It does not rely on the analysis in the Y–12 EA beyond 10 years.

02 05 05 Comment Number 6

Comment noted. The Final PEIS includes a description of the upgrades that would be made to facilities at Y–12 to accommodate the long-term storage of HEU (Section 2.3.1 and Figure 2.3.1–9).

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Structural integrity of buildings

The buildings currently employed for the storage and processing of highly enriched uranium have, with one exception, exceeded their design life. DOE's own Safety Survey indicates that seven of the eight highly enriched uranium buildings would sustain significant damage or be destroyed in a design-basis earthquake (see Appendix A). The University of North Carolina in Chapel Hill published a study in 1994 which noted the East Tennessee Seismic Zone (includes Y-12) is the second highest region of seismic activity in the nation. The study also concludes that the regular activity current in the region suggests that a high activity event is likely in the future.[4] In conducting a study on the necessity of upgrades to make old buildings meet new standards, Y-12 employees noted that "Since 1970, the seismic demand for the Oak Ridge sites has generally increased as new seismic data became available.[5] Taken together, these three studies demonstrate that the Department of Energy, the public, and workers at Y-12 can not rely on the current facilities to meet the goal of safe, secure storage. The collapse of a highly enriched uranium building would violate DOE's own requirement that material be stored in reliable buildings [DOE Order 5480.28][6]; it would also mean loss of workers lives, loss of material accountability, an environmental disaster, and a cleanup challenge heretofore uncontemplated. 7/02.05.05

In addition, most current highly enriched uranium processing and storage takes place in above-ground, unreinforced facilities constructed rapidly during the Manhattan Project of hollow clay tile. These facilities are particularly vulnerable to attack by hostile parties. The air space above the Y-12 plant is not restricted. The proximity of Y-12 to uncontrolled public areas offers ample opportunity for hostile attacks; from the standpoint of protection from terrorists, the facilities do not meet the minimum safeguard standards. 8/01.06.00

The facilities were also not designed for their current mission. Activities currently take place in eight buildings scattered among the dozens of buildings at Y-12 and material moves among the buildings in a modified bread delivery truck in a crazy-quilt of activity. Safety, security, and material accountability would all be strengthened if highly enriched uranium activities took place in a single facility explicitly designed for the mission it is required to perform. 9/15.00.00

In an effort to minimize the appearance of risk from natural phenomena, DOE has adopted the classification of the Nuclear Regulatory Commission and designated the Y-12 facilities "moderate hazard" facilities. This designation relaxes the requirements for resistance to tornadoes and earthquakes; it shifts the focus of building performance assessments on safety issues only and avoids addressing environmental risks and material control and accountability requirements. This approach is outlined in DOE's March, 1992, White Paper on the Hollow Clay Tile Program which states in bold print: "Some of the existing moderate-usage buildings may not meet the performance goals established by UCRL-15910, even after the contribution of infilled HCTWs is fully utilized. Therefore, an approach was developed, not necessarily to bring these buildings into full compliance with the newer requirements, but to demonstrate or establish adequacy from a safety point of view."[7] 7/02.05.05 cont.

The Oak Ridge Environmental Peace Alliance does not agree that facilities storing the nation's highly enriched uranium should only be required to meet the standards of "moderate hazard facilities" or that safety is the only peformance standard to be met. Highly enriched uranium is not reactor fuel, it is weapons-usable material. When stored 10/08.03.01

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02 05 05 **Comment Number 7**

The Y–12 EA and CRD, which are incorporated by reference, reference recent studies which provide the basis for determining the adequacy of the structural (seismic) integrity of the related Y–12 buildings and the appropriate hazard classification. The seismic study by C. A. Powell of the University of North Carolina was included as a cited reference in the Y–12 EA. Various studies have offered hypotheses regarding faulting in the eastern Tennessee seismic zone. However, there is uncertainty with respect to the faulting hypotheses and any conclusions regarding a large potential for future earthquakes compared with the historical record.

Under both No Action and the Upgrade Alternative for this PEIS, the Y–12 storage facilities would undergo the capital improvements to ensure that all HEU storage criteria are met including seismic criteria, as appropriate. The Final PEIS includes a description of the upgrades that would be made to facilities at Y–12 to accommodate the long-term storage of HEU (Section 2.3.1 and Figure 2.3.1–9) under the Upgrade Alternative (Preferred Alternative).

01 06 00 **Comment Number 8**

Should the Upgrade or No Action Alternative be selected in the ROD, implementation would include considerations to assure that all safeguards and security requirements have been met.

15 00 00 **Comment Number 9**

Comment noted.

08 03 01 **Comment Number 10**

The HEU materials for long-term storage will meet the criteria for safe storage (50 years) of HEU, similar to those for safe storage of Pu. The criteria for HEU is under development. The Y–12 facilities at ORR could be modified (including new construction) to ensure safe and secure storage of HEU, and would be supported by appropriate environmental analyses.

in the quantities planned for Oak Ridge, an earthquake or tornado exceeding the moderate hazard standard (either is fairly likely over the next fifty years) which results in the destruction of an HEU building will create profound environmental devastation and extreme worker safety risks. The destruction of an HEU processing facility in a tornado might well result in the release of HEU particulates in air which would pose unacceptable hazards to the off-site population and environment as well. The facilities in which the nation's highly enriched uranium is processed and stored must meet the most stringent structural standards in the world; anything less is unacceptable. The loss of control and accountability, release to the environment, exposure to workers and potential for exposure to the public which would result from building collapse in a tornado or earthquake may simply not be allowed to happen. 10/08.03.01 cont.

Transparency, international verification and control

The nonproliferation policy goals of the United States of America play a key role in driving the Storage and Disposition PEIS. Included in our nonproliferation policy is a commitment by the President of the United States to "Submit US fissile material no longer needed for our deterrent to inspection by the International Atomic Energy [Agency]."[4] The decisions made in the Storage and Disposition PEIS must support the US nonproliferation policy goals and, ideally, would advance those goals.

In fifty years, if the current US policy goals on nonproliferation are achieved, the vast majority (if not all) of US fissile materials will be under international control. Handling, processing, and storage will require complete transparency. This is not possible in the facilities currently being considered for long-term storage without significant and dramatic modifications. In fifty years, if the US policy on nonproliferation is in effect, fissile materials will be safeguarded while in storage and during processing. This is not possible in the facilities at Y-12 currently being considering in the Storage and Disposition PEIS for long-term storage. 11/01.06.00

The PEIS Data Report [Y/ES-043/R2] which DOE relies upon to assess the upgrades required at Y-12 dismissed the possibility of international verification from the outset and ignores transparency as a goal. The Data Report states, p.2: "...this long-term storage mission does not consider any need for an HEU inventory held under International Atomic Energy Agency (IAEA) safeguards. Therefore, this report does not include any international inspection facilities."

On page 11 the same report lists the criteria which must be met in order to achieve programmatic requirements as "full ES&H compliance, security, capability, capacity." No mention is made of transparency, nor is there any indication that the Data Report on upgrades considered the possible need for transparency at any time. Achievement of US nonproliferation policy goals will require transparency at weapons-material sites in the US as well as in other countries. This requirement must be accomodated in the plan for long-term storage; it should be a priority. 12/01.06.00

The Y-12 Data Report also presumes that the Y-12 Plant will be a "multimission" site in the year 2020 and beyond, combining a weapons production/quality assurance program with dismantlement and storage operations (p.9). The Data Report indicates these operations will take place along side one another in the same building. This is a scenario which contradicts the international treaty on the Nonproliferation of nuclear weapons (NPT), which commits the US to the pursuit of nuclear disarmament. This scenario also makes international inspection and verification virtually impossible. 13/01.06.00

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01 06 00 Comment Number 11

The United States will meet all international safeguard requirements, and, over time, make all unclassified weapons-usable fissile materials available for IAEA inspections while in storage and during processing if the material is surplus and subject to disposition. Where new facilities are required, they will be built to provide such requirements. To the extent that existing facilities are used at Y–12 or elsewhere in the DOE complex, they will be upgraded to accommodate international safeguards and inspection requirements.

01 06 00 Comment Number 12

All of the facilities and processes required for long-term storage of unclassified fissile materials and disposition of those materials declared surplus, will be designed to meet all international safeguards requirements and accommodate IAEA inspections and related transparency requirements. Classified materials will not be made available for IAEA inspections, nor will any transparency measures be implemented. However, development of technology is underway that may allow classified materials to be inspected to verify the presence and quantity of the material without divulging the classified information. If successfully developed, this technology may be implemented in the future.

01 06 00 Comment Number 13

The Storage and Disposition PEIS and the Stockpile Stewardship and Management PEIS evaluate various missions for the Y–12 site at ORR. Potential activities to be conducted at Y–12 include dismantlement of weapons components, materials storage, and materials disposition. Although the United States is reducing its weapons stockpile, it is also maintaining a portion of that stockpile and supporting operations needed to provide that maintenance capability. These activities are all consistent with domestic and international nonproliferation policies and treaties.

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The US currently has a significant quantity of HEU placed under the administrative control of the IAEA at Y-12 in Oak Ridge. This situation is a model for other nations around the world; it gives moral standing to the US call for other nations to provide international verification and control of nuclear materials. It has been cited by the Secretary of Energy as one of our proudest achievements. The Storage and Disposition PEIS should envision not a reversal of this achievement, but the further realization of the goal of international control of nuclear materials; verification and administrative control of all strategic and surplus HEU no longer in warheads by the IAEA is not only a laudable goal, it is a reasonable alternative and must be analyzed in the Storage and Disposition PEIS. 14/01.06.00

From A to C

Weapons-usable highly enriched uranium exists around the nuclear weapons complex in a variety of physical forms, as secondaries, metals, oxides, scraps, residues and, in some cases, alloyed to other materials. To transform these materials from their current status (A) to the preferred form for long-term storage (C)—metal in a hollow cylinder—a significant amount of processing (B) will be required.

Currently, DOE has no NEPA analysis of the environmental impact of the processing operations required to prepare the nation's strategic HEU for long-term storage. The Storage and Disposition PEIS presumes materials are already processed. The Data Report [Y/ES-043/R2] states, p.12: "The Disposition Program Organization assumes that all such material conversion will have been completed by the year 2020...Therefore, the Disposition PEIS does not consider the environmental impacts associated with material processing and repackaging required to render all HEU suitable for extended storage." 15/08.00.00

NEPA does not allow for the dismissal of consideration of environmental impacts by assuming they will be complete. DOE must, in some document, provide NEPA analysis of the significant waste streams and potential environmental impacts resulting from the processing and conversion of materials into the preferred long-term storage form. The Storage and Disposition PEIS is the obvious place for that analysis, and it must be included here. DOE can not leap from A to C without talking about B. 16/01.01.00

Conclusion

The buildings currently used for HEU processing and storage in Oak Ridge have outlived their design life and may not be depended upon to store HEU reliably for fifty or a hundred more years. The minimal upgrades proposed in the Storage and Disposition PEIS would ostensibly achieve a "moderate hazard" facility level of protection; this is not adequate for facilities processing and storing fissile nuclear weapons materials.

Use of current Y-12 facilities, even with upgrades, fails to achieve: 7/02.05.05 cont.

- health and safety protection of workers, the environment, or the public in the event of a design-basis tornado or earthquake
- material accountability in the event of a design basis tornado or earthquake
- safeguards of fissile weapons materials from hostile attack.
- the accomodation of international inspection, verification, or

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01 06 00 Comment Number 14

Comment noted. As stated in Section 1.3 of the PEIS, the surplus fissile materials will be subject to international inspections, including inspections by the IAEA.

08 00 00 Comment Number 15

The processing of HEU for storage is outside of the scope of the PEIS. The Y–12 EA describes the processing required for both HEU secondaries and residues and provides the related environmental analyses.

01 01 00 Comment Number 16

The PEIS identifies and analyzes the waste streams for all of the disposition alternatives. With regard to the long-term storage alternatives, the PEIS only considers storage of materials that have been stabilized and separated. The processing stabilization of materials and any supporting NEPA analysis required is included in DOE's Environmental Management Program.

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control of dismantlement, processing and storage of HEU

What appears most reasonable from this analysis is that DOE should consider building a new facility, according to modern design standards, with a design life of at least 500 years, which would incorporate safeguards and transparency requirements to meet the international standards we would like other nations to meet. 17/01.01.00

DOE does not analyze a new facility as a reasonable alternative. In the redrafted Storage and Disposition PEIS, DOE must consider reasonable alternatives to the lone "upgrade in place alternative" analyzed in the current document, including the most reasonable of all alternatives—construction of a long-term, safeguarded storage facility with built in transparency, dedicated exclusively to the dismantlement, processing and storage of highly enriched uranium in non-weapons form. 18/01.04.00

DOE must also address in the Storage and Disposition PEIS the processing which will be required to turn HEU in its current state—whether as alloys, residues, scraps, secondaries or other forms—into the form expected for long-term storage. DOE has no NEPA analysis of these operations at the present time, and it may not leap over them to a hypothetical time when they are complete. To get from A to C one must go through B, and DOE must analyze that step in the Storage and Disposition PEIS. 19/01.01.00

Notes.

[1] The Finding of No Significant Impact for the Interim Storage of Enriched Uranium Above the Maximum Historical Level at the Y-12 Plant in Oak Ridge, Tennessee [DOE/EA-0929, September 1994] states: "The Environmental Assessment (EA) evaluates the environmental effects of transportation, prestorage processing, and interim storage of bounding quantities of enriched uranium at the Y-12 Plant over a ten-year period."

[2] Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, *Comments on: Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Level at the Y-12 Plant in Oak Ridge, Tennessee*, December 8, 1994, p.4, comment #9 and p.6, comment #15, which states: "Of facilities listed in this EA (section 3.2) to be used for storage, none currently pass natural phenomena hazard assessments (appendix G)."

[3] Letter from Victor Reis to Ralph Hutchison, coordinator of the Oak Ridge Environmental Peace Alliance, August 28, 1995.

[4] *A Seismotectonic Model for the 300-Kilometer-Long Eastern Tennessee Seismic Zone*, Christine A. Powell, et. al., SCIENCE, Vol. 264, 29 April 1994, pp. 686ff. The article states: "The model indicates that the potential for a large, damaging earthquake in the East Tennessee Seismic Zone may be higher than the available historical record suggests."

[5] *Making Old Buildings Meet New Standards*, Y/EN-4665, D.R. Denton, et.al., August 1992, p.1.

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01 01 00 **Comment Number 17**

Comment noted.

01 04 00 **Comment Number 18**

The construction of new facilities for HEU and Pu storage is covered by the Collocation Alternative. Stabilization and storage of non-weapons-usable HEU are the subjects of other environmental documents and are beyond the scope of this PEIS.

01 01 00 **Comment Number 19**

As described in Chapter 1 of the PEIS, DOE has an ongoing program to stabilize miscellaneous uranium materials. The Y-12 EA describes the processing required for both HEU secondaries and residues and provides the related environmental analyses. This PEIS addresses separated stabilized materials.

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[6] DOE Order 5480.28 requires all facilities must maintain structural integrity to prevent loss of capability to perform functions consistent with their programmatic mission.

[7] *White Paper on the Hollow Clay Tile Wall Program*, Y/EN-4671, Center for Natural Phenomena Engineering, March 1992, p.3.

[8] *Nonproliferation and Export Control Policy Fact Sheet*, The White House, Office of the Press Secretary, September 27, 1993. This document is provided in Appendix A.1 of the Storage and Disposition PEIS.

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Appendix A

An Evaluation of the Seismic Tolerances of Y-12 Uranium Facilities

The EA on interim storage evaluates facilities for EU processing and storage over an "interim" period of 10+ years.

Assumption:
A significant earthquake is possible in Oak Ridge within the next ten years.

Basis:
Science magazine, April 20, 1994, published an article which reported that East Tennessee had the second highest release of seismic strain energy in the US in the last ten years (New Madrid was highest). The authors, from UNC-Chapel Hill concluded "our model indicates the potential for a larger, damaging earthquake in the East Tennessee Seismic Zone may be higher than the available historical record suggests."

Current information on the buildings at Y-12 is available from two sources.

The Environmental Assessment, conducted in 1994, references UCRL-15910, as interpreted by Benedict (1993) in an in-house memo, which says the earthquake load was evaluated according to its ability to withstand ground motion at .18g. The figure was revised in April 1994 to .19g.

The US Department of Energy Defense Programs Safety Survey Report (Volume III: Appendix B, Uranium Facilities, prepared in November 1993 by SAIC for DOE, also references UCRL-15910, and notes "the earthquake specified in UCRL 15910 for design of high hazard facilities...for the Oak Ridge area, the event has a peak horizontal ground acceleration of .32g.

Horizontal Ground Acceleration in minimum seismic event according to UCRL - 15910

Environmental Assessment	*Safety Survey*
.19g	.32g

The application of these different numbers to each building results in widely

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divergent findings of seismic integrity. These buildings are listed in the EA as those involved in the handling, processing or storage of enriched uranium. Appendix G of the EA examines the seismic tolerance of the buildings. The table which follows offers a comparison of the results of the different standards.

Comparison of seismic tolerances of Enriched Uranium Facilities at Oak Ridge Y-12 Plant

Building	EA	SS
9204	does not meet requirements concrete reinforcement required	not included
9204-2E	met target, some reinforcement required	not included
9204-4	not included in App G	does not meet DOE design criteria total collapse at .095 - .17*g*
9206	not included in App G	total collapse at .32*g*
9212	meets "intent" of DOE STD 1020-94 provided modifications are made. Some wings do not meet seismic requirements	can withstand .12*g* 100% failure at .30*g* collapse at .32*g*
9215/9998	generally sound, some welding required	would withstand .32*g* sprinkler system not seismically qualified
9720-5	not included in App G	vaults would withstand .40*g*; other areas, including HFIR fuel rod storage would not withstand .32 *g*

Buildings 9201-5N , 9201-5W, and 9995 are included in Appendix G of the EA though they are not listed as buildings active in enriched uranium operations in the text of the document.

Total collapse of buildings would result in worker injury and death, loss of control of special nuclear material, release of some quantities of HEU and other contaminants into the atmosphere, and pose clean-up challenges that are difficult to contemplate.

From the perspective of DOE's mission (dismantlement of nuclear weapons and secure storage of HEU for the next 10-30 years) it seems these buildings hardly qualify as "reliable."

It should be further noted that all facilities are above-ground facilities; such facilities are not considered completely safeguarded as they are vulnerable to attack from the air. This is true of Oak Ridge's facilities; air space above the Oak Ridge Reservation is not restricted from routine aviation traffic.

SUMMARY

The Department of Energy's Safety Survey Guidance indicates that key facilitites engaged in the handling, processing and storage of HEU would be expected to experience total collapse in an earthquake of the magnitude the regulations assume for the Oak Ridge region (.32g peak ground acceleration).

Total collapse of buildings would result in worker injury and death, loss of control of special nuclear material, release of some quantities of HEU and other contaminants into the atmosphere, and pose clean-up challenges that are difficult to contemplate.

Earthquakes are a distinct possibility in Oak Ridge, as the East Tennessee Seismic Zone, which includes Oak Ridge, has been determined to be the region of second highest release of seismic strain energy in the last decade. Researchers at UNC-Chapel Hill also determined that the potential for a large, damaging earthquake is greater than was previously thought.

All evidence suggests that the buildings designed and built in the 1940's of hollow, unreinforced clay tile, are not reliable for the critical mission of dismantlement, processing and secure storage of highly enriched uranium for the next 10-30 years.

RECOMMENDATION

DOE should address these problems immediately. DOE should report in an Environmental Impact Statement on the potential for modification of buildings to meet the Safety Survey design criteria rather than the more relaxed standards established in-house in Oak Ridge in 1993. The potential for achieving this level of

OAK RIDGE ENVIRONMENTAL PEACE ALLIANCE, OAK RIDGE, TN, RALPH HUTCHISON
PAGE 14 OF 14

building integrity and its cost should be measured against the cost and benefits of a new facility, designed especially for the dismantlement, processing and storage of HEU.

A new facility should be given serious consideration. A new facility, designed to today's standards, which could accomodate verification requirements, which would offer greater protection to workers, the public and the environment, which would include adequate waste management facilities, would be preferable to the current conditions in which outdated, substandard and unreliable buildings which were designed for a different mission are pressed in a piecemeal fashion into service in a new mission.

M-277

OAK RIDGE RESERVATION LOCAL OVERSIGHT COMMITTEE, OAK RIDGE, TN, AMY S. FITZGERALD
PAGE 1 OF 4

LOC INC
Oak Ridge Reservation
Local Oversight Committee

May 2, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

RE: STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT, (DOE/EIS-0229-D, FEBRUARY 1996)

The Oak Ridge Reservation Local Oversight Committee, Inc. (LOC) has reviewed the above-referenced document, and submits the following comments and recommendations:

General Comments:

1. Local governments and citizens have been overwhelmed by DOE's timing in releasing major National Environmental Policy Act documents. While the agency may save money by holding multiple hearings in two days, cost savings do not outweigh the negative aspects of a concurrent process. — 1/08.02.00

2. The Oak Ridge Reservation locations chosen for long-term storage alternatives (Figure 2.3-5, p. 2-38) and for the disposition of plutonium (Figure 2.4-5, p. 2-81) are extremely poor choices; these sites should be removed from consideration. Other potential sites should be thoroughly analyzed to assure the public that proposed sites are suitable. — 2/01.04.00

3. Figure S-15, on page S-37, is missing the Electrometallurgical Treatment Alternative. — 3/16.00.00

Preferred Alternatives:

1. The statement on p. 2-258 is of great concern: "At the present time, the Department does not have sufficient information upon which to select a preferred alternative. The Final PEIS will contain a preferred alternative." If the DOE does not have sufficient information to make a decision, it is premature for the agency to issue a final PEIS or ROD. It is unreasonable to expect the public to make informed judgements, given that the comment period and information was insufficient, and that the agency was not able to identify preferred alternatives. — 4/08.03.00

2. The Upgrades at Multiple Sites Alternative for Long-Term Storage appears to be the most viable option. A more thorough analysis of potential environmental impacts at the Pantex Site on the Ogalalla acquifer, however, is essential. Consolidation of some of the material at the Nevada Test Site's P-Tunnel may be feasible, and may enable inclusion of the Rocky Flats material. — 5/08.03.01, 6/08.03.01

3. The LOC is unequivocally opposed to the co-location of plutonium and highly enriched — 7/08.03.01

Anderson • Meigs • Rhea • Roane • City of Oak Ridge • Knox • Loudon

136 S. Illinois Avenue, Suite 208 • Oak Ridge, Tennessee 37830 • Phone (615) 483-1333 • Fax (615) 482-6572

M-131

08 02 00 Comment Number 1

The Department of Energy acknowledges the commentor's concern about the integration of public meetings on draft EISs. The joint meetings on the Storage and Disposition PEIS, the Stockpile Stewardship and Management PEIS, and the Pantex EIS were held using an integrated format at the request of several organizations and citizen advisory boards. They stated that such meetings "would be more convenient and provide a less confusing format for public participants. It would avoid duplication, permit a much more efficient use of the public's time and allow a more-informed decision about the issues."

01 04 00 Comment Number 2

Consistent with NEPA, DOE evaluated ORR as well as a range of other reasonable sites for storage and disposition of weapons-usable fissile materials.

16 00 00 Comment Number 3

The Electrometallurgical Treatment Alternative was mistakenly left out of Figure S–15 in the Draft PEIS Summary. Based on comments received, the bar charts have been deleted for the Final PEIS Summary.

08 03 00 Comment Number 4

Between the issuance of the Draft and Final PEIS, DOE has obtained information from a variety of sources. One of those sources of information was the public. Public input was used to determine the Preferred Alternative for the Final PEIS.

08 03 01 Comment Number 5

The Department of Energy acknowledges the commentor's support for the Upgrade Storage Alternative. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

OAK RIDGE RESERVATION LOCAL OVERSIGHT COMMITTEE, OAK RIDGE, TN, AMY S. FITZGERALD
PAGE 2 OF 4

uranium. The Oak Ridge site has considerable expertise in the handling of HEU; long-term storage should be performed, with appropriate safeguards and upgrades, at Y-12. Other sites with expertise in the handling of plutonium should continue with that work. The two functions should not be co-mingled at any site. | 7/08.03.01 cont.

4. The selection of a preferred alternative for disposition of plutonium is problematic at this time; the DOE should seriously consider separating disposition from the process--as was done with the Disposition of HEU--in order to reach a timely decision on Long-Term Storage. | 8/01.00.00

Discussion of Disposition Alternatives

1. No Action would, in effect, make long-term monitored storage indefinite. However, given current uncertainties associated with disposition alternatives, it may be more cost effective to continue safe, secure storage until more studied options are presented. The recently issued Rocky Flats Cleanup Agreement includes provisions for temporary, on-site storage pending shipment off-site, long-term storage which allows for retrieval and monitoring, and permanent on-site disposal. The goal is to have plutonium removed from the site, beginning no later than 2010. The final PEIS should incorporate provisions of the Rocky Flats agreement. | 9/08.03.01

2. The Deep Borehole alternative needs additional analysis on geological consequences; site characterization would have to precede a decision, as western locations would perform differently from sites in proximity to ground and surface water. Immobilized Disposition may be a viable alternative, but not enough is currently known for DOE to make a decision by late 1996. Further development is necessary. | 10/08.03.00

3. Immobilization, especially Electrometallurgical Treatment, appears promising, but creates high-level waste. High-level waste has not yet been addressed (it was outside the scope of the Waste Management PEIS). Therefore, the option does not appear viable at this time. | 11/05.03.08

4. Reactor options in the U.S. are not politically acceptable at this time. This situation may change, as global impacts of fossil fuel usage become better understood by the U.S. public. Reactor options are not currently economically viable either; the blending of HEU will provide domestic reactors with ample fuel in the near term. The DOE should continue exploring the CANDU Reactor, and possibly other foreign plutonium reactor options. | 12/08.03.01

Thank you for the opportunity to comment on these important issues.

Sincerely,

Amy S. Fitzgerald

Amy S. Fitzgerald, Ph.D.
Executive Director

cc: Earl Leming, Manager, TDEC DOE-Oversight Division
Jim Hall, Manager, Oak Ridge Operations Office

M-131

08 03 01 Comment Number 6

The Department of Energy acknowledges the commentor's support for new missions at NTS. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 7

The Department of Energy acknowledges the commentor's opposition to the Collocation Alternative. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 00 00 Comment Number 8

Separating the storage decision from the disposition decision would not effectively meet the purpose of and need for the Proposed Action. Planning for storage of the surplus Pu pending disposition is closely related to the planning for disposition itself, and could be affected by the technology(ies) selected to implement the Proposed Action. DOE is confident that a decision can be made on the disposition technology(ies) at the ROD, based on available data and environmental, technical, cost, schedule, and nonproliferation assessments completed to date.

08 03 01 Comment Number 9

Comment noted. The Final PEIS includes consideration of various agreements DOE has with external organizations, including the *Rocky Flats Cleanup Agreement*. These agreements will be integrated in DOE's decisionmaking process, as appropriate, for fissile materials storage and disposition.

OAK RIDGE RESERVATION LOCAL OVERSIGHT COMMITTEE, OAK RIDGE, TN, AMY S. FITZGERALD
PAGE 3 OF 4

RESOLUTION NUMBER 96-3

WHEREAS, the Oak Ridge Reservation Local Oversight Committee (LOC), being comprised of elected officials and citizen representatives of Anderson, Knox, Loudon, Meigs, Rhea, and Roane Counties and the City of Oak Ridge, was created to provide local input into decisions affecting the continued operation of the U.S. Department of Energy's (DOE) Oak Ridge Reservation; and

WHEREAS, thousands of U.S. and Russian nuclear weapons are slated to be retired within the next decade, resulting in excess weapons-grade fissile materials; and

WHEREAS, the improper management of fissile materials constitutes a threat to national and international security; and

WHEREAS, the DOE has issued the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) which addresses activities that would result in the storage of weapons-usable plutonium and highly enriched uranium, and the disposition of surplus weapons-usable plutonium; and

WHEREAS, the DOE has simultaneously issued the Draft PEIS for Stockpile Stewardship and Management which recommends a technical program for maintaining the safety and reliability of the nuclear stockpile; and

WHEREAS, the DOE unduly restricted local government and public involvement on these important topics by issuing the documents at the same time and by holding concurrent public hearings in Oak Ridge; and

WHEREAS, the DOE has not developed a preferred alternative for either long-term storage or disposition of plutonium or long-term storage of highly enriched uranium; and

WHEREAS, employees at the Oak Ridge Y-12 facility are uniquely experienced in the safe and secure long-term storage of highly enriched uranium; and

WHEREAS, the proposed sites for co-location of plutonium and highly enriched uranium, and for disposition of plutonium on the Oak Ridge Reservation are technically unsuitable, and would conflict with economic diversification initiatives; and

WHEREAS, the National Academy of Sciences has concluded that none of the current options for long-term disposition of excess weapons plutonium can be expected to substantially reduce the inventories of excess plutonium from nuclear weapons for at least a decade; and

M-131

08 03 00 **Comment Number 10**

The Department of Energy acknowledges the commentor's support for additional research and development before decisions are made on the Borehole and Immobilization Alternatives.

05 03 08 **Comment Number 11**

As noted in Appendix H of the Draft PEIS, DOE is addressing how the immobilized forms would perform in a high-level waste repository compared to those forms currently being evaluated for disposal in a licensed repository.

08 03 01 **Comment Number 12**

The Department of Energy acknowledges the commentor's support for the CANDU Reactor Alternative. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

OAK RIDGE RESERVATION LOCAL OVERSIGHT COMMITTEE, OAK RIDGE, TN, AMY S. FITZGERALD
PAGE 4 OF 4

WHEREAS, the citizens of LOC jurisdictions are entitled to assurances that the environmental and socioeconomic impacts associated with DOE's proposed alternatives are systematically evaluated; therefore, be it

RESOLVED that the Board of Directors of this Committee recommend that DOE implement the Upgrade Alternative for the storage of highly enriched uranium and the Upgrade at Multiple Sites Alternative for the long-term storage of plutonium, with some consolidation of materials where feasible; and be it further

RESOLVED that this Board of Directors urges the DOE to implement a modified No Action alternative for the disposition of plutonium, to include secure, above ground storage coupled with international inspections, until such time that more technically sound, economically viable, and politically acceptable options for long-term disposition are identified; and be it further

RESOLVED, that this resolution and attached comments shall be submitted to the U.S. Department of Energy for consideration in its preparation of the Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement, and that the Executive Director send a copy of this resolution to the Tennessee Congressional delegation and other relevant federal and state officials.

This, the 2nd day of May 1996.

Edmund A. Nephew

Edmund A. Nephew, Chairman
Board of Directors
Oak Ridge Reservation Local Oversight Committee

Amy S. Fitzgerald

Amy S. Fitzgerald, Ph.D.
Executive Director

M-131

OIL, CHEMICAL, & ATOMIC WORKERS INTERNATIONAL UNION, RICHLAND, WA, JIM L. WATTS
PAGE 1 OF 2

DEPARTMENT OF ENERGY PLUTONIUM BURN HEARING

MEMBERS OF THE PANEL:

I'M JIM WATTS, I'M PRESIDENT OF THE OIL, CHEMICAL AND ATOMIC WORKERS UNION, LOCAL 1-369 AND ITS DISTRICT #1, COVERING NINE WESTERN STATES. I'M ALSO THE LABOR REPRESENTATIVE FOR THE HANFORD ATOMIC METAL TRADES COUNCIL ON THE HANFORD ADVISORY BOARD. THE HANFORD ATOMIC METAL TRADES COUNCIL IS THE GOVERNING BODY OF FOURTEEN AFFILIATE UNIONS THAT REPRESENT WORKERS ON THE HANFORD PROJECT. WE REPRESENT A HANFORD WORK FORCE OF OVER 3000 MEMBERS AND A NATIONAL MEMBERSHIP OF FOUR MILLION MEMBERS.

I APPEAR IN SUPPORT OF THE NATIONAL ACADEMY OF SCIENCES RECOMMENDATION TO BURN PLUTONIUM. LABOR HAS A NUMBER OF REASONS FOR SUPPORTING THIS OPTION AND IF ITS THE OPTION THAT'S PICKED, WE BELIEVE THAT BOTH THE FUEL FABRICATION AND THE BURN SHOULD OCCUR HERE. OUR RATIONAL FOR THIS BELIEVE IS BASED ON SOME OF THE FOLLOWING REASONS. 1/08.03.01

WE BELIEVE ITS IN THE NATIONAL INTEREST TO ELIMINATE THE WEAPONS GRADE PLUTONIUM RELEASED BY THE START AGREEMENTS. IN TODAY'S COST CONSCIOUS WORLD, WE THINK THE SENSIBLE THING TO DO IS CONVERT IT TO ENERGY BY BURNING IT IN REACTORS. THE HANFORD AREA IS UNIQUELY SUITED TO DO THIS FOR A NUMBER OF REASONS. WE CURRENTLY HAVE TWO MACHINES THAT HAVE THE ABILITY TO DO THE BURN (FFTF AND WNP-2) AND ANOTHER THAT COULD BE COMPLETED TO DO THE JOB (WNP-1). WE ALSO HAVE A BRAND NEW, NEVER USED, 750 MILLION DOLLAR FUEL FACILITY (FMEF). THUS, WE HAVE SEVERAL BILLION DOLLARS WORTH OF TRIED AND TESTED EQUIPMENT TO DO THE JOB WITHOUT THE DEPARTMENT OF ENERGY GOING THROUGH THE EXPENSE OF DOING BURN, OR ONE OF THE ALTERNATIVES, AT A TIME WHEN BUDGET DOLLARS ARE SHORT.

IN ADDITION TO THE EQUIPMENT TO DO THE JOB, WE ALSO HAVE THE EXPERTISE. WE HAVE SIEMANS WITH THE ABILITY TO MANUFACTURE THE FUEL. WE HAVE SANDVIK SPECIAL METALS TO MANUFACTURE THE TUBING TO HOUSE THE FUEL AND WE HAVE A DEDICATED WORK FORCE WITH THE EXPERTISE TO DO THE WORK AND SAFELY HANDLE THE WASTE. WE ALSO HAVE A COMMUNITY WHO ACCEPTS THIS TYPE OF WORK AND THE RESPONSIBILITY THAT GOES WITH IT.

WA-022

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for new missions at Hanford. Decisions on storage and disposition of weapon-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

OIL, CHEMICAL, & ATOMIC WORKERS INTERNATIONAL UNION, RICHLAND, WA, JIM L. WATTS
PAGE 2 OF 2

WE HAVE NOTICED THAT THERE HAS BEEN AN INCREASED ACCEPTANCE FOR THIS MISSION STATEWIDE. THE GOVERNOR HAS EXPRESSED HIS WILLINGNESS TO ALLOW BURN TO GO FORWARD UNDER CERTAIN CONDITIONS. A NUMBER OF ENVIRONMENTAL GROUPS, EAGER TO DISPOSE OF PLUTONIUM IN ITS WEAPONS GRADE FORM, HAVE EXPRESSED RESERVED SUPPORT FOR BURN PROVIDED THAT THE RESULTING WASTE FROM SUCH A PROCESS DOESN'T FIND A PERMANENT RESIDENCE AT HANFORD. THEREFORE, LET ME SUMMARIZE LABOR'S POSITION AS FOLLOWS:

1. WE SHOULD DO THE BURN OPTION, AND DO IT AT HANFORD, MAXIMIZING THE POTENTIAL OF OUR EXISTING AND POTENTIAL EQUIPMENT AND THE EXPERTISE OF OUR WORK FORCE.

2. WE SHOULD MANUFACTURE THE FUEL USING THE FMEF FACILITY. IN FACT, IF THE BURN IS NOT DONE HERE, THE FUEL MANUFACTURE SHOULD BE DONE HERE IN ANY CASE.

3. THE RESIDUAL WASTE AND ALL MATERIAL SHOULD ONLY RESIDE AT HANFORD IN TEMPORARY STORAGE.

4. BECAUSE THE STATE AND THE COMMUNITY ARE WILLING TO PERFORM THIS NATIONAL SERVICE, HANFORD WASTE SHOULD HAVE A PRIORITY STATUS FOR OFF-SITE STORAGE.

1/08.03.01
cont.

THANK YOU FOR THE OPPORTUNITY TO PRESENT OUR VIEWS.

OIL, CHEMICAL & ATOMIC WORKERS
INTERNATIONAL UNION, LOCAL 1-369
BOX 524
RICHLAND, WASHINGTON 99352

JIM L. WATTS,
PRESIDENT

WA-022

Comment ID: P0013
Date Received: April 18, 1996
Name: D. Olson
Address: Victor [ID]

Transcription:

I would like to not see any of that plutonium come here. That's all. Bye. | 1/08.03.01

P-013

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at INEL. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Comment ID: P0014
Date Received: April 18, 1996
Name: Kim Olson
Address: Victor, ID

Transcription:

I vote no to any more nuclear waste of any kind in Idaho. That's all. Thanks. | 1/08.03.01

P-014

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at INEL. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Operation Commonsense

April 22, 1996
DOE Hearing

THE LESSONS OF HISTORY

Five years ago the business community rallied for an event that was to hail a revival for the business fortunes of the Texas Panhandle. Hundreds of supporters and advocates of an enlarged Pantex paraded to the Civic Center, where boosters promised the crowd an expanded Pantex plant and 10,000 to 15,000 new jobs.

Local newspapers heralded the event as a spearhead for an economic renaissance and noted the unqualified and total support from the community. As details of the expanded operations were disclosed, a more sober appraisal revealed that some of the missions might be less than desirable and others far too risky for reasonable people, concerned with the area's long term best interest, to consider. Now after five years we know that not only did 10,000 jobs never materialize, no new jobs materialized and in fact Pantex has announced a cut back in jobs beginning in 1998. Wisely, the community decided not to tie its future to Pantex and now our economy is reponding nicely and there is every reason to believe this economic progress will continue.

Today this community is a better more informed community. Despite hundred of thousands of dollars spent by the city on a public relations campaign intended to scare residents into unconditional support for Pantex, citizens have developed a more cautionary approach, recognizing the important differences and distinctions in various missions considered for the plant. The often repeated scare tactics warning that Pantex is closing and Amarillo will quickly be a ghost town fall are no longer working and reasonable people have decided that some work at Pantex is fine and other work, like plutonium reprocessing, is unacceptable.

The day is gone when issues surrounding Pantex fit neatly into simplistic categories of "for Pantex or against it". Most of us support Pantex. The issues today surrounding future missions at Pantex are multi-layered issues often requiring technical, scientific and public policy inputs. While generally the local community supports disassembly and interim storage, the public is more ambivalent towards longer term storage and high explosive burning, and a clear majority are flat against plutonium reprocessing.

Plutonium processing has a long and troubled history in this country. The Scientific American Magazine, in the current month's issue, reports that Hanford Washington, only one site where processing took place, has spent $9 billion dollars thus far on cleanup and will spend one billion dollars per year for the next 40 years on additional cleanup work. The job currently employs 14,000 workers and is the largest civilian project in our country's history with cleanup representing more than one third of the DOE budget. Whether it is Rocky Flats

Box 9618 Amarillo, Texas 79105 – Phone 806-372-3877 Ext: 104 – Fax 345-7266
Internet Address: who@tbp.com

1/08.03.01

TX-062

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

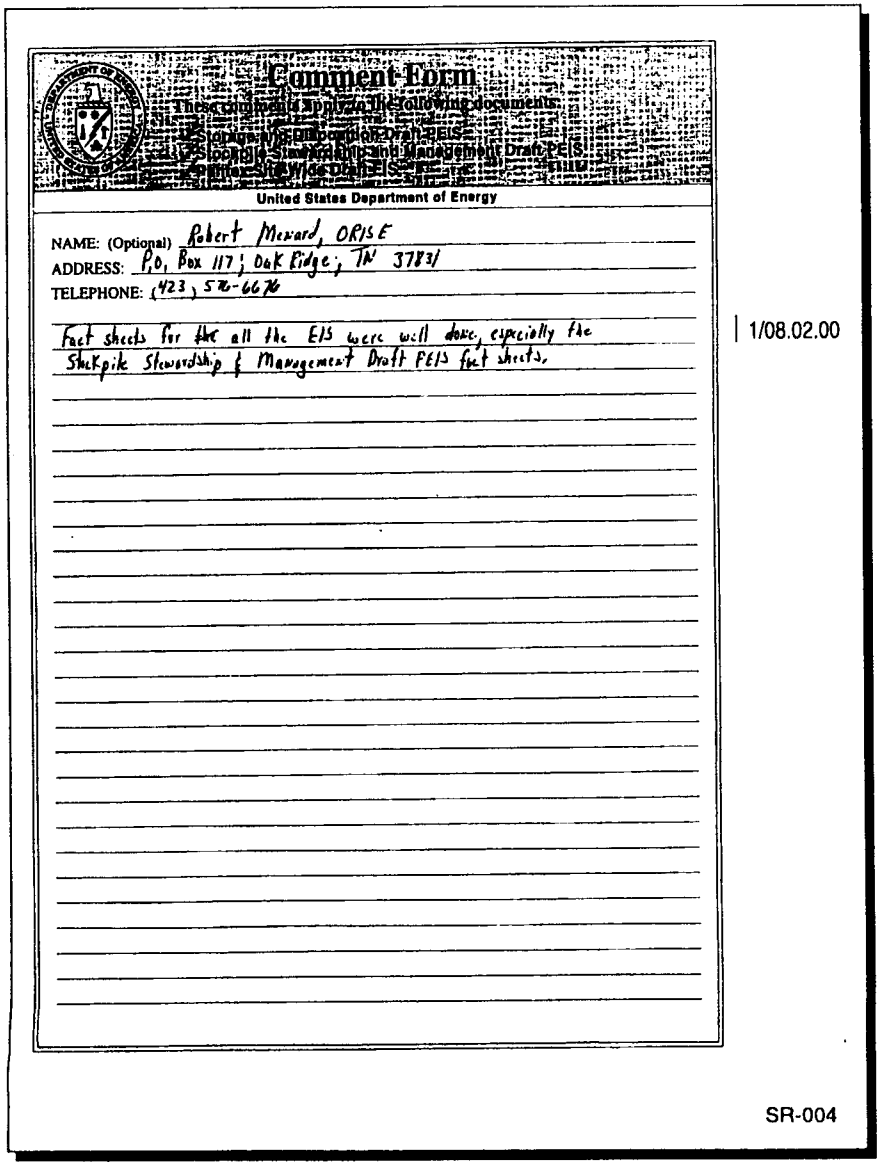
or Hansford the story is always the same – total contamination of the sites and surrounding areas including damage to people, water, air and land. DOE call these areas "national sacrifice areas". We don't want to become a national sacrifice area.

The message here is simple. People are not prepared to sign off on a "anything goes" mentality. We are certainly not ready to be the national guinea pig for untested plutonium reprocessing technologies that have contaminated every site in the country and now require billions of dollars a year to restore and will continue to do so over the next few decades. We are not ready to sacrifice our quality of life, our agricultural assets, and our safety for a short term economic boost.

1/08.03.01 cont.

TX-062

ORISE, OAK RIDGE, TN,
ROBERT MENARD
PAGE 1 OF 1



Comment Form

These comments apply to the following documents:

- Storage and Disposition Draft PEIS
- Stockpile Stewardship and Management Draft PEIS
- Pantex Site Wide Draft EIS

United States Department of Energy

NAME: (Optional) Robert Menard, ORISE
ADDRESS: P.O. Box 117; Oak Ridge, TN 37831
TELEPHONE: (423) 576-6676

Fact sheets for the all the EIS were well done, especially the Stockpile Stewardship & Management Draft PEIS fact sheets. | 1/08.02.00

SR-004

08 02 00 **Comment Number 1**

Comment noted.

OSBORNE, JERI, AMARILLO, TX
PAGE 1 OF 3

COMMENTS REGARDING PANTEX HEARINGS

AMARILLO, TEXAS: APRIL 22, 1996 by JERI OSBORNE

I am Jeri Osborne. My husband Jim and I live and farm across FM 293 on the northside, downwind and downstream from the Pantex site. We raised our family of three children, one nephew, and kept another nephew and neice a good part of their lives on the farm. Jim and his brother and sisters were also raised there. His father bought the place in 1927.

I have come to speak on health and safety issues as well as the feasibility of having plutonium, other nuclear materials, and other types of hazardous materials and chemicals in our front yard as well as over the areas major water supply and in this very productive and vital agricultural area--major food source -- for the nation as well as the world just for Amarillo's "powers that be" to possibly create a few more jobs and wealth for themselves.

At this time, there are no known results of long term health exposures to the effects of whatever is the present mission of Pantex --let alone future missions that may result from DOE's new plan. The technology is just not available at this time to perform many of the proposed missions. DOE does not now know what to do with surplus and weapon grade plutonium and other nuclear materials. How can they be so sure of the consequences of future missions that may be brought to the site?

1/01.05.00

TX-064

01 05 00 **Comment Number 1**

All technologies described in the PEIS are either proven, existing, or are being demonstrated at this time. DOE has eliminated the immature technologies during the screening process to ensure that all the reasonable alternatives analyzed in the PEIS would be ready for implementation as planned. Alternatives selected will be implemented in compliance with all environmental, health, and safety standards and requirements, and will not result in long-term health exposures.

Pantex is probably cleaner than other DOE sites, but it is on the superfund list. It may be safer than other sites, but we can prove that accidents -- at least I hope the incidents that have affected us personally were accidents --have happened that has endangered our property as well as our personal safety and others in the neighborhood of Pantex. There have been numerous major fires on the site, three or four within the past two years. We took cold drinks and ice to the firemen on various occasions. We have had cast steel shrapnel chunked at us. We have picked up some 300 to 400 pounds of a naval breech block -- one piece weighing 59 pounds. Some of this shrapnel was found some one and one-half to two miles from where it was exploded. We have had tractor tires ruined from it.

2/09.09.04

Through the years, we have had windows broken, pictures knocked off walls, etc. On October 4, 1995, a very large charge of explosive was set off to signal the start of an emergency management drill. This "test" broke our house, cracked the slab, rafters, walls, brick, shower, plumbing causing flooding of the basement, and other damages resulting in some $30,000 in repairs and replacement of carpets and other floor coverings, rebuilding the shower, cracks, etc. We also must have the house leveled. This incident was not only very frightening and dangerous, but has caused us much anxiety and inconvience. Trying to put up family for my mother's death and funeral and having family in for Christmas with a flooded basement, large holes drilled through the living room floor and in other areas of the house causes a great deal of stress to say the least.

TX-064

09 09 04 Comment Number 2

The Department of Energy is committed to conducting operations at Pantex and all other facilities in a manner that is in strict compliance with DOE Orders and applicable regulations to protect the environment, health, and safety of workers and the public. Section 3.5.9 of the PEIS discusses a number of related topics including human health effects studies for communities surrounding Pantex, the accident history related to the actions of this PEIS, and the Emergency Management Program that would be activated in the event of an accident. The impacts to the public of normal operations and potential accidents are presented in Chapter 4 and Appendix M, respectively.

OSBORNE, JERI, AMARILLO, TX
PAGE 3 OF 3

Too many questions are yet unanswered by the studies that have been conducted. Granted, it would be impossible to anticipate all potential problems that may arise, but there does seem to be a lack of scientific research used for the study. It would appear that a conclusion has been drawn and figures to support that conclusion were used without any real scientific information. 3/08.00.00

One must question the credibility of those responsible for the documents and the realibility of the studies when such glaring inaccurate information can be found within the documents. One example of this is found in Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement, Volume II, Pages 4-796 and 4-797 clearly show the town of Canyon outside the 80 kilometers radius and located within Deaf Smith County just north of Castro County. The population distribution map should show Canyon to be just south of Amarillo in Randall County, perhaps some 40 kilometers from Pantex. at the most. 4/09.00.08

We do not see the location of long term storage of nuclear materials, the possibility of processing /reprocessing, modification of pits, or the location of nuclear reactors at Pantex very good ideas. Nor do we believe the moving of all the high explosive activities to Pantex in our best interests. The DOE has sites that are much larger and much farther away from population, agricultural areas, and major sources of water for its future missions than is Pantex. 5/08.03.01

Thank you.

TX-064

08 00 00 **Comment Number 3**

The Department of Energy is required to present comparable information on each of the alternatives to which that information is available. The level of technical information available is the least for the Borehole Alternatives, highest for the Reactor Alternatives, with Immobilization Alternatives falling in between these two categories.

In separate studies, DOE has prepared Technical Summary Reports that use the best available technical data to provide the public with additional technical cost and schedule information on each of the alternatives.

09 00 08 **Comment Number 4**

The maps located in all sections of the PEIS, including the Environmental Justice section, were reviewed and updated, as necessary, prior to the publication of the Final PEIS.

08 03 01 **Comment Number 5**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

COMMENTS REGARDING PANTEX HEARINGS

AMARILLO, TEXAS, APRIL 22, 1996 by JIM OSBORNE

I am Jim Osborne and I farm across the road north from Pantex. We don't have enough water.

Amarillo dried up our domestic well ten days after they started pumping a well across the fence from us in 1965. Since then, we have lost 125 feet of water from static level. Most of Amarillo's, wells all located within a five mile radius of Pantex, two of which are within one-half mile of the north boundary, won't pump but one-half what they did earlier.

Pantex's wells are pumping only one-half the water they did at one time. 1/08.03.01

We don't have enough water for reprocessing. We don't have enough water for nuclear reactors.

According to an enclosure with the water bills a couple of years ago, Amarillo set a new one day record on June 26, 1994, for one day's pumping of 92 million gallons. They have pumped one and one-half times their allowable for at least the last six years. They have a variance from Panhandle Ground Water Conservation District if they would develope other sources of water. Amarillo, Southwestern Public Service and the Canadian River Water Authority have been swapping water rights to land that doesn't have enough water to justify development. I've heard that Amarillo drilled 10 test holes in

TX-059

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

OSBORNE, JIM, AMARILLO, TX
PAGE 2 OF 2

northeastern Potter County and the best test they had was 320 gallons per minute. So they didn't develope that field. I have heard a rancher say he couldn't even get good livestock water in places.

Amarillo is not worried about contamination of the Ogallala aquifer! They are going to dry up their well field here in Carson County north of Pantex before it becomes contaminated.

I understand the city is refurbishing old wells in the field southwest of Amarillo that they already pumped almost dry and abandoned 25 years ago. They won't pump much water from those wells. They are already talking water use restrictions for the city for this summer. They should practice good water conservation anyway. 2/09.04.04

From where will Pantex import water and at what cost for plutonium processing/reprocessing or for cooling nuclear generators?

I understand that a property owner may sue a government entity or entities for devaluating the land more that 25%. Our land has certainly been devaluated more than that.

If it takes 10 to 15 years to get a reactor into production and the expected life of that reactor is about 40 years, from where is the water coming at at what cost? 2/09.04.04 cont.

I find a tremendous descrepancy in the groundwater withdrawal stated in Volumn II of Storage and Disposition. It stated the facility currently use is 836 million liters (221 million galons per year) when Amarillo set a new record for one day's pumping of 92 million gallons in one day, June 26, 1994.

We just don't have enough water for any new DOE projects.

TX-059

09 04 04 Comment Number 2

It is possible that treated wastewater from the City of Amarillo could be used to supply the Evolutionary LWR (Section 4.3.5.4.4). Cost issues are not within the scope of this PEIS. In this case, there would be no additional impacts over the No Action Alternative to groundwater resources. Environmental impacts from siting an Evolutionary LWR at Pantex would be evaluated in future site-specific reviews, as required, if this technology is chosen as a disposition alternative.

In regards to groundwater withdrawals, Pantex groundwater withdrawals are much less than those from the City of Amarillo well field. The quantities given for Pantex are accurate.

For all new construction, Pantex will comply with Executive Order 12902, *Energy Efficiency and Water Conservation at Federal Facilities* for water conservation.

OUD, ALORA, RUPPEE, ID
PAGE 1 OF 1

Comment ID: P0012
Date Received: April 18, 1996
Name: Alora Oud
Address: Ruppee, ID

Transcription:

This is Alora Oud at 208-745-6038. My husband and I are not in favor of bringing plutonium grade material to the INEL. Due to, we don't believe it's as safe as they try to make us believe. Thank you. | 1/08.03.01

P-012

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at INEL. Decisions on the storage and disposition of weapons-usable fissile materials [illegible] based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

OVERSBY, VIRGINIA M., LIVERMORE, CA
PAGE 1 OF 1

April 4, 1996

U. S. Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
Washington, D. C. 20026-3786

Subject: Comments on the *Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.*

The Draft PEIS includes several options for burning of plutonium in mixed uranium-plutonium oxide fuels. These options have the benefit of using the energy content of the plutonium while converting the plutonium into spent fuel, in agreement with the National Academy recommendations. The use of MOX fuel, however, can be seen as encouraging fuel cycles that can be used to breed plutonium.

A new fuel type is being developed in Switzerland by staff at the Paul Scherrer Institute. The fuel is based on zirconium dioxide as the matrix for incorporating plutonium in solid solution. The fuel is stabilized by addition of yttria and reactivity is controlled by addition of erbium oxide. The fuel can be used at rather high plutonium contents and produces 95% destruction of the fissile ^{239}Pu, which is much higher than achieved in MOX burning. 1/14.00.00

An additional advantage of the zirconia-based fuel is that it could be used as a disposal waste form of high durability either before or after burning. Thus, the fuel pellets could be considered as a parallel option for ceramic immobilization of plutonium as well as an additional option for reactor burning of plutonium.

I would like to suggest that the Department of Energy add the use of this non-fertile fuel to the options for disposition of plutonium in the final PEIS. A more detailed discussion of the advantages of this fuel for plutonium disposition is contained in the enclosed document " Plutonium destruction in a non-fertile, ZrO_2-based fuel - a reactor option for disposition of surplus plutonium", by V. M. Oversby and C. C. McPheeters, UCRL-ID-123613.

V. M. Oversby

Virginia M. Oversby
1647 Vancouver Way
Livermore, CA 94550

M-027

14 00 00 Comment Number 1

The Department of Energy applied a screening process along with public input to identify a range of reasonable alternatives for analysis in the Draft PEIS, and utilized technical reports and analyses from national laboratories and industry to develop a final list of alternatives. Details were published in a separate report, *Summary Report of the Screening Process to Determine Reasonable Alternatives for Long-Term Storage and Disposition of Weapons-Usable Fissile Materials* (DOE, March 1995).

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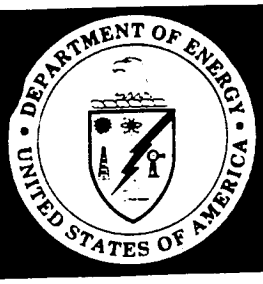

Office of
Fissile Materials Disposition

United States Department of Energy

Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Comment Response Document

Volume IV - Part B

December 1996

For Further Information Contact:
U.S. Department of Energy
Office of Fissile Materials Disposition, 1000 Independence Ave., SW, Washington, DC 20585

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Attention: Storage and Disposition of Weapons-Usable Fissile Materials
Final Programmatic Environmental Impact Statement/Volume IV - Part B

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COVER SHEET

RESPONSIBLE AGENCY: U.S. Department of Energy (DOE)

TITLE: *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE/EIS-0229)

CONTACTS:

For further information on this programmatic environmental impact statement (PEIS), call (202) 586-4513 or fax (202) 586-4078 or contact:
Mr. J. David Nulton
Director
Office of NEPA Compliance and Outreach
Office of Fissile Materials Disposition
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585
(202) 586-4513

For further information on the U.S. Department of Energy/*National Environmental Policy Act* (NEPA) process, call (800) 472-2756 or contact:
Ms. Carol Borgstrom
Director
Office of NEPA Policy and Assistance (EH-42)
Office of Environment, Safety and Health
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585
(202) 586-4600

ABSTRACT: This document analyzes the potential environmental consequences of alternatives for the long-term storage (up to 50 years), including storage until disposition, and disposition of weapons-usable fissile materials from U.S. nuclear weapon dismantlements under the responsibility of the DOE. Long-term storage of nonsurplus inventories of weapons-usable plutonium (Pu) and highly enriched uranium (HEU) are required for national defense purposes, while the disposition of surplus weapons-usable Pu is necessary in order to implement our national nonproliferation policy. In addition to the No Action Alternative, this PEIS assesses three storage alternatives (that is, upgrade at multiple sites, consolidation of Pu, and collocation of Pu and HEU) at six DOE candidate sites located across the country. These sites are Hanford Site, Nevada Test Site, Idaho National Engineering Laboratory, Pantex Plant, Oak Ridge Reservation, and Savannah River Site. Although they are not candidate sites for storage, Rocky Flats Environmental Technology Site (RFETS) and Los Alamos National Laboratory are assessed for the No Action Alternative. For the disposition of surplus Pu, three alternative categories (that is, deep borehole, immobilization, and reactor) with nine primary alternatives are assessed at several DOE and representative sites for analysis purposes. Evaluations of impacts on site infrastructure, water resources, air quality and noise, socioeconomics, waste management, public and occupational health and safety, and environmental justice are included in the assessment. The intersite transportation of nuclear and hazardous materials is also assessed. DOE's Preferred Alternative is identified in this Final PEIS. The Preferred Alternative for storage is a combination of No Action and Upgrade Alternatives for the various DOE sites, and phaseout of Pu storage at RFETS. The Preferred Alternative for disposition of surplus Pu is to pursue a disposition strategy involving a combination of immobilization and reactor alternatives, including vitrification, ceramic immobilization, and existing reactors.

PUBLIC INVOLVEMENT: The DOE issued a Draft PEIS on March 8, 1996, and held a formal public comment period on the Draft through June 7, 1996. In preparing the Final PEIS, DOE considered comments received via mail, fax, electronic bulletin board (Internet), and transcripts of messages recorded by telephone. In addition, comments and concerns were recorded by notetakers during interactive public meetings held during March and April 1996 in Denver, CO, Las Vegas, NV, Oak Ridge, TN, Richland, WA, Idaho Falls, ID, Washington, DC, Amarillo, TX, and North Augusta, SC. Comments received and DOE's responses to those comments are found in Volume IV of the Final PEIS.

PANHANDLE AREA NEIGHBORS AND LANDOWNERS, PANHANDLE, TX, DORIS AND PHILLIP SMITH
PAGE 1 OF 7

PANAL — Panhandle Area Neighbors and Landowners

HCR 2 BOX 20 PANHANDLE, TEXAS 79068 (806)335-1050

June 6, 1996

Mr. J. David Hulton
U.S. Department of Energy
Office of Fissile Materials Disposition, MD-4
Forrestal Building
1000 Independence Ave., S.W.
Washington, DC 20585

Re: Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Dear Mr. Hulton:

Our grassroots group of Panhandle Area Neighbors and Landowners (PANAL) believes very strongly that this document is inadequate in so many ways. In light of this and in addition to our endorsement of the May 6 letter to Secretary of Energy Hazel O'Leary, requesting that DOE produce an adequate draft PEIS after all our concerns have been addressed, we submit the following comments.

The document lists reasonably foreseeable future actions that have the potential to be implemented at Pantex as:Long-term Storage and Disposition Alternatives, Waste Management Alternatives and Stockpile Stewardship and Management Alternatives.

As is stated numerous times throughout the document, "Pantex has the greatest potential to experience adverse cumulative impacts " in all areas except for biological resource; we beg you to keep these statements in your final document and reinforce them with the historic facts from this area and with (Heaven forbid) 'common sense'.

As the people who live adjacent to Pantex we realize more than anyone else the tremendous adverse impacts the site presently has on our water resources, air quality, land resources, soil, vegetation, public and occupational health and safety, the present agricultural economy, cultural resources, and socioeconomics. With the addition of any one of the possible future actions at Pantex - this area stands to lose not only its economic base and stability, but also those resources which cannot be defined with facts and figures.

We feel that it is necessary to let you know that the people of the Amarillo Area are gravely concerned about the possibility of plutonium storage, processing, waste disposal, reactor possibilities, etc., as outlined in this document.

1/08.03.01

M-280

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

DOE/EIS-0229

Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Comment Response Document

Volume IV - Part B

United States Department of Energy
Office of Fissile Materials Disposition

December 1996

FOREWORD

This is the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (PEIS), prepared by the U.S. Department of Energy, Office of Fissile Materials Disposition. The document is composed of four volumes and a separate Summary. Changes made since the Draft PEIS are shown by change bar notation (vertical lines adjacent to the changes) in this Final PEIS for both text and tables. Deletion of one or more sentences is indicated by the phrase "Text deleted." in brackets. This Final PEIS includes the Preferred Alternative, which is a combination of alternatives. The Preferred Alternative is described in Section 1.6 and Chapter 2 of Volume I, and analyzed in Chapter 4 of Volume II. For all the alternatives, including the Preferred Alternative, a comparison of alternatives is presented in Section 2.5 of Volume I and a summary of impacts is presented in Section 4.6 of Volume II (Part B). Information from these sections is also presented in the Summary.

Volume I contains Chapters 1 through 3 of the PEIS. Chapter 1 includes a description of the history and background of the fissile materials disposition program, the purpose of and need for the proposed action, a summary of changes made to the Draft PEIS, and the Preferred Alternative. Chapter 2 gives a description of the proposed long-term storage and disposition alternatives, a description of how the alternatives were selected and why others were eliminated from further consideration, and a comparison of the alternatives in terms of their potential environmental impacts. Chapter 3 describes the affected environment at candidate long-term storage locations, and at sites and environmental settings for the disposition alternatives.

Volume II (Parts A and B) contains Chapters 4 through 10 of the PEIS. Chapter 4 describes the potential environmental impacts resulting from construction and operation of the proposed long-term storage and disposition alternatives, including the Preferred Alternative. Also contained in this chapter are intersite transportation impacts, a discussion of environmental justice issues, cumulative impacts due to the implementation of the proposed alternatives in addition to other actions at a site, avoided environmental impacts, and a summary of impacts. Chapter 5 provides a list of references used in the preparation of this document. Chapter 6 provides an index to the main text of the PEIS. Chapter 7 is a glossary of key terms used in the document. Chapter 8 is a list of preparers. Chapter 9 lists government agencies and organizations contacted during the preparation of this PEIS. Chapter 10 provides a distribution list for the document.

Volume III contains the appendices to this PEIS. Appendix A contains the fact sheet on the President's *Nonproliferation and Export Control Policy*, and the Joint Statement Between the United States and Russia on Nonproliferation. Appendix B provides specifications for key buildings within each facility complex analyzed in this PEIS. Appendix C describes requirements for construction and operation of the various facilities required to accomplish the storage and disposition activities essential to the alternatives described in this PEIS. Appendix D provides information on overall water usage for the storage and disposition facilities discussed in this PEIS. Appendix E gives a general overview of the Department of Energy (DOE) environmental restoration and waste management program, baseline waste management at DOE sites, and project-specific waste management activities associated with the proposed long-term storage and disposition alternatives. Appendix F provides detailed data supporting the air quality and noise analyses. Appendix G describes the methodology used for intersite transportation risk analysis and provides a summary of hazardous materials shipped to and from DOE sites, plus information on shipping containers. Appendix H evaluates various plutonium waste forms for potential disposal in a high-level waste repository. Appendix I describes operations of a Canadian Deuterium Uranium Reactor. Appendix J identifies the compliance requirements associated with the Proposed Action, as specified by the major Federal and State environmental, safety, and health statutes, regulations, and orders. Appendix K lists the scientific names of common nonthreatened and nonendangered animal and plant species identified in Chapters 3 and 4. Appendix L includes the supporting data used for assessing the No Action

Alternative in the socioeconomics sections of this PEIS. Appendix M presents detailed information on the potential health risks associated with releases of radioactivity and hazardous chemicals from the proposed storage and disposition alternatives during normal operations and from postulated accidents. Appendix N describes different concepts for, and provides cost and benefit information on, the multipurpose reactor. Appendix O provides a description of facilities and operations for a can-in-canister approach to plutonium immobilization at the Savannah River Site in South Carolina. Appendix P describes the potential environmental impacts of using the Manzano Weapons Storage Area in New Mexico for the long-term storage of plutonium pits. Appendix Q identifies the potential health impacts from the storage of Rocky Flats Environmental Technology Site plutonium pits at the Pantex Plant in Texas. Appendix R discusses the aircraft crash and radioactive release probabilities for proposed storage and disposition facilities at Pantex Plant in Texas. A separate Classified Appendix was also prepared, which provides detailed analysis results for intersite transportation risks based on classified inventories of materials stored at DOE sites.

Volume IV (Parts A and B) is the Comment Response Document. It contains an overview of the public comment process, the comments received on the Draft PEIS during the public review period, and the DOE responses to those comments, including identifying changes made to the Draft PEIS in response to public comments.

The Summary provides a brief overview of the PEIS. It includes the purpose of and need for the Proposed Action, a description of the storage and disposition alternatives including the Preferred Alternative, and the potential environmental impacts resulting from these alternatives.

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LIST OF ACRONYMS AND ABBREVIATIONS

AADT	Average Annual Daily Traffic
ACEC	Area of Critical Environmental Concern
ACGIH	American Conference of Governmental Industrial Hygienists
AEA	*Atomic Energy Act*
AEC	Atomic Energy Commission
AGV	automated guided vehicle
ALARA	as low as reasonably achievable
ALE	Arid Lands Ecology Reserve
ANL-W	Argonne National Laboratory-West
APSF	Actinide Packaging and Storage Facility
AQCR	Air Quality Control Region
ARA	Auxiliary Reactor Area
ARIES	Advanced Recovery and Integrated Extraction System
BEA	Bureau of Economic Analysis
BEIR	biological effects of ionizing radiation
BLM	Bureau of Land Management
BOP	balance-of-plant
BPA	Bonneville Power Administration
BWR	boiling water reactor
CAA	*Clean Air Act*
CANDU	Canadian deuterium uranium
CAS	Chemical Abstracts Service
CCDF	complimentary cumulative distribution function
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
CI	confidence interval
CIC	can-in-canister
CLUP	Comprehensive Land-Use Plan
CMR	Chemistry and Metallurgy Research

COE	Corps of Engineers
Complex	Nuclear Weapons Complex
CRD	Comment Response Document
CRT	Cargo Restraint Transporters
CWA	*Clean Water Act*
D&D	decontamination and decommissioning
DAF	Device Assembly Facility
DCG	derived concentration guide
DHLW	defense high-level waste
DNB	departure of nucleate boiling
DNFSB	Defense Nuclear Facilities Safety Board
DNL	day and night average sound levels
DNWR	Desert National Wildlife Range
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DP	Office of Defense Programs
DRCOG	Denver Regional Council of Governments
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EBR	Experimental Breeder Reactor
EDNA	Environmental Design for Noise Abatement
EIA	Energy Information Administration
EIS	environmental impact statement
EM	Office of Environmental Management
EPA	Environmental Protection Agency
ERR	excess relative risk
ES&H	Office of Environment, Safety, and Health
ESA	*Endangered Species Act*
ETF	effluent treatment facility
FAIR	Forest, Agriculture, Industry, and Research
FCF	Fuel Cycle Facility
FEMA	Federal Emergency Management Agency
FFCA	Federal Facility Compliance Agreement
FFTF	Fast Flux Test Facility

FLPMA	*Federal Land Planning Management Act*
FMEF	Fuels and Materials Examination Facility
FMF	Fuel Manufacturing Facility
FONSI	Finding of No Significant Impact
FR	Federal Register
FSAR	Final Safety Analysis Report
GBZ	Glass-bonded zeolite
GESMO	Generic Environmental Statement on Mixed Oxide
GIS	Geographical Information System
GMA	*Growth Management Act*
GMODS	Glass Material Oxidation Dissolution System
HAD	hazard analysis document
Hanford	Hanford Site
HE	high explosives
HEAST	Health Effects Summary Table
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HEU EIS	*Disposition of Surplus Highly Enriched Uranium Environmental Impact Statement*
HFEF	Hot Fuel Examination Facility
HI	Hazard Index
HLW	high-level waste
HQ	Hazard Quotient
HRA EIS	*Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan*
HVAC	Heating Ventilation and Air Conditioning
HWR	Heavy Water Reactor
IAEA	International Atomic Energy Agency
ICPP	Idaho Chemical Processing Plant
ICRP	International Commission of Radiological Protection
INEL	Idaho National Engineering Laboratory
IRIS	Integrated Risk Information System
ISCST2	Industrial Source Complex Short-Term Model Version 2
ISO	International Standards Organization
IWG	Interagency Working Group
K-25	K-25 Site

L/ER	Energy Research Program Office
LA	Limited Area
LAA	Limited Access Area
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Scattering Center
LCF	latent cancer fatalities
LDR	Land Disposal Restriction
LEU	low-enriched uranium
LIGO	Laser Interferometer Gravitational-Wave Observatory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LOB	Laboratory Office Building
LWR	Light Water Reactor
MAA	Material Access Area
MACCS	Melcor Accident Consequence Code System
MC&A	Material Control and Accountability
MD	Office of Fissile Materials Disposition
MEI	maximally exposed individual
MHR	Modular Helium Reactor
MMI	Modified Mercalli Index
MOX	mixed oxide
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAGPRA	*Native American Graves Protection and Repatriation Act*
NAS	National Academy of Sciences
NCDC	National Climatic Data Center
NCRP	National Commission of Radiological Protection
NEIC	National Earthquake Information Center
NEPA	*National Environmental Policy Act*
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFS	Nuclear Fuel Services Fuel Fabrication Plant
NHPA	*National Historic Preservation Act*
NIOSH	National Institute of Occupational Safety and Health
NMSF	Nuclear Material Storage Facility

NMSM	Nuclear Materials and Stockpile Management
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NRHP	National Register of Historic Places
NTS	Nevada Test Site
NTS EIS	*Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*
NWI	National Wetlands Inventory
NWPA	*Nuclear Waste Policy Act*
NWS	National Weather Service
OCRWM	Office of Civilian Radioactive Waste Management
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PA	Protected Area
Pantex	Pantex Plant
Pantex EIS	*Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*
PBF	Power Burst Facility
PCV	Primary Containment Vessel
PEIS	programmatic environmental impact statement
PEL	Permissible Exposure Level
PFP	Plutonium Finishing Plant
PFP EIS	*Plutonium Finishing Plant Stabilization Environmental Impact Statement*
PIDAS	Perimeter Intrusion Detection and Alarm System
PNNL	Pacific Northwest National Laboratory
PPA	Property Protection Area
PRA	probabilistic risk assessment
PSAR	Preliminary Safety Analysis Report
PSD	Prevention of Significant Deterioration

PUREX	Plutonium-Uranium Extraction Plant
PWR	pressurized water reactor
R&D	Research and Development
RCRA	*Resource Conservation and Recovery Act*
REA	regional economic area
RIA	reactivity insertion accident
RFETS	Rocky Flats Environmental Technology Site
RIMS II	Regional Input-Output Modeling System
RL	Richland Operations Office
ROD	Record of Decision
ROI	region of influence
RSWF	Radioactive Scrap and Waste Facility
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SAR	Safety Analysis Report
SARA	*Superfund Amendments and Reauthorization Act*
sd	standard deviation
SDWA	*Safe Drinking Water Act*
SEB	Security Equipment Building
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SISMP	Site Integrated Stabilization and Management Plan
SMR	Standardized Mortality Ratio
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SRR	standardize rate ratio
SRS	Savannah River Site
Stockpile Stewardship and Management PEIS	*Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*
Storage and Disposition PEIS	*Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement*
SST	safe secure trailer
START	Strategic Arms Reduction Talks

TA	Technical Area
TAN	Test Area North
TCLP	toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environmental Conservation
TDS	total dissolved solids
TI	transport index
TLV	Threshold Limit Values
TNRCC	Texas Natural Resources Conservation Commission
TRA	Test Reactor Area
TRU	transuranic
TSCA	*Toxic Substance Control Act*
TSD	Transportation Safeguards Division
TSP	total suspended particulates
TSR PEIS	*Tritium Supply and Recycling Programmatic Environmental Impact Statement*
TVA	Tennessee Valley Authority
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Survey
VOC	volatile organic compound
VRM	Visual Resource Management
WAC	Waste Acceptance Criteria
Waste Management PEIS	*Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*
WIPP	Waste Isolation Pilot Plant
WMIS	Waste Management Information System
WNP	Washington Nuclear Power
WPPSS	Washington Public Power Supply System
WSA	Weapons Storage Area
WSCC	Western Systems Coordinating Council
WSCF	Waste Sampling and Characterization Facility
Y–12	Y–12 Plant
Y–12 EA	*Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Level at the Y–12 Plant, Oak Ridge, Tennessee*
YMSCO	Yucca Mountain Site Characterization Office
ZPPR	Zero Power Physics Reactor

CHEMICALS AND UNITS OF MEASURE

°C	degrees Celsius
Ci	curie
cm	centimeter
CO	carbon monoxide
CO_2	carbon dioxide
Co-60	cobalt-60
Cs	cesium
Cs-137	cesium-137
CsCl	cesium chloride
Cu	copper
dB	decibel
dBA	decibel A-weighted
°F	degrees Fahrenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
g	gram
G	gravitational acceleration
gal	gallon
Gd	gadolinium
GWd	gigawatt-days
ha	hectare
H_2	hydrogen
HF	hydrogen fluoride
HNO_3	nitric acid
hr	hour
I-129	iodine-129
in	inch
k_{eff}	effective neutron multiplication factor
kg	kilogram
km	kilometer
km^2	square kilometer

Kr	krypton
kV	kilovolt
l	liter
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
mCi	millicurie
mg	milligram
mi	mile
mi^2	square miles
min	minute
mph	miles per hour
mrem	millirem (one thousandth of a rem)
MW	megawatt
MWe	megawatt electric
N_2	nitrogen
nCi	nanocurie (one-billionth of a Curie)
Ni	nickel
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
oz	ounce
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocurie (one-trillionth of a Curie)
PM_{10}	particulate matter less than or equal to 10 microns
ppm	parts per million
Pu	plutonium
PuCl	plutonium chloride
PuO_2	plutonium dioxide
rad	radiation absorbed dose
rem	roentgen equivalent man
RfC	Reference Concentration
RfD	Reference Dose

s	second
SO_2	sulfur dioxide
Sr-90	strontium-90
t	metric ton
Tc-99	technetium-99
ton	short ton
U	uranium
U-233	uranium-233
U-234	uranium-234
U-235	uranium-235
U-236	uranium-236
U-238	uranium-238
UF_6	uranium hexafluoride
UNH	uranyl nitrate hexahydrate
UO_2	uranium dioxide
U_3O_8	triuranium octaoxide
VOC	volatile organic compound
yd	yard
yr	year
μg	microgram (one-millionth of a gram)

METRIC CONVERSION CHART

To Convert Into Metric			To Convert Out of Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor
exa-	E	$1\,000\,000\,000\,000\,000\,000 = 10^{18}$
peta-	P	$1\,000\,000\,000\,000\,000 = 10^{15}$
tera-	T	$1\,000\,000\,000\,000 = 10^{12}$
giga-	G	$1\,000\,000\,000 = 10^{9}$
mega-	M	$1\,000\,000 = 10^{6}$
kilo-	k	$1\,000 = 10^{3}$
hecto-	h	$100 = 10^{2}$
deka-	da	$10 = 10^{1}$
deci-	d	$0.1 = 10^{-1}$
centi-	c	$0.01 = 10^{-2}$
milli-	m	$0.001 = 10^{-3}$
micro-	μ	$0.000\,001 = 10^{-6}$
nano-	n	$0.000\,000\,001 = 10^{-9}$
pico-	p	$0.000\,000\,000\,001 = 10^{-12}$
femto-	f	$0.000\,000\,000\,000\,001 = 10^{-15}$
atto-	a	$0.000\,000\,000\,000\,000\,001 = 10^{-18}$

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MICHAEL J. LAWRENCE
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PSC

Pajarito Scientific Corporation
778 DP Road
Los Alamos, NM 87544
Tel (505) 662 4182
Fax (505) 667-2786

April 11, 1996

J David Nulton
Director, NEPA Compliance and Outreach
US Department of Energy
Office of Fissile Material Disposition
Post Office Box 23786
Washington, DC 20026-3786

Dear Mr. Nulton:

Thank you for the opportunity to comment on DOE's Draft Programmatic Environmental Impact Statement on the Storage and Disposal of Weapons-Usable Fissile Materials. In addition to my participation at the DOE's public meeting in Richland, WA on April 11, 1996, I would like to submit the following comments and white paper.

My comments are based upon twenty-one years experience with the US Department of Energy, six as Manager of the Hanford Site, four years with the US Department of State as Counselor for Nuclear Policy to the International Atomic Energy Agency in Vienna, Austria, and my current position as President/CEO of Pajarito Scientific Corporation in Los Alamos, New Mexico, a wholly owned subsidiary of British Nuclear Fuels Limited.

I strongly believe that the reactor option for plutonium disposition using mixed oxide fuel is the best course of action for the US to pursue. It has the following advantages over other options:

- It virtually destroys the weapons plutonium making it impossible to use for future weapons.
- It is consistent with the plans of Russia and other major nuclear countries.
- It is irreversible and, therefore, acceptable to non-nuclear weapons states party to the Nuclear Nonproliferation Treaty.

1/08.03.01

WA-023

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

PAJARITO SCIENTIFIC CORPORATION, LOS ALAMOS, NM,
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- It can be fully accomplished based upon existing, proven technology.
- It will generate revenues from power production to reduce the cost of plutonium disposition.

1/08.03.01 cont.

BNFL has extensive experience in mixed oxide fuel production and can produce fuel from US excess weapons plutonium either in facilities at it's Sellafield plant or a new facility in the US, in full compliance with international safety and safeguard requirements. Several reactor options may be necessary to meet plutonium disposition requirements in a timely manner and BNFL is capable of providing fuel for multiple reactor types.

It is important that the PEIS acknowledge that the disposition of weapons usable fissile material is not a unilateral action, but part of an international obligation the US has made with Russia as part of last year's decision to indefinitely extend the nuclear non-proliferation treaty. The nuclear weapons states are committed to reduce their nuclear stockpiles and permanently render excess weapons material unusable for future weapons use. Non-nuclear weapons states, particularly from the lesser developed countries, are closely watching the actions of the US and Russia to see that we quickly and effectively follow through on our commitments. Prolonged storage or reversible disposition options are not acceptable.

2/01.03.00

The burning of excess weapons plutonium is totally consistent with our international treaty obligations and should not be misrepresented as undercutting US nonproliferation policy. Reprocessing and recycle of commercial nuclear fuel for power production is a different and distinct issue which should be made clear in the PEIS.

3/08.03.01
4/06.00.09

Sincerely,

Michael J. Lawrence

Michael J. Lawrence
President/ CEO

WA-023

01 03 00 **Comment Number 2**

Comment noted. The timing and suitability of alternatives was evaluated in a separate nonproliferation analysis issued by DOE in late 1996.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

06 00 09 **Comment Number 4**

The Department of Energy agrees with the commentor's statement. The use of MOX fuel derived from surplus Pu does not involve reprocessing/recycling of Pu. All reactors are on once-through fuel-cycles and all the Pu has already been separated such that additional reprocessing is not involved.

PAJARITO SCIENTIFIC CORPORATION, LOS ALAMOS, NM,
MICHAEL J. LAWRENCE

Plutonium Disposition:
A Global Commitment And Responsibility

After nearly fifty years of producing tons of plutonium and highly enriched uranium, the United States and the Former Soviet Union are dismantling tens of thousands of nuclear weapons. These countries are faced with the task of ensuring to each other and to all Nuclear Nonproliferation Treaty signatories that this material will never again be used in nuclear weapons. The recent indefinite extension of the NPT would never have been possible without the commitment of the major nuclear weapons states to live up to their treaty obligations with the ultimate objective of eliminating nuclear weapons altogether. Despite its imperfections, the establishment of the NPT has provided the legal basis to detect and prevent nuclear proliferation, and its indefinite extension is a major accomplishment.

There is general agreement that excess highly enriched uranium can be blended down into low enriched fuel for use in nuclear power reactors. The blending process alone is considered adequate to render the uranium unusable for nuclear weapons since the enrichment needed to return the blended material back up to weapons grade, is the same for either fresh fuel or blended weapons uranium. Plutonium disposition options however are not readily agreed to. Since there is no ready supply of non weapons plutonium (such as plutonium 240) which could be used to dilute and denature plutonium, and even reactor grade plutonium can be fashioned into a crude nuclear device, a blending approach similar to uranium is not considered acceptable.

Plutonium can be made into power reactor fuel and burned up in a reactor. Ample experience exists in the fabrication and use of mixed oxide fuels containing plutonium. While the economics of using mixed oxide fuels are not considered favorable, at least by the U.S. and especially in the near term, several countries use or plan to recycle plutonium as a matter of strategic national policy. While the United States has no such policy or strategy, Russia does plan to recycle plutonium both from spent fuel and excess weapons. The United Kingdom, France, Japan, China and several other Western European countries also support plutonium recycle.

The United States plans on direct disposal of spent power reactor fuel. Direct weapons plutonium disposal in a geologic repository in a glass form is under consideration. This would be difficult to recover and would be inaccessible for diversion except under extreme and easily detected means. It is questionable however if it would satisfy the requirements of other countries since it is reversible. If Russia is physically destroying their excess plutonium they are not likely to settle for anything less on the part of the United States. Even if the United States could convince Russia not to recycle but to store and dispose of vitrified plutonium, it is questionable if the non nuclear weapons states would be agreeable.

The burning of plutonium in the United States would create a number of problems. First, it is not part of fuel cycle plans for commercial reactors. The regulatory basis and facilities, both fuel fabrication and reactors, to enable plutonium burning to occur would have to be provided. There is no current economic or energy driving force for U.S. plutonium utilization and there is substantial public opposition. But the objective of

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PAJARITO SCIENTIFIC CORPORATION, LOS ALAMOS, NM,
MICHAEL J. LAWRENCE
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plutonium burning would not be wide scale commercial utilization of plutonium for power production, but the destruction of excess weapons plutonium so that this material could never be used in nuclear weapons. Facilities to dispose of the plutonium under any option, including vitrification, would have to be provided with the accompanying regulatory requirements and environmental impacts and risks. Both options, burning or disposal, would require tight government control and security as well as international safeguards by the International Atomic Energy Agency.

Given these considerations, the burning of plutonium has the advantages of first, destroying plutonium and making it impossible to use for future weapons; second, being consistent with the plans of Russia and other major nuclear countries; third, being irreversible and therefore, acceptable to other non nuclear weapons states; fourth, can be accomplished based upon existing technology and fifth; power produced as a by product of burning can be used to offset some of the costs of plutonium destruction.

There are several locations in the United States where plutonium burning could be performed. It would be desirable to choose a location that would minimize transportation, further plutonium contamination, and new facility construction. Independent regulatory control should be required and international safeguards by the IAEA are essential. The pace at which the plutonium is destroyed, in my opinion, is not as important as beginning to make a start on the destruction.

The Hanford Site has the facilities and experience to burn excess weapons plutonium in the next five to ten years but radically strengthened oversight and controls would be necessary. Other sites also have many of the same capabilities. Washington State has borne a large portion of the impact, both negative and positive, from past plutonium production. It has the capability to also play a major role in the solution to the plutonium disposition problem.

Regardless of which plutonium disposition option is chosen, and which location is selected, the United States has international obligations to greatly reduce its nuclear stockpile and permanently render its excess weapons material unusable for future weapons use. The U.S. cannot unilaterally select which option it will pursue, but must meet the approval of Russia and the international community. Strict safety regulation by an independent authority and safeguards by the IAEA are a prerequisite. The benefits from promptly and permanently beginning to destroy excess nuclear weapons material are too great not to pursue with the same determination and urgency as the Manhattan Project.

Michael J. Lawrence
September 25,1995

Presented at the Plutonium Roundtable: Risks and Solutions
Tri-Cities and Seattle, Washington
October 5 - 7, 1995

WA-023

PANGBORN, SALLY MACARTHUR, SEATTLE, WA
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Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): Sally MacArthur Pangborn
Address (optional): 2521 - 35th Ave. E
Seattle, Wa. 98112-2921

Don't send heavy expensive mailings. Like to be notified of meetings in Seattle.

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. Materials Immobilization/Vitrification - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

2. Deep borehole disposal - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

3. Reactor Options - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

4. Storage Options - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

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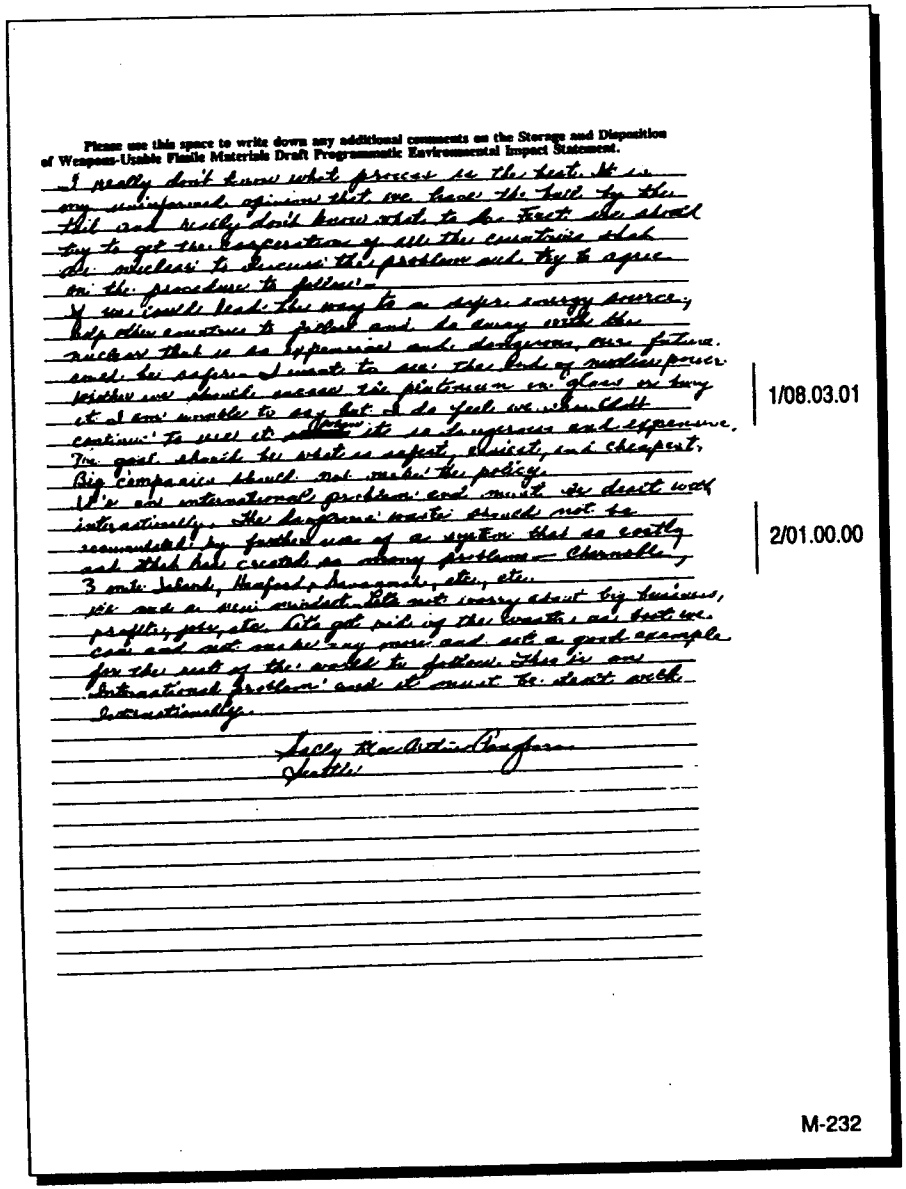
PANGBORN, SALLY MACARTHUR, SEATTLE, WA
PAGE 2 OF 2



Please use this space to write down any additional comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

I really don't know what process is the best. It is my uninformed opinion that we have the ball by the tail and really don't know what to do. First we should try to get the cooperation of all the countries that are nuclear to discuss the problem and try to agree on the procedure to follow.
If we could lead the way to a safer energy source, help other countries to follow and do away with the nuclear that is so expensive and dangerous, our future could be safer. I want to see the end of nuclear power. Whether we should encase the plutonium in glass or bury it I am unable to say but I do feel we shouldn't continue to use it when it is dangerous and expensive. The goal should be what is safest, easiest, and cheapest. Big companies should not make the policy.
It's an international problem and must be dealt with internationally. The dangerous waste should not be accumulated by further use of a system that is costly and that has created so many problems — Chernobyl, 3 mile Island, Hanford, Savannah, etc., etc.
We need a new mindset. Let's not worry about big business, profits, jobs, etc. Let's get rid of the waste as best we can and not make any more and set a good example for the rest of the world to follow. This is an International problem and it must be dealt with Internationally.

Sally MacArthur Pangborn
Seattle

1/08.03.01

2/01.00.00

M-232

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 00 00 **Comment Number 2**

The Department of Energy has the responsibility to implement the President's Nonproliferation Policy by finding a path forward for the disposition of surplus weapons-usable Pu which is not wasteful. Disposition of this Pu would generate wastes and spent nuclear fuel. Operation of the disposition facilities would meet applicable regulations and standards, and external regulatory oversight would be used as appropriate. Previous incidents at Chernobyl and other locations would be used as lessons learned to prevent reoccurrence.

PANHANDLE 2000

May 2, 1996

U.S. Department of Energy
Office of Reconfiguration
P.O. Box 3417
Alexandria, VA 22302

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, DC 20026

Re: Public Comment on the Department of Energy's Stockpile Stewardship and Management (SSM), Storage and Disposition (S&D) of Weapons-Usable Fissile Materials, and the Pantex Site-Wide Draft Programmatic Environmental Impact Statements (PEISs).

Dear Sirs:

Thank you for the opportunity to comment on the U.S. Department of Energy's (DOE) Draft Programmatic Environmental Impact Statements (PEISs) on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials, as well as the Pantex SWEIS. Also, please consider this our comments on the Pantex Site-Wide Environmental Impact Statement (SWEIS).

As we explained in our communication on these subjects during the past few years, we were appointed by the City Commission of the City of Amarillo, Texas, on February 8, 1991 to co-chair Panhandle 2000, a group of Amarillo-area citizens interested in the environmentally sound retention and expansion of Pantex. We were also requested to organize community support for Pantex. Ours is a broadly representative organization of individuals and entities who reflect the strong support of the vast majority of area residents for DOE's work in the Texas Panhandle at Pantex.

The issues addressed in the three Drafts are of paramount concern to the people sharing the Texas Panhandle with the Pantex Plant and the DOE. The dramatic employment reductions forecasted in the Draft SSM PEIS will severely impact the Panhandle economy. While Pantex is willing to participate, if necessary, in efficient downsizing of the nuclear weapons complex, any reductions at Pantex should come only after intensive cost and technical analyses to assure that national security needs are still being met in a cost-effective manner.

M-123

PANHANDLE 2000, AMARILLO, TX,
JERRY JOHNSON AND WALES MADDEN, JR.
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Ensuring confidence in the United States' nuclear stockpile and the safety and reliability of the nation's nuclear deterrent are vital issues that have been addressed by activities at the Pantex Plant for over forty years. As neighbors to the plant, we are very aware, and proud, of the critical role that Pantex plays in fulfilling our nation's goals for defense and energy needs. We look forward to maintaining a vital role in meeting our present and future national security needs.

The Administration's proposals to disseminate current Pantex functions to other sites seems certain to adversely affect the nation's ability to produce nuclear weapons in the future, and to dangerously weaken national security. This is reflected in the SSM PEIS's workload assumptions of 1,000 warheads in the future stockpile, a number far lower than even the 3,500 set in still-unratified START 2 treaty. We urge you to recognize the importance of DOE's production complex, and avoid surrendering the victory we gained in the Cold War through the planned obsolescence of our production capability, which can only be rebuilt at great cost in later years.

As DOE presses toward its Record of Decision regarding SSM and S&D functions, we find it necessary to begin with a summary of the existing facilities Pantex possesses which would require minimal upgrading to meet many of the needs presented in the Drafts. The following table presents the list of existing facilities that are available for particular stockpile management and plutonium storage missions:

Capability	Facilities
1. Weapons assembly/disassembly	Existing facilities in Pantex Zone 12
2. Nonnuclear components	Existing facilities with modifications
3. Nuclear components:	
a. Pit storage	Existing facilities with modifications
b. Pit reuse (minor)	Existing facilities in Pantex Zone 12
c. Replacement pit fabrication and reuse (major)	Existing facilities with modifications
d. Secondaries and cases	Existing facilities in Pantex Zone 12 with modifications
4. High explosives components	Existing facilities in Pantex Zones 11 and 12

Keeping this in mind, please consider the following comments on plans for the Complex as DOE prepares its final drafts on upgrading and/or downsizing facilities at the sites where Stockpile Management capabilities are located, and where Stockpile Storage and Disposition missions are contemplated.

I. SSM PEIS.

A. Assembly/Disassembly Functions at Pantex, and Strategic Reserve Storage.

We are pleased DOE selected Pantex as the preferred alternative for assembly/disassembly (A/D) functions, abandoning earlier, cost-prohibitive plans to

transfer these functions from Pantex to the Nevada Test Site (NTS). Pantex's demonstrated experience and strong safety record, as well as the monumental costs associated with recreating A/D facilities elsewhere, make Pantex the ideal site in maintaining these functions.

Further, DOE mentions that strategic storage should be co-located with disassembly, but does not emphasize the protection of those reserves to meet future national security needs. Pantex should be the preferred site for such a mission in coordination with its stewardship functions. Parenthetically, Pantex should be selected for all S&D storage functions. It makes no sense from any perspective, budget or otherwise, to site strategic storage at one site and surplus at another. 1/08.03.01

Just as maintaining core scientific competencies in the three national laboratories will help ensure the safety and reliability of a smaller stockpile, *maintaining the core production competencies of Pantex* (the sole authorized site for weapons assembly) will ensure our ability to meet future national security needs for stockpile assembly and disassembly. Pursuing complete unilateral disarmament would run contrary to stated national security objectives. Absent total disarmament, we must maintain an assembly infrastructure capable retrofitting aged weapons and assembling new weapons as needed in the future. While DOE plans no new construction at the existing plant, Pantex should be considered for upgrading and/or new construction to prepare for these nuclear weapons production needs.

Finally, in its deliberations, *DOE should insist that budgetary comparisons between Pantex and other sites are accurate, and include capital, transportation, training, remediation, security, and other costs.*

B. High Explosives Fabrication at Pantex.

While we are pleased with Pantex maintaining A/D functions, we are very concerned that DOE did not name Pantex as the preferred site for continuing high explosives fabrication. In conjunction with the A/D functions, it is necessary to maintain HE fabrication at the corresponding site; thus, these functions should remain at Pantex.

The Draft SSM PEIS implies that Pantex would keep HE functions should it retain A/D functions. Since DOE intends to keep A/D at Pantex, Pantex should also retain HE fabrication. In any event, because of ongoing disassembly work at Pantex, DOE admits the plant "would have to retain disposition and disposal capability for the HE inventories currently on site and those expected from near-term weapon dismantlement regardless." In addition, should future needs arise for weapons production, it will be critical to have the HE facilities at the weapons production/assembly site.

If establishing core competencies at the labs are so important for high explosives, why is it not so for uranium functions? DOE has made it clear that in the instance of HEU, maintaining core competencies at the production site is a priority. Why not so for HE?

M-123

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

We adamantly disagree with the statement in the draft PEIS that there is no significant cost benefit to siting HE at Pantex as opposed to the national labs. Earl Whiteman of DOE's Albuquerque Field Office admitted in the April 23 PEIS hearing that it would be more expensive to relocate HE to LANL and LLNL, but he attempted to justify this saying it was "only for a one-time cost." This analysis raises serious questions as to the criteria used to determine the cost considerations for this and other transfers. The capital outlay alone necessary for transfer is admittedly cost-prohibitive; and while transferring HE functions may be less expensive than transferring other functions, the least expensive alternative is to maintain those functions at Pantex. DOE appears to be overlooking or ignoring other glaring considerations like the upgraded facilities and trained personnel at Pantex versus those present (or, more accurately, absent) at the labs. The assertion in the Draft SSM PEIS that it might be cheaper to transfer HE to the labs than it would be to downsize at Pantex is fantastic and defies logic since transfer would still ultimately require some duplication of facilities. In order to reach such a conclusion, one must assume that capital, training, and other costs are not taken into account. Incredibly, the Draft SSM PEIS assumes that the labs, which have failed in every instance to successfully implement *any* production on the magnitude necessary to meet national security needs, could for the first time accomplish this with high explosives. At the public hearings, Mr. Whiteman admitted that Pantex has both capabilities necessary for high explosives work (the quality assurance component), while he labs only have one (the ability to "press" explosives, but at a level which does not match Pantex). Finally, DOE must account for the costs and safety risks associated with transportation of high explosives components between the labs and Pantex. There is no justifiable reason for initiating the unnecessary costs and increased risks associated with transferring HE functions to the labs.

C. New construction/stewardship activities at Pantex.

Until recently, DOE concentrated research and development functions at the labs and production functions at the industrial sites. It appears DOE is headed in a new direction. While the drafts propose to continue concentrating all stewardship functions and to transfer particular industrial functions to the labs, the DOE overlooks the potential for Pantex to perform new stewardship functions complimentary to its current management functions. The scientific, technical, and managerial competence presently at Pantex, combined with additional technical resources from Mason & Hanger, Battelle, and the Higher Education Consortium, offer the human and material resources necessary for the future needs of the SSM Program.

Pantex has the necessary resources, with the required safeguards and security, to meet the goal to downsize and/or consolidate facilities while providing an effective and efficient production capability for a smaller stockpile. Facilities are currently in place to perform almost all the necessary mission elements of the stockpile management program, a fact that should not be overlooked as the DOE seeks to preserve the integrity of the nuclear stockpile under increasing budgetary constraints.

The obvious advantage of Pantex is, by utilizing the facilities already in place, DOE could eliminate the capital cost for establishing the same capabilities elsewhere. The cost of unnecessarily duplicating facilities (*currently in place at Pantex*) at another site would cost the DOE tens of millions of dollars in infrastructure alone, notwithstanding the additional expense of related transportation, environmental remediation, start-up and training costs required at a redundant site which would cost taxpayers additional millions of dollars.

Another fact that should not be overlooked is that Pantex is the candidate site located nearest to the LANL, the preferred site for the Atlas facility, and the planned site for plutonium pit fabrication. This facility is key to DOE's ability to address stockpile reliability and safety issues by means other than nuclear testing due to the indefinite extension of the nuclear testing moratorium in July 1993. The conclusion to be drawn is that the location of SSM Program functions at Pantex would not only take advantage of current storage and dismantlement capabilities, but would also capitalize on the geographical proximity of Pantex and LANL that would be conducive to the exchange of technological information necessary for effective management of a smaller nuclear weapons complex.

In addition to Pantex, the Texas Panhandle also boasts of the Amarillo National Resource Center for Plutonium (ANRCP) which is taking a lead role in environmental and nuclear research. The ANRCP is operated by the Higher Education Consortium, comprised of three of the nation's preeminent university systems (The Texas A&M University System, Texas Tech University System, and The University of Texas System). Consistent with the SSM Program non-proliferation objectives, the Consortium is coordinating the U.S.-Russian Summit Working Group on the Disposition and Accumulation of Fissile Materials in order to ensure that the nation's arms-control objectives are met. The involvement of the Consortium adds an academic dimension of research excellence and third party monitoring that ensures continued competency of the people who must make the scientific and technical judgments related to the safety and reliability of nuclear weapons. We want to stress that we view the role of the ANRCP as complimentary to the labs, and supplementing, not supplanting, their functions.

The Consortium and the development of the ANRCP are logical extensions of the current allocation of functions within the U.S. nuclear weapons complex. In light of continuing changes in the national security picture for the U.S., and given the importance of resolving dismantling issues and issues related to the future stewardship of the nuclear stockpile, the *siting of research and technical functions at Pantex for the SSM Program is highly appropriate*.

The significant nuclear stockpile still present in the former Soviet Union under sometimes suspect surveillance makes our continued cooperation with Russia regarding management of the nuclear stockpile critical to international security. The key role the

Amarillo National Resource Center for Plutonium is playing for DOE in SSM and fissile materials activities with Russia argue for an expanded role for Pantex.

Accordingly, it is appropriate to consider Pantex as an alternative site for future defense missions. The location of new activities at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost to the American taxpayers.

II. S&D PEIS.

A. Fissile Materials/Plutonium Storage and Disposition at Pantex.

In addition to DOE's hesitation to name a preferred site for HE, we are also concerned that the Draft S&D PEIS did not list a preferred site for plutonium storage and disposition. Whether the decision reached is for "No Action" or "Consolidate," plutonium will continue to be present at Pantex through assembly/disassembly operations. President Clinton last year announced that he was declassifying 38.2 metric tons of weapon-grade plutonium as excess to national security needs. Of that amount, 21.3 metric tons are located at Pantex. For this reason alone, Pantex should be the preferred site for storage, disposition, and utilization. Doing so would avoid the economic and other attendant costs of transporting plutonium to a new site as well as the massive infrastructure costs of unnecessarily recreating a Pantex-like facility at another site. 1/08.03.01 cont.

1. Storage.

As aforementioned, Pantex is already safely storing most of the weapons-usable surplus plutonium from the dismantled stockpile. Pantex presently has more than 8,500 plutonium pits stored on site and can easily be expanded to hold more than 20,000. We fully support the proposed action in the SWEIS to expand Pantex's storage capabilities to 20,000 pits. The plant is also scheduled to be upgraded to prepare the storage bunkers for receipt of plutonium pits relocated from Rocky Flats. This will increase further the plutonium stockpile present at Pantex.

One major concern is, as it is currently drafted, the S&D PEIS does not emphasize a continuation of the Strategic Plutonium Reserve necessary to meet continued national security needs. Once again, storage of the strategic reserve is a logical mission at Pantex as an extension of its assembly/disassembly functions and long-term plutonium storage consideration. Neither the SSM PEIS nor the S&D PEIS takes the logical next step by naming Pantex as the site for storage of strategic and surplus plutonium. At the hearing, Earl Whiteman of DOE said at the hearing "it made sense" to collocate strategic storage and assembly/ disassembly to minimize transportation, and to collocate strategic storage with surplus storage, since the strategic stockpile may be declared surplus at some point. Mr Whiteman said that Pantex has a facility which is "exactly the right size" for strategic storage, and that there was sufficient space at Pantex for all functions DOE should not 2/01.00.00

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01 00 00 Comment Number 2

The issue of strategic reserve, as it relates to national security needs, is addressed in the Stockpile Stewardship and Management PEIS.

only recognize that storage should follow disassembly, but also that certain disposition options should follow storage to minimize transportation and other costs. It is important that a stockpile of strategic reserve remain a stated objective of S&D functions included in either plutonium storage or pit fabrication duties. Since Pantex also is in close proximity to LANL, the preferred site for pit fabrication, designating Pantex as the alternative site for a strategic reserve would be the most cost-effective choice.

With regard to storage, the focus should be squarely on the issue of storing the pits safely, and we fully support storage of plutonium and other fissile materials at Pantex under both the "no action" and "long-term" alternatives, given adequate assurances that such storage is safe and environmentally sound. In addition to extensive environmental safety protections already in place, Pantex has built an elaborate security system to protect stored plutonium from potential theft. Safe storage is critical for maintaining the integrity of the stockpile and our commitment to international safety. Pantex is the only site currently capable of this level of protection to prevent possible proliferation of stolen weapons-grade plutonium.

Ensuring safety and accountability of our surplus plutonium stockpile can best be accomplished through the construction of a new consolidated storage and staging facility at Pantex. Such a facility would:

- Strengthen national and international arms control efforts by fostering continued and enhanced cooperation with Russia on transparency issues, and bilateral agreements to monitor dismantlement and maximize options for the disposition of surplus weapons-usable fissile materials;
- Ensure that storage and disposition of weapons-usable fissile materials is carried out in compliance with environment, safety, and health (ES&H) standards;
- Consolidate all nuclear materials which would provide significant cost savings for surveillance, storage, and disposition.

1/08.03.01 cont.

Siting a new consolidated storage facility at Pantex also would further the "stored weapons standard" which envisions the same high standards of security and accounting applied to storage of nuclear weapons being maintained for weapons-usable fissile materials throughout the process of dismantlement, storage and disposition. Pantex has put in place, and is accustomed to maintaining, the high security and accounting standards for nuclear weapons storage for decades as the Complex' sole site of disassembly.

Siting long-term storage at Pantex also will help us achieve the Administration's nonproliferation goals. No current treaty requires us to disassemble nuclear warheads, but only to disable the delivery vehicle; the warheads can remain intact under treaty, and the U.S. is disassembling voluntarily and unilaterally. If the U.S. is to strive for reciprocity, and encourage Russia and other countries to "go the extra mile" and disassemble nuclear arms as opposed to merely "dismantling" them, Pantex, being the sole U.S. site for disassembly, would be the consummate site for storage of fissile materials.

3/01.03.00

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01 03 00 **Comment Number 3**

Comment noted.

PANHANDLE 2000, AMARILLO, TX,
JERRY JOHNSON AND WALES MADDEN, JR.
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We disagree with DOE's findings that under either the "No Action Alternative," or the "Long-Term Storage and Disposition Alternatives," that Pantex has the greatest potential to experience adverse cumulative impacts. This conclusion is almost wholly based on what DOE terms as the "small, compact area" in which Pantex is sited. This conclusion fails to take into consideration the fact that DOE already owns the 10,000 acres on which Pantex is located, and that more land is available for any new or upgraded facilities, at no cost to the federal government. Further, Pantex is located 14 miles from a central city; the finding that cultural, socioeconomic (such as level of road service in the event of construction), and public and occupational health and safety impacts would be greater at Pantex is incorrect. For example, to imply that intersite transportation impacts would be greater at Pantex is absurd, since (1) Pantex currently houses the vast majority of plutonium pits, thus avoiding the lion's share of any transport (and the appurtenant budgetary, environmental, and political costs related thereto) if it was selected as the preferred alternative for S&D; and (2) is the site closest to LANL, the proposed site for pit fabrication. Even if one were to accept such a finding regarding Pantex, the differences between candidate sites would be so small to demand that they not be seriously considered as an accurate or meaningful criterion on which to base selection. — 4/09.00.04

If DOE chose not to construct a new consolidated storage facility, we would support the upgrade of Pantex storage capability necessary to comply with current design and environment, safety, and health requirements. — 5/10.00.00

2. Disposition Alternatives.

DOE has not yet decided on the preferred alternative for disposition or the sight for disposition, but whatever decision is reached, Pantex should be the preferred site since it is already the current storage site for plutonium removed from dismantled weapons and the site of strategic plutonium reserve. — 6/08.03.01

While the *implementation* of any disposition option must be environmentally sound, the *ultimate decision* of which options will be chosen will be *based largely on national security considerations*, especially the success or failure to reach accord with Russia on these issues. — 1/08.03.01 cont.

While the U.S. should take any unilateral actions it deems appropriate if its national security interests are maintained, the volatility of the former Soviet republics and the changing world scene dictate that *reciprocity* guide our actions. The Draft S&D PEIS identifies three major alternatives as reasonable for plutonium disposition: immobilization in glass or ceramic form; burning in reactors as MOX fuel; or deep burial in boreholes either directly or in immobilized form. — 7/01.03.00

How do these options fit into reciprocity? The White House Fact Sheet on Nonproliferation contains the policy statement that the U.S. should "seek to eliminate...the accumulation of stockpiles of...uranium and plutonium," including those from civil nuclear

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09 00 04 **Comment Number 4**

Based on comments received, the Summary was revised. The bar charts providing the comparison of impacts for both storage and disposition were deleted from the Summary. The related text was revised to clarify the comparison of impacts and to delete reference to "adverse" impacts. There was no intention to portray Pantex, the Pantex region, or the Texas Panhandle region in a negative fashion. Each DOE site was analyzed and studied in the same manner and presented in the Draft PEIS accurately per these analyses and studies. The cumulative impact analysis in Section 4.7 does not attempt to rank the potential for cumulative impacts at the sites. The Summary has been revised to better reflect the cumulative impact analysis in Section 4.7.

10 00 00 **Comment Number 5**

The Pu material at Pantex, as well as Pu and HEU at the other five sites, was assumed to be present for the transportation analysis. For the storage alternatives, Table 4.4.3.2–2 of the Draft PEIS indicates Pantex would have the lowest number of potential fatalities. For disposition, almost all surplus pits were assumed to be at Pantex. This is indicated by Pantex having the lowest number of potential fatalities for pit disassembly in Table 4.4.3.3–1 of this PEIS.

08 03 01 **Comment Number 6**

The Department of Energy acknowledges the commentor's support for the Upgrade Storage Alternative. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 03 00 **Comment Number 7**

The PEIS addresses the environmental impacts of the reasonable alternatives for DOE's Proposed Action. Analyses of cost, schedule, technical, and Nonproliferation Policy impacts are described in separate documents to support DOE's ROD. The cost, schedule, and technical analyses were made available for public review beginning in July 1996. The nonproliferation

programs. It is unrealistic to believe that any disposition decision by the U.S. which does not contemplate the use of plutonium as fuel will cause other countries - either with or without nuclear weapons - to abandon the use of plutonium in reactors. For example, Russia, with its large investment in its nuclear infrastructure, and its lack of financial means to convert to other forms of energy, is highly unlikely to forego the use of nuclear power, including the use of plutonium. Also, European nations like France, which lack the vast natural resources of oil, gas, and coal which the U.S. enjoys, have little incentive to give up their reliance on nuclear power. If that is the case, and in full recognition that reactor-grade plutonium can easily be used in weapons, the U.S. will be compelled for "reciprocity" and national security reasons to maintain plutonium in pits for some period of time and plan to utilize it through the mixed oxide fuel option. The U.S. cannot lead by positing unacceptable or unfeasible options; it must recognize the circumstances which it and other nations face, and pursue a course which will benefit its national security goals, and possibly other goals as well.

We are not convinced that plutonium is more of a liability than an asset. Why can't we make swords into plowshares, and utilize these resources - which took so much time, effort, and money to develop - and examine the peaceful uses of these materials? Examination of possible beneficial uses is one of the primary purposes of the research being conducted at DOE research facilities across the country. We strongly support, as part of this research, the review of long-term options for plutonium disposition, including environmental considerations. This review can involve research and policy study on the best forms of plutonium for storage, disposition, and utilization, storage options, security and safeguards and other issues. 8/01.06.00

Further, we believe that this option, with its emphasis on education and research, will help reverse the "brain drain" which could adversely affect the Nuclear Weapons Complex as its primary function changes. The Defense Nuclear Facility Safety Board has said that the government is losing most of its veteran experts. While DOE has attempted to address this problem through instituting a program to attract new young scientists to the Complex, we believe that more young scientists will have the incentive to develop and maintain expertise in these disciplines if the types of serious research which the "beneficial use" option offers is available through DOE.

The questionable efficacy of the "irreversibility" of vitrification or boreholes argues for use in reactors, at least for pits and other "MOX-able" plutonium. While we recognize that some plutonium "scrap" can only be disposed through avenues other than MOX, the extraordinary advances in science, especially in this important area, render naive the notion that sometime in the near future the technology to "reverse" vitrification, boreholes, or any other such "waste generating" process will be readily available to those who desire it. 9/08.03.01

Accordingly, we support a course which will provide a tangible demonstration to the affected citizens that there exist long-term disposition options which both fit our national security interests as well as a common sense desire to reap a beneficial use from these materials. The Administration should consider a joint program between Russia and

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analysis was made available to the public beginning in October 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the analysis on the Nonproliferation Policy as it relates to the Proposed Action and alternatives.

01 06 00 **Comment Number 8**

Comment noted.

08 03 01 **Comment Number 9**

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

the U.S. (and perhaps other countries) which actually would take a plutonium pit apart, make plutonium oxide, fabricate mixed oxide fuel, and burn the fuel in a commercial light water reactor.

Such a policy would meet the "spent fuel standard" by making the plutonium as inaccessible for weapons use as the plutonium in spent nuclear fuel from commercial power reactors. It also recognizes the fact that the only course to safe disposition is to separate the atom through fission. It also looks beyond the spent fuel standard by maximizing the options available to DOE and the Administration with regard to disposition.

3. Environmental Safety and Health Criteria.

a. Airplane Crash Risk Analysis:
The 1994 "Finding of No Significant Impact" arising from the Environmental Assessment found an airplane crash/accident occurring at Pantex to be an "incredible event" not justifying the preclusion of additional storage at Pantex. Even so, the plant subsequently worked with the Department of Defense and the FAA to reduce flights paths over Pantex, and took other steps to ameliorate the situation. However, the Draft SWEIS does not account for the reduced flights thereby exaggerating the probability for airplane accidents at Pantex and their resulting impacts, and, incredibly, *increases* the probability of a crash from the 1994 "FONSI." In the recent hearings, Nan Founds responded to this concern by saying that DOE is formulating its own analysis not dependent on FAA data, but also stated there were serious problems with DOE's analysis, which would be addressed. In its initial analysis, DOE is ignoring not only credible work already completed, but also the obvious reduction in accident potential for use in determining the ES&H of siting new functions at Pantex. This undermines the perceptions for fair and equal criteria for use in accurately comparing the various sites under consideration. We urge DOE to correct the analysis and avoid the wrongful preclusion of Pantex for consideration of additional functions. 10/09.09.04

b. Environmental Impacts of Potential Increased S&D Functions:
In the Draft S&D PEIS, DOE characterizes Pantex as having the "greatest potential" to experience adverse cumulative impacts from an increased role in plutonium storage and disposition. However, this characterization is way beyond the means of DOE's cursory analysis. NEPA regulations require that environmental impact statements discuss "significant" impacts and support these with evidence. DOE has taken license to ignore these regulations by discussing potentiality and susceptibility without basing these in fact. We object to this type of characterization which unfairly and inaccurately misrepresents Pantex's ability to handle an increased role in S&D. These conclusions also totally contradict those contained in the SWEIS which characterize the impacts as "minimal" and "negligible." It is imperative that DOE correct the inaccurate mischaracterizations before making its final decisions for plutonium storage and disposition missions. 11/01.00.00

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09 09 04 **Comment Number 10**

Appendix R has been added to the Final PEIS to discuss aircraft crash and radioactive release probabilities for proposed storage and disposition facilities at Pantex.

01 00 00 **Comment Number 11**

Based on public comments, the Summary of the Draft PEIS was revised. All revisions appear in the Summary of the Final PEIS.

4. Cost savings due to avoidance of transport of special nuclear materials.

Regardless of the final decision for storage and disposition, DOE must make accurate budgetary comparisons a primary consideration in its analysis of where to site these functions. *DOE should insist that budgetary comparisons between Pantex and other sites are accurate, and include capital and transportation costs, and also take into consideration the political consequences of transfers from Pantex.* We also urge DOE to compare on a "side-by-side" basis all six candidate sites for: (1) Conduct of operations; (2) Implementation thereof; (3) Security; (4) Relationship between management, unions, community; (5) Quality system programs; (6) OSHA/ ES&H envelope; (7) Engineering systems; (8) Radiation safety; (9) Applied technology; (10) Training programs; (11) Explosive and nuclear safety programs; and (12) Employee involvement in daily operations. 12/07.00.00

Accurate comparisons between all sites under consideration should once again make Pantex the preferred site. Maintaining and expanding the interim storage facilities at Pantex would all but eliminate the significant transport costs, and the attendant environmental and political risks involved with moving these functions to another site. Eliminating the unnecessary transportation of radioactive materials, will translate into less cost and greater public safety and protection. Ignoring or miscalculating the risks and costs associated with weapons materials would be a serious omission.

We are confident that any fair comparison of economic and political costs will favor Pantex over the other sites included in consideration, since recreating this infrastructure at another site would be cost-prohibitive.

5. Economic factors.

Pantex is perhaps the most cost-effective alternative for any new construction of SSM and S&D facilities if DOE pursues that course. First, labor costs are low. The existing work force in the Amarillo area has the skills necessary to meet the construction and operation requirements for any new functions and to do so at highly competitive wage rates. With a civilian labor force of 110,200, the Amarillo Metro Area can provide the project with a large, well-educated, and comparatively inexpensive labor pool. Average wage costs for manufacturing employment in Amarillo are 18% below the national average. Second, utility costs are highly competitive. According to the Utility Data Institute, the SPS industrial rate currently ranks in the lowest 11 percent among U.S. investor-owned utilities. SPS has a long history of low rates and presently offers the lowest rates among investor-owned utilities in Texas. If new facilities were operational now, SPS's standard rate for this class of firm service at 80 percent load factor would average 3.2 cents per kWh. Also, land to house new construction is readily available. The Department of Energy presently owns the 10,000 acres on which the Pantex plant is located. More land is available for any new facility, at no cost to the federal government. 13/09.08.04

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07 00 00 **Comment Number 12**

Comment noted.

09 08 04 **Comment Number 13**

Selection of the Preferred Alternative for the Storage and Disposition PEIS was based on numerous factors, including socioeconomics. All of the candidate sites identified in the PEIS are considered reasonable alternatives for long-term storage. The site selection reflected in the Preferred Alternative is based, in part, on the ability of DOE to use the available work force and the existing infrastructure to minimize the cost of implementation.

Finally, the City of Amarillo has excess water capacity to an extent enjoyed by no other candidate site, without depleting the Ogallala Aquifer.

6. Public and political support.

In addition to the economic factors listed above, local support for the Pantex Plant, and its expansion, is extraordinarily strong. A Shipley and Associates poll of the four county area surrounding the plant (Armstrong, Carson, Potter, and Randall) found that 99% of the respondents believe that Pantex is important to the local economy, 88% said that Pantex is a facility that they can be proud of, 79% favored Pantex expansion, and 88% agreed that Pantex is safe. In May 1991, a Lance Tarrance poll showed that 85% of area residents supported an expanded Pantex. Also, a July 1991, poll conducted by the Amarillo Globe-News showed that almost 75% of the respondents favored expansion of Pantex. Consideration of the results of the 1991 Tarrance poll (Republican) and the Shipley poll (Democratic) reveals that regardless of party affiliation of the pollster or time the poll is conducted, Pantex enjoys the overwhelming support of Panhandle residents, at a level perhaps unsurpassed by any other Complex site.

Area and state elected public officials are virtually unanimous in support of current and expanded plant operations. Essentially the entire 32-member Texas Congressional Delegation has pledged support for expansion and will be active in the effort in the future, as well as the Governor, Lieutenant Governor, area legislators, and other public officials. Thus, the message is clear from the nation's elected representatives that the role that Pantex plays in the future of the weapons complex is vital to the nation's nuclear deterrent and the safety and reliability of nuclear weapons.

III. Conclusion.

On all accounts, Pantex clearly is the best and most cost-effective alternative to DOE for stewardship and management, storage and disposition, and other defense-related missions. We respectfully urge DOE to designate Pantex as the preferred alternative site for all existing and new functions in DOE's Final PEISs and Records of Decision. Thank you for the opportunity to share our thoughts and concerns with you.

Yours truly,

Jerry Johnson
Co-Chair, Panhandle 2000

Wales Madden, Jr.
Co-Chair, Panhandle 2000

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PANHANDLE AREA NEIGHBORS AND LANDOWNERS, PANHANDLE, TX, DORIS AND PHILLIP SMITH
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PANAL Panhandle Area Neighbors and Landowners
HCR 2 BOX 20 PANHANDLE, TEXAS 79068 (806)335-1050

June 6, 1996

Mr. J. David Nulton
U.S. Department of Energy
Office of Fissile Materials Disposition, MD-4
Forrestal Building
1000 Independence Ave., S.W.
Washington, DC 20585

Re: Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Dear Mr. Nulton:

Our grassroots group of Panhandle Area Neighbors and Landowners (PANAL) believes very strongly that this document is inadequate in so many ways. In light of this and in addition to our endorsement of the May 6 letter to Secretary of Energy Hazel O'Leary, requesting that DOE produce an adequate draft PEIS after all our concerns have been addressed, we submit the following comments.

The document lists reasonably foreseeable future actions that have the potential to be implemented at Pantex as:Long-term Storage and Disposition Alternatives, Waste Management Alternatives and Stockpile Stewardship and Management Alternatives.

As is stated numerous times throughout the document, "Pantex has the greatest potential to experience adverse cumulative impacts " in all areas except for biological resource; we beg you to keep these statements in your final document and reinforce them with the historic facts from this area and with (Heaven forbid) 'common sense'.

As the people who live adjacent to Pantex we realize more than anyone else the tremendous adverse impacts the site presently has on our water resources, air quality, land resources, soil, vegetation, public and occupational health and safety, the present agricultural economy, cultural resources, and socioeconomics. With the addition of any one of the possible future actions at Pantex - this area stands to lose not only its economic base and stability, but also those resources which cannot be defined with facts and figures. 1/08.03.01

We feel that it is necessary to let you know that the people of the Amarillo Area are gravely concerned about the possibility of plutonium storage, processing, waste disposal, reactor possibilities, etc., as outlined in this document.

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08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

PANHANDLE AREA NEIGHBORS AND LANDOWNERS, PANHANDLE, TX, DORIS AND PHILLIP SMITH
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Plutonium storage is extremely dangerous, the facilities Pantex presently uses are insufficient, outdated and totally inadequate for future storage. To construct new facilities at Pantex to store plutonium, when there are more than adequate facilities at Manzano Weapons Storage Site at Kirtland Air Force Base, is completely unrealistic and economically not expedient. For the DOE to disregard this alternative in the Draft PEIS is reprehensible. The Manzano WSS is considered a reasonable alternative in the Pantex Site Wide EIS - it should also be analyzed as a reasonable alternative in the S&DPEIS. To disregard Manzano WSS because of nearby population, our concern is - are the people of the Texas Panhandle expendable? After all, we are helping to produce the food that the people of Albuquerque eat! — 2/01.04.00

The plutonium processing options do not belong over the Ogallala Aquifer, which is our sole source of water. The contamination created at the facilities where this work has been done should be proof enough to the DOE that to contaminate another site is ludicrous. There is no technology to prevent this disaster from happening at Pantex, which lies on top of the Ogallala Aquifer and in the center of production agriculture. — 3/09.04.04

The disposition options are not adequately analyzed. MOX fuel should not even be considered because of environmental, non-proliferation, economic, health and safety reasons and impacts. The nuclear industry is pushing this option with no regard for the communities which have to endure all the undesirable consequences of such processes. DOE should eliminate this option entirely. — 4/08.03.01

This area must not be subjected to any reactor or reactors, not only because of impacts on the environment, we do not have sufficient water, but also because of the waste generated. Burning Pu in a reactor does not totally destroy the Pu and the waste generated by these reactors will be radioactive and in all probability remain on site. Pantex does not have the facilities to handle this type and/or amount of waste and storage over our water source is unjustifiable. — 3/09.04.04 cont.

The agricultural economy of the Panhandle/Amarillo area is totally disregarded in this PEIS. This is the Cattle-Feeding Capitol of the world. The cereal grains produced here are sent all over the world. We feed the hungry of the world, while at Pantex DOE builds weapons of mass destruction to kill people. The dichotomy that exists here is heart-wrenching. — 5/09.08.04

You may have just learned that our Ogallala Aquifer has been found to have contamination from the high explosives used at Pantex. How does the DOE plan to compensate the people of this area for this tragic happening? What will the final result be for agriculture and our agricultural products? What will the DOE substitute for our water supply? How will the economic stability of this area survive? — 6/09.00.04

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01 04 00 Comment Number 2

Combined storage of pits and non-pit Pu at the Manzano WSA was originally eliminated as a reasonable alternative in the Draft PEIS. After considering separate storage of pits from non-pit Pu, the option to store these pits at the Manzano WSA no longer appears unreasonable. The Manzano WSA was evaluated in the Pantex EIS and Section 2.1.3 of the Final PEIS. The Final PEIS was revised to clarify the consideration of the Manzano WSA for combined storage, and a description of the WSA was included in Appendix P.

09 04 04 Comment Number 3

Waste/hazardous material treatment/handling operations are regulated to minimize the potential for releases of hazardous substances to the soil or surface water which could then migrate to the groundwater.

08 03 01 Comment Number 4

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 08 04 Comment Number 5

The Proposed Alternatives for Pantex would be performed on existing DOE land and would not disturb any prime farmland. Furthermore, because the Proposed Alternatives would operate in full compliance with all Federal, State, and local environmental regulations, the operations would have no adverse impact on grain production. Thus, there would be no impact on the agricultural economy of the Panhandle/Amarillo area.

The DOE had better take care of the problems they presently have at Pantex and not consider any of those future actions listed in the S&DPEIS for location at Pantex. There are other places to handle the processes necessary to carry this country into the 21st century. THE DOE needs to STOP weapons research, development, and testing. The cold war is over - now its time to dismantle and dispose in logical, common sense ways. Stop construction of new facilities - it time to lay to rest this nuclear beast forever!

1/08.03.01 cont.

Sincerely,

Doris & Phillip Smith
Co-chairs

Enclosure

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09 00 04 Comment Number 6

Current and future operations at Pantex are not expected to affect the water quality of the Ogallala Aquifer. Waste/hazardous treatment/handling operations are regulated to minimize the releases of hazardous substance to the soil or surface water which could then migrate to the groundwater. However, since this aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge), Pantex operations contribute to the depletion of the Ogallala Aquifer and are analyzed in the PEIS. Also, current and future operations at Pantex are not expected to impact the soil used for agriculture and farming in the Pantex region.

PANHANDLE AREA NEIGHBORS AND LANDOWNERS, PANHANDLE, TX, DORIS AND PHILLIP SMITH
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THE IMPACT OF AGRICULTURE ON THE HIGH PLAINS TRADE AREA

In the pursuit of new industries, we oftentimes fail to recognize and build on an existing primary and stable industry in the area – AGRICULTURE. The second leading industry in the state of Texas, agriculture essentially is based on renewable resources and offers enormous economic benefits for technology-based gains in productivity.

"Texas leads the nation in the production of cattle and calves, cotton, wheat and sorghum. Texas ranks among the top ten states in the production of 17 of the nation's top 25 agricultural commodities."
Governor's Task Force on Agricultural Development (January 1987)

The dollar value of the agricultural industry to the High Plains Trade Area (HPTA) economy is immense, close to $4 billion dollars a year. In all likelihood, this figure underestimates the value of agribusiness due to the omission of government offices such as the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Department of Wildlife and Fisheries, independent feed stores and other small agribusinesses, agribusiness publications whose staffs and printing facilities are located in the HPTA and secondary processing of agricultural products. One of every four dollars of cash receipts from crops and livestock comes from the 26-county HPTA.

CROP PRODUCTION

HPTA crops annually bring in revenues exceeding $591 million as detailed below:

Wheat	$182 million
Grain Sorghum	136 million
Corn	103 million
Cotton	63 million
Sugar Beets	30 million
Vegetables/Other	77 million

Seven of the ten leading counties in wheat production in Texas are in the HPTA. These seven counties (Dallam, Moore, Sherman, Hansford, Ochiltree, Deaf Smith, and Carson) together grew 25.8% of the state's total wheat production in 1990. Almost half (46%) of all the wheat grown in Texas comes from the HPTA. This area produced 59.35 million bushels of wheat in 1990 of which 34.147 million bushels were irrigated. Texas produced 38.5 million bushels of irrigated wheat; in other words this area of Texas produces 89% of the state's irrigated wheat. HPTA also produces 25.2 million bushels of dryland wheat, or 27% of the state's non-irrigated wheat. 36% of Texas continuous crop wheat comes from this production area.

Parmer, Castro, Hale, Dallam, Moore, Hartley, Sherman, and Deaf Smith counties produce 63% of Texas corn.

Of the ten leading counties in sorghum production in 1989, five are in this trade area: Hansford, Deaf Smith, Ochiltree, Moore and Carson counties. 72% of the irrigated sorghum and 5% of the non-irrigated sorghum produced in Texas came from the HPTA in 1990; 26% of all sorghum produced in Texas came from HPTA.

In soybean production, four of the ten leading counties are in this trade area: Hale, Floyd, Lamb, and Swisher - which produce 42% of the state's soybeans. Five counties in this trade area produce 61% of the state's production of sunflowers. 28% of the Texas irrigated upland cotton is grown in seven counties in this trade area, 16% of all upland cotton in Texas is grown here.

LIVESTOCK PRODUCTION

The total sales for livestock and livestock products were 1.849 million for 1986, which is the latest year on which facts were available.

This trade area has been referred to as the cattle-feeding capital of the world. Approximately 80% of the world's supply of grain-fed cattle are fed in the United States. Texas ranks number one in fed cattle production in the United States, supplying 25% of the nation's fed beef. Of the state's production, 76.1% comes from this HPTA. This area has 22% of the total of all cattle and calves in the State of Texas, accounting for 3 million head.

AGRIBUSINESS EMPLOYMENT

The agribusiness sector includes: retail trade; wholesale trade; manufacturing; agricultural services; transportation and public utilities; finance, insurance and real estate. Of the total area work force of 115,491 persons, approximately 31,700 salaried employees (27%) work in jobs related to agribusiness in this area, excluding government employees. The 1986 payroll of agribusiness firms accounted for $446.21 million, 24% of the total area payroll of $1,869,966,000.

Of the 19 manufacturing industry groups in the HPTA, seven are classified as agribusiness: food and kindred products; textile mill products; apparel and other textile products; lumber and wood products; furniture and fixtures; paper and allied products; and leather and leather products. During 1986, these seven agribusiness industries employed 11,407 people or about 51% of the total employment in manufacturing. Payroll is $220.5 million, 42.4% of the total wages paid in manufacturing in the HPTA.

Agribusiness firms within the wholesale trade category employ 4,897 people with an annual payroll of $88.5 million, which is 44% of total employment and 43% of total payroll in wholesale trade.

Of the eight retail trade categories listed in the HPTA, three are agribusiness related. These are building materials and garden supplies, food stores and eating places. These three industries employed 13,843 people with an annual payroll of $115,955,000 in 1986. These figures represent 19% of the total employment and 9% of the total payroll in HPTA retail trade.

M-280

PANHANDLE AREA NEIGHBORS AND LANDOWNERS, PANHANDLE, TX, DORIS AND PHILLIP SMITH
PAGE 6 OF 7

Agricultural services is the third largest category, including veterinary services, animal services, and landscape and horticultural services. It has approximately 1,074 employees and accounts for $15.15 million in annual payroll. Eight companies were engaged in the warehouse and storing of commodities, with a payroll of $4.3 million, and about 200 employees. Agricultural credit institutions employ 94 persons, with a payroll of $1,795,000.

The above data does not include the payroll of commodity organizations, such as: state headquarters of the wheat growers, corn growers, sugar been growers, cattle feeders and the American Quarter Horse Association which are all located in the trade area.

People recognize the High Plains Trade Area as an agricultural region, but few realize the magnitude of the industry in terms of revenues, tax base, and employment for area residents.

AGRICULTURAL QUICK FACTS

Texas ranks first in the number of farms and ranches and first in the amount of farm and ranch land. Texas is the third largest agricultural state. It accounts for the nation's second highest farm income at some $12 billion annually. Texas ranks first in the value of farm real estate, first in cash receipts for livestock and products, second in cash receipts for all commodities and fifth in cash receipts for crops.

"TEXAS PROCESSES ONLY 6% OF THE NATION'S PROCESSED COMMODITIES, YET TEXAS RANKS SECOND IN THE VALUE OF RAW COMMODITIES PRODUCED. FOR EVERY PERCENTAGE POINT WE ADD TO OUR PROCESSING TOTAL, WE WOULD ADD 90,000 JOBS AND 9 BILLION DOLLARS TO THE TEXAS ECONOMY. WE MUST PROCESS OUR OWN PRODUCTION"
Governor's Task Force on Agricultural Development, Lubbock Hearing, June 27, 1988.

The economic clout which we have we need to use, value-added processing would bring billions of dollars into the HPTA. Historically, growth and development in Texas have been closely associated with a progressive and productive agricultural industry. The production of agricultural products expands economic activity in Texas far beyond the farm gate. Suppliers, processors, distributors - all agribusiness - benefit from agricultural production; ONE DOLLAR OF FARM SALES STIMULATES OVER $3.40 IN ACTIVITY WITHIN THE TEXAS ECONOMY.

That's what IS happening. Here is what COULD happen. If area economic developers pushed to develop some of the facets of agriculture as they have pushed to develop other industries, AND if they brought to optimum use of value added in the acres and various items that are produced in the Texas Panhandle, the economic impact of agriculture of the entire area would be in excess of four Super Colliders.

Put *that* in your economic-multiplier and see what you come up with!

M-280

RESOURCES:

The Impact of AGRIBUSINESS IN THE TEXAS HIGH PLAINS TRADE AREA, October 1989, Richard Edwards and Steve Amosson, Texas Agricultural Extension Economists; Jim Smith, Potter County Extension Agent; Texas A & M University System, published in cooperation with the City of Amarillo, Amarillo Economic Development Corporation and Southwestern Public Service.

1989 and 1990 Texas Agricultural Statistics, Texas Agricultural Statistics Service; Texas Department of Agriculture; U. S. Department of Agriculture.

Governor's Task Force on Agricultural Development, Lubbock Hearing Testimony, June 27, 1988.

Recommendations of the Business Development and Jobs Creation Task Force, submitted to Governor William P. Clements, Jr., January 1987.

June 1991, Doris Smith, HCR 2, Box 20, Panhandle, TX 79068, (806)335-1050.

PANHANDLE GROUND WATER CONSERVATION DISTRICT NO. 3, WHITE DEER, TX, C. E. WILLIAMS
PAGE 1 OF 2

Panhandle Ground Water Conservation District No. 3

John Spearman, President
Frank Simms, Vice-President
Charles Duncan, Secretary
Phillip Smith, Director
Jerry Glenn, Director
Jim Thompson, Director
Robert A. Clark, Director
C. E. Williams, Manager

P.O. Box 637 • White Deer, Texas 79097 • Ph. 806/883-2501 • Fax 883-2162

May 7, 1996

DOE-Office of Fissile Materials Disposition,
c/o SAIC-PEIS
P.O. Box 23786
Washington, D.C. 20026-3786

RE: Comments on Storage and Disposition of Weapons-Usable Fissile Materials Draft PEIS

The District's purpose is provide for the conservation, preservation, protection, recharging and the prevention of waste of the underground water reservoir through Subtitle B. Groundwater Management, Chapter 36, Texas Water Code.

In fulfilling our charge, I would agree with the two statements on page s-46 of the summary.

Long - Term Storage Alternatives

"Among the DOE sites under consideration, Pantex has the greatest potential to experience adverse cumulative impacts, particularly because of its relatively small, compact area. Water resources and biological resources would be vulnerable, and land resources, air quality, cultural resources, socioeconomics, public health and safety, wastemanagement, intersite transportation, and environmental justice could be susceptible to adverse cumulative impacts."

F-032

PANHANDLE GROUND WATER CONSERVATION DISTRICT NO. 3, WHITE DEER, TX, C. E. WILLIAMS
PAGE 2 OF 2

Page 2
May 7, 1996

Disposition Alternatives

"Implementation of the various proposed disposition alternatives to one or more of the DOE sites has the potential for incremental cumulative impacts in addition to the cumulative impacts identified above for the long-term storage alternatives. Among the DOE Sites used for analysis purposes, Pantex would have the greatest potential to experience adverse cumulative impacts."

After review of the document, it is apparent to me that there are better locations for the referenced missions than at Pantex. I am not willing to accept the risks that they might have on the Ogallala Aquifer. | 1/08.03.01

Sincerely,

C. E. Williams
General Manager

F-032

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Waste/hazardous material treatment/handling operations are regulated to minimize the potential for releases of hazardous substances to the soil or surface water that could then migrate to the groundwater. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

PANHANDLE PLASTIC SURGERY, AMARILLO, TX,
JOHN C. KELLEHER, JR.
PAGE 1 OF 2

PANHANDLE PLASTIC SURGERY, P.A.
JOHN C. KELLEHER, JR., M.D., F.A.C.S.
Diplomate American Board of Surgery
Diplomate American Board of Plastic Surgery

1616 Coulter Drive Amarillo, Texas 79106
(806) 358-5721 FAX (806) 358-5837 1-800-488-5804

April 3, 1996

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, D.C. 20026

Re: Stockpile Stewardship and Management and Storage and Disposition of Weapons-Usable Fissile Materials.

Dear Sirs:

Thank you for the opportunity to comment on the U.S. Department of Energy's (DOE) Programmatic Environmental Impact Statements (PEISs) on Stockpile Stewardship and Management and Storage and Disposition of Weapons-Usable Fissile Materials. Please also consider this my comment on the Pantex Site-Wide Draft Environmental Impact Statement, since most of the issues addressed in these documents are identical.

Of utmost concern has always been safety in the Pantex Plant and a certainty that the operations will be conducted in an environmentally sound manner. As a physician, I want to ensure that Pantex expansion is implemented in a way that does not impair the health or safety of area residents or have an adverse affect on the environment.

While the DOE has selected Pantex as the preferred alternate for assembly/disassembly, they failed to recognize Pantex as the preferred candidate site for new and/or consolidated stockpile management facilities. In doing to, the DOE has overlooked the best site for maintaining the integrity of the new U.S. nuclear stockpile and attaining maximum efficiencies and cost savings.

I feel that Pantex is the best site for new construction/ stewardship activities. Any comparisons the DOE looks at should be closely examined, especially being sure that comparisons are accurate including capital required, transportation, training, remediation, and other costs.

Pantex is obviously the best site to continue high explosives fabrication, having performed this for more than 40 years with an excellent safety record.

M-014

PANHANDLE PLASTIC SURGERY, AMARILLO, TX,
JOHN C. KELLEHER, JR.
PAGE 2 OF 2

U.S. Department of Energy
April 3, 1996
Page Two

I would urge the DOE to designate Pantex as the preferred alternate site for all existing and new stockpile management and stewardship functions as well as consolidation of all plutonium storage and disposition in any related functions. Thank you very much for the opportunity to comment on these documents. 1/08.03.01

Sincerely,

John C. Kelleher, Jr., M.D.

au

M-014

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

PARUCHURI, KAVENDRA
PAGE 1 OF 3

Department of Energy
POBox 3417
Alexandria, VA 22302

Dear DOE,

Your claim that you want citizen involvement and the best possible alternative for dealing with nuclear weapons and waste sounds terrific, yet I cannot help to find numerous contradictions in your statements in the SS&M and PEIS.

You fail to note:

1)We are trying to get rid of our plutonium and HEU, not make more of it in new and old reactors. Building more reactors can, in turn, spur the development of more nuclear weapons by the use of reactor byproducts. This plan for reusing plutonium in reactors breeds the proliferation of nuclear weapons not only in the US but also in other countries. Countries can start with the guise of using "commercial" reactors and secretly build nuclear weapons(see North Korea). Also, by reusing the plutonium, we will get more hazardous waste than we originally had. 1/01.06.00

2)DOE's visions need to be long-term, not short-term. Sure, nuclear reactors can give us energy in the short term, but is it worth risking the health and well-being of our children for 20,000 years to come? No. No. No. Even though death may not be immediate, radiation leads to death by 2/01.00.00

M-208

01 06 00 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Spent fuel produced under the weapons Pu disposition mission would be essentially the same as fuel normally produced in commercial reactors (both have Pu in the spent fuel form) which would not be more hazardous. The spent fuel would meet the same criteria as the commercial reactor spent fuel that would eventually be sent to an NWPA geologic repository.

01 00 00 **Comment Number 2**

It is only prudent and responsible to include both short and long terms. If Pu disposition is not implemented in the short term, the "clear and present danger" of nuclear proliferation could cause significant long-term irreversible damage to mankind.

changing DNA. No level of radiation is proven to be safe! Taxpayers end up footing many health bills that result from the radioactive poisoning that the DOE has allowed.

3)DOE needs to stop lying to the public about information that it has presently and about government deception in the past. DOE continues to lie to the people(see the reactor and people at Hanford, Washington who were poisoned by a radioactive cloud that the government secretly released). Unless the government opens its records to the public, we will never get at the truth. 3/01.00.00

4)DOE needs to consider more alternatives. By using the same contractors over and over, DOE fails to see new ideas and methods of disposal. Independent scientists, academics, analysts, and experts(working on their own; not for corporate America or the government) need to collaborate to research and find the safest method of disposal. Alternatives like vitrification must be considered. 4/01.00.00

5)Worker and community safety need to be the number one priority. Also, DOE needs to be consistent with the global urgency of eliminating all nuclear weapons. Nuclear reactors need to be shut down because as long as there are nuclear reactors, a potential for bomb making is present. 5/01.00.00

6)DOE really does not care about public opinion despite its claims. This debate is the most pressing issue facing Americans today, yet why did the government nationally encourage participation. I see Army 6/08.02.00

M-208

01 00 00 Comment Number 3

The Department of Energy has declassified a great deal of information regarding weapons-usable fissile materials. Inventories and locations of these materials were documented in a report released by the Secretary in her Openness Initiative in 1993 and again in 1996.

01 00 00 Comment Number 4

The Department of Energy considered a total of 37 alternatives for Pu disposition, and selected nine "reasonable" alternatives for further analyses in this PEIS. The screening process to select these alternatives was documented and reviewed by the Interagency Working Group (membership includes various Federal agencies and the White House Office of Science and Technology). DOE efforts also considered and built on the extensive previous work of the NAS.

01 00 00 Comment Number 5

Comment noted.

08 02 00 Comment Number 6

The Department of Energy uses a wide variety of methods to communicate with the public on these important issues. These methods include public meetings, as part of the NEPA process, and meetings outside of the process, such as the Plutonium Round Table. Numerous fact sheets and displays are made available at the meetings as well as by mail. All of this information is available on the Program's electronic bulletin board.

commercials all the time, but I did not see any commercials about SS&M and PEIS. Why was the local Nashville football debate set above the nuclear debate?

In addition, the PEIS(all 3,000 pages) is too confusing and complicatedly written for most citizens to understand. The incessant use of jargon terms, although useful in a DOE spelling contest, only serve to perplex the reader. 7/08.00.00

The terrible truth is: no citizen has time to read 3,000 pages of jargon. I suggest that the government create a nationally televised forum in which the DOE goes up for questioning on this issue. I'm not talking about a one sided DOE lecture. I'm talking about intensive scrutiny of the DOE by independent scientists, environmental activists, community leaders, academics, and other people who are against proliferation. If the DOE is so certain that it has all the options, let the members of DOE take on the unheard voices in front of the media and the American people. 8/08.02.00

If read, I'm sure that this letter will be dismissed as a letter from "just another one of those hippie freaks." Rest assured, I am not a hippie and certainly am not a freak.

Outraged United States CITIZEN,

Kavendra Paruchuri

M-208

08 00 00 Comment Number 7

It is recognized that storage and disposition of surplus weapons-usable fissile materials is a complex situation and necessarily involves the use of many technical terms. DOE has made every effort to keep the PEIS a readable document. The size of the document not only reflects the complexity of the proposed proceedings but also provides the public all of the information needed to fully participate in the decisionmaking process.

08 02 00 Comment Number 8

The *National Environmental Policy Act* requires the government to make documents such as the PEIS available to the public for comment so that the scrutiny of all members of the public can be applied to the Proposed Action. DOE also holds a number of interactive public meetings at which senior DOE officials present information, answer questions, and accept public comments. DOE strives to hold meetings and open avenues for comment in such a manner that there are no unheard voices.

PEACE ACTION TEXAS, DALLAS, TX,
JAN SANDERS
PAGE 1 OF 4

Jay Rose
Office of Reconfiguration, U.S. Dept. of Energy
1000 Independence Ave., S.W.
Washington, D.C. 20585

April 24, 1996

Dear Mr. Rose,

Please find here comments on the PEIS's that have recently been issued related to the reconfiguration of the Nuclear Weapons Complex. It is with great seriousness and concern that I am writing.

The comments are limited and incomplete due to the complexity of the subject, the voluminous nature of your "dictionary-size" reports, and the shortness of the time to comment.

I represent, in principle, the positions taken by the statewide group of which I am chair, Peace Action Texas, and of the national organization, with which we are affiliated with the same name. Together we are the largest grass roots peace organization in the country, we are an NGO to the United Nations and cooperate and support similar peace organizations in others countries.

As a peace activist who has been for years an advocate of nuclear disarmament, a Comprehensive Test Ban and a world treaty for Non Proliferation, I am celebrating the fact that we are finally on the path. Indeed, we are now living through a time of historic opportunity. Our actions, our policies will effect generations throughout the world for thousands of years to come. I hope and pray that we have the will and the moral courage to grasp this opportunity.

The United States can and must lead the world on a path to peace---peace with one another and peace with our fragile planet. Our decisions and actions related to our Nuclear Weapons Complex will be a major part of that journey for mankind.

Sincerely,

Jan Sanders

Jan Sanders
Chair, Peace Action Texas

Peace Action Texas is a grassroots based organization whose mission & purpose is to educate the public in order to recruit members and organize them into a nonviolent citizens' movement with the sustained political power to reverse the world arms race, abolish nuclear weapons, teach and practice non-violent resolution of conflict and construct a world of peace & justice.

Jan Sanders, Chair 7326 Malabar Lane Dallas, TX 75230 (214)369-9388

M-216

PEACE ACTION TEXAS, DALLAS, TX,
JAN SANDERS
PAGE 2 OF 4

Comments
by Jan Sanders
re the Draft Programmatic Environmental Impact Statement for the Stockpile Stewardship and Management of Nuclear Weapons and the Storage and Disposition of Nuclear Materials

Process for public comment: I called the DOE one week prior to the Amarillo meetings to get the schedule and format so that I could meet the deadline for air fares to travel from Dallas. The schedule, as told to me, changed in that week. Indeed local members said that had been a problem throughout the lead time for this meeting.

I am concerned about all three of the PEIS's, but I needed to be four places at once Monday evening, which was impossible. Because I was told that everything would be over by noon on Tuesday I was not able avail myself of the additional sessions on Tuesday afternoon.

I would encourage the Dept. in planning future meetings, hearings or workshops to automatically notify those who have participated in the past and to notify national offices of groups that would be interested in providing public input on the topics at stake. 1/08.02.00

The message? Public input, questions, and comments are not really being sought in this round of reviews.

Questions and Requests:

1) I would like to have sent to me the documents, memorandum or legislation from the President and the Congress that directs the DOE "to maintain the safety and reliability of the enduring nuclear weapons stockpile." p S-1 What is the number of warheads that the Dept. is being asked to maintain in the ready arsenal? How was this number determined? Was there public debate on this?

I was surprised to be told in Amarillo that the number (NWSP) was classified as a matter of national security. Is the number so small that the touted "nuclear deterrence" would be questioned? In light of the collapse of the Soviet Union, the signing of the NPT treaty extension and the discussions of a CTB, and the fact that we do indeed live in free and open society--I plan to request a Freedom of Information request for this information. It is impossible to respond to the issues of safety and environmental impact when the numbers range in the thousands.

"Stockpile stewardship and management capabilities are independent of foreseeable future stockpile sizes." S-3 It is hypocritical to say that we will lead the world toward nuclear disarmament, our NPT position, but we want to keep on the ready the capability of putting a bomb together tomorrow.

2) In light of the negotiations for a CTB and the Testing Moratorium that has been in effect under both a Republican and Democratic President, why is the Nevada Test Site being maintained and funded?

3) Why must an alternative to underground nuclear testing be developed to verify the "safety and reliability of weapons"? S-1 Our arsenal has been tested, repaired, & maintained for years We have accumulated a huge stockpile and an incredible amount of knowledge. Didn't we learn how to do it? How can the additional expense be defended?

4) In light of the knowledge (an lack of it) that we have acquired in the 50 years of the atomic era, why would we even consider the continuation or the new construction that would result in the

M-216

08 02 00 **Comment Number 1**

The Department of Energy, including the Office of Fissile Materials Disposition, makes every effort to automatically notify those who have participated in the past of public meetings about the availability of documents.

PEACE ACTION TEXAS, DALLAS, TX,
JAN SANDERS
PAGE 3 OF 4

creation of more low and high level waste? We are struggling with the waste we already have! To construct new facilities that would provide the plutonium processing that formerly was at Rocky Flats in this era of nuclear disarmament seems to make a mockery of our treaties, it insults the intelligence of the American taxpayer and is an incredible threat to the environment.

5) In the alternative to consolidate the "capability", translate that the ability to build new nuclear bombs, that moves the Rocky Flats plutonium processing to Pantex, I would like to ask if any or all of the other DOE facilities are located over an aquifer? | 2/09.04.08

6) Clarify for me the level of importance placed on the impact of jobs lost or jobs gained in any particular area in making your recommendations. | 3/08.03.00

I hope to receive answers to the above questions. In light of these questions, I would like to take some clear positions on the issues.

Positions and urgings:
1) Develop a program that would continue the orderly disassembly of our nuclear arsenal. Use this disassembly action to lead and provide an incentive to the other nuclear powers to do the same. Concentrate our research and considerable technical expertise on the safe disposal of the lethal material.

Use the nuclear labs and our trained and dedicated workers throughout the complex in a collaborative way to assist other nuclear powers in safely disposing of the nuclear arsenals over a period of time, with open inspections and exchange of expertise.

2) Provide American citizens with information that will enable them to participate in the development of a sound and safe nuclear public policy. The removal of the "classified for national security" blanket will set the stage for transparency in dealing with our international global neighbors. | 4/08.02.00

3) If other DOE sites are not over aquifers of the size and importance as the Ogalalla, I would urge the storage of plutonium or the vitrified or ceramic treatments of the waste at any of these other sites. There is no good location, but we do know that if radio-active material from plutonium enters the water supply it will be there for what number of years?---25,000? or just a few hundred? | 5/08.03.01

4) I strongly oppose the use of surplus plutonium by the nuclear energy companies here or abroad. It continues the waste stream, threatens the environment at every movement and handling of the material, and it leaves plutonium in the spent fuel that could be diverted to nuclear weapons. I know it is hot, difficult, etc., but the plutonium is still there and plutonium is a crucial component of the bomb. | 6/08.03.01

5) Shut down the Nevada Test Site. Convert it to a solar energy testing site or is the area to hot?

6) Shut down one of the labs. Does the myth of the "competition" still rein? When I learned that Nagasaki bomb was from the 2nd lab it made me grieve with shame that we might have used Nagasaki as a test. Convert the remaining lab into an all out effort to do the research on waste disposal or neutralization of radio-active materials.

M-216

09 04 08 **Comment Number 2**

Potential impacts to groundwater quality are considered to be minimal at all facilities due to hazardous material/waste handling and treatment/disposal Federal and State requirements. Due to the current and expected future depletion of the Ogallala Aquifer, the potential to affect groundwater availability is a concern at Pantex.

08 03 00 **Comment Number 3**

Socioeconomic factors, such as the number of jobs lost or gained under each alternative, have been analyzed in the PEIS. That information will be presented to the decisionmakers in making decisions on the storage and disposition of weapons-usable fissile materials. Socioeconomic environmental factors include the number of direct jobs (construction and operation), indirect jobs, local area infrastructure (police, hospitals, transportation, and education), and environmental justice.

08 02 00 **Comment Number 4**

The PEIS and its source documents referenced in Chapter 5 (*References*) of the PEIS are unclassified to the extent practicable without compromising national security. The classified information needs to be protected in order to reduce the probability of the nuclear materials being taken by terrorists, foreign or domestic. DOE is committed to an Openness Policy. A significant portion of the information used to prepare this PEIS was declassified in the last 2 years.

08 03 01 **Comment Number 5**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

PEACE ACTION TEXAS, DALLAS, TX,
JAN SANDERS
PAGE 4 OF 4

7) Stop the connection between technological research and development and war and killing. If our scientists would benefit from the development of a super computer, fine. Place it in one of our great universities or hospitals or at the Peace Institute not for new bomb making.

8) Peace Action has as one of its four program areas its support for economic conversion from a war-defense contracted economy to a peace economy. It includes job conversion and/or re training of workers loyal to and dependent as their localities have also been on the large government defense contracts. We would not turn our backs on their needs, nor would we ever support the continuation of bomb making as a jobs program. The DOE should not allow the boosterism of the Chamber of Commerce of one area (Panhandle 2000) dictate these decisions of national and international import. And finally,

9) Peace Action has taken a position in support of Abolition 2000, a worldwide movement to abolish nuclear weapons by the year 2000. Therefore, I urge that you consider the Start II treaty just that, a start toward the very attainable goal of Abolition 2000. To allow the Start II treaty to limp on anyway our leadership in the Non Proliferation work (p 8-7) would be wrong. 7/01.06.00

Some further observations, questions and comments:

With a stockpile numbering in the thousands, which was built over a period of years, I would make the logical assumption that it will age over a period of time as well. What if we cannibalized parts from one to another to make repairs and to maintain as many as possible, how long would it take for us to drop to zero? If, during this wear down period, we took a leadership role in the Non-Proliferation movement, we could produce a much safer and secure world, than we would have if were bristling with new weapons "capability".

In recent years the military genius of this country has produced modern, non nuclear weapons that approach the destructive power of a nuclear warhead. As a peace advocate, I'm not particularly proud of that, but I would point out that the environmental risks from the raw materials, the transport, the manufacturing, the assembling and the deployment of those weapons are not as great or as long lasting as those associated with nuclear bombs. How can we put our own people and our own environment at this level of health and safety risk when we have in hand safer alternatives? Have we, in the build-up and now in the prospects of the "stewardship" of an arsenal capable of blowing up the world, deterred the bomb from being dropped on us by others, but instead have we not dropped it on our selves?

The power, the near worship of the power of the nuclear bomb is evil. It undermines the moral character of this country that we are willing to continue to possess weapons of mass destruction of this magnitude and by the possession threaten the peoples of the world with their use.

During the height of the arms race during the Cold War the Bishops of the Catholic church challenged the bomb making and then the Bishops of the Methodist church in their "In Defense of Creation" pastoral letter challenged even the possession.

I intend to copy these comments to the President, the Secretaries of Defense and Energy and to my elected representatives to Congress -
Thank you - Jan Sanders

M-216

08 03 01 **Comment Number 6**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 06 00 **Comment Number 7**

Comment noted.

Storage and Disposition of Weapons Fissile Materials
Comments on Draft PEIS
April 2,1996

Bob Peelle
130 Oklahoma Avenue
Oak Ridge, TN 37830

Summary:

1. The "no disposition" option should be chosen for surplus weapons plutonium in the short run. Since treaty obligations probably require effort soon to reduce the amount of weapons plutonium stored, a plan must be developed to reduce the total amount of plutonium through its use as fuel in suitable nuclear reactors. Note that mixed oxide fuel use in current light water reactors would not reduce the total plutonium figure very much. (Total Pu = weapons Pu + reactor fissile Pu.) — 1/01.00.00

2. The number of storage sites for weapons plutonium should be reduced (not necessarily to one). This thought is based on efficiency and the need to abandon some storage sites. — 2/02.00.08

3. Plutonium and HEU storage should not be co-located. If the same site must be employed, strict separation between the areas used for each material should be assured. This suggestion is based on the assumption that fissile materials will be processed to some extent at each storage site. The health physics needs at the facilities can efficiently be met if workers at the HEU storage site are sure that plutonium cannot be present. — 3/08.03.01, 4/02.04.08

Details leading to Recommendation 1:

The author recognizes that this recommendation rests on different bases from those generally adopted. These are:

a. DOE and relevant agencies in other responsible nations should show concern for the long-term future of our society. Here, I suggest a time horizon of 1000 years for our nation and at least 1000 generations for human civilization. — 1/01.00.00 cont.

b. Energy resource depletion will eventually be a problem, so we should avoid compromising the resources that will be required. If breeder reactors come to be needed, plutonium reserves will be of great value for startup.

OR-001

01 00 00 Comment Number 1

The Department of Energy's Proposed Action is to conduct disposition for surplus Pu and provide safe and secure long-term storage for nonsurplus weapons-usable fissile materials to support national defense. The intent of the Proposed Action for Pu disposition is not to pursue total Pu destruction, but to convert the Pu into a proliferation-resistant form that meets the Spent Fuel Standard as recommended by the NAS. DOE, in considering the Spent Fuel Standard, evaluated the adequacy of the Standard versus the greater degree of destruction achievable with other options such as the Advanced Deep Burn Reactor Option and the Accelerator Option. It was judged that the Spent Fuel Standard is adequate since it would convert the weapons Pu to a form that would make it as difficult to retrieve and reuse in weapons as the Pu contained in the much larger existing volume of spent fuel from commercial nuclear reactors.

02 00 08 Comment Number 2

Comment noted.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to the Collocation Alternative. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

02 04 08 Comment Number 4

Comment noted.

c. After a few hundred years, spent reactor fuel (or Cs-137 spiked plutonium) can be safely processed by national groups or by terrorist organizations.

d. For either good or evil purposes, spent fuel repositories will be mined once fission product radioactivity has decayed to the level that the work can be done safely. If weapons grade plutonium (or HEU) is present, use in weapons will be considered.

e. Terrorist nations or organizations are assumed to be able to do anything that is possible. It is stated that reactor grade plutonium can be used to make nuclear explosives. (National Academy of Sciences, "Management and Disposition of Excess Weapons Plutonium" (1994) p30. I don't have the underlying reference) — 1/01.00.00 cont.

A quick response to my approach might be "...future generations will have to care for themseves." They must, but we should give them a chance for success whenever we can. Disposing of weapons plutonium quickly seems unimportant if much larger amounts of reactor plutonium are present and becoming available. The best course must be to pause and think hard before taking hasty expensive action.

Needs for careful analysis in the final PEIS:

Topics are listed below that need to be discussed in the final PEIS if the present recommendations are to be considered. Perhaps the author failed to locate adequate sections that are already included in the draft PEIS.

a. Show the estimated switchover and operating costs for plutonium storage as a function of how many storage sites are maintained, for a fixed total amount of plutonium. — 5/07.02.00

b. Indicate the extent to which chemical and/or physical processing are expected to take place at the major plutonium storage sites. Surface treatments and machining should be included. The interest is in supporting estimates of likely environmental releases. — 6/02.00.08

c. Estimate the extra capital and operating costs expected to be required if storage facilities for HEU and plutonium are co-located in such a fashion that health physics operations must distinguish during field monitoring whether alpha particles have been emitted from uranium or plutonium. — 5/07.02.00 cont.

d. Indicate what can be foreseen about the security of deep underground storage against a determined national effort to utilize guided drilling from a surface location external to the secure area at a storage location. (Note remarks in the — 7/13.00.00

OR-001

07 02 00 Comment Number 5

Cost data, along with technical and schedule data, were provided in a Technical Summary Report for storage beginning in late July 1996.

02 00 08 Comment Number 6

A basic assumption for this environmental analysis is that the materials are already in a stabilized form before they are received for storage. Actions taken for materials stabilization are covered by analyses under the Environmental Management Program.

13 00 00 Comment Number 7

The security aspects of the storage and disposition alternatives will be developed further in detailed designs for the selected alternative(s).

August 1995 American Nuclear Society panel report "Protection and Management of Plutonium", page 26.) 7/13.00.00 cont.

e. Is spent fuel easy to process safely to extract plutonium once most fission products have decayed, say after 300 years? 8/15.00.00

f. The acceptance of the finding that availability of reactor grade plutonium (high percent Pu-240) is as sensitive for proliferation concerns as pure plutonium-239 has grave policy implications. If the statement is fully true, the problem with surplus weapons-grade plutonium pales compared to the total plutonium nonproliferation problem.

Is it likely that the extra difficulties and dangers of building nuclear explosives with reactor-grade plutonium would discourage national or renegade terrorists from using this route to terror? Should DOE reverse its finding? If so, the idea of using mixed oxide fuel in light water reactors would be much more sensible than it is under the current "all plutonium is equivalent" dictum. 1/01.00.00 cont.

g. How rigid are the treaty obligations relative to how soon disposition of excess weapons plutonium must be accomplished?

h. Have reactors been developed for which discharged fuel does not contain as much plutonium as spent fuel from light water reactors now does? What about CANDU or equivalent reactors? My memory is that heavy water reactors can utilize most of the plutonium they produce.

The above comments represent only myself. I am a nuclear physicist retired from ORNL and a fellow of the American Nuclear Society. I was long a Roane County Commissioner.

OR-001

15 00 00 **Comment Number 8**

This would require appropriately designed facilities including extensive chemical processes. While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions any subsequent reprocessing and extraction of Pu from that spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort.

PETERS, DON, POCATELLO, ID
PAGE 1 OF 1

Comment ID: P0020
Date Received: April 18, 1996
Name: Don Peters
Address: Pocatello, ID

Transcription:

I'm for using the expertise that is available at the INEL to glassify nuclear waste, however, the storage problem has got to be solved. If the State of New Mexico continues to stall on the utilization of the storage facility that has been built down there, it should be closed, and if they stall saying they need roads around their cities, to me that's just another stall. The overhead that is being spent at taxpayer's expense down there for, in my estimation, no good purpose should be terminated, and if Nevada is going to pull the same thing, then we should be taking a hard look at that. Idaho has got the expertise and an area that can process this material without undue harm if it's left above ground and not in storage. If the storage problem should ever contaminate the aquifer out there, the down stream area of Idaho could be seriously damaged. That's my comments.

1/08.03.01

2/12.00.00

3/09.04.03

P-020

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Electrometallurgical Treatment Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, existing agreements, and public input.

12 00 00 **Comment Number 2**

Comment noted.

09 04 03 **Comment Number 3**

Hazardous material handling/storage operations are regulated to minimize the potential for releases of hazardous substances to the soil or surface waters where they could migrate to the groundwater.

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): Daniel E Peterson
Address (optional): 9127 75th Ave N.E.
Seattle, Wa., 98115

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. **Materials Immobilization/Vitrification** - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

After listening to public forum presentations vitrification seems the best option. The gov should consider securing of mix of materials that prevent reuse for weapons. 1/08.03.01

2. **Deep borehole disposal** - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

Current problems with 22 yr time frame or budget limits lead me to oppose short sighted but stabilization this might be tried on a limited basis before mass disposal 2/08.03.01

3. **Reactor Options** - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

This is less desirable and calls for security on an increased scale. 3/08.03.01

4. **Storage Options** - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

M-111

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

PETERSON, DANIEL E., SEATTLE, WA
PAGE 2 OF 2

Please use this space to write down any additional comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

These topics are very complex but there is no doubt the cost factor is high in all of them.

As a US taxpayer living on a modest retirement income I want to go on record as wishing to pay increased taxes that would be earmarked for storage and disposition of weapons-usable fissile materials. This includes aiding Russian and other nations improve their security and methodology in these areas.

All of my tax paying years I have supported defense spending while calling for limits on such spending when it reduces spending for social issues. I feel the cold war "victory" should not be frittered away by now saving money but failure to spend on programs of security storage and disposition. For those of us in the state of Washington the Hanford legacy of mismanagement and "down wind" problems makes this a life and death issue.

Daniel Peterson

4/01.03.00

M-111

01 03 00 **Comment Number 4**

The PEIS focuses on the environmental impacts of each alternative. DOE's decision process will be based on the results of the Final PEIS, together with information from technical and economic studies, national policy objectives, and public input. This process will provide the United States with the basis and flexibility to implement Pu disposition efforts multilaterally or bilaterally through negotiations, or unilaterally as an example to Russia and other nations.

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): Merry Ann Peterson
Address (optional): 2038 Marine View Dr. So
Seattle WA 98144-4211

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. Materials Immobilization/Vitrification - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics. 1/08.03.01
Maybe we don't need this if it will be buried very deep.

2. Deep borehole disposal - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole. 1/08.03.01 cont.
This sounds good

3. Reactor Options - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials. 2/06.00.08
I understand this would not get rid of all the plutonium, is that right?

4. Storage Options - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites. 3/08.03.01
NO

M-116

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Borehole Alternatives. Decision on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

06 00 08 Comment Number 2

The commentor is correct. Whereas there is a net reduction in the Pu inventory by an appreciable fraction, typically 25 to 35 percent, and perhaps as high as 50 percent, the total inventory is not destroyed. Note that the residual Pu is encapsulated in a highly radioactive spent fuel assembly and is no longer considered to be weapons-usable.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Please use this space to write down any additional comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

I am wondering if there are still problems as there were when the sheep down wind died in the 1940s; radiation sickness as in Japan since 1945; radiation escaping as in the Silkwood case. I understand the Chernobyl incident was a worker induced problem where workers over rode all safety devices to test a theory.

Thank you for addressing these issues.

4/15.00.00

M-116

15 00 00 **Comment Number 4**

Comment noted.

PHYSICIANS FOR SOCIAL RESPONSIBILITY, DENVER, CO,
SAMUEL H. COLE
PAGE 1 OF 2

COLORADO CHAPTER

PHYSICIANS FOR SOCIAL RESPONSIBILITY

The U.S. Affiliate of International Physicians for the Prevention of Nuclear War
Recipient of the 1985 NOBEL PEACE PRIZE
1738 Wynkoop, Suite 1, Denver, Colorado 80202 • (303) 298-8001

May 7, 1996

Office of Fissile Materials Disposition
Department of Energy
P.O. Box 23786
Washington, DC 20026-3786

Comments on the Storage & Disposition Draft PEIS

Please accept these comments on behalf of the Colorado Chapter of Physicians for Social Responsibility on the Draft Programmatic Environmental Impact Statement for the Storage and Disposition of Weapons-Usable Fissile Materials:

Introduction

The United States government bears the awesome responsibility of protecting its vast quantity of plutonium stored in Colorado and other states from ever ending up in a nuclear weapon. Decisions the United States government makes on the future disposition and storage of plutonium must also protect the public, workers and the environment from hazards associated with the plutonium.

(Although these comments specifically refer to plutonium, they also pertain to highly enriched uranium, as applicable.)

Specific Comments

1. Disposition option should be limited to immobilization: The only option the Department of Energy (DOE) should be considering is immobilizing the plutonium which would 1) stabilize it, 2) help prevent theft or diversion and 3) would make a very important statement to the rest of the world that plutonium has no value or usefulness thereby discouraging other countries for using it too, whether for civilian or military purposes. The immobilization process most promising is vitrification. A pilot vitrification facility should be studied for Rocky Flats without delay. Because plutonium at Rocky Flats is likely to be stored on site for many years, the DOE should begin making plans for storing it in a manner that addresses nuclear non-proliferation and safety. Absent from the draft PEIS are any such plans for the possible scenario of longterm storage of plutonium at Rocky Flats. This should be included in the final document in the context of exploring vitrification at Rocky Flats. | 1/08.03.01 | 1/08.03.01 cont. | 2/01.05.00 | 2/01.05.00 cont.

2. Reactor fuel and deep borehole disposal should not be under consideration: The use of plutonium as a fuel for nuclear reactors would be unwise from two standpoints. First, such an option is not | 3/08.03.01

M-169

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 05 00 **Comment Number 2**

Rocky Flats Environmental Test Site is not included in the PEIS as a candidate site for any of the alternatives evaluated. DOE has made a decision to move all weapons-usable materials out of RFETS and clean up the site. Any decision to vitrify Pu will involve RFETS only to the extent necessary to provide for stabilization of materials prior to their transfer to another DOE site.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to the disposition alternatives. The President's Nonproliferation Policy says the United States will not recycle Pu. Burning weapons-usable Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted into a nonproliferation form as spent reactor fuel.

The Reactor Alternative using MOX fuel is a reasonable alternative that converts the surplus Pu into spent fuel that meets the Spent Fuel Standard. Dependent upon fuel management, it is likely that no additional spent fuel would be generated beyond that of a conventional uranium fuel cycle.

The Department of Energy is committed to waste minimization and waste minimization considerations will be included in the implementation of the selected disposition alternatives. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

PHYSICIANS FOR SOCIAL RESPONSIBILITY, DENVER, CO,
SAMUEL H. COLE
PAGE 2 OF 2

congruent with nuclear non-proliferation since it treats plutonium as a useful product and would legitimize similar actions by other countries. This would make it difficult for the United States to determine the true motives of plutonium possession by other nations as military use of plutonium could be disguised as civilian use. Second, the MOX fuel option creates an enormous amount of radioactive waste - in a sense diluting the radioactivity of the fuel. Therefore, the DOE is encouraged to adopt a Nuclear Waste Standard in considering its disposition options in which the option chosen must produce the least amount of waste. | 3/08.03.01 cont.

Information is scant on the science behind the deep borehole option. Nevertheless, there are health, safety and environmental concerns that should be thoroughly addressed should this option be explored more closely.

3. Disposition should be congruent with future activities at Rocky Flats: The PEIS must better address how its disposition and storage decisions are congruent with the activities at Rocky Flats. The path forward in the document must address how the work at Rocky Flats fits into that plan. Processing should make the plutonium proliferation resistant. | 4/01.00.00

4. The processing and transport must be kept to a minimum: To protect the health and safety of workers and the public, processing and transportation of plutonium in the PEIS must be kept to a minimum. | 5/01.00.00

5. Plutonium must be subject to outside regulation: DOE's Advisory Committee on External Regulation has recommened the independent oversight of DOE's plutonium activities. The PEIS should likewise do the same. | 6/01.06.00

6. Plutonium must be labeled a waste by the DOE: To seriously discourage nuclear non-proliferation in the world, the DOE should determine, for the purposes of this PEIS, that plutonium is a waste, has no value and should be immobilized, perhaps in glass, in extremely secure conditions. | 7/01.04.00

Thank you for your consideration of these comments.

Signed,

Samuel H. Cole
Executive Director

M-169

01 00 00 **Comment Number 4**

The schedule analysis is presented in a separate document along with cost and technical analyses to support the DOE's ROD, which would lay out a path forward for implementing the Proposed Action.

01 00 00 **Comment Number 5**

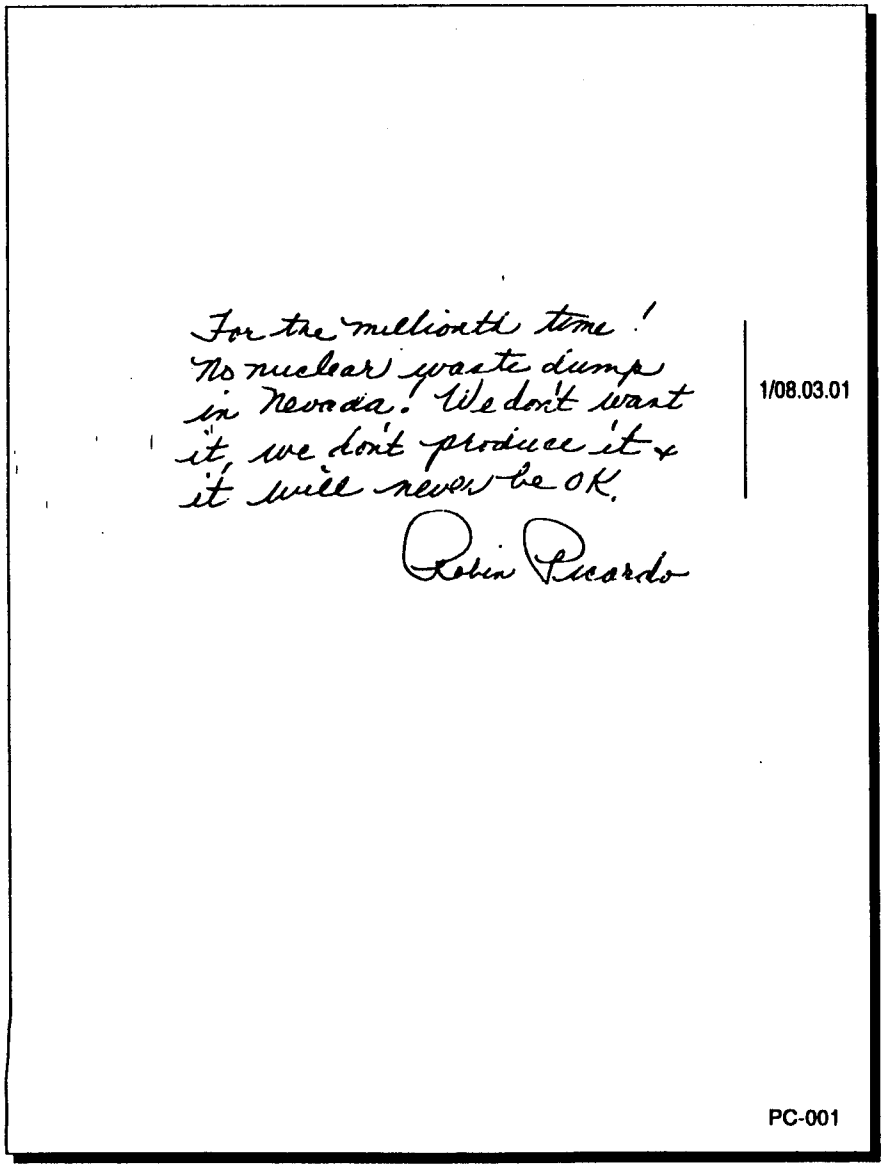
Comment noted.

01 06 00 **Comment Number 6**

Comment noted. DOE is still evaluating external regulatory options for its activities.

01 04 00 **Comment Number 7**

The determination of whether or not Pu should be considered a waste is beyond the scope of the PEIS. Furthermore, whether or not Pu is a waste will not change the range of disposition alternatives addressed in the PEIS. NEPA requires that the environmental impacts for all reasonable alternatives be considered. While immobilization is clearly a reasonable alternative, so are the Reactor and Borehole Alternatives. The nonproliferation risks of each alternative will be carefully considered and factored into the ROD for disposition. Cost, schedule, and technical analyses have been conducted by DOE and will also be factored into the ROD.



08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at NTS. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

POE, W. LEE, JR., AIKEN, SC
PAGE 1 OF 3

807 E. Rollingwood Rd
Aiken, S. C. 29801
May 6, 1996

U. S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-5156

Dear Sir:

Re: Comments on Draft PEIS "Storage and Disposition of Weapons-Usable Fissile Materials"

I would like to provide the Department my comments on the recent PEIS. I have a single comment on my view of what alternative should be selected. I have several comments on the materials presented in the PEIS and how they should be modified to improve the quality of the document.

Proposed Action.

The Department should select the MOX alternative for the proposed action. My judgment is based upon the following points.

- The surplused plutonium has large fuel value and should not be discarded. My view is that this plutonium should be fabricated into fuel and used to produce electrical energy. Recycle of the irradiated MOX-SNF should be used again to produce more energy, etc.. As the Department of Energy has indicated the U. S. dependence on imported oil has increased from ~33% to ~67% over the last 15 years. This plutonium should be used to help turn-around this dependence on imported fuel by this country.

- Use of the plutonium can be accomplished in a safe and secure manner. This use will not increase proliferation. It can be safeguarded; all we need do is to turn our energies to developing this approach. This development can be accomplished in the same time that production of MOX fuel takes. Other nations have safely used this recycled plutonium while safeguarding it.

- This turning from an illogical posture (that of not reusing all of our energy sources) will show the world that the United States understands world needs and is prepared to help with premier approaches that meets all of the needs for energy and provides a tight safeguard system to ensure that the surplused weapon materials are not stolen and pose clandestine threats to world security.

1/08.03.01

M-165

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

- The cost-effectiveness of this alternative should include the cost of replacing the energy generated by using the surplused plutonium with fossil fuel at todays oil prices and also at the cost of this replacement oil in say 20-years. Consideration should also be given to costs if the foreign oil producers decide to limit pumping of this oil to raise prices.

Specific Comments.

- Revise the last sentence of the summary to show that when used properly these stocks of weapons-usable materials do not poise a threat to world security. | 2/09.00.08
- Page S-4 the PEIS references DOE-STD-3013-94. Please have a copy of that standard sent to me.
- In several places in the PEIS (see page S-18 as an example), the statement is made that "because of the high percentage of minority and low populations in certain counties surrounding SRS, the potential exists for these populations to be disproportionately affected by an accident." This statement is not incorrect when all of the information presented in the PEIS is used but it does not apply only to SRS, it applies to most if not all DOE sites. At best, it is inflammatory to the minority residents and points out that in the areas surrounding SRS, minorities are at risk. From my understanding of the executive order pertaining to this subject, it requires DOE to evaluate "highly adverse" and " disproportant" impacts. This PEIS did not evaluate either of these. Revise to place in perspective and apply to all of the DOE sites in the PEIS. | 3/09.08.08
- The PEIS assumes a threshold of 100 person-rem as some standards below which analysis is not required or given. The source and intent of this <100 person-rem floor is unclear. | 4/09.09.08
- The schedule for implementing the various alternatives should play a more impoqtant roll in the PEIS. It is clear to me that the large driver for this PEIS is the need to get this weapon-usable plutonium under strict control as soon as possible. This raises several questions not addressed with sufficient clarity near the front of this PEIS. Several related points that need addressing early in the report are:
  - Safeguarding of U. S. governments Pu.
  - Safeguarding of other governments Pu around the world. As I see it the prime justification for these actions is the Pu stored in the former Soviet countries. If this is the case, the PEIS should show how actions in the U. S. will affect these other countries' protection of their Pu.

  | 5/01.00.00
- The deep borehole technology described in the PEIS seems to be in a very early stage of development and not sufficient for it to be a viable alternative in this PEIS. As I have seen in other projects, a proponent of a new technology underestimates the task of bringing such a technology to fruition and underestimates the associated risks. This section should discuss this items in sufficient detail that the reader can assess the alternative. Environmental affects of this alternative assume only technical risks. What about political risks and stakeholders concern of "disposal - not in my state". The Department has been hung-up on these disposal issues at Nevada for many years. | 6/04.00.00 | 7/04.03.00

Sincerely
W. Lee Poe, Jr.

M-165

09 00 08 Comment Number 2

By meeting the Stored Weapons Standard, the storage of weapons-usable fissile materials managed by DOE will not pose a threat to world security.

09 08 08 Comment Number 3

The PEIS evaluates demographic data for all of the candidate DOE sites. SRS has potentially affected minority and low-income populations within 80 km (50 mi) of the site. Although the health analysis for SRS indicates that there would be no significant adverse health impacts from operational and accidental releases of hazardous and radioactive materials, the PEIS acknowledges the possibility that dispersion of radioactive emissions could flow in the direction of minority or low-income populations. This could happen if an accident occurred and the wind conditions were unusual. However, the PEIS notes that the probability of such an accident is low and that under average meteorological conditions (based on the prevailing wind direction), accidental release of radiation would not lead to a disproportionate exposure to these populations.

09 09 08 Comment Number 4

The Final PEIS has been corrected. 100 person-rem is not a standard below which analysis is not given or required for NEPA purposes. Proposed 10 CFR 834 (see 58 FR 16268) would require that potential annual population dose be limited to ALARA and generally total effective dose equivalent be limited to 100 person-rem/yr from all pathways combined for DOE activities. The radiation exposure to the public is limited by the maximum individual dose of 100 mrem/yr.

01 00 00 Comment Number 5

Analyses of the cost, schedule, and proliferation impacts are discussed in separate documents to support DOE's ROD. The cost, schedule, and technical analyses were made available for public review beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996. A series of public meetings to discuss the proliferation analysis were conducted by DOE prior to issuance of the Final PEIS.

POE, W. LEE, JR., AIKEN, SC
PAGE 3 OF 3

04 00 00 **Comment Number 6**

More detailed information on a borehole technology is available in the Technical Summary Report and related borehole alternative summary reports made available to the public beginning in late July 1996.

04 03 00 **Comment Number 7**

As described in Section 1.5 of the PEIS, environmental considerations, technical, economic, domestic and international policy, and schedule analyses will support the ROD.

Comment ID: P0031
Date Received: May 1, 1996
Name: Father Ted Pottson
Address: 5005 Klinkey Road
Amarillo, TX 79107

Transcription:

I'm calling in to say that I am against Pantex having and storing nuclear waste and plutonium near where I live. Actually about four miles away. I as a citizen am against this. Thank you. | 1/08.03.01

P-031

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Amarillo Public Meeting Oral Comments - April 22 &23, 1996

Public Meeting Comments

Pantex Site
April 22 & 23, 1996

Evening Meeting - April 22, 1996

Plenary Session

C: [Prepared statement of Senator, Mac Thornberry (see attached)].

C: [Prepared statement of Representative, Larry Combest (see attached)].

C: [Prepared statement of State Senator, Teel Bivens (see attached)].

C: [Prepared statement of State Representative, David Swinford (see attached)].

C: [Prepared statement of Mayor of Amarillo, Kel Seliger (see attached)].

C: [Prepared statement of City Commissioner, Dianne Bosch (see attached)].

C: [Prepared statement of Amarillo Economic Development Corporation, Vance Reed (see attached)].

Evening Meeting
Breakout Sessions

C: Fuel fabrication is not a new technology for uranium oxide, but we are talking about the technology to produce plutonium oxide. Significant changes to the facilities and processes would not be required. | 1/06.01.08

C: There would be a one-half percent increase. The language of adverse impact when the impact would not be significant and it is not used at any of the other sites that have a slight increase is very harsh and misleading. ***(Note: This comment was made after a discussion concerning adverse impacts of water usage at Pantex.)*** | 2/09.04.04

C: If DOE would not build the mixed oxide fuel facility at Pantex then the land would be used for something else. For example, if the land was used for farming, more water would be used than if the land was used for a mixed oxide fuel or storage facility. DOE needs to compare | 3/09.04.04

AM-001

Note: A number of documents submitted during the public meetings were recorded as part of the minutes. The same documents, in some instances, were also submitted as hand-ins at the end of the meeting. In those cases, the documents are analyzed once, either as part of the minutes or as stand alone documents.

Listed below are the names of the organizations/individuals who submitted documents as part of the minutes and the page numbers containing DOE's responses to the comments:

U.S. House of Representatives, Congressman William "Mac" Thornberry	3–1088
U.S. House of Representatives, Congressman Larry Combest	3–691
State of Texas, Senator Teel Bivins	3–107
State of Texas, State Representative, David Swinford	3–1003
Amarillo Mayor Kel Seliger	3–107
City of Amarillo, Commissioner Dianne Bosch	3–140
Amarillo Economic Development Corporation, Vance Reed	3–16
No Name Submitted	3–521

06 01 08 **Comment Number 1**

Fabrication and use of MOX fuel using reactor grade Pu is a mature, industrial scale technology in Europe with at least three vendors actively fabricating MOX fuel. There are some differences introduced by the use of weapons-grade Pu, which DOE is addressing as part of an ongoing weapons-grade MOX fuel development program.

09 04 04 **Comment Number 2**

The depletion of the Ogallala Aquifer is a serious concern for the Panhandle region. Pantex is the only DOE site considered in this PEIS where depletion of water resources is a concern. Since the Ogallala Aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge), Pantex operations contribute to the depletion of the Ogallala Aquifer and are analyzed in the PEIS.

Amarillo Public Meeting Oral Comments - April 22 &23, 1996

the disposition processes with other land usages rather than zero usage. DOE is overreacting to the water usage at Pantex. | 3/09.04.04 cont.

C: But it is not a fair perspective, if there is a small change with not a large adverse impact. We (the citizens of Amarillo) are very sensitive, when this language is used against the natural resources that we have. As stated before, the water usage for farming would be for irrigation. | 2/09.04.04 cont.

C: DOE needs to clarify predicted water use, define the baseline, and put water use in perspective to other local uses (i.e., irrigation). ***(Note: This comment summarizes participants' concerns regarding water usage.)*** | 4/09.04.04

C: DOE gives the impression that they have ranked sites. If DOE has ranked the sites then DOE needs to provide the basis for and an explanation about how the ranking will be used. | 5/09.00.08

C: DOE should not consider small impacts that have no significant effect. DOE needs to change the language so that true impacts are expressed and insignificant ones are not. | 6/09.00.08

Evening Meeting
Summary Session

C: Any person opposed to using Pantex for any of these processes would oppose anything proposed in Antarctica. | 7/08.03.01

C: By trading one fuel for another, the waste would be different. In order to replace mining and milling, the United States would have to build a mixed oxide fuel fabrication facility, which would increase the amount of waste. | 8/09.11.08

C: I am concerned about using the mixed oxide fuel process, which will contaminate the plutonium, rendering it no longer as a proliferation threat. Vitrification could accomplish this without the additional waste. | 9/08.03.01

Morning Meeting - April 23, 1996

Plenary Session

C: The slide from the storage and disposition brief showed public input to the Record of Decision in reference to the preferred alternative. However, there has been no discussion on what the preferred alternative might be and the public is trying to provide comments. During the discussions last night on this issue there were no answers. DOE has seemed to make the | 10/08.00.00

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09 04 04 Comment Number 3

The disposition environmental analyses in the PEIS are provided so that the decisionmaker can choose a disposition technology or combination of technologies. Site-specific analyses were provided in this document to provide a range of environments that could be affected. All comparisons are made to the No Action Alternative, so that a conservative analysis of the impacts is performed.

09 04 04 Comment Number 4

The No Action Alternative water use estimates for the year 2005 were used as the baseline against which each of the alternatives are compared in Chapter 4. Consistent with NEPA, the potential for impacts from operations at Pantex is analyzed; analysis of users outside the ROI is not within the scope of this PEIS. Since Pantex contributes to the depletion of the Ogallala Aquifer, the impacts are analyzed in the PEIS.

09 00 08 Comment Number 5

The Department of Energy did not intend to give the perception that the sites were ranked. Based on comments received, the Summary of the Draft PEIS was revised. All revisions made appear in the Summary of the Final PEIS.

09 00 08 Comment Number 6

Based on comments received, the Summary of the Draft PEIS was revised. All revisions made appear in the Summary of the Final PEIS.

08 03 01 Comment Number 7

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

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preferred alternative moot to this process. | 10/08.00.00 cont.

Morning Meeting
Breakout Sessions

C: I urge DOE to collocate the storage facilitates for strategic and surplus materials. | 11/08.03.01

C: The radiological impacts chart showed that for storage there would be minimal impacts and for disposition the impacts would be within standards.

C: Can DOE reference the standard or criteria that reached this basis. ***(Note: This comment was related to a discussion on acceptable radiation exposure levels to workers.)*** | 12/09.09.04

C: There is not any reason not to consider long-term storage or disposition at Pantex. | 7/08.03.01 cont.

C: The wording within the document should be checked. The summary says there are adverse impacts to water usage at Pantex. | 13/09.04.04

Morning Meeting
Summary Session

No summary session

Afternoon Meeting- April 23, 1996
Plenary Session

C: [Prepared statement of Source Unknown (see attached)]

Afternoon Meeting
Breakout Sessions

Q. Executive Order 12898 addresses the Federal actions to be taken on environmental justice. A February 11, 1994 memo from President Clinton to all government agencies and department heads requires that the socioeconomic effects at site communities not just health effects are to be analyzed? Why have health effects only been covered in the draft Programmatic Environmental Impact Statements? ***(Note: This question did not appear to be answered in the course of the meeting.)*** | 14/09.12.08

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09 11 08 **Comment Number 8**

The PEIS acknowledges the fact that constructing and operating a MOX fuel fabrication facility would increase the wastes generated at any sites selected for analyses. The wastes generated for the MOX fuel fabrication facility are presented in Section E.3.2.3. The impacts associated with operating the MOX fuel fabrication facility are presented in Section 4.3.5.1.10.

08 03 01 **Comment Number 9**

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 00 00 **Comment Number 10**

A Preferred Alternative was not identified in the Draft PEIS for two reasons. First, DOE wanted to obtain public input on the alternatives before identifying a Preferred Alternative. Second, DOE wanted to develop additional information on technical, cost, schedule, and policy considerations independent of the NEPA analyses. The results of the technical, cost, and schedule analyses were issued by DOE beginning in July 1996, and the results of the nonproliferation study were issued in October 1996. This information will be used in reaching a ROD.

08 03 01 **Comment Number 11**

The Department of Energy acknowledges the commentor's support for the Collocation Alternative. Decisions on storage alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

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C: The cumulative potential for adverse impacts in the storage and disposition summary show that Pantex has the highest impacts. I know adverse is a technical term used by the National Environmental Policy Act, but it is a scary and emotional term. Can DOE re-examine this and state exactly what adverse means.

C: I am concerned about the cumulative impacts in the storage and disposition document and summary, the document itself and the summary do not relate. I can't understand the basis for the statement adverse impacts? On pages 18, 19, 20, 28 and 31 of the summary, "could have adverse impacts" is stated for several sites, however, on S-72 "sites are expected to comply with ambient air standards and guidelines" both of these statements are referring to the upgrade alternative. I do not understand why Pantex, Savannah River Site, Idaho National Engineering Laboratory, and Richland are singled out. 15/09.00.08

Q. The Council on Environmental Quality Guidelines published in 40 CFR 1500 defines cumulative impact as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over period of time. Why is there no analysis of the incremental socioeconomic impact of this action when added to other past and present actions such as the cancellation and closure of several government programs? *(Note: This question did not appear to be answered in the course of the meeting.)* 16/09.08.04

C: DOE needs to address the issue of the definition for adverse impacts with the Council on Environmental Quality. 15/09.00.08 cont.

Afternoon Meeting
Summary Session

No summary session

The meeting was recessed, DOE representatives stayed until the 6 p.m. adjournment. During that time one individual came and a statement was presented to DOE by Cecil Wilson concerning the newspaper article by Mark C. Self. (Copy attached.)

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09 09 04 Comment Number 12

The Federal radiation exposure limit for an individual worker is 5,000 mrem/yr which is set forth in the Federal Code (10 CFR 835). This is the basis for limiting the radiation exposure to workers on DOE sites. Furthermore, DOE has also established an administrative exposure level of 2,000 mrem/yr (DOE/EH 0256T) for the workers. DOE requires all sites to maintain worker radiation exposure levels ALARA, preferably below the administrative level.

09 04 04 Comment Number 13

Since the Ogallala Aquifer is being depleted (that is, the withdrawal is exceeding the recharge), Pantex operations contribute to the depletion of the Ogallala Aquifer and therefore are analyzed in the PEIS.

Additional groundwater drawdowns from the Proposed Actions for the various long-term storage alternatives are expected to be very small. The Summary was revised to emphasize that, under the No Action Alternative, Pantex's water use from the Ogallala Aquifer is expected to decrease significantly by the year 2005, and that additional withdrawals attributed to the long-term storage alternatives are expected to be very small (less than 0.5 inches [in]/yr).

09 12 08 Comment Number 14

Socioeconomic impacts are analyzed in detail in all of the environmental statements noted by the commentor. The PEIS analyzes potential socioeconomic impacts for all of the Proposed Alternatives. For those alternatives that would add a new mission to a particular DOE site, there would be no adverse socioeconomic impacts. In fact, the analyses indicate that the impacts of these alternatives would be small but beneficial to the affected regional economies. There would be no environmental justice issues associated with these alternatives. For those alternatives involving phaseout of storage facilities, the job loss would be very small in all cases except RFETS. Even in the case of RFETS storage facility phaseout, the employment loss would only have a minimal impact on the local communities and the regional economy. Hence, there would be no environmental justice impacts from these alternatives.

Thank you for allowing me the opportunity to make a few remarks.

Many of the others who will testify
will discuss the outstanding record of the Pantex plant,
the unparalleled level of community support which the plant enjoys,
and the willingness to consider other missions
as we sort out the nuclear weapons complex after the Cold War.

I'm going to focus on some broader questions
which certainly affect Pantex
but also the larger security needs of the country.

I do so not because I disagree with the other points
or because I don't think they are important.
Pantex's record, its people, its community support,
and its openness to other possibilities are its key strengths
and no one else can match them.

But during my tenure in Congress, on a much
I have attempted to make a serious study
of our nuclear weapons complex,
in part because I represent one of its crown jewels
and in part because I believe
that a modern, effective nuclear capability
is absolutely necessary to our national security.

I won't say that I have learned all I can or intend to,
and I won't represent to you that I know all the answers
during this time of change and turmoil.

But I am confident that I know enough to raise some serious questions
that relate to the subject today and to our children's security.

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09 00 08 **Comment Number 15**

Based on comments received, the Summary was revised. The related text was revised to clarify the comparison of impacts and to delete references to "adverse" impacts. Also, language in the cumulative impacts section of the Summary has been revised to better reflect the impact analysis in Section 4.7 of the Final PEIS.

09 08 04 **Comment Number 16**

The proposed storage alternatives at Pantex would involve relatively small numbers of new workers and would not have a large impact on the regional economic area. In fact, adding new missions at Pantex would counter the projected decrease in workforce over the next decade that will result from the reconfiguration of the nuclear weapons complex. The Phaseout Alternative would involve the loss of only five jobs and even with projected future reductions, the cumulative impact would be small. These issues are discussed in Section 4.7.2.4.8 of the PEIS.

This is, of course, a time of great change
brought about by the end of the Cold War,
by the fact that the DOE was not as careful
in the past as it should have been,
and by this administration's decision to stop all nuclear testing.

Stockpile Stewardship and Stockpile Management

In my view, stockpile stewardship and stockpile management
are important for the nation
regardless of whether we conduct nuclear tests or not.

We should use a number of methods to make as sure as we can
that our nuclear weapons are safe and reliable.
In doing so, we are making a serious mistake
if we neglect to factor in the importance
of highly skilled workers at production plants.

I tend to agree with those who argue that we need smart people in labs
and maybe even that we need smart people at two labs
to compete against one another.

But every bit as much as we need smart people in labs,
we need experienced, knowledgeable people in production plants
who know how to take a design or a procedure
and produce a product that meets the requirements
safely and efficiently
time after time
so that we have weapons that are safe and reliable
on which we can stake our children's freedom.

That's what people at plants like Pantex do.

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It's like if you're building a house,
you need architects to draw up the blueprints and to consult with,
but there is absolutely no substitute
for skilled carpenters, and plumbers and painters
who know how to get the work done,
who know what problems there may be
in translating the blueprints and procedures into precise components;
and who have a proven track record
of having done it -- time after time.

I am afraid that an undercurrent in DOE today,
that sometimes even rises to the surface,
is a lack of appreciation
for the importance of those workers on the assembly line
at Pantex and elsewhere.

If we lose them, we are a weaker nation
and no number of PhD's at the labs
will replace what we've lost.

I find it incredible that DOE would ask more and more
of at least one of our production plants
and yet allocate less money for it to fulfill its mission.

If we can't keep the trained, experienced personnel at Pantex,
the country won't reach its goals for Stockpile Stewardshp and Mgmt
We will begin to lose confidence in our nuclear deterrent,
and we will have been penny wise and pound foolish.

I am also concerned
that we are just focusing on dragging out the life
of current weapons
without taking positive steps

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toward replacing our existing weapons
which will all too soon be at the end of their intended design life.

A real question is whether we will be able to build nuclear weapons again
and how.
There are many improvements which could be made now,
others which we will want to make in the near future,
and all the while we have to be prepared
to deal with changes in Russia, China and elsewhere.
I'm not sure we're ready.

<u>High Explosives</u>

Let me address the one issue in the PEIS
for which no preferred alternative was included,
that is high explosives.

When you compare apples to apples,
no one seriously disputes
that the most cost effective option
is retaining the existing mission at Pantex.

The sole justification to moving high explosives
to Los Alamos and Livermore
is that we need to keep knowledge and competence
of high explosives in the Labs.
OK - but we need to keep it at the production level too.

You can do all the research you want
and have all the knowledge you can handle,
but if you can't reliably and safely translate that knowledge
into real production,
you have nothing.

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There is no reason in the world
that the Labs can't continue to send people to Pantex as needed
for the manufacture of high explosives,
but to remove high explosives
completely out of the production complex
would be a big mistake.

Disposition -

The issue of what we're going to do
with the excess plutonium and uranium is of key concern here.

As you know, we've got several thousand pits stored here
with more being added every day.
I am disappointed that the PEIS gives so little guidance
on what's to be done.

We need to get on with making these key decisions.
Two weeks ago at Los Alamos,
I was able to see firsthand some of the work involved in the Aries project.

We have some very promising technologies,
but the country needs leadership.
and our area needs confidence that DOE knows what it is doing
and is doing the right thing.

As long as I am in the Congress,
I will be involved in making these decisions
and I will do everything I can
to see that our area is protected,
to see that our nation is secure,
and to see that our children have the opportunity to live in freedom.

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U.S. REPRESENTATIVE LARRY COMBEST
(TEXAS--19)
THE U.S. DEPARTMENT OF ENERGY'S
PUBLIC HEARINGS
AMARILLO, TEXAS
APRIL 22, 1996

I would like to thank the Department of Energy (DOE) for holding these series of public hearings in Amarillo so that our Panhandle neighbors can have an opportunity to share their views on the DOE's Programmatic Environmental Impact Statements (PEISs) on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons Usable Fissile Materials. I am pleased to be a participant in these public hearings to discuss Pantex's future.

Since the Pantex Plant's earliest origins in World War II as a site that built conventional bombs for the U.S. Army, countless numbers of individuals from across the Panhandle have made instrumental contributions to the United States' winning of the Cold War. In the post-Cold War era, Pantex workers have once again answered the call to duty in peacetime and found a new role in disassembling nuclear weapons. I stand here today to tell you that Pantex is not only ready, but uniquely qualified to continue to enhance its role as a vital component of our nation's nuclear weapons industrial base as we prepare for our national security needs for the 21st Century. 17/08.03.01

I can fully appreciate the DOE's responsibility to reconfigure the country's nuclear weapons production complex for the 21st Century. As the Chairman for the U.S. House of Representatives' Permanent Select Committee on Intelligence, I recently conducted a year-long review of what is commonly referred to as the "intelligence community," the classified government agencies that collect information to advise the president and Congress on actions of foreign governments and terrorists. The legislative proposal I introduced as a result of this year-long review will ready the nation's secret intelligence-gathering efforts for the 21st Century. The approach I took in crafting this proposal brings these agencies to end unnecessary duplication and work efficiently for better intelligence to keep America safe from nuclear proliferation, from terrorism, and from narcotics. America continues to need strong, highly-capable and ever-flexible intelligence community to provide the earliest-possible warning and analysis in a world that is still a very dangerous place. I want our nation to continue to meet the challenges of the next century, we should ask no less of our nation's nuclear weapon complex.

In the post-Cold War era, many have called for a retreat of our resources and readiness regarding national security. I believe that the post-Cold War era with nuclear proliferation leaves our nation more vulnerable than ever. Now that we no longer have the Soviet Union, we never know where our next threat is going to

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08 03 01 Comment Number 17

The Department of Energy acknowledges the commentor's support of continued and new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national considerations, and public input.

come from. I urge the DOE to reject these specious arguments, and ensure that the nuclear weapons complex of the 21st century maintains our nuclear deterrent for the foreseeable future. With nuclear weapons remaining a vital component of our national security into the 21st Century, Pantex is the only facility that can fulfill this mission.

However, first and foremost I am adamant that any current and future functions at Pantex will be conducted in a safe and environmentally sound manner. The first priority for any expansion at Pantex is that it be implemented in a way that does not impair the health or safety of area residents or have an adverse affect on the environment. I believe these points serve as a prerequisite to any current or future activities at Pantex. 17/08.03.01 cont.

I do not take these points lightly. I was born and raised in the Panhandle. I grew-up not far from the Pantex Plant on a family farm. I would never support any proposal or effort that would endanger the lives or environment of this region. This is my home and members of my family reside here.

I am proud of the Pantex Plant's reputation as one of the cleanest facilities in the DOE's nuclear weapons complex. They have been good stewards of the land. As a matter fact, if I were not in Amarillo today talking about the importance of Pantex to our country, I would be singing their praises from back in Washington, D.C. Today, in Washington, the DOE's Pantex Plant is being recognized as a "Model Facility" and will receive the "White House Closing the Circle Award" for its efforts on waste minimization and recycling activities. Only twenty-two federal facilities from across the country received a "Closing the Circle" award. Clearly, Pantex takes its environmental safety responsibilities very seriously and I am pleased that this national award is highlighting their hard work.

In the DOE's draft PEIS, I am pleased that the department selected Pantex as the preferred alternative for assembly and disassembly. Wisely abandoning earlier plans to transfer those functions to the Nevada Test Site (NTS) which would have been cost prohibitive and painfully inadequate to meet future needs. In addition, I am pleased the DOE draft recognized the importance of Pantex to the country's nuclear weapons complex.

Pantex is perhaps the most cost-effective alternative for any new construction of Stockpile Stewardship and Management facilities. Among many of the reasons, labor, costs, utility rates and water and land availability at Pantex, as well as public and political support, are more agreeable than those at any other site in the complex. Pantex should be considered as an alternative site for future defense-related facilities to complement activities at the national labs. Location of additional defense-related activities at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost to American taxpayers. In deliberations, the DOE

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should insist that budgetary comparisons between Pantex and other sites are accurate, and include capital, transportation, training, remediation, and other costs.

With the production assembly and disassembly functions remaining at Pantex, the high explosives functions should be present at the corresponding site. Even the DOE draft admits that Pantex must retain high explosives capabilities to process the inventories already on site from dismantling. Therefore, the least expensive alternative is to maintain high explosives functions at Pantex. I would also take issue with the draft PEIS statement that there are no advantages to siting high explosives at Pantex as opposed to the national labs. The capital outlay alone necessary for transfer is cost prohibitive. Also of importance, should future need arise for new weapons production it will be critical to have the high explosives facilities at the weapons production and assembly site.

As the DOE considers its options regarding the dismantling of a significant portions of the nuclear stockpile and searches for productive and environmentally sound uses for the dismantled components of our nuclear arsenal, Pantex and its functions are uniquely qualified for these new missions. Pantex has the necessary safety, security and surveillance capabilities to accommodate and expanded role with minimal costs to the federal government.

Once again, I would like to thank the Department of Energy for holding these hearings on the future of Pantex. I firmly believe the Pantex Plant will continue to play a vital role in our nuclear weapons complex well into the 21st Century. I applaud all of you who are here tonight to make your views known on this critical issue. I pledge to you that I will work with Representative Mac Thornberry and the rest of the Texas delegation in Congress to ensure that Pantex is a vital component of our country's nuclear weapons industrial base. I appreciate the opportunity to participate in this public hearing, and respectfully request the DOE to consider my recommendations. Thank you.

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PUBLIC MEETING ORAL COMMENTS, AMARILLO, TX
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SENATOR TEEL BIVINS
DISTRICT 31

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The Senate of
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April 22, 1996

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, DC 20026

Thank you for the opportunity to comment on the U.S. Department of Energy's Programmatic Environmental Impact Statements on Stockpile Stewardship and Management and Storage and Disposition of Weapons-Usable Fissile Materials. Please also consider this my comment on the Pantex Site-Wide Draft Environmental Impact Statement, since most of the issues addressed in these documents are identical.

First and foremost, I am adamant that any current and future functions at Pantex will be conducted in a safe and environmentally sound manner. Our first priority is to ensure any expansion at Pantex be implemented in a way that does not impair the health or safety of area residents or have an adverse affect on the environment. These goals serve as a prerequisite to any current or future activities at Pantex, including expansion.

I. Generally, I am pleased that DOE selected Pantex as the preferred alternative for assembly/disassembly, thereby abandoning earlier plans to transfer those functions to the Nevada Test Site which would have been cost prohibitive and never been adequate to meet future needs. However, by failing to recognize Pantex as the preferred candidate site for new and/or consolidated stockpile management facilities, the DOE overlooks the best site for maintaining the integrity of the U.S. nuclear stockpile and attaining maximum efficiencies and cost savings.

II. SSM PEIS:

1. Pantex is the best place to site new construction/stewardship activities. Pantex is perhaps the most cost-effective alternative for any new construction of SSM facilities. First, labor costs, utility rates, and water and land availability at

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Pantex, as well as public and political support, are more amenable than those at any other Complex site. DOE makes no mention of a strategic plutonium reserve that is necessary to meet future national security needs, even though the PEIS mentions that strategic storage should be co-located with disassembly. Pantex should be the preferred site for such a mission in coordination with its management functions. In its deliberations, DOE should insist that budgetary comparisons between Pantex and other sites are accurate, and include capital, transportation, training, remediation and other costs.

2. **Pantex is the best site to continue High Explosives fabrication.** Consistent with the strengths identified above for increased stewardship and management duties, the high explosives functions should also remain at Pantex. Because the production assembly/disassembly functions remain at Pantex, the HE fabrications duties should be present at the corresponding site. After all, the SSM Draft admits that Pantex must retain HE capabilities to process the inventories already on site from dismantling. Therefore, the least expensive alternative is to maintain HE functions at Pantex. I adamantly disagree with the statement in the draft PEIS that there are no advantages to siting high explosives at Pantex as opposed to the national labs. The capital outlay alone necessary for transfer is cost prohibitive. In addition, should future need arise for new weapons production, it will critical to have the HE facilities at the weapons production/assembly site. More over, this is a highly trained group of workers at Pantex with vast experience in HE fabrication. Creating a new workforce at another location would be inefficient, expensive and potentially dangerous.

III. Fissile Materials (Plutonium) Storage and Dispositions PEIS. As the sole DOE-authorized facility for the assembly and disassembly of nuclear weapons, Pantex has historically handled storage in a safe and efficient manner for more than 40 years. Once again, acknowledging cost saving considerations, Pantex could continue to store plutonium, which is already at the site, and upgrade facilities for any and all storage options being considered by DOE with minimal cost and difficulty. Pantex currently safehouses more than 8,000 surplus pits and plans are being made to ship additional pits from Rocky Flats to Pantex. It makes little sense to re-create storage facilities at another site and the unnecessarily transport large amounts of plutonium across the country from Pantex. The budgetary and political costs for such a decision would be enormous.

Of the three disposition options identified in the PEIS, it appears that only mixed-oxide fuel fabrication would be relevant to Pantex. Because this is an experimental procedure, I believe three criterion are critical before it be commenced: 1) It must be demonstrated beyond the shadow of a doubt that this plutonium processing can be done safely and in an environmentally sound fashion. The sad truth is DOE's history with processing plutonium is not a good one.

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2) The community of the Texas Panhandle must come together and support this technology being conducted at the Pantex Plant. Pantex currently enjoys widespread community support. If this technology meets criteria number one, I anticipate that the support could also go to the implementation of a mixed-oxide fuel processing program. 3) Independent regulatory oversight is more critical for disposition than any other area of DOE nuclear materials operations. From a public policy standpoint, it makes no sense that there is no independent regulatory oversight of DOE's handling of nuclear materials. (While Congress created the Nuclear Facilities Safety Board, it lacks the authority to shut down a plant.) Because of the regulatory morass that currently exists in the State of Washington, I believe that this regulatory oversight should be vested in one agency outside of the DOE. The lead agency could be a state agency or a federal agency. The lead agency would then contract with the other state and federal agencies needed to provide seamless regulatory oversight without overlap of function and jurisdiction.

IV. Conclusion. Based upon these reasons, I respectfully urge DOE to designate Pantex as the preferred alternative site for all existing and new stockpile management and stewardship functions, as well as, consolidation of all plutonium storage. Thank you for the opportunity to comment on these documents.

Sincerely,

Teel Bivins

TB/tsb

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DAVID SWINFORD
STATE REPRESENTATIVE

COMMITTEES
APPROPRIATIONS
AGRICULTURE AND LIVESTOCK
LOCAL AND CONSENT CALENDARS

April 15, 1996

COPY FOR YOUR INFORMATION

U.S. Department of Energy
Office of Reconfiguration
P.O. Box 3417
Alexandria, VA 22302

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, D.C. 20026

Re: Comment on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statements (PEISs).

Thank you for the opportunity to comment on the U.S. Department of Energy's (DOE) Programmatic Environmental Impact Statements (PEISs) on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials. Please also consider this my comment on the Pantex Site-Wide Draft Environmental Impact Statement, since most of the issues addressed in these documents are identical.

First and foremost, I am adamant that any current and future functions at Pantex will be conducted in a safe and environmentally sound manner. Our first priority is to ensure any expansion at Pantex be implemented in a way that does not impair the health or safety of area residents or have an adverse affect on the environment. These goals serve as a prerequisite to any current or future activities at Pantex, including expansion.

I am pleased that DOE selected Pantex as the preferred alternative for assembly/disassembly, thereby abandoning earlier plans to transfer those functions to the Nevada Test Site (NTS) which would have been cost prohibitive and never been adequate to meet future needs. However, by failing to recognize Pantex as the preferred candidate site for new and/or consolidated stockpile management facilities, the DOE overlooks the best site for maintaining the integrity of the U.S. nuclear stockpile and attaining maximum efficiencies and cost savings.

Pantex is perhaps the most cost-effective alternative for any new construction of SSM facilities. First, labor costs, utility rates, and water and land availability at Pantex, as well as public and political support, are more amenable than those at any other Complex site. It is appropriate to consider Pantex as an alternative site for all future defense-related facilities to

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POTTER AND MOORE COUNTIES

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complement activities at the national labs (such as the planned Atlas Facility and plutonium pit fabrication site at Los Alamos National Laboratory. Doe makes no mention of a strategic plutonium reserve that is necessary to meet future national security needs, even though the PEIS mentions that strategic storage should be co-located with disassembly. Pantex should be the preferred site for such a mission in coordination with its management functions. The location of additional defense-related activities at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost to the American people. In its deliberations, DOE should insist that budgetary comparisons between Pantex and other site are accurate, and include capital, transportation, training, remediation and other costs.

Consistent with the strengths identified above for increased stewardship and management duties, the high explosives functions should also remain at Pantex. Because the production assembly/disassembly functions remain at Pantex, the high explosives fabrications duties should be present at the corresponding site. After all, the SSM Draft admits that Pantex must retain High explosives capabilities to process the inventories already on site from dismantling. Therefore, the least expensive alternative is to maintain these functions at Pantex. I adamantly disagree with the statement in the draft PEIS that there are no advantages to siting high explosives at Pantex as opposed to the national labs. The capital outlay alone necessary for transfer is cost prohibitive. In addition, should future need arise for new weapons production, it will be critical to have the high explosives facilities at the weapons production assembly/disassembly site.

As the sole DOE-authorized facility for assembly and disassembly of nuclear weapons, Pantex has historically handled these functions in a safe an efficient manner for more than 40 years. One of the challenges faced after dismantling a significant portion of the nuclear stockpile is processing or disposal with the materials that remain. The DOE is considering several options. Once again, acknowledging cost savings considerations, Pantex could continue to store plutonium which is already at the site and upgrade facilities for any and all storage options being considered by DOE with minimal cost and difficulty. Pantex currently warehouses more than 8,000 surplus pits and plans are being made to ship additional pits from Rocky Flats to Pantex. It makes little sense to re-create storage facilities at another site and then unnecessarily transport large amounts of plutonium across the country from Pantex. The budgetary and political costs for such a decision would be enormous. Because of these costs, Pantex also should be designated the preferred site for any disposition options and related functions. It makes budgetary and policy sense to site disposition where storage already exists. Furthermore, it makes no sense from any perspective, budget or otherwise, to site strategic storage at one site and surplus at another. Pantex should be selected for both storage functions. Pantex has the necessary safety, security, and surveillance capabilities to accommodate an expanded role with minimal costs and it is the production site closest to Los Alamos, the planned pit fabrication site.

Based upon these reasons, I respectfully urge DOE to designate Pantex as the preferred alternative site for all existing and new stockpile management and stewardship functions as well as consolidation of all plutonium storage and disposition and any related functions. Thank you for the opportunity to comment on these documents.

Sincerely,

COPY FOR YOUR INFORMATION

AM-001

CITY OF AMARILLO

May 3, 1996

KEL SELIGER
MAYOR

U.S. Department of Energy
Office of Reconfiguration
P.O. Box 3417
Alexandria, VA 22302

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, DC 20026

Re: Comment on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statements (PEISs).

Dear Sirs:

Thank you for the opportunity to comment on the U.S. Department of Energy's (DOE) Programmatic Environmental Impact Statements (PEISS) on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials. Also, please consider these my comments for the Pantex Site-Wide Environmental Impact Statement (SWEIS).

As the mayor of Amarillo, I have an obvious personal stake in the activities at Pantex as this plant is the largest employer in the region. But my first and foremost responsibility is to the welfare of the people and environment which is why I am adamant that any current and future functions at Pantex will be conducted in a safe and environmentally sound manner. While the Amarillo economy would surely benefit from an expansion of Pantex, my first priority is to ensure any expansion be implemented in a way that does not impair the health or safety of area residents or have an adverse affect on the environment.

That being said, I noted with great interest at the April 22-23 hearings that many of our residents who make their living "off the land" (including public officials such as Congressman Mac Thornberry and St. Rep. David Swinford) have recognized DOE's findings that there are "no significant impacts" of any planned or current activities at Pantex. While the safeguarding the environment is a prerequisite to any current or future activities at Pantex, I want to ensure that Pantex is not "passed over" for any functions which could be performed safely. Further,

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such incorrect applications of NEPA serve to mislead, and in some cases unjustly concern, our residents. I urge DOE to correct its findings which unfairly discriminate against Pantex by rankings which are not based on "significant" impacts.

I. Generally. By failing to recognize Pantex as a candidate site for new stockpile management facilities, the DOE overlooks the best choice for consolidation of functions to maintain the integrity of the U.S. nuclear stockpile and attain maximum efficiencies and cost savings. Pantex played an important role in our Cold War victory and the plant will continue to serve as the sole DOE site for maintaining a safe and reliable nuclear deterrent to meet our national security needs.

II. SSM PEIS:

1. Pantex is the best place to site new construction/stewardship activities. I support DOE's finding that Pantex is the best site for assembly/disassembly and related management functions. Pantex is perhaps the most cost-effective alternative for any new construction of SSM facilities. First, labor costs, utility rates, and water and land availability at Pantex, as well as public and political support, are more amenable than those at any other Complex site. The location of new or consolidated activities at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost to the American people. In this regard, I recall, at the 1995 Notice of Intent hearings in Amarillo, that DOE said it "will not build duplicative facilities, *unless DOE decides to do so.*" If I ran the City of Amarillo this way, we would be swimming in red ink. In its deliberations, *DOE should insist that budgetary comparisons between Pantex and other sites are accurate, and include capital and transportation costs.*

2. Pantex is the best site to continue High Explosives fabrication. Consistent with the strengths identified above for increased stewardship and management duties, the HE functions should also remain at Pantex. Since assembly/disassembly functions will remain at Pantex, it follows that HE fabrications duties should be present at the same site. Should the need arise for new weapons production, it will be critical to have the HE facilities at the production site. Further, DOE officials at the April 22-23 hearings admitted that it would cost more to move these functions to the labs, and that the labs lacked the critical quality assurance capability which Pantex already possesses. How then can DOE assert that there is no cost advantage to either site? Again, DOE is ignoring not only the cheapest site, but the best site for maintaining our nuclear deterrent.

III. Fissile Materials Storage and Disposition PEIS. As the sole DOE-authorized facility for assembly/disassembly for nuclear weapons Pantex has historically handled these functions in a safe and efficient manner. Once again, acknowledging cost savings considerations, DOE should maintain the current storage of surplus and Strategic Reserve plutonium which is already at the site and upgrade facilities for expanded long-term missions. Pantex currently safehouses more than 8,500 surplus pits and plans are being made to ship the pits from Rocky Flats to Pantex. It makes little sense re-create storage facilities at another site and then transport

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large amounts of plutonium across the country from Pantex. DOE said at the hearing "it made sense" to collocate strategic storage and assembly/disassembly to minimize transportation, and to collocate strategic storage with surplus storage, since the strategic stockpile may be declared surplus at some point. DOE should not only recognize that storage should follow disassembly, but also that certain disposition options should follow storage to minimize transportation and other costs. In addition, since most of the plutonium deemed surplus is already at Pantex, and given Pantex's close proximity to LANL (the new site for pit fabrication), it makes practical and economic sense to site any plutonium disposition functions at Pantex.

IV. Site-Wide EIS. I am concerned about the "plane crash" analysis. As Mayor, I have been deeply involved in efforts to reduce overflights over the plant, and other preventative measures. How can it be that the probability of a crash causing a release has increased since your 1994 Finding of No Significant Impact, after Pantex and the Amarillo Airport? Even the DOE officials at the hearings conceded that their analysis had serious problems, and needed to be corrected. I urge your office to correct these errors, and act to avoid wrongfully depriving Pantex of future functions for which it may be selected.

V. Conclusion. Based upon these reasons, I respectfully urge DOE to designate Pantex as the preferred alternative site for all existing and new stockpile management functions as well as consolidation of plutonium disposition and control. Thank you for the opportunity to comment on these reports.

Yours truly,

Kel Seliger

Kel Seliger
Mayor of Amarillo

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PUBLIC MEETING ORAL COMMENTS, AMARILLO, TX
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HON. DIANNE BOSCH
CITY COMMISSIONER
CITY OF AMARILLO, TEXAS

COMMENTS ON THE STOCKPILE STEWARDSHIP AND MANAGEMENT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT, STORAGE AND DISPOSITION OF FISSILE MATERIALS PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT AND PANTEX SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT

THANK YOU FOR THE CHANCE TO ADDRESS THE DEPARTMENT OF ENERGY IN THIS INTERACTIVE WORKSHOP FORMAT. AS AN AMARILLO CITY COMMISSIONER SINCE 1989, I HAVE WITNESSED COUNTLESS D.O.E. HEARINGS ON PANTEX. THE GIVE-AND -TAKE BETWEEN THE AUDIENCE AND THE D.O.E. OFFICIALS IS VERY INFORMATIVE TO EVERYONE IN ATTENDANCE. THE D.O.E. IS TO BE APPLAUDED FOR THE USE OF AN INTERACTIVE FORMAT, AND SHOULD CONTINUE TO USE IT IN FUTURE HEARINGS.

THE D.O.E. IS ALSO TO BE APPLAUDED FOR THE OPEN MANNER WITH WHICH IT HAS, AND CONTINUES TO, ADDRESS LOCAL ENVIRONMENTAL CONCERNS. WE ARE ALSO THANKFUL THAT GOOD MANAGEMENT AT PANTEX BY THE D.O.E.'S CONTRACTORS, MASON & HANGER AND BATTELLE, HAS PREVENTED PANTEX FROM HAVING ENVIRONMENTAL PROBLEMS OF THE TYPE AND MAGNITUDE FOUND AT OTHER D.O.E. SITES. AS IS EVIDENT BY THE LARGE TURNOUT TONIGHT, THIS COMMUNITY STRONGLY SUPPORTS PANTEX, AND THIS

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SUPPORT COMES IN LARGE MEASURE FROM THE D.O.E.'S COMMITMENT TO OUR LOCAL ENVIRONMENT. THAT CONTINUED COMMITMENT TO THE ENVIRONMENT IS CRITICAL FOR COMMUNITY SUPPORT OF ALL CONTINUED OR NEW MISSIONS AT PANTEX.

REGARDING THE STOCKPILE STEWARD SHIP AND MANAGEMENT PEIS, I STRONGLY SUPPORT THE CHOICE OF PANTEX AS THE PREFERRED ALTERNATIVE FOR THE ASSEMBLY AND DISASSEMBLY MISSION. THIS COMMUNITY IS EXTREMELY PROUD THAT PANTEX PLAYED AN IMPORTANT PART IN WINNING THE COLD WAR, AND WILL CONTINUE TO PLAY A CRITICAL ROLE IN REDUCING THE SIZE OF THE NATION'S NUCLEAR ARSENAL IN THE POST-COLD WAR PERIOD. KEEPING THIS MISSION AT PANTEX IS NOT ONLY THE RIGHT CHOICE FOR AMARILLO, IT ALSO MAKE SENSE FROM A NATIONAL PERSPECTIVE BECAUSE IT MAINTAINS A CONTINGENT PRODUCTION CAPABILITY, AND IT SAVES MORE THAT 1.5 BILLION DOLLARS WHEN COMPARED TO THE COST OF TRANSFERRING THE WORK TO THE NEVADA TEST SITE.

AS LONG AS WE ARE ON THE SUBJECT OF COST SAVINGS AND RETENTION OF PRODUCTION CAPABILITY, THE D.O.E. MUST NOT LET THE HIGH EXPLOSIVE (H.E.) FABRICATION MISSION BE MOVED FROM PANTEX. PANTEX EMPLOYEES HAVE SUCCESSFULLY PERFORMED THIS MISSION FOR MORE THAN FORTY YEARS, AND THERE IS

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ABSOLUTELY NO REASON FOR THIS WORK TO BE MOVED. WHEN THE WEAPONS COMPLEX WAS ORGANIZED, IT MADE LOGICAL SENSE TO LOCATE HIGH EXPLOSIVE WORK WITH ASSEMBLY AND DISASSEMBLY. IT STILL MAKES SENSE. FURTHERMORE, THE D.O.E.'S OWN ANALYSIS INDICATES THAT THE COST OF TRANSFERRING H.E. WORK TO NEW MEXICO LABS WOULD BE FIFTY MILLION DOLLARS. IT IS INCONCEIVABLE. THAT THE D.O.E. MIGHT SEEK TO JUSTIFY SPENDING FIFTY MILLION DOLLARS ONLY TO END UP WITH LESS PRODUCTION CAPABILITY IN A LOCATION THAT HAS NEVER PERFORMED THIS MISSION.

IN TERMS OF STORAGE AND DISPOSITION ACTIVITIES, I WOULD FIRST LIKE TO NOTE MY PREVIOUS COMMENTS ABOUT THE NEED TO PROTECT THE ENVIRONMENT. I AM ENCOURAGED BY THE PREVIOUS COMMENTS ABOUT THE NEED TO PROTECT THE ENVIRONMENT. I AM ENCOURAGED BY THE OUTSTANDING ENVIRONMENTAL RECORD THAT PANTEX HAS REGARDING STORAGE OF PLUTONIUM OVER MANY YEARS. I HOPE THAT THE D.O.E. WILL MAKE THE RIGHT CHOICE AND CONTINUE THE SAFE STORAGE OF SURPLUS PLUTONIUM AT PANTEX. I ALSO HOPE THAT THE D.O.E. WILL KEEP IN MIND THAT PLUTONIUM FROM DISMANTLED WEAPONS REPRESENTS A TREMENDOUS INVESTMENT AND MAY PROVE TO BE A VALUABLE ASSET IN CIVILIAN

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USE. I URGE THE D.O.E. TO CHOOSE PANTEX AS THE SITE FOR ENVIRONMENTALLY SOUND DISPOSITION ACTIVITIES.

ONCE AGAIN, THANK YOU FOR THE OPPORTUNITY TO COMMENT ON THE D.O.E.'S PLAN FOR THE FUTURE OF PANTEX. PANTEX HAS BEEN AN IMPORTANT PART OF OUR REGIONAL ECONOMY FOR MANY YEARS, AND WE SUPPORT THE CONTINUATION OF ENVIRONMENTALLY SOUND OPERATIONS AT THE PLANT. I WOULD ALSO LIKE TO THANK ALL THE CONCERNED CITIZENS OF OUR COMMUNITY WHO HAVE MAKE THE EFFORT TO ATTEND THIS MEETING TONIGHT.

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Mr. Vance Reed
President, Amarillo Economic Development Corporation

Comments on the Stockpile Stewardship & Management PEIS,
the Storage & Disposition of Fissile Materials PEIS, and
the Pantex Site-Wide EIS

Thank you for this opportunity to provide input to the Department of Energy regarding the operation of the Pantex plant. I would like to address two primary issues tonight regarding Pantex's future: 1) the environment, and 2) jobs.

Starting with the environment, I would like to reiterate this community's adament position that all work performed at Pantex continue to be done in a fashion that protects the environment. While the public has heard a great deal about "contamination" at Pantex, there has been little media attention given to the nature of pollution problems at Pantex. Most contaminants at Pantex are related to solvents and hydrocarbons that are very similar to those that would be found at practically any large manufacturing facility. This community is very reassured by the fact that Pantex has not had contamination problems from radioactive materials, such as occurred at Rocky Flats and Hanford.

The Amarillo Economic Development Corporation views Pantex in much the same manner as we view other large manufacturers in terms of presenting risks to the environment. For instance, if we were recruiting a computer chip manufacturer, we would realize that these plants have hazardous waste streams including arsenic and other heavy metals. The A.E.D.C. would only recruit a company that is committed to full compliance with E.P.A. and state environmental regulations. High tech businesses have created whole new industries and thousands of jobs, while working with very hazardous substances. This shows that protection of the environment and job creation can go hand-in-hand.

Likewise, we believe that Pantex can be a site where good, high-paying jobs are created in a work environment that includes potentially dangerous materials. When

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measured in terms of total payroll, Pantex is by far the area's largest employer. With 3,500 employees at the plant, a job multiplier of 3.87 shows that Pantex is responsible for a total of over 13,500 jobs in this region. This multiplier was established by Dr. Ray Perryman at Southern Methodist University. The multiplier reflects the fact that the money that Pantex brings into the local economy supports many retail, medical, educational, finance, insurance and real estate jobs. All told, employment related to Pantex represents over 12% of all jobs in the Amarillo metropolitan area. I urge the D.O.E. to correct the socio-economic impact portions of all three EIS documents to accurately reflect the impact of Pantex on our local economy.

Because of the importance of Pantex to our local economy, the A.E.D.C. is very pleased that Pantex has been chosen as the preferred site for continued assembly and disassembly functions. We also believe this decision is in the best economic interests of the nation, as it saves more than 1.5 Billion dollars to American taxpayers. I also urge the D.O.E. to continue the high explosive fabrication mission that is currently performed at Pantex. Again, this not only protects jobs in our region, it saves American taxpayers 60 Million dollars compared with the cost of moving these operations to New Mexico.

For Pantex's future, the D.O.E. should locate storage and disposition missions at Pantex, as long as they can be done in an environmentally safe fashion. I urge the Department to make use of the expertise of the Amarillo National Resource Center for Plutonium This resource center, which is operated by the University of Texas System, the Texas A&M University System, and the Texas Tech University System, can provide world-class evaluation of disposition options. I believe the Amarillo area will prove to be an outstanding operating environment for those storage and disposition functions that have been fully scientifically evaluated and safely implemented.

Once again, thank you for the opportunity to address you in this workshop tonight.

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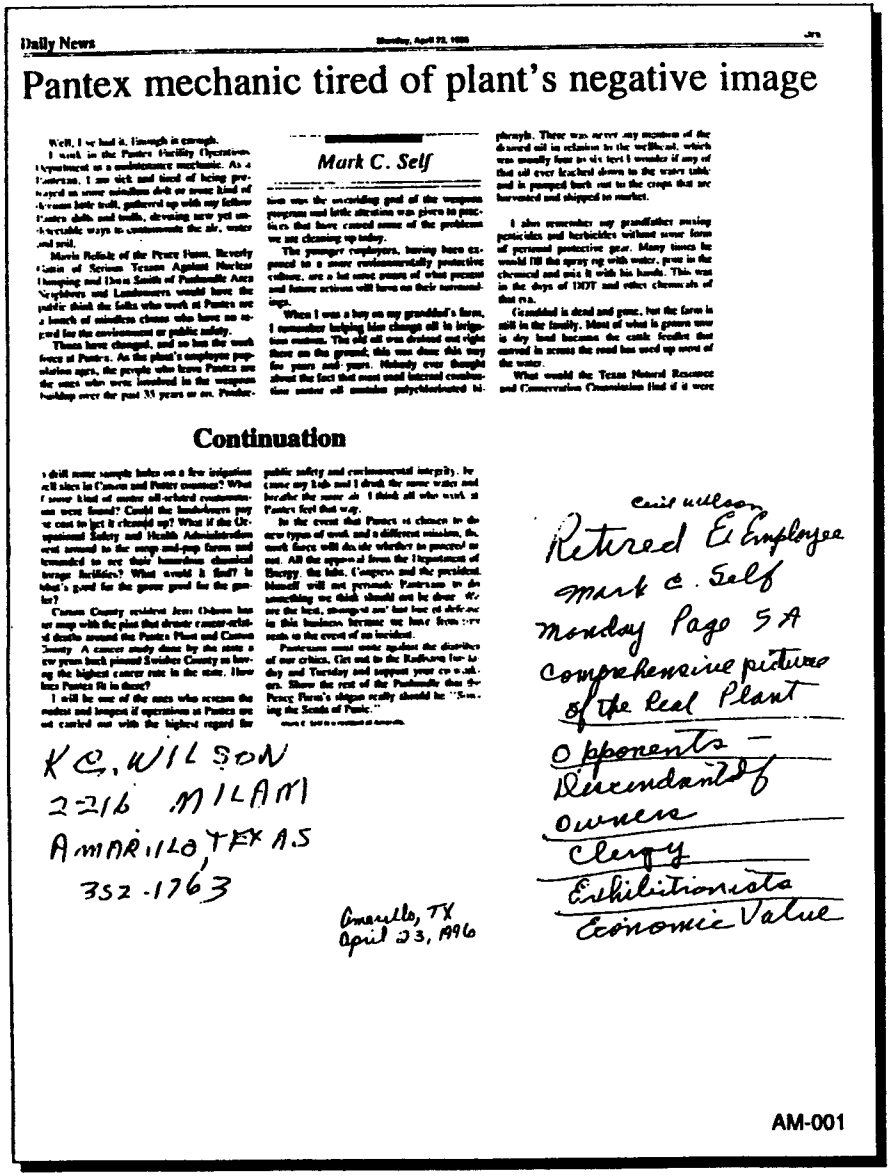

PUBLIC MEETING ORAL COMMENTS, AMARILLO, TX
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Daily News — Monday, April 22, 1996

Pantex mechanic tired of plant's negative image

Mark C. Self

Well, I've had it. Enough is enough.

I work in the Pantex Facility Operations Department as a maintenance mechanic. As a Pantexan, I am sick and tired of being pre-trayed as some mindless dolt or some kind of dreams little troll, gathered up with my fellow Pantex dolts and trolls, devising new yet undetectable ways to contaminate the air, water and soil.

Mavis Belisle of the Peace Farm, Beverly Gatlin of Serious Texans Against Nuclear Dumping and Dora Smith of Panhandle Area Neighbors and Landowners would have the public think the folks who work at Pantex are a bunch of mindless clones who have no regard for the environment or public safety.

Times have changed, and so has the work force at Pantex. As the plant's employee population ages, the people who leave Pantex are the ones who were involved in the weapons buildup over the past 35 years or so. Production was the overriding goal of the weapons program and little attention was given to practices that have caused some of the problems we are cleaning up today.

The younger employees, having been exposed to a more environmentally protective culture, are a lot more aware of what present and future actions will have on their surroundings.

When I was a boy on my granddad's farm, I remember helping him change oil in irrigation motors. The old oil was drained out right there on the ground; this was done this way for years and years. Nobody ever thought about the fact that most used internal combustion motor oil contains polychlorinated biphenyls. There was never any mention of the drained oil in relation to the wellhead, which was usually four to six feet I wonder if any of that oil ever leached down to the water table and is pumped back out to the crops that are harvested and shipped to market.

I also remember my grandfather mixing pesticides and herbicides without some form of personal protective gear. Many times he would fill the spray rig with water, pour in the chemical and mix it with his hands. This was in the days of DDT and other chemicals of that era.

Granddad is dead and gone, but the farm is still in the family. Most of what is grown now is dry land because the cattle feedlot that moved in across the road has used up most of the water.

What would the Texas Natural Resource and Conservation Commission find if it were

Continuation

to drill some sample holes on a few irrigation well sites in Carson and Potter counties? What if some kind of motor oil-related contamination were found? Could the landowners pay the cost to get it cleaned up? What if the Occupational Safety and Health Administration went around to the mom-and-pop farms and demanded to see their hazardous chemical storage facilities? What would it find? Is what's good for the goose good for the gander?

Carson County resident Jess Osborn has her map with the pins that denote cancer-related deaths around the Pantex Plant and Carson County. A cancer study done by the state a few years back pinned Swisher County as having the highest cancer rate in the state. How does Pantex fit in there?

I will be one of the ones who scream the loudest and longest if operations at Pantex are not carried out with the highest regard for public safety and environmental integrity, because my kids and I drink the same water and breathe the same air. I think all who work at Pantex feel that way.

In the event that Pantex is chosen to do new types of work and a different mission, the work force will decide whether to proceed or not. All the opposed from the Department of Energy, the labs, Congress and the president, himself will not persuade Pantexans to do something we think should not be done. We are the best, strongest and last line of defense in this business because we have from [illegible] seats in the event of an incident.

Pantexans must unite against the diatribes of our critics. Get out to the Radisson for today and Tuesday and support your co-workers. Show the rest of the Panhandle that the Peace Farm's slogan really should be "Sowing the Seeds of Panic."

[illegible]

Cecil Wilson
Retired E Employee
Mark C. Self
Monday Page 5A
Comprehensive picture of the Real Plant
Opponents –
Descendants of
Owners
Clergy
Exhibitionists
Economic Value

K.C. WILSON
2216 MILAM
AMARILLO, TEXAS
352-1763

Amarillo, TX
April 23, 1996

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PUBLIC MEETING ORAL COMMENTS, AMARILLO, TX
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Amarillo Meeting
Afternoon, April 23, 1996

1. Go slow on disposal

2. With our present President we do not know from one day to the next what he is going to do!

France is testing
China is testing etc.

It is foolish to be thinking of reducing the stockpile as it seem to be proposed.

3 The environment damage that you may seem will affect this area. No consideration is given to all the chemicals that is poisoning the human body by allowing the chemical companies to put all their chemicals into our food supply which will harm all humanity in the U.S.

a. which is worse "the pollutants" put out by Pantex that affects the local population. or

b. all the chemicals that go into our food which affects the whole nation

4. It will hurt the economy of this city to have another "pay roll" eliminated. the maine 4 plans under plans to dispose of, and those already gone are - the air Base. Bill Helvington

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PUBLIC MEETING ORAL COMMENTS, AMARILLO, TX
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[illegible] what next.

I am not in favor of
cutting the payroll
of this city further.

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Augusta Public Meeting Oral Comments - April 30, 1996

Public Meeting Comments

Savannah River Site
April 30, 1996

Morning Meeting
Plenary Session

C: Please clarify the time frame of the documents release

C: The cost should not drive the decision but it should be considered. Timing could have a stronger driving force and it has not been mentioned. You (DOE) did not mention future generations and the conservation of nonrenewable resources. Other countries will have nuclear technologies available and the United States will be behind technologically. I am looking for a complete environmental analysis that includes cost, timing, impacts to future generations, and conservation of nonrenewable resources. — 1/01.00.00

C: My initial fears about the Savannah River Site have been reassured, allowing me to ignore all of the negative statements I have heard in the past which did not have a basis in fact. I am now reassured that the site is safe and environmentally sound. Savannah River Site is logical for the storage and disposition options The Savannah River Site community is involved and wants to keep the public and environment safe The site is the largest employer in the area and with the downsizing effort there have been some negative impacts from an economic standpoint. I urge DOE to use the Savannah River Site and its intellect and physical infrastructure We welcome you. — 2/08.03.01

C: I would like to address two issues 1) I am fearful that without having a continued needed mission at the Savannah River Site, DOE will lose this nuclear weapons expertise and experience; 2) Savannah River Site has a good future use plan, the other sites may not. I would hope that the other sites have a wildlife preservation plan for their undeveloped areas. DOE should make it a policy to not build on green field sites, but build new facilities by using brown field sites, a complex wide program DOE needs to disregard the deep borehole option — 3/15.00.00, 4/08.03.01

C: The Savannah River Site has touched everyone's life directly or indirectly. Through my work as Director of Planning for the Lower Savannah Council, I feel the Savannah River Site programs, manpower, and experience are an integral part of this community. Informing the public has been good and it is very important to know what is going on with the Savannah River Site and — 2/08.03.01 cont.

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Note: Some documents submitted during the public meeting were recorded as part of the minutes. The same documents, in some instances, were also submitted as hand-ins at the end of the meeting. In those cases, the documents are analyzed once, either as part of the minutes or as stand alone documents.

Listed below is the name of the individual who submitted a document as part of the minutes and the page number containing DOE's responses to the comments:

American Nuclear Society, James Dewes 3–32

01 00 00 Comment Number 1

Cost and timing (schedules) were not addressed in the PEIS since it focuses primarily on environmental analyses. However, cost and schedules were considered in a separate Technical Summary Report issued in July 1996. These factors will be considered, along with environmental impacts of the candidate alternatives, as part of the ROD. Conservation of nonrenewable resources for Reactor Alternatives is considered in this PEIS.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for SRS. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

15 00 00 Comment Number 3

Comment noted.

08 03 01 Comment Number 4

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Augusta Public Meeting Oral Comments - April 30, 1996

its potential. We (citizens) would like to see the Savannah River Site utilized. We (citizens) feel the Savannah River Site has the ability and experience to do perform these options, the economics are not only in the best interest for the community but for the United States.	2/08.03.01 cont.
C: If the plutonium was turned into a powder or dust form, low income areas and minorities would be disproportionately impacted if dispersed.	5/09.12.08
C: It is important to bring the public into this process. What is the weakness within public outreach that a more diverse group is not here at this meeting to learn and raise their concerns. A more diverse group would assist DOE in decisionmaking and they would be involved in the process.	6/08.02.00
Q: Why can't DOE reopen and process the fuel rods and radioactive material at the Barnwell Plant?	7/15.00.00
C: I understand that DOE has five reactors containing spent fuel that have been sitting for five years, why doesn't DOE use them. Why is DOE letting them sitting there?	8/01.04.00
C: Participant showed a slide on the future use of Savannah River Site. (slide attached)	
C: The Barnwell Plant closed fifteen years ago. It was shut down by President Carter, he shut the plant down without conducting the National Environmental Policy Act process. It is not encouraging that other countries have done processes that the United States did not encourage and they have preformed them successfully, for example, reprocessing. So why does the United States think we can influence them now?	9/01.03.00
Q: Referencing the calculation of potential risks in the summary, Savannah citizens are in the range of the site for getting cancer. Did DOE look at the Savannah River Site only for the release of radiation or did DOE look at all of the industries in the area combined with the Savannah River Site that could cause effect?	10/09.00.06
A: I believe it covers the cumulative impacts from the Savannah River Site only. DOE will review that again to make it clearer.	
C: That is not fair to the citizens of Savannah. There should be a combination of the Savannah River Site and industry impacts. It could show that we may live longer if the Savannah River Site was closed.	11/09.00.06

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09 12 08 **Comment Number 5**

A review of the geographical distribution of minority and low-income populations and meteorological data indicates that if an accidental release of radiation were to occur, these particular populations would not be disproportionately affected. The prevailing wind conditions at SRS, for example, would not lead to dispersion of the Pu to cause these populations to receive higher doses than other populations.

08 02 00 **Comment Number 6**

The Department of Energy announces, in advance, public meetings on NEPA documents with the intent of involving all interested parties. These meetings are advertised in a number of ways in order to encourage full public participation. Eight public meetings were held concerning this PEIS to present information contained in the Draft PEIS and to receive public comment. All comments submitted received equal consideration.

15 00 00 **Comment Number 7**

This would require appropriately designed facilities including extensive chemical processing. While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of Pu from that spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort.

01 04 00 **Comment Number 8**

Existing DOE reactors were operated for the purpose of R&D. Most of these reactors are of smaller scale and would not have sufficient infrastructure to support the Pu disposition mission.

01 03 00 **Comment Number 9**

The goal of the materials disposition program is to utilize processes that place Pu in a form that meets the Spent Fuel Standard, a condition where the Pu is as inaccessible and difficult to retrieve and reuse in nuclear weapons as the Pu

Augusta Public Meeting Oral Comments - April 30, 1996

C: Under Stockpile Stewardship and Management it seems that more pits will be made and under Storage and Disposition, DOE is trying to figure out what to do with the pits. This doesn't make sense for one document to make more plutonium and then the other does not know what to do.	12/01.00.00
Q: The possible use of two options being an "either" "or" situation has not been addressed. How long would it take to vitrify 50 tons? How long would it take to process 50 tons in a reactor? How long would it take if both options were used for the 50 tons?	13/05.01.08 14/06.00.08 15/01.04.00
Morning Meeting Breakout Sessions	
C: DOE needs to realize that with the public meetings and breakout sessions there will always be a room of people that are not well-versed on the topic. DOE needs to address this situation	16/08.02.00
C: If DOE could commit now to using the European capability the space would be available. With a commitment, the capacity for the lead test assembly or test demonstration program and the first core loading will be available. However, it has to be committed early, instead of waiting and the capacity being full.	17/15.00.00
Q: What is the greatest negative of using mixed oxide fuel? *(Note: This comment initiated a discussion about proliferation when converting plutonium to mixed oxide fuel but there was never a definitive statement of risk.)*	18/06.01.06
Q: Why is the commercial industry in the United States considered to be a proliferation risk? Why can't the commercial industry be trusted to reprocess when DOE trusts Mario Fiori? *(Note: The response provided at the meeting did not appear to fully respond to the issue.)*	19/01.06.00
C: In an International Atomic Energy Agency report that looked at large scale processing plants and mixed oxide production, it said there is no proliferation risk. For Europe, the International Atomic Energy Agency is concerned about nonproliferation	20/01.06.00
C: With that answer, I would think the reactor option would be discounted because of the waste generated	21/08.03.01

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that is present in spent fuel from nuclear reactors. While the PEIS discusses the generation of spent fuel as a result of potential disposition actions, any subsequent reprocessing and extraction of Pu from the spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort. The fact that the PEIS evaluates disposition of surplus weapons Pu through use in MOX fuel, but does not further evaluate reprocessing of the spent fuel, does not preclude future changes in the U.S. Nonproliferation Policy.

09 00 06 Comment Number 10

In accordance with NEPA regulation 40 CFR 1508.7, *Cumulative Impacts* are defined as impacts that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. With respect to radiological impacts from normal operations, the contribution from the Vogtle Nuclear Plant (located across the Savannah River from SRS), considered a present action under this definition, is included in the cumulative impacts presented in Section 4.7.2.6.9. There are no other facilities in the area of SRS that release radioactivity to the environment.

09 00 06 Comment Number 11

No other Federal, State, local, or private reasonably foreseeable actions were found that would contribute to cumulative impacts for the time period being considered. When possible, planned projects before the year 2005 No Action baseline have been incorporated into the No Action Alternative. The No Action Alternative takes into account existing site operations and includes the impacts resulting from planned changes to operations until the year 2005. Projects planned for beyond the 2005 No Action baseline would be in such a preliminary stage as to make analysis speculative.

01 00 00 Comment Number 12

No new weapons are being produced, but the United States needs to maintain the core competency and capabilities to produce pits to support national defense in a dynamic world. Existing pits declared surplus need to undergo the disposition process to fulfill the goals of the President's Nonproliferation Policy and to provide visible evidence of irreversible disarmament.

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C: It is not in the draft Programmatic Environmental Impact Statement. *(Note: This comment was made at the end of a discussion regarding how DOE accounted for waste generated by the mixed oxide fuel option as compared to the waste generated by uranium mining and burning of the fuel. DOE committed to do more with this in the final Programmatic Environmental Impact Statement.)*	22/09.11.08
C: Salt drifts would be released to the aquatic environment and the wetlands with the reactors mentioned earlier that use cooling towers. There are several endangered animals along the Savannah River which would be impacted, this should be analyzed. The salt is corroding the beaches in Savannah.	23/09.06.06
C: The deep borehole option would place the plutonium in itself. The barrier is the length of the hole. Then there is the mixed oxide fuel reactor, which could create energy giving it an economic value. Both options create nuclear waste, however, mixed oxide fuel may create more waste. The United States has the potential to reprocess the fuel now. The immobilization and deep borehole options will require very sophisticated technology and equipment to retrieve the plutonium. Wouldn't it be easier to reprocess the plutonium in case it is needed later, since it is harder to retrieve material from immobilization or from the deep borehole	9/01.03.00 cont.
C: If you look at the amount of plutonium being discussed today and the amount of plutonium generated in commercial reactors over fifteen to seventeen years, it is about two percent of the total available	24/15.00.00
C: If the United States does not use mixed oxide fuel it will lose technology and expertise. The United States was a technology leader now will become a beggar.	25/08.03.01
C: My comment and question regard excess (surplus) plutonium. People don't understand the difference between the commercial spent fuel issue and the nonexcess material. This confusion should be cleared up. How will DOE get the material to the spent fuel standard and not change the isotopic content?	26/01.04.00 27/01.00.00
C: I have heard today that on one hand DOE does this and on the other hand DOE does that. It seems that some things have been taken out of context when DOE is suppose to have put this altogether and considered everything. The United States just keeps chasing its tail. There are some people who cannot grasp the information and get the correct perspective. One statement says DOE is doing this to get rid of plutonium then DOE is generating plutonium. It bothers me that statements contradict each other.	28/01.00.00

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05 01 08 **Comment Number 13**

Current plans call for vitrifying 4 or 5 t (4.4 or 5.5 tons) of Pu per year, resulting in a 10- to 12-yr campaign for the full 50 t (55 tons).

06 00 08 **Comment Number 14**

The details vary with selections of reactor designs and specific core designs. Typically, a very large LWR is capable of consuming MOX fuel at a rate of 1 t (1.1 tons) of Pu per year. If 5 reactors were used, then the irradiation campaign would be about 10 years, not including an approximate 10-yr period required to make the fuel available to the reactors.

01 04 00 **Comment Number 15**

The length of time depends on the throughput of each facility and how many facilities are being used, which in turn is determined by the urgency of the mission and the amount of available congressional funding. Analyses of the cost, schedule, technical, and Nonproliferation Policy impacts are described in separate documents to support DOE's ROD. The cost, schedule, and technical analyses were made available for public review beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996.

08 02 00 **Comment Number 16**

Comment noted.

15 00 00 **Comment Number 17**

Comment noted.

06 01 06 **Comment Number 18**

The use of MOX fuel is analyzed for the Reactor Alternatives in the PEIS to provide an understanding of their potential environmental impacts, and how these impacts differ from those of the other alternatives. No attempt is made to rank the alternatives since all of the impacts are within acceptable environmental, safety, and health limits.

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C: DOE is fooling itself, if it (DOE) thinks that it can influence another country to do what the United States wants. DOE needs to look at what can be done and how to move forward instead of linking it with an unpredictable party. I am trying to justify what our time is being spent on.	29/01.00.00
C: The agreement on disposition seems to be an element of uncertainty. The United States should use the technology it has now to deal with our problems and not wait for the Russians. Things are taken out of context, one idea is jumped on then it is dropped, the public ends up getting the wrong impression. I am sure some of the public today is searching for information.	30/01.06.00
C: Future generations are not mentioned in the draft Programmatic Environmental Impact Statement. What happens when the United States runs out of fossil fuels? The National Environmental Policy Act states that the impact of making energy resources inaccessible or irretrievable should be considered. What is the impact for the year 3000 is not the impact for the year 2010. Will DOE look at the alternatives, for example operational reactors, partially constructed reactors, and new reactors? These would supplement the energy of fossil fuels and reduce carbon dioxide emissions. The cost and cost benefits need to include the cost of research and development of other plants, when will it be made available.	31/01.04.00
C: What are the barriers DOE perceives for closer coordination with the United States program, to include light water reactors, perhaps even to burn the Russian plutonium in addition to the United States plutonium and what is being done to bring the barriers down?	32/01.06.00
C: There is momentum for the Canadian option because of pairing. I don't think that the United States pairing has been explored enough, it needs a harder look.	33/01.03.00
C: Russia won't give us their material for free and the Canadians will be getting the energy value, I don't want my taxpayer money that has been used and will be used to be spent for that way.	34/08.03.01
C: DOE should contact Phyllis Laser of Texas for information on the problems with deep boreholes in Texas.	
C: The amount of waste generated from mixed oxide use seems to be a lifetime figure not an annual figure, could DOE get a specific answer and sent it to us?	35/09.11.08
C: I would suggest that in the final document this should be reworded so that the whole conclusion rather than just the bad part is stated. *(Note: This comment refers to comments in the summary relating to environmental justice impacts.)*	36/09.12.08

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01 06 00 Comment Number 19

The Department of Energy does not consider commercial industry a proliferation risk, as evidenced in the Existing LWR Alternative which uses commercial reactors to carry out the Pu disposition mission. While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of Pu from that spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort.

01 06 00 Comment Number 20

Comment noted.

08 03 01 Comment Number 21

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 11 08 Comment Number 22

The Avoided Impacts section of the PEIS (Section 4.9) has been updated not only to include avoided human health impacts from mining, milling, and enrichment operations, but avoided air quality impacts, avoided waste generation, and other avoided environmental impacts. This section includes the displacement of uranium fuel by MOX fuel.

09 06 06 Comment Number 23

A detailed analysis of potential impacts from salt drift was not presented in this PEIS because design parameters have not been developed for the alternative. Section 4.3.5.4.6 of the PEIS states that potential impacts due to salt drift may be evaluated in additional environmental documentation, if required.

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C: In the tables of background radiation (Volume I, Chapter 3 - tables for each site), the public should be given the range of background radiation for a 50 mile area. The ability to compare the person rems from background radiation to the person rems at the Savannah River Site, would show how minuscule the increase is. Not having a comparison of the numbers does not show a true reflection. This information needs to be put in context. | 37/09.09.06

C: If there was not the mixed oxide fuel option, the following is what you would expect from a uranium fuel cycle: 340 cubic ineters of high level waste glass, 5 million additional cubic meters of mill tailings, and 3,400 cubic meters of enrichment tails. This would be the waste generated if the mixed oxide option was not chosen. | 38/09.11.08

C: Regarding the movement of the pits from Pantex to the Savannah River Site which could be surplus and strategic. It is unwise to store them together in same facility and an unwise decision to approach. | 39/08.03.01

C: DOE does not want the strategic pits to be found.

C: There are a significant amounts of oxides. | 40/15.00.00

Q Can DOE clarify the minorities statement, is DOE saying that minorities will not be affected? ***(Note: The response provided at the meeting did not appear to fully respond to the issue.)*** | 41/09.12.06

C: Because the minorities are affected, more public relations is needed for the minorities. Minorities should have some voice in this decisionmaking process. | 42/08.02.00

C: The same was thought for Carlsbad 20 years ago. ***(Note: This comment came from a discussion on the deep borehole and its viability and site selection probability.)*** | 43/04.03.00

Morning Meeting
Summary Session

C: Two things: 1) There needs to be outreach activities beyond the present outreach activities to reach the minorities and low income areas and involve them in this process. Outreach through brochures, television, and radio is not enough. Particularly downstream and rural communities Most minorities could not take professional leave today without penalty. DOE needs to think of ways to bring in the communities affected. A strategic effort is needed to train these individuals, a base of understanding needs to be established; 2) The analyses need to take | 44/08.02.00 | 45/08.02.00

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15 00 00 **Comment Number 24**

Comment noted.

08 03 01 **Comment Number 25**

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

01 04 00 **Comment Number 26**

Comment noted. The PEIS indicates that only the storage of all weapons-usable fissile materials (both surplus and nonsurplus) and the disposition of materials declared surplus to national defense needs are addressed in the document. The document also indicates that the Pu in commercial spent fuel is not addressed.

01 00 00 **Comment Number 27**

The purpose of the Spent Fuel Standard is to convert Pu to a form that makes it as unattractive and inaccessible as the residual Pu in commercial spent fuel. Once the Pu is converted, it is very difficult to retrieve and separate out. Any Pu separated would become weapons-usable, regardless of its isotopic content.

01 00 00 **Comment Number 28**

Comment noted.

01 00 00 **Comment Number 29**

The Department of Energy is proposing to take action on storage and disposition of weapons-usable fissile materials in the United States. Once the decision is made late this year, there will be a path forward for the storage and disposition of these materials. DOE also hopes that other nations will follow our example and seek our technical assistance.

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into consideration the low income areas affected with the combination of the Savannah River Site and area industry impacts. We (Citizens for Environmental Justice) don't want to come to more meetings without the involvement of black community. Local officials need to become more involved, especially in Georgia. It is a disservice for DOE to ask the public to wade through the size of these documents. The average citizen has a third grade intellect. We (Citizens for Environmental Justice) want facts from independent sources, not just DOE. — 45/08.02.00 cont.

C: People of color need to become more informed. We (DOE and minorities) should be working together. DOE needs more input from the minority population. — 46/08.02.00

C: The employees of the Savannah River Site have not been represented, they received an e-mail about this meeting yesterday. It would be nice for DOE to bring in these employees, maybe have a meeting at the site, they need to be included. — 47/08.02.00

C: The material from the Savannah River Site should be moved to either Oak Ridge or Pahtex. Low income or people of color are largely impacted in this area. — 48/08.03.01

C: We (minorities) don't want to fall into the syndrome of not in my back yard. The information needs to be throughly analyzed to make sure that the risk to all humans is minimized. — 49/09.12.06

Evening Meeting
Plenary Session

Q: More precise information is needed for the deep borehole option. How will the different radioactive wastes be placed in these deep boreholes? Phyllis Laser has reported about the deep borehole process (not in relation to the Materials Disposition program) and the problems that have been encountered in Texas with them. Are there more public meetings on these subjects or is this the last? *(Note: The response provided at the meeting did not appear to fully respond to the issue.)* — 50/04.00.00

C: The Aiken Chamber of Commerce would like to state on behalf of the Chamber of Commerce in the areas surrounding the Savannah River Site we are united for future missions. I am representing 30,000 employees from 3,000 employers in seven counties with four Chambers of Commerce from two states with one message. We want future missions for the Savannah River Site — 2/08.03.01 cont.

C: The Building and Trades Union, second the Chamber of Commerce comments and look forward to working with the Savannah River Site in the future.

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01 06 00 **Comment Number 30**

The Department of Energy is proposing to take action on storage and disposition of weapons-usable fissile materials in the United States. Once the decision is made late this year, there will be a path forward for storage and disposition of these materials. DOE also hopes that other nations will follow our example and seek our technical assistance. It is important for the United States to work with Russia on disposition options to help them focus their efforts, make technology decisions, and begin implementation of disposition activities. The United States is not likely to proceed with Pu disposition unless Russia takes reciprocal action.

01 04 00 **Comment Number 31**

This PEIS analyzes the environmental impacts of various reasonable alternatives now and in the foreseeable future, following NEPA guidance. Impacts in the year 3000 involve a great deal of uncertainties and would be unrealistic to predict at this time.

01 06 00 **Comment Number 32**

The use of domestic LWRs for disposition of U.S. Pu has been analyzed in the PEIS. Disposition of Russian Pu in U.S. reactors was not considered as an option. Disposition of both Russian and U.S. Pu in CANDU reactors was considered since it was proposed by Canada as a non-weapons state.

01 03 00 **Comment Number 33**

Comment noted.

08 03 01 **Comment Number 34**

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. This will include an appropriate level of analysis by Canada before any decision on burning Pu in a CANDU reactor is implemented.

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C [Prepared statement submitted (see attached)].

Evening Meeting
Breakout Sessions

C This program could benefit by accelerating the site disposition decision along with the storage decision. DOE should not follow in the foot steps of the Foreign Research Reactor Spent Nuclear Fuel Environmental Impact Statement decisionmaking process. | 51/08.03.00

C From the long-term perspective, disposition seems to take the material from an "as is" condition to a spent fuel form. The full life cycle costs don't seem to be laid out in the document. The disposition of the material after it is used and future mortgage do not seem to be addressed in your (DOE) decisionmaking process. | 52/06.01.06 | 53/08.00.00

C: I accept this as an open issue. The unknowns here should be translated into economic or environmental impacts that get added to the analysis when they are compared to other alternatives that do not have the same amount of unknowns. ***(Note: This comment was made following a discussion on whether or not waste from mixed oxide fuel could be certified.)*** | 54/09.11.06

C: [Prepared statement of American Nuclear Society, Central Savannah River Section (see attached)].

Evening Meeting
Summary Session

No summary session

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09 11 08 **Comment Number 35**

Impacts reported in Sections 4.2 and 4.3 of the PEIS are annual values for each of the storage and disposition alternatives. Impacts reported in Sections 2.5, 4.6, and the Summary of the PEIS are for the life of each alternative.

09 12 08 **Comment Number 36**

The environmental justice analysis, Section 4.5 of the PEIS, summarizes potential environmental justice impacts for all the sites so that the decisionmaker has all information available. The Summary contains a condensed description of the impacts of the available information. Based on comments received, the Summary of the PEIS was revised.

09 09 06 **Comment Number 37**

To better understand the natural background environmental radiation levels and the Proposed Action's incremental radiation levels, the natural background environmental radiation levels at each potential site involved in the Pu storage and disposition alternatives are presented in Chapter 3 of the PEIS. For the same purpose, the incremental radiation levels from Proposed Actions are compared to the natural background environmental radiation levels in the same area in Chapter 4 of the PEIS. In all cases, the natural background environmental radiation levels are the major source of exposure to the general population.

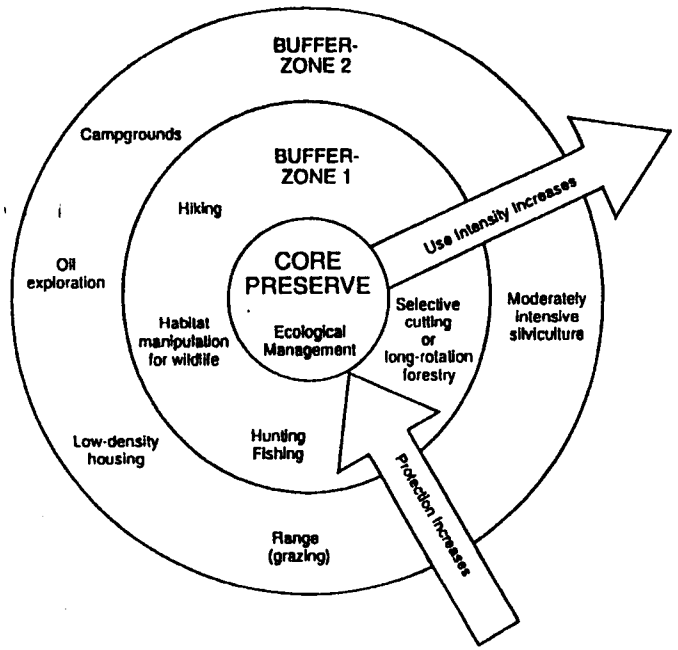
09 11 08 **Comment Number 38**

The Avoided Impacts section of the PEIS (Section 4.9) has been updated not only to include avoided human health impacts from mining, milling, and enrichment operations, but avoided air quality impacts, avoided waste generation, and other avoided environmental impacts. This section includes the displacement of uranium fuel by MOX fuel.

08 03 01 **Comment Number 39**

Comment noted.

MULTIPLE USE MODEL



Source: R. Noss, "Protecting Natural Areas In Fragmented Landscapes," Natural Areas Journal (1987), 6.

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15 00 00 **Comment Number 40**

Comment noted.

09 12 06 **Comment Number 41**

The environmental justice analysis does not assess whether minorities would be affected, but whether minorities and low-income populations would be disproportionately affected. This is accomplished by combining detailed demographics data for the areas surrounding the candidate sites with the results from the public health and socioeconomic analysis. The public health and socioeconomic analyses assess whether all of the surrounding populations would be affected by the Proposed Alternatives. These sections do not distinguish among sub-population groups.

08 02 00 **Comment Number 42**

All members of the public have a voice in the decisions to be made on this very important area. All comments receive equal weight and are given equal consideration. All comments are given to the decisionmakers so that good sustainable decisions are made.

04 03 00 **Comment Number 43**

Comment noted.

08 02 00 **Comment Number 44**

The Department of Energy uses a wide variety of methods to communicate with the public on these important issues. These methods include public meetings, as part of the NEPA process, and meetings outside of the process, such as the Plutonium Round Table. Numerous fact sheets and displays are made available at the meetings as well as by mail. All of this information is available on the Program's electronic bulletin board.

AMERICAN NUCLEAR SOCIETY - SAVANNAH RIVER SECTION STATEMENT REGARDING STORAGE AND DISPOSITION OF WEAPONS-USEABLE FISSILE MATERIALS DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

My name is John Dewes and I am Vice Chairman of the Savannah River Section of the American Nuclear Society. Our local section consists of some 800 scientists and engineers in the Central Savannah River Area. On behalf of the Section, I would like to make a statement concerning the Storage and Disposition of Weapons-Useable Fissile Materials Draft Programmatic Environmental Impact Statement.

We believe that all of the long term storage options are acceptable from the standpoint of environmental, safety and health. We also believe that any of the Long Term Storage sites proposed have sufficient infrastructure to handle the engineering & design of such a facility.

We strongly support the recommendations contained in the American Nuclear Society Special Panel Report on the Protection and Management of Plutonium[1], a Panel chaired by Glen T. Seaborg, who discovered Plutonium almost 60 years ago. This report recommended implementation of the reactor irradiation option for disposal of surplus weapons-useable plutonium.

The stated goal of the PEIS is to make surplus plutonium inaccessible and unattractive for use as nuclear weapons. We believe that the reactor irradiation option has several advantages over the other options in meeting this goal. It is the only option that converts weapons grade plutonium to reactor grade plutonium. This is a crucial point, because our weapons testing history indicates that, although possible, it is extremely difficult to build a successful nuclear weapon from reactor grade plutonium, and that the infrastructure required to either build a successful weapon or to purify the plutonium to weapons grade presents a tremendous barrier to diversion. The reactor irradiation option is also the quickest way to reach the goal of the Spent Fuel Standard for protection from misuse.

Jill Lytle, Deputy Assistant Secretary, in her prepared comments for the Citizens Advisory Board Plutonium Forum, indicated that she wanted a "sustainable decision", one which considers the issue in light of other decisions under review and one that garners long term public support. The decision should therefore reflect the long term need to protect the public from diversion of the materials in question. The French have recognized this issue, and are currently taking advantage of the long term protection associated with the use of mixed oxide fuel for their civilian stockpiles of plutonium.

We believe that if the mission of the DOE is to ensure a stable energy supply for our country's needs, then the energy value of the plutonium, estimated at 32 billion dollars, should be considered when selecting the preferred alternative. Plutonium is not a waste - it is the closest thing to a peace dividend our country will ever see. We also believe that the DOE needs to pay attention to scientific facts related to plutonium rather than irresponsible and irrational statements made concerning its toxicity and potential impact on the population.

We strongly urge you to select the reactor irradiation option as the most beneficial and effective method for dispositioning of weapons-useable fissile material. Thank you for the opportunity to provide comment on this important issue.

[1] Protection and Management of Plutonium, American Nuclear Society Special Panel Report, Glen T. Seaborg, August 1995.

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08 02 00 **Comment Number 45**

The analyses in the PEIS take into consideration low income areas that could potentially be affected by decisions on storage and disposition of weapons-usable fissile materials.

Local officials in South Carolina and Georgia have been provided copies of the Draft PEIS, or it has been made available for their use.

08 02 00 **Comment Number 46**

Comment noted.

08 02 00 **Comment Number 47**

The Department of Energy uses a wide variety of methods to communicate with the public on these important issues. These methods include public meetings, as part of the NEPA process, and meetings outside of the process, such as the Plutonium Round Table. Numerous fact sheets and displays are made available at the meetings as well as by mail. All of this information is available on the Program's electronic bulletin board.

08 03 01 **Comment Number 48**

The Department of Energy acknowledges the commentor's opposition to new missions at SRS. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 12 06 **Comment Number 49**

One objective of the PEIS is to identify potential impacts from each of the Proposed Alternatives so that human health risks are taken into account in the decisionmaking process. DOE is committed to implementing a program that minimizes risks to all workers and all affected populations.

04 00 00 **Comment Number 50**

More detailed information on the borehole technology is available in the Technical Summary Report and related borehole alternative summary reports made available to the public beginning in July 1996.

08 03 00 **Comment Number 51**

The Department of Energy is working to make decisions on these very important issues in a timely manner using all available information such that wise, sustainable decisions can be implemented in a deliberate, properly scheduled manner.

06 01 06 **Comment Number 52**

Technical, schedule, cost, and nonproliferation analyses along with the environmental analysis will be used by the decisionmaker in determining the ROD. The technical, schedule, and cost analyses were made available for public review beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996.

08 00 00 **Comment Number 53**

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses, along with the environmental analysis and public input, will be integrated into DOE's decisionmaking process.

09 11 06 **Comment Number 54**

Appendix H of this PEIS evaluated the various Pu waste forms for potential disposal in a HLW repository to include MOX spent nuclear fuel. The environmental impacts associated with the operation of the HLW repository are not within the scope of this PEIS. The environmental impacts of constructing and operating a HLW repository would be completed in a separate NEPA analysis. This PEIS analyzes the construction and operation of a MOX fuel fabrication facility and the associated reactors in Section 4.3.5.

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Rocky Flats Public Meeting Oral Comments - March 26, 1996

Public Meeting Comments

Rocky Flats Environmental Technology Center
Tuesday, March 26, 1996

Afternoon Meeting
Plenary Session

C: I am in favor of moving this material off Rocky Flats. | 1/08.03.01

Afternoon Meeting
Breakout (Combined) Session

C: The population parameters should be kept visible in the matrix, because it is the great deterrent for not using Rocky Flats. | 2/01.05.00

C: I don't see security listed as a parameter, if we have to have 371(not identified as a building or area) and a new vault then security will have to be increased, therefore, increasing costs. I don't see maintenance and operation listed. These subjects should be considered in relation to the matrix. | 3/13.00.00

C: [Prepared statement of Kenneth Werth (see attached)]

C: In reviewing the summary I noticed that whenever transportation was dealt with it was written in the summary as, "and intersite transportation would be susceptible to cumulative impacts." I recognize that there will be transportation of these materials. I think that the public will be concerned with the security measures associated with the transport of this material. The processes used to transport the material should be displayed and explained better to the public. A better statement of the security should be addressed in the final Environmental Impact Statement to further allay the public's fears. I recommend that a general statement saying, "Security measures are in place" be added, at least, in the final document, even if most of the security measures are classified. | 4/13.00.00

Q: Is there a policy forthcoming on the movement of the material by interstate highways and roads? ***(Note: DOE staff present at the meeting acknowledged that they did not have an answer to this question and asked the participant to fill out an unanswered question card.)*** | 5/01.00.00

C: I don't think it's a good idea to give too much latitude to the standards or policies on how to deal with this material or to allow too many decisionmakers. If the United States has the capability, it should be used. | 6/01.06.00

C: Senator Nunn will speak on nuclear safety tomorrow on C-SPAN. I propose for Colorado to use interim storage of the weapons-usable material but not at Rocky Flats. A new vault for storage is not a problem but the vault should be placed on a military base for security reasons, do not place the vault at Rocky Flats. Northeast Colorado has minuteman silos for storage, why couldn't DOE use these silos for material storage? | 7/08.03.01

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Note: Some documents were submitted during the public meetings and were recorded as part of the minutes. The same documents, in some instances, were also submitted as hand-ins at the end of the meeting. In those cases, these documents are analyzed once, either as part of the minutes or as stand alone documents.

Listed below is the name of the individual who submitted a document as part of the minutes and the page number containing DOE's responses to the comments:

Kenneth Werth 3–1119

08 03 01 Comment Number 1

All storage alternatives in the PEIS analyze the removal of all weapons-usable fissile materials from RFETS for long-term storage or disposition.

01 05 00 Comment Number 2

The site selection process including criteria for evaluating candidate storage sites is described in Chapter 2 of the PEIS.

13 00 00 Comment Number 3

The security aspects of the storage and disposition alternatives will be developed further in detailed designs for the selected alternative(s).

13 00 00 Comment Number 4

In response to comments, DOE has expanded the transportation analysis (Section 4.4 and Appendix G) to include a more detailed description of issues involved in transportation of the weapons-usable fissile materials. This revision is included in the Final PEIS.

Rocky Flats Public Meeting Oral Comments - March 26, 1996

C: Thanks to DOE Site and Headquarters personnel for coming out. I am sorry for the small turn out to today's meeting. The people in this area have become satisfied.

Afternoon Meeting
Summary Session

No summary session

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01 00 00 **Comment Number 5**

Transportation of weapons-usable fissile materials will comply fully with applicable DOT regulations. Should new Federal regulations or policies be promulgated, DOE will comply.

01 06 00 **Comment Number 6**

Comment noted.

08 03 01 **Comment Number 7**

The Department of Energy acknowledges the commentor's opposition to storage of weapons-usable fissile materials at RFETS. All storage alternatives in the PEIS analyze the removal of all weapons-usable fissile materials from RFETS. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

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Rocky Flats Public Meeting Oral Comments - March 26, 1996

Evening Meeting
Plenary Session

C: I would like to see more balance between the federal agencies and the private sector with the issue of handling hazardous waste. The more stringent requirements demanded of the private sector should be demanded of the federal agencies. During a visit to Rocky Flats it seemed the monitoring is slowing down, the plastic covering the buildings is decaying because of weather and other elements, this makes one wonder about the steps taken for monitoring. I would like to see the monitoring efforts for Rocky Flats increase and not decrease. Thank you for the opportunity to speak I think that DOE and Rocky Flats is moving forward but more work is needed. | 8/15.00.00

C: I think that all nuclear countries should work toward disposition of nuclear weapons, not just the Russians. The Chinese are threatening to destroy Hawaii and California, then there is the speculation about a recent Chinese nuclear test. DOE may be moving forward but they are going too fast. The President giving away plutonium to the United Nations was not a good idea. He should be placed in jail. At present, higher importance has been placed on other trivial political issues, for example: Whitewater and Clinton's alleged affairs. The United States should place the issue of plutonium before all of them. President Clinton took the responsibility for giving the plutonium to the United Nations. | 9/01.03.00

C: There are two objectives that need to be talked about tonight. One is the disposition of surplus weapons. Weapons using plutonium is a major problem. The second is the draft Programmatic Environmental Impact Statement as it is related to long term-storage. I am disappointed that the presentation by Dr. Canter did not go into the technologies that are available. There are many issues about costs, security, and safety, however, DOE needs to include health officials in monitoring and making sure there are no problems. | 10/01.04.00

C: I would like to see more attention given to storage issues. The disposition of surplus weapons should be reviewed for a longer period of time, since it seems that there are still a number of questions about the technologies. Too much attention is being given to forcign policy. We need a stronger emphasis on making certain the material is stored safely and securely now, and that it can be inspected by health officials as well as safeguard agencies. | 11/02.00.08

Q: How does the spent fuel standard relate to the technical alternative(s) for immobilization? The value is limited to the retrieval of the material. Is the value of placing the plutonium in a nonproliferable form greater than having to retrieve the material out of spent fuel and spending more money? ***(Note: The response provided at the meeting did not appear to fully address the issue.*** | 12/04.02.00 | 13/07.01.00

C: The interim storage vault decision for Rocky Flats is a wise decision. | 14/08.03.01

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15 00 00 **Comment Number 8**

Comment noted.

01 03 00 **Comment Number 9**

The Department of Energy believes that the process for making decisions, including national policy considerations, will provide the basis for implementing Pu disposition actions that will encourage other nations to dispose of their Pu. The technical disposition process may not be the same for all nations.

01 04 00 **Comment Number 10**

One of the screening criteria DOE used for selection of reasonable alternatives to be analyzed in the PEIS is environment, safety, and health. In implementing the selected alternative, DOE will meet the high standard of public and worker health and safety, and all applicable environmental laws and regulations.

02 00 08 **Comment Number 11**

The PEIS provides the environmental analysis for the storage alternatives and sites in sufficient detail to provide the decisionmaker with the information to choose the storage alternative(s) and site(s). This analysis will provide the basis for long-term storage capability for the period required to reach decisions and implement actions required to achieve final disposition. Disposition alternatives are also analyzed to provide the decisionmaker with the information to choose a technology(ies). Further technology demonstrations and designs may be required before site selection and implementation of a disposition alternative.

04 02 00 **Comment Number 12**

Immobilization technologies meet the Spent Fuel Standard which makes Pu as inaccessible for weapons use as the residual Pu contained in commercial reactor spent fuel.

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C: DOE does not have viable disposition alternatives in the draft Programmatic Environmental Impact Statement - DOE needs to focus on safety and security. Immobilization of the material is not a wise decision. The long-term storage options, glass or ceramics, should be poisoned with material other than highly hazardous materials. DOE needs to initiate a national dialogue to decide what will happen with the surplus plutonium. | 15/01.02.00 | 16/08.03.01 | 17/05.00.08

Evening Meeting
Breakout (Combined) Session

C: On April 30, 1996, a second meeting (near the Rocky Flats Site) will be held for comments on this document. Rocky Flats is currently missing a ton of plutonium, for which the public has not received an adequate answer as to where it went. The public has been told that DOE can explain how the plutonium became (was found to be) missing. | 18/15.00.00

C: I live here and I also work for the U.S. Geological Survey. Some of our guys monitor the soils and water at Rocky Flats. I'm concerned with radiation and whether there is any safe way to dispose of this material. I don't think the No Action alternative has negligible adverse impacts. Our land, air, and water resources would be impacted. The No Action alternative seems to imply that it is safer not to touch the material. To me, the No Action alternative reflects that, if you don't do anything, you won't impact the economy, but if the material stays here it will still have a big affect on the environment and the people. | 19/02.01.07

C: The No Action alternative is required by the National Environmental Policy Act; however, several ecological impacts would exist. Choosing the No Action alternative at Rocky Flats seems more viable than getting cows off public land. | 20/08.03.01

C: DOE needs to consider values that are not just about economics, such as the value of a nuclear weapons-free world. | 21/08.03.00

C: I like the deep borehole alternative because it puts the material totally out of the way of harming people. | 22/08.03.01

C: I would not be in favor of the deep borehole alternative, the United States should get some use out of this material. I am in favor of No Action alternative. The United States needs to make sure that the world is stable before disposing of this material. | 23/08.03.01 | 24/08.03.01

C: The deep borehole alternative would have been safe many years ago. For example, three million years ago there was a natural nuclear African reactor where daughter products did not travel far. | 22/08.03.01 cont.

Q: Would heat be an issue with the deep borehole alternative, causing a dangerous situation? *(Note: The response provided at the meeting did not appear to fully respond to the issue.)* | 25/04.00.00

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07 01 00 **Comment Number 13**

Cost data, along with technical and schedule data, were provided in Technical Summary Reports for disposition beginning in late July 1996. Recovery of Pu from the "much larger and growing quantity of Pu that exists in spent nuclear fuel" is outside the scope of the PEIS.

08 03 01 **Comment Number 14**

The Department of Energy acknowledges the commentor's support for interim storage of weapons-usable fissile materials at RFETS. However, decisions on interim storage are not within the scope of this PEIS. The scope of the PEIS is long-term storage.

01 02 00 **Comment Number 15**

One of the screening criteria for selection of reasonable alternatives is the feasibility/viability of the disposition technology. The reasonable alternatives analyzed in the PEIS are considered technically viable. DOE will demonstrate the chosen disposition technologies prior to their implementation.

08 03 01 **Comment Number 16**

The Department of Energy acknowledges the commentor's opposition to the Immobilization Alternatives. Decisions on disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

05 00 08 **Comment Number 17**

Comment noted.

15 00 00 **Comment Number 18**

Accountability of materials at RFETS is beyond the scope of the PEIS. This subject is addressed in RFETS site-specific documents.

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C: You can institute storage that deters proliferation or theft by a subnational group. I don't think any of the options shown here tonight would stop use by the host nation, including deep borehole. | 26/13.00.00

C: I think we should reject the disposition options we have right now and continue our research in that area while making our long-term storage as proliferation-resistant as possible. | 27/01.00.00

C: The deep borehole alternative seems very "out there", and I hope it is not a likely alternative. DOE should try to get the energy out of the material. Deep borehole seems like it was thrown in there just to have another option. | 23/08.03.01 cont.

C: Political instability is a crazy reason to move so quickly. One administration should not make this decision, and it should not be made in a year, this decision is too important to rush. The United States moving quickly will not rush the Russians to dispose of their material. | 28/08.03.00

C: I would like to see a level of respect for the material, the materials seem to be larger than the storage facilities. I would like to see more emphasis on monetary issues for future generations. I am concerned that the United States will not be able to keep track of the material within the next 50 years. The United States created it and everyone needs to take responsibility for it. This is an enormous responsibility. The public should inform Congress of this real problem that needs to be dealt with.

C: The United States can't expect that our example will be followed. The United States needs to work with all nations together, to make plutonium and highly enriched uranium harder to use. Mixed oxide fuel use could spur a plutonium economy, this might be a problem. DOE should use Rocky Flats as a research location for a suitable immobilization technique. | 29/01.03.00 | 30/08.03.01 | 31/08.03.01

C: It is important to develop technologies and to share these technologies with other countries, in order to be a leader. Once the United States takes the lead, the United States will have greater benefits for our society and the world. | 32/01.03.00

C: DOE cannot characterize their waste. This is a problem. | 33/09.11.08

C: I would like to thank DOE for a very clear presentation.

Evening Meeting
Summary Session

No summary session

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02 01 07 **Comment Number 19**

The *National Environmental Policy Act* requires the analysis to include the No Action Alternative as a baseline to compare the potential environmental impacts. The No Action Alternative may not accomplish the purpose and need, as identified by the PEIS, which is the case for storage and disposition. However, should the No Action Alternative be chosen, ongoing actions such as material stabilization and security, health and safety improvements would continue under the current management direction to ensure that the environment and the people are protected.

08 03 01 **Comment Number 20**

Comment noted.

08 03 00 **Comment Number 21**

Comment noted.

08 03 01 **Comment Number 22**

The Department of Energy acknowledges the commentor's support for the Borehole Alternatives. Decision on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 23**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 24**

The Department of Energy acknowledges the commentor's support for the continued storage of surplus Pu (No Action Alternative). Decisions on

disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

04 00 00 Comment Number 25

No. As discussed on page 1–5 of the Deep Borehole PEIS Data Input Report (Direct Disposal), "heat generation by the Pu is not great enough to disturb the stagnant fluid regime at depth."

13 00 00 Comment Number 26

Comment noted. The purpose of assessing the various reasonable alternatives in the PEIS is to find ways to execute the Proposed Action to meet the objectives in the President's Nonproliferation Policy.

01 00 00 Comment Number 27

The Department of Energy acknowledges the commentor's support for the continued storage of surplus Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 00 Comment Number 28

The Department of Energy is not in a rush to make decisions in these very important areas of national security and proliferation concerns. DOE is following a schedule that allows the careful consideration of all relevant information, such as this PEIS, technical and economic studies, and commentors' input. Then, good sustainable decisions can be made.

01 03 00 Comment Number 29

The intent of DOE's Proposed Action is not only to take the lead in Pu disposition, but also use the environmental, technical, cost, schedule, and policy analyses results obtained during the decisionmaking process to enhance the flexibility of the U.S. negotiations with Russia and other nations, so that cooperative efforts in Pu disposition can be reached through bilateral or multilateral agreements.

08 03 01 **Comment Number 30**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input..

08 03 01 **Comment Number 31**

The Department of Energy acknowledges the commentor's support for research of a suitable immobilization technique for weapons-usable fissile materials at RFETS. However, decisions on interim storage are not within the scope of this PEIS. The scope of the PEIS is long-term storage.

01 03 00 **Comment Number 32**

Comment noted. The United States and Russia currently have a joint technical working group that is assessing disposition technologies. The purpose is to evaluate and exchange information on technology already developed in each country to help the decision process and expedite implementation. A Report of the Joint Working Group issued in September 1996 considers reactor, immobilization, and borehole technologies, as well as economics and safeguards. Plans also call for conducting small-scale technical demonstrations to various dispositon alternatives.

09 11 08 **Comment Number 33**

The conceptual designs for the consolidated and collocated facilities and the disposition facilities have, as part of their design, waste management facilities that would treat and package all waste generated into forms that enable long-term storage and/or disposal in accordance with RCRA and other applicable Federal and State regulations and DOE Orders. As the designs mature, Process Waste Assessments, which include individual waste stream characterization, will be completed. No waste stream will be generated that cannot be treated and packaged into a form than enables long-term storage and/or disposal.

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Public Meeting Comments

Idaho National Engineering Laboratory
April 15, 1996

Afternoon Meeting
Plenary Session

C: I am pretty familiar with the Governor's Agreement and it does not refer to all the plutonium in Idaho as waste. | 1/01.00.00

C: In reference to the eradication of the plutonium. I understand that material from the first splitting of the atom is still in its original state. I hear proposals but no solutions. Like the Waste Isolation Pilot Plant where billions are being spent, and it is still not ready. | 2/12.00.00

C: [Prepared statement of John Commander (see attached)].

C: I have discovered how to change matter through electron donors. An implosion machine emits protons, but not gamma or x-rays. I do not have the ability to check the emission of alpha or beta rays. I will submit the photographs taken which show this through the blue balls on the picture. The implosion machine can dissolve materials with no residue. I am an expert in Plasma Particle Physics. I can create new DNA in persons enabling them to become younger. When you add electron particles materials will change. I will also submit my carbon formula which violates the second law of thermodynamics. I have constructed a cyclotron which will get rid of plutonium-239 and waste. Through this process the plutonium and waste would be placed in another time phase. If cells in the human body can be restructured, then why can't it work on metals and restructure solid matter? With my procedures hair would begin to grow back. It has worked for me. As individuals we are programmed to believe what we believe until proven differently. I have documentation for everything I have told you today | 3/14.00.00

Afternoon Meeting
Discussion Session

C: At present there is ongoing construction for two additional lanes going into the Idaho National Engineering Laboratory. These additional lanes will relieve the transportation burden placed on lanes now *(Note: This comment follows a discussion in the PEIS analyses of impacts of level of service of local roads.)* | 4/09.08.03

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Note: A number of documents submitted during the public meetings were recorded as part of the minutes. The same documents, in some instances, were also submitted as hand-ins at the end of the meeting. In those cases, the documents are analyzed once, either as part of the minutes or as stand alone documents.

Listed below are the names of the organizations/individuals who submitted documents as part of the minutes and the page numbers containing DOE's responses to the comments:

American Nuclear Society, John Commander	3–40
State of Idaho, Governor Philip E. Batt	3–909
Steve Herring	3–363

01 00 00 **Comment Number 1**

The *National Environmental Policy Act* requires that DOE consider a range of reasonable alternatives for the storage and disposition of weapons-usable fissile materials. INEL and five other DOE sites are evaluated in the PEIS as potential storage sites. In addition to site evaluations, the document considers a range of storage approaches such as retention or off-site shipment of current inventories.

The final decisions on materials storage will be based on programmatic cost and policy considerations, as well as environmental analyses. Consistent with efforts to foster the cooperative spirit that we want to see continue to emerge from our agreement with the State of Idaho, DOE will not make any decision regarding the storage of weapons-usable fissile materials at INEL without first discussing the matter with the State of Idaho.

12 00 00 **Comment Number 2**

Comment noted.

14 00 00 **Comment Number 3**

Comment noted.

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C: Transport of material would have to be in compliance with Department of Transportation regulations and maximize the interstate system. All interstates in Idaho go across sovereign nations.

C: As defined in the Programmatic Environmental Impact Statement, nonproliferation is the peaceful, beneficial reuse of the materials whenever possible. I don't think the United States can get other countries to stick this material in a hole, because they will want to use it. The United States needs to lead by example through the way it deals with the material. | 5/01.06.00

C: It would be helpful to weight this issue *(latent cancer rates)* to be a zero as far as the danger to the public. If the ranking changes the issue should be reevaluated. | 6/09.09.08

C: There is a problem with the *(latent cancer)* rates and numbers in the document showing three decimal places, this appears to make the rates and numbers more precise than they are. | 7/09.09.08

C: Personal cancers are difficult to accurately estimate. The risks from background radiation are often more dangerous than the true impact of proposed activities. The way they are presented in the document could be misleading. | 8/09.09.08

C: In a magazine story, Dr. Unman discusses radioactive doses, he sited that the public is used to living in a radioactive environment. He asks, have you gotten your dose today? However, studies of cancer cases through the United States, have looked at cancers caused by radiation. The results have seemed to be analogous with the corn belt and not near nuclear facilities.

C: I thought that an environmental impact statement was to look at impacts of the options that will be used, not at worst case impacts of options that will never be used This is a waste of time and money if it doesn't reflect reality. | 9/08.00.00

(Note: The following two statements were made during a discussion about plutonium and spontaneous combustion between meeting participants.)

C: There was a fire in a glove box at Rocky Flats which burnt a facility down.

C: There were two fires at Rocky Flats that occurred about 10 years apart, but the facilities did not burn down.

C: Greenpeace is telling half-truths when they say that plutonium is dangerous Plutonium is the most hazardous when it is in weapons form; we're trying to get it out of weapons, and that's good. Botulism is more dangerous than plutonium The United States is talking about 900 tons of highly enriched uranium and 200 tons of plutonium, approximately 1000 tons total. My cost figures estimate the material at $500 a gram, which would equal approximately that one-half | 10/08.03.01

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09 08 03 **Comment Number 4**

The Department of Energy acknowledges the commentor's observation and has revised text in Section 4.2.3.8 of the Draft PEIS as necessary.

01 06 00 **Comment Number 5**

Comment noted.

09 09 08 **Comment Number 6**

Potential human health impacts from the Proposed Actions are calculated and documented in this PEIS as required by NEPA. To inform the public and the decisionmakers, all latent cancer risks associated with the Proposed Alternatives are presented in the PEIS even if the risks are very small. The ranking or decisionmaking analysis for the alternatives is based on various factors including the human health impacts. Since the human health impacts are very small for all alternatives, it will not affect the ranking or decisionmaking analysis.

09 09 08 **Comment Number 7**

In order to provide information to the public and decisionmakers, the human health risk and latent fatal cancers are presented in the Draft PEIS even though they are very small numbers. To aid the public understanding of the risk numbers, an explanation of how to interpret these risk numbers is also included in Section M.5. Due to the inherent uncertainties associated with risk assessment, the parameters related to human health risk assessment should be kept to two significant digits. Risk numbers that are more than two significant digits were modified in Chapter 4 of the Final PEIS. Presenting more significant digits does not affect the decisionmaking process, but artificially grouping ranges of numbers may disguise significant discriminators.

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trillion dollars that have been spent on weapons. Placing this material in the ground is irresponsible considering the money that has been spent. | 10/08.03.01 cont.

C: The total amount of plutonium we are discussing could be stored under the table. However, few people understand critical mass, why the material can't be stored together. The size of a hockey puck is enough (8 oz.) material to make a nuclear warhead. Botulism kills now, whereas plutonium will kill forever and ever. Plutonium can accelerate as does anything with a nuclear charge. DOE should explain critical mass, and how it is being dealt with. | 11/09.09.08

C: 22.4 kilograms of material placed together can obtain critical mass. The only way to get rid of it is to burn it. Other countries will believe that the United States is stupid if the material is placed in a hole. This information needs to be taken to Secretary O'Leary. | 10/08.03.01 cont. | 12/08.03.01

C: DOE is talking about a generic hole, however, when DOE begins site characterization on this generic hole all hell will break loose, as what happened with the Waste Isolation Pilot Plant and Yucca Mountain. People provide answers with no solutions. | 13/01.02.00

C: During the Cold War, the United States and Russia built up a weapons stockpile. The United States should deal with this in a responsible manner now so that our grandchildren don't have to deal with our stupidity. | 14/01.06.00

C: The document summary provides too much information on environmental impacts, for example, the tables give too much detail. It doesn't answer questions relating to critical mass, amounts of plutonium, and the specific facilities that would be used. DOE needs to summarize all of the document not just the environmental impacts. | 15/01.00.00

C: There is a political party who wants to get rid of DOE. I don't see how politics can be divorced from the decision process.

C: It was implied that the decision made would be political, not technical. Upper management of DOE needs to stand true to the oath they have taken and make decisions based on technical information. I would like to know which way you think the decision will be made. | 16/01.06.00

C: The public needs to be educated on critical mass. Only a small amount of plutonium can be burned at once. Twelve years to get something on line is out of the question. The United States economy is shot. Isn't it true that United States economy is ruled by politics? | 11/09.09.08 cont.

C: I don't know if I will be around in fourteen years to see if the decision is made to open Yucca Mountain. I don't think DOE will come up with any ideas in 40 to 50 years since nothing has been done since 1955. | 17/12.01.00

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09 09 08 **Comment Number 8**

To better understand the potential health impacts from background environmental radiation and the Proposed Actions, the natural background radiation levels occurring at each potential site being considered as a Pu storage and disposition alternative are presented in this PEIS. These site background radiation levels were compared to the natural background radiation in the same area.

08 00 00 **Comment Number 9**

The Department of Energy under NEPA is required to analyze the environmental impact of all reasonable alternatives. DOE used a formal screening process, plus input from a NAS Report, to develop the list of alternatives. This list was then discussed with the public during the scoping process. Modifications and changes were made as a result of public comment.

08 03 01 **Comment Number 10**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 09 08 **Comment Number 11**

Critical mass is explained in the PEIS's *Glossary* in Chapter 7. The PEIS does present the potential environmental and health impacts for the Proposed Alternatives which includes analyzing criticality accidents.

08 03 01 **Comment Number 12**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

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C: The United States likes to rename things, so if DOE is eliminated, it will probably just be renamed or be given to the state level of government. The United States doesn't give solutions to problems. | 18/01.00.00

C: Personally, I am concerned about human safety. Argonne National Laboratory-West has proven to have safe storage. It would be in the best interest of the state, nation, and economy to continue with this project. | 19/08.03.01

Afternoon Meeting
Summary Session

No summary session

Evening Meeting
Plenary Session

C: There is the need to have an alternative that will store the material. That would enable the United States to use the material again for weapons, if needed.

C: [Prepared statement of Idaho Governor's Office, Bob Ferguson (see attached)]

C: [Prepared statement of Dr. Steve Herring (see attached)]

C: I agree with the intent of the disarmament agreement with Russians, which would see highly enriched uranium and plutonium unusable for weapons, as soon as possible. It is easy to decide what to do with the material in the short term, if DOE could decide on the final disposition chosen. Those individuals who worked with this valuable material hate to see it thrown away. We would prefer to see it used in reactors. I am sure that the disposition alternatives are technically safe; however, the deep borehole alternative seems expensive. I would not like to see underground disposal interfere with disposal of commercial spent nuclear fuel. Don't downgrade Uranium-233, it could be valuable in space reactors. | 10/08.03.01 cont. | 12/08.03.01 cont.

Evening Meeting
Discussion Session

Q: With regard to disposition or immobilization of the material-would that be done now or down the road? DOE should not preclude future use of the material. Plutonium has real value, the taxpayer has paid a lot of money for it and any value from the material should be given back to the taxpayer by energy or power. Deep borehole and immobilization is not an option. If DOE | 20/07.01.00 | 10/08.03.01 cont. | 21/08.03.01

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01 02 00 **Comment Number 13**

Comment noted.

01 06 00 **Comment Number 14**

Comment noted.

01 00 00 **Comment Number 15**

Based on public comments, the Summary was revised.

01 06 00 **Comment Number 16**

This PEIS addresses the environmental impacts of the reasonable alternatives for DOE's Proposed Action. Analyses of cost, schedule, technical, and Nonproliferation Policy impacts are described in separate documents to support DOE's ROD.

12 01 00 **Comment Number 17**

Comment noted.

01 00 00 **Comment Number 18**

Comment noted.

08 03 01 **Comment Number 19**

The Department of Energy acknowledges the commentor's support for additional missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

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hydrides the material the facility should be at the storage location. *(Note: The response provided at the meeting did not appear to fully address the issue.)*

C: Those processes should be done in an area with a significant buffer. Idaho National Engineering Laboratory has that buffer and the Snake River can be environmentally protected. The decision should be made based on technical information. — 22/08.03.01

C: A small amount of the material should only be blended down to 20% for research reactors; it may be a help to University reactors to give them some of the 20% fuel for education purposes. — 23/15.00.00

C: The same technology can be used to burn plutonium as to breed it, and because of this we seem to cater to certain interest groups that think we are going to create more plutonium. — 24/14.00.00

Q: Did DOE consider giving the fuel to other contractors beside Canada? *(Note: The response provided at the meeting did not appear to fully address the issue.)* — 25/01.03.00

C: With regard to disposition or immobilization of the material would that be done now or down the road. DOE should not preclude future use of the material. Plutonium has real value, the taxpayer has paid a lot of money for it and any value from the material should be given back to the taxpayer by energy or power. Deep borehole and immobilization in not an option.

C: A lot of people don't have electricity. By DOE not using the Integral Fast Reactor, The United States is giving up our technology to other countries. The Integral Fast Reactor would destroy in plutonium. Nonproliferation is not achieved if the plutonium is not destroyed. True nonproliferation means destruction of the material. — 26/01.05.00

C: If the Integral Fast Reactor was chosen, the United States could use the fuel and have 10,000 years of world energy. If the environment would not be impacted, then why not take the material and reprocess? The amount of waste would be smaller. Our country could be taken over in 100 years. How our fuel is dealt with would be very important if this happened and the material was not placed in a nonproliferable form. There are 33 countries with light water reactors generating plutonium. Electroprocessing creates the same non-retrieval barrier for the material as glass, however the electroprocessed material would be harder to retrieve. DOE should use that process to make the material nonproliferable. Continuation of scientific research should be foremost, not political reasoning. — 27/08.03.01, 26/01.05.00 cont.

C: The current administration is opposed to nuclear power. I am concerned that final Programmatic Environmental Impact Statement will be released in September, with the Record of Decision released in November. DOE needs to address the issues brought up during these meetings now and have the final Programmatic Environmental Impact Statement sent out after the election. With that schedule another administration will make the decision. President Clinton — 28/08.03.00

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07 01 00 **Comment Number 20**

Generally, the goal is to complete disposition within 25 years of the ROD. The storage decision will be for long-term storage up to 50 years. Schedule data, along with technical and cost data, were provided in a Technical Summary Report for storage and disposition in late July 1996.

08 03 01 **Comment Number 21**

The Department of Energy acknowledges the commentor's opposition to the disposition alternatives. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 22**

The Department of Energy acknowledges the commentor's support for additional missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

15 00 00 **Comment Number 23**

Comment noted.

14 00 00 **Comment Number 24**

During the screening of alternatives for inclusion in the PEIS, a Reactor-Burning concept was evaluated involving a variation of the Integral Fast Reactor concept. However, this concept, which would use a reactor fuel cycle design still under development, would be more costly and less timely than other mature reactor options. The development program was recently terminated by the Administration and Congressional action. Since Pu disposition can be accomplished using existing technologies, there is no justification for developing this advanced technology for Pu disposition.

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wants to limit nuclear power.

C: I have visited the Argonne National Laboratory-West; its electroprocessor is working now. This technology could be spread throughout the country rapidly Technical issues should come before political issues. | 29/01.05.00

C: Third World Countries need power - maybe the United States could build a reactor to show it can be done and licensed. The United States would show the Third World Countries by leading. It is possible that the United States could export the reactor design and fuel, so they will stop using fossil fuel and damaging the environment. | 30/01.03.00

C: Secretary O'Leary has said that the chance of Yucca Mountain opening is 50/50. The chance of the deep borehole option occurring now or in my child's future is zero. Also, the Waste Isolation Pilot Plant is not open, and with that most of the underground technologies have been exhausted. DOE keeps saying that some technologies require long schedules, but two out of the three proposed options are still not available. Completion of one of the options listed will probably take 40 to 50 years. | 31/12.00.00

C: There is no time to finish the Integral Fast Reactor when it will produce 10,000 years of energy with plutonium It may be two decades before the Integral Fast Reactor would be completed, during which the United States will be using up the fossil fuels available There are a lot of pieces that need to be put together. With the plan of having electric cars in the future, the United States needs to be prepared. DOE might as well save the material or burn it. How does this tie in with the Integral Fast Reactor and its ability to make 10,000 years of energy? No one has been killed in 10,000 years by reactors, even in Russia only 200 persons have died Which still makes reactors the safest energy source. DOE does not have America's interest at heart

C: The State of Idaho supports the Integral Fast Reactor and is not willing to let it die. The Governor's comments state that this disposition option is in place. DOE would miss out if they didn't address restoring the Integral Fast Reactor to facilitate disposition of the material. The Integral Fast Reactor is closer to burning the material than any other reactor. | 32/01.04.00

Evening Meeting
Summary Session

No summary session

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01 03 00 Comment Number 25

The Department of Energy also considered the possibility of fabricating and burning MOX fuel in European facilities. This option was eliminated since the capacities of European fabrication facilities and reactors are being balanced to minimize accumulation of civilian Pu from reprocessing. If U.S. weapons Pu were introduced into the European fuel cycle, it would upset this balance and increase the accumulation of civilian Pu. While utilizing European facilities is not a long-term solution, it may be able to support the U.S. disposition mission in the short-term. Until an equilibrium is achieved among European reprocessing, fuel fabrication, and reactor facilities, there may be some excess MOX fabrication capacity available that could be utilized for a limited period to fabricate MOX fuel from U.S. weapons Pu for use in U.S. reactors. In the event that the Reactor Alternative using MOX fuel is selected in the ROD, this excess capacity could help get disposition efforts in the United States underway pending startup of a domestic MOX fuel fabrication facility.

01 05 00 Comment Number 26

The Integral Fast Reactor technology would require a significant amount of time and money to implement, complete technology development and demonstration, and build necessary facilities. Destruction of all Pu would take hundreds of years because of the many cycles of reprocessing and reintroduction into liquid metal reactors. Use of existing reactors can place the Pu into a form that makes it as difficult to use in a weapon as the Pu in commercial reactor spent fuel.

08 03 01 Comment Number 27

The Department of Energy acknowledges the commentor's support for the Electrometallurgical Treatment Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, existing agreements, and public input.

IANS Statement Re: Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement

My name is John Commander. I am Vice-Chair of the Idaho Section of the American Nuclear Society, and represent some 900 members located predominately in Southeast Idaho. On behalf of the section, I would like to make a statement concerning the Storage and Disposition of Weapons Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

We believe that all of the long term storage options are acceptable from the standpoint of safety and environmental impact; however' the option for the Collocation of the Plutonium and Highly Enriched Uranium receives our support as the most favorable alternative. We also believe that any of the Long Term Storage sites proposed could be designed to be acceptable. — 33/08.03.01

We believe that the Plutonium Disposition Alternatives which involve disposal with out utilization as fuel for use in reactors are unacceptable. We support the recommendations contained in the ANS Special Report on the Protection and Management of Plutonium (Special Panel Report, Glen T. Seaborg August 1995). This report recommended implementation of the reactor irradiation option for disposal of surplus weopons-usable plutonium. — 10/08.03.01 cont.

The Special Panel Report also recommended continuation of development work on reprocessing and breeder (Integral Fast Reactor) as a promising approach to proliferation-resistant fuel cycle. We strongly support this recommendation also. — 34/14.00.00

Sincerely,
John Commander

170 Fieldstream Lane
Idaho Falls, ID. 83404

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08 03 00 **Comment Number 28**

Comment noted.

01 05 00 **Comment Number 29**

Comment noted.

01 03 00 **Comment Number 30**

Comment noted.

12 00 00 **Comment Number 31**

At this time, DOE is continuing efforts to characterize the Yucca Mountain site for receipt of HLW and efforts to open the WIPP site. If these efforts are unsuccessful, the United States will identify other sites and/or approaches for accommodating waste from materials disposition and other DOE activities. In the event that sites cannot be identified in time to receive waste, safe temporary storage arrangements will be made pending availability of a final waste acceptance site.

01 04 00 **Comment Number 32**

Comment noted.

08 03 01 **Comment Number 33**

The Department of Energy acknowledges the commentor's support for the Collocation Alternative. Decisions on storage alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

14 00 00 **Comment Number 34**

Comment noted.

OFFICE OF THE GOVERNOR
P.O. BOX 83720
BOISE 83720-0034

PHILIP E. BATT
GOVERNOR

(208) 334-2100

Testimony regarding the
Draft
Fissile Materials Disposition
Programmatic Environmental Impact Statement

Monday, April 15, 1996
Idaho Falls, Idaho

As the Governor of the great state of Idaho, I appreciate the Department of Energy's efforts to come to grips with the by-products of the Cold War. To those of you who have traveled great distances to attend today's meeting, I extend to you my warm greetings.

This nation entered the nuclear age fifty years ago with big dreams, high hopes and in the case of nuclear weapons, horrible fears about what might some day be unleashed. At the same time we entered in the nuclear era, we were ill prepared for what to do with the final waste streams that come about through nuclear activity.

The DOE is addressing these issues now through multiple environmental impact statements. Not all of them affect Idaho, but because the decisions DOE will make on the Draft Fissile Materials Disposition Programmatic Environmental Impact Statement will impact our state, it is important that DOE listen to what Idahoans have to say. Many fear what your decisions will do to the environment. Others fear what it will do to their pocketbook. Whatever decisions are made, it is important that DOE listen.

...gh the EIS process DOE has undertaken is difficult and fraught with a certain degree of inevitable controversy, this process is an opportunity to peacefully decide what to do with what are essentially surplus war materials. Rather than using them in war, we now have the opportunity to calmly and rationally decide what to do with these surplus Cold War materials.

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The products under consideration in the Draft Fissile Materials Disposition Programmatic Environmental Impact Statement include plutonium and highly enriched uranium. As a nation, we must do something with these materials to make them safer and protect ourselves from the potential for misuse.

Under the draft PEIS, DOE officials are currently considering several options regarding what to do with these by-products. The draft PEIS identifies three long-term storage alternatives for plutonium and highly enriched uranium: upgrade facilities at multiple sites; consolidate the nation's plutonium at a single site; and co-locate plutonium and highly enriched uranium. The six candidate storage sites are: the Idaho National Engineering Laboratory, Hanford Site, Nevada Test Site, Oak Ridge Reservation, Pantex Plant and the Savannah River Site.

Let me make it perfectly clear to the DOE, media and citizens of Idaho: bringing nuclear waste material to Idaho for long term storage is not acceptable by either the letter or the spirit of the historic agreement reached last year.

Under the terms and principles of our agreement, transuranic waste material is specifically prohibited from entering Idaho until a treatment facility for that material is constructed and operating. Once the transuranic material is brought to Idaho, it has six months to be in Idaho before treatment and it must leave within six months after treatment. Transuranic waste is that waste contaminated with plutonium and other radioactive elements.

The state of Idaho considers any plutonium material brought to Idaho to be transuranic waste and therefore covered under the agreement.

Plutonium is a transuranic material because it contains more than 100 nanocuries of alpha-emitting transuranic isotopes with half-lives greater than 20 years per gram of waste.[1] Surplus plutonium is a waste because it is DOE's stated purpose and intent to treat this material so that it can be made proliferation resistant pending its ultimate disposition in a geologic repository. This EIS proposes to treat the plutonium by vitrification or MOX fuel fabrication. If DOE proposes to construct and operate either of these treatment facilities in Idaho, then Idaho will hold DOE to its obligation under the agreement -- treatment within six months of receipt and shipment out of Idaho within six months of treatment.

Furthermore, if DOE decides to bring either plutonium or highly enriched uranium to Idaho for long term storage rather than treatment, Idaho will regard this as a direct violation of the spirit of our agreement. Both federal parties and Idaho agreed to act in good faith to effectuate and fully support this agreement. There was no doubt that the

[1] United States v. Phillip E. Batt, Civil No. 91-0054-S-EJL, Oct. 17, 1995, definition section sites "transuranic waste as "defined as set forth in Spent Nuclear Fuel EIS, Volume 2, Appendix E.

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purpose of the agreement was to set the ground rules for how DOE would bring radioactive materials into Idaho and when these materials would leave.

Our agreement does allow DOE to request a modification of the agreement if a National Environmental Policy Act (NEPA) analysis results in the selection of an action that conflicts with the terms of the agreement. If Idaho doesn't agree with DOE, the court can decide whether DOE's proposal is reasonable. In this case, shipping large quantities of plutonium and highly enriched uranium for storage in Idaho makes little sense and is clearly unreasonable given DOE's other options.

Idaho has just 4.5% of the nation's plutonium and 10.1% of the nation's declassified highly enriched uranium. In contrast, Tennessee has 66.4% of the declassified highly enriched uranium and Texas has 66.4% of the nation's plutonium.[2] It would seem to make sense that if DOE wants to simply consolidate its holdings of these materials, there are places other than Idaho that are better suited for this purpose.

Idaho is no longer a nuclear dump site. Again, if DOE merely wants to bring plutonium and highly enriched uranium to Idaho for "long term storage" in violation of the agreement, that is unacceptable.

Idaho must be and will be ever vigilant. Under my administration, I assure every Idahoan that we will continue to hold INEL to the very highest standards. As part of that effort, the state of Idaho's Division of Environmental Quality recently issued 61 notices of violation at INEL.[3] Protecting Idaho's environment is an absolute must.

Having said that, let me add this. My administration still seeks new jobs and new missions for INEL. Just recently I came out in strong support of medical radioisotope production at Idaho's National Engineering Laboratory. I will continue, with others, including Idaho's Congressional Delegation, to seek new projects that provide quality jobs for eastern Idaho. I mention this because I believe that INEL scientists and engineers are some of the very best in the nation. I am confident that they can safely handle any material sent to them.

Radioactive material carries with it a lot of emotion. I believe the state's position addresses the fears of many. We want INEL to be clean. We want your operations to be safe. We want to see nuclear waste go to safe geologic repositories for permanent disposal. We also want good jobs at INEL, but simply bringing nuclear material to Idaho for indefinite "long term storage" does not achieve that objective and does not meet the spirit or letter of the agreement that was reached last year.

[1] Department of Energy National Governors' Association handout, "Department of Energy Nuclear Materials and Waste Status and Pending Decisions, March 19, 1996." Relevant graphs attached.

[2] For more information, contact Dave Pisarski, Bureau Chief, Enforcement Bureau, Idaho Division of Environmental Quality, 208-373-0502.

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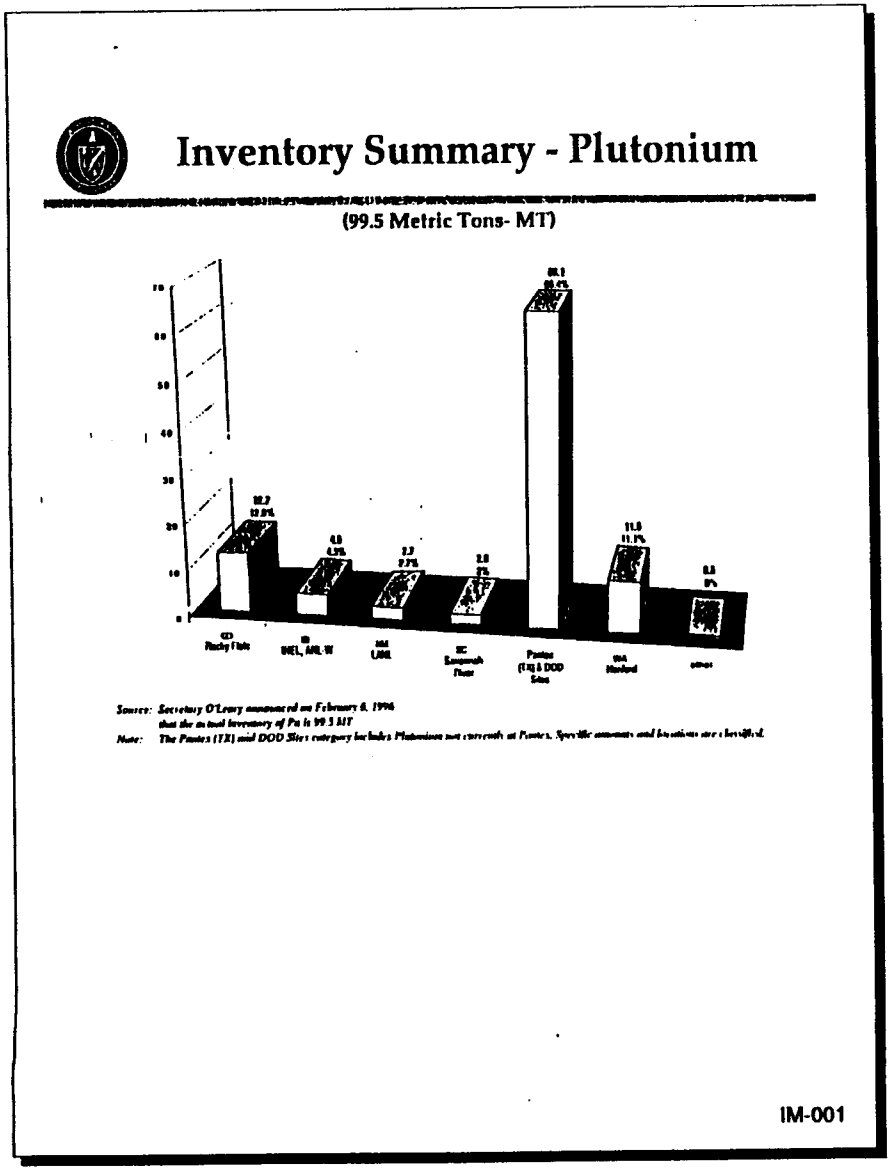
Inventory Summary - Plutonium
(99.5 Metric Tons- MT)
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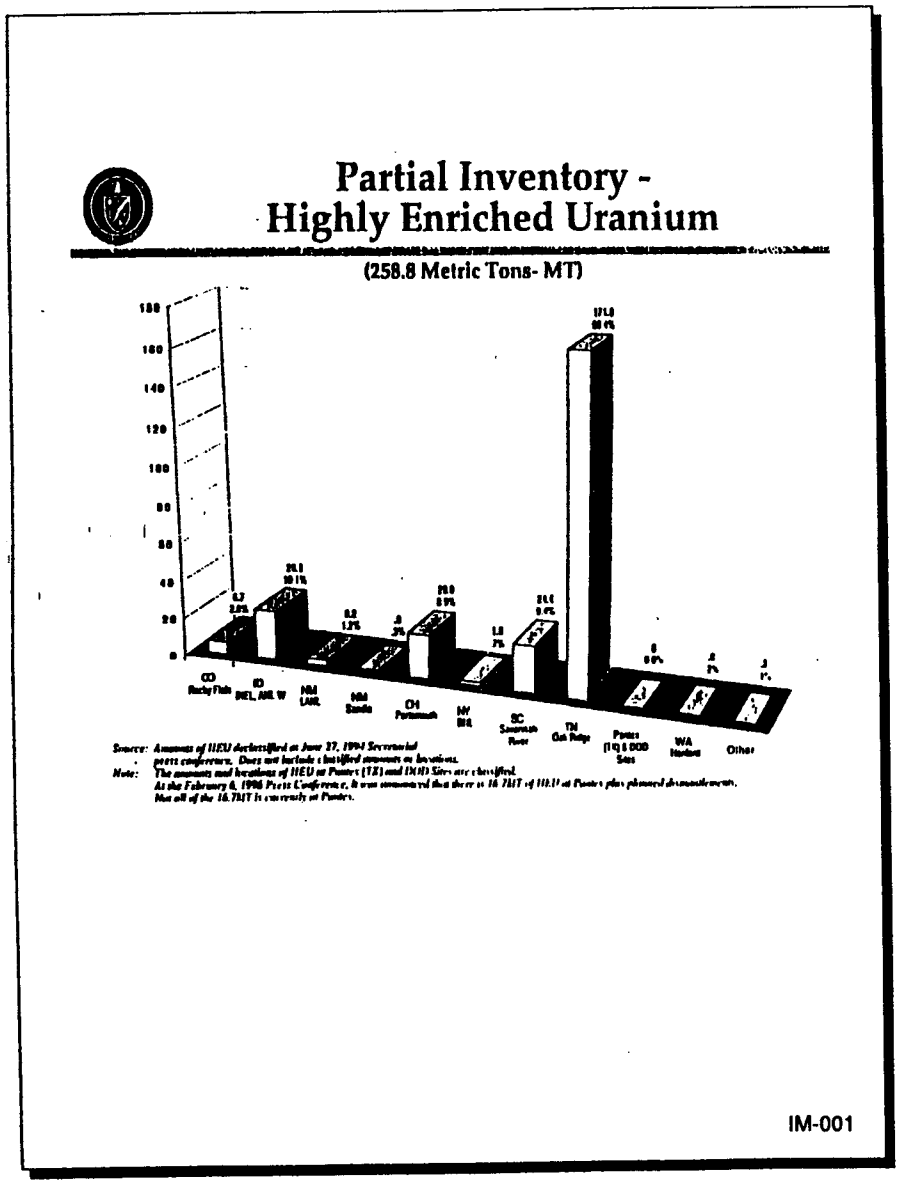
Partial Inventory -
Highly Enriched Uranium
(258.8 Metric Tons- MT)
CO
Rocky Flats
ID
INEL, ARL W
NM
LANL
NM
Sandia
OH
Portsmouth
NV
SRS
SC
Savannah River
TN
Oak Ridge
Pantex
(TX) & DOE Sites
WA
Hanford
Other
Source: Amounts of HEU declassified as June 27, 1994 Secretarial press conference. Does not include classified amounts or locations.
Note: The amounts and locations of HEU at Pantex (TX) and DOE Sites are classified.
At the February 6, 1996 Press Conference, it was announced that there is 16.7MT of HEU at Pantex plus planned downblendings. Not all of the 16.7MT is currently at Pantex.
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Statement by Dr. Steve Herring
298 Call Avenue
Idaho Falls, Idaho 83402

April 15, 1996

1. A critical requirement for any alternative is that it must ensure that the weapons-usable material cannot be clandestinely fashioned into a weapon for centuries to come. The NAS study established the "spent fuel standard" as a criterion by which to judge disposition alternatives. According the spent fuel standard," the plutonium is in a form from which it is as difficult to recover as the plutonium contained in spent LWR fuel. One assured way of meeting the "spent fuel standard" is to incorporate the plutonium in LWR fuel and then to use that fuel to high burnup.

2. Our priorities must be to advocate a safe, technically sound and proliferation-resistant process first , a fiscally responsible alternative second and, only as a third priority, to advocate alternatives located at the INEL.

3. The environmental impacts of the various alternatives are difficult to sort out of the EIS Summary Document without applying much more time and study (probably of the main EIS documents). They are not likely to exceed significantly the impacts of existing/on-going activities.

4. Disposal of the Pu through burnup use in commercial power reactors provides a "Peace Dividend" for weapons-usable materials. Commercial reactors already produce considerable plutonium (concurrent with burning it up via the fission process). A number of commercial nuclear plants including WPPSS-have expressed an interest in using weapons Pu in their plant as a way to lower overall fuel costs.

5. The MOX fuel fabrication facility would likely be built where the Pu storage is consolidated. It is appropriate to support the INEL for this role

6. According to the EIS, some forms of Pu may not lend themselves to MOX fabrication. For these forms, the INEL should play a major role, either through the ANL-W EM process or via one of the other immobilization alternatives. If the treated material is shipped out of Idaho in a timely manner, it would meet the terms of the 1995 Waste Agreement

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Las Vegas Public Meeting Oral Comments - March 28 & 29, 1996

Public Meeting Comments

Nevada Test Site
March 28 & 29, 1996

Evening Meeting - March 28, 1996
Plenary Session

C: The United States always says that the government will protect you, but what about the Western Shoshone Treaty? Is the government going to take the Shoshone land again and make the Shoshone come to DOE for our land. The deep borehole alternative will contaminate the soil and water table, no matter what DOE thinks. Why does DOE ignore the land owners of the Nevada Test Site and Yucca Mountain? Why are there no Shoshone at the meeting tonight? I have been saying for years that DOE ignores the Native people throughout the world. DOE only brings destructive material to our lands. The Shoshone want living things to continue growing, we (Shoshone) are tied to the land. I hope you (DOE) are listening. | 1/09.07.02

Evening Meeting
Storage and Disposition Breakout Session 1

C: It is my understanding that the Canadians are studying the draft Programmatic Environmental Impact Statement but no decisions have been made on whether they will agree on the CANDU option. | 2/01.03.00

C: Basic fundamental science is missing from this issue, specifically colloid chemistry. DOE doesn't understand this process. All isotopes can be destroyed in the deuterium reactors. It has been done, however this was not listed. Colloid chemistry stops any idea of transporting or storing the material. Any material DOE places in the ground, the public will eventually drink. Again, the basic science is missing. | 3/06.05.08

C: That is not true. ***(Note: This comment was made by a participant in response to DOE's statement that ... "Yucca Mountain is being considered for spent nuclear fuel, not for storage of surplus fissile materials.")***

C: The underground storage of material is prohibited in any area. Underground storage can not be done safely and securely. | 4/02.00.08

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09 07 02 **Comment Number 1**

The Department of Energy understands that the Western Shoshone have disputed the U.S. Government's ownership of lands on NTS and Yucca Mountain. The land ownership issue has been brought to court several times.

The Department of Energy seeks input from Native Peoples through the NEPA process and has instituted, and follows, the DOE *American Indian Policy*, as well as regulations under *American Indian Religious Freedom Act*, *National Historic Preservation Act* of 1966, and *Native American Graves Protection and Repatriation Act* that require such input. For this PEIS, scoping meetings were held for the public to discuss and influence the course of the project prior to document preparation. Also prior to document preparation, an NOI was published in the *Federal Register*. Applicable Federally recognized tribes were sent the NOI, a notification of the scoping meetings, and the Draft PEIS. After the Draft PEIS was issued, public meetings were held, and applicable Federally recognized tribes received advance notice of these meetings and the open public comment period.

01 03 00 **Comment Number 2**

The Department of Energy has received formal support for the concept of MOX fuel use in the CANDU reactor from the Canadian Government. However, should this alternative be selected for implementation, formal agreement between the two governments will be reached.

06 05 08 **Comment Number 3**

There are no chemical processes, colloidal or otherwise, capable of destroying Pu. A range of Reactor Alternatives was considered by DOE, including ones capable of destroying large fractions of the Pu inventory (deep burn reactors). All Deep Burn Reactor concepts were too immature to be considered technically viable for this mission.

02 00 08 **Comment Number 4**

Comment noted.

Las Vegas Public Meeting Oral Comments - March 28 & 29, 1996

C: I disagree with the statement that Yucca Mountain is not considered, when all of the storage alternatives except deep borehole need to use a repository. There are hazy lines between long-term storage and disposition. | 5/01.00.00

C: Until another repository option is made available, Yucca Mountain is the only repository where the material could be stored. | 6/12.01.00

C: DOE talks about burying the material in Yucca Mountain and hauling the material to the Nevada Test Site. I am concerned about transportation safety. How dangerous is the material on the roadways? The United States has already wiped out the Shoshone, how many lives is DOE going to take before a stop is put to this? What is the transportation mechanism that will be used for this material; rail, air, or highway? DOE employees are brainwashed. | 7/10.00.00

C: DOE is stating that waste is not a weapon, but it could be used as a weapon if put in the environment. In the future the material will be and must be eliminated and not placed in the ground. The technology was developed 50 years ago, the United States needs to address our citizens and our future, not Russia or other countries. | 8/01.00.00

C: The most dangerous material is slated for storage at Yucca Mountain. If there is not a way to securely immobilize the material, it should be placed in an area where the distance between the material and the population is large enough to not affect the population. | 9/12.00.00

C: DOE wants to solve the problem but it's the politicians that are deciding where the material should go.

C: Initially, the radiation barrier was the factor for using the spent fuel standard. The spent fuel standard definition being used by DOE is not the same as the National Academy of Sciences wording. | 10/01.05.00

C: What the National Academy of Sciences was looking at as the primary barrier was radiation. | 11/01.05.00

C: The National Academy of Sciences is talking about conning the Russians into using the materials as waste. | 12/01.03.00

C: There was material destroyed at the Lawrence Livermore National Laboratory. I know of a way to destroy the material, and DOE has stated there isn't a way. With high power x-rays, deuterium atoms can be inserted into plutonium, then the plutonium becomes heat, gamma rays, etc. DOE is talking about a game with Russia, but destruction could get rid of all of this material. I can't believe that no one in DOE knows this process. | 13/14.00.00

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01 00 00 **Comment Number 5**

Consideration of Yucca Mountain as a potential geologic repository site is a national policy prescribed by Congress in the NWPA Amendment. This PEIS analyzes the environmental impacts of surplus Pu storage and disposition alternatives, not the impacts of siting and operating a geologic repository. Whether or not Yucca Mountain is the site has little relevance to the comparison of alternatives when the same geologic repository is being used.

12 01 00 **Comment Number 6**

Comment noted.

10 00 00 **Comment Number 7**

The stringent Federal regulations require the use of packaging that cannot release dangerous quantities of radioactive material in any credible accident conditions; therefore, the health risks for transporting these materials by either truck or rail are low. The potential health risks from transporting materials associated with the proposed storage and disposition alternatives are evaluated and presented in Section 4.4 and Appendix G of the PEIS. However, there has never been an accidental release of radioactive material which has caused injury or death during more than 40 years of DOE shipment activity.

01 00 00 **Comment Number 8**

Comment noted.

12 00 00 **Comment Number 9**

Comment noted.

Las Vegas Public Meeting Oral Comments - March 28 & 29, 1996

C: DOE should look at the options versus the spent fuel standard. With mixed oxide fuel being the spent fuel standard, DOE seems to be modifying the definition. DOE should look at retrieval of material from deep borehole versus retrieval of material from spent fuel. With the acceptance of the spent fuel standard as the goal, it seems that DOE has imposed this standard on the public from one recommendation (National Academy of Sciences). The public should have more of a say. There should be a range of alternatives regarding the standard to be used. — 11/01.05.00 cont.

Q: What percent of fissile materials is waste? What percent of fissile materials is a weapons-usable resource? What percent of fissile materials will be disposed of? *(Note: No response was provided at the meeting to these questions.)* — 14/01.00.00, 15/01.02.00

C: DOE needs to provide a direct and forthright response to the public. Stop using flowery phrases and be direct - say what you mean. — 16/08.02.00

C: DOE needs to analyze all hybrid combinations of the options (mix and match). These combinations should be analyzed in the document and cumulative impact data provided especially for the specific selection chosen. — 17/01.00.00

C: The public has not been afforded the opportunity to look at those mixes and matches. If DOE comes up with this in the final Programmatic Environmental Impact Statement, then there is not a lot of basis for commenting on the draft Programmatic Environmental Impact Statement, because DOE will be placing new options in the final Programmatic Environmental Impact Statement that were not available in the draft evaluation. — 18/08.02.00

C: Past persons working with plutonium in secrecy were protected, but this is not the case anymore. How is DOE going to avoid potential legal ramifications, particularly when it doesn't understand the basic science showing that the material cannot be safely or securely stored? When the shroud of secrecy protecting DOE actions is lifted, DOE may find that it is violating environmental laws like it has done in the past. — 19/01.00.00

Q: To what extent to date has DOE addressed a science-based rather than policy approach to storage and disposition, stockpile stewardship and management, downsizing, and nonproliferation? Who are the scientists working on this, what are their credentials, who decided which scientists it would be, and what if these scientists take the information from DOE and sell it or take it to Korea? DOE needs the best scientists now. The best should be done now, not later. It will matter to the victims. *(Note: DOE staff present at the meeting acknowledged that they did not have a complete answer to these questions and asked the participant to fill out an unanswered question card.)* — 20/01.00.00

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01 05 00 Comment Number 10

The Department of Energy, in considering the Spent Fuel Standard, did evaluate the adequacy of the Standard versus the greater degree of destruction achievable with other options such as the Deep Burn Reactor Option and the Accelerator Option. It was judged that the Spent Fuel Standard is adequate since it would convert the weapons Pu to a form that would make it as difficult to retrieve and reuse in a weapon as the Pu contained in the much larger existing volume of spent fuel from commercial nuclear reactors.

The Department of Energy concluded that the shorter disposition time achievable with more mature technologies was more desirable than the greater Pu destruction that could only be achieved over a much longer time period through the use of Deep Burn Reactors and Accelerators. The NAS also adopted the Spent Fuel Standard as the most acceptable form for conversion of weapons Pu.

01 05 00 Comment Number 11

Mixed oxide spent fuel will be essentially the same as all uranium in commercial reactor spent fuel; therefore, it will meet the Spent Fuel Standard. Vitrification Alternatives will be mixed with or embedded in high-level waste which will provide a radiation field equivalent to that of spent fuel. For the Borehole Alternative, although a radiation barrier will not be provided, the extreme difficulty in accessing the buried Pu is considered to provide a physical barrier equivalent to the radiological barrier of MOX and immobilization.

01 03 00 Comment Number 12

Comment noted.

14 00 00 Comment Number 13

The intent of the proposed Pu disposition action is not to pursue total Pu destruction. Rather, it is to convert the Pu into a proliferation-resistant form that meets the Spent Fuel Standard as recommended by the NAS. DOE, in

Las Vegas Public Meeting Oral Comments - March 28 & 29, 1996

C: Did DOE take land away from the Shoshone? Or did DOE buy it? Or did DOE whip us? I am proud of that land, it provides food and other resources for me, but DOE does not care. The Shoshone are taking action about our land in court, the court has said that it will take a Congressional decision to allow the land to be used by DOE. Did DOE get Congressional permission? I hope DOE enjoys the land! — 21/09.01.02

Evening Meeting
Storage and Disposition Breakout Session 2

C: I did not receive a document and I called the provided 1-800 number. — 22/08.02.00

Evening Meeting
Summary Session

C: This is not a Nevada or United States specific issue, it affects the future. We are the last generation that can address this responsibly. It may be expensive, but it is more expensive to blow away mankind and all organic life forms. The material can be vectored to the Sun, Moon, or Venus, and this can be done safely, but the material cannot be placed underground or stored. This is a science based mission. Where are the scientists and are they the best? DOE needs the best scientists to deal with this issue because the United States is out of time. The best scientists can get it right the first time, give them the money they need. DOE needs to recognize what we are dealing with, the problem is not nuclear but human nature. We are out of time! — 23/01.00.00

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considering the Spent Fuel Standard, did evaluate the adequacy of the Standard versus the greater degree of destruction achievable with other options such as the Deep Burn Reactor and the Accelerator Option. It was judged that the Spent Fuel Standard is adequate since it would convert the weapons Pu to a form that would make it as difficult to retrieve and reuse in weapons as the Pu contained in the much larger existing volume of spent fuel from commercial nuclear reactors.

The Department of Energy concluded that the shorter disposition time achievable with more mature technologies was more desirable than the greater Pu destruction that could only be achieved over a much longer time period through the use of Deep Burn Reactors and Accelerators.

01 00 00 Comment Number 14

None of the weapons-usable Pu is considered waste. The exact percentages of Pu that go to vitrification or to reactor use would be determined as the result of the stabilization process for the Pu materials.

01 02 00 Comment Number 15

According to the Proposed Action, the end state of all the surplus Pu disposition alternatives is disposal.

08 02 00 Comment Number 16

Comment noted.

01 00 00 Comment Number 17

Since the PEIS analyzed the maximum impact of each Pu disposition alternative, and all the alternatives are well within acceptable environmental limits, it is predictable that any hybrid alternative would have much less impact than the combined maxima analyzed.

Las Vegas Public Meeting Oral Comments - March 28 & 29, 1996

Morning Meeting - March 29, 1996
Plenary Session

C: Then maybe you should not include that line in your briefing. DOE doesn't pay a lot of attention to the local public. ***(Note: This comment was made by a participant following an exchange regarding Yucca Mountain decisions and an overhead in DOE's presentation stating that a "more informed public means better decisions.")*** | 24/08.02.00

C: The security at Nevada Test Site leaves a lot to be desired. The military has more ability (i.e., warhead disassembly) than just simple storage. | 25/13.00.00

Morning Meeting
Breakout Session

C: Education and communication with the public is needed for risk perception. The public does not know or understand the numbers and their meanings in relation to risk perception. | 26/08.02.00

C: DOE has mentioned several Programmatic Environmental Impact Statements that will generate nuclear waste. Storage and transportation of this material is a major concern. Clark County is not the place to transport the material through. I propose using a rail system that would bisect the state to reach the Nevada Test Site. A rail system, in turn, could bring more industry to Nevada and some equity for the residents. | 27/10.00.00

C: I realize that we are not creating high-level waste, but we are disassembling nuclear devices at Nevada Test Site. I would like to see an alternative route for transportation, not through Clark County. | 28/10.00.00

C: A railway would provide a dedicated right-of-way for transporting these materials, and they could establish a suitable buffer zone if problems did occur. The rail shipments could be scheduled to occur at times when the least amount of people would be at risk. This would take away the fear people have of shipping this on public highways. DOE needs to use the most viable alternative. | 29/10.00.00

C: I understand the security concerns, but there are inequities toward the Tribes. ***(Note: This comment was made by a participant regarding DOE coordination with tribal communities following an exchange on transportation accidents and emergency response.)*** | 30/10.01.00

C: DOE needs to have a translator for individuals to understand the documents. DOE should not provide documents that the average person cannot read and understand. An example | 31/08.02.00

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08 02 00 **Comment Number 18**

The Department of Energy has not placed any new options (alternatives) in the Final PEIS. As stated in Chapter 2 of the Final PEIS, each of the disposition alternatives can be implemented in a number of ways as a variant of a specific alternative. A list of possible variants is included in Table 2.4–1. The alternatives analyzed are considered bounding for any of the variants suitable for the programmatic analyses included in the Final PEIS.

01 00 00 **Comment Number 19**

Analysis of the Nonproliferation Policy impacts of the various storage and disposition alternatives, including safeguards and security of the facilities, is presented in a separate document to support DOE's ROD. This document was available for public review in October 1996. DOE intends to comply with all laws even if various materials, documents, and data are classified.

01 00 00 **Comment Number 20**

Comment noted.

09 01 02 **Comment Number 21**

In the mid-1800s, lands that now comprise NTS were included within the boundary of a treaty between the United States and the Western Bands of the Shoshone Indians (that is, *Ruby Valley Treaty*). In 1951, the Shoshone tribe sought compensation for the loss of aboriginal title to these lands and was later awarded $26 million in compensation. All of the land within NTS is owned by the Federal Government and is administered, managed, and controlled by DOE.

08 02 00 **Comment Number 22**

Comment noted.

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is the use of risk numbers. There needs to be greater emphasis on how they affect the public's concerns. Nevadans are interested in short-term effects, such as, property values, construction, etc. A region of influence of more than 50 miles needs to be developed. DOE is looking at costs, but what is DOE's decisionmaking process for the criteria to decide on transportation routes? The public should be able to see these. In the Record of Decision, DOE needs to make sure that Nevadans know what how it relates to the public, area counties, and the state. Negotiations should start for these issues either before or at least by the scoping meetings. | 32/01.00.00 | 33/08.03.00

C: It took 5 years to receive funding to just expand the road in Pahrump. I am concerned about the impact that project costs and the availability of funding are going to have on the timetable for these programs. | 34/09.08.02

C: What I am hearing today are some process problems. Public comments should have been incorporated before the draft document was issued. For example, the Environmental Impact Statement for the Nevada Test Site and Offsite Locations in the State of Nevada affected environment section identifies pollution levels that color the public's perception of alternatives being considered. Emphasis needs to shift to consider local needs and concerns first, not after the proposed action. | 35/08.03.00

C: I applaud DOE in trying to address issues regarding nuclear material and waste. I would like to point out the fact that tourism in this area was not hurt during the years when we were detonating hundreds of nuclear devises. Nevada is a large state with a vast amount of federal lands, skilled workforces, and ample resources to address this problem. The factor that needs to be addressed is transportation. | 36/10.00.00

C: Maybe this meeting is not concerned about Yucca Mountain, but the people here are. | 37/12.01.00

C: The Yucca Mountain Site characterization has not been completed and the Environmental Impact Statement for the Nevada Test Site and Offsite Locations in the State of Nevada Record of Decision is slated for July. This Record of Decision will be made before any of the Yucca Mountain decisions will be made. I don't feel that DOE is integrating the issues, especially when they will impact the Nevada Test Site. | 38/11.01.02

Q: What is going on environmentally with these options and how many problems are there going to be? How much damage will there be? ***(Note: No response was provided at the meeting to these questions.)*** | 39/09.00.02

C: The Nevada Test Site should be utilized - it has fantastic infrastructure and is relatively remote from populations. | 40/08.03.01

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NM-001

01 00 00 **Comment Number 23**

Comment noted.

08 02 00 **Comment Number 24**

Comment noted.

13 00 00 **Comment Number 25**

Comment noted.

08 02 00 **Comment Number 26**

The Department of Energy acknowledges and understands the need for education and communication with the public on the subject of risk, accident probability, and related subjects. To help meet the goal of providing meaningful risk information, several pages of explanatory information on risk have been included in the Appendices to the PEIS (specifically see Appendix M).

10 00 00 **Comment Number 27**

Hazardous material transportation routes are predetermined by DOT in conjunction with the States. The risk from normal (nonaccident) transportation of radioactive materials by DOE is minimal. Even severe accidents are highly unlikely to cause injury or death from a radiological release because of the stringent Federal DOT/NRC packaging design and transport safety requirements. In over 40 years of shipment activity, neither DOE nor its predecessor has ever experienced an injury or death from a radiological release during transportation. If a Proposed Action is accepted (by the ROD), additional detailed analyses would be conducted to address specific problem areas identified in the PEIS, such as the need for a railroad to service a site.

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Morning Meeting
Summary Session

No summary session.

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NM-001

10 00 00 Comment Number 28

Federal laws govern the transport of hazardous materials in the United States to ensure the safety of the public and security of the cargo. The DOT is the principal Federal agency to implement the regulations, ensure compliance, and provide emergency response guidance. Radioactive materials under this PEIS would be transported through numerous states and local jurisdictions in full compliance with Federal laws (49 CFR) that are applicable to, and cannot be preempted by, individual states. The actual routes are classified. However, they are selected to circumvent populated areas, maximize the use of interstate highways, and avoid adverse weather. Exceptional precautions are taken to ensure safe transport.

10 00 00 Comment Number 29

The methodology for the safe transportation of nuclear materials (Pu and HEU) is well established. Acceptable risk is not dependent upon the transportation mode (truck versus rail) but rather upon the rigorous packaging design requiring Federal safety certification. The packaging must retain its contents under the most severe accident conditions (fire, impact, puncture, or water immersion). Rail transportation for Pu and HEU was abandoned in favor of the SST several years ago, and is not now considered a viable transportation alternative for these materials.

10 01 00 Comment Number 30

Pursuant to *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, DOE and other Federal agencies identify and address appropriate disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. This may also include necessary coordination and communication with tribal communities regarding potential transportation risks and emergency response.

08 02 00 **Comment Number 31**

The Department of Energy acknowledges and understands the need for education and communication with the public on the subject of risk, accident probability, and related subjects. To help meet the goal of providing meaningful information, several pages of explanatory information on risks have been included in the Appendices to the PEIS (specifically see Appendix M).

01 00 00 **Comment Number 32**

The PEIS performs the risk analysis to estimate health impacts to workers and the public. The risk analysis can only quantify tangible impacts, such as cancer fatalities, on exposed populations. Estimating potential impacts such as future property values and construction activities at sites greater than 80 km (50 mi) from NTS would be speculative and would not fulfill the intent of NEPA. The potential storage and disposition activities that are evaluated for NTS are of smaller scope than previous activities (underground nuclear testing) which apparently had no adverse affect on either the population growth rate or the property values in Clark County and the State of Nevada.

08 03 00 **Comment Number 33**

Transportation of special nuclear materials is by DOE's SST transportation system. This system involves coordination with State and local municipalities along the transportation routes to ensure proper response as required. The actual shipment times and routes vary and are classified for security reasons.

09 08 02 **Comment Number 34**

The funding used to implement the Fissile Materials Disposition Program is unrelated to funding used for road upgrades. The Fissile Materials Disposition Program would have no impact on the availability of funds nor the timetable for completing the Pahrump project.

08 03 00 **Comment Number 35**

Public comments on the scope of the Proposed Action have been included in the PEIS. Further, the relationship between other NEPA documents recently completed or in preparation (draft released) have been included in the PEIS.

10 00 00 **Comment Number 36**

The potential risk from radiological exposure during transportation is low because safety is built into the packaging used to transport radioactive materials. Type B packagings are tested to retain their contents under the most severe accident conditions. During the more than 40 years of DOE shipment activity, there has never been an accidental release of radioactive material that has caused injury or death. The maximum potential health risk from transporting materials associated with the Proposed Alternatives is evaluated and presented in Section 4.4 and Appendix G.

12 01 00 **Comment Number 37**

Comment noted.

11 01 02 **Comment Number 38**

Consideration of the Yucca Mountain site as a potential geologic repository site is a national policy prescribed by Congress in the NWPA. This PEIS analyzes the environmental impacts of the surplus Pu storage and disposition alternatives, not the impact of siting and operating a geologic repository. Whether or not the site is Yucca Mountain has little relevance to the comparison of alternatives when the same geologic repository is being used.

09 00 02 **Comment Number 39**

An environmental analysis has been conducted on all alternatives in the following areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, waste management, and transportation. All impacts at proposed

sites are described in Chapter 4 of this PEIS and summarized in Sections 2.5 and 4.6 and the Summary to this PEIS for all resources specified.

08 03 01 Comment Number 40

The Department of Energy acknowledges the commentor's support for new missions at the NTS. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

Oak Ridge Public Meeting Oral Comments - April 2, 1996

Public Meeting Comments

Oak Ridge Reservation
April 2, 1996

Morning Meeting
Plenary (S&D & SS&M) Session

C: I appreciate the opportunity to speak today and thank the press for their participation in the meeting. When I was sworn into office there was a fear in the Oak Ridge area of the Oak Ridge production facilities being sent to design laboratories. Many citizens feel that through the programmatic environmental impact statement process the Oak Ridge technologies will be taken out of Oak Ridge, however, myself and my colleagues are working to ensure that this will not happen. I would like to thank the Citizens for National Security for their work and drive to recognize the work needed for humanity not just Oak Ridge. Your Congressional Officials and myself have worked this year to save the funding for Y-12. In my meeting with Hazel O'Leary, she stated that it was a no-brainer that DOE needs to leave the weapons production capabilities in Oak Ridge. The standdown that occurred in Oak Ridge was concerned with the money that had been spent and was not necessary. When I visited Los Alamos National Laboratory to see their production facilities, I left a list of 18 unanswered questions. I have a list of those questions and answers available for everyone today.

The programmatic environmental impact statement process does a couple of things: 1) It allows input from people who know what they are doing; and 2) DOE has pitted the partners of the Manhattan Project against each other. DOE needs to be a team today! DOE should not allow the sites to pit against each other therefore allowing a site to save itself while sacrificing the DOE complex. I disagree with the new found fear of nuclear energy, weapons, and waste. The nuclear deterrent is why our country is strong and won the cold war, the United States must maintain its deterrent and production capabilities. **DOE needs to leave uranium storage and production capabilities in Oak Ridge. Do not violate National Environmental Policy Act, why would DOE want to contaminate green field sites and leave brown field sites?** This makes no sense! DOE needs to slow down and not move so quickly to move weapons production. DOE should not allow partisan and parochial politics to drive this process. The public and DOE can not allow this to happen. ***(Note: This comment is primarily directed toward SSM except for the bolded statements, which can be considered directed to both documents.)***

1/08.03.01

1

OM-001

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for continued HEU missions at the ORR. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

Oak Ridge Public Meeting Oral Comments - April 2, 1996

Morning Meeting
Breakout Sessions

C: I do not think any citizen feels that Oak Ridge is a place for storage of plutonium. The option of collocated storage of plutonium and highly enriched uranium needs to be cut out of the final draft. If storage of plutonium did occur at Oak Ridge, this would require a radioactive waste facility to be built. | 2/08.03.01

C: There is not an analysis for nonproliferation. This is the time for the United States to show more leadership. The United States should lay the ground work and show other countries how to handle the highly enriched uranium and place it under international control. | 3/01.06.00

C: The deep borehole concept has several adverse effects and there are a number of issues raised with these effects. It seems that the deep borehole option should be placed on a secondary option list, so that the public would only need to discuss realistic options. | 4/01.04.00

Q: The public would like to make comments on the technical and cost analyses reports. The dismantlement activities for nuclear weapons removed from the stockpile are vague, in particular Volume 3, page 185. I have questions about how the weapons are removed from the stockpile and dismantled in relation to Y-12. Where is this process in the realm of doing things? *(Note: The response provided at the meeting did not appear to fully respond to the issue.)*

Q: Are the weapons-usable 50 metric tons to be given to the United States Enrichment Corporation the same 50 metric tons in the Highly Enriched Uranium Environmental Impact Statement? Would the highly enriched uranium be titled to the United States Enrichment Corporation? If so, would the titled material be kept on DOE property with the United States citizens paying for storage until the United States Enrichment Corporation can take the material? Would the United States government have to babysit it? *(Note: The response provided at the meeting did not appear to fully respond to the issue.)*

Morning Meeting
Summary Session

No summary session

2

OM-001

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to Pu storage at ORR. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 06 00 **Comment Number 3**

Comment noted. A nonproliferation analysis was conducted during the summer and fall of 1996 and will be integrated into the decisionmaking process.

01 04 00 **Comment Number 4**

Comment noted.

Oak Ridge Public Meeting Oral Comments - April 2, 1996

Evening Meeting
Plenary Session

C: At the highly enriched uranium meeting it was stated that the draft Programmatic Environmental Impact Statement was going to be sent to us; however, we did not receive it. I would hate to see this happen again with the cost analysis report, by not having the report available to the public. Reviewing the cost information in the analysis report is very important. — 5/08.00.00

C: No disposition of the material should occur. The time horizon is very truncated. What is long-term storage? If the spent fuel is stored more than 200 years in a repository, it will become non-radioactive and then could be mined. Fourteen tons of reactor grade fuel has been separated out in this document, but the total in the country is very large. DOE should avoid making problems for the future. Trying to destroy plutonium is both futile and unrealistic. Making the plutonium unusable may not be good for the future, because the plutonium will probably have to be recovered for energy and nonproliferation needs. It is assumed by the United States that the material will be safe, however, terrorists can do anything. DOE needs to have a more thorough discussion about plutonium, beyond the focus of tonight's meeting. Do not rush into this and make a mistake for the future. The National Academy of Sciences' report (from last summer) has some very good points. — 6/08.03.01 — 7/08.03.01

C: This may be a problem that DOE cannot solve by itself. If the United States is headed toward energy problems DOE should not move too quickly.

C: It was first established that all of DOE's highly enriched uranium would be stored at Y-12. However, figure S-2 on page S-4 shows that all the highly enriched uranium would stay at Y-12; then page S-3 states that there are several different ways to deal with the highly enriched uranium. I also looked for cost information in the document. I am confident that the cost of moving the highly enriched uranium to other sites will be rolled into the cost analysis. Highly enriched uranium storage is important to Y-12 - it should be the preferred alternative. — 1/08.03.01 cont.

C: Collocation of the material is for safeguards and security purposes.

Evening Meeting
Breakout Session - Remained together

C: In reference to creating a radiation field as a proliferation deterrent, I do not think the radiation field would deter a terrorist or potential antagonist. The field will not eliminate the material, it would just make it difficult for future retrieval. — 8/13.00.00

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08 00 00 **Comment Number 5**

Cost data, along with technical and schedule data, was provided in Technical Summary Reports for storage and disposition in the summer of 1996.

08 03 01 **Comment Number 6**

The Department of Energy acknowledges the commentor's opposition to the disposition alternatives. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 7**

The Department of Energy acknowledges the commentor's support for long-term storage of fissile materials. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

13 00 00 **Comment Number 8**

The intent is to make the surplus Pu as unattractive and inaccessible as spent nuclear fuels. A committed terrorist would have to have the technical specialists and equipment to transport these radioactive materials and conduct extensive remote chemical processing in order to extract the Pu for weapons use.

Oak Ridge Public Meeting Oral Comments - April 2, 1996

C: The position of the local section of the American Nuclear Society is to endorse the "*Protection and Management of Plutonium - Special Panel Report*", especially its key conclusions and recommendations. For example: Strong support for the conversion of all plutonium now scheduled for release from the United States and Russian weapons stocks to a form which is protected from theft or seizure by intense radioactivity; and the prompt implementation of the reactors irradiation option for disposition of surplus United States and Russian weapons plutonium by employing available reactors in the United States, Russia, or other countries. | 9/08.03.01

C: A lot of utilities are trying to get rid of reactors because of decommissioning and decontamination activities and cost. DOE may be able to purchase a reactor cheaply, then the government would only have to decontaminate and decommission that reactor. | 10/06.00.09

C: The Stockpile Stewardship and Management and Storage and Disposition draft Programmatic Environmental Impact Statements are full of jargon and are hard to read and understand. These highly technical documents need to be comprehensive, and the documents should be written to an eighth grade level so that the average citizen will be able to read and understand them. | 11/08.02.00

C: I am concerned about the socioeconomic impacts dealing with plutonium and its negative impacts. Negatives may be psychological versus real. These should be addressed in the document. | 12/09.08.08

Evening Meeting
Summary Session

No summary session

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08 03 01 **Comment Number 9**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

06 00 09 **Comment Number 10**

Comment noted.

08 02 00 **Comment Number 11**

The Department of Energy acknowledges and understands the need for education and communication with the public on the subject of risk, accident probability, and related subjects. To help meet the goal of providing meaningful information, several pages of explanatory information on risk have been included in the Appendices to the PEIS (Specifically see Appendix M).

09 08 08 **Comment Number 12**

The socioeconomic analysis estimates impacts to employment, income, housing, and community services. These impacts are estimated using standard methodology, and can be quantified and compared across sites. Addressing "risk perception" issues would be highly speculative and not quantifiable. Furthermore, it would not be possible to compare alternatives in a consistent manner.

PUBLIC MEETING ORAL COMMENTS, RICHLAND, WA
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Richland Public Meeting Oral Comments - April 11, 1996

Public Meeting Comments

Hanford Site
April 11, 1996

Afternoon Meeting
Plenary Session

C: According to the Programmatic Environmental Impact Statement and briefing, these actions are being taken because of the Nuclear Nonproliferation Treaty and are considered an international obligation. The Fuels Material Examination Facility has been considered for mixed oxide fuel fabrication and storage in the draft Programmatic Environmental Impact Statement. It is unclear how the Fuels Material Examination Facility could be used as a production plant and as a storage facility. — 1/02.00.01

C: I am concerned about destroying weapons that the United States may need later. The Russians can not be trusted, they may use their material to produce weapons, and to establish relations with terrorist groups. — 2/01.03.00

C: The plethora of Environmental Impact Statements has bombarded the public in terms of Programmatic Environmental Impact Statements and how to encompass the environmental impacts under these. Since there are so many programmatic documents being produced and the Environmental Impact Statements are so segmented, I have no sense of the cumulative environmental impacts. The Environmental Impact Statements should be sub-projects of the Programmatic Environmental Impact Statements and not separate Environmental Impact Statements. — 3/08.00.00

C: I would like to see a shell environmental document (Programmatic Environmental Impact Statement) that could handle waste as it is generated. This could be accomplished by having the cumulative impacts for an Environmental Impact Statement being provided to an overall shell. As of now, the public only sees a portion of the cumulative impacts. The public should be able to see the whole picture.

C: This is an exercise in futility. DOE should not lead the public on to think that a decision will be made based on this draft document. The decisions will be made for DOE by an extraneous group. This document has not progressed far enough in terms of technology, cost, research, and in discussions with Russia in order to able to be meaningful enough to include the public for comment solicitation. It seems that these meetings are a disclaimer, so that DOE can check off public participation from its list. — 4/08.02.00

WM-001

Note: A number of documents submitted during the public meetings were recorded as part of the minutes. The same documents, in some instances, were also submitted as hand-ins at the end of the meeting. In those cases, the documents are analyzed once, either as part of the minutes or as stand alone documents.

Listed below are the names of the organizations/individuals who submitted documents as part of the minutes and the page numbers containing DOE's responses to the comments:

Tri-City Industrial Development Council, Sam Volpentest	3–763
State of Washington, State Representative, Shirley Hankins	3–1025
Benton County Commissioner, Sandi Strawn	3–65
American Nuclear Society	3–41
City of Richland, Councilman Ken Dobbin	3–147
City of Richland, Mayor Larry Haler	3–144
State of Washington, Department of Ecology, Max S. Power	3–1011

02 00 01 Comment Number 1

The FMEF is considered for use as a long-term storage facility for Pu and the impacts are included in Section 4.2.1 of the PEIS. For the production of MOX fuel, a generic facility was considered for all six DOE sites. At Hanford the MOX fuel fabrication facility would be located in the 200-Area adjacent to 200 East. The utilization of the FMEF would be a variant for MOX fuel fabrication at Hanford, which is bounded by the environmental analysis for the MOX fuel fabrication facility located in the 200-Area. Table 2.4–1 of the PEIS provides a brief description for variants which includes "Modification/Completion of existing facilities for MOX fabrication." The storage options for Hanford also include constructing a new facility.

Utilization of FMEF for the Upgrade Alternative would not preclude its use to also support Pu disposition activities, for either Reactor or Immobilization Alternatives.

Richland Public Meeting Oral Comments - April 11, 1996

Afternoon Meeting
Breakout Sessions

C: I would like to thank DOE for the opportunity to speak today. If the Hanford Site is considered for storage and disposition, there should be a quid-pro-quo on the other laws, agreements, and treaties which are in place with the State of Washington related to clean-up. DOE needs to ensure that the clean-up of the Hanford Site will not be hindered. Acceptance of material should consider the storage facilities available and cost. Transportation of the waste off of the Hanford Site should require research on area weather and conditions. This draft Programmatic Environmental Impact Statement has not evaluated transportation issues as detailed as other Environmental Impact Statements. Transportation is a national issue and local officials are very concerned. Emergency preparedness will require proper funding and other state and local organizations will need to be kept abreast of the transportation of the material. 5/11.00.01 6/10.01.00

C: I appreciate the amount of work that has been placed in this draft Programmatic Environmental Impact Statement, however, I see some glaring omissions. The Fuels Material Examination Facility was not originally included in the document but now I understand the reason, since the facility was not functional at the time the document analysis was initiated. The Fuels Material Examination Facility is the newest DOE facility which could support mixed oxide fuel fabrication and DOE should consider the facility in the final Programmatic Environmental Impact Statement. The potential of using Hanford's capabilities should be considered. This option can be accomplished for just the cost of completing the existing facilities. In terms of considering life cycle costs for the next decade the Fuel and Materials Examination Facility is extremely good. I am confused about the economics, would life cycle cost or short-term economics be the overriding element? Short-term economics are perhaps foolish. I hate to see the Russians ahead of the United States again, as with what happened in space. The ordinary taxpayer thinks little about energy. Ordinary taxpayers and those who are not polarized in their thinking believe DOE is committed to the long-term. This material needs to be looked at not as a waste, but as an energy source. Long-term storage for the average citizen is 100 to 200 years. 1/02.00.01 cont. 7/07.00.00

C: The Russian material should be placed in safe storage. I support the reactor disposition option for mixed oxide fuel for the following reasons: 1) The reactor burns the material so it will not be weapons-usable. By burning the fuel as mixed oxide, the material will be down graded; 2) The United States will be consistent with Russia and other countries' strategies; 3) The process is irreversible and makes it acceptable to other Nonproliferation Treaty countries; 4) The process has been proven based on existing technology here and in other countries; and 5) Using the reactor would generate revenues, which would off-set the disposition cost. A mixed oxide fuel facility may need to be built or is there a possibility of using an existing facility. British Nuclear Fuels has a facility that produces mixed oxide fuel and could handle this material. The mixed oxide fuel option is not an action that is against nonproliferation, it is focused on the 8/15.00.00 9/08.03.01

2

WM-001

01 03 00 **Comment Number 2**

Comment noted. DOE is responsible for implementing the President's Nonproliferation Policy as a result of the arms reduction at the end of the Cold War. DOE is also implementing a Stockpile Stewardship and Management Program to maintain the core competency and capabilities in support of national defense missions.

08 00 00 **Comment Number 3**

The Department of Energy works to assure that each environmental document is not connected, in the NEPA sense, to other DOE-prepared sitewide EISs. In these documents, the cumulative impacts of all current and foreseeable new missions, plus deletions to current missions are analyzed. In this manner the public and the decisionmaker can see the whole picture on a Proposed Action at a particular site.

08 02 00 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for coordination and increased understanding on the decisions to be made on the storage and disposition of weapons-usable fissile materials. The National Dialogue Project, which is beyond the scope of this PEIS, is being implemented by DOE.

11 00 01 **Comment Number 5**

Comment noted. DOE's Fissile Materials Disposition Program is an integrated effort that will require the participation of a number of DOE sites that have weapons material experience. DOE acknowledges the commentor's concern about the potential effect that the selection of Hanford for new missions could have on the Hanford cleanup program. It is DOE's intent that the implementation of Fissile Materials Disposition Program decisions will have little or no impact on ongoing clean up programs. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input. The decision process will also give consideration to existing agreements between DOE, the State of Washington, and the EPA.

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destruction of the material. Although some may think it is inconsistent with nonproliferation policy, theburning of mixed oxide fuel would ensure the destruction of weapons-grade material rather than the focus primarily being energy production. Thank you for allowing me to make my comments. | 9/08.03.01 cont.

C: We support the mixed oxide reactor option. It is a technically and economically viable option. Timeliness in this issue is very important - ten years is too long. This is an international issue that will not go away. Thank you for allowing me to make my comments. | 10/08.03.01

C: I understand that consolidated storage may need to occur, but it does not solve the problems as summarized by the National Academy of Sciences. All of the disposition options require pit disassembly and conversion. I don't think that pit disassembly and conversion needs to occur, because the standard process is not capable of handling the tons of material DOE is addressing. DOE is not ready to go forward with technology, because it has only been proven using kilog[illegible] current population is living with results of the haste in which the weapons program was put together. Funds need to be earmarked for the identification of waste streams created from pit disassembly and for conversion and development of the technology necessary to treat what will be generated in the conversion process. Taking the time and establishing technology to deal with waste may alleviate the possibility of the existing problems at Hanford happening somewhere else. | 11/03.01.08 | 12/01.00.00

C: [Prepared statement of Sam Volpentest (see attached)]

C: The local government and community organizations hold real concerns for many issues regarding worker and community health and safety; the Hanford clean up; and the continued commitment to the Tri-Party Agreement. Organized a couple of years ago, the "Hanford Communities" is a group made up of community leaders, who look at issues dealing with local governments. The "Hanford Communities" has put together an advisory committee with expertise in the areas of concern. I would like to introduce some of these individuals here tonight. We will be delivering formal written comments later. I appreciate the openness of DOE on the issues. Transportation issues of the material and location of new material into the Hanford mission will receive scrutiny, and we want to ensure that decisions made by DOE through this draft Programmatic Environmental Impact Statement do not impede or preclude prior commitments to clean up the site. | 13/11.00.01 | 13/11.00.01 cont.

C: I appreciate DOE holding public meetings in Portland and Seattle. Plutonium is extremely toxic to humans and causes dramatic health effects. 80 micrograms can cause cancer to those exposed. Oxides of plutonium are more toxic than pure plutonium in elemental form. In reference to the waste stream chart, the waste streams from burning mixed oxide fuel are at the top end of the chart when compared with waste generated by the other options. I disagree with a previous speaker's statement that the reactor option offers irreversibility and eliminates | 14/06.00.08

10 01 00 **Comment Number 6**

Logistical planning and meteorological surveillance are standard concerns which normally receive a great deal of attention during transportation operations such as this; transfer of materials to Hanford will hold no exceptions. Emergency preparedness personnel (that is, Emergency Response Teams) will be supplied with the necessary equipment and training commensurate with DOT, DOE, and NRC regulations. Sufficient funding for these concerns will be available to satisfactorily ensure that potential contingencies are dealt with in an effective and timely manner. DOE provides liaison with appropriate agencies for special nuclear material shipments. However, due to their classified nature, specific information on times and dates cannot be provided.

07 00 00 **Comment Number 7**

The Department of Energy agrees that the materials are surplus rather than waste. Cost data, along with technical and schedule data, was provided in a Technical Summary Report for disposition beginning in late July 1996. Additional comments were noted.

15 00 00 **Comment Number 8**

Comment noted.

08 03 01 **Comment Number 9**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 10**

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

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weapons usability of the material. It is always possible to extract weapons-usable material from spent waste. The dates for opening a repository keep slipping with no end in site. If Saddam Hussein or like organizations could get their hands on mixed oxide fuel they could make a scary weapon. I can't believe that DOE would want to transport mixed oxide fuel to England, considering the problems that Japan has had in transporting plutonium. Does the government endorse burning mixed oxide fuel? It is premature to attribute the Governor's support to the reactor option. This Programmatic Environmental Impact Statement is a shared responsibility, the public is having a hard time focusing on all of the Environmental Impact Statements. The piecemeal approach DOE is using does not allow the public to see the breadth and depth of the nuclear problem, which pits states against states, and sites against sites. National dialogue similar to the ones fostered by Tom Grumbly, Assistant Secretary for Environmental Management, and health and safety groups such as the Plutonium Round Table are needed to directly address the outcomes that should derive from the draft Programmatic Environmental Impact Statement. | 14/06.00.08 cont. | 15/01.02.00 | 4/08.02.00 cont.

C: There is a clear and present danger with this material. Ten to twelve years is an unacceptable time frame to deal with this issue. I will leave the Governor's comments on the storage and disposition of weapons-usable fissile material and ask that they be made available tonight and submitted to the record.

[Note: The following comments reflect an exchange between two members of the public]

C: DOE needs to look at the source term in regards to off-normal accidents. In reference to a previous speaker stating that plutonium is the most deadly material, I respond that plutonium has no harm even if it is absorbed though the skin. With plutonium everyone should worry about air particles. Shipment of plutonium can be done under maritime regulations and it has been done by air. There is technology which can handle the material. Persons of the public do not have to use scare tactics. | 16/09.09.08

C: The health effects of plutonium are due to inhalation, ingestion is not the issue.

C: There is a transport and delivery system for the material. The material is transported in closed glove boxes.

Afternoon Meeting
Summary Session

No summary session

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03 01 08 **Comment Number 11**

The Department of Energy is developing an Advanced Recovery and Integrated Extraction System (ARIES) prototype for demonstration of pit disassembly and conversion process to remove Pu from weapons pits and convert it into either an oxide or a metal. Unlike previous pit disassembly processes, the ARIES process is a low waste, dry process that does not generate aqueous liquid waste from dissolution of Pu in acid. The individual parts of the ARIES process have already been demonstrated using several dozen pits. The prototype program will demonstrate the complete integrated process at a scale that can be used to support the design of a production system that can disassemble and package the inventory of surplus Pu pits. The worst-case waste streams for operation of an ARIES production facility have been identified in the PEIS. Operation of the prototype will enable further refinement of these waste stream estimates.

01 00 00 **Comment Number 12**

Pit disassembly and Pu conversion use existing technologies. Waste streams are estimated based on the throughput of the facilities used for processing the Pu. When applying for operating permits from the State where the facilities reside, DOE must convince the state authorities that the waste streams meet the applicable standards and criteria set by the State.

11 00 01 **Comment Number 13**

Comment noted. DOE's Fissile Materials Disposition Program is an integrated effort that will require the participation of a number of DOE sites that have weapons material experience. DOE acknowledges the commentor's concern about the potential effect that the selection of Hanford for new missions could have on the Hanford cleanup program. It is DOE's intent that the implementation of Fissile Materials Disposition Program decisions will have little or no impact on ongoing clean up programs. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input. The decision process will also give consideration to existing agreements between DOE, the State of Washington, and the EPA.

Richland Public Meeting Oral Comments - April 11, 1996

Evening Meeting
Plenary Session

C: [Prepared statement of Shirley Hankins (see attached)]

C: [Prepared statement of Sandi Strawn (see attached)]

C: The Richland Chamber of Commerce supports the burning of mixed oxide fuel in light water reactors and not wasting what the United States has spent billions of dollars developing. This option would be less costly. | 17/08.03.01

C: The American Nuclear Society feels committed to the return of plutonium. The issue of nonproliferation brings in the political factor. The American Nuclear Society has prepared a study *"Protection and Management of Plutonium - Special Panel Report"* addressing the technical issues involved. The American Nuclear Society has decided on three things that are needed to do a good study: 1) Place recognizable people on the panel for the study; 2) The study should be from an international perspective; and 3) Look at the context of all plutonium in all places. The major finding of the study was to use the burn option because it supports nonproliferation. Burning changes the isotopic content of the material and will convey a responsibility on the part of the United States that they are serious. Contrary to other comments, none of the members of the study feel that the United States or Russia would use the material to make weapons.

C: [Prepared statement of American Nuclear Society representative (see attached)]

C: [Prepared statement of Ken Dobbin (see attached)]

C: [Prepared statement of Larry Haler (see attached)]

C: [Prepared statement of Max S. Power (see attached)]

C: Reactor fissioning uses existing technologies. It offers the fastest, least cost route and can achieve effective electric rate fares. This would be a win for the Northwest. DOE already has an agreement with Bonneville Power at the Washington Nuclear Plant-2 facility. The Bonneville Power employees on site can do all of this work. DOE should take into consideration the benefits of our relationship. | 9/08.03.01 cont.

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06 00 08 **Comment Number 14**

It is true that Pu can be extracted from spent fuel. However, the Pu is not considered weapons-usable until it is extracted from spent fuel. The goal of the Fissile Materials Disposition Program is to render the Pu to a state in which it is not directly weapons usable, like Pu in spent fuel.

01 02 00 **Comment Number 15**

The *National Environmental Policy Act* requires evaluation of all reasonable alternatives. Reactor use of the MOX fuel containing surplus Pu is a reasonable alternative for Pu disposition and, therefore, has been analyzed in the PEIS.

09 09 08 **Comment Number 16**

The human health impacts from potential accidents are presented in this PEIS for all of the proposed facilities including the facilities in the Borehole Option. For each of the anticipated accidents, the impacts analyzed include the cancer risk to workers and the maximally exposed individual (MEI), as well as the potential cancer fatalities for the regional population up to 80 km (50 mi). The anticipated accidents analyzed cover a wide spectrum of the potential accidents including those that have large consequences but low probability, such as criticality accident (a nuclear reaction) and earthquake (catastrophe). The anticipated accidents include an analysis of the initiating events, materials at risk, source terms, probabilities, and consequences.

08 03 01 **Comment Number 17**

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Richland Public Meeting Oral Comments - April 11, 1996

[Note: The following two comments reflect an exchange between two members of the public]

C: Thanks for the opportunity to speak and for extending meetings to the Portland and Seattle areas. I would like to invite all of the participants tonight to attend these meetings. As a physician, the toxicity of plutonium is important to address. Plutonium is extremely hazardous. The inhalation of a very small quantity will cause cancer. However, plutonium oxides are more dispersible than the elemental form, therefore easier to inhale. The implication that waste streams from mixed oxide fuel would not zero is incorrect. Mixed oxide fuel is a contributor to the waste streams, more so than other options being assessed, as well as compared to other energy sources that could be used. Waste from burning the material in light water reactors is higher than other stabilization options that are being considered. This option would add to a 50-year waste problem that DOE has not yet been able to solve. The United States can not consider the reactor option when DOE has not dealt with the present waste problem. Post haste and International Atomic Energy Agency oversight are necessary when dealing with this issue. To move forward and make more waste is irresponsible. 18/06.01.08

C: Waste disposal is a political problem and it is exacerbated by persons like yourself that do not understand.

C: The National Environmental Policy Act is the reason I am here today. It requires DOE to open up the process to public input. Other reasons for my attendance would be that I have live and worked in this area for a long time, which has enabled me to develop a lot of expertise on how to deal with uranium and plutonium. The security of our country is the most important driver of these decisions. Nonproliferation is not a good word to use if you want it to mean that it is to save the world. I have a major interest in the supply system. If the United States takes the lead, plutonium could be burned in local reactors. Other health and environmental related jobs need to be addressed. The information available such as the summary is excellent; the American Nuclear Society provision is a fine summary; and the National Academy of Sciences' report should be added to this decisionmaking process. All of these documents have a good point. I understand that the United States is just talking to the Russians with no evidence of anything other than talking being made. The Fast Flux Test Facility should be a part of the program. The tritium proposal for the Fast Flux Test Facility is great. DOE is not going very fast and the public should demand faster action. Lots of area citizens, except those here tonight, are uninformed about this issue. 19/01.06.00

C: The timing on the completion of the draft Programmatic Environmental Impact Statement and the closure of the comment period is too short to be able to provide responsible comments. The comment period should be extended. 20/08.01.00

06 01 08 **Comment Number 18**

The environmental impact of the MOX fuel waste streams is presented in Chapter 4 and Appendix H of this PEIS.

01 06 00 **Comment Number 19**

Comment noted. The NAS report is included in the decisionmaking process.

08 01 00 **Comment Number 20**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

Richland Public Meeting Oral Comments - April 11, 1996

C: DOE needs to be financially sound with their decisions. The draft Programmatic Environmental Impact Statement should not just explain how to store and dispose of the material and how to keep even with Russia. I do not mind giving a couple of million to the Russians if that is the best use of the money to help alleviate this problem. 21/01.03.00

Evening Meeting
Summary Session

No summary session

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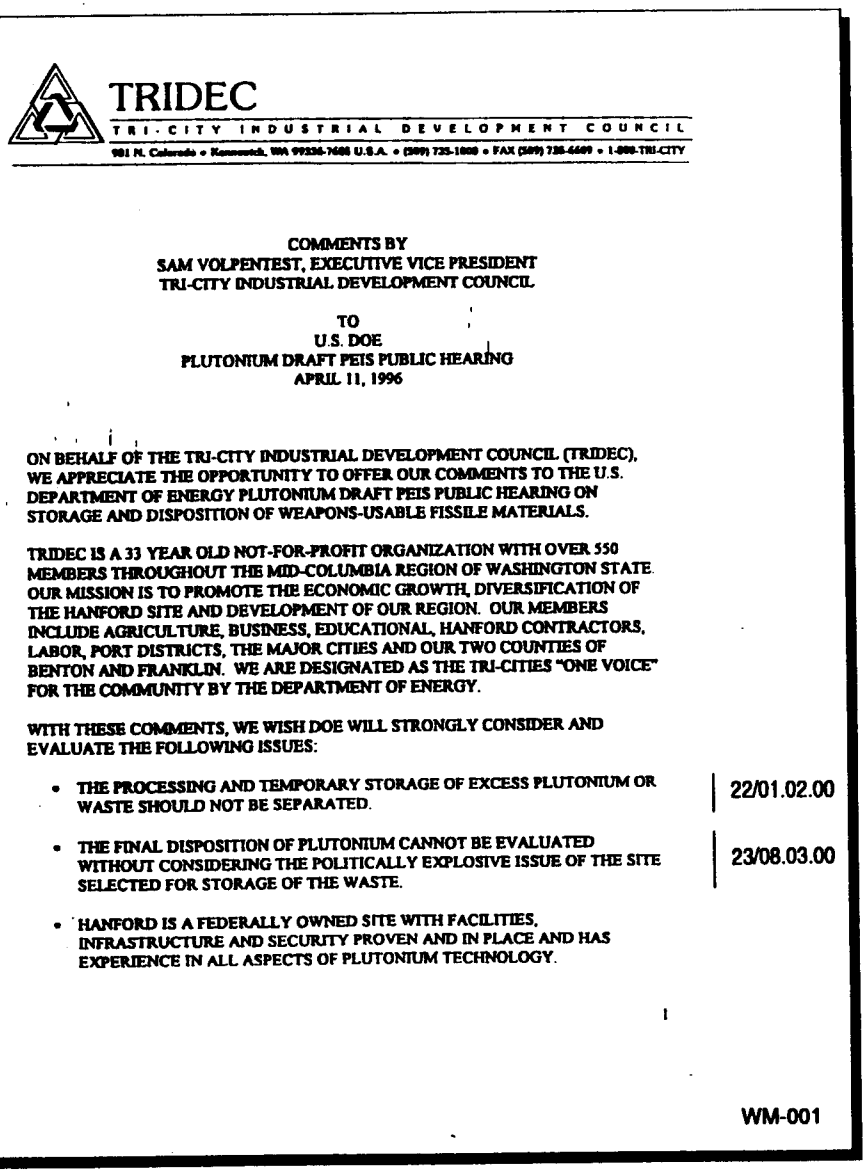
01 03 00 **Comment Number 21**

Comment noted.



TRIDEC
TRI-CITY INDUSTRIAL DEVELOPMENT COUNCIL
[illegible] • FAX [illegible] • 1-800-TRI-CITY

COMMENTS BY
SAM VOLPENTEST, EXECUTIVE VICE PRESIDENT
TRI-CITY INDUSTRIAL DEVELOPMENT COUNCIL

TO
U.S. DOE
PLUTONIUM DRAFT PEIS PUBLIC HEARING
APRIL 11, 1996

ON BEHALF OF THE TRI-CITY INDUSTRIAL DEVELOPMENT COUNCIL (TRIDEC), WE APPRECIATE THE OPPORTUNITY TO OFFER OUR COMMENTS TO THE U.S. DEPARTMENT OF ENERGY PLUTONIUM DRAFT PEIS PUBLIC HEARING ON STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS.

TRIDEC IS A 33 YEAR OLD NOT-FOR-PROFIT ORGANIZATION WITH OVER 550 MEMBERS THROUGHOUT THE MID-COLUMBIA REGION OF WASHINGTON STATE. OUR MISSION IS TO PROMOTE THE ECONOMIC GROWTH, DIVERSIFICATION OF THE HANFORD SITE AND DEVELOPMENT OF OUR REGION. OUR MEMBERS INCLUDE AGRICULTURE, BUSINESS, EDUCATIONAL, HANFORD CONTRACTORS, LABOR, PORT DISTRICTS, THE MAJOR CITIES AND OUR TWO COUNTIES OF BENTON AND FRANKLIN. WE ARE DESIGNATED AS THE TRI-CITIES "ONE VOICE" FOR THE COMMUNITY BY THE DEPARTMENT OF ENERGY.

WITH THESE COMMENTS, WE WISH DOE WILL STRONGLY CONSIDER AND EVALUATE THE FOLLOWING ISSUES:

- THE PROCESSING AND TEMPORARY STORAGE OF EXCESS PLUTONIUM OR WASTE SHOULD NOT BE SEPARATED. | 22/01.02.00
- THE FINAL DISPOSITION OF PLUTONIUM CANNOT BE EVALUATED WITHOUT CONSIDERING THE POLITICALLY EXPLOSIVE ISSUE OF THE SITE SELECTED FOR STORAGE OF THE WASTE. | 23/08.03.00
- HANFORD IS A FEDERALLY OWNED SITE WITH FACILITIES, INFRASTRUCTURE AND SECURITY PROVEN AND IN PLACE AND HAS EXPERIENCE IN ALL ASPECTS OF PLUTONIUM TECHNOLOGY.

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01 02 00 **Comment Number 22**

Comment noted. For Pu disposition, the end state of all the alternatives described in this PEIS call for ultimate disposal in a geologic repository. Prior to shipment of the spent fuel or vitrified wastes to this geologic repository, onsite storage is planned. For the Existing LWR Alternative, the utility company operating the LWR would be responsible for storage of the spent fuel while the Canadian utility company would be responsible for the spent fuel in the CANDU Reactor Alternative.

08 03 00 **Comment Number 23**

The PEIS discusses the potential final disposal of the spent fuel if a Reactor Alternative was selected and the final disposal of the immobilized "logs" if an Immobilization Alternative was selected. There is no final disposal requirement for a Borehole Alternative. Both the spent fuel and the logs would be placed in the NWPA-HLW repository. This would take place whenever and wherever that repository is located.

- AN EXPERIENCED WELL TRAINED WORK FORCE IS IN PLACE OR AVAILABLE TO UNDERTAKE A PLUTONIUM MISSION.

- SELECTION OF THE "PLUTONIUM BURN" OPTION COULD USE EXISTING AND AVAILABLE FACILITIES AT HANFORD. THEY INCLUDE FFTF - WNP-2 AND/OR WNP-1 - AND THE COMPLETED BUT UNUSED FUELS MATERIAL EXAMINATION FACILITY (FMEF).

I WILL BRIEFLY COMMENT ON THE ABOVE ISSUES:

ON SEPARATION AND INTERIM STORAGE, WE BELIEVE DOE MUST TAKE AN OVERALL "SYSTEMS" APPROACH TO THE PROBLEM. INTERIM STORAGE MUST BE BASED ON ACCEPTABLE WASTE FORMS WHICH IN TURN WILL DEPEND ON THE DISPOSITION OPTION. FOR EXAMPLE, IF THE DISPOSITION OPTION IS TO "BURN" THE PLUTONIUM AS MIXED OXIDE FUEL IN LIGHT WATER REACTORS, THE WASTE TO BE STORED IS SPENT FUEL. INTERIM STORAGE THAT IS NOT AN INTEGRAL PART OF A WELL PLANNED DISPOSITION PLAN WILL BE POLITICALLY DIFFICULT, IF NOT IMPOSSIBLE, TO SELL TO THE PUBLIC. NO ONE, INCLUDING OUR TRI-CITIES, WANTS TO BE THE STORAGE SITE FOR THE PLUTONIUM WITH NO CLEAR AGREED UPON PLAN FOR ITS ULTIMATE DISPOSAL.

22/01.02.00 cont.

WE SINCERELY URGE DOE TO ADOPT THE "PLUTONIUM BURN" OPTION FOR MANY REASONS. FOR EXAMPLE, THERE IS NO NATIONAL POLICY AS TO WHERE TO STORE OR HOW TO DISPOSE OF THE MATERIAL. THE NATIONAL ACADEMY OF SCIENCE LAST YEAR STUDIED THE ISSUE AT GREAT LENGTHS AND CONCLUDED "THE ONLY FEASIBLE AND ACCEPTABLE METHODS WERE TO "BURN" THE MATERIAL IN A POWER REACTOR AS FUEL OR DISPOSE OF THE MATERIAL IN SECURE DEEP BORE HOLES. AT A RECENT PLUTONIUM WORKSHOP, TOM COCHRAN OF THE NATIONAL RESOURCES DEFENSE COUNCIL ENDORSED THE USE OF THE MATERIAL AS REACTOR FUEL WITH DISPOSAL OF THE SPENT FUEL RODS AT YUCCA MOUNTAIN. THE ABOVE SCENARIO PROVIDES OPPORTUNITIES FOR THE POSSIBLE USE OF EXISTING HANFORD FACILITIES SAVING THE TAXPAYERS MILLIONS OF DOLLARS.

9/08.03.01 cont.

OUR EVALUATION OF THIS ISSUE HAS IDENTIFIED MANY OPPORTUNITIES FOR POSSIBLE USE OF EXISTING HANFORD FACILITIES IN A PLUTONIUM DISPOSITION PROGRAM WHICH INCLUES THE FOLLOWING:

- USE OF THE FMEF AS A PROCESSING FACILITY FOR CONVERSION OF THE METALLIC PLUTONIUM TO AN OXIDE FOR SAFE STORAGE.

- USE OF THE EXISTING FMEF AND PFP PLUTONIUM VAULTS FOR INTERIM STORAGE OF THE PROCESSED PLUTONIUM. ADDITIONAL STORAGE FACILITIES BEYOND THESE WOULD BE REQUIRED FOR THE MISSION. THE

1/02.00.01 cont.

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FMEF COULD PROVIDE THIS ADDITIONAL STORAGE REASONABLY AND ECONOMICALLY.

- UTILIZATION OF THE FMEF AS A MIXED OXIDE FUEL FABRICATION FACILITY. THERE ARE NO OTHER PLUTONIUM FABRICATION FACILITIES IN THE UNITED STATES. THE FMEF HAS THE CAPACITY AND INSTALLED EQUIPMENT TO PERFORM THIS MISSION, WHICH WAS ITS ORIGINAL DESIGN FUNCTION. — 1/02.00.01 cont.

- DISPOSAL OF THE PLUTONIUM BY "BURNING" IN THE FFTF EITHER ON A DEMONSTRATION OR PRODUCTION BASIS. THIS COULD BE COUPLED WITH THE WNP-2 PROPOSAL FOR THE OPERATION OF THAT REACTOR WITH A MIXED OXIDE FUEL. — 24/01.02.00

- GOVERNOR LOWRY SUPPORTS THE BURN OPTION IN THE STATE OF WASHINGTON.

WE STRONGLY BELIEVE THE DRAFT PEIS IS DEFICIENT AS IT DOES NOT EVALUATE THE COMBINED USE OF HANFORDS ASSETS FOR THE "PLUTONIUM BURN" MISSION. THESE ASSETS INCLUDE FMEF-FFTF-WNP-1 AND WNP-2. WE WILL SUBMIT A MORE DETAILED STATEMENT SUPPORTING THESE OPTIONS UNDER SEPARATE COVER. WE REQUEST THAT THE DEPARTMENT OF ENERGY EITHER REVISE THE CURRENT DRAFT PEIS OR ISSUE A SUPPLEMENT TO IT WITH AN OBJECTIVE EVALUATION OF THE HANFORD SITE "BURN" OPTION CONSIDERING THE UTILIZATION OF THE AVAILABLE ASSETS BEFORE REACHING A DECISION. — 24/01.02.00 cont.

THANK YOU FOR CONSIDERING OUR VIEWS ON THIS VERY CRITICAL NATIONAL ISSUE.

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01 02 00 Comment Number 24

Liquid metal reactors were not included as alternatives for Pu disposition in the PEIS due to the longer time and greater cost required to complete their construction. The FFTF, on the other hand, is an existing reactor and could be used for Pu burning. However, the limited capacity of the FFTF would limit the rate at which Pu could be dispositioned and would require a much longer timeframe for disposition than that which could be achieved with the reactor options addressed in the PEIS.

The Department of Energy is in fact considering the FFTF, pursuant to the ROD for the TSR PEIS. The ROD (December 1995, 60FR 63878) for the TSR PEIS addressed the FFTF for tritium production as follows:

> A private group has recently suggested that it purchase the FFTF from DOE and DOE then contract with the private group to make tritium at that facility. In the [Tritium Supply and Recycling Final] PEIS, the use of FFTF was considered and dismissed as a long-term tritium supply option because the amount of tritium that it could produce would only meet a percentage of the steady state tritium requirements, and it was not reasonable to rely on operating the facility far beyond the end of its design life. However, DOE will evaluate the presentation made by the private group to determine whether the operation of the FFTF might be able to play any role in meeting future tritium requirements. If any changes are warranted to this ROD following that review, or further NEPA documentation is required, DOE will take appropriate action.

The Secretary of Energy has requested a review by the JASONS Panel (eminent academic scholars and scientists) as part of the evaluation of tritium production with the FFTF. Should the outcome of this evaluation lead to a DOE proposal to restart the FFTF for tritium production, additional environmental analyses would be performed as appropriate. If the FFTF were to be restarted, a substantial portion of the surplus Pu that would be used for MOX fuel could be used to fabricate FFTF driver fuel, thereby achieving the Spent Fuel Standard for Pu disposition through irradiation in the FFTF. Further description of the FFTF has been added to Appendix N of the PEIS.

The FMEF was a candidate storage facility under the Upgrade Alternative for storage of weapons-usable fissile materials.

Prepared Comments
Shirley Hankins
Washington State Representative
8th District
April 11, 1996
Richland, Washington

I'd like to thank the Department of Energy for providing this opportunity to deliver comments on the Programmatic Environmental Impact Statement for Storage and Disposition of Weapons-Usable Fissile Materials. Clearly, this is an issue of great magnitude for all citizens of the United States, and especially for residents of the Tri-Cities because of the potential we have for direct involvement with this program.

I'm pleased to be able to provide comments on the management of material that previously had one use, that of nuclear weapons and weapons capability. What a positive course of action for both the United States, the Russian, and other former Soviet Union governments to put this material to a productive use.

With respect to the three options the Department of Energy is analyzing for disposition of surplus plutonium, I would urge the Department to select in whole or part the Reactor Irradiation option.

- This option, which is heavily endorsed by the National Academy of Sciences, offers the most timely method for rendering this material non-usable to terrorist or other threatening countries or organizations.

- Disposal of the surplus plutonium, through the form of Mixed Oxide Fuel, is a proven technology, already used in many reactors throughout the world.

- The use of MOX fuel in U.S. nuclear reactors would allow for the generation of valuable electricity. Imagine, actually putting material once packaged into nuclear weapons to productive use for generating electricity. Government regulation of MOX fuel use would ensure the material is used in a way so that public health and safety are optimally protected.

- Through the DOE's Hanford Site, and the Washington Public Power Supply System, we have the needed infrastructure and capability to fabricate and consume MOX fuel right here, offering the Department of Energy a timely, comprehensive, and efficient manner in which to dispose of surplus plutonium.

I hope the Department of Energy will give serious thought to the reactor irradiation option, and when it comes time to deliver the Record of Decision, that this option will be selected.

Thank you.

WM-001

TESTIMONY OF
COMMISSIONER SANDI STRAWN
BENTON COUNTY, WASHINGTON
at the
U.S. DEPARTMENT OF ENERGY HEARING
APRIL 11, 1996
RICHLAND, WA

Re: Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Good evening. My name is Sandi Strawn and I am a Benton County Commissioner. I represent the county in which most of the Hanford Reservation is located. I am providing testimony tonight on behalf of the entire Board of Benton County Commissioners.

The outbreak of peace has presented us with a decidedly better future and a significant challenge. Plutonium warheads -- those very items we once felt were so necessary -- now are surplus to our needs. Peace is at hand, but this country's work is not yet done.

I want to offer several pieces of input to your Draft Programmatic EIS.

1. Keep moving forward.

We are pleased to see the Department of Energy is taking steps to address this challenging set of issues. The Department has evaluated a host of potential approaches, and has made significant progress by developing the set of alternatives outlined in the Draft EIS. We applaud your effort to date, and encourage you to keep pressing ahead on this internationally important issue. The complexities of the problem should not be used as a reason for avoiding any action. The "No-Action" and "Long-term Storage" alternatives are neither acceptable nor effective.

2. Follow the recommendation of independent experts.

The National Academy of Sciences has suggested fabrication of plutonium into reactor fuel is one of the few promising alternatives in management and disposition of fissile materials.

3. We are willing to continue to do our part.

We recognize two of the critical steps in plutonium disposition could be supported at the Hanford Site. Those steps are the fabrication of mixed oxide fuel at the Fuels and Materials Examination Facility, and the fissioning of that fuel at WNP 2 and the Fast Flux Test Facility (FFTF).

As the host county government, we support the use of these facilities and the Tri-Cities area technical resources for these two activities. This should stand in contrast to the situation in Nevada, where the most notable product of intergovernmental relations has been a delay in solving national problems.

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4. The mixed oxide fuel approach is the least costly and quickest path.

As a representative of taxpayers, we urge you to use proven technologies whenever possible. When this is done, the costly steps of investigation and experimentation are avoided. The mixed oxide fuel approach has been proven viable in this country and others. No new technologies are needed, and parties have offered you their technologies and facilities to pursue this alternative. The mixed oxide fuel approach will allow us as a nation to take the biggest possible bite our of this problem with the least resources, and in the shortest period of time.

We urge you to move quickly to reduce the quantity of material which could find its way into irresponsible hands, and to quickly help the former Soviet states to reduce their stockpiles of nuclear material. The mixed oxide approach will provide the quickest demonstration of our seriousness, it will embrace a pathway that the Russians may emulate, and it will reduce stockpiles of materials.

These are the things we are FOR. Now let me mention one we are against.

5. Consolidation of plutonium at Hanford is not necessary.

The Draft EIS poses as an option the consolidation of all surplus plutonium materials at the Hanford Site. We strongly object to this approach. Benton County residents have been and will continue to willingly fulfill our part of the solution. We recognize our responsibilities to safely manage, stabilize, and dispose of the substantial amount of plutonium already existing at Hanford. But, we will not become the nation's dumping ground for all plutonium scrap and mixed waste. There are already enough items on our Hanford cleanup "to-do" list. Movement of plutonium materials should only occur right before treatment.

Thank you for conducting a hearing in Richland to hear from those who are most directly affected by DOE actions. We urge you to continue forward with timely development of technically sound and fiscally responsible solutions to these very important issues.

Linda Strauss
4/11/96

WM-001

AMERICAN NUCLEAR SOCIETY

Position Paper Abstract - Disposition of Plutonium

Short-Term: Surplus Weapons Plutonium

1. We strongly support conversion of all plutonium released from weapons stocks to a form in which it is protected from theft or seizure by intense radioactivity (the "spent fuel standard"). Place immediate emphasis on protecting stocks as securely as when they were active weapons. We urge that higher priority and attention be devoted to assuring that this standard is being met.

2. We recommend prompt implementation of the reactor irradiation option for disposition of surplus U.S. and Russian weapons plutonium, employing available reactors in the United States and Russia, or in third countries.

3. The time schedule for both initiation and completion of conversion should be shortened.

4. All released plutonium in the United States and Russia should be placed under international safeguards as early as possible.

Longer-Term: Civil Plutonium

5. Energy demand, especially for electric power, is increasing steadily in the developing countries. We cannot and should not wish these countries to forgo the benefits of abundant energy that the industrial world has enjoyed for so long.

6. The use of nuclear energy will take place primarily in industrialized countries, making fossil fuel resources more accesible and affordable for use in the developing world.

7. Current proven reserves of reasonably priced uranium are insufficient to support a long-term, major contribution of nuclear energy to meeting world energy demand. Breeder reactors can overcome this limitation.

8. The issue of the proper level and structure of development on the breeder and other advanced reactor systems calls for further assessment. We urge that this be undertaken.

9. The recent U.S. decision to stop all development work on reprocessing and the breeder should be reversed.

10. The development of permanent waste repositories is essential, since these will be needed for either spent fuel or fission product waste disposal.

11. We see no need for international uniformity in selection of fuel cycle options.

12. The IAEA should place increased emphasis on containment and surveillance and other nonaccountancy safeguards measures.

13. The IAEA should be called on to review the adequacy of national measures for protection of nuclear materials against subnational threats.

14. It is essential that the IAEA be assured of the financial, technical and manpower resources and the political support necessary to carry out its increasingly vital tasks.

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Comments of West Richland Councilman, Ken Dobbin
April 11, 1996 Public Meeting on Storage and
Disposition of Weapons-Useable Fissile Materials
Draft Programmatic Environmental Impact Statement

The Fast Flux Test Facility (FFTF) will need 800kg
to one metric ton per year of weapons return plutonium
to fuel the multi-missions it will be asked to perform.
The FFTF will use a once-through fuel system that
converts the plutonium to a spent fuel standard. It
will not be recycled.

These FFTF missions include tritium for national
security, medical isotopes for cell-directed cancer
therapy and treatment of other major diseases, and
commercial isotopes for agriculture and industry.

Advanced Nuclear and Medical Systems, called ANMS,
is a consortium of companies negotiating with the
Department of Energy to operate the FFTF to privately
provide these missions for our Nation. ANMS has
widespread Congressional and professional support
for the privatization of the FFTF.

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Comments of West Richland Councilman, Ken Dobbin

ANMS has proposed an alliance with the Washington Public Power Supply System to jointly burn plutonium in the FFTF and WNP-2. That proposal provides synergism between the two facilities and will use the already constructed Fuels and Materials Examination Facility, called the FMEF, for plutonium fuel management.

These facilities take advantage of the reduced security issues of all three located on the Hanford site. The FFTF and FMEF already have state-of-the-art plutonium security systems. Eleven metric tons of the plutonium is already located on the Hanford site.

The FFTF creates a teaming opportunity with Russia. The United States wants Russia to use a once-through fuel system and not recycle. Russia wants to burn the plutonium in their fast reactors. The FFTF would demonstrate how to convert the plutonium to a spent fuel standard without recycle. They could be provided to the Russians.

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Comments of West Richland Councilman, Ken Dobbin

Converting weapons-usable plutonium to a spent fuel standard cooperatively with the Russians while providing medical isotopes is a win-win for both the Hanford area and the Nation.

I urge the Department of Energy to include the FFTF as a viable plutonium disposition option in the Programmatic Environmental Impact statement on the Disposition of Weapons-Usable Fissile Materials.

Thank you,

Ken Dobbin
Councilman, City of West Richland, Washington
Member, American Nuclear Society Eastern Washington
Section, Public Information Committee

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Comments of Richland Mayor Larry Haler
April 11, 1996 Public Meeting on Storage and
Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Good evening. I am Larry Haler, Mayor of Richland. I also serve as Chairman of the "Hanford Communities," an intergovernmental organization that represents the interests of cities and counties most directly affected by Hanford. As you are concluding a long day of meetings, let me extend a somewhat belated welcome to the Tri-Cities!

I have a prepared statement I would like to read and leave with you. We will be submitting written comments within the month.

The Programmatic Environmental Impact Statement, or PEIS, on Storage and Disposition of Weapons-Usable Fissile Materials is of great interest to the City of Richland and the other local governments in this area. Hanford, directly to our north, is identified as one of six DOE candidate sites for long-term storage of weapons-usable plutonium. Two of the disposition alternatives noted in the PEIS are particularly well suited to Hanford.

We would be proud to have Hanford help reduce the global nuclear weapons threat. However, we do have some misgivings. Nearly half of all Hanford workers live in Richland. I am concerned about their health and safety, as well as their economic well-being. Public safety associated with transport of radioactive materials through our communities is a factor we must consider. We must also safeguard the quality of our natural environment.

Beyond these tangible issues, we are anxious that our community not be perceived by others in the Pacific Northwest as a dumping ground for radioactive wastes. As DOE is reducing employment opportunities at Hanford, we must recruit new enterprises into this area to remain viable. Positive community image is critically important to our economic diversification efforts.

Our formal written responses to this PEIS will be carefully developed. We have appointed a technical advisory committee to explore the health and safety, transportation, and socioeconomic impacts of a new plutonium mission for Hanford. The committee began its analysis this week, and we hope to have our elected governing boards review their work and recommendations by the end of the month.

(Over, please)

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Fabricating plutonium into mixed-oxide, or MOX, fuel and burning it in reactors is one of the disposal options noted in the PEIS. The Washington Public Power Supply System has made a proposal to the Department of Energy to burn a bundle of MOX fuel as a demonstration. Our City Council fully supports the Supply System in this endeavor. We also encourage DOE consider the Supply System's unfinished nuclear power plant on the Hanford Site as a second MOX fuel facility. The Fast Flux Test Facility, or FFTF, provides yet another opportunity for burning of MOX fuel. The FFTF offers additional value in the potential for production of tritium and vital medical isotopes. We also have at Hanford the "Fuel and Materials Examination Facility," or FMEF, the only facility in the country that has been designed and is available to cost-effectively manufacture MOX fuel.

As you can see, Hanford offers a complete, safe, and secure industrial complex capable of storing plutonium, manufacturing and burning MOX fuels, vitrifying waste products, and handling spent fuel. The Supply System and private companies have indicated interest in participating in this important endeavor. We have a talented and experienced work force and the industrial infrastructure necessary to perform a plutonium storage and disposal mission. Assuming we achieve necessary public understanding and support and address legitimate concerns through effective mitigative measures, I believe Hanford will prove to be well suited to play a plutonium storage and disposal mission.

In closing, I should mention that the short timeline for commenting on the PEIS has made our review particularly difficult. One problem is that there are very few copies of the PEIS currently available. We have requested additional copies for our committee and hope to receive them soon. I hope you will consider extending the comment period to give the public better opportunity to participate.

Thank you again for the opportunity to provide comments this evening. We will be carefully evaluating this opportunity for Hanford to be of service to the nation. You can expect a thoughtful written response to the PEIS from us.

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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
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Comments on Plutonium PEIS
April 11, 1996
Presented by Max S. Power
Nuclear Waste Program

My name is Max Power. I represent the Washington State Department of Ecology, and I am presenting the agency's comments.

I want to begin by stressing three basic points, based on positions taken by Governor Lowry at the time of scoping (August 1994) and the Plutonium Roundtable (October 1995):

- Nonproliferation: Action to convert weapons usable plutonium to form that discourage weapons use is urgent. The United States needs to be seen to be acting forcefully and with public support to assure that this material is not available for reuse in nuclear weapons. The consequences of *not* acting are immense.

- Equity. All the states and regions of the country benefited from the defense provided by nuclear weapons. Now all need to share in an equitable way in the overall costs and risks of closing the circle on production of nuclear weapons material. Washington State has borne more than its share of the costs and risks in the past. We have both expertise and facilities that can help deal with plutonium and radioactive wastes, but we are only willing to play a role if others assume their fair share of the burdens.

- Cleanup commitments. Washington will not accept additional burdens on Hanford that detract from or delay commitments to cleanup the legacy of past contamination.

Within this context, we offer these specific comments on the PEIS:

1. We appreciate the effort USDOE has made to provide public discussion on complex issues. As selection of disposition options proceeds, DOE should use information such as that developed in the draft PEIS to inform a broader national equity dialogue. Decisions about plutonium storage and disposal must be made in the broader context of such a dialogue, dealing with treatment storage and disposal of all surplus nuclear materials and wastes.

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2. We encourage DOE to take a conservative approach on storage options. It does not make sense to ship significant quantities of plutonium to a consolidated or collocated storage site, only to have to ship most of it again to yet another site for disposition. Near-term emphasis should be on selection of a disposition approach; long-term storage decisions can then be linked to the configuration of the disposition system.

3. Ecology commends DOE for the level of analysis and documentation in the PEIS:
   - a good basis for assessing generic disposition alternatives
   - recognizes need for additional NEPA documentation to select disposition sites
   - sufficient analysis to evaluate storage options once disposition path selected

4. We also emphasize the need to identify the full extent of risks, costs, technology development needs, and further requirements for public decision-making. This should be an important document contributing to public awareness and national equity dialogue.
   - The PEIS includes information that puts plutonium disposition in context of the legacy of weapons production. E.g. substantial information about wastes, storage facilities, etc. at candidate sites.
   - The PEIS makes reasonable efforts to identify emissions and waste streams from proposed storage, treatment, and disposal facilities. DOE is to be commended for using appropriate site-specific data in the conceptual analysis of the disposition options.
   - However, we are concerned that some materials may not be covered in this PEIS or others

5. Therefore, we ask DOE to clarify how--and how much of--Hanford plutonium stock is included.
   - Fig. 1.1.1-1 indicates 1.7 t. of Hanford Pu identified as "surplus" There is approximately another 2.1 t. in forms other than spent fuel. Some may be concentrated and become surplus; some may become waste. It is not clear that the latter category, which is explicitly beyond the scope of this PEIS, is included in other programmatic documents.
   - The PEIS needs more explicit discussion about the implications of non-pit forms of plutonium for the configuration of storage, treatment, and disposal options.

In conclusion, the disposal option , or combination of options, selected should:
- minimize overall risk to public and worker health, and to the environment;
- take account of equity among sites and regions;
- not divert resources from or delay cleanup of past contamination at nuclear weapons production sites;
- have a clear and reasonable path forward to develop and implement the technology; and
- accommodate the plutonium metal scrap and other forms that could nonetheless be used in weapons.

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Public Meeting Comments

DOE Headquarters
April 17 & 18, 1996

Afternoon Meeting- April 17, 1996

Plenary Session

C: Most of the 14 tons of nuclear material at Rocky Flats is considered surplus and represents a concern. A decision needs to be made to treat this material as a waste: it is toxic and not a resource. The material needs to be put into a form that renders it proliferation resistant as quickly as possible. The options presented in the Storage and Disposition draft Programmatic Environmental Impact Statement are not viable options to obtain this objective. Geological repositories are not available and disposition options are reversible. The mixed oxide fuel option has many flaws. Mixed oxide fuel: 1) Is more costly than uranium; 2) Creates an opportunity for theft of plutonium; 3) Presumes that the material can be deposited in Yucca Mountain; 4) Generates heavy plutonium that may be attractive to other governments in the future; and 5) Needs to be safeguarded against criticality conditions. The risks outweigh any resource considerations. The electrometallurgical technology option should be rejected. DOE needs further research before the vitrification and ceramic technologies can be considered viable. The material needs to be put into a stable form for storage, but containers analyzed are only good for 50 years. DOE needs to focus on storage since no feasible disposition options are available. The technology alternatives need considerably more research and should be addressed in international dialogue.

1/01.00.00
2/08.03.01
3/08.03.01
4/08.03.01
5/08.03.01
6/14.00.00

Afternoon Meeting
Breakout Session

C: The draft Programmatic Environmental Impact Statement process continues to appear fragmented and convoluted. A particular concern that results from this fragmentation is that reprocessing is not comprehensively addressed in the Storage and Disposition draft Programmatic Environmental Impact Statement or addressed in any of the Programmatic Environmental Impact Statements. The use of electrometallurgical treatment as a reprocessing option, commonly referred to as "pyroprocessing," should have been considered under an Environmental Impact Statement instead of an Environmental Assessment. Another area that needs more attention from DOE is in their treatment of tribes as nations. DOE should notify tribes residing in the areas of proposed activities early in the process on a government-to-government basis, so that impacts of the actions can be reviewed against treaties with the individual tribes.

7/01.00.00
8/08.00.00
9/08.02.00

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01 00 00 **Comment Number 1**

The materials at RFETS would be stabilized under DOE's Environmental Management Program before they are packaged and shipped to the storage site(s) pursuant to this PEIS.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to the disposition alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning and immobilization must be considered. Suitability of waste forms for disposal in a geologic repository has been analyzed and is included in Appendix H of the PEIS. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to the Electrometallurgical Treatment Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 4**

Research and development is both on-going and planned to support the disposition alternative. If either the vitrification or ceramic technology is selected, the ROD would include pilot facilities as a means of learning more about these technologies.

08 03 01 **Comment Number 5**

The Department of Energy acknowledges the commentor's support for the continued storage of surplus Pu (No Action Alternative). The materials would be stabilized and packaged for the long-term storage timeframe. Decisions on

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C: The Shoshone Tribe is against pyroprocessing technology being developed to dispose of nuclear material because it can be used to separate highly enriched uranium and plutonium from spent nuclear fuel. It should not be considered as an alternative in the Storage and Disposition draft Programmatic Environmental Impact Statement. | 3/08.03.01 cont.

C: I would like to see DOE develop an outline for nonproliferation like the outline used in the long-term storage and disposition impacts fact sheet. The fact sheet outline goes through some of the categories addressed in the draft Programmatic Environmental Impact Statement. It would be useful for DOE to develop a standard framework that everyone agrees on in terms of analysis, which would outline the nonproliferation impacts that are trying to be measured. This would be useful to DOE even beyond the Storage and Disposition draft Programmatic Environmental Impact Statement. | 10/01.00.00

C: DOE should provide the public with draft copies of the other analyses being prepared in parallel with the Environmental Impact Statement, and broaden the public support and involvement in the decisionmaking process. | 11/08.00.00

C: I represent the Military Production Network. We sued DOE in an effort to have an integrated presentation of their proposed activities and to get public involvement in the process as required by National Environmental Policy Act. We have found the fallout of this action is what we call "participation proliferation," and unfortunately a further fragmentation of the issues. For example, the increase of waste resulting from the different programs is being addressed separately and not cumulatively. We, therefore, feel that the National Environmental Policy Act process is deteriorating as is DOE's image of open mindedness, primarily because the current approach is not addressing connections of various actions and is not comprehensive. | 12/08.00.00

C: It is hard to comment on one Environmental Impact Statement when they are all interrelated.

C: It is important that the Federal Government conduct ongoing epidemiological studies of impacts within a 10 mile radius of the various sites. | 13/09.10.08

C: We are making a strategic mistake downsizing the weapons complex. There is no "New World Order". Red China is the largest communist state ever, and Boris Yeltsin may soon be removed from office. I think history will show that it was wrong to downsize our military.

C: Some of what might be called fragmentation has in fact improved the efficiency of DOE activities. The Disposition of Highly Enriched Uranium Environmental Impact Statement is a prime example. It was a good idea to handle highly enriched uranium separately from plutonium because it was more appropriate to address disposition of weapons highly enriched uranium and weapons plutonium separately. | 14/01.00.00

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disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

14 00 00 Comment Number 6

Comment noted. The United States currently has a joint effort with Russia to assess the technical feasibilities of the various Pu disposition alternatives including plans for joint demonstration of some of the technologies. The success of this joint effort would provide the basis for negotiation with other nations.

01 00 00 Comment Number 7

While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of Pu from that spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort. However, consistent with U.S. policy not to reprocess spent nuclear fuel, the spent fuel from burning MOX in reactors will be disposed of in a geologic repository along with other domestic spent fuel.

08 00 00 Comment Number 8

The Department of Energy's evaluation of the electrometallurgical process for purposes other than disposition of fissile materials is outside of the scope of this PEIS.

08 02 00 Comment Number 9

The Department of Energy recognizes the special status of the American Indian tribes in relation to the Federal government. DOE has issued specific guidance for full involvement of tribes in the NEPA process. Further, DOE has prepared a detailed listing of the tribes that could be affected by Proposed Actions. All of the tribes on that list, and others who have indicated an interest in storage and disposition of weapons-usable fissile materials, have been notified about the PEIS on a regular basis.

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C: Today's *Washington Post* had an article on the danger of nonproliferation. It appears that even the draft Programmatic Environmental Impact Statement process is adding to the threat because it delays appropriate actions being made in an efficient and direct manner and thereby increases the risk of others getting at it. | 15/08.03.00

C: In a lecture at Stanford University, Professor Wolfgang Stohl of Germany summarized the results of an Electric Power Research Institute report on European countries in the nuclear business. He stated that mixed oxide fuel is commonly used there under even difficult conditions. The European impression of the United States' policy is that we have our head in the sand and need to control, rather than ignore, the technology. | 16/01.06.00

Afternoon Meeting
Summary Session

No summary session

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01 00 00 **Comment Number 10**

Comment noted. DOE will use analyses to assess domestic and international policy impacts (including Nonproliferation Policy) and the Proposed Action described in the PEIS to support the ROD.

08 00 00 **Comment Number 11**

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses along with the environmental analysis and public input will be integrated into DOE's decisionmaking process.

08 00 00 **Comment Number 12**

The combining of meetings was done at the specific request of the public near several DOE sites and was not considered to have any negative impact on the public review process. This request was based upon a need to hear how these documents were related to one another and to avoid requiring public attendance at several meetings spanning several days. The Draft PEIS and reference documents were made available in advance of the public meetings.

09 10 08 **Comment Number 13**

The Federal Government, as well as other local governments and interested organizations, has conducted or sponsored relevant epidemiology studies for various sites analyzed and considered for Pu storage and disposition alternatives. These studies are described in Section M.4 of the PEIS. In addition, any site selected for a storage or disposition alternative will continue to have an extensive environmental monitoring program to ensure that any releases associated with normal facility operations will not impact human health.

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Morning Meeting - April 18, 1996

Plenary Session

C: Regarding the new DOE policy on integrated hearings particularly from a budgetary standpoint, the integration of hearings may be useful and interesting. However, this integration has made the opportunity for the public dialogue more difficult and less substantive. The Programmatic Environmental Impact Statements become longer and more technical as they progress throughout the National Environmental Policy Act process. Greenpeace does not like this format. — 17/08.02.00

Morning Meeting
Breakout Session

C: I am not saying that the United States add capacity, just that we utilize the existing excess capacity. It will take seven to ten years to build a reactor, and approximately another fifteen years to complete the whole process. The United States is then looking at a twenty-five year time frame. During this twenty-five year time frame, the foreign excess capacity could be used to eliminate the materials. — 18/06.01.09

C: Other comments I have are: 1) The statement in the document that a "mixed oxide fuel fabrication facility must be built", should instead state *may* instead of *must*; 2) There will be no increase in spent fuel with or without reactors using mixed oxide fuel. The waste forms will be the same; 3) Credit should be given to displacement of uranium fuel that would have to be mined, milled, enriched, fabricated, and transported; 4) Mixed oxide fuel will use excess tails; 5) There will be no impacts on shipping, the same amount of material will be shipped to the reactors as is now; 6) The reactor option is the only one that reduces the fissile content; 7) The reactor option ensures closely reaching disposition as defined by the spent fuel standard in the document; and 8) The document needs to further explain that plutonium could be recovered from immobilization and vitrification. — 19/06.01.08; 20/09.11.08; 21/09.11.08; 22/10.00.00; 23/08.03.01; 24/05.00.08

C: Tables in the document incorrectly show an increase in the amount of spent fuel. Also, if the number of assemblies being transported is the same and DOE transports the material in a more safe secure environment, it would seem to me the fatalities should go down. — 20/09.11.08 cont.; 25/10.02.00

C: Many environmental and nonproliferation organizations would like to preclude the foreign option. The use of international plutonium facilities are antithetical to the United States policy. The European's have huge environmental problems. There are serval questions to be answered before foreign industries can be used. The use of foreign industries is a proliferation risk. I am concerned with the safety issues of shipping the plutonium. However, this does not — 26/01.06.00; 27/10.00.00

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01 00 00 **Comment Number 14**

Comment noted.

08 03 00 **Comment Number 15**

It is critical that DOE make good, sustainable decisions on the important issues related to the storage and disposition of weapons-usable fissile materials. Part of making good decisions is presenting the decisionmaker with the environmental impacts of taking action based upon a range of reasonable alternatives. Therefore, the time and money used in determining the potential impacts on our environment is well spent. The value of informed decisionmaking outweighs the risk of delay caused by the study.

01 06 00 **Comment Number 16**

Comment noted.

08 02 00 **Comment Number 17**

The Department of Energy acknowledges the commentor's concern about the integration of public meetings on draft EISs. The joint meetings on the Storage and Disposition PEIS, the Stockpile Stewardship and Management PEIS, and the Pantex EIS were held using a integrated format at the request of several organizations and citizen advisory boards. They stated that such meetings "would be more convenient and provide a less confusing format for public participants. It would avoid duplication, permit a much more efficient use of the public's time and allow a more informed decision about the issues."

06 01 09 **Comment Number 18**

Europe is moving toward a balance between the capacity to fabricate MOX fuel and the capacity to utilize MOX fuel in reactors. Additionally, Europe has excess separated Pu stores which they intend to use as MOX fuel as the fuel fabrication infrastructure and reactor infrastructure permits. Therefore, use of European reactors for consumption of U.S. Pu-source MOX fuel would merely displace the use of separated European Pu and result in no net

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seem to be a concern to DOE. The cost and time frame is immense, DOE needs to get on track and not be sidelined with suggestions of using foreign industries.

C: There is an urgency to this problem. DOE could reassure the public that the problem is being solved if the mixed oxide option is chosen. DOE should not preclude any option even if it is controversial. The foreign option should be considered if it is the quickest way to get on with the job. I support the mixed oxide option. | 18/06.01.09 cont.

C: As the population grows, you can project the need for future energy and the life expectancy of current facilities. New capacity will be needed in the future. Energy Information Agency projections show the electricity need and market.

C: There is no indication of the parameters considered for the environmental impact on global change. As for the questions of whether there a need for energy - the answer is yes, demographics show the need through the continued growth of the country. Present facility life shows there will be the need for new facilities and/or capacity of this material. The carbon dioxide release number should be an important factor for evaluating the options. I understand that if plutonium is substituted for uranium in present plants that there would be no net environmental change on carbon dioxide from a global climate change. However, if a plant is partially completed or an advanced plant is put online, there would be a net change in the total carbon dioxide release. | 28/09.00.08 | 29/09.03.08

C: There should be a broader scope of multi-purpose reactors in the final Programmatic Environmental Impact Statement. | 30/01.00.00

C: There have been numerous documents which have looked at overseas facilities regarding nonproliferation and the development of National Environmental Policy Act documents. Should there be any consideration of overseas facilities, I would hope that the nonproliferation concerns are included in the assessment. | 26/01.06.00 cont.

Q: Have decommissioning and decontamination costs been considered for all options, such as processing facilities, deep boreholes, vitrification, and reactors, when some of these options will not have decontamination and decommissioning costs associated with them? Is DOE considering that by the United States not participating in this technology and not having a technological lead that the United States is abandoning its right to participate in nonproliferation issues in the world? *(Note: No response was provided at the at the meeting to these questions.)* | 31/07.00.00 | 32/05.01.08

C: I am concerned about cost information availability and the comment period ending before this information is available. This seems to circumvent the whole National Environmental Policy Act process. The driver for this is not nonproliferation, although you (DOE) imply that nonproliferation should be the driver. The point of the National | 33/08.00.00

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reduction in world inventories of separated Pu. Hence, the statement that Europe has no excess MOX fuel capacity. Additionally, facility utilization projections indicate that, while some excess MOX fuel fabrication capacity may exist in Europe for the next few years, current capacity is soon expected to be fully utilized for commercial MOX fuel fabrication. Therefore, the United States may not be able to rely on the use of existing European MOX fuel fabrication capacity for the entire disposition campaign. However, as a part of efforts to develop weapons-grade Pu MOX fuel, DOE is consulting with European Fuel Fabricators to benefit from their experience in MOX fuel fabrication and may have some MOX Lead Test Assemblies and/or initial core loads fabricated in Europe. Also, participation in the construction and operation of a MOX Fuel Fabrication Facility in the United States will be open to European fuel vendors.

06 01 08 Comment Number 19

Comment noted. DOE is considering the construction of a new facility for MOX fuel fabrication using surplus weapons-usable Pu, but also considers the conversion of existing facilities for MOX fuel fabrication with surplus weapons-grade Pu. Table 2.4–1 of the PEIS provides a brief description for variants, including "modification/completion of existing facilities for MOX fabrication."

09 11 08 Comment Number 20

The MOX fuels designed for serving Pu disposition would not stay in the reactors' cores for recovering their full economic values. The MOX fuel cycle for the purpose of Pu disposition for each refueling would be shorter than the current typical commercial nuclear power plants. The data developed for this PEIS assumed that the MOX fuel bundles would be removed as soon as the fuel had been irradiated to the point where it had met the Spent Fuel Standard. This assumption, resulting in a greater amount of spent fuel from the reactors, was used in order to bound the impacts for spent fuel generation and storage. Also, it would dispose of the excess weapons-usable fissile materials as quickly as possible.

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Environmental Policy Act is public input; therefore, all of the information needed to make responsible and substantive comments should be available at the same time. Other DOE Environmental Impact Statements have shown the nonproliferation concerns in the document and this one does not. | 33/08.00.00 cont.

C: Prior National Environmental Policy Act documents including the Foreign Research Reactor Spent Nuclear Fuel Environmental Impact Statement and the Environmental Assessment on Electrometallurgical Treatment all incorporated specific sections on proliferation.

C: The Russians have a different problem, they do not have light water reactors. They have mixed mononitride reactors; and there are some advantages to them. DOE should consider this option. | 34/14.00.00

C: Mixed oxide fuel is used in reactors. However, experience relating to the use mixed oxide fuels in reactors is not in the private/public domain, so the public cannot analyze it. The information on mixed oxide fuel technology should be made available to the public through the National Environmental Policy Act, if DOE has access to the proprietary technical information. | 35/08.00.00

Morning Meeting
Summary Session

No summary session

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09 11 08 **Comment Number 21**

The Avoided Impacts section of the PEIS (Section 4.9) has been updated not only to include avoided human health impacts from mining, milling, and enrichment operations, but avoided air quality impacts, avoided waste generation, and other avoided environmental impacts. This section includes the displacement of uranium fuel by MOX fuel.

10 00 00 **Comment Number 22**

The intersite transportation for existing LWR includes only transportation of material to pit disassembly/conversion and Pu conversion sites and transportation of material to the MOX fuel fabrication site since transportation from the fuel fabrication site and spent fuel transportation is already occurring. For the partially completed LWR, all transportation steps are included (to pit disassembly/conversion and Pu conversion, to the MOX fuel fabrication site, to the reactor, and to the repository) since no transportation is currently involved for the partially completed reactors (not in operation).

08 03 01 **Comment Number 23**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

05 00 08 **Comment Number 24**

The recoverability of Pu from each of the disposition alternatives is discussed in results of nonproliferation reviews which were published in fall 1996, and are included in the decisionmaking process. This nonproliferation report is included with other supporting documents in the DOE Public Reading Rooms.

10 02 00 **Comment Number 25**

The number of fatalities is based on several factors including the radiation environment of the package, the type of package used, type of vehicle, number of miles to be traveled, and the type of roads to be traveled. The PEIS evaluates the transport of MOX fuel assemblies and the associated blendstock to the fuel fabricator and then to the reactor site. After the fuel assemblies have been burned up in a reactor for the transportation analysis, the MOX spent fuel assemblies are assumed to be identical to uranium spent fuel assemblies. The same vehicles and packages will be used and all factors are assumed to be identical.

01 06 00 **Comment Number 26**

The two disposition alternatives that would involve foreign industries are the CANDU Reactor Alternative and the Existing LWR Alternative using foreign MOX fuel fabrication. In the former case, Canada as a nonnuclear weapons state, would burn both U.S. and Russian Pu in heavy water reactors. This alternative would require final approval from the Canadian Government. Both the U.S. and Canadian Governments would oversee the operations which would comply with domestic and international inspections and the Nonproliferation Policy. In the latter case, MOX fuel fabrication in existing European facilities would be conducted for a limited period of time pending availability of a domestic MOX fuel fabrication facility. The shipment and handling of Pu and fabrication of MOX fuel would likewise be conducted in accordance with international inspections and safeguards regimes.

10 00 00 **Comment Number 27**

The use of British and/or French facilities to produce MOX fuel is a viable option, and therefore included in the PEIS. Their facilities are readily available and currently producing nuclear fuel; this is a clear short-term advantage. Measures would be taken to safeguard materials throughout the production cycle. Nuclear industry-owned ships, specifically designed to transport radioactive materials, could be used to ensure appropriate safety and security of the cargo. Although cost is not the principal factor, there is little reason to believe that cost would be significantly higher for this method versus other MOX fuel production options. If this method is considered further, a cost analysis would be conducted prior to implementation.

09 00 08 **Comment Number 28**

The scope of this PEIS is to analyze the environmental impacts at each candidate or representative site as described in Chapter 3 of the PEIS. The general approach and specific methods for assessing environmental consequences, along with estimated results and potential cumulative impacts, are presented in Chapter 4. The information and environmental analyses are intended to address all significant issues raised during the scoping process. The general environmental impact on global change is beyond the scope of this PEIS with the exception of transportation. There is a description of the impact on Global Commons in Appendix G.

09 03 08 **Comment Number 29**

The net outputs of carbon dioxide using MOX fuel in an existing operating reactor, a partially completed reactor, or an advanced reactor during operation would be similar. The construction involved with completing a partially completed reactor or constructing an advanced reactor would produce a net gain of carbon dioxide. On a global scale, the gain would be minimal. The production of electricity from any operating reactor would significantly reduce carbon dioxide emissions relative to a similarly sized fossil fueled power plant.

01 00 00 **Comment Number 30**

Comment noted.

07 00 00 **Comment Number 31**

Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition beginning in late July 1996. D&D costs were also included, where appropriate, in the cost evaluations included in the Technical Summary Reports.

05 01 08 **Comment Number 32**

The United States is strongly committed to participation in nonproliferation issues. The United States is fully engaged in the IAEA, and the President has committed to offering surplus fissile materials for IAEA safeguards.

08 00 00 **Comment Number 33**

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses along with the environmental analysis and public input will be integrated into DOE's decisionmaking process.

14 00 00 **Comment Number 34**

During the screening process to select reasonable alternatives for evaluation in the PEIS, several advanced reactor options including mononitride reactors were considered. However, because the technology of the mononitride reactors needs further development which would involve time and cost, this option was considered less reasonable than other reactor options using existing or more mature technologies.

08 00 00 **Comment Number 35**

All of the source material used in preparing the PEIS is available to the public in DOE Public Reading Rooms or upon request to DOE. DOE has used open, publicly available information to the maximum extent possible. No commercial organization's proprietary information was used in preparing the PEIS.

PUBLIC SAFETY RESOURCES AGENCY, PORTLAND, OR, W. P. MEAD

W. P. Mead, Director
Public Safety Resources Agency
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June 6, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

RE: Personal comments on "Programmatic Environmental Impact Statement on Storage and Disposition of Weapons Usable Fissile Materials."

I am writing to voice concerns I have after being informed that the above PEIS includes burning weapons-grade product in reactors as a disposal option. I am faxing this document to your office in order to meet the filing deadline and will mail a printed copy.

I have not reviewed the PEIS, but would like to include my comments, as follow, into the official record. Due to the nature and scope of the issues involved, I also request that the Congressional Record of the Subcommittee Hearing, cited below, be included as an addendum to this comment document; specifically as the Record's testimony may be relevant to any proposal involving a change in the current status of the WPPSS #1 reactor facilities at the Hanford Reservation.

I also would take this opportunity to request (1) that a copy of the above PEIS document series be sent to me at the above address, and (2) that I be included on the mailing list to receive all future documents relating to this project.

If you review the Department's records, you will see that in the 1980's I was a consultant to several health and state agencies about several projects at the Hanford Reservation. In that capacity I testified before state legislative committees and working groups, advised public health departments, provided research services for citizens' forums and intervenors, and testified before a Congressional Sub-Committee about converting the WPPSS-1 nuclear generating plant.

While I agree with the Encapsulation option for *short term* storage, followed by Deep Storage disposal once the technology has been proven; I very strongly object to "processing" this new inventory of fissile material in power reactors because of the current lack of technical knowledge, the history of poor operational safety in this area of nuclear energy, and the creation of additional low-level and high-level waste streams that such a project would incur.

1/08.03.01

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08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

PUBLIC SAFETY RESOURCES AGENCY, PORTLAND, OR,
W. P. MEAD
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Several years ago I was asked to testify before a Congressional Sub-Committee about a proposal to convert the WPPSS Unit #1 at the Hanford Reservation [1/]. That project was a poorly-conceived plan to salvage the canceled WPPSS #1 power generator at taxpayer's and ratepayer's expense by taking experimental theory and scaling it up as a full-scale operational MOU testbed despite the Department's own peer review finding of its own in-house technical feasibility studies that warned of "...an outstanding safety issue, the problem of in-vessel re-criticality." [2/].

The idea of burning a MOX fuel mixture, while certainly achievable, is not advisable for several reasons. Although these reasons are valid regardless of where the project is sited, a siting of the reactor option at the Hanford Reservation would pose *additional* hardship on the populations and environment of the Northwest: 1/08.03.01 cont.

1. In order to fabricate MOX fuel, the fissile product(s) must be transformed from their current states, formulated to the desired level of enrichment, stabilized and then fabricated into new fuel assemblies. This process alone increases the probabilities of adding to the current MUF inventory and poses security risks during several stages of processing.

2. Manufacture of MOX fuel assemblies also will produce new waste streams that will increase the quantity of wastes by several times the volume currently associated with these same inventories in their present states. Although much of this waste will be "low level," these processes will necessarily also generate a new volume of TRU wastes, with the special handling required by those TRU waste streams. Our waste management efforts should be focused on reducing the *current* inventory of hazardous and/or radiologic wastes; not on a search on how to create new wastes. 2/06.01.08

3. In the past, projects such as these have depended on the use of new reactors or the modification of existing facilities to burn the new fuels. The time needed to complete construction of new facilities, or the modification of an existing plant, would be much greater than the time needed to construct an encapsulation facility and begin the vitrification/encapsulation process. If the United States sincerely wants to remove plutonium from the active SNM inventory, then the Encapsulation alternative would accomplish this goal much faster and at a greatly-reduced cost than would the reactor option. 3/08.03.01

4. Cost, of course, is yet another factor that must be considered when deciding the disposal options. The MOX-fueled reactor plan would undoubtedly require an outlay of several billion dollars to achieve the goals of even a mediocre "burning" option. In my experience, based on several years of research, the Department has *never* completed a significant project of similar scale within the timeline and budget estimates stated in its' studies, nor those specified in contracts with its' vendors. 4/07.01.00

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06 01 08 **Comment Number 2**

The environmental impact of the MOX fuel waste streams is presented in Chapter 4 and Appendix H of this PEIS.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

07 01 00 **Comment Number 4**

Cost data, along with technical and schedule data, was provided in a Technical Summary Report for disposition beginning in late July 1996. This information will be integrated into DOE's decisionmaking process.

PUBLIC SAFETY RESOURCES AGENCY, PORTLAND, OR,
W. P. MEAD
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5. Transportation issues also must be examined on several levels: First, based on the "per-tonne-mile" costs for shipping the MOX components to the fabrication facility, and then shipping the assemblies to the reactor; and then at a greatly-increased "per-tonne-mile" costs for transporting the irradiated fuel assemblies from the reactor to a disposal facility -- assuming that such a facility exists by the time the reactor has been built. 4/07.01.00 cont.

6. Speaking of disposal facilities, ten years ago we had more than 70,000 Metric Tonnes of irradiated fuel assemblies that the Department wanted to bury at Hanford's proposed MRTP Repository. Reactor physics being what they are, it is reasonably safe to assume that during the past ten years many of these same reactors continued to generate waste for which the Department still does not have a home. We should clean up this existing lethal legacy before constructing a new plant to generate even more waste. 5/12.00.00

The argument can be made that once the MOX-fuel assemblies have been irradiated in a reactor, that the plutonium content is much safer from terrorists than in its present form. This is only marginally correct due to the dangers associated with separating the SNM from the fission products. It is my belief that the additional steps needed to change the SNM from its' existing form through the final disposal (hopefully in a dry burial vault somewhere within Hanford's Rattlesnake Mountain above the existing water table) is much more hazardous, costly and time-consuming than is justified.

I sense the re-emergence of a dangerous pattern in this project as it has been described to me. Many of us mistakenly believed that when the Department ceased its major production-oriented operations at the Hanford Reservation that its future efforts would focus on the remediation of the reservation's contaminated sites.

Instead, this proposal seems to be a replay of past efforts to salvage Hanford's reactor operations infrastructure at the expense of the public's health, wealth and safety:

1. As of January 1996, Hanford's TRIDEC infrastructure organization still wanted to convert the abandoned WPPSS-1 Power Reactor to a tritium production reactor. This proposal was the subject of the 1985 Congressional Subcommittee hearing cited above.

2. As of the present date, many of these same players have dropped the latest WPPSS-1 conversion plan in favor of using the FFTF as a tritium production reactor.

The above instances are cited only as examples of the continuing use of the local industrial/business communities in the Tri-Cities area to keep reactors operating at the Hanford Reservation. A far better option would be to channel these support efforts from existing and/or new reactor operations and to the immediate decontamination of the Hanford Reservation. 1/08.03.01 cont.

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12 00 00 **Comment Number 5**

Comment noted.

The Department should concentrate on rebuilding its image and increase its level of public trust instead of pursuing the reactor option. Any attempt to use the reactor option without first demonstrating a "good faith" effort to dispose of the current wastes at Hanford is morally indefensible and would call attention to the Department's 50-year history of having a "business as usual" mindset regardless of the public's wishes. 6/01.02.00

Ten years ago Michael J. Lawrence, USDoE's Richland Operations Office Manager bragged about the amount of high level tank wastes that had been condensed during 1984. As I pointed out in my rebuttal [3/], that entire effort had reduced the Reservation's volume by less than the amount produced by a single day's operation of the PUREX Plant, and that figure only accounted for high level liquid wastes, thus ignoring the other waste streams generated by the PUREX Plant.

This mindset intensified during the 1980's, and we in the Northwest vividly recall several of the Hanford Reservation's more infamous projects:

1. The unnecessary restart of the PUREX Plant in 1983 to process target fuel assemblies that really had never been needed for national defense purposes;
2. The $200 million dollar "Head Shed" modification project to enable the PUREX Plant to reprocess fuel assemblies from civilian power reactors;
3. Hanford's failure to meet INPO reactor operating standards;
4. USDoE's on-going refusal to comply with NRC safety regulations;
5. The $70 million dollar expenditure to retrofit the N-Reactor's safety systems only *after* the Chernobyl-4 Reactor explosion;
6. The Department's attempt to violate the NPT by converting the WPPSS-1 Reactor from a commercial civilian power reactor to a Department-owned tritium production reactor;
7. The adoption of "ALARA" radiation dose "*goals*" for occupational exposures instead meeting the ICRP's established dose limits;
8. The insane desire to continue FFTF operations when all reason dictates its' decommissioning, not its' modification.

SNM is not a plaything. It is time to isolate this material from the environment without further delay. Encapsulate it and then bury it without first irradiating it. 7/08.03.01

Sincerely;

W. P. Mead

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01 02 00 **Comment Number 6**

Comment noted.

08 03 01 **Comment Number 7**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

PUBLIC SAFETY RESOURCES AGENCY, PORTLAND, OR,
W. P. MEAD
PAGE 5 OF 5

Cited References:

[1/] "Potential Conversion of WPPSS 1 Commercial Nuclear Powerplant to a Production Reactor." Oversight Hearing before the Subcommittee on General Oversight and Investigations of the Committee on Interior and Insular Affairs, House of Representatives, 100th Congress, 1st Session; held at Portland, Oregon, 12/07/1986; Serial No. 100-42, U.S. Government Printing Office, Washington, D.C., 1988.

[2/] Ibid., page 63.

[3/] "1984 Hanford Reservation Waste Generation Abstract." Public Safety Resources Agency, Portland, OR, 1986

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Comment Form

These comments apply to the following document:

_X_ Storage and Disposition Draft PEIS

NAME: (Optional) William C. Rask

ADDRESS: 10295 W. Warren Ave. Lakewood, CO 80227

TELEPHONE: (303) 988-9651

The following comments are in regard to the long-term storage of plutonium as discussed in the Storage and Disposition of Weapons-Usable Fissile Materials Draft PEIS, dated February 1996.

Introduction

Surplus and non-surplus plutonium must be packaged and stored in a manner that ensures material control and accountability, safeguards and security, as well as public and worker safety for at least 50 years until the material is permanently dispositioned -- i.e., "The Stored Weapons Standard." In placing the plutonium into such a storage configuration, the Department further desires to implement the President's Nonproliferation and Export control Policy in a safe, reliable, cost-effective, technically feasible, and timely manner.

The Department has made significant progress toward a materials storage Record of Decision considering the referenced goals, however the options currently under consideration by the Department in the Material Disposition Program (MD) encompass only renovation of existing facilities and/or construction of new facilities at DOE sites thereby limiting options that provide for increased safety, timeliness, and cost effectiveness with less environmental insult. Furthermore the Department has limited itself by considering Storage to be only a domestic issue to be decided by the Secretary of Energy while Disposition is considered an International issue to be decided by a larger audience -- Joint Chief's, etc. 1/01.04.00 2/01.00.00

The Concept

The relatively simple concept for interim storage of plutonium in minuteman missile silos that has significant political (international), cost, materials control and accountability, safety, and environmental impact advantages over the current options should be considered by the Department. This option makes use of existing facilities already designed and constructed for secure storage of plutonium under the most extreme conditions and the supporting infrastructure which is currently providing safety and security assurance for U.S. strategic weapons and associated launch systems. 3/14.00.00

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01 04 00 **Comment Number 1**

The Department of Energy utilized a screening process to select the alternatives which were analyzed in the PEIS. Safety, timelines, cost, and environmental impacts were factors considered in the screening process and continue to be considered in DOE's decisionmaking process.

01 00 00 **Comment Number 2**

Both storage and disposition of weapons-usable fissile materials are important domestic and international issues. Decisions made in the United States can influence decisions in Russia, and possibly other foreign nations, and should result in international progress and cooperation to reduce the global nuclear danger.

14 00 00 **Comment Number 3**

The use of existing facilities at non-DOE sites for storage was considered but eliminated in the screening process. The reasons for the elimination include cost, environmental, safety, and health concerns, and public and institutional acceptance. In the case of a Department of Defense (DoD) site, the additional costs and regulatory requirements for support facilities such as radioactive materials analytical laboratories, radioactive waste treatment, and nuclear material processing facilities associated with long-term storage could be very high. Furthermore, the public and other Government agencies would express concern over creating another DOE nuclear site when several are being phased out.

RASK, WILLIAM C., LAKEWOOD, CO
PAGE 2 OF 4

Discussion

Utilizing minuteman missile silos for storage of plutonium could be perceived as creating "new" plutonium sites. However, these missile silos have been storing plutonium for almost 30 years in a form and under conditions which pose a much greater risk to the public and workers than what is proposed herein. In fact, this concept would reduce the overall risk to the workers and public, eliminating plutonium sites by consolidating plutonium from several existing DOE sites.

With regard to the direct support facilities needed for packaging disassembly, material analysis, repackaging, and waste management, they are not required under this concept. The Department's proposed Primary Containment Vessels (PCV) could be placed within a third containment/shipping vessel that could be fully instrumented with continuous-remote monitoring -- any detected "issue" problem would cause that vessel to be removed and sent to a processing facility (LANL, for example). In principle this operation would be similar to any needed corrective or maintenance items required for the missiles and the respective nuclear packages today. A two part surveillance program could be implemented that would enhance the Department's knowledge of long-term storage, complementing missile silo storage that could include: 1) a Storage Reliability Evaluation Program and 2) a Shelf-Life Monitoring Program, similar to existing pit surveillance programs.

Utilizing minuteman missile silos for storage of plutonium could be considered as a concept with increased risk since metal and oxide as well as "contained" pits would be stored. Plutonium in pits exist as a metal form, sealed within an inert environment, and packaged in specially designed containers that ensure a very low probability of breach, metal oxidation, and dispersion of oxidation products. Metal pieces and ingots, packaged to the Department's new storage/packaging standard represents a similar packaging configuration with minimal risk similar to that of the pits. The issue is with oxides and their potential dispersibility in various accident scenarios. To mitigate this problem the Department could improve upon the packaging system or simply stabilize the material form to one that is not dispersible. Non-dispersible forms of oxide can in fact be produced through processing that could be at least as simple as the existing proposed oxide stabilization-calcination process without any detriment to proposed disposition alternatives. The Department appears to erroneously assume plutonium oxide is always dispersible from past practices of weapon production processing versus alternatives available for long-term storage.

Utilizing the silos for storage of plutonium would enhance transparency of plutonium storage and operations for purposes of nonproliferation assurance and compliance as well as compliance with nuclear arms reduction and control requirements established by the START treaties (not in DOE's backyard). Not only are the existing silos located in remote and open areas and readily observable through satellite networks, but they could be instrumented with safeguard systems similar to those already developed by SNLA for potential use in dismantlement agreements with Russia to enhance a regime of reciprocal inspections. The Department with interagency coordination could implement this concept in concert with or in addition to the present treaties thereby enhancing the United State's credibility and flexibility in negotiations on bilateral or multilateral nonproliferation of weapons-usable fissile material inventories. Dedicated plutonium storage facilities separate from existing Department sites would provide a level of safeguards and security and degree of nonproliferation assurance not reasonably achieved with existing or proposed facilities at DOE sites.

The capability to contain plutonium within a missile silo under the most adverse conditions has been demonstrated both by full scale proof of principle testing and severe accidents which have occurred within active missile silos. As a matter of comparison, Rocky Flat's most natural phenomena resistant facility, Building 371, is designed to about 1/2 Gs and is considered "good." while minuteman missile silos are designed to withstand forces greater than 100 Gs.

3/14.00.00
cont.

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Safeguards requirements could be satisfied through an "item" control and accountability system. This would require a 100% inspection and verification of the plutonium form and quantity that is loaded into each PCV and vessel. In addition to standard Department safeguards, surplus plutonium could be inspected and verified by the Department and IAEA, and/or Russia through a bilateral or trilateral agreement.

Storage of plutonium in minuteman silos should be licensed by the NRC. Independent regulatory oversight of these facilities with clear and definitive conditions and requirements will reassure the stakeholders and state governments that the plutonium is not a significant risk to the workers and the communities or the environment.

Difficulty has been experienced in the design and construction of the new storage facility in Russia -- the cost effectiveness and implementation could be greatly expedited under the missile silo concept if utilized in Russia also -- a significant improvement for the timeliness of nonproliferation. The same benefits that accrue to the Department and the U.S. would also be realized by the Russian utilization of their similar assets, thus bettering our relative positions in environmental safety and nonproliferation.

The Environmental Impact

Potential impacts to cultural and paleontological resources are eliminated since there is no ground disturbance for this concept, an improvement as compared to the three proposed alternatives (TPA). Again impacts to air quality would be less than the TPA since construction would be limited to modifications within the silos. There would be negligible impacts to community services similar to those of the TPA. There would be no impacts to land use nor any adverse visual resource impact with this concept. Water resource requirements for this concept would be less than the TPA. The potential for environmental justice impacts would be reduced. 3/14.00.00 cont.

Employment and income would generally remain stable in the storage locations with a small increase during the modification activities. Increases could be expected from international inspection and verification activities. DOE sites could expedite the respective cleanup missions which could impact required technical qualifications and worker skills.

The key environmental resource discriminators and issues of public concern are biological resources, waste management, public and occupational health and safety, and transportation. For biological resources and waste management the missile silo concept would have no or negligible impacts. In terms of public and occupational health and safety, the silos offer a far superior facility to any modification or new facility considered by the TPA. Transportation impacts would be similar to that of the proposed Consolidation and Co-location Alternatives.

Technical Description

A minuteman silo is basically a hardened concrete structure extending approximately 80-feet underground with a 12-foot diameter steel tube extending from the top to the bottom of the structure. At the top of the concrete structure is a circular room approximately 28-feet in diameter and 22-feet high. The missile and warheads were housed within the steel launch tube. The on-site launch support and security systems were housed on shock isolation tables in the open bay surrounding the missile tube.

The concrete structure, missile door and support systems are designed and constructed to survive detonation of a nuclear weapon in very close proximity to the silo and permit subsequent deployment of the weapons system. The resultant shock from the nearby detonation of a nuclear

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weapon would subject the silo structure to violent ground motions (and atmospheric over pressure) far exceeding those anticipated from any conceivable earthquake or other natural event.

A high degree of access security is inherent in the silo design and is assured by the Air Force SWAT teams that provide physical security for the active missile fields. Thus, the basic structure of the minuteman missile silos and the existing AF security operations provides a level of physical security and structural integrity and safety that is not reasonably achievable in any new or existing DOE storage vault(s). In addition, all of the missile silos are located in open areas that permit a degree of access transparency for demonstrated assurance of compliance with nonproliferation agreements and commitments that is also not available or readily achievable on existing DOE sites.

In addition to the added reduction of active missile silos, further consideration should be given to the strategic benefits of storing the material in silos that are in the same field of silos that will continue to be operational in the national defense. Future technological enhancements to protect our ability for retaliatory strikes will therefore benefit the protection for the plutonium storage silos also.

In concept the missile silos would be modified for the storage of plutonium similar to LANL's vertical tube storage concept proposed for Rocky Flats and Russia. The primary containment vessels (PCV) could be stored within an additional stainless steel vessel to facilitate handling/transportation and to provide a third inerted containment barrier. Several of these vessels could be stacked in the multiple vertical storage racks of the silo. The storage racks could be spaced and constructed for engineered criticality control and passive cooling. With a PCV loading process and procedures for metal and oxide, for example, that would ensure a 4.5 Kg per PCV, the authorized limit for a PCV, each silo could safely store up to 4.4 MT of plutonium.

The Department in the final decision process is to consider implementation in a cost-effective and timely manner. Preliminary cost estimates provided to MD for long-term interim storage facilities are between $500M and $1B with total life cycle costs at over $4B. Total life cycle costs utilizing mission silos has been reviewed and preliminary estimated by industry experts to be 1/4 to 1/3 of that amount. Greater cost-effective concepts should be seriously evaluated. Rocky Flats proposes to construct a new passive storage facility for about $70M with total life cycle costs of $660M (to 2015). In comparison, four missile silos could be modified for about $35M to contain all 12.9MT of the plutonium presently stored at the Site with a total life cycle cost for 20 years at $150M to $250M, as estimated by industry experts.

3/14.00.00
cont.

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REYNOLDS, ROBERT, VICTOR, ID
PAGE 1 OF 1

Comment ID: P0023
Date Received: April 18, 1996
Name: Robert Reynolds
Address: Victor, ID

Transcription:

I want to voice my opposition to anyone bringing any nuclear waste into the State of Idaho. That's all I got to say. | 1/08.03.01

P-023

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at INEL. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

RICHARDS, MATT, SAN DIEGO, CA
PAGE 1 OF 12

March 29, 1996

Matt Richards
10383 Caminito Banyon
San Diego, CA 92131

Mr. J. David Nulton
Director, NEPA Compliance & Outreach
U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

SUBJECT: Review of DOE/EIS-0229-D, "Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement"

Dear Mr. Nulton:

I have reviewed the subject draft PEIS (Ref. 1). My comments are categorized into the following areas:

Disposition Schedule: Schedule for demonstration of disposition technology and completion of disposition.

Final Waste Form Characteristics: Suitability of the final waste form for permanent disposal, in terms of long-term safeguards requirements, long-term radionuclide containment, and potential for underground criticality.

Miscellaneous Comments: Issues associated with using borosilicate glass as a vitrification option, viability of using electrometallurgical treatment (pyroprocessing) as an immobilization option, and a recommendation for evaluating a coated-particle waste form for Pu immobilization.

Please note that I am submitting these comments as an individual. I have also provided these comments to General Atomics (GA). GA may choose to include my comments in a separate submittal to DOE.

1. Disposition Schedule

Before the draft PEIS (Ref. 1) was prepared, all potential options for Pu disposition were screened using criteria given in DOE/MD-002, "Summary Report of the Screening Process" (Ref. 2). The Ref. 2 criteria are similar to those used by the National Academy of Sciences (NAS) in its 1994 report (Ref. 3). One of the criteria, timeliness, was initially defined by DOE as follows:

> "The technology concept should be demonstrated within ~20 years and disposition should be completed within ~50 years."

As stated, this criterion would have allowed for development of advanced, deep-burn reactor

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technologies for Pu disposition, including the PC-MHR. Of equal significance, this criterion would have allowed for a single, ~1GW, plant (PC-MHR or LWR) to complete the disposition mission (~50 mt of surplus weapons-grade Pu) over the expected operating lifetime of the plant. In other words, the potential environmental impacts would be limited to those for a single plant.

In Ref. 2, the DOE changed the timeliness criterion to "require that the disposition be able to start within about a decade and be able to be completed within about three decades." The reason stated by DOE for adopting this more urgent schedule was input from the public and stakeholders "relating to the urgency of taking action stemming from the 'clear and present danger' associated with these materials." However, this reasoning is not supported by the DOE's own questionnaire data reported in Appendix A of Ref. 2 (see Figs. 1 and 2, taken from Ref. 2). From Fig. 1, five of the nine criteria received higher rankings of "very important" than given to timeliness. From Fig. 2, the ranking of timeliness relative to the other criteria indicates clearly that the questionnaire respondents viewed timeliness as being of secondary importance.

Other factors also do not justify forcing the Pu disposition mission to a more urgent schedule. According to the draft PEIS, the DOE also proposes to provide a long-term, 50-year storage system for Pu and HEU declared to be non-surplus. The non-surplus material is categorized into naval nuclear fuel, strategic reserves, material for weapons R&D, and programmatic materials. The DOE acknowledges that some of the non-surplus material could be classified as surplus material in the future. During the disposition mission, it is likely that surplus and non-surplus material would be stored and secured at common locations. For Pu being stored and secured at a given location, it would be absurd to determine that material classified as surplus poses a "clear and present danger," while material classified as non-surplus does not pose a similar risk, particularly when the classification boundary could change over time. The "clear and present danger" argument does not justify adoption of the more urgent disposition schedule, since fissile material of potentially unknown classification (surplus or non-surplus) will be in storage for time periods exceeding the more urgent disposition schedule. 1/07.00.00

The DOE acknowledges that the risks for theft and diversion of fissile material are greater in Russia than in the U.S., because of the less stable political climate in Russia. Perhaps the justification for the more urgent schedule is to encourage the Russians to adopt a similarly urgent schedule, thereby reducing the risks of theft and diversion. While plausible, this strategy is not consistent with desires expressed by the Russians. The Russians have actively encouraged development of the PC-MHR for Pu disposition. As part of a private, cost-sharing initiative with General Atomics and Framatome, Russian engineers and scientists are presently working on the PC-MHR design. At the recent Third International Policy Forum: Management & Disposition of Nuclear Weapons Materials (Lansdowne, Virginia, March 19-22, 1996) high-level Russian representatives confirmed their strong support for continuing development of the PC-MHR. Despite growing international support, the DOE has actively discouraged this private initiative. From Fig. 2, it is interesting to note that the criterion "Influence on Russia and Other Countries" was rated as being of somewhat greater importance than timeliness. 2/07.03.00

Finally, in its 1995 report on reactor-related options for Pu disposition (Ref. 4), the NAS viewed the more urgent schedule as a "very severe constraint" that did not provide a useful basis for comparative evaluations. For comparing the various reactor options, the NAS assumed that 50 mt of Pu would be processed over the nominal lifetimes of the reactors.

M-008

07 00 00 Comment Number 1

The data in the referenced figures were presented as received; however, some respondents reacted to the timeliness statement that "The technology concept should be demonstrated within approximately 20 years and disposition should be completed within approximately 50 years." These respondents ranked our stated definition of timeliness low indicating that 20 and 50 years was too long and it was important for DOE to start and finish earlier. Also, public comments received through questionnaires, including comments to this document, continue to support the importance of starting disposition within approximately10 years and completing within approximately 30 years.

07 03 00 Comment Number 2

Comment noted. The U.S./Russian approaches need not necessarily be identical.

RICHARDS, MATT, SAN DIEGO, CA
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The impacts of adopting the more urgent Pu disposition schedule are clear:

- Advanced, deep-burn reactor technologies, including the PC-MHR, are eliminated from further consideration.
- The required number of ~1 GW, plants is increased from one to two, and the associated environmental impacts are doubled.
- The potential for strong international cooperation on Pu disposition and proliferation-resistant fuel cycles is hampered.

The first impact supports the current Administration's policy to curtail development of nuclear energy and eliminate development of advanced reactors. The second impact would tend to favor non-reactor, vitrification/immobilization options relative to reactor options, which is also consistent with the Administration's anti-nuclear policy. The third impact was probably not anticipated by DOE, but it clearly works aghinst the most top-level objectives associated with the Pu disposition mission.

It is apparent that the decision to adopt a more urgent Pu disposition schedule is based more on political and institutional objectives in the U.S. and less on real issues associated with Pu disposition.

Recommendation: The PEIS should be expanded to include a flexible schedule that can accommodate disposition of Pu over the expected reactor lifetime, and advanced, deep-burn reactor options should be evaluated as part of the EIS process. The "clear and present danger" argument is highly subjective and open to a wide range of interpretation. This argument should not be used to eliminate alternatives that require only a somewhat longer schedule than currently dictated by DOE. 3/07.01.00 1/07.00.00 cont.

2. Final Waste Form Characteristics

An important issue for any Pu disposition strategy is the suitability of the final waste form for permanent disposal. Respondents to the DOE questionnaire (Ref. 2) recommended additional criteria that should be used to screen Pu disposition technologies, including several criteria related to final waste form characteristics. During the screening process and preparation of the draft PEIS, DOE gave little consideration to final waste form characteristics, other than the annual volume of high-level waste generated by a disposition alternative. 4/12.00.00

Volume alone is a poor measure of the environmental impact of the final waste form. In fact, a larger volume may be an attribute, since the dilution of Pu (residual Pu if the waste is spent fuel) provides greater resistance to diversion and reduces the potential risk of underground criticality. Also, the geologic repository loading density and required repository land area are determined by decay heat load of the spent fuel and not physical volume. For the PC-MHR, the annual volume of spent fuel would be ~10 times that from a commercial LWR or Pu-disposition LWR (PD-LWR), on an equivalent electrical energy basis, but the required land area for PC-MHR spent fuel would be about one-half that required for LWR spent fuel. The greater volume of PC-MHR spent fuel is a consequence of the low power density of the PC-MHR core, which helps to provide inherent, meltdown-proof safety during normal operation and hypothetical accidents. Approximately 83% of

M-008

07 01 00 Comment Number 3

Generally, the goal is to complete disposition within 25 years after the ROD. This schedule will include the use of reactors (if selected as a disposition alternative) to irradiate the MOX fuel, meeting the Spent Fuel Standard, thereby fulfilling the purpose and need of the PEIS. The Deep Burn concept is not necessary to meet the purpose and need, and would require either more time, more reactors, or both.

12 00 00 Comment Number 4

Comment noted. See Appendix H of the Final PEIS.

Mr. J. David Nulton Page 4

the PC-MHR spent fuel volume is high-purity, nuclear-grade graphite, which by itself would be classified as low-level waste. The high-level waste is confined to the fuel compacts, and the bulk of this waste (99.9%) is contained within the coating layers of the fuel particles. The PC-MHR would destroy and degrade weapons-grade plutonium well beyond the commercial LWR spent fuel standard. The final waste form would be rendered permanently resistant to proliferation, would be contained effectively for geologic time periods by multiple layers of highly corrosion-resistant ceramic coatings (Refs. 5 through 7), and would be well suited for permanent disposal in a geologic repository. The graphite is also highly resistant to corrosion (Ref. 8) and would serve as an additional protective overpack after permanent disposal. The long-term environmental impacts of permanent disposal would be significantly reduced, and potential high consequence scenarios would be eliminated, including recovery of spent fuel canisters to obtain Pu for weapons (i.e., the Pu mine issue would be eliminated), large-scale radionuclide releases caused by severe climatic changes and/or increased seismic activity (i.e., much less reliance would be placed on the geosphere for radionuclide containment), and underground criticality. With regard to these issues, PC-MHR spent fuel would be a nearly ideal waste form for permanent disposal (Ref. 9). 5/14.00.00

In screening reactor technologies for Pu disposition, the DOE has determined that the commercial LWR "spent fuel standard" was a sufficient end point. The basis for the spent fuel standard stems form the 1994 NAS study (Ref. 3). The NAS recommended that "options for long-term disposition of weapons plutonium should seek to meet a 'spent fuel standard' - that is, to make this plutonium roughly as inaccessible for weapons use as the much larger and growing stock of plutonium in civilian spent fuel." The NAS and DOE have recognized that high levels of radiation are the primary barrier to diversion of Pu in spent fuel and that this barrier decays over time. The NAS stated that "long-term options will be needed to reduce the proliferation risks posed by the entire global stock of plutonium, particularly as the radioactivity of spent fuel decays," and that "options for reducing these risks include placement of spent fuel in geologic repositories, or pursuit of fission options that would burn existing plutonium stocks nearly completely." 5/14.00.00 cont.

Without performing proper analyses, the DOE has determined that geologic disposal will provide the necessary long-term safeguards. In justifying the spent fuel standard, the DOE states in Ref. 2 that "there is a path forward established by the Nuclear Waste Policy Act (of 1982) for disposal of spent fuel in a mined geologic repository, where geologic barriers will reduce the reliance on institutional controls." This conclusion is flawed for the following reasons: 4/12.00.00 cont.

- There is no consensus among experts that isolation of spent fuel (or immobilized Pu) in a geologic repository would provide adequate long-term safeguards. It is important to realize that the NAS study (Ref. 3) makes no judgements and draws no conclusions regarding safeguards provided by geologic isolation. According to the Yucca Mountain Total System Performance Assessment (Ref. 10) and to the 1995 NAS report (Ref. 4), the eventual loss of institutional controls and human intrusion is considered to be a credible scenario for assessing long-term performance of a repository. An International Atomic Energy Agency (IAEA) advisory group concluded (Ref. 11) that LWR spent fuel "does not qualify as being irrecoverable at any point prior to, or following, placement in a geologic formation commonly described as a 'permanent repository,' and that safeguards should not be terminated on spent fuel." In a recent report (Ref. 12), the U.S. Congress Office of Technology Assessment (OTA) expressed "concerns about leaving plutonium in a repository that might be mined sometime in the future for the purpose of making weapons." This same concern was raised recently by an American Nuclear

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The Advanced Deep Burn Reactors Option, including MHRs, was considered in the screening process. Notwithstanding the many potential benefits of their use, the technical immaturity would call for costly and lengthy development and demonstration efforts to bring them to a viable status. The Screening Committee decided that the increased Pu burn-up offered by this option would not counterbalance its cost, schedule, or technical risks, and therefore, eliminated this option from further consideration.

Society (ANS) Special Panel on Protection and Management of Plutonium (Ref. 13). During a presentation at a recent DOE workshop (Ref. 14), Peterson concluded that "geologic repositories will provide attractive sources of fissile material for nuclear explosives for roughly 200,000 years." These concerns raised independently by NAS, IAEA, OTA, ANS, and others provide strong justification for developing a disposal strategy in which fissile materials are destroyed before geologic disposal, since safeguards and institutional controls cannot be guaranteed for tens of thousands of years.

- Even if it were determined that geologic disposal does provide adequate long-term safeguards, there is currently no permanent repository for spent fuel, and there is the distinct possibility that a repository would not be available for many decades. The political controversy associated with the Yucca Mountain repository project has slowed progress considerably. After spending more than $2 billion, there has still been no determination of whether the site is acceptable for disposal of commercial spent fuel. In the Ref. 2 screening report, the DOE acknowledges "the tremendous cost and time being taken to evaluate the suitability of Yucca Mountain as a mined geologic high-level waste repository."

- Mixed-oxide (MOX) spent fuel from a PD-LWR would be significantly more attractive for diversion than commercial LWR spent fuel, particularly after the radiation field has decayed to lower levels. According to the 1993 DOE Pu disposition study (Ref. 15), a PD-LWR MOX spent fuel assembly would contain up to 30 kg of weapons-usable Pu, which is enough Pu to manufacture up to 4 weapons. For comparison, a typical commercial LWR spent fuel assembly would contain ~3.5 kg of similar quality Pu. A PC-MHR spent fuel element would contain only ~0.25 kg of much lower quality Pu. In addition to increased diversion risks, the high Pu content of PD-LWR MOX spent fuel would have a negative impact on the design of a spent fuel canister and repository loading strategies. Additional processing of MOX spent fuel may be required to lower the Pu density.

Other issues associated with unprocessed LWR spent fuel as a permanent waste form are poor long-term containment provided by metal-clad fuel rods within metallic canisters and the potential for underground criticality because of the relatively high concentration of fissile material in LWR spent fuel (especially in MOX spent fuel). According to the Ref. 10 performance assessment, a large fraction of LWR spent fuel would become exposed within several hundred to several thousand years because of the expected failure of Zircaloy cladding and corrosion of metallic canisters, and the only remaining barrier for release to the accessible environment would then be the surrounding geologic media. The effectiveness of this barrier for long time periods is uncertain and could be compromised by unforeseen events, including climatic changes and increased seismic activity. In testimony before the House Commerce Subcommittee on Energy and Power on June 30, 1995, John Cantlon, Chairman of the Nuclear Waste Technical Review Board (NWTRB), stated that the NWTRB "has repeatedly urged the DOE to develop a robust, long-lived waste package that will work together with other engineered barriers and the geology at the site to provide long-term isolation of the radioactive waste from the accessible environment." Cantlon stated also that "the use of such waste packages can help improve confidence in the long-term performance of the repository and thus facilitate licensing of the facility." Other experts on disposal of high-level radioactive waste have stated (Ref. 16) that "any strategy of isolation should emphasize the near-field containment of radionuclides, a function primarily of waste form or 'waste package' performance" and that "strategies that rely solely on long travel times, dispersal, or dilution, implicitly presume release and

movement of radionuclides." In a recent report (Ref. 17), the NAS concluded that the most harmful releases of radionuclides from a geologic repository could occur well after 10,000 years, which further underscores the need to provide effective near-field containment of radionuclides for geologic time periods. Other potential benefits of superior near-field containment are less required geological characterization of the candidate repository site and greater likelihood that a given site would be found acceptable.

Recently, Bowman and Venneri proposed scenarios in which fissile material disposed in a geologic repository could eventually assume unstable critical configurations, leading to supercriticality and large energy releases (Ref. 18). The Bowman/Venneri hypothesis has been heavily criticized, on the grounds that the scenarios are highly contrived, based on idealized assumptions, and are highly improbable (Ref. 19). For LWR spent fuel, the Bowman/Venneri hypothesis may be highly improbable, but geologic time scales could provide sufficient time for even highly improbable scenarios to occur. In the Ref. 19 critique of the Bowman/Venneri hypothesis, it is stated that design choices could reduce the potential for underground criticality, including "dilution of fissile material" and use of "highly durable ceramic waste forms."

Final waste form characteristics (and not just near-term diversion resistance) will determine the overall schedule for achieving effective disposition of plutonium. Plutonium disposition using deep-burn reactors like the PC-MHR could satisfy long-term safeguards requirements without relying on the availability of a geologic repository or the determination that the repository would provide the needed long-term safeguards. This is a very significant advantage for deep-burn reactors that has been completely overlooked during the DOE screening process. PC-MHR spent fuel would be a highly stable and highly diversion resistant waste form during potentially long-term storage and after permanent disposal. If future generations could respond to the DOE questionnaire, they would undoubtedly rate final waste form characteristics as the most important criterion for evaluating high-level radioactive waste forms, including those generated from disposition of surplus plutonium.

Recommendation: Final waste form characteristics and long-term environmental impacts should be given a high priority when evaluating technologies for Pu disposition. Advanced technologies that produce clearly superior permanent waste forms and have the potential to eliminate long-term, high-consequence scenarios should be evaluated as part of the EIS, particularly if the schedules for implementing these technologies are not significantly longer than those for more established technologies and if the potential for strong international collaboration exists. The PC-MHR would clearly meet these conditions.

4/12.00.00 cont.
5/14.00.00 cont.

3. Miscellaneous Comments

Use of Borosilicate Glass for Vitrification

The vitrification alternative proposed in the draft PEIS would involve manufacturing borosilicate glass logs containing Pu and high-level waste. Recent evaluations have raised significant issues that may preclude borosilicate glass as a host phase for immobilization of plutonium. These issues include potentially poor long-term durability in a geologic repository and the potential for underground criticality. These issues received considerable attention during a recent DOE Plutonium Stabilization and Immobilization Workshop in Washington, DC (December 12-14, 1995). Since weapons-grade Pu consists mostly of the fissile isotope Pu-239, with a half-life of ~24,000 years, the time over which the waste remains highly radiotoxic and is of concern for

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underground criticality would likely exceed the expected lifetime of the glass. Scientists at Argonne National Laboratory have been developing a more durable glass for Pu immobilization (Ref. 20).

Recommendation: DOE should acknowledge the potential problems with borosilicate glass and evaluate alternative glass forms during preparation of the EIS. 6/05.01.08

Viability of Electrometallurgical Treatment

According to the draft PEIS, the DOE will consider electrometallurgical treatment as an option for Pu disposition. Electrometallurgical treatment was derived from pyroprocessing technology developed for reprocessing liquid metal reactor spent fuel. In its 1995 report (Ref. 4), the NAS evaluated pyroprocessing as an option for Pu disposition. The NAS determined that pyroprocessing has several disadvantages that "effectively rule it out as a serious competitor for the near-term plutonium disposition mission." The NAS raised concerns with regard to the maturity of the technology, the size of the facility required to complete the disposition mission, and suitability of the final waste form for permanent disposal. 7/05.03.08

Recommendation: In light of this evaluation by the NAS, the DOE should provide stronger justification for continuing to evaluate electrometallurgical treatment as a viable option for Pu disposition.

Coated-Particle Waste Form for Pu Immobilization

Coated particles were once considered by the DOE as an alternative waste form for immobilization of high-level waste, and research programs were conducted at Pacific Northwest Laboratory and Oak Ridge National Laboratory (ORNL) in the early 1980s (e.g., Refs. 5 through 7). The feasibility of coating high-level waste was established at ORNL, and coated particles were judged to have by far the best performance potential of the candidate alternative waste forms.

For plutonium immobilization, the more established processes developed for coating nuclear fuel would be more applicable. One concept for a plutonium-immobilization, coated-particle waste form would be similar to a gas-cooled reactor fuel element. Kernels composed of zircon, zeolite, or alternative materials and loaded with plutonium and neutron poison would be coated in a fluidized-bed coater. The coated particles would be loaded into holes within a graphite container. The coated particles could also be consolidated into compacts prior to loading into the graphite container. To provide additional diversion resistance, vitrified high-level waste could be placed into some of the holes in the graphite container. The graphite containers would be loaded into metal canisters. The proposed coated-particle plutonium waste form would offer a number of advantages: 8/14.00.00

(i) The waste form would be well-suited for both long-term interim storage and permanent geologic disposal. The coatings would provide defense-in-depth to ensure that the plutonium and neutron poison remain together for hundreds of thousands to millions of years and to ensure that the plutonium does not migrate through the geosphere to the accessible environment.Providing this extra measure of containment should increase the confidence of regulatory agencies, stakeholders, and the general public in long-term integrity of the waste form.

(ii) The graphite, which is also highly corrosion resistant (Ref. 8), would provide structural stability for very long time periods.

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05 01 08 Comment Number 6

Alternative glass forms were evaluated before issuing the Draft PEIS. These results are reported in the document (available in DOE Public Reading Rooms) entitled *Screening of Alternative Immobilization Candidates for Disposition of Surplus Fissile Materials*, February 9, 1996 (UCRL-ID 118819 [L-20790-1]).

05 03 08 Comment Number 7

The Electrometallurgical Treatment Alternative was considered a reasonable alternative after completion of the screening process and scoping for the PEIS. The NRC recommended successful demonstration of the electrometallurgical treatment process prior to implementation. Upon making the decision on disposition technologies, DOE will demonstrate these technologies prior to their implementation.

14 00 00 Comment Number 8

During the screening of alternatives for inclusion in the PEIS, various immobilization forms were considered. The decision was made to include immobilization in ceramic and glass forms. The specific ceramic form was not identified. R&D is both on-going and planned to support the disposition alternative(s), which would include pilot facilities for processes (such as ceramic coated particles) and materials, as necessary. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and input.

Mr. J. David Nulton Page 8

(iii) Because containment is provided by the coatings and structural stability is provided by the graphite, the canister design would be very simple and inexpensive.
(iv) The interim storage period could be extended for very long time periods, which may be necessary if a repository is not available or if other options are pursued for permanent disposition of plutonium. If necessary, the radiation barrier could be replenished by loading additional vitrified high-level waste into the graphite containers.
(v) The technologies needed for all components of the waste form are fairly well established, and the disposition mission could be completed within the time constraints imposed by DOE.

8/14.00.00 cont.

Recommendation: DOE should evaluate the proposed coated-particle waste form for Pu immobilization as part of the EIS process.

In general, I believe that DOE has manipulated (if not corrupted) the EIS process in order to suit specific political and institutional objectives of the current Administration. These actions are certainly not consistent with the intentions of the National Environmental Policy Act of 1969. The DOE has taken similar actions with regard to the PEIS on tritium supply (Ref. 21). I strongly encourage you to consider the comments that I have provided in this letter. The DOE should put the technology evaluations associated with the EIS processes back on a level playing field.

9/08.02.00

Sincerely,

Matt Richards, Ph.D.

cc: The Honorable Randy Cunningham
Representative, California 51st District
227 Cannon House Office Building
Washington, DC 20515

Mr. David Alberstein
Director, Defense Reactor Projects
General Atomics
Power Reactor Group
P.O. Box 85608
San Diego, CA 92186-9784

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08 02 00 Comment Number 9

Comment noted. The alternatives analyzed in the PEIS were determined through a screening process that included public input on the selection criteria. This process was not politically or institutionally biased.

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Figure 1. (From 03E/A0-0002, R.f. 2)

Relative Importance:	Theft / Diversion	Retrieval / Reuse	Technical Viability	ESH	Cost	Time	Internat'l Influence	Public / Institutional	Additional Benefits	
Very Important	124	78	104	101	38	64	57	48	49	
Moderate	16	33	39	34	60	49	47	58	39	
Less Important	7	23	2	10	43	32	36	40	40	
Inappropriate	1	15	0	1	8	10	8	8	16	

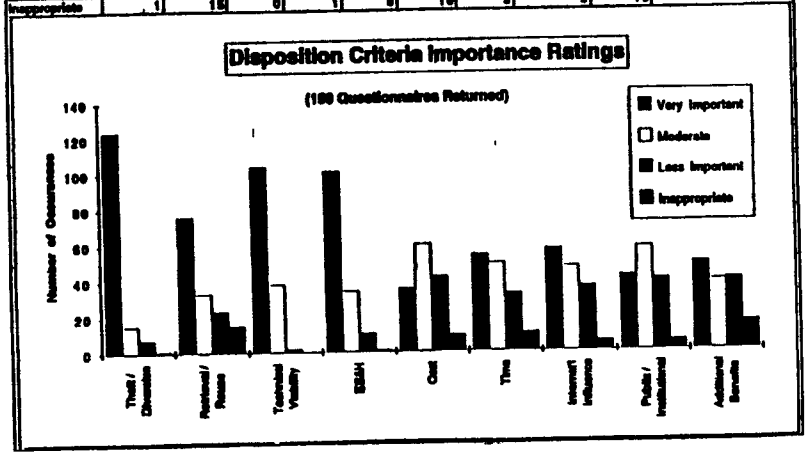

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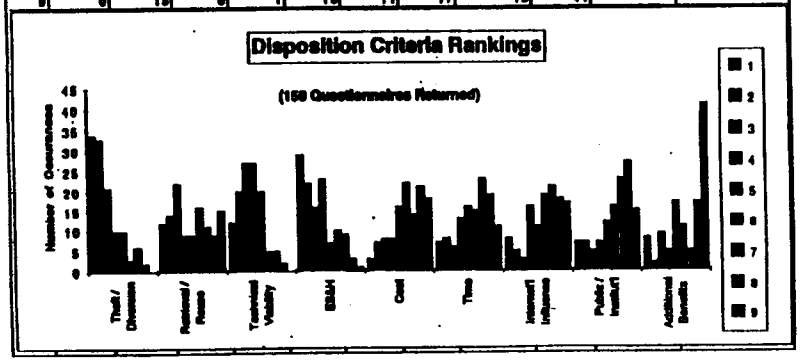
Figure 2. (From 005/MO-0002, Ref. 2)

Rank:	Theft / Diversion	Retrieval / Reuse	Technical Viability	ES&H	Cost	Time	Internat'l Influence	Public / Institut'l	Additional Benefits		
1	34	12	12	28	3	7	8	7	8		
2	33	14	20	22	7	8	5	7	2		
3	21	22	27	16	8	6	3	5	9		
4	10	8	27	23	8	13	19	7	5		
5	10	9	20	7	16	16	11	12	17		
6	3	16	5	10	22	15	19	16	11		
7	6	11	5	9	14	23	21	23	5		
8	2	8	2	3	21	19	18	27	17		
9	0	15	0	1	18	11	17	15	41		



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ROCKY FLATS CITIZENS ADVISORY BOARD, LOUISVILLE, CO,
RUEBEN O. MAES
PAGE 1 OF 2

ROCKY FLATS CITIZENS ADVISORY BOARD

An Advisory Board to the U.S. Department of Energy

MEMORANDUM

TO: Office of Fissile Materials Disposition

FROM: Erin Rogers
Rocky Flats CAB, Program Coordinator

DATE: March 25, 1996

SUBJECT: Citizen Comments on the Programmatic Environmental Impact Statement

I am forwarding to you an article that was written by a citizen of the Denver area. Mr. Reuben Maes asked that I forward this to you for input as you consider options for disposition of plutonium.

This is not the opinion of the Rocky Flats Citizens Advisory Board. Our role is simply to pass along this information to you.

Any response should be directed to:

Mr. Reuben O. Maes
P.O. Box 565
Louisville, CO 80027

Thank you.

9035 Wadsworth Parkway Suite 2250 • Westminster, Colorado 80021 • 303-420-7855 • Fax 303-420-7579

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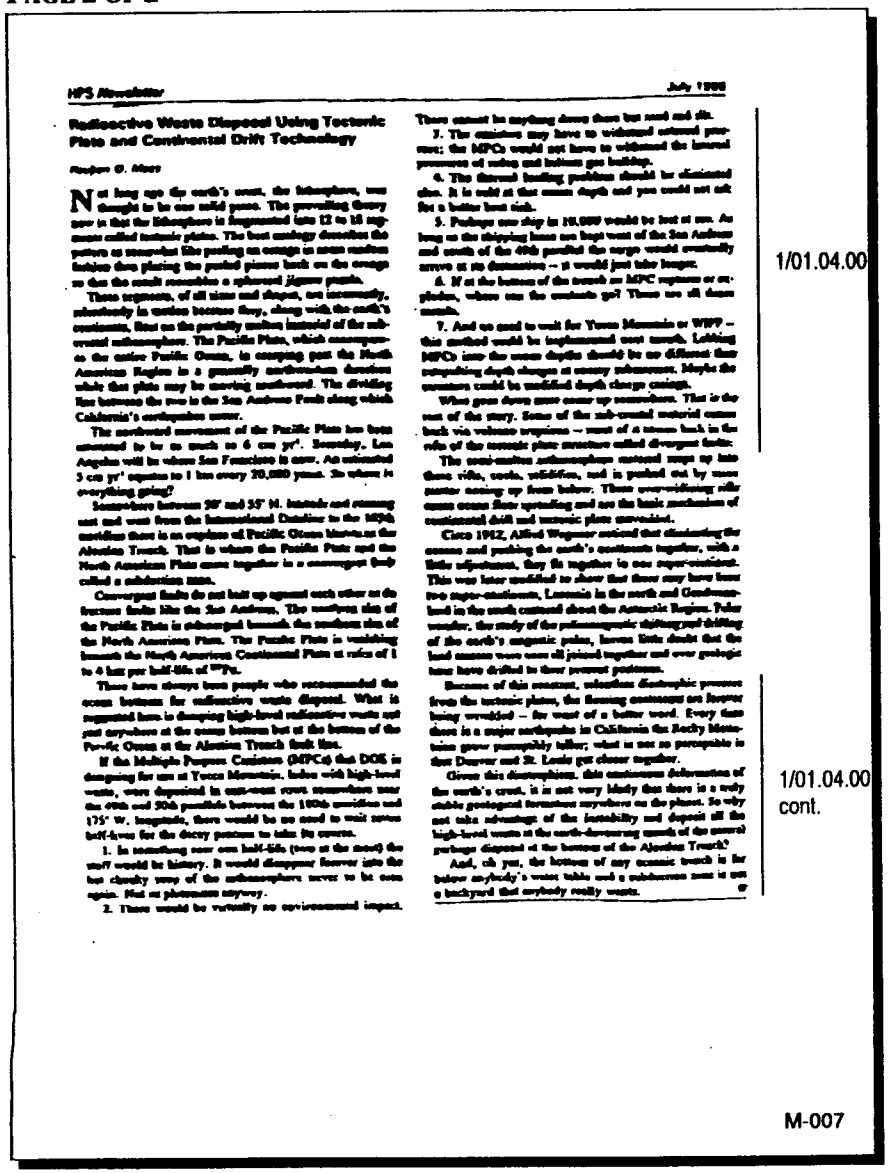

HPS Newsletter — July 1998

Radioactive Waste Disposal Using Tectonic Plate and Continental Drift Technology

Reuben O. Maes

Not long ago the earth's crust, the lithosphere, was thought to be one solid piece. The prevailing theory now is that the lithosphere is fragmented into 12 to 15 segments called tectonic plates. The best analogy describes the pattern as somewhat like the peeling on orange in seven sections before then placing the peeled pieces back on the orange so that the result resembles a sphereoid jigsaw puzzle.

These segments, of all sizes and shapes, are constantly, relentlessly in motion because they, along with the earth's continents, float on the partially molten material of the sub-crustal asthenosphere. The Pacific Plate, which encompasses the entire Pacific Ocean, is creeping past the North American Region in a generally northwestern direction while that plate may be moving southward. The dividing line between the two is the San Andreas Fault along which California's earthquakes occur.

The northward movement of the Pacific Plate has been estimated to be as much as 6 cm yr^{-1}. Someday, Los Angeles will be where San Francisco is now. An estimated 5 cm yr^{-1} equates to 1 km every 20,000 years. So where is everything going?

Somewhere between 20° and 35° N. latitude and running east and west from the International Dateline to the 180th meridian there is an explosion of Pacific Ocean bottom on the Aleutian Trench. That is where the Pacific Plate and the North American Plate come together in a convergent (sub-ducted) a subduction zone.

Convergent faults do not butt up against each other as do fracture faults like the San Andreas. The southern rim of the Pacific Plate is submerged beneath the northern rim of the North American Plate. The Pacific Plate is vanishing beneath the North American Continental Plate at rates of 1 to 4 km per half-life of ^{239}Pu.

There have always been people who recommended the ocean bottom for radioactive waste disposal. What is suggested here is dumping high-level radioactive waste not just anywhere at the ocean bottom but at the bottom of the Pacific Ocean at the Aleutian Trench fault line.

If the Multiple Purpose Canisters (MPCs) that DOE is designing for use at Yucca Mountain, laden with high-level waste, were deposited in east-west zones somewhere near the 40th and 50th parallels between the 180th meridian and 175° W. longitude, there would be no need to wait seven half-lives for the decay process to take its course.

1. In something near one half-life (two at the most) the earth would be history. It would disappear forever into the hot chunky soup of the asthenosphere never to be seen again. Not as plutonium anyway.

2. There would be virtually no environmental impact. There cannot be anything down there but sand and silt.

3. The canisters may have to withstand external pressure of water and helium gas buildup.

4. The thermal loading problem should be eliminated also. It is cold at that ocean depth and you could not ask for a better heat sink.

5. Perhaps one ship in 10,000 would be lost at sea. As long as the shipping lanes are kept west of the San Andreas and south of the 40th parallel the cargo would eventually arrive at its destination -- it would just take longer.

6. If at the bottom of the ocean an MPC ruptures or explodes, where can the contents go? There are all those metals.

7. And we need to wait for Yucca Mountain or WIPP -- this method could be implemented next month. Lobbing MPCs into the ocean depths should be no different than torpedoing depth charges at enemy submarines. Maybe the canisters could be modified depth charge casings.

When guns down more come up somewhere. That is the rest of the story. Some of the sub-crustal material comes back via volcanic eruptions -- most of it comes back in the form of the tectonic plate structure called divergent fault.

The semi-molten asthenosphere material rises up into these rifts, cools, solidifies, and is pushed out by more material coming up from below. These ever-widening rifts create ocean floor spreading and are the basic mechanism of continental drift and tectonic plate movement.

Circa 1912, Alfred Wegener noticed that eliminating the oceans and pushing the earth's continents together, with a little adjustment, they fit together in one super-continent. This was later modified to show that there may have been two super-continents, Laurasia in the north and Gondwanaland in the south centered about the Antarctic Region. Polar wander, the study of the paleomagnetic shifting and drifting of the earth's magnetic poles, leaves little doubt that the land masses were once all joined together and over geologic time have drifted to their present positions.

Because of this constant, relentless diastrophic process from the tectonic plates, the flowing continents are forever being wrinkled -- for want of a better word. Every time there is a major earthquake in California the Rocky Mountains grow perceptibly taller; what is now an perceptible is that Denver and St. Louis get closer together.

Given this diastrophism, this continuous deformation of the earth's crust, it is not very likely that there is a truly stable geological formation anywhere on the planet. So why not take advantage of the instability and deposit all the high-level waste at the earth-devouring mouth of the natural garbage disposal at the bottom of the Aleutian Trench?

And, oh yes, the bottom of any oceanic trench is far below anybody's water table and a subduction zone is not a backyard that anybody really wants.

1/01.04.00

1/01.04.00 cont.

M-007

01 04 00 **Comment Number 1**

The process and justification for selection of technologies evaluated in the PEIS are described in a separate Screening Report prepared by DOE. A number of alternatives involving placement of materials below the earth's surface were considered including emplacement in the sub-seabed and injection into the earth's magma. There is little data available to support these options and the retention of Pu in these media is questionable. A major concern would be the environmental impacts of any release of Pu materials following emplacement. Furthermore, the time and cost of developing these technologies would be significant and the outcome uncertain. It is expected that regulatory requirements would be extremely difficult to achieve, particularly if international waters were involved. Therefore, these types of technologies were eliminated from consideration.

ROCKY FLATS CITIZENS ADVISORY BOARD, WESTMINSTER, CO,
TOM MARSHALL
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ROCKY FLATS CITIZENS ADVISORY BOARD

An Advisory Board to the U.S. Department of Energy

May 2, 1996

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

Greetings:

Enclosed please find the recommendations prepared by the Rocky Flats Citizens Advisory Board (RFCAB) with respect to the Draft Programmatic Environmental Impact Statement on the Storage and Disposition of Weapons-Usable Fissile Materials.

RFCAB appreciates the opportunity to provide these recommendations and asks that they be considered in preparation of the final document and any Records of Decision that will be forthcoming. We would like to be notified in writing that these comments have been received and the status of their inclusion once that has been determined.

Sincerely,

Tom Marshall

Tom Marshall
Chair

cc: Mark Silverman, Manager, DOE-RFFO

9035 Wadsworth Parkway Suite 2250 • Westminster, Colorado 80021 • 303-420-7855 • Fax 303-420-7579

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ROCKY FLATS CITIZENS ADVISORY BOARD

An Advisory Board to the U.S. Department of Energy

Recommendations on the
Draft Programmatic Environmental Impact Statement on
the Storage and Disposition of Weapons-Usable Fissile Materials

May 2, 1996

General:	
• DOE should reduce transport of fissile materials to a minimum, thus protecting the health and safety of workers and the public, and the integrity of the environment along the transportation corridors.	1/10.00.00
• DOE should reduce the current and future risk of nuclear proliferation. Furthermore, the U.S. should promote international inspection of both non-surplus and surplus Pu and HEU, thus implementing U.S. non-proliferation policy in a way that positively involves other countries.	2/01.06.00
• All activities associated with weapons-usable fissile materials should be subject to external, independent regulation, as recommended in December 1995 by DOE's Advisory Committee on External Regulation of Nuclear Safety. Having external regulation should help assure availability of funding.	3/01.06.00
• DOE should provide for full public participation in all decisions regarding the storage and disposition of weapons-usable fissile materials.	4/08.02.00
• Any options that DOE selects should protect the health and safety of the public and the workers, assure the integrity of the environment, and protect future generations.	5/08.03.00
Any Processing at Rocky Flats Should:	
• Reduce or eliminate the necessity for any future processing or handling at Rocky Flats or at another site.	6/01.00.00
• Make the Pu as proliferation-resistant as possible.	
• Put the Pu in a form suitable for disposition.	
Surplus Plutonium:	
• Should be regarded as a proliferation liability.	7/01.06.00
Storage:	
• All storage options should result in proliferation-resistant material.	8/01.01.00
• DOE should consider other Pu storage containers besides the 50-year can.	

9035 Wadsworth Parkway Suite 2250 • Westminster, Colorado 80021 • 303-420-7855 • Fax 303-420-7579

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10 00 00 **Comment Number 1**

The human health risks of material transportation associated with the proposed Pu storage and disposition alternatives are evaluated and presented in Section 4.4 of the PEIS. The more detailed description of the methodology and supporting data for the analysis is presented in the Appendix G. Transportation of radioactive materials between sites includes health risks for both normal operations and accident conditions for the public and workers.

01 06 00 **Comment Number 2**

The United States has taken steps and continues to work domestically, and in Russia, to dismantle weapons, stabilize weapons materials, improve storage capability, and improve materials control and accountability. Storage and disposition actions considered in this PEIS will continue these efforts in the United States for the long-term. DOE is also working on a joint technical working group with the Russians to evaluate, and hopefully expedite, similar efforts there. The United States is promoting and making provisions domestically for IAEA inspections of surplus materials. Efforts are also under way to develop means of verifying classified materials that, because of their shape, cannot be inspected and verified using more conventional means.

01 06 00 **Comment Number 3**

Comment noted. DOE is still evaluating external regulatory options for its activities.

08 02 00 **Comment Number 4**

Comment noted. DOE is committed to full public participation in the NEPA process. Public meetings for scoping and receiving public comments on the Draft PEIS were held throughout the United States near the sites potentially affected by the Proposed Actions. Numerous methods of providing public comments were used such as mail, fax, electronic bulletin board, telephone, hand-ins, and transcripts from the public meetings. Further, separate from the NEPA process, DOE made available to the public the results of the technical, cost, schedule, and nonproliferation analyses. DOE also accepted comments on these documents. The results of these analyses and the environmental analysis as well as the public input will be considered in reaching the ROD.

ROCKY FLATS CITIZENS ADVISORY BOARD, WESTMINSTER, CO, TOM MARSHALL

Disposition:

- DOE should promote and support a national and international dialogue on disposition of surplus fissile materials. To be successful, disposition must be a multi-national effort. | 9/01.06.00
- DOE should release all cost study information for the MOX fuel option in time for public review and comment before release of the final PEIS. | 10/08.00.00
- DOE should further research the deep borehole technology, and focus on environmental, safety, and health uncertainties. | 11/01.00.00
- DOE should analyze other technologies.

Processing:

- DOE should reduce processing and handling of fissile materials to the absolute minimum, thus protecting the health and safety of workers and the public, as well as the integrity of the environment at sites where processing, storage, or disposition work occurs. | 12/01.02.00
- Processing should put the Pu in a form suitable for disposition.
- Immobilizing Pu seems the best option for storage, but DOE should further analyze immobilization technologies to ensure proliferation-resistant material. | 13/08.03.01
- DOE should consider vitrification and ceramification as the preferred options, and it should determine their comparative merits for putting Pu in proliferation-resistant, disposition-ready form.
- DOE should develop small-scale vitrification or ceramification pilot plants in as many sites as necessary to prove the technology, so as to determine whether stabilization and immobilization can be accomplished in a single step. | 14/05.01.08

QUESTIONS REGARDING INFORMATION ON ROCKY FLATS

1. Table 4.2.7.9-1, note b, on page 4-341 states that the "annual natural background radiation level at RFETS is 353 mrem for the average individual." Since we no longer live in an environment of "natural background radiation level," shouldn't this note refer instead to the "average annual background radiation level" resulting from natural background plus fallout from atmospheric nuclear explosions? Accordingly, the line in the table referring to "percent of natural background" should also be corrected. Finally, the text needs to provide a source for the 353 mrem figure. | 15/09.09.07
2. Table 4.2.7.9-2 on page 4-342 gives numbers for "50-year fatal cancers" in the Rocky Flats workforce. The space for this category under workers "involved" in Pu operations is blank, the space under workers "not involved" is 15. Then the table gives a total for all workers of 16 50-year fatal cancers. How can this be? Is it true that more-exposed workers experience only a single fatality while those less exposed experience 15? | 16/09.09.07

RFCAB Recommendations on the Storage and Disposition PEIS *page 2*

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08 03 00 Comment Number 5

Comment noted. The results of the environment safety and health analyses included in the PEIS will be considered in reaching the ROD.

01 00 00 Comment Number 6

Comment noted. Each of the commentor's points are part of DOE's purpose and need.

01 06 00 Comment Number 7

Comment noted. Nonproliferation is an integral part of the purpose and need; in this regard, DOE has prepared a nonproliferation analysis for public comment, which will be considered in reaching the ROD.

01 01 00 Comment Number 8

The 50-yr container would meet the criteria for safe storage of Pu metals and oxides. Other existing containers may not meet these stringent criteria, and developing new containers may be costly and require a considerable amount of time. However, this does not preclude the development of new containers. Proliferation resistance will be an integral part of storage decisions. Analyses of the cost, schedule, technical, and Nonproliferation Policy impacts are described in separate documents and will be considered in DOE's decision. The *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Materials Storage and Plutonium Disposition Alternatives* was made available for public review in October 1996.

01 06 00 Comment Number 9

The Department of Energy has established a joint technical working group with Russia to evaluate options for disposition of Pu. A report on disposition options evaluated by this group was issued in September 1996. DOE is pursuing joint technical demonstration opportunities with Russia. It is hoped that these activities will help focus and expedite disposition efforts in Russia. DOE has also engaged the other nations of the G-7 to collaboratively address this global issue.

08 00 00 **Comment Number 10**

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses along with the environmental analysis and public input will be integrated into DOE's decisionmaking process.

01 00 00 **Comment Number 11**

During fiscal year 1997, DOE plans to continue to expand a range of small-scale tests of Pu disposition technologies to remove any uncertainties in viability. An assessment of the geology and safety of boreholes is being performed. Should the Borehole Alternative be selected to implement the Proposed Action, siting of boreholes would be conducted, and more detailed analyses of the borehole characteristics and environmental impacts would be performed as appropriate. A reasonable range of technologies has been analyzed in detail in the PEIS, and some variants have been noted. The Final PEIS has been expanded to discuss one of these variants (*Can-in-Canister Variants*, Appendix O); further analyses of technology variants will be included in tiered NEPA analyses.

01 02 00 **Comment Number 12**

The Department of Energy is committed from a health and safety, environmental, and cost standpoint to keeping both material processing and handling at a minimum. Both the Pu conversion and pit-disassembly and conversion processes would prepare the material for the particular disposition technology(ies) selected in the ROD.

08 03 01 **Comment Number 13**

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

05 01 08 **Comment Number 14**

If the Ceramic Immobilization Alternative is selected in the ROD, maximizing synergy between stabilization and immobilization activities will be an important goal.

09 09 07 **Comment Number 15**

Detailed natural background radiation information was presented in the Chapter 3 of the PEIS. This information includes the sources and values of the natural background radiation. Radiation from the weapons test fallout was also included in Chapter 3. In general, the radiation from the weapons test fallout is only small fraction of natural background radiation (<1 mrem/yr vs. >300 mrem/yr, respectively).

09 09 07 **Comment Number 16**

The noninvolved workers are those workers onsite but not directly involved in the alternatives. Generally, the noninvolved workers comprise most of the total onsite workforce (about 98 percent). The involved workers are those workers who are directly involved in the alternatives (No Action). The fatality difference in this table is the difference of the radiation latent cancer fatalities between the noninvolved workers and the involved workers. There are many more noninvolved workers (about 6,000 in RFETS) than involved workers (about 100 for No Action). The average dose for the involved worker is about twice the average dose of the noninvolved worker.

ROCKY FLATS CLEANUP COMMISSION, INC., LAKEWOOD, CO,
JAMES S. STONE
PAGE 1 OF 8

Rocky Flats Cleanup Commission, Inc.
James S. Stone, P.E., Technical Adviser
2510 Miller St., Lakewood, CO. 80215-1323; V/Fax (303) 237-8050; FMDFRIB DOE; 5/8/96

J. David Nulton, Director, NEPA Compliance & Outreach
U.S. Department of Energy, Office of Fissile Materials Disposition
P.O. Box 23786, Washington, D.C. 20026-3786

Re: Public comment on DOE/EIS-0229-D

Thank you for the opportunity to present my comments on the Storage and Disposition of Weapons-Usable Fissile Materials. Please excuse the late reply. I was waiting to review the complete document, which has not yet arrived.

The technical adequacy of the Summary document is excellent; however, there is another alternative that should be considered. A private stakeholder has submitted a conceptual design type Alternative to provide the engineering and a specific site for the storage and disposition of all waste and special nuclear materials from the Rocky Flats Environmental Technology Site. The preliminary evaluation by RFETS is " An advantage this alternative has over other offsite disposal alternatives is the reduced transportation costs and risks." The site graded 87 to 95% in the Geotechnical, Hydrological Environmental, and Economical rating matrix in the DOE Technical Approach Document (050425 Rev.1, 4/88). See attached Prospectus. 1/14.00.00

RFCC agrees that the RFETS is not suitable for the stewardship and management of nuclear weapons components and special nuclear materials, including the storage and disposition of weapons-usable fissile materials, that is now stored precariously according to the DFNSB. A more compelling fact for your help is that these materials must be removed at the earliest date, because about two million people in the surrounding metro-Denver area are in eminent danger. The unsafe storage facilities are in close proximity with unstable hazardous and radioactive materials and the simultaneous decontamination - decommissioning operations. Also, the cost of a temporary D&D program to strengthen storage buildings or build new ones, with the current mortgage of about $2 million/day, would deplete the budget and perpetuate the danger indefinitely. 2/08.03.00

The Proposed Alternative for a New Offsite Facility near RFETS for the disposition of all waste and the safe interim storage of special nuclear materials is logical, feasible, cost effective, and would incurs less risk than any other alternatives evaluated to date. It also provides for near term compliance with requirements of the "Settlement Agreements and Compliance Orders on Consent No. 93-04-23-01", which compels DOE and its contractors to implement the Mixed Residue Reduction Program in a timely and adequate manner. 1/14.00.00 cont.

In conclusion, RFCC requests that DOE include this Alternative in the final EIS to allow implementation of this plan, providing of course that it is also selected as a preferred alternative in the final Accelerated Site Action Plan being evaluated by RFETS.

Thank you for your consideration. Sincerely,

James S. Stone, P.E.

Copy to Mark Silverman, Manager, DOE/RFO/RFETS

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14 00 00 **Comment Number 1**

The recommended alternative would not meet the basic goals of the purpose and need described in the PEIS. The described alternative provides only interim storage and would add an additional site to the DOE complex, while one goal is to reduce storage and infrastructure cost. Further, the goal is long-term storage. The described alternative also does not meet the goals for disposition as described by the "Spent Fuel Standard."

Should a decision be made to provide "interim" storage for the RFETS materials, that decision will be coordinated and integrated with the decisions from this PEIS.

08 03 00 **Comment Number 2**

In accordance with existing agreements, DOE is moving toward the removal of all weapons-usable fissile materials from RFETS. This is the reason that all alternatives for long-term storage in the PEIS include the environmental impacts of the removal of the materials from RFETS.

ROCKY FLATS CLEANUP COMMISSION, INC., LAKEWOOD, CO,
JAMES S. STONE
PAGE 2 OF 8

Stone Environmental Engineering Services, Inc.
James S. Stone, P.E., Vice President Engineering
2510 Miller St., Lakewood, Colorado 80215-1323; Ph /Fax 303-2379358; RADWAS06.RPP; 12/4/95

ACCELERATED SITE ACTION PROJECT
Rocky Flats Environmental Technology Site, Denver, Colorado

PROPOSED NEAR OFF-SITE DISPOSAL/STORAGE FACILITY FOR ASAP II SCENARIO I WITH MONITORED AND RETRIEVABLE DISPOSAL SITE FOR ALL RADIOACTIVE WASTE, SAFE REPOSITORY FOR ALL SPECIAL NUCLEAR MATERIALS, AND A RESEARCH FACILITY.

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JAMES S. STONE
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ROCKY FLATS CLEANUP COMMISSION, INC., LAKEWOOD, CO,
JAMES S. STONE
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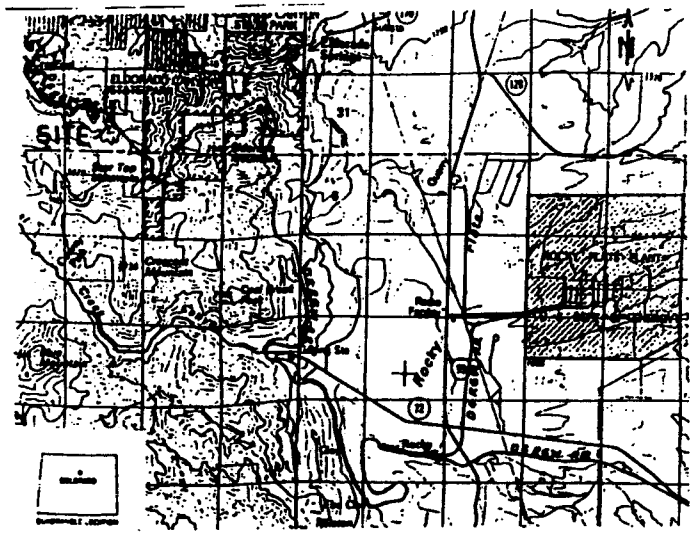

FIG. 1 SURFACE MANAGEMENT STATUS 1986
B.L.M., DENVER WEST, COLORADO QUADRANGLE, 1" = 1 mile

1. SURFACE MANAGEMENT STATUS: Stone Environmental Engineering Services, Inc owns a 38 acre, remote, dry, stable, granite mesa located in the foothills ~ 6 miles W-NW in a straight line from the Rocky Flats Environmental Technology Site. SEES offers the site and 3 conceptual designs that complement Kaiser-Hill's Accelerated Site Actions Project. Our version of Scenario No. 1 (Greenfield) provides for off-site monitored and retrievable disposal of Low Level & Low Level Mixed Waste, with the option for different price ranges, and the safe monitored storage of Transuranic Waste and Special Nuclear Material and a Research Facility. The site is ~ 30 miles by railroad from RFETS and ~ 3 miles East from Crescent Village, Boulder County, Colorado. The site is bordered on the West by the Eldorado Canyon State Park; on the South by the Denver & Rio Grande Western Railroad, and on the North and East by private property. In 1963, D&RGW RR designed the railroad spur track and trestle for ash disposal at this site from our proposed municipal waste incinerator in Denver. In 1965, the County of Boulder administrators approved the site for ash disposal, but the City Council of Denver opted to develop the Lowry Landfill. In 1986, U.S. Environmental Protection Agency considered the site for disposal of Radium from Denver, but opted to move the Radium into storage sheds in Denver. In 1992, U. S. Department of Energy considered SEES' proposal for Interim Storage of TRUW at the site, but opted for completion of the Waste Isolation Pilot Plant in New Mexico. The site is surrounded by abandoned Uranium mines and is naturally radioactive, which has curtailed local residential development. This design provides adequate protection from all other foreseeable hazards. See the USDOE "TECHNICAL APPROACH DOCUMENT - Table 5.3 Geotechnical, hydrological, environmental, and economic rating matrix" shown. Rating = 87%. Residences and the Research Center (Opt. 3.3 only) would be located on the east access road overlooking the planed sawmill, Gore Mountain Range, and Green Reservoir or located in Crescent Village/RR Int. Recreation includes hiking, horseback riding, fishing, rock climbing, and serenity. We hope you will approve this plan. We would be pleased to answer questions at your convenience. Please call Jim Stone, P.E. (303) 237 8058). Thanks for your consideration.

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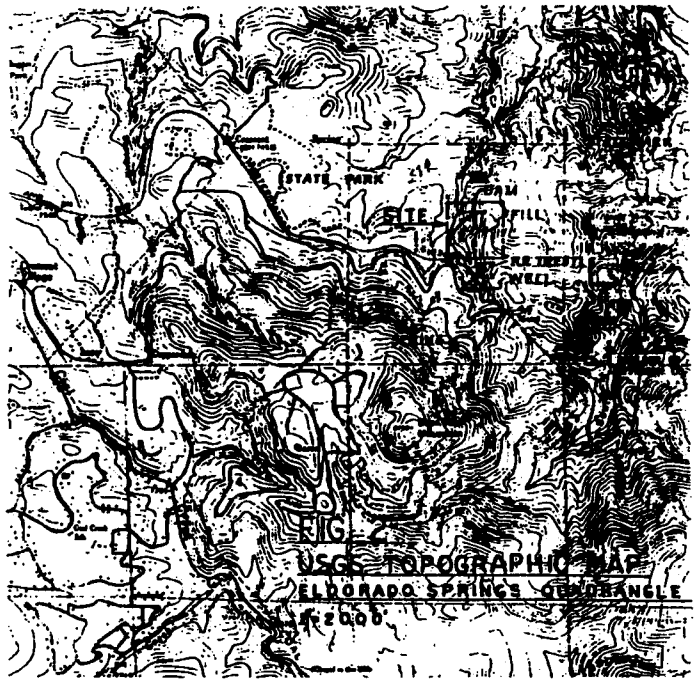

2. TOPOGRAPHY: The site was formed by fluvial dissection of Precambrian granitic bedrock. There is no recorded seismic activity in the last 10,000 years, within 10 miles of the site. The floor of the ravine appears to be dry, undisturbed, and drains into Johnson Gulch at the NW property corner. The ravine has a plan area of ~ 15 acres; is ~ 1000 ft. long; ~ 1100 ft. wide; ~ 250 ft. deep at the maximum fill elevation of 7200 ft.; and gross volume of ~ 2.5 million cu. yds. The storm water shed on the south slope of Scar Top Mountain is ~ 124 acres and would produce ~ 61 cu. ft./sec. runoff from a 100 year storm. The railroad track berm has always diverted the runoff into Johnson Gulch. A perennial spring is located ~ 3600 ft. NW from the NW property corner. Well # 10, near the north end of Tunnel # 17, is rated at ~ 10 gals/min. The population density is ~ 4 residences per adjacent square mile and the closest residence is ~ 3/4 mile from the site. The primary route to the site is by D&RGW RR. The secondary roads, built by the defunct developer are obsolete, but are passable with a four-wheel vehicle. It is proposed that the original right-of-way road to the site, just inside the south fence line, would be improved from Crescent RR Junction to extend across the dam and double back on an improved abandoned road. Proposals for transporting LLA/LLM waste to the site are to use an aerial cable-bucket line or a buried belt-conveyor corridor. A secured railroad car would be used to transport TRUW/EMM. Additional land (~ 100 acres) will be required for a buffer zone.
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ROCKY FLATS CLEANUP COMMISSION, INC., LAKEWOOD, CO,
JAMES S. STONE

OPTIONS FOR A "NEAR OFF-SITE" WASTE FACILITY

3. CONSTRUCTION OPTIONS FOR KAISER-HILL's ASAP for RFETS: The background for the project is described in Fig's 1 & 2. This general preconstruction work applies to all Options and includes: Purchase of ~ 900 acres for a secured buffer zone; Improve ~ 9,000 ft access road; Clear-cut trees & rock clearance on ~ 25 acres; Use 2 security guards, full time ~ 2 yrs.; Construct ~ 2,000 ft. RR spur, ~ 600 ft. long x 30 ft. high trestle, & RR on-off loading dock. Install ~ 6,000 ft. security fence, with 1 duck gate and 2 road gates; Install site facilities and utilities to suit the respective Option. Comply with all applicable USDOE design and construction standards for the respective type facility.

Opt. 3.1 This option specifies an open ravine, that is safe, dry, stable, granite, accessible by DRGW RR, to provide for the off-site/safe/retrievable storage of ~ 1,500,000 net cu. yds. of LLA/LLMW/DDW, in bulk, 55 gal. drums, & large crates from RFETS.
The work required includes: Seal floor and walls of ravine; Construct a concrete mix plant in the track area; Construct a concrete, roller-compacted, monolithic, gravity dam/shield, with granite face surfaces, in 12" lifts; Maintain a 4 ft. min. freeboard height above the anticipated waste supply level; Install structural steel racks & niches (~ 6,150,000 gross sq. ft. floor total area on 24 - 30 ft. levels) for receiving/retrieving waste in concert with the characteristics & volume of the waste supply; Install vent/drain piping for each container; Install an automatic sump/pump/holding tank system (s), to monitor surface runoff and drainage from containers; Install a site security facility including: A 2,000 sq. ft. building for living/office/service with: Facilities & utilities; Service vehicles; Site & building fire protection systems, Remote waste monitoring, communications by phone/radio; Propane tank, 10,000 gal ; Water well, with 10 gpm pump/hydrostatic system/10,000 gal storage tank.

*Opt. 3.2 This option specifies a ravine per Opt. 3.1, filled with a 3,300,000 gross cu. yds. of stabilized waste/solidified cement monolith, to provide for the off-site/ disposal of ~ 2,200,000 net cu. yds. LLA/LLMW DDW, from RFETS.
The required work includes: Construct a concrete lab/cement/waste mix plant in the track area; Construct a concrete, roller-compacted face shield , with a granite face surface, monolithic with the cement/waste solidified monolith, in 12" lifts. Install all applicable facilities, utilities, shelter features and requirements, as described in Opt.3 1. Install sand and a planted soil cover on the roof.

Opt. 3.3 This option provides for off-site/monitored/retrievable/storage of ~ 1,200,000 net cu. yds. LLA/LLMW/DDW, safe/monitored/retrievable/storage of ~ 10,000 net cu. yds. TRUW/SNM, from RFETS, and a Waste Management Research Facility, together in a secured/modern/subterranean building.
The required work includes: Seal floor and walls of ravine; Construct a fire/earthquake resistant, reinforced concrete, subterranean building in the ravine, with an occupancy partition between the Repository/Office section & the Retrievable Storage section. Backfill the void outside the walls with sand/gravel. The R/O is ~ 30 ft wide x ~ 11000. long x ~ 250 ft. (24 floors) high, with ~ 330,000 sq. ft. gross floor space for Offices, Laboratory, Equipment/Maintenance rooms, and Vaults for TRUW/SNM. The R/O has: the main access road on top; Secured access silos & guard towers; Freight silo with elevator. The RS has 24 matching floors in height and ~ 6,300,000 sq. ft. open floor space for retrievable storage of LLA/LLMW. Install a network of access holes in each floor and the roof, connecting to road network on the roof. Install all applicable facilities, utilities, shelter features and requirements, as described in Opt.3 1. Install a planted soil cover on roof.

4. ATTRIBUTES:
4.1 The concept of an off-site Repository in Colorado to care for our own radioactive waste is unique and laudable.
4.2 This proposal offers an off-site facility with three design options, as follows:
4.2.1 Safe/monitored/retrievable/storage of 1,500,000 net cu. yds.of LLA/LLMW/DDW in an open facility
4.2.2 Safe/monitored/disposal of 2,200,000 net cu. yds. of LLA/LLMW/DDW in a 3,300,000 gross cu. yds. stabilized waste/solidified cement monolith
4.2.3 Safe/monitored/retrievable/storage of 1,200,000 net cu. yds. of LLA/LLMW/DDW, and safe/monitored/retrievable/storage of 10,000 net cu. yds. of TRUW/SNM, and a secured, modern Waste Management Research Facility.
4.3 The evaluation of this site was 87% in USDOE's "Technical Approach Document on geotechnical, hydrological, environmental and economic rating matrix
4.4 We believe this site is more acceptable to the Stakeholders &
4.4.1 This proposal allows Kaiser-Hill's ASAP *GREENFIELD* scenario to be better evaluated.
4.4.2 This proposal allows a 20 mi. safe railroad haul, eliminates a lot of truck traffic/air pollution, and promotes research the control of radioactivity

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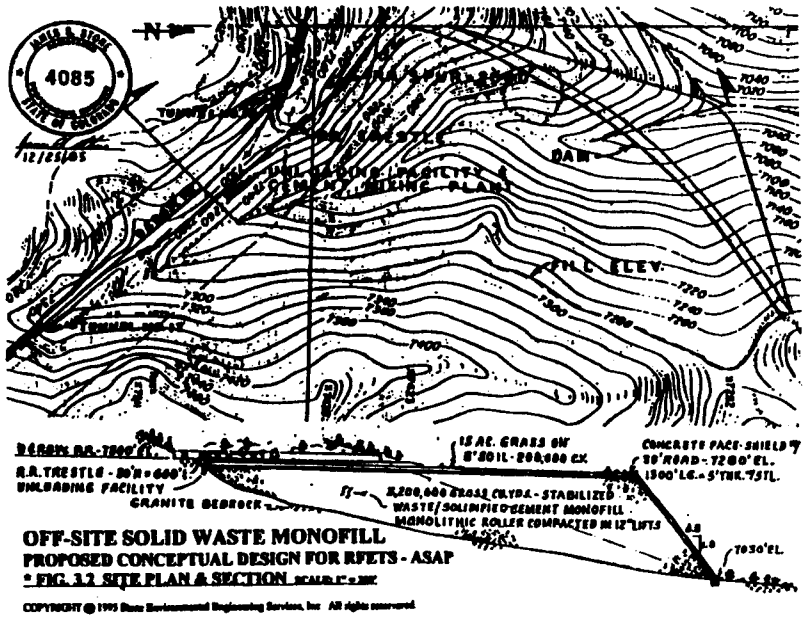
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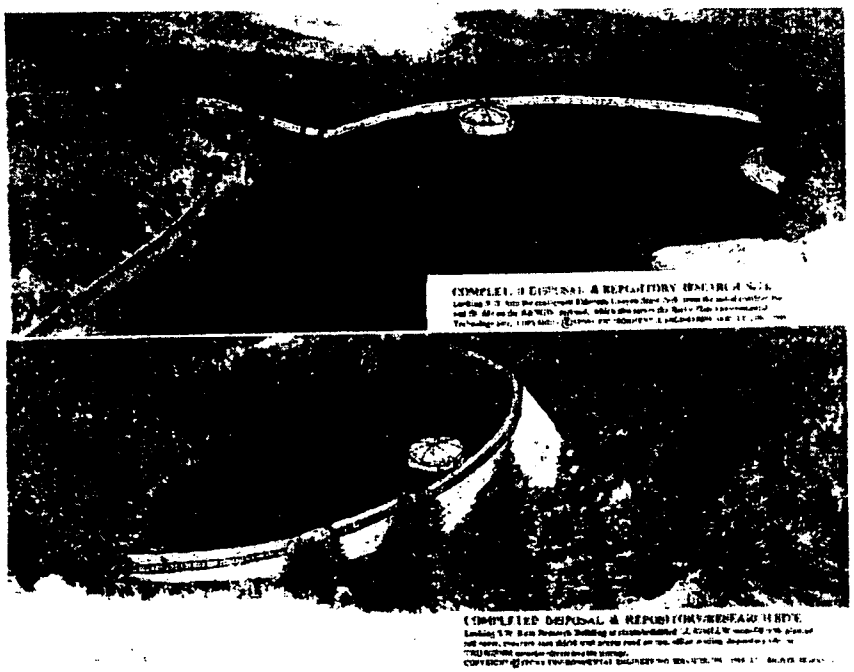
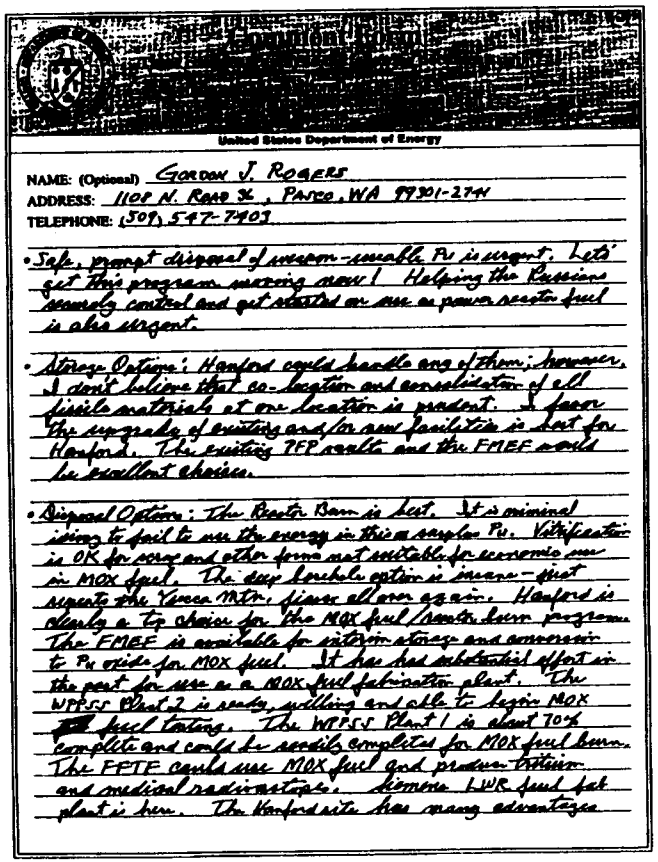
ROCKY FLATS CLEANUP COMMISSION, INC., LAKEWOOD, CO,
JAMES S. STONE
PAGE 8 OF 8



M-178

ROGERS, GORDON J., PASCO, WA
PAGE 1 OF 2



United States Department of Energy

NAME: (Optional) Gordon J. Rogers
ADDRESS: 1108 N. Road 36, Pasco, WA 99301-2744
TELEPHONE: (509) 547-7403

- Safe, prompt disposal of weapon-usable Pu is urgent. Let's get this program moving now! Helping the Russians remedy control and get started on use as power reactor fuel is also urgent.
- Storage Options: Hanford could handle any of them; however, I don't believe that co-location and consolidation of all fissile materials at one location is prudent. I favor the upgrade of existing and/or new facilities is best for Hanford. The existing TEP vaults and the FMEF would be excellent choices.
- Disposal Options: The Reactor Burn is best. It is criminal idiocy to fail to use the energy in this weapon Pu. Vitrification is OK for scrap and other forms not suitable for economic use in MOX fuel. The deep borehole option is insane - just repeats the Yucca Mtn. fiasco all over again. Hanford is clearly a top choice for the MOX fuel/reactor burn program. The FMEF is available for interim storage and conversion to Pu oxide for MOX fuel. It has had substantial effort in the past for use as a MOX fuel fabrication plant. The WPPSS Plant 2 is ready, willing and able to begin MOX fuel testing. The WPPSS Plant 1 is about 70% complete and could be readily completed for MOX fuel burn. The FFTF could use MOX fuel and produce tritium and medical radioisotopes. Siemens LWR fuel fab plant is here. The Hanford site has many advantages

1/01.06.00
2/08.03.01
3/08.03.01
4/08.03.01
5/08.03.01
6/08.03.01
3/08.03.01 cont.

M-173

01 06 00 **Comment Number 1**

Comment noted.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to the Collocation Alternative. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's support for new missions at Hanford. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 5**

The Department of Energy acknowledges the commentor's support for the MOX Reactor and Vitrification Alternatives. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 6**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

ROGERS, GORDON J., PASCO, WA
PAGE 2 OF 2

Storage/Disposition PEIS Page 2

in existing facilities and infrastructure. This program would take advantage of our skilled worker population. | 3/08.03.01 cont.

- This nat storage/disposition program must be funded indipendently of the current Hanford EM program. There will be opportunities to combine certain functions of the disposition program with the EM cleanup programs such as waste treatment of Pu conversion waste streams. | 7/11.00.01

- The estimated environmental impacts of the several portions of the overall program seem to be very minor for such a major and important activity and are clearly acceptable. Current technology and accumulated experience provide clear evidence that such work can be carried out while avoiding the environmental insults of the cold war era.

- I believe the community and region can support the conduct [illegible] portion of this program at Hanford provided it does not unduly delay the current EM program. This program is truly a grand opportunity to close the open circle of the plutonium era started at Hanford. It can work to the benefit to the region, the nation and the world. | 8/11.01.01

- Thanks for the opportunity to comment.

M-173

11 00 01 **Comment Number 7**

Funding for all alternatives under the Fissile Materials Disposition Program will be through the Government budget process. This program will be funded independent of the Environmental Management Program.

11 01 01 **Comment Number 8**

Comment noted.

Date: Tue, 23 Apr 1996 0400

Subject: FORUM Form - incoming

serial_no = 162
MailTitle = FORUM Form - incoming

name = karen ruddy
title = Researcher/InformationScientist
company = Amarillo College
addr1 =
addr2 =
city = Amarillo
state = Texas
zip = 79109
phone = 806 353 0552
fax =
email = mkruddy@actx.edu
ctype = public
subject =

** The following is the text of the Author's Comment.

All system go! It is important to continue the program for Pantex and Amarillo, Tx. | 1/08.03.01
END comment

E-003

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

RUMSY, RUSS
PAGE 1 OF 1

Comment ID: P0015
Date Received: April 18, 1996
Name: Russ Rumsy
Address:

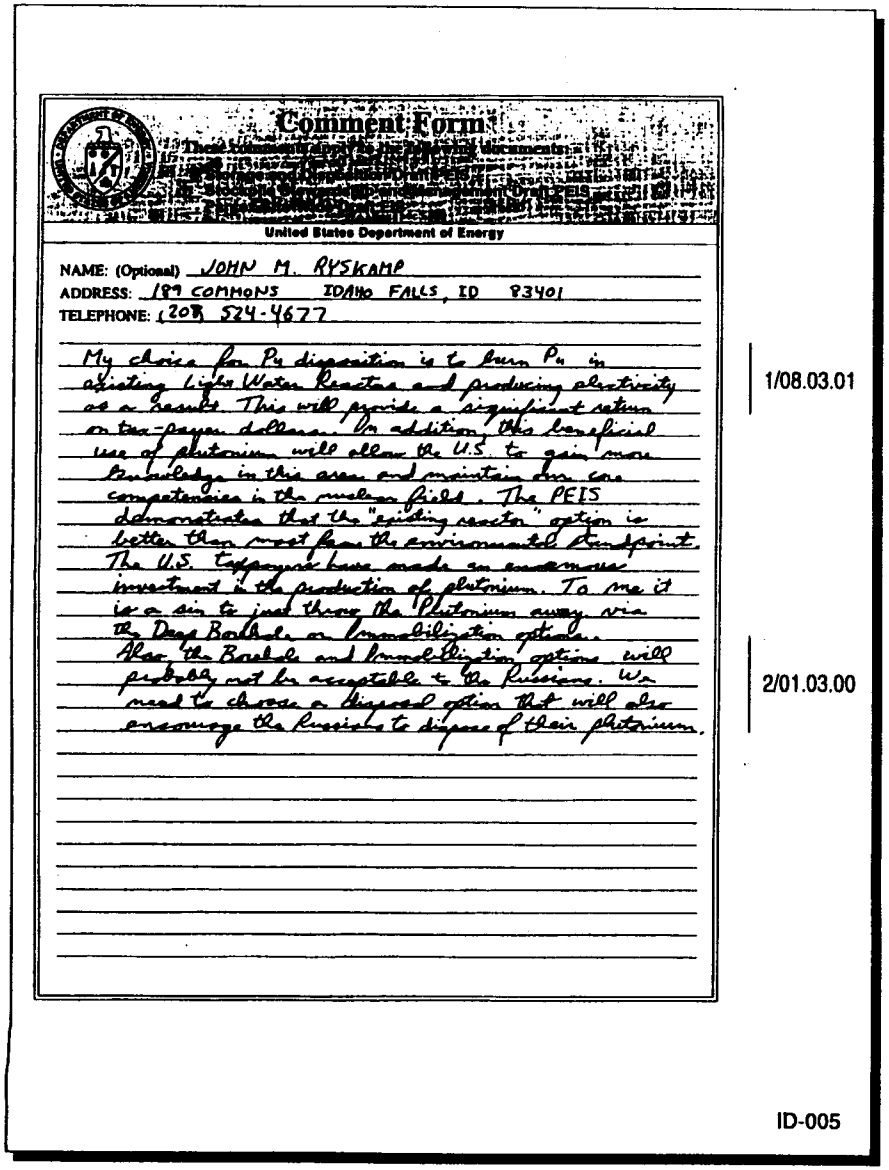
Transcription:

I am totally against any shipments of any waste into Idaho of any kind, and I would like to see the whole INEL out there be dismantled and taken out of the state. I don't believe we need it here, and I am not happy with what's been going on out there for years. Thank you very much. | 1/08.03.01

P-015

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at INEL. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.



Comment Form

United States Department of Energy

NAME: (Optional) JOHN M. RYSKAMP
ADDRESS: 189 COMMONS IDAHO FALLS, ID 83401
TELEPHONE: (208) 524-4677

My choice for Pu disposition is to burn Pu in existing Light Water Reactors and producing electricity as a result. This will provide a significant return on tax-payer dollars. In addition, this beneficial use of plutonium will allow the U.S. to gain more knowledge in this area and maintain our core competencies in the nuclear field. The PEIS demonstrates that the "existing reactor" option is better than most from the environmental standpoint. The U.S. Taxpayers have made an enormous investment in the production of plutonium. To me it is a sin to just throw the Plutonium away via the Deep Borehole or Immobilization options. Also, the Borehole and Immobilization options will probably not be acceptable to the Russians. We need to choose a disposal option that will also encourage the Russians to dispose of their plutonium.

1/08.03.01

2/01.03.00

ID-005

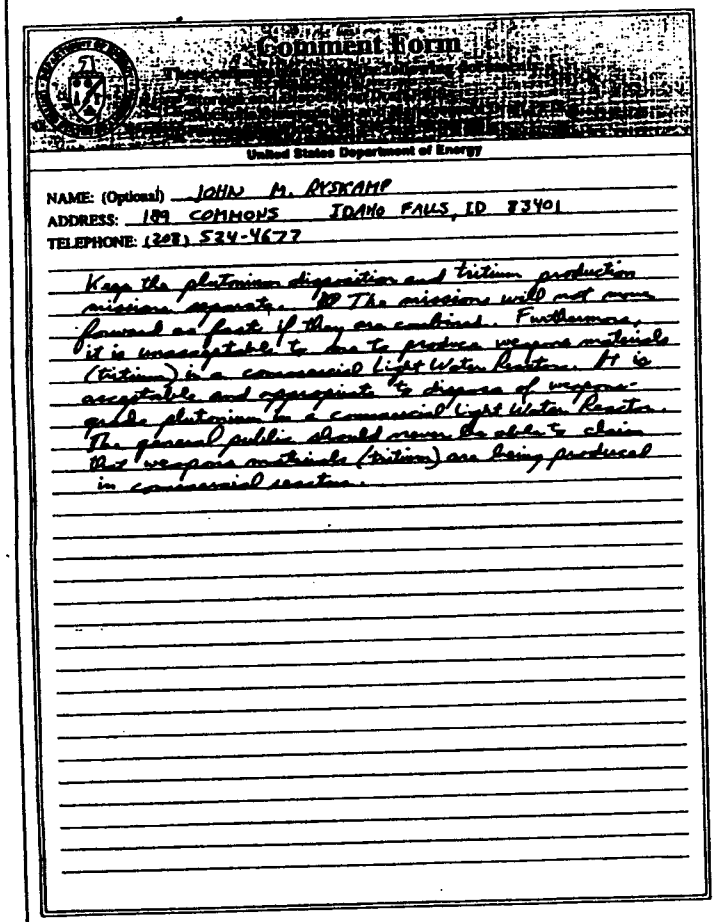
08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 03 00 **Comment Number 2**

The Department of Energy believes that the process for making decisions, including national policy considerations, will provide the basis for implementing Pu disposition actions that will encourage other nations to dispose of their Pu. The technical disposition process may not be the same for all nations.

RYSKAMP, JOHN M., IDAHO FALLS, ID
PAGE 1 OF 1



Comment Form

United States Department of Energy

NAME: (Optional) JOHN M. RYSKAMP
ADDRESS: 189 COMMONS IDAHO FALLS, ID 83401
TELEPHONE: (208) 524-4677

Keep the plutonium disposition and tritium production missions separate. The missions will not come forward as fast if they are combined. Furthermore, it is unacceptable to use to produce weapons materials (tritium) in a commercial Light Water Reactor. It is acceptable and appropriate to dispose of weapons-grade plutonium in a commercial Light Water Reactor. The general public should never be able to claim that weapons materials (tritium) are being produced in commercial reactors.

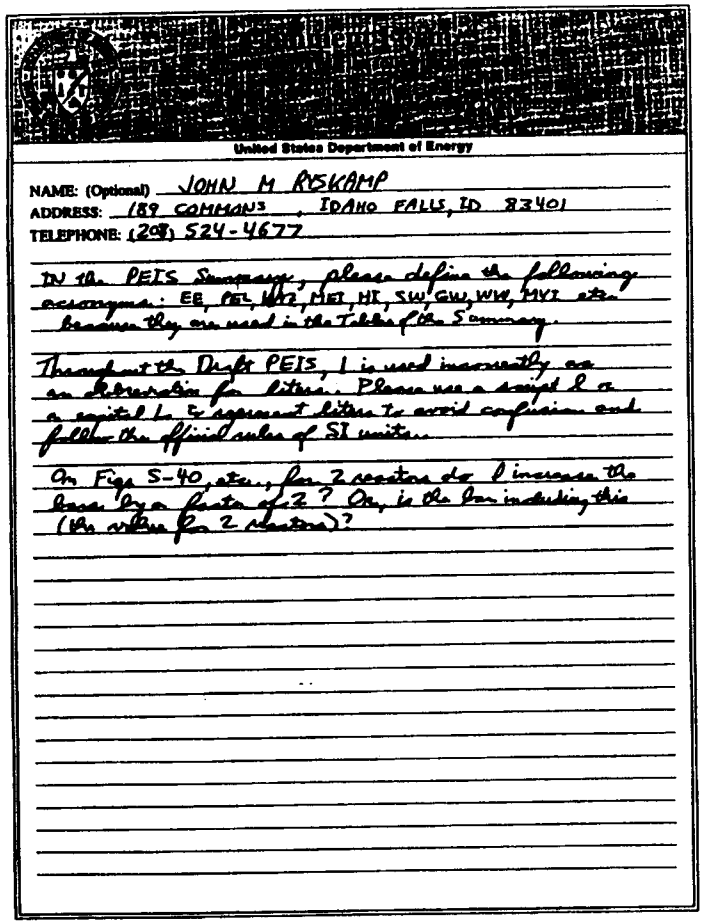
1/11.01.08

ID-006

11 01 08 **Comment Number 1**

The Department of Energy acknowledges the commentor's suggestion to keep the tritium production mission separate from the Pu disposition mission. The separation of these two missions is the DOE's current position. However, the Multipurpose Reactor Option was preserved as an option for future consideration.

RYSKAMP, JOHN M., IDAHO FALLS, ID
PAGE 1 OF 1



United States Department of Energy

NAME: (Optional) JOHN M RYSKAMP
ADDRESS: 189 COMMONS , IDAHO FALLS, ID 83401
TELEPHONE: (208) 524-4677

In the PEIS Summary, please define the following acronyms: EE, PEL, MEI, HI, SW, GW, WW, MYI etc. because they are used in the Tables of the Summary. 1/16.00.00

Throughout the Draft PEIS, l is used incorrectly as an abbreviation for liters. Please use a script ℓ or a capital L to represent liters to avoid confusion and follow the official rules of SI units. 2/16.00.00

On Fig S-40, etc., for 2 reactors do I increase the dose by a factor of 2? Or, is the bar including this (the value for 2 reactors)? 3/09.00.08

ID-007

16 00 00 **Comment Number 1**

All acronyms used in the Final PEIS Summary are included in the Acronyms and Abbreviations section of the document.

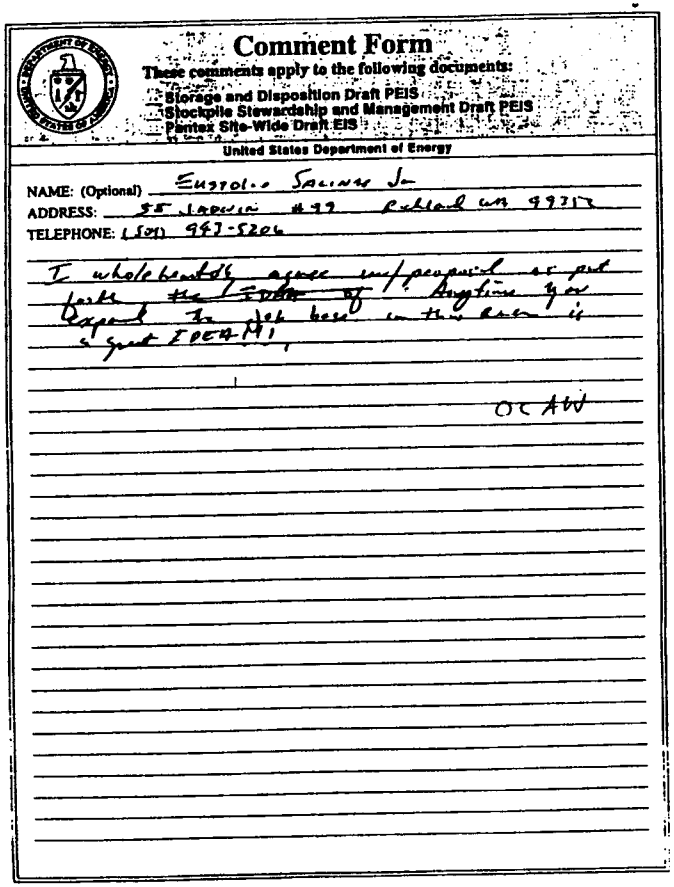
16 00 00 **Comment Number 2**

A lowercase "l" was used as an abbreviation for liters in order to maintain consistency with other DOE EISs currently being prepared. This abbreviation is consistent with the Style Guide used for this document.

09 00 08 **Comment Number 3**

Figures S–39 through S–44 in the Summary of the Draft PEIS reflect the total impacts for each of the Reactor Alternatives. The x-axis key on each of the graphs identifies the number of reactors that were used to determine the total impact. Therefore, the bar charts reflect the impacts for the number of reactors identified.

SALINIS, EUSTOLNE, JR., RICHLAND, WA
PAGE 1 OF 1



Comment Form

These comments apply to the following documents:
- Storage and Disposition Draft PEIS
- Stockpile Stewardship and Management Draft PEIS
- Pantex Site-Wide Draft EIS

United States Department of Energy

NAME: (Optional) Eustolne Salinas Jr
ADDRESS: 55 Jadwin #99 Richland WA 99352
TELEPHONE: (509) 943-5206

I wholeheartedly agree w/proposal as put forth ~~the IDEA of~~ Anytime you expand the job base in this area is a great IDEA M1,

OC AW

1/08.03.01

WA-003

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for new missions at Hanford. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

April 9, 1996

David Nulton
U.S. Department of Energy
Office of Fissile Material Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

Re: COMMENTS SUBMITTED ON THE DRAFT FOR STORAGE AND DISPOSITION OF FISSILE MATERIALS

Dear Mr. Nulton:

The Department of Energy lists two categories for the disposition of fissile materials: long term storage and plutonium disposition. Alternatives presented to the public from these two categories are undefined and probable to be "hybrids" from many options. Under these circumstances, it is nearly impossible for the public to offer comment on the agency's most probable actions and to foresee consequences of those actions. Public health and safety should be the agency's highest priority in the selection of alternatives for the management of fissile materials. Restoration of public trust would logically follow from such a priority system. 1/01.04.00 2/08.03.00

The agency defines "long term" as fifty years. The "no action" alternative would be logically interpreted to mean that the agency intends to leave fissile materials on-site with no actions implemented to protect the public, workers, and the environment from contamination by these materials. This alternative does not appear to be reasonable or have serious merit for agency consideration. 3/02.01.08

Upgrading of existing facilities should be fully explained to the public. "Partial consolidation" should be clearly defined as to what materials are being consolidated, where potential sites for consolidation have been identified by DOE, in what amounts, and with what future agency intentions. Agency terminology of consolidation with no future intentions "at this time" is not likely to inspire confidence from the public regarding the agency's openness. 4/02.00.08

The consolidation alternative poses many unsolved technical problems and risks to the public. Transportation of this material to centralized or regionalized sites would contain risks from exposure to workers, communities along transportation routes, commercial carriers, and the "host" communities of the storage facilities. It would appear that the consolidation alternative has inherent potential problems and that reducing risks of "smaller" disasters cannot be reasonably accomplished by consolidation of materials in one or two sites for "larger" disasters. 5/09.00.08

M-031

01 04 00 Comment Number 1

The PEIS evaluates two Proposed Actions: long-term storage of weapons-usable fissile materials and the disposition of materials declared surplus to national defense needs. Long-term storage is not a disposition option. Long-term storage has three alternatives analyzed in the PEIS: Upgrade at Multiple Sites, Consolidation of All Pu At a Single Site, and Collocation of Pu With HEU At a Single Site. Disposition has three categories of alternatives: Pu Burning in Reactors, Pu Immobilization in a Glass or Ceramic Form, and Emplacement of Pu in Deep Boreholes. It is possible that a hybrid alternative involving more than one disposition option could be selected in the ROD. It is also possible that the same site could be chosen for storage and some disposition activities. The PEIS (Chapter 4) reflects the cumulative impacts of these activities. Cumulative impacts are also provided in the Summary.

08 03 00 Comment Number 2

The Department of Energy acknowledges the commentor's suggestion regarding the criteria that should be used in determining the Preferred Alternative for the storage and disposition of weapons-usable fissile materials. The criteria, along with other input provided through the public review process, will be presented to the decisionmaker to support the ROD.

02 01 08 Comment Number 3

The *National Environmental Policy Act* requires the analysis to include the No Action Alternative as a baseline to compare the potential environmental impacts. The No Action Alternative may not accomplish the purpose and need as identified by the PEIS, which is the case for storage and disposition. However, should the No Action Alternative be chosen, ongoing actions such as material stabilization, security, health, and safety improvements would continue under the current management direction to ensure that the environment and the people are protected.

2

PLUTONIUM DISPOSITION:

Two of the three alternatives presented by the agency for plutonium are immobilization and reactor use. From conversation on or about April 2, 1996 with Cheryl Moss of the Nuclear Energy Institute, the alternative of plutonium used for nuclear reactor fuel is being promoted by some interests as a one time run-through with disposal afterward. Both alternatives postpone, but do not eliminate the problem of that. Proven technology exists for repository disposal. "Recycling" as a one time run-through for use as nuclear reactor fuel does not eliminate the problem of waste disposal and containment. It merely postpones dealing with the problem.

It would appear to me that asking the public to pay for reactor conversion for a one-time run through to extract energy from this material before disposal is not well considered use of public funds. (THE CINCINNATI ENQUIRER. "PLUTONIUM MAY BE RECYCLED," Saturday, March 30, 1996. Copy enclosed) 6/01.02.00

. . .the civilian nuclear power industry clearly is interested in the material, especially if the government provides it free and pays for reactor conversions. (IBID.)

The third alternative, deep borehole, has no proven merit and no realistic possibility that a site could be selected with public approval. The concept of public approval should be inherently part of the agency's decision in disposition of materials under its management. The agency has offered assistance to local and state governments in its spent nuclear fuel EIS. The agency has suggested that DOE would offer assistance to state and local governments to site necessary facilities, if opposition from the public required assistance, to law enforcement personnel. I would respectfully request that the agency offer assistance to the public to meaningfully participate in the agency's decision-making process rather than offer assistance to site facilities over public objections. 7/08.03.01

The agency has defined "long term" as fifty years. Given the current lack of alternative with likelihood of success for even this time period, the most preferred alternative may well be continued research for a disposal method with probability of containment from the environment.

Consequences of miscalculations and human error in the disposition of fissile materials are irreversible. I respectfully ask the agency to consider the long term

M-031

02 00 08 **Comment Number 4**

The Final PEIS describes the storage alternatives, with sections explaining the approach for each site including locations and quantities. The intent of the storage alternatives is to provide safe, secure storage of the surplus materials until they can be processed for disposition, or for long-term (up to 50 years) storage of the nonsurplus materials.

09 00 08 **Comment Number 5**

The risks to workers and the public at DOE sites and communities along transportation routes are considered in the decisionmaking process. Other areas of potential impacts include biological, cultural, air quality, water, and socioeconomics. All were given consideration before the Preferred Alternative was selected and will be considered in reaching the ROD.

01 02 00 **Comment Number 6**

Comment noted.

08 03 01 **Comment Number 7**

The Department of Energy has an on-going national dialogue effort to obtain input to its decisionmaking process, cross-cutting various programs, to achieve fully integrated decisions.

The timeframe of 50 years for long-term storage was deemed appropriate when considering the lifecycle of a facility. Anything beyond that period would likely be considered speculative in the NEPA sense. Research and development is both on-going and planned to support disposition alternative(s) if selected, the ROD would include pilot facilities.

implications of its actions in Record of Decision beyond the fifty year time period. Given the present pressures from development interests on the agency for specific actions and funding to for those actions, I request that the agency consider "preferred alternatives" for the protection of the public health and safety. Please see attached letter of March 12, 1996 from Mr. Steven Carter of Ohio Valley Regional Development Commission to the DOE regarding distribution of funding allocated to the agency for site remediation at the Portsmouth Gaseous Diffusion Plant located in Piketon, Ohio. It would appear that public funds for agency projects determined to be necessary for the public health and safety under National Environmental Policy Act are considered potential sources of revenue for the siting of development projects. 7/08.03.01 cont.

The agency is too frequently perceived as a funding source for development interests and quasi-governmental entities. The only long term and consistent interest in agency decision-making process comes from the directly affected public. It is the public that bears the risk, pays the cost, and lives with the long term consequences of agency decisions.

Thank you for any consideration given my comments on this vitally important issue.

Respectfully submitted,

Diana Salisbury
7019 Ashridge Arnheim Road
Sardinia, Ohio 45171
(513) 446-3135 telephone and fax

cc: The Honorable Rob Portman

enclosures

M-031

ATTACHMENT # 3

NATION — A — SATURDAY, MARCH 30, 1996 — THE CINCINNATI ENQUIRER

Plutonium may be recycled

Nuclear reactors could use surplus as fuel

BY H. JOSEF HEBERT
The Associated Press

WASHINGTON — A proposal to turn tons of Cold War plutonium into commercial reactor fuel has caught the interest of U.S. utilities. But critics are worried it could make things easier for terrorists seeking weapons-grade material.

Seventeen U.S. power companies operating 37 nuclear reactors have expressed interest in the idea being considered by the Energy Department, according to department documents obtained Friday. A Canadian utility is interested as well.

Energy Secretary Hazel O'Leary is expected by the end of the year to decide on the disposal of more than 42 tons of plutonium left over from old warheads and warhead production.

Among the options being considered is to turn the plutonium into a mixed uranium-plutonium oxide. That material could then be used at any of the 109 commercial nuclear power plants with relatively little reactor modification, according to nuclear experts.

Ms. O'Leary has emphasized that the department has yet to decide and also is examining vitrification — a process in which plutonium is encased in glass and then put into storage.

But the civilian nuclear power industry clearly is interested in the material, especially if the government provides it free and pays for reactor conversions.

Among the utilities that have expressed interest are Duke Power Co. in North Carolina, Commonwealth Edison Co. in Illinois, Georgia Power Co., the Arizona Public Service Co. and Virginia Power Co., all major operators of nuclear reactors.

Critics of the plutonium mix contend it would go counter to the Clinton administration's overall policy of reducing the risks of nuclear proliferation, and send the wrong signal to the Europeans as well as the Russians.

"The United States will be signaling that plutonium has some value. It would encourage countries to pursue plutonium (as a fuel) contrary to administration nonproliferation policies," said Daniel Horner of the private Nuclear Control Institute.

The group urged Ms. O'Leary recently to reject the idea.

M-031

OHIO VALLEY REGIONAL DEVELOPMENT COMMISSION

A Regional Partnership Dedicated to the Development of Southern Ohio

March 12, 1996

U.S. Department of Energy
Environmental Information Center
FY'98 Prioritization Comments
505 West Emmitt Avenue, Suite 3
Waverly, OH 45690

Dear Sirs:

Thank you for the invitation to attend the February 26, 1996, Public Stakeholders Meeting inviting input into the U.S. Department of Energy's FY'98 Environmental Management Budget for the Portsmouth Site in Piketon, Ohio. Our written comments follow:

1) It has been our understanding in listening to public comments from Thomas Grumbly, Assistant Secretary for Environmental Management, during his presentation at the March 1995, DOE Worker Transition/Local Governments Conference in Washington, D.C. that he encouraged local governments and Community ReUse Organizations to request a percentage of DOE Site Environmental Management Budgets for use in Community Transition Planning/Projects. The Ohio Valley Regional Development Commission requests 10% of DOE's Portsmouth Environmental Budget to be utilized for projects prioritized by OVRDC and its Community ReUse Organization, in addition to future requests for 3161 funding through the DOE Office of Worker & Community Transition. It is our expectation to request this percentage of DOE's Portsmouth Environmental Management/Project budget for the forthcoming fiscal year. Local governments have authority and responsibilities under the National Environmental Protection Act to exercise review of federal environmental management programs affecting local jurisdictions, and we plan to assist local governments in this effort.

2) It is evident that the FY'98 ADS/RDS Development Process did not solicit stakeholder input during the initial Fall-Winter 1995 development stages of drafting project and environmental clean-up priorities for the Portsmouth and Oak Ridge sites. It is our understanding that stakeholder input will be solicited during these early developmental stages in future planning/budget years, and we offer our assistance in planning such future meetings.

3) We have comments regarding the Management Evaluation Matrix (MEM) which was developed to prioritize environmental projects by a ranking and scoring process. It is not evident to the Ohio Valley Regional Development Commission how the category percentages for Public Safety & Health (25%), Site Personnel, Safety & Health (15%); Environmental Protection (15%), Compliance (12%); Mission Impact (15%); Mortgage Reduction (15%); and Social, Cultural, Economic (3%) were arrived at, by whom, and with what rationale? It is our thought that even with personnel safety training procedures in place that the category of Site Personnel, Safety & Health (15%) should have as high a category percentage ranking as Public Safety & Health (25%)

M-031

It is also the Commission's opinion that the remaining 50% of percentage rankings should be divided up equally among the other five (5) categories including an increase in the percentage ranking (to at least 10%) given to the category of social, cultural, and economic values. It is also our opinion that where mitigation is possible, that cost factors include appropriate amounts of funds to safeguard or remediate impacted social, cultural, and economic values.

4) It is our observation that the entry points for stakeholder input during the Environmental Management Budget Process do not correlate well among the November 15, 1995 "ADS/RDS Development Process" and "ORO - Specific Process" transparencies in the "Environmental Management Risk-based Prioritization Public Presentation," and the "Public Participation in Fiscal Year 1998 Environmental Management Budget" pamphlet.

Thank you for this opportunity to address these requests, concerns, and issues during this public comment period. Overall the proposed DOE budget/project prioritization process is a major improvement in that it does involve local governments, citizens and affected stakeholders in the evolving multi-billion dollar environmental cleanup missions at DOE sites throughout the nation.

Sincerely yours,

Steven T. Carter/bc

Steven T. Carter
Economic Development Director

cc: Gene Gillespie, Portsmouth DOE Site Office
Thomas Grumbly, U.S. Department of Energy
Dan Neff, Governor's Office of Appalachia
Randy Runyon, Community ReUse Organization Chairman
Ohio EPA

M-031

SANFORD & ASSOCIATES, NASHVILLE, TN,
CHARLES S. SANFORD
PAGE 1 OF 4

SANFORD & ASSOCIATES

1803 Princeton Avenue Nashville, Tennessee 37212

Charles S. Sanford

9 April 1996

H. Mark Blauer, Ph.D.
Tetra Tech, Inc.
5203 Leesburg Pike
Suite 900
Falls Church, VA 22041

Ref.: DOE Oak Ridge Environmental Report (ES/ESH-31/V1, p. 5.6)
Re.: DOE Draft PEIS Stockpile Stewardship and Management

Dear Mr. Blauer:

At the public meeting in Oak Ridge on April 2nd the public record contains our statements of disagreement. Please accept the enclosure as substantiation of my position that DOE Oak Ridge (Y-12) has "unmonitored" airborne emissions. Your information led you to deny their existence. Please review the referenced enclosure and assist me in correcting the public record. This clarification is necessary in order to disseminate accurate and timely information for public discussion.

The DOE Hanford Engineering Laboratory's HERMES computer model has used a "semi-infinite plane" for calculating dispersion of airborne radioactive hazardous waste. The Hanford GENII computer dispersion model used at DOE Oak Ridge is based on a "semi-infinite plume". Please comment on the calculated mass emission loading for these models as it relates to an annual average theoretical dose versus an actual cumulative dose. 1/09.10.08

If you can acknowledge that there is a geographical "ridge and valley" preference for plumes with their airborne pollutant loadings, then I believe that we can deduce that biosphere accumulation is along the streams which are within the valleys. Biosphere accumulation of haz-wastes occurs downwind from the E-25 site along the East Fork Poplar Creek. The plume's decreasing temperature causes air pollution particulates to settle into the East Fork Poplar Creek Drainage Basin. The State Forester (private conversation) has stated that Pine Beetles attack stressed vegetation. Hence, the East Fork Poplar Creek Pine Beetle infestation can be directly linked to waterborne and airborne pollutants. Confirmation of this thesis can be made by atomic absorption analysis of the infested tree stock. Historical comparison can be made by correlating tree ring growth with infrared aerial photographs of the area where a diseased tree canopy cover reflects a different solar wavelength than a healthy one. 2/09.03.05

M-209

09 10 08 **Comment Number 1**

The radionuclide emissions in this PEIS are assumed to be from single or multiple stack releases other than ground mass loading emissions. For stack releases of radioactive material, "semi-infinite plume" models such as GENII are appropriate for estimating radionuclide dispersion in air and subsequent human health effects. Also, the GENII code is widely used in DOE and NRC assessments of radiological human health effects at operating nuclear facilities.

09 03 05 **Comment Number 2**

The dispersion characteristics of an air pollutant plume depend on the source characteristics (release height, exit temperature, exit velocity), terrain over which the plume is emitted, the meteorology of the area, and the mixing height. There is no geographical preference for plumes with airborne pollutant loadings independent of the environmental parameters previously delineated.

The commentor's information relative to the conduct of atomic absorption analysis and historical studies of color infrared aerial photography to assess stressed vegetation is noted. Analyses to address possible impacts resulting from existing operations not related to the Proposed Action at ORR are not within the scope of this PEIS.

Since public scoping meetings and comment meetings are inter-related, and since preceding DOE Records of Decision are a precursor to current Programmatic Environmental Impact Statements; then this comment letter should be applicable to not only the current PEIS, but it should also be capable of improving deficiencies in past meetings and past documents. Please forward this letter and your response to: T.S. Tyndell, government information coordinator, Federal Information Exchange (ttyndell @fedix.fie.com); and other relevant program contact personnel.

Please believe me to be cordially yours.

Sincerely,

encl.

xc. DOE ORR
EPA-4
DOE/OR Site Specific Advisory Board
Senator Bill Frist
Senator Fred Thompson
Congressman Bob Clement

OAK RIDGE RESERVATION ENVIRONMENTAL
REPORT FOR 1992

VOLUME 1: NARRATIVE

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Date Published: September 1993

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under Contract No. DE-AC05-84OR21400

M-209

SANFORD & ASSOCIATES, NASHVILLE, TN,
CHARLES S. SANFORD
PAGE 4 OF 4

Table 3.1. 1992 Y-12 Plant airborne uranium emissions estimates[a]

Source of emissions	Quantity emitted	
	(kg)	(Ci)
Enriched uranium process exhaust (monitored)	8.5	0.036
Depleted uranium process exhaust (monitored)	4.8	0.004
Enriched uranium process and laboratory exhaust (unmonitored)	0.1	0.004
Depleted uranium process and laboratory exhaust (unmonitored)	4.6	0.002
Enriched uranium room exhaust (unmonitored)	0.2	0.011
Depleted uranium room exhaust (unmonitored)	5.6	0.003
Total	17.8	0.060

[a]See Table 2.2 for off-site committed dose equivalents resulting from Y-12 Plant uranium emissions.

Emissions from the unmonitored process and laboratory exhausts were from 73 emission points. Two of the sources, Stack 112 and Stack 115, were sampled by impinger-type samplers because of the corrosive conditions in the stacks until the processes were shut down in January 1992. The 71 additional unmonitored process and laboratory exhausts are all categorized as minor emission sources, and estimates were generated according to EPA-approved calculation methods.

Emissions from room ventilation systems are estimated from health physics data on airborne radioactivity concentrations in the work areas. Any monthly concentration averages that exceeded 10% of the derived air concentration (DAC) were included in the annual emission estimate. The DAC is a radionuclide concentration level established by DOE orders. It is designed to protect the health of workers in radiation areas. The annual average concentrations are used with the design ventilation rates to arrive at the annual emission estimate. There were 12 ventilation areas from the enriched buildings and 15 ventilation areas from the depleted buildings where the average concentration exceeded 10% of the DAC in 1992.

Radionuclides other than uranium are handled in millicurie quantities as a part of Oak Ridge National Laboratory (ORNL) and Y-12 laboratory activities at facilities in the Y-12 Plant. The releases from these activities are minimal and have a negligible impact on the total Y-12 Plant dose; therefore, only Y-12 Plant uranium discharges are shown in Table 3.1.

3.2.1.3 Discussion

An estimated 0.060 Ci (17.8 kg) of uranium was released into the atmosphere in 1992 as a result of Y-12 Plant processing operations (Figs. 3.1 and 3.2). Because the specific activity of enriched uranium is much greater than that of depleted uranium, about 85% of the curie release was from emissions of enriched uranium particulate, whereas only 5% of the total mass of uranium released was from enriched uranium losses.

As illustrated in Fig. 3.1, 1992 Y-12 Plant uranium emissions estimates in total curies were essentially the same as in 1991. This decrease reflects a reduction in Y-12 Plant process activities, continued improvements in administrative controls of the process activities still operating, and improvements in contamination control throughout the Y-12 Plant (notable in the room exhaust estimates from health physics data). Only five buildings contained areas where uranium concentrations exceeded 10% of the DAC in 1992.

Twenty-eight stacks with the greatest potential to emit significant amounts of uranium are equipped with breakthrough monitors, which alert operations personnel to process-upset conditions or to a decline in filtration system efficiencies. The breakthrough monitors have been instrumental in helping to reduce excessive emissions from several enriched process areas over the past few years. When an alarm is received, operations personnel take prompt action to reduce or stop the emission, such as shutting down a

SAVANNAH RIVER SITE CITIZENS ADVISORY BOARD,
SAVANNAH, GA, BOB SLAY
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Savannah River Site

CITIZENS ADVISORY BOARD

A U. S. Department of Energy Site-Specific Advisory Board

May 16, 1996

Mr. Gregory Rudy
U.S. Department of Energy - MD-1
Office of Fissile Materials Disposition
1000 Independence Ave. S.W.
Washington, D.C. 20585

Dear Mr. Rudy:

Please accept the Savannah River Site Citizens Advisory Board's recommendation on the *Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.*

Recommendation No. 20 was adopted on May 14, 1996, in Savannah, Ga.

If you have any questions regarding this recommendation, please feel free to contact me or the Nuclear Materials Management Subcommittee Chair Tom Costlayen at (803) 838-5000.

Sincerely,

Bob Slay

Bob Slay
Chairperson

cc: Mr. Thomas Grumbly
Dr. Marie Fieri
Ms. Denise Koles
SRS CAB Members

F-043

SAVANNAH RIVER SITE CITIZENS ADVISORY BOARD, SAVANNAH, GA, BOB SLAY
PAGE 2 OF 3

Savannah River Site

CITIZENS ADVISORY BOARD

Recommendation No. 20
May 14, 1996

1. As all disposition options require decades for implementation, it is essential to first focus on the safe and secure interim storage of the surplus plutonium.

2. The programmatic environmental impact statement (PEIS) indicates that there are no significant differences in the possible health effects between interim storage options at the various feasible locations. If this is the case, then the choices of locations should be made primarily on the basis of security and cost effectiveness. | 1/08.03.00

3. Risks associated with the transportation of plutonium are primarily derived from the possibility of highway and/or rail collisions that could injure people, not health effects related to the material. Furthermore, established methods for movement of nuclear materials minimize the likelihood of accidents. This being the case, shipment of plutonium between sites should be acceptable in any alternative that provides the necessary safety, security and cost effectiveness. | 2/10.00.00

4. We do not believe that deep boreholes should be pursued as a disposition option because:
(a) It would face extreme political obstacles,
(b) It would be difficult to be certain that a contaminating event orclandestine theft could not develop over centuries ahead, and
(c) It might preclude the possible future recovery of the plutonium as a fuel. | 3/08.03.01

5. The choice of a Mixed Oxide (MOX) option for the disposition of weapons plutonium should include the consideration of using commercial reactors if it is a cost effective measure. | 4/06.02.08

6. The PEIS accepts without question the Spent Fuel Standard as the desired end result for both the vitrification and reactor options. However, it is questionable whether this is an entirely appropriate objective in making a long term disposition decision. As the overriding outcome of the program must be the minimization of risk that plutonium is diverted for weapons use, options that actually dispose of the material should be sought. The necessity of the Spent Fuel Standard can be questioned because of the following considerations: | 5/01.04.00

SRS CAB Recommendation #20

F-043

08 03 00 **Comment Number 1**

Comment noted.

10 00 00 **Comment Number 2**

The human health risks of material transportations associated with the proposed Pu storage and disposition alternatives are evaluated and presented in Section 4.4 of this PEIS. The more detailed description of the methodology and supporting data for the analysis is presented in the Appendix G. Transportation of radioactive materials between sites includes health risks for both normal operations and accident conditions to the public and workers.

08 03 01 **Comment Number 3**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

06 02 08 **Comment Number 4**

This alternative is addressed in the PEIS.

01 04 00 **Comment Number 5**

The Department of Energy, in considering the Spent Fuel Standard, evaluated the adequacy of the Standard versus the greater degree of destruction achievable with other options such as the Deep Burn Reactor Option and the Accelerator Option. It was judged that the Spent Fuel Standard is adequate since it would convert the weapons Pu to a form making it as difficult to retrieve and reuse in weapons as the Pu contained in the much larger existing volume of spent fuel from commercial nuclear reactors.

The Department of Energy concluded that the shorter disposition time achievable with more mature technologies was more desirable than the greater Pu destruction that could only be achieved over a much longer time period through the use of Deep Burn Reactors and Accelerators. The NAS also adopted the Spent Fuel Standard as the most acceptable form for conversion of weapon Pu.

SAVANNAH RIVER SITE CITIZENS ADVISORY BOARD, SAVANNAH, GA, BOB SLAY
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Recommendation No. 29 continued

- With both western Europe and former Soviet states being committed to the full recovery of plutonium's energy value, the benefit of the United States, a declared nuclear weapons power, setting an example against this is, at best, uncertain.
- In the United States, security for and transparency of the country's interim management of its surplus plutonium from all sources should be achievable through a guarded repository combined with International Atomic Energy Agency (IAEA) safeguards.
- Because the Spent Fuel Standard depends on relatively short lived fission products being mixed with the very long lived plutonium, there may be significant environmental, security and safety questions with a long term geologic repository.

Therefore, any plutonium disposition plan should include exploring various options that go beyond the spent fuel standard and that actually reduce plutonium stocks. These would include reactor concepts that burn relatively high fractions of plutonium as well as ones that do not generate plutonium. The options presented in the PEIS have the advantage of established technology and, perhaps, economic advantages in the near term.

5/01.04.00 cont.

However, these other options, which are not tied to the Spent Fuel Standard and which consume plutonium, should be evaluated because of:

- The very possible long term benefits of superior waste management.
- The environmental and supply uncertainties of fossil fuels.
- The advantage of maintaining/enhancing the country's technology in an area of potentially great future importance.

7. If the evaluation process concludes that SRS is a preferred site for a plutonium storage and disposition program that is secure, safe, and cost effective, the SRS CAB supports and welcomes such a decision.

6/08.03.01

F-043

08 03 01 **Comment Number 6**

The Department of Energy acknowledges the commentor's support for SRS. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

SCOTT, RICHARD G., AMARILLO, TX
PAGE 1 OF 1

Comment ID: P0032
Date Received: May 1, 1996
Name: Richard G. Scott
Address: 4305 Emil Street
Amarillo, TX

Transcription:

I am against the storage of plutonium or any type of storage of nuclear materials at the Pantex Plant in Amarillo. The Amarillo Chamber of Commerce does not speak for all of us. I am a World War II veteran and retired and have lived in Amarillo for 25 years. This is to let you know that a lot of the people in the city and in the area are not for any storage of nuclear materials at the Pantex Plant. Thank you. 1/08.03.01

P-032

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

SEATTLE WOMEN ACT FOR PEACE/WOMEN STRIKE FOR PEACE, SEATTLE, WA

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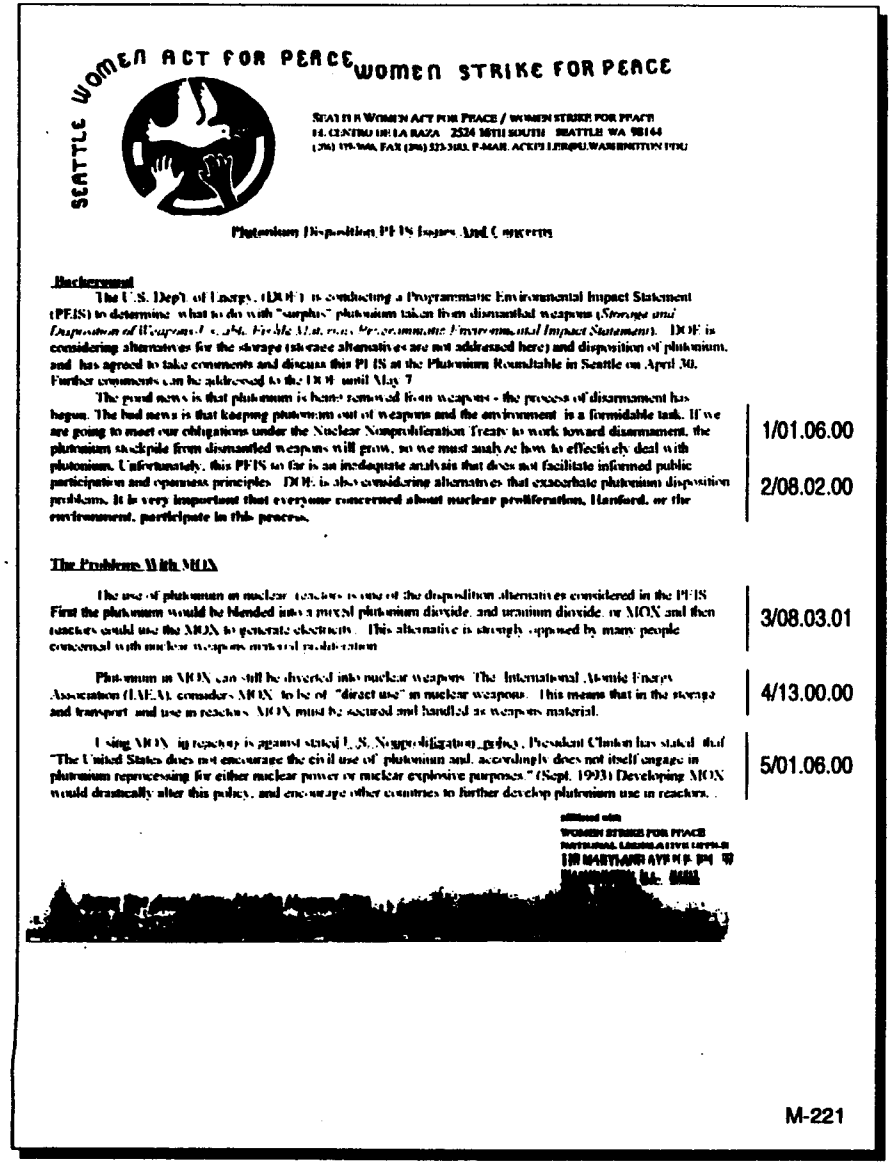

SEATTLE WOMEN ACT FOR PEACE WOMEN STRIKE FOR PEACE

SEATTLE WOMEN ACT FOR PEACE / WOMEN STRIKE FOR PEACE
EL CENTRO DE LA RAZA 2524 16TH SOUTH SEATTLE WA 98144
(206) 379-3666, FAX (206) 523-3103, E-MAIL ACKELLER@U.WASHINGTON.EDU

Plutonium Disposition PEIS Issues And Concerns

Background

The U.S. Dep't. of Energy, (DOE) is conducting a Programmatic Environmental Impact Statement (PEIS) to determine what to do with "surplus" plutonium taken from dismantled weapons (*Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement*). DOE is considering alternatives for the storage (storage alternatives are not addressed here) and disposition of plutonium, and has agreed to take comments and discuss this PEIS at the Plutonium Roundtable in Seattle on April 30. Further comments can be addressed to the DOE until May 7.

The good news is that plutonium is being removed from weapons - the process of disarmament has begun. The bad news is that keeping plutonium out of weapons and the environment is a formidable task. If we are going to meet our obligations under the Nuclear Nonproliferation Treaty to work toward disarmament, the plutonium stockpile from dismantled weapons will grow, so we must analyze how to effectively deal with plutonium. Unfortunately, this PEIS so far is an inadequate analysis that does not facilitate informed public participation and openness principles. DOE is also considering alternatives that exacerbate plutonium disposition problems. It is very important that everyone concerned about nuclear proliferation, Hanford, or the environment, participate in this process. 1/01.06.00 2/08.02.00

The Problems With MOX

The use of plutonium in nuclear reactors is one of the disposition alternatives considered in the PEIS. First the plutonium would be blended into a mixed plutonium dioxide, and uranium dioxide, or MOX and then reactors could use the MOX to generate electricity. This alternative is strongly opposed by many people concerned with nuclear weapons material proliferation. 3/08.03.01

Plutonium in MOX can still be diverted into nuclear weapons. The International Atomic Energy Association (IAEA) considers MOX to be of "direct use" in nuclear weapons. This means that in the storage and transport and use in reactors MOX must be secured and handled as weapons material. 4/13.00.00

Using MOX in reactors is against stated U.S. Nonproliferation policy. President Clinton has stated that "The United States does not encourage the civil use of plutonium and, accordingly does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes." (Sept. 1993) Developing MOX would drastically alter this policy, and encourage other countries to further develop plutonium use in reactors. 5/01.06.00

[illegible]
WOMEN STRIKE FOR PEACE
NATIONAL LEGISLATIVE OFFICE
[illegible]

M-221

01 06 00 Comment Number 1

Comment noted.

08 02 00 Comment Number 2

The Department held eight public meetings to present the information contained in the Draft PEIS and to receive public comments. These meetings were advertised in a variety of ways to encourage full public participation. All comments submitted received equal consideration.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

13 00 00 Comment Number 4

While the Pu is in the MOX fuel form, it is owned by the U.S. Government and would be subject to high standards of safeguards and security. The utilization of MOX fuel for Pu disposition is consistent with the President's Nonproliferation Policy. The surplus Pu in this form would be inspectable by IAEA, as appropriate.

SEATTLE WOMEN ACT FOR PEACE/WOMEN STRIKE FOR PEACE, SEATTLE, WA
PAGE 2 OF 4

The U.S has no facility to develop a MOX fuel that could be run in a commercial reactor. A MOX fabrication facility would have to be built, or a current facility adapted. *This could be done at Hanford at a cost as yet undisclosed.* Potentially plutonium from around the country would be brought to a Hanford MOX fabrication facility. — 6/06.01.01

Also, because there is currently no U.S. MOX fabrication facility, the PEIS assumes that if an existing light water reactor in the U.S. were to use MOX fuel, a "timely supply" of MOX fuel would have to be sought while an U.S. fabrication facility is developed. *This means DOE would send U.S. plutonium to Europe where MOX fuel would be developed and then sent back to the U.S. reactors* (PEIS Summary pp. 15, 32). — 7/06.01.08

MOX in commercial reactors is a concern. Because MOX is a direct use weapons grade fuel, its use in commercial reactors would turn many utility nuclear energy plants into de facto weapons facilities. Increased security to prevent diversion of plutonium would be required — 4/13.00.00 cont.

High Level Waste generated from MOX is likely to be a serious problem. Commercial Spent Fuel generated from MOX reactors is supposed to go to a waste repository. The Development of a repository has been fraught with difficulty. There is no guarantee that a suitable repository will exist for even more high level waste generated from MOX reactors. Simply stating that it will go to a repository, which does not yet exist, is not good enough. Hanford, as well as other sites in the nuclear weapons complex may end up with this waste if a repository is not available — 8/12.00.00

One alternative in the PEIS is to use Canadian CANDU reactors. According to the PEIS, Canada would then be responsible for the waste generated from the reactors. This encourages international commerce in plutonium (as does any alternative calling for plutonium or MOX shipment to and from Europe.) It may also set a dangerous precedent for the U.S. to give up control of weapons material to other countries, and it brings up a question of fairness: Why should Canadian citizens take plutonium, and waste that they did not develop? — 9/01.03.00

Instead of MOX, plutonium should be declared a waste and immobilization alternatives developed. — 10/01.04.00

We should declare plutonium a waste and ensure that it is not used in weapons, or in reactors. By doing this in the U. S. we can also take a leadership role in preventing an international industry and commerce in plutonium that would be increasingly difficult to control. — 11/01.06.00

Immobilization technologies should be vigorously pursued because these technologies provide the greatest ability to isolate plutonium from the environment, and prevent proliferation of weapons material. Immobilization technologies should be developed shared and with other countries. Meanwhile, storage of plutonium should maintain plutonium so as to prevent harm to the environment and diversion into weapons. This means that risks involved in transport should be avoided. — 12/08.03.01

Public Participation and Openness in the PEIS Process

This PEIS lacks credibility because DOE has not furthered informed public participation in the process, or adhered to basic principles of openness — 2/08.02.00 cont.

M-221

01 06 00 Comment Number 5

The President's Nonproliferation Policy states the United States will not recycle Pu. Burning weapons-usable Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel.

Decisions on disposition of weapons-usable fissile materials will be made based on environmental analyses, technical and economic studies, national policy considerations, and public input.

06 01 01 Comment Number 6

Comment noted. Hanford, along with other sites, is included as a "representative site" in DOE's consideration for analyzing a MOX fuel fabrication facility.

06 01 08 Comment Number 7

Comment noted.

12 00 00 Comment Number 8

The Department of Energy's recently released *Program Plan for the Civilian Radioactive Waste Management Plan* continues to maintain a year 2010 startup date for the NWPA-HLW repository. In the interim, the Fissile Materials Disposition Program has established that each alternative be evaluated assuming the entire inventory of material forms can be stored onsite until an NWPA-HLW repository is available.

01 03 00 Comment Number 9

Should the CANDU Reactor Alternative be selected with the ROD, agreement from the Canadian Federal and Provincial Government must be obtained, and a Canadian environmental assessment with public involvement must take place prior to implementation of this alternative.

DOE secretively solicited the nuclear industry in pursuit of MOX. In December, 1995, DOE included in a Request For Expressions of Interest for Tritium Production, a solicitation in pursuit of commercial reactors that would like to use MOX. This action, taken between the Plutonium Disposition PEIS Scoping Hearings and the draft PEIS, was done without notice to the public or incorporation into the PEIS. Not until March 29,1996 were Expressions of Interest (EOI's) released. This solicitation indicates a substantial furtherance of MOX despite the fact that DOE has not chosen a preferred alternative. No EOI process has been followed for any of the other disposition alternatives. *Among EOI responses from utilities interested in MOX was one from the Washington Public Power Supply System (WPPSS) to use MOX at the WNP 2 reactor sited at Hanford.* 13/08.00.00

DOE is not including cost studies and nonproliferation studies for public scrutiny along with the PEIS. Cost studies and nonproliferation studies are going on outside of this PEIS process. Since these studies will effect the outcome of the PEIS, they must be made publicly available so that citizens can make informed comments on the PEIS. Given that the need for action on plutonium disposition is based upon proliferation concerns,(PEIS Summary, S-1 to S-4, and PEIS pp 1-4 to 1-6), there is an appalling lack of consideration of proliferation impacts throughout this PEIS. Also, full cost analysis of MOX, including cleanup costs of a MOX fabrication facility, and MOX reactor sites, and the costs of a suitable repository, should be done and available for public comment, as should cost estimates for all other alternatives. 14/08.00.00 15/01.06.00 14/08.00.00 cont.

DOE should extend the comment period and hold hearings in additional locations. Additional time is needed for the public to fully consider the PEIS, especially with additional cost and nonproliferation information. Hearings ought to be held in additional locations. For example actions at Hanford should require hearings throughout the Northwest (Seattle, Portland, Spokane etc.) Now that some of the potential reactor sites for MOX are known, hearings in those areas should be considered. 16/08.01.00

M-221

01 04 00 **Comment Number 10**

Comment noted. In accordance with NEPA, the PEIS evaluates a range of reasonable alternatives for the disposition of surplus Pu. The disposition of Pu in reactors using MOX fuel is considered a reasonable alternative and is, therefore, analyzed in the PEIS.

01 06 00 **Comment Number 11**

Comment noted.

08 03 01 **Comment Number 12**

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 00 00 **Comment Number 13**

The Preferred Alternative for Pu disposition as stated in the Final PEIS, includes Reactor Alternatives. Should a Reactor Alternative be selected at the ROD, DOE would issue a Request for Proposal to interested parties to solicit MOX fuel fabrication facility design and construction proposals.

08 00 00 **Comment Number 14**

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, was provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses along with the environmental analysis and public input will be integrated into DOE's decisionmaking process.

01 06 00 **Comment Number 15**

The purpose of the Proposed Action is, in part, to establish the technical and program infrastructure that will enable the United States to take unilateral action or negotiate reciprocal actions with other nations for the disposition of surplus weapons-usable Pu. This PEIS addresses the environmental impacts of the reasonable alternatives for DOE's Proposed Action. Analyses of the cost, schedule, technical, and Nonproliferation Policy impacts are described in separate documents to support DOE's ROD. The cost, schedule, and technical analyses were made available for public review beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the analysis of the Nonproliferation Policy as it relates to the Proposed Action and alternatives.

08 01 00 **Comment Number 16**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days. DOE held public meetings for scoping of the PEIS, as well as to provide information and to receive comments on the Draft PEIS as part of the NEPA process. Also, there were separate meetings to present DOE analyses of the nonproliferation aspects of the storage and disposition alternatives. Each of these sets of meetings were advertised in a variety of ways to encourage full public participation. DOE was also invited to participate in meetings held by local groups concerning the management of weapons-usable fissile materials in Seattle and Portland.

SEEWALD, WILLIAM H.
PAGE 1 OF 2

PANTEX WORKSHOPS April 22, 1996
Statement by William H. Seewald

Given the time allotted and the amount of information to be covered in these "workshops," remarks will have to be brief and abridged. However, notwithstanding the voluminous issues of great concern, some reference must be made to the process. Combining these three documents into a single opportunity for public input together with the very short amount of time much of the material has been available does justice neither to the NEPA process itself, nor to the people and agencies that wish to make reasoned responses to these documents. At least in the case of the Stockpile Stewardship as well as the Storage and Disposition, the documents are substantive enough to require careful analysis. It is also an unavoidable conclusion that the hearing process envisioned by NEPA has been transformed by DOE into a format they feel they can more effectively control — that being the workshops. There is nothing wrong with workshops per se, but they do not meet the government's full responsibility to the public. That any of us at all are standing here to give testimony is only the result of citizen lobbying and the willingness of individuals to face down any obstacles to get their concerns into the public record. 1/08.01.00

One overriding point must be made regarding the Stockpile Stewardship and Management document even though one also must look at the cumulative impact of all three. It is clear that one of the significant premises compelling much of the decision-making process is the extraordinary attempt by the government to justify the continued operation of all three of the major DOE weapons laboratories, Los Alamos, Sandia, and Lawrence Livermore. The redundant laboratory capacity built during the cold war to spur competition can now only be characterized as an obscene abuse of the tax-payers pocketbook. That such a political decision gets made in Washington is certainly no surprise, but it is incumbent on all of us to demand accountability in these decisions, to refuse to acquiesce in expedient political decisions as well as those that are based on bad science or a disregard for the natural resources of the Panhandle.

The Storage and Disposition document with its potentially momentous effect on our area is tragically flawed in three important areas. Number one, it doesn't really live up to the second part of its title. If long-term storage decisions are to be made, it seems absolutely essential that they be informed by a least a fairly concrete sense of the method of disposal as well as where that will happen, the time frame, and a reasonable consideration of the processes themselves. Secondly, this EIS, as with the others under consideration today, does not make a realistic distinction between strategic and surplus plutonium. The effort to maintain two thirds of all the plutonium ever produced in the U.S. as "strategic" evidences a less than serious commitment to disarmament as well as giving rise to the suspicion that some effort to generate commerce in plutonium is superseding the security need to immobilize this dangerous substance. Thirdly, this 2/01.02.00 3/01.00.00 4/01.06.00 5/09.00.04

TX-055

08 01 00 Comment Number 1

The combining of meetings was done at the specific request of the public near several DOE sites and was not considered to have any negative impacts on the public review process. This request was based upon a need to hear how these documents were related to one another and to avoid requiring public attendance at several meetings spanning several days. The Draft PEIS and reference documents were made available in advance of the public meetings.

01 02 00 Comment Number 2

It is true that the long-term storage decision is related to the decision on disposition, especially with regard to timing which will impact the storage capacity required, and siting which should reflect the experience base and existing infrastructure at a particular location. DOE is confident that a decision can be made on disposition technology(ies) at the ROD, based on available data and environmental, technical, cost, schedule, and nonproliferation assessments completed to date. DOE is conducting small-scale tests and demonstrations of some Pu disposition technologies to remove uncertainties in their viability.

01 00 00 Comment Number 3

As defined in Chapter 1 (Figure 1.4–1) and in the Summary (Figure S–1) of the Draft PEIS, Pu in the strategic reserve is not surplus.

01 06 00 Comment Number 4

Comment noted. The amount of Pu determined to be "strategic" is beyond the scope of this PEIS. The Secretary's February 1996 Openness Initiative announced the amount of surplus Pu which supported the basis for the quantity analyzed in this PEIS.

09 00 04 Comment Number 5

Comment noted.

document sets out options that would obligate plutonium processing, generating all kinds of new nuclear waste streams that have never existed at Pantex before. The document gives little or no consideration to the effects on Panhandle agriculture. Just the threat of contamination from these activities could devastate the marketability of our products. It furthermore remains unconscionable that apparently considerations other than the water needs of domestic and agricultural usage seem to preclude the realistic designation of the Ogallala as an aquifer eligible for the fullest protection of federal law and policy. 5/09.00.04 cont.

The Site-Wide EIS, an effort brought about by citizen lobbying of the Department of Energy, has not really been in the public domain long enough for a detailed consideration. Unfortunately, the substance of the document itself may require much less time than the gravity of the issues warrants. There is again no consideration of the most basic industry of the Panhandle, agriculture. The agreement to evaluate alternative storage sites for pits, specifically Department of Defense sites seems to have been an insubstantial one since that site is not included in the actual storage EIS. If, as implied in the analysis, Manzano mountain becomes ineligible because of the the threat such a facility represents to Albuquerque, what are we to make of the government's concern for the residents of the Panhandle?

Sad to say we hear more about jobs than grave issues relative to safety and the protection of natural resources. But the best way absolutely to protect jobs in the Panhandle, whether in agriculture or at the Pantex Plant itself, is to keep the plant from becoming the next Rocky Flats. When that happens the only jobs will be for nuclear waste handlers and the state regulators who can only step in after the damage is actually done but who have no federally mandated authority over many of the processing functions being proposed. On top of the Ogallala Aquifer is the wrong place for long-term storage of plutonium, nuclear waste facilities, or any kind of plutonium processing. 6/09.04.08

TX-055

09 04 08 Comment Number 6

Potential impacts to groundwater quality are considered to be minimal at all facilities due to hazardous materials/waste handling and treatment/disposal Federal and State requirements.

2237 Peachtree Street
Amarillo, TX 79109
May 7, 1996

U. S. Department of Energy, Office of Fissile Materials Disposition
c/o SAIC-PEIS (S+D PEIS)
P. O. Box 23786
Washington, D. C. 20026-3786
FAX 800-820-5156

Dear U. S. Department of Energy
Office of Fissile Materials Disposition:

Thank you for the opportunity provided to the public to comment upon the draft Storage and Disposition Programmatic Environmental Impact Statement for Weapons-Usable Fissile Materials. I understand that I may also comment on the Pantex Sitewide Environmental Impact Statement. I would like to say that I have found it difficult to prepare comments based on the draft Documents, because I find them to be inconclusive in terms of what is being proposed for the Texas Panhandle, and I believe that others share this concern. Possibilities for Storage and Disposition are presented, but, partly because of unknown factors in safe storage and disposition of nuclear waste, high level or other, it seems that the PEIS is inconclusive. Perhaps the best proposal in such circumstances is to seek a safe storage program while furthering research for Pu and HEU at the sites where they are currently stored. This could result in an economy of funds in the long run. 1/01.04.00

I realize that an effort is being made to ensure the best results regarding the storage and disposition of high-level nuclear materials; however, if the best conclusions are not able to be reached at this time, further work may be necessary to insure the safety and security of our environment. Panhandle residents acknowledge the Ogallala Aquifer as the largest and most significant fresh-water resource in The United States. Isn't this very important as a factor in this study? The use of land for agriculture is prime in The United States: one in four Panhandle residents is employed in Texas agriculture. The Government could be aware that these are significant elements to be considered in a serious study such as this. Panhandle residents are also bottom-line aware of this, speaking on the issue or not. Our newspaper reflects upon agricultural concerns every day; if a problem is understood, there will be a public response in probability. The potential problem, as I understand it, lies in fully evaluating the environmental impact of storing more plutonium here, or working with it here in any way that will promote more active waste, dangerous to our soil and water. There is an airport here, accepting international flight connections. Our area residents are proud of the Panhandle with good reason! We have been and are patriotic citizens. 2/09.00.04

There is reason for the Department of Energy to take every effort to sort out possible alternatives for safe and reasonable storage of weapons materials without evoking problems at sites where clean-up work can now be managed (as we hope to presume is possible at this time at Pantex). Finding the best disposition for nuclear material should be accomplished before many more steps are taken; this would be a responsible thing to do before more decisions are made. It may be the long-term best decision to plan Storage and Disposition before moving more nuclear materials to this site, both in economic good sense and environmental sense. 1/01.04.00 cont.

Thank you for receiving these comments.

Mary L. Shennum

F-031

01 04 00 Comment Number 1

One of the screening criteria used for selection of reasonable alternatives to be analyzed in the PEIS is technical feasibility. To the extent possible, DOE will use existing and proven technologies for construction and operation of the storage and disposition facilities in the Proposed Action. Should new technologies be chosen for Pu disposition, DOE will demonstrate them prior to implementation.

09 00 04 Comment Number 2

Current and future operations at Pantex are not expected to affect the water quality of the Ogallala Aquifer. However, since this aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge), Pantex operations contribute to the depletion of the Ogallala Aquifer and are analyzed in the PEIS. Also, current and future operations at Pantex are not expected to impact the soil used for agriculture and farming in the Pantex region.

SHILLINGLAW, FAUN, APPLETON, WI
PAGE 1 OF 1

June 7, 1996
1952 Palisades Dr.
Appleton, WI 54915

US DOE
Office of Fissile Materials Disposition:

I would like to comment on the PEIS – Programmatic Environmental Impact Statement on Storage and Disposition of Weapons Usable and Fissile Materials which I understand a local Wis. Utility – Wis. Public Service at Kewaunee is interested in. I strongly oppose this misguided proposal. MOX use has proliferation problems and increases waste volume and radioactivity. Vitrification is the only prudent measure for public safety. You have created a waste problem. Don't put it at local plants in our back yards. We already have enough problems with casks of spent fuel having explosions at our nearby Pt. Beach plant the past week. These dangerous materials need great monitoring and careful handling. We certainly don't want MOX fuel in Wisconsin or any more nuclear waste creation. Please put the waste in a form nobody can use for weapons as soon as you can, and don't consider the MOX option. People in Wisconsin are very concerned about nuclear waste issues and MOX fuel will only add to the problems we already are dealing with now.

Thank you,
Faun Shillinglaw

1/08.03.01

2/08.03.01

1/08.03.01 cont.

2/08.03.01 cont.

M-272

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

SIERRA CLUB NATIONAL NUCLEAR WASTE TASK FORCE, TALLAHASSEE, FL, ELLEN WINCHESTER

PAGE 1 OF 2

Ellen Winchester, Editor
Nuclear Waste Briefs, Sierra Club
2405 Delgado Drive
Tallahassee, FL 32304
May 3, 1996

Mr. J. David Nulton
Director, NEPA Compliance & Outreach
Office of Materials Disposition
Department of Energy
Washington, DC 20585

Dear Mr. Nulton:

The Storage and Disposition of Weapons-Usable Fissile Materials Draft PEIS, as summarized, raises more questions than it answers. Because the discussion of alternatives is very repetitive, my comments concern general considerations that apply to several alternatives.

First, the PEIS does not sufficiently satisfy the question of safe isolation of fissile materials, both those in the inventory and those produced by the processing of fissionable materials for long term storage (defined as fifty years). Instead, it indicates that for each of the options considered, "the annual radiological dose to onsite workers would be within radiological limits, and the dose to the population living within 80 km (50 mi) of the site would be within 100 person-rem per year." The unstated implication is that a population dose of within 100 person-rem per year (person-rem is the average dose to a person multiplied by the number of persons exposed) is a harmless dose. 1/09.09.08

In contrast, the widely accepted BEIR Report of the National Academy of Sciences concluded that there is no threshold radiological dose. Thus even a very small dose to an individual could cause some irreversible damage. If the population size in an area within an 80 km radius happened to be small, a 100 person-rem per year population dose could allow a great deal more for individuals than our 100-200 millirem annual background dose (or the 360 millirem NRC has calculated as our average background dose). The PEIS seems to be saying that it is no worse to zap most individuals in a small population with a high dose, possibly lethal, than to spread the dose thinly in a large population.

Secondly, with regard to the dependance on MOX for waste vitrification and Pu burn-up, this question arises: Is the PEIS assuming a relaxation of US opposition to reprocessing? If so, this is a major shift in our no-reprocessing policy endorsed by every President from Ford to Clinton. Reprocessing has not been practiced by DOE since 1992, primarily because it would encourage world trade in Pu among countries depending on MOX and make nuclear proliferation more difficult to control. Why therefore does this PEIS operate on the premises that 1) burning mixed oxide fuel in reactors is an acceptable way to reduce stocks of plutonium or 2) that reprocessing is acceptable as a step towards providing the Pu content of spent fuel with greater stability through vitrification? If US power reactors burned MOX, our example for the rest of the world would be particularly poor. 2/01.06.00

We acknowledge that, should the US prohibition against reprocessing be lifted, an action the Sierra Club National Nuclear Waste Task Force would deplore, burning MOX would meet the spent fuel standard, but how would DOE handle the resultant spent fuel? Is it DOE's expectation that it would be stored "as is" in a permanent repository? If so, that is a questionable option. After several decades of work on geologic isolation no permanent repository has been licensed, and there is no certainty that within fifty years repositories with a capacity to store all of the nation's high level waste and spent fuel, including commercial spent fuel, will be built and licensed. 3/01.04.00

M-214

09 09 08 **Comment Number 1**

The health impacts from proposed Pu storage and disposition facilities during normal operation and potential accidents are analyzed and presented in the Final PEIS. The results include the radiation dose and latent cancer risk for the MEI, population within 80 km (50 mi), and the involved workers and their applicable radiation limit. The radiation doses are regulated by individual dose; not collective population dose. Proposed 10 CFR part 834 (see 58 FR 16268) would require an ALARA program and would generally limit the potential annual population dose to 100 person-rem/yr from all pathways combined for DOE activities. This requirement does not imply that the radiation dose for the MEI could exceed the respective regulatory limit. Actually, this is an additional radiation limit to the exposed public.

01 06 00 **Comment Number 2**

Burning weapons Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this disposition action will not be extracted for reuse in new fuel. The Reactor Option will utilize a once-through fuel cycle. Spent fuel will be disposed of with other commercial reactor spent fuel. This is consistent with U.S. policy since no Pu is being recycled. Pu would arrive at the reactor in the form of fresh fuel which could not be used in weapons without extensive reprocessing to extract the Pu. Necessary safeguards and security during the MOX fuel fabrication process and at the reactors would be provided.

01 04 00 **Comment Number 3**

The spent fuel produced from burning MOX fuel in reactors would be essentially the same as spent fuel currently produced by commercial reactors. This spent fuel would eventually go to a permanent geologic repository as in the case of commercial spent fuel. Although it is true that no permanent repository has yet been licensed, this option would displace spent fuel that would have otherwise been created by commercial reactors.

SIERRA CLUB NATIONAL NUCLEAR WASTE TASK FORCE, TALLAHASSEE, FL, ELLEN WINCHESTER
PAGE 2 OF 2

If, on the other hand, the MOX spent fuel is reprocessed in a lengthy recycling effort to harvest and burn the remaining Pu, the problem of storing the resulting high level wastes will still remain. These problems of safe storage and handling of MOX wastes, whether the spent fuel is stored as is or will be reprocessed before storage, are not clearly addressed in this PEIS. The omission is serious. We should remember that spent fuel is rich in hard to handle radioactive isotopes of transuranic elements, especially americium and curium, much richer than its unburnt components. Moreover, reprocessing produces a greater volume of highly radioactive wastes than the spent fuel reprocessed. 4/01.06.00

A member of the public has to sympathize with employees of DOE as they struggle to find ways to isolate fissile materials. Not the least difficult problem is guarding against criticality incidents, or even large scale disasters. These seem to be especially severe with regard to 1) the highly radioactive liquids produced by reprocessing, and 2) vitrification processes in which PuO2, by not dissolving completely, may clump enough to cause criticality. Nevertheless, the statement that "MOX fuel fabrication (but not reactor burning) at European facilities remains a reasonable short-term option . . ." sounds like an unacceptable effort to make an end run around difficulties and dangers (and possible environmental regulations) that should not be exported. 5/08.03.01

On the whole, the problems involved in reducing criticality risks seem equally hazardous, whether DOE opts (1) to vitrify Pu which, aside from stockpiles, would first require reprocessing to separate it from spent fuel (producing large volumes of highly radioactive liquid waste that must be perpetually kept cool) or (2) to carry out repeated cycles of burning and reprocessing MOX to reduce Pu stockpiles--but increasing the accumulation of HLW.

It may be that such hazards are reduced in vitrifying the immense amount of already processed Pu on hand in the PANTEX plant and Rocky Flats, which could presumably be fabricated into MOX. However, since the overall burnup of Pu in MOX is a slow process (because when Pu is loaded as fuel and consumed, some is also created by neutron capture by the U-238 in the mix), and more high level waste is being produced, burning the stockpiled Pu does not appear to be the perfect way to relieve the US of its embarrassment of Pu riches. As for vitrification, it may be as difficult to find long term storage sites for the vitrified but still highly radioactive Pu as it is for the unvitrified stockpiles. 6/01.02.00

I have not commented on the deep borehole alternative because it seems highly unlikely to be a serious candidate for an immense fraction of the tight DOE budget. In view of all the above considerations, if I were a decision maker in the choice of alternatives for DOE to pursue, I would favor the Long Term Storage alternative. However, I would add the proviso that, while making all of its existing facilities as safe to operate and as good neighbors as is now humanly possible, DOE should concentrate on developing methods of long term custodianship that will assure to future peoples the ability to maintain control of their fissile inheritance. 7/08.03.01

It would lighten the burden of those heirs of our rapid industrialization and wartime faith in technology if the US Department of Energy would be a world leader in phasing out the use of nuclear energy, with its accelerating accumulation of high and low level wastes, unless problems of both their long term isolation and short term custodianship can be solved.

Sincerely,
Ellen Winchester

Ellen Winchester
for the Sierra Club National Nuclear Waste Task Force

M-214

01 06 00 **Comment Number 4**

The President's Nonproliferation Policy says the United States will not recycle Pu. Burning weapons Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel.

08 03 01 **Comment Number 5**

The Department of Energy acknowledges the commentor's opposition to MOX fuel fabrication at European facilities. Criticality controls will be provided in the technical details of the alternative(s) chosen for both storage and disposition. Decisions on storage and disposition of weapons-usable fissile materials will be made based upon environmental analysis, technical and economic studies, national policy considerations, and public input.

01 02 00 **Comment Number 6**

The Pu disposition process would not involve reprocessing. In the case of MOX fuel burning in reactors, the Pu extracted from the weapons-usable fissile materials (not spent fuel) would be made into MOX fuel and consumed in reactors in a once-through cycle. The MOX fuel would displace uranium oxide fuel. The spent MOX fuel then would be disposed of in a geologic repository like other spent fuel from reactors. In the case of vitrification, the vitrified Pu would also be disposed of in an NWPA geologic repository.

08 03 01 **Comment Number 7**

The Department of Energy acknowledges the commentor's support for long-term storage of fissile materials. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

SIERRA CLUB, VIRGINIA CHAPTER, VIRGINIA BEACH, VA,
ROBERT F. DEEGAN
PAGE 1 OF 1

Robert F. Deegan
Sierra Club Virginia Chapter
[illegible] Road
Virginia Beach, VA [illegible]

"When we try to pick out anything by itself,
we find it hitched to everything else in the universe."
John Muir

June 7, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

Thank you for this opportunity to comment on the Programmatic EIS on Storage and Disposition of Weapons-Usable Fissile Materials. Please add my name to the mailing list for all future information on the PEIS.

The alternative of MOX reactor fuel to dispose of plutonium should be discarded. Using electric utility reactors for this purpose would be particularly unwise and raise problems of reactor safety in the steadily aging utility reactors. Moreover, the MOX reactor fuel would add to reactor site security problems and nuclear waste disposal problems. 1/08.03.01

Yours respectfully,

Robert F. Deegan

Robert F. Deegan

Nuclear Waste Issues C airman

Robert F. Deegan
Sierra Club Virginia Chapter
[illegible] Road
Virginia Beach, VA [illegible]

M-271

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

SIMS, LYNN, PORTLAND, OR
PAGE 1 OF 3

Thank you for the opportunity to comment.

As far as I know USA is the only country considering public comment on this extremely important and historic decisionmaking concerning the worldwide dilemma of plutonium disposition. The inclusion of the public voice is certainly at least one step in the right direction, for after all, the bomb and its horrific legacy was created in the first place to protect and defend Democracy.

I hope the voices of the ordinary public, as distinguished from the industrial, commercial or political public, will carry great weight. The nature of this problem is so profound and eternal that it is absolutely necessary to reach beyond the scientific, technologic, political and economic considerations. We must contemplate what decision will be wise, what will reflect the best nature of humankind and what will set the stage for the possibility of a reasonable and manageable vision of the future for generations upon generations upon generations to come. 1/08.02.00

What a task to comment upon. The multifaceted dilemmas, the complexities, the inability to estimate and predict consequences and situations and technology availability into tens of thousands of years into the future make policymaking quite overwhelming, yet a path must be chosen. The day of reckoning as best we can with the legacy we have created has begun.

Certainly we cannot store plutonium for a long term, but in the short term it is necessary to provide funds for plant security, road and storage bunker maintenance, upgraded radiation detection equipment and alarms. To choose a long term storage option would indicate a stockpile policy that indicates we will value and use plutonium, which is a dangerous signal for the development of a rational and comprehensive world policy. 2/08.03.01

I believe the option to use plutonium in MOX plants is equally dangerous and UNWORTHY OF IMPLEMENTATION. In the first place policymakers and utility companies rejected this concept some years ago. Not only would we have to construct processing facilities, but we would have to assume the risks associated with fuel fabrication and assume the costs of licensing, transporting and safeguarding connected with this, let alone contending with the actual accounting for the amounts of plutonium in blended fuels and spent fuels plus the attendant disposition problems associated with the creation of more radioactive waste streams. 3/08.03.01

F-016

08 02 00 **Comment Number 1**

All comments provided to DOE carry equal weight. The comments will be analyzed and responses provided as part of the Final PEIS.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to continuing or long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

The Science and Global Security Disposition of Separated Plutonium position paper states that "commercial recycling of plutonium raises troubling ECONOMIC AND SECURITY issues. Even if plutonium is considered a "free good" (so none of the costs of reprocessing are charged to the cost of the MOX fuel), a utility using MOX will incur a cost penalty of $200-$500 per kilogram of MOX, assuming a uranium price of $40 per kilogram...this cost differential implies a cost of recycling 100 tonnes of weapons-grade plutonium in MOX of about one half to one billion dollars. Extra inspection effort and physical security would also have to be extended to reactors using MOX fuel." This is a very expensive option in more ways than one.

It is obvious that the nuclear industry would welcome a second wind and a whole new generation of plants to extend this sagging industry, but our plants are aging, the true and comprehensive health, environmental and economic costs of nuclear power are becoming more evident. The whistleblowers are crying to be heard and the Nuclear Regulatory Commission is fast losing credibility with the public. Using the MOX option would be a bad decision. It would promote the siphoning of research and development monies away from long neglected R&D for alternative, sustainable energy resources. Using the MOX option would indicate to other countries that this sort of recycling, sort of distorted wise use is acceptable. How then could other countries ever be persuaded to stop any civilian use of plutonium? The MOX option creates more radioactive waste, maybe not quite as usable for a terrorist bomb, but none-the-less it is a bomb, a terrible relentless assault upon the environment virtually forever. It is not acceptable. Any union of "military special nuclear material waste" with some kind of civilian, utility, industrial use for squeezing risky, costly energy dollars out of it is appalling and alarming and should be immediately withdrawn from the options list!! 4/01.06.00

There may be no such a thing a safe, secure and environmentally sound storage and ultimate disposition solution. If vitrification is shown to be workable in this country it may provide a possibility of isolation from the environment and the hands of man. Immobilized disposition in a borehole pending finding a suitable site seems to make sense if security is assured. 5/08.03.01

If it is true that a focus of the U.S nonproliferation policy is to establish nuclear reductions, then it should be noticed that every nuclear power plant produces plutonium in spent fuel and it should be emphasized that Plutonium should be declared a waste, a liability and should be named illegitimate.

F-016

01 06 00 Comment Number 4

Using surplus Pu as MOX fuel in reactors is a one-time event. This approach to Pu disposition is not planned as the beginning of a Pu fuel cycle. In the United States Pu will not be recycled, but will be used as a once-through fuel cycle and the spent fuel will be disposed of. Fuel will not be recycled to extract residual Pu for reuse as fuel. If Pu is not extracted for reuse, it will not be available for reuse in weapons.

08 03 01 Comment Number 5

The Department of Energy acknowledges the commentor's support for borehole disposition using the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

It is true that this problem encompasses everyone from now on. We need more than intelligence, strategy, interdepartmental and international cooperation, more than adequate technology and sufficient funds, we need vision and wisdom and at this time it is those elements that also must be formulated and articulated.

It is time for a national comprehensive review to examine, coordinate, update and articulate an integrated nuclear policy. The U.S. has a chance to lead the world in the right direction in these serious undertakings and policymaking and we all pray we do a good job. | 6/01.00.00

Respectfully submitted,

Lynn Sims

Lynn Sims
3959 NE 42
Portland, OR 97213
(503) 287-6329

F-016

01 00 00 Comment Number 6

The purpose of the PEIS is to evaluate environmental impacts of alternatives for storage and disposition of weapons-usable fissile materials. The PEIS does not cover the much broader issue of an integrated nuclear policy in the United States.

June 7, 1996

J. David Hulton
Office of Fissile Materials Disposition
PO Box 23786
Washington, D.C. 20026

Dear Mr. Hulton,

As the deadline approaches for the formal comment on the DPEIS for the Storage and Disposition of Fissile Materials, I can not help again considering the enormity and complexity of the problem. Although I have already outlined opinions in a prior statement, I must now reiterate my strong opposition to the reactor alternative, even in combination with other options.

Not only would the reactor alternative legitimize plutonium in a commercial circuit, sending a message of its "value" to other countries, but that option would also create more streams of wastes, an unacceptable consequence. Moreover, once a system for such "reprocessing" is in place, it is naive to believe that it would ever end. It is a situation similar to "being a little bit pregnant". Either we choose to enter the dangerous plutonium age or we don't. Now is the time for historic and perhaps unalterable decision making. 1/08.03.01

Do not choose the reactor option for any part of "disposition". Mankind cannot manage it at this time.

Sincerely,

Lynn Sims

Lynn Sims
3959 NE 42
Portland, OR 97213
(503) 287-6329

F-061

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

SINGLETON, DON, AMARILLO, TX
PAGE 1 OF 1

May 3, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026

I am opposed to the storage of plutonium at Pantex.

Certainly you can find a place where there will be less damage to people, crops, the water table, and transportation routes when radiation is released than the Panhandle of Texas. 1/08.03.01

I know that this must be stored somewhere, but please. Not here.

Sincerely,

DON SINGLETON
6614 Roxton
Amarillo, Texas 79109

M-121

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

May 4, 1996

United States Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
Washington, D. C. 20026-3786

I am opposed to the storage of plutonium and any other nuclear waste at Pantex. I feel that the risks to our water and agricultural products are too great. 1/08.03.01

I realize that we've gotten ourselves in a dilemma and there probably isn't anywhere to put it. Surely, though, more research will indicate a site which is less a threat to the nation's breadbasket. Here at Pantex is shortsighted and unconscionable.

Sincerely,

Donna Singleton

M-155

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

SLAGGLE, NORBERT, SHAMROCK, TX
PAGE 1 OF 1

Comment ID: P0034
Date Received: May 1, 1996
Name: Norbert Slaggle
Address: Route 2, Box 83
Shamrock, TX

Transcription:

Just wanted you to know I oppose any further expansion of Pantex. Would urge you really to go the other direction. The agricultural impact a disaster could have would be terrible, not only on the water supplies in the Ogalalla, but also in the contamination of land all around the area. Agriculture should come first. The location of nuclear weapons and storage should be in areas where there is little or no agriculture or not as nearly productive as agriculture is in the Panhandle of Texas. Thank you. 1/08.03.01

P-034

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. Potential impacts to groundwater quality are considered to be minimal at all facilities due to hazardous materials/waste handling and treatment/disposal Federal and State requirements.

SMITH, DORIS
PAGE 1 OF 2

April 22, 1996

To the United States Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

In a democracy the voice of all people should be listened to and considered in decision-making when policies so greatly affect grassroots America. Being concerned with the preservation of rural America, I am seriously troubled by the Programmatic Environmental Impact Statement prepared for the Department of Energy regarding Storage and Disposition of Weapons-Usable Fissile Materials.

Although I recognize the need to assure safe, secure, long-term storage and disposition of the significant quantities of surplus fissile materials, which include plutonium (Pu) and highly enriched uranium (HEU), I believe this document fails to address very critical human issues. 1/09.00.04

In reviewing the alternatives for the possible future of Pantex, it becomes very evident that all of the nation's weapons-usable plutonium not in active warheads would be stored at Pantex - 20,000 pits, plus much of the plutonium now at Rocky Flats Plant, Colorado; Hanford, Washington; Los Alamos, New Mexico; Savannah River, South Carolina; and the Idaho National Engineering Laboratory.

Before 1989, plutonium pits were never stored at Pantex. However, with the closing of Rocky Flats, Pantex is the interim storage site for at least 12,000 pits. Now this document proposes not only storing plutonium pits, but other more undesirable forms of plutonium.

Once stored at Pantex, this site is being considered for a plutonium pit disassembly/conversion facility to cut the pits and process them into metal or oxide; a plutonium conversion facility to process other types of Pu; a facility to mix plutonium with uranium to make mixed oxide fuel (MOX); nuclear power reactors to use the MOX fuel, plus storage of the spent fuel from the reactors, as well as storage of all the mixed waste generated from all these processes. It is processing of plutonium which has contributed to the national environmental degradation which saddles our nation with a $300 billion dollar cleanup problem.

This document states there would be few negative effects from doing any and all of these activities at Pantex. What the document fails to address is the impact on the good reputation of our agricultural products. Agriculture is the one industry which has consistently sustained the Panhandle for decades.

The food chain begins here in the prime agricultural farmland of the Texas Panhandle. The meat products and cereal grains produced here are shipped throughout the world; 25% of the Nation's beef is produced and processed here. The quality and wholesomeness of these products would be placed in jeopardy with the siting of these processes at Pantex. Without production agriculture this part of Texas would cease to exist. When one of every four people is employed in an agriculture related job, the loss to this High Plains trade area of these jobs would create untold problems.

A second issue the document fails to address is the location of Pantex above the Ogallala aquifer, the source of groundwater for the plains of Texas and seven other Midwestern food producing states. With high explosives, chemicals, solvents, and radioactivities, Pantex has contaminated the fine grained layer of water bearing muds above the Ogallala aquifer. With the downward migration of the recharging waters, how long will it be before the Ogallala itself will be contaminated? 1/09.00.04 cont.

Water and agriculture are the real wealth of the Texas Panhandle. Without them there would be no "Texas Panhandle." We cannot stand by and allow these resources to be compromised in any way. Food is the most important commodity we have - it must be protected.

Not all alternatives for siting these processes at other sites were analyzed in this document. Before choosing a preferred alternative, other options need to be considered. The siting of these missions at Pantex means shortsighted and ill-conceived. The environmental impact in conjunction with these processes has the potential to devastate this food producing region.

The Panhandle is too valuable to be used as a plutonium storage, processing and waste facility.

Sincerely,

David Smith
As a member of the Pantex Plant Citizens Advisory Board I oppose Pu Storage at Pantex and strongly oppose any processing 2/08.03.01

M-112

09 00 04 **Comment Number 1**

Radiological and chemical releases resulting from the Proposed Actions for normal operations would be within Federal and State regulatory limits. Therefore, the quality of agriculture in the Panhandle would not be affected, and agriculture-related employment in the Panhandle region would remain unaffected.

Also, current and future operations at Pantex are not expected to affect the water quality of the Ogallala Aquifer. However, since this aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge), and since Pantex operations contribute to the depletion of the Ogallala Aquifer, impacts to the aquifer were analyzed in the PEIS.

Current and future operations at Pantex are not expected to impact the soil used for agriculture and farming in the Pantex region. All activities will be limited to Pantex and any impacts to the surrounding areas are within Federal, State, and local regulatory limits.

The PEIS includes analyses on the radiological and chemical impacts to workers and the public from both normal operations and accidents. These analyses also address the effects to local plant and animal resources as well as the effects on prime farmland.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

of plutonium over the Ogallala aquifer. It makes no sense to have the most deadly radioactive material in the world in the middle of production agriculture. It's like putting poison in your cereal bowl.

Thank you for your consideration of this major issue. Doris Smith

2/08.03.01 cont.

M-112

Comments for PEIS Public Hearing on
Storage and Disposition of Weapons-Usable Fissile Materials
and
Stockpile Stewardship and Management
Amarillo, TX April 22, 1996
Doris Berg Smith

In a Democracy the voice of the people is important in any decision-making policies regarding how our government will manage surplus nuclear materials and what forms of disposition are being considered. At this time it is vital that all the right questions are asked to protect the natural resources of this area for the future generations of not only the Texas Panhandle and the State of Texas, but of the world.

Many issues come into play in this very over-arching discussion. Not the least among them the cost to us the taxpayer to produce these documents and to find them flawed in many ways. These Documents are lacking important information in many areas that make it virtually impossible to even begin the discussion.

The over-all cost to you and me, neighbor, for implementing the expensive options characterized in these documents are not prudent or wise. Why is the Department of Energy so intent on building new Research, Development and Testing facilities when the entire world is looking to the U.S. for leadership in an extension of the Non-Proliferation Treaty, and a zero threshold for a Comprehensive Test Ban. Instead the intent seems to be continue to build and test!

In the SSM-PEIS the scenario for these options, in a downsizing of the nuclear weapons complex, alone is expected to exceed $30 Billion within a decade. These proposed new facilities are expensive! In this time of tight budget constraints, we the grassroots people should be imploring our Congressional leaders to stop all this massive spending on projects which lead to a build up in nuclear weapons. How many weapons do we need before we say, "That's enough?" How many nuclear warheads have we used?

It is time now, with the downsizing, to really actively pursue REAL D NSIZING. Do we want to continue to drag our country into further indebtedness by continuing nuclear weapons production? What is the real reason behind pouring dollars into Defense - are we trying to keep war and war games going in the pretense that this is the way to build peace and to achieve economic development in rural communities across America? This is a 'sunset industry', my friends and neighbors, and needs to be managed as such.

What will the DOE and "We" do with all the waste that will be generated for at least the next 20 years? There are no licensed facilities to accept the wastes that are piled up on facilities throughout the DOE Complex at this time - why generate more than needs to be generated. 1/12.03.00

We are now faced with storage and disposition of surplus fissile materials, every option considered has tremendous waste streams attached to any option. Where will this waste go? It seems quite evident that the site that creates the waste, keeps the waste. Will that saddle communities across this country with the economic and environmental problems of hosting waste treatment, storage and processing facilities?

TX-066

12 03 00 Comment Number 1

As noted in the PEIS, TRU wastes will be stored at the disposition site(s) until geologic disposal is available. The products from the Immobilization Alternatives would also store the immobilized Pu product until geologic disposal is available.

SMITH, DORIS BERG, AMARILLO, TX
PAGE 2 OF 2

In the PEIS's where were the impacts to the present agricultural economy which has built and sustained this area? Why were the risks to this economic stronghold not assessed? What will happen when we no longer produce food for people, where is our priority? Are bombs more important than food? We in agriculture strive to produce quality,wholesome food for the world population -one farmer feeds in excess of 131 people, yet the industry across the road from us builds bombs to annihilate people. Where is our sense of morality and respect for life? — 2/09.00.08

The documents fail to address the issue of the location of Pantex over the Ogallala Aquifer. Water and agriculture are the real wealth of the Texas Panhandle, without them there would be no "Texas Panhandle". Food is the most important commodity we produce - it must be protected.

Not all alternatives for siting the processes for storage and disposition were analyzed - if Manzano Weapons Storage Site at Kirtland Air Force Base has facility that could store 30,00 pits, why was it not further characterized in the other documents? — 3/01.05.00

We say to you DOE, we want no storage of surplus plutonium at Pantex because it is dangerous and will lead to plutonium processing which results in additional waste generation and storage. — 4/08.03.01

No processing of plutonium at Pantex since every plutonium processing facility has created large amounts of contamination which has adversely affected the workers and the public.

No waste disposal facilities at Pantex because we must preserve and protect the Ogallala aquifer. — 5/09.04.08

Historically the plutonium at Pantex has been in pit form, now with these documents all of a the nation's weapons-usable plutonium not in active warheads will be stored at Pantex - plutonium will come to Pantex from Rocky Flats, Colorado; Hanford, Washington; Los Alamos, New Mexico; Savannah River, South Carolina; Nevada Test Site; and the Idaho National Engineering Lab. We find this unacceptable to an agricultural productive area.

No nuclear power reactors at Pantex - there is no need to construct them and the use of MOX fuel in them will not destroy the plutonium - it only creates more plutonium.

Please do not turn the Texas Panhandle, known for its beef and cereal grain production, into a plutonium waste site. You have created enough of these tragic land problems across the United States - the is no need to create another one here. It is very much like putting poison in your cereal bowl! When this area becomes contaminated - what have we gained? — 4/08.03.01 cont.

TX-066

09 00 08 **Comment Number 2**

Any radiological and chemical releases resulting from the Proposed Alternatives would be within regulatory limits. Therefore, the quality of agriculture in the Panhandle would not be jeopardized, and agriculture-related employment in the Panhandle region would remain unchanged.

Also, current and future operations at Pantex are not expected to affect the water quality of the Ogallala Aquifer. However, since this aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge), Pantex operations contribute to the depletion of the Ogallala Aquifer and are analyzed in the Draft PEIS.

Current and future operations at Pantex are not expected to impact the soil used for agriculture and farming in the Pantex region.

01 05 00 **Comment Number 3**

Combined storage of pits and non-pit Pu at the Manzano WSA was originally eliminated as a reasonable alternative in the Draft PEIS. After considering separate storage of pits from non-pit Pu, the option to store these pits at the Manzano WSA no longer appears unreasonable. The Manzano WSA was evaluated in the Pantex EIS and Section 2.1.3 of the Final PEIS. The Final PEIS was revised to clarify the consideration of the Manzano WSA for combined storage, and a description of the WSA was included in Appendix P.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 04 08 **Comment Number 5**

Potential impacts to groundwater quality are considered to be minimal at all facilities due to hazardous materials/waste handling and treatment/disposal Federal and State requirements.

SMITH, FRANK WHITE, BOULDER, CO
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Mr. Thomas Grumbly , UnderSecretary of Energy
Dept of Energy, 1000 Independence Avenue, S.W
Washington, D.C. - 20585

June 2, 1996

Ref: Enclosures

My dear Mr. Secretary:

Budget limitations promise to kill progress at Rocky Flats, so the former weapon silo proposal is an option for you to consider in the draft PEIS on Storage and Disposition of weapon-usable fissile materials. It is a budget-maker that could save costs of both storage capacity and security until a disposition facility is on line, and should be in our interest to reduce our cost for plutonium security in Russia.

An Environmental Impact Statement on Storage and disposition of weapon-usable Fissile Materials fail;s to propose observable U.S. and Russian storage of pits from weapon dismantlement and stabilized, canned weapon-usable fissile material now poorly-held at Rocky Flats and at Pantex. I propose feasibility study of their storage in Minuteman silos, until our surplus fissile materials can flow to disposition, not wasting U.S. or Russian silos by implosion. 1/14.00.00

I am writing to the President and Speaker and others, asking for feasibility study of Minuteman silos ... to capture great potential budget savings (silos having been found feasible for inert storage), as economical, hardened interim-storage sites already in place in both the United States, and in Russia.

Minuteman silos here are such unique assets, young enough in their design-lives to furnish the U. S. and IAEA secure and accountable storage on both our own store of pits, and the stabilized canned inventory to flow from Rocky Flats. Perhaps with Russians witness of our sealing silos here they will match us, with silo storages witnessed there, until future means of disposition are in place and agreed upon for both inventories. I believe you should expect the Russians to also recognize silo storage as a budget-maker, with costs of both facilities and guarding them militarily a least controversial method for both nations for adequate defense and security, under IAEA oversight. 2/15.00.00

My references show that some 1,000 Minuteman silos were built, and Nightline recently reported only 138 wasted so far by implosion; they were shown robust, hardened, and easily servicable for loading missile-conformal casks of pits and canned fissile inventory, using Air Force missile-erection vehicles servicing sites today.

M-286

14 00 00 **Comment Number 1**

The use of existing facilities at non-DOE sites for storage has been considered but was eliminated in the screening process. The reasons for the elimination include cost, environmental, safety, and health concerns, and public and institutional acceptance. In the case of a DoD site, the additional costs and regulatory requirements for support facilities such as radioactive materials analytical laboratories, radioactive waste treatment, and nuclear material processing facilities associated with long-term storage could be very high. Furthermore, the public and other Government agencies would express concern over creating another DOE nuclear site when several are being phased out.

15 00 00 **Comment Number 2**

Comment noted.

SMITH, FRANK WHITE, BOULDER, CO
PAGE 2 OF 4

And please note that Warren AFB's silo-squadrons in Colorado-Nebraska-Wyoming were studied in the EIS cited for Peacemaker, which found the silo locations benign, most importantly as lacking seismic risk, but also benign on all other environmental parameters.

I am a Rocky Flats stakeholder on Plutonium and HEU vulnerability here, and have found that because of treaty requirements, your Manager has not pursued feasibility study of former weapon silos. Pits, however, are at the DoD/DoE interface, and both Departments have the duty (and need) to economize weapon dismantlement-and-storage in both the United States and Russia. Both should search out the most affordable means of addressing the holding of fissile materials in secure, monitorable and economical interim storage.

Minuteman silo infrastructure interim-storage may well help you workaround the probable NIMBY contest(s) against interim-storage options inside the Weapons Complex, since remote silo sites, to their rural neighbors, are risks no greater than at present from armed weapons in their silos, to which they have become accustomed:

- inert-gassed storage of pits and 50-year canned inventory, in a particular silo that now holds an armed weapon would in fact reduce specific risk to its neighbors; and

- the population at risk around inerted silos used for storage of pits and 50-year canned inventory, is greatly less than urban populations at risk in Denver and Amarillo, and thus justify silo interim-storage.

1/14.00.00 cont.

Storage of fissile materials in metropolitan Denver upwind of more than two million people and a seat of government, and the storage of pits in targetable, unhardened surface bunkers, already at storage capacity on Pantex, near Amarillo's population _ per the O.T.A. reference, fully justifies feasibility study of the former weapon silo alternative, for inerted interim storage of fissile materials in facilities kept under military surveillance of the highest order by the Air Force..

And in Russia, silos are also likely located far from metropolitan centers as well, a compelling point of mutual interest and justification which, if silos are found feasible, could easily lead to the mutual abandonment of treaty-required silo implosion.

Mr. Secretary, I have no need-to-know, but the several others listed below do have the need to learn that engineering, security, risk and cost feasibility of weapon silos are in fact not feasible. And they will be eager to hear of the Finding which, if positive, will save budget resources for many other pressing needs than interim-storage, under the severe budget limitations facing Defense and Energy.

Now finally, the Draft Environmental Impact Statement on long-term Storage and Disposition of Weapons-Usable Fissile Materials, under Dr. Canter's leadership, does not look outside DoE sites for storage options, but has recognized Denver's 2.3 million people at risk, and on-site storage at Rocky Flats terrorist-targetable. I hope you will direct the proposed feasibility study now, so that it will have been considered in the Secretary's Record of decision that will flow from draft DoE/EIS-0229-D, written without any off-site storage option. And naturally enough, the proposal is an inert-gas storage option against the new on-site storage facility you committed to build here for the Rocky Flats inventory of casked, canned, stabilized inventory. 3/01.01.00

You agree in principle, I am sure, that the feasibility of using former Minuteman silos, in cooperation with the Air Force, should not be overlooked for interim-storage, with near-term silo availability also assured for better security in the weapons-dismantlement program.

At your disposal, and red-badged for Rocky Flats Plant

Frank White Smith
285 Mohawk Drive
Boulder, CO - 80303

Copies to: President and Speaker, Sec. O'Leary and Perry; House Members Schaefer, Schroeder and Skaggs; Senators Lugar and Nunn; Gov. Romer and Lt. Gov. Dr.Schoettler; Dr. Canter and Wm. Rask, DoE.

M-286

01 01 00 **Comment Number 3**

The Department of Energy's Proposed Action for storage of weapons-usable fissile materials includes moving the weapons-usable Pu out of RFETS and into one or more designated storage facilities at the selected storage sites. The planned schedule calls for these long-term storage facilities to begin operation in the year 2005. Interim storage of various nuclear materials at RFETS is addressed in the RFETS Interim Storage EIS.

SMITH, FRANK WHITE, BOULDER, CO
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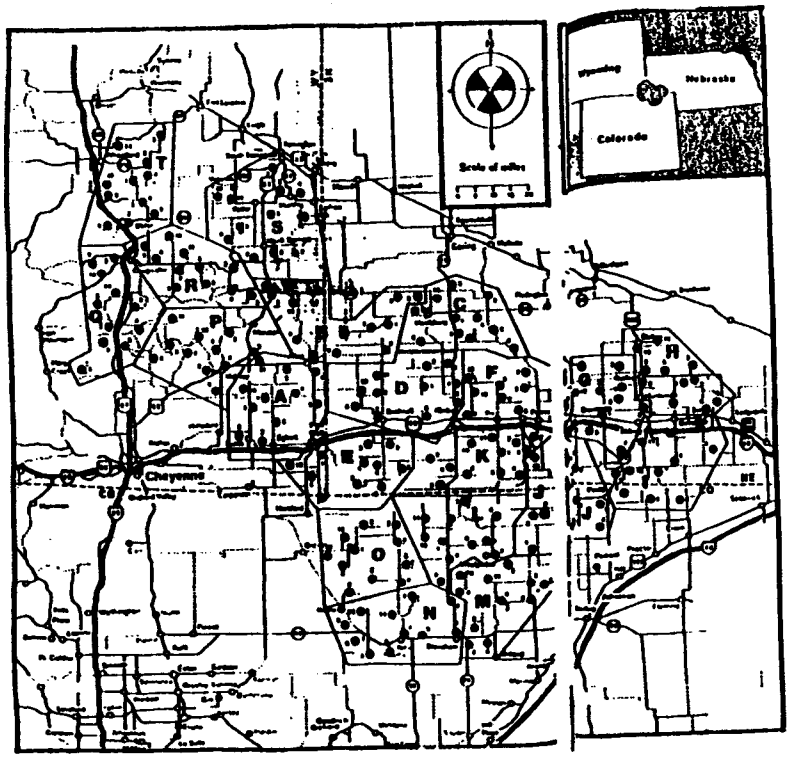

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SNAKE RIVER ALLIANCE, BOISE, ID,
ROBERT MCENANEY
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Snake River Alliance

P.O. Box 1731 · Boise ID 83701 · 208/344-9161
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June 6, 1996

Mr. J. David Nulton
Director
Office of NEPA Compliance and Outreach
Office of Fissile Materials Disposition
U.S. Department of Energy
P.O. Box 23786

Washington, D.C. 20585
By FAX: 1-800-820-5156

Dear Mr. Nulton:

The Snake River Alliance is an Idaho-based citizens organization that has served as the citizen monitor of activities at the Idaho National Engineering Laboratory for the past 17 years. We have 1,200 individual, family, and business members, most of whom live in southern Idaho. On their behalf, I offer the following comments on the *Storage and Disposition of weapons Usable Fissile Materials Draft Programmatic Environmental Impact Statement.*

The Snake River Alliance's primary concerns are:

The Disposition Draft PEIS Might Actually Promote Proliferation
Some of the alternatives in the Draft PEIS do not reduce the risk of proliferation. In fact, two of the proposed disposition options might encourage further proliferation throughout the world. President Clinton's Presidential Decision Directive No.13 directs the United States to eliminate stockpiles of highly-enriched uranium and plutonium to reduce the global risk of proliferation. Two of the three proposed disposition technologies do not necessarily eliminate these stockpiles from being used in a bomb. Electrometallurgical reprocessing and placing plutonium in a reactor only recycle plutonium. Part of the problem is the stored weapons standard

1/01.06.00

F-066

01 06 00 Comment Number 1

The purpose of the PEIS alternatives, including the Electrometallurgical Treatment Alternative and the Reactor Alternative using MOX Fuel, is to provide potential paths forward to make this Pu as inaccessible for weapons use as the much larger and growing quantity of Pu that exists in spent nuclear fuel (Spent Fuel Standard). These alternatives would convert Pu to a much more proliferation-resistant form for disposal in a geologic repository. While the residual Pu could be recovered through the reprocessing before disposal, such reprocessing of this form, it would be technologically difficult, costly, and would involve high radiation exposure; thus, theft or diversion would be highly visible and no more likely than retrieval of the Pu from the much larger inventory of spent fuel produced over many decades of commercial reactor operation.

SNAKE RIVER ALLIANCE, BOISE, ID,
ROBERT MCENANEY
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used in the Disposition PEIS is practically interchangeable with the spent fuel standard. DOE claims that the spent fuel standard will ensure that stockpiled materials will be rendered inaccessible. The DOE also defines under the spent fuel standard spent fuel as a resource. By this logic, stockpiled material-plutonium and HEU might still be considered resources also. This is the case under the electrometallurgical treatment process alternative and the reactor category. Both technologies do not permanently dispose of the stockpiled material so that it can never be used again. Plutonium and HEU under both proposed categories could be recycled to be used in a bomb. Even if disposed material is never recycled in the U.S., it sets the wrong example for the rest of the world. If the U.S. does not permanently dispose of stockpiled material, it makes it more difficult for the U.S. to implement global policies with other nations to reduce the world's stockpiles of bomb grade material. 2/01.04.00

Even a worse message would be sent if DOE chooses to implement the reactor category in the Disposition PEIS. For one, it directly violates the President's directive that the "United States does not encourage the civil use of plutonium." Using plutonium or HEU in a reactor only encourages a plutonium-based economy in the U.S.; and for the rest of the world also. Potential bomb-building countries will find it far easier to justify the use of plutonium-based reactors under the guise of a civilian program because of the precedent set by the U.S. It would be far more difficult for the U.S. to discourage potential new bomb building countries from abandoning their own plutonium reactor programs if the U.S. cannot eliminate its own use of plutonium in a reactor program. 3/01.06.00

The DOE should use the Nuclear Waste standard in order to ensure that the disposition program meets the President's own directive. DOE should remember that a major reason we are dealing with the mess of stockpiled materials in the first place is because it applied the spent fuel standard to irradiated reactor material. So long as we consider spent fuel as a resource, there will always remain the possibility that spent fuel could be one day reprocessed again in order to extract the plutonium and the HEU for bomb building purposes. It is not unreasonable to think that the same type of logic that justified reprocessing spent fuel in the past is now being applied to plutonium and HEU in the Disposition PEIS. So long as these materials are defined as "resources," DOE cannot adequately carry out the mission of forever ensuring that these materials cannot be used in nuclear bombs. 4/01.06.00 5/01.04.00

The Disposition PEIS Does Not Justify Disposal Alternatives
The Disposition PEIS ruled out a number of technologies because it was found that certain technologies just could not make it to the table as working proposals for the draft Disposition PEIS. A number of deep 6/01.05.00

F-066

01 04 00 **Comment Number 2**

Technologies that meet the Spent Fuel Standard will convert surplus fissile materials to a form that is inaccessible for reuse in weapons. HEU is considered a resource if it can be blended down and used in fresh fuel for nuclear reactors. Although Pu can also be used in fresh fuel (MOX) for nuclear reactors, it is not generally considered a resource because uranium fuel can be produced more economically. The cost of burning MOX fuel in a reactor, although not as economical as all uranium fuel, is somewhat reduced because of the revenues produced from electricity production. However, HEU and Pu are not considered resources after they have been burned in reactors and have achieved the Spent Fuel Standard.

The Electrometallurgical Treatment Alternative would place Pu into a glass-bonded zeolite (GBZ) waste form that would be sent to a geologic repository for disposal. The Pu under this alternative would not be used in a reactor.

01 06 00 **Comment Number 3**

Comment noted.

01 06 00 **Comment Number 4**

The President's Nonproliferation Policy states the United States will not recycle Pu. Burning weapons-usable Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel.

Decisions on disposition of weapons-usable fissile materials will be made based on environmental analyses, technical and economical studies, national policy considerations, and public input.

01 04 00 **Comment Number 5**

The spent fuel that would result from burning weapons-usable fissile materials in reactors is not considered a resource, nor is existing spent fuel from domestic commercial nuclear reactors. Reprocessing of materials that meet the Spent Fuel Standard is not proposed under the disposition effort.

geologic alternatives such as "Injection into Continental Magma" or "Emplacement in the Sub-Seabed" were found to be "Immature and "very immature." There certainly is no dispute that a number of similarly ruled out options are indeed immature. But it is then even more difficult to comprehend why those technologies that made it to the draft are any more "mature" than those that were ruled "immature." The Disposition PEIS does not provide an adequate background nor are there any accompanying studies that elaborate why alternatives like the deep-bore hole option are mature. It would not be that daring to assert that the current disposition proposals are indeed "immature" also. The deep-bore hole suggestion has no associated real world experience that can at all justify whether it will ever be an adequate option. The same also applies to the reactor category and the electrometallurgical reprocessing proposal. Not a single disposition option has truly been tested in real world terms. It is safe to say that it is immature of DOE to go ahead and proceed with technologies that have not been tested. 6/01.05.00 cont.

What is more troubling is the inability or the unwillingness of DOE to adequately anticipate all of the future impacts of its disposition alternatives. The disposition PEIS claims that if and when any of these disposition technologies are implemented, any unforeseen impacts will be addressed by future site specific PEIS's. The Disposition PEIS should address any impacts associated with disposition technologies now, not later. To implement a disposition option with a wait and see attitude is simply unacceptable. If there any impacts concerning any of the alternatives, they must be addressed in this document. Either DOE is not providing the whole story in the Disposition PEIS, or it understands that the breadth of this PEIS at this point is truly in the immature stage. Whatever that answer might be, DOE does not address the actual imparts of any of these disposition technologies. There is simply not enough information to go on to make a sound decision about plutonium and HEU disposition. 7/01.02.00

Specific Concerns About the Electrometallurgical Treatment Alternative at Argonne-West

There are major contradictions within DOE policy when it comes to dealing with materials that are potential proliferation risks. In one instance DOE states that reprocessing to generate fuel for a reactor is an incompatible option for disposition because "during reprocessing to separate Pu from spent fuel to fabricate more fuel, there are stages in the processing and handling when weapons-usable materials are more vulnerable to theft or diversion than the stored weapons standard." Despite this kernel of truth, the DOE has decided to go ahead with a reprocessing technology whose original purpose was to do exactly that-generate fuel to be used in a

F-066

01 05 00 Comment Number 6

The process and justification for selection of technologies evaluated in the PEIS are described in a separate Screening Report prepared by DOE and in Chapter 2 of the PEIS. A number of alternatives involving placement of materials below the earth's surface were considered, including emplacement in the sub-seabed and injection into the earth's magma. There is little data available to support these options and the retention of Pu in these media is questionable. A major concern would be the environmental impacts of any release of Pu materials following emplacement. Furthermore, the time and cost of developing these technologies would be significant and the outcome uncertain. It is expected that regulatory requirements would be extremely difficult to achieve, and that these would be internationally sensitive particularly if international waters were involved. Therefore, these types of technologies were eliminated from consideration. Although the Borehole Option considered in the PEIS is less mature than the Reactor and Immobilization Alternatives considered, it was found in the screening process to be mature enough for inclusion as an option in the PEIS. It was also recommended for study by the NAS in their 1994 study on the *Management and Disposition of Excess Weapons Plutonium.*

01 02 00 Comment Number 7

The PEIS analyzes six DOE sites for many of the facilities, and generic sites for some facilities such as the borehole complex. All facilities are described in terms of their conceptual design. The intent of the environmental analyses is to provide a bounding condition for the impacts, which would be sufficient for comparison of the alternatives at this time. Once the disposition technologies have been selected for implementation, DOE would invest in more detailed facility designs, testing and demonstrations, and appropriate site-specific tiered environmental analyses to help determine which site or sites (and which location or building within each site) would be used for disposition. To conduct detailed designs and analyses at various sites for all the technologies at this early stage is not necessary at the programmatic level.

SNAKE RIVER ALLIANCE, BOISE, ID,
ROBERT MCENANEY
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reactor.

The Alliance recognized this contradiction in its comments addressing the Electrometallurgical EA Demonstration Project in April 1996:

> Pyroprocessing is the reprocessing portion of the IFR program transformed imperfectly into a spent fuel "management" program. Since it was in large part spent fuel reprocessing that led to cancellation of the IFR, Argonne has been trying to mask the program ever since. In fact, the National Academy of Sciences and the Secretary of Energy are among those who have stressed that plutonium separation was the intended use of the technology when it was part of the Integral Fast Reactor. 8/11.00.08

It is illogical for DOE to proceed with a project like electrometallurgical reprocessing that generates materials that are serious proliferation risks and then possibly go ahead with the electrometallurgical reprocesser at ANL-West as a treatment for plutonium disposition also. In fact, DOE is using the current Electrometallurgical Demonstration Projectas justification for possibly using ANL-West as a treatment site for disposition. In other words, it is using a reprocessing technology, which DOE admits is a serious proliferation risk, in order to champion disposition to avoid proliferation 9/08.03.01 10/01.06.00

Again, DOE is sending the wrong message to the rest of the world--that it is all right to reprocess as long as it is for environmental management reasons. So long as the stored weapons standard is practically identical to the spent fuel standard, DOE will continue to run into contradictions like these.

In assessing the cumulative imparts of the proposed actions, the PEIS lists those site-specific reviews that support the proposals in the Disposition PEIS:

> Additional site-specific environmental reviews are currently being prepared by DOE. A listing of these reviews is provided in Table 1.4 2. In particular, the site-specific, site-wide EIS's being prepared cover continued operations for some of the sites evaluated in the Storage and Disposition PEIS. (1-9)

The document that is listed that supports actions for INEL is the *Electrometallurgical Treatment Research and Demonstration Project at the fuel Conditioning Facility at ANL-West Environmental Assessment* This is an EA, not a site-specific EIS like the rest of the documents in the table. It is disingenuous at best to pass off the EA as anything but an EA. First, the Electrometallurgical Demonstration Project cannot sufficiently support the 11/11.01.08

F-066

11 00 08 Comment Number 8

Comment noted.

08 03 01 Comment Number 9

The Department of Energy acknowledges the commentor's opposition to the Electrometallurgical Treatment Alternative. The GBZ logs will be disposed of in a geologic repository, thereby meeting the Spent Fuel Standard. The electrometallurgical treatment process will not "reprocess" the Surplus Pu, but rather convert it to a GBZ. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 06 00 Comment Number 10

Electrometallurgical treatment was considered a reasonable alternative after completion of the screening process and scoping for the PEIS. The NRC recommended successful demonstration of the electrometallurgical treatment process prior to implementation. Upon making the decision on disposition technologies, DOE will demonstrate these technologies before their implementation. The electrometallurgical process in not reprocessing Pu, but rather converting the material to GBZ logs. These logs will be disposed of in a geologic repository, thereby meeting the Spent Fuel Standard.

11 01 08 Comment Number 11

Site-specific NEPA reviews are listed only for purposes of information and for use in assessing cumulative impacts; there is no intent or suggestion that the Electrometallurgical Treatment Demonstration EA is an EIS. Should the Electrometallurgical Treatment Alternative be selected in the ROD, further site-specific environmental analyses would be performed.

actions that take place in the Disposition PEIS. Its intent is to deal with the reprocessing of a limited amount of spent fuel. Second, the Electrometallurgical EA only examines a demonstration project. It does not address the environmental impacts of disposition or the current waste management abilities of ANL-W to handle the significant increase in waste that a disposition alternative would undoubtedly bring. Third, all of the other supporting documents in *Table 1.4-2* are EIS's, most of them site-wide EIS's that attempt to address the major impacts associated with waste management missions at the other defense sites. There is a major difference between an EA for a demonstration project and a site-wide EIS. An EA, especially the Electrometallurgical EA, cannot adequately address associated impacts let alone justify that a major action like disposition can be sufficiently supported at the INEL site. 11/11.01.08 cont.

Besides that, the current PEIS does not elaborate upon how much potential plutonium could be disposed of at ANL-W, whether these wastes would remain in a consistent form (as was a concern of the NAS), and Argonne's actual storage capabilities. All of these impacts needed a far more serious study before the electrometallurgical treatment process should have even been considered as an option. 12/05.03.03

The Disposition PEIS Limits Comments on the Electrometallurgical Treatment Process

Possibly one of the most fundamental principles behind the NEPA process is that an PEIS like this must solicit comments from any interested individual or group that has a vested interest in the PEIS's outcome. These comments mold the final outcome in the Record of Decision. The Alliance believes that the ability to comment about the future impacts of the electrometallurgical treatment process have been severely compromised-if not totally nullified-by the completely insufficient analysis of the electrometallurgical treatment process in this PEIS. In fact, the actual electrometallurgical treatment process is not analyzed within the PEIS. This is evident by the fact that it is not even cited as source in the references section. 13/01.04.00

A large part of this might have to do with the obvious fact that the DOE did not complete its evaluation of the current Electrometallurgical EA draft proposal by the time the PEIS was distributed. DOE cannot excuse itself from this mere circumstance by stating that, "The National Academy of Sciences recently completed an evaluation and draft report on this subject. The results of this evaluation will be considered in the preparation of the Final Storage and Disposition PEIS." Well, that just does not cut it. DOE does not maintain the privilege or the right to withhold one's ability to analyze a proposed project's impact. If the EA is not completed by the time of the PEIS's publication so that the public cannot make sufficient 14/05.03.08 15/11.01.08 16/08.03.00

F-066

05 03 03 **Comment Number 12**

The Electrometallurgical Treatment Demonstration EA is not being used and should not be construed as justification for Pu disposition. Electrometallurgical treatment, which would be performed at any site, is a reasonable alternative for Pu disposition and is analyzed since all reasonable alternatives must be analyzed under the CEQ regulations implementing NEPA.

01 04 00 **Comment Number 13**

The PEIS evaluates the disposition of approximately 50 t (55 tons) of Pu for all of the alternatives considered including the Electrometallurgical Treatment Alternative. The product of electrometallurgical treatment would be a GBZ material capable of disposal in an NWPA geologic repository for an indefinite period of time. If this alternative is selected, onsite storage of the waste forms would have to be provided pending availability of an NWPA geologic repository.

05 03 08 **Comment Number 14**

More specific information and clarification regarding the basis for analyzing the Electrometallurgical Treatment Alternative is included in Section 2.4.4.3 of the Final PEIS. The data input for the environmental analysis for the Electrometallurgical Treatment Alternative is reported in reference LLNL 1996b.

11 01 08 **Comment Number 15**

The *Environmental Assessment for the Electrometallurgical Treatment Technology* was in preliminary draft form when the PEIS was ready for distribution. A review of the preliminary draft indicated that there was no evidence to support the rejection of the Electrometallurgical Treatment Alternative as a reasonable alternative for Pu disposition from the environmental perspective. Section 2.4.4.3 of the PEIS describing the Electrometallurgical Treatment Alternative was revised to provide the results of the NAS report and to include the decisions made from the Electrometallurgical Treatment Demonstration EA.

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ROBERT MCENANEY
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comments about a proposed project's impacts, DOE should realize that this particular project cannot be analyzed in this PEIS. And even if DOE does include the conclusions made by the NAS on the Electrometallurgical EA demonstration project in the final draft, DOE is then confusing reprocessing a set amount of EBR-II fuel rods with the proposed electrometallurgical treatment of plutonium scantily described in the Disposition PEIS. One would think there is a significant difference between reprocessing spent fuel and treating surplus plutonium. If DOE proposes to electrorefine plutonium while adding cesium-137 as a radioactive barrier in order to create a new waste form at ANL-West, DOE simply must evaluate that action as a new and unique impact. Not only that, DOE should also evaluate the cumulative impacts that the current proposal to electrometallurgically treat plutonium and the Electrometallurgical Demonstration Project might have together upon the whole INEL complex in a separate PEIS. 16/08.03.00 cont.

DOE Fails to Analyze the Cumulative Impacts of the Proposed Action

Under the proposal to build a MOX reactor or evolutionary MOX reactor at a current DOE site, the DOE properly analyzes the various impacts site by site. For instance, the customary NEPA checklist of Land Resources, Site Infrastructure, Air Quality and Noise, Water Resources, Geology and Soils, Biological Resources, Cultural and Paleontological Resources, Socioeconomics, and Public and Occupational Health and Safety are all applied to each site on a case by case, individual basis. But when we get to the most important checklist item for this PEIS, "Waste Management," the DOE chooses to analyze this impact generically. Rather than looking at the waste management impacts at Hanford or Savannah River for example, DOE provides a generic analysis of the possible imparts for all of the sites. In one turn, DOE analyzes each site as if they have unique concerns, but then states that the waste management impacts can be applied to each site as if the waste management capabilities and the associated impacts are the same for every sight. DOE knows better than this. Certainly Hanford has different waste management concerns than Oak Ridge or the INEL. To claim otherwise illustrates that DOE is not actually willing to elaborate upon the impacts in this Disposition PEIS, or DOE just does not know what the impacts might be. Either way, the Disposition PEIS over and over again fails to analyze all of the cumulative impacts for each particular disposition alternative. 17/09.11.08

This is exacerbated by the fact that in the Disposition PEIS, one site might host more than one disposition alternative listed in the PEIS. For instance, one DOE site could end up vitrifying plutonium while also implementing a separate program to burn plutonium in a reactor. The Disposition PEIS does not even look at the magnified impacts that would 18/01.04.00

F-066

08 03 00 Comment Number 16

The Finding of No Significant Impact (FONSI) for the *Environmental Assessment of Electrometallurgical Treatment* was approved on May 15, 1996 after the public comment period and public meetings. The electrometallurgical treatment process is analyzed in the PEIS as a reasonable alternative for Pu disposition. The PEIS has a different purpose and need from that of the limited demonstration for treatment of Experimental Breeder Reactor (EBR)-II fuel. Should the Electrometallurgical Treatment Alternative be selected in the ROD, further site-specific environmental analyses will be performed, as appropriate.

09 11 08 Comment Number 17

The waste management analysis assumed generic greenfield facilities for the disposition alternatives and Consolidation and Collocation Storage Alternatives to meet programmatic requirements for total storage capacity and disposition throughput. For the Upgrade Storage Alternative, site-specific facilities were determined to meet site-specific storage requirements. The resultant waste generated from each of these facilities was added to the existing site No Action waste being generated and compared to site waste management infrastructure (storage, treatment, and disposal capacities). Each site with a clear adequate capacity or lack of capacity to handle a particular waste stream was highlighted in the waste management analysis. In the site selection process, DOE will consider the experience and current waste management infrastructure of all the sites. Coordination of all waste activities being proposed at each site is being done by DOE's Waste Management Program. The cumulative impacts section of the PEIS has a site-specific analysis for waste management of storage alternatives. A generic disposition cumulative impacts section was added in Section 4.7 of the PEIS for the disposition alternatives. Site-specific disposition waste management cumulative impact analyses will be performed in future tiered NEPA documents, as appropriate.

occur if two or more alternatives are implemented at one DOE site. Waste management concerns should not just address what types of wastes will be generated, but how each site can accommodate future storage of wastes on top of the wastes that are already managed at all of the affected DOE sites.

These decisions cannot be made in a vacuum. Past expertise in dealing with similar waste forms should be considered in this analysis. If and when DOE decides upon a course of action, the PEIS that justifies the action has to take into account past experiences. For instance, if DOE decides upon collocation, the final PEIS must fully examine past experiences of the Oak Ridge and Pantex complexes in their struggles to deal with consolidation of their stockpiles of materials. If mistakes were made in the past, DOE cannot deny that these problems could arise again to impact various sites. In September 1994, DOE found over 1,300 violations or noncomformances for the handling and storage of HEU at the Oak Ridge Reservation. DOE's infrastructure has not changed dramatically since those storage problems were identified at the Oak Ridge Reservation. If anything, spending for the DOE has been on the decline since September 1994. The same infrastructure that allowed these problems to occur is the same infrastructure (with fewer resources at hand) that will be implementing a disposition policy. Hence, problems that have occurred in the past could arise as problems in the future.

17/09.11.08 cont.

19/09.02.08

Conclusion

The Snake River Alliance would like to emphasize that we believe the disposition of weapons-usable material is an extremely important mission for this country to embark upon. Disposing of this material so it meets a spent fuel standard is at least a step in the right direction. But rather than implementing options that are discussed in the Draft PEIS, DOE should direct itself to action that would remedy the current problem at hand. The construction of a pilot vitirification plant to demonstrate the safe stabilization of plutonium residues, for example, would not preclude DOE from implementing other strategies considered in the PEIS. The implementation of such a project would instead send the positive signal that DOE is resolved to address the disposition problem as well as addressing current pressing environmental and health issues.

20/08.03.00

In conclusion, the Department has a significant amount of work ahead before it can produce an adequate Draft PEIS on the storage and disposition of weapons-usable fissile materials. The document at hand is woefully inadequate and flawed. At this point the Department should provide another opportunity for public comment after the concerns previously mentioned in our comments have been adequately addressed in a revised Draft PEIS. Nothing less than a fully sufficient NEPA analysis

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01 04 00 Comment Number 18

The possibility of more than one alternative being selected for disposition is discussed in Section 2.5.2.1 of the Draft PEIS. The Final PEIS identifies the impacts associated with a hybrid alternative consisting of more than one technology. The Final PEIS also examines combined impacts for storage plus disposition for the Preferred Alternative.

09 02 08 Comment Number 19

The Y–12 Plant currently stores HEU in several facilities, all located within the Plant's PA. Category I and Category II quantities of HEU (as defined by DOE Order 5633.3B, *Control and Accountability of Nuclear Materials*) are stored in Material Access Areas (MAAs). Within each specific MAA, the HEU is stored within properly designed and built vaults or vault-type rooms. These existing storage facilities meet current security and ES&H regulations and requirements. Under the No Action Alternative for ORR, DOE is committed to maintaining these facilities to ensure safe operation for the balance of the facilities useful lives. For the other reasonable storage and disposition alternatives, compliance with all applicable ES&H requirements is an integral and important part of each storage or disposition facility design.

08 03 00 Comment Number 20

The Department of Energy acknowledges the commentor's support for a vitrification pilot plant. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

should be expected.

Submitted by

Robert McEnaney

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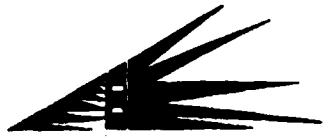

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June 7, 1996

United States Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

Dear People,

These comments are in addition to oral comments made by Don Hancock in Amarillo, Texas on April 22 and to the letter signed by SRIC and numerous other organizations and sent to Secretary O'Leary on May 6.

SRIC strongly believes that the Draft Programmatic Environmental Impact Statement (PEIS) on the Storage and Disposition of Weapons-Usable Fissile Materials is fatally flawed and must be substantially revised and reissued for additional public comment before it can be used for decisions about storage or disposition of fissile materials. 1/08.00.00

Safe and verifiable storage and disposal of surplus plutonium and highly-enriched uranium is one of the most urgent and significant international security matters of our time. However, precipitous decisions about disposition based on inadequate technical, cost, and proliferation information will likely exacerbate existing deficiencies in handling of fissile materials, thereby making the difficulties of implementing any decisions even greater.

The National Environmental Policy Act (NEPA) dictates that DOE present a credible and accurate discussion of reasonable alternatives in its review of this issue. Further, the potential consequences of an inappropriate decision compel DOE to demonstrate better than its normal quality of NEPA performance - ensuring particularly that the nonproliferation and cumulative impacts of its decision are soundly addressed. The current Draft PEIS meets neither of these standards.

Regarding disposition, it is clear from DOE's research bias toward mixed oxide (MOX) fuel and reactor technologies that the draft PEIS and DOE's policy are being driven by the desires of the nuclear industry to gain politically and economically by receiving government subsidies such as free fuel for existing reactors and federal funding for new reactors. The NEPA process should not be hijacked by such pork barrel politics. 2/01.02.00

F-057

08 00 00 Comment Number 1

Although DOE is committed to public input and openness, DOE does not contemplate additional public comment on this PEIS. Public comments have already been received in scoping and public meetings. The comment period for the PEIS was extended to 92 days; in addition, technical, cost, schedule, and nonproliferation analyses were released for public comment.

01 02 00 Comment Number 2

The alternatives analyzed in the PEIS were determined through a screening process that included public input on the selection criteria. This process was not politically or institutionally biased.

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Given the difficulties in making and implementing disposition decisions for the next decade or more, the real public and international focus on fissile materials will be their storage, whether DOE considers such storage "interim" or "long-term." Thus, an adequate draft PEIS should provide a comprehensive look at all reasonable alternatives and their environmental impacts. 3/01.01.00

I. However, the draft PEIS is seriously deficient in its consideration of alternatives:

* It fails to consider all reasonable alternatives for the long-term storage of weapons-usable fissile materials, particularly plutonium pits. Currently, in the Pantex Site-Wide Environmental Impact Statement, the Department acknowledges that interim storage of pits at Department of Defense (DOD) facilities, specifically at Kirtland Air Force Base's Manzano Weapons Storage Area, is a reasonable alternative which must be analyzed in the EIS. The DOD is also a cooperating agency in that Pantex EIS. The Draft PEIS rejects this alternative for long-term storage of pits although it is clearly as reasonable an alternative for long-term storage as for interim. DOD facilities should be included as alternative sites, and DOD should be a cooperating agency in a revised and re-issued draft PEIS.

The draft PEIS (p. 2-6) briefly dismisses the Manzano site because of the need to provide long-term storage of plutonium in forms other than pits and the "ES&H concerns" associated with handling plutonium not in pit form "in proximity to the metropolitan Albuquerque area." However, continuing storage of pits for longer than the 5-10 years considered in the Pantex draft EIS is clearly both a reasonable alternative and is very likely to occur in any case. Thus, the draft PEIS must include as a reasonable storage alternative having pits stored in pit form and storing other plutonium in non-pit forms in a separate facility or at another site. 4/01.04.00

Of particular interest is the ability of the Manzano Weapons Storage Area to store pits for longer than 5-10 years. Since the draft PEIS states that a new storage facility would have to be built for long-term storage at any of the DOE sites, the possibility that the existing Manzano site (and potentially other DOD sites) could be used for pit storage (even if not suitable for other forms of plutonium) must be fully considered.

* It fails to consider alternatives for storage containers for plutonium. Only one container, which is not yet certified, is analyzed in this document despite the fact that this container is not appropriate for storage of plutonium in all of the variety of forms in which it currently resides throughout the complex. A range of adequate containers must be examined in order to ensure that plutonium stabilization and storage can be done safely. 5/02.00.08

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01 01 00 **Comment Number 3**

Comment noted.

01 04 00 **Comment Number 4**

Combined storage of pits and non-pit Pu at the Manzano WSA was originally eliminated as a reasonable alternative in the Draft PEIS. After considering separate storage of pits from non-pit Pu, the option to store these pits at the Manzano WSA no longer appears unreasonable. The Manzano WSA was evaluated in the Pantex EIS and Section 2.1.3 of the Final PEIS. The Final PEIS was revised to clarify the consideration of the Manzano WSA for combined storage, and a description of the WSA was included in Appendix P.

Other non-DOE sites (including DoD sites) were considered in the Screening Report, and were eliminated because of cost effectiveness, ES&H, and public/institutional acceptance concerns, with no overriding advantages compared to existing DOE sites already safeguarding nuclear materials. Under these circumstances, DoD was not included as a cooperating agency.

02 00 08 **Comment Number 5**

The PEIS assumes that all surplus Pu at Hanford, INEL, Pantex, SRS, RFETS, and LANL has been transformed to a stable form that meets the DOE *Standard Criteria for Safe Storage of Pu Metals and Oxides* (DOE-STD-3013-94) for materials greater than 50-percent Pu. Stabilization of the material and the impacts are not within the scope of this PEIS. The material would be stored in containers consistent with the transportation of the materials on or to the site. Containers analyzed for storage of pits include the FL container (currently certified) and the AT-400 (currently under review for certification). Material would not be moved and stored in the AT-400A container without proper certification. Other containers were analyzed for the transportation of other Pu materials (for example, the BUSS R-1 cask for As and the MO-1 for MOX fuel).

* It fails to consider alternatives that would promote full international inspection of all surplus plutonium and highly enriched uranium. Such an alternative must be considered reasonable since it is expressly included in the President's Nonproliferation policy (p. A-2). Analysis of the alternative should include the ease or difficulty of such international inspection at various sites. For example, how could international inspection be done in Zone 12 at Pantex, the area designated for many long-term storage activities, which will also continue to be the weapons assembly/disassembly area, and which presumably would not be open to international inspection? Are DOE sites which do not have a Defense Programs mission more easily opened to international inspection? How could DOD sites be subject to international inspection? 6/01.06.00

II. The draft PEIS is also severely deficient in its analysis of environmental impacts:

* it fails to consider fully activities associated with the processing and interim storage of plutonium and highly enriched uranium that will be required to transition this material from its current status at various sites around the complex to the preferred form(s) for long-term storage. The draft PEIS seems to presume that such processing and repackaging receives comprehensive NEPA coverage in some other document(s). That is not the case. Instead, the various existing NEPA documents considering interim stabilization and storage are incomplete. There has been no comprehensive analysis of the stabilization and storage issues, an analysis that should be included in the PEIS. 7/01.01.00

* It fails to consider comprehensively all of the existing surplus plutonium. Some of the existing surplus plutonium is not, in fact, included in the PEIS, although the draft PEIS says it is (p. 1-2). For example, some of the 11.9 metric tons of surplus plutonium at Rocky Flats has been inappropriately excluded from the draft PEIS. Some of these materials are being analyzed in the Draft Environmental Assessment for Solid Residue Treatment, Repackaging, and Storage, DOE-EA-1120, March 1996. That EA is not even listed in the draft PEIS as a related document (p. 1-9). The table on that page also is a vivid, though incomplete, description of the fragmented NEPA process that DOE is engaged in. 8/01.00.00

A related matter is that for the disposition alternatives, all material is assumed to be in a form suitable for shipping (p. 4 779). However, the environmental and worker impacts of processing those materials into such a form is not included in the draft PEIS, nor in any other NEPA document. 9/10.00.00

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01 06 00 Comment Number 6

The discussion of inspectability by the IAEA is shown in Chapter 1, pages 1–5 and 1–6 of the PEIS.

01 01 00 Comment Number 7

As described in Chapter 1 of the PEIS, DOE has an ongoing program to stabilize non-pit materials containing Pu and miscellaneous uranium materials to meet the requirements of the *Plutonium Vulnerability Management Plan*. The NEPA coverage for stabilization of the weapons-usable fissile materials is beyond the scope of this PEIS, since the PEIS addresses only separated materials. The management of materials stabilization activities, including any NEPA analysis that might be required, is being conducted under the DOE's Environmental Management program in accordance with DNFSB Recommendation 94-1 Site Corrective Action plans.

01 00 00 Comment Number 8

This PEIS addresses the storage and disposition of separated materials including residues (of greater than 50-percent Pu by volume), scrap, and other materials that have been stabilized. The processes and facilities required to achieve stabilization are addressed in other NEPA documents. A discussion of RFETS residues and their treatment appears in Chapter 1 of the PEIS. Reference to the *Solid Residues Treatment, Repackaging, and Storage at the Rocky Flats Environmental Technology Site Environmental Assessment*, and FONSI is included in Section 1.1.1 of the PEIS.

10 00 00 Comment Number 9

Under the No Action Alternative, DOE sites with surplus Pu (Hanford, INEL, Pantex, and SRS) would continue to store Pu-bearing materials in storage vaults and other similar facilities. All Pu materials will be stabilized and repackaged, as necessary, to ensure safe storage. The cleanout, stabilization, and storage of readily retrievable Pu materials are being addressed in several NEPA documents (for example, the Plutonium Finishing Plant Stabilization

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• In its analysis for various sites, the draft PEIS focuses only on the particular area of the site that would be used for storage or disposition, rather than comprehensively looking at the other activities at a site that could affect storage or disposition. For example, at Pantex, it fails to discuss how the on-going weapons activities in Zone 12 could conflict with plutonium storage.	10/11.00.08
• The analysis of environmental impacts at all sites is severely limited by the "pre-design" information regarding buildings and facilities (p. B-1 and C-1). The draft PEIS tries to excuse this flaw as regards disposition decisions by stating that no siting decisions will be made in this PEIS (p. 4-1). However, siting decisions will be made regarding storage, so the sites must be looked at comprehensively and the cumulative impacts of storage along with other existing or proposed missions of each site must be fully considered.	11/11.00.08
• The environmental impacts of particular activities, specifically related to plutonium conversion and MOX fuel facilities, are grossly underestimated. For example, the draft PEIS does not use previous experience of plutonium processing and conversion as the baseline environmental impacts. Operational problems and accidents, for example, at DOE facilities that have engaged in similar activities should be included, as DOE cannot just assume that "improved technologies" will eliminate the possibility of future problems.	12/09.00.08
• It fails to include in its analysis of disposition options for plutonium the significant impacts surrounding the disposal of high-plutonium-content spent fuel resulting from a Mixed-Oxide (MOX) disposition decision. These impacts are economic as well as environmental. Specifically, the draft PEIS fails to address issues regarding repository disposal of spent MOX fuel raised by the National Academy of Sciences in its 1995 Reactor Options study of plutonium disposition. For instance, DOE fails to consider the higher thermal power of MOX spent fuel and its implications for the cost and safety of a high-level waste repository. The failure to consider issues raised by the NAS study is all the more egregious because the DOE has repeatedly stated that it would be guided by the NAS studies on plutonium disposition. DOE should also carefully address the potentially greater consequences of an accident in a reactor loaded with MOX fuel. A more thorough analysis of MOX use would raise significant concerns about, for example, its link to future reprocessing and long-term U.S. policy regarding reliance on the plutonium fuel cycle.	13/09.11.08 14/09.09.08 15/01.00.00
• The site-specific analysis is often wrong. For example, page 4-727 states that at Pantex "no groundwater would be withdrawn for the project from the aquifer" for construction and operation of evolutionary LWR. That statement is, of course, totally wrong	16/09.04.04

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EIS at Hanford, the Pantex EIS for Pantex, the Interim Management of Nuclear Materials EIS at SRS, and the RFETS Interim Storage EIS) as well as DNFSB Recommendation 94-1 Site Corrective Action Plans. Therefore, the impacts from these actions are not included in the PEIS.

11 00 08 Comment Number 10

Discussions of ongoing and anticipated activities at various DOE sites and how these activities would affect the environmental resources at the sites are given under the title "Cumulative Impacts" in Section 4.7 of the PEIS.

Ongoing assembly and disassembly activities at Pantex occur in bays, cells, and special purpose facilities. Storage activities would occur in building 12-66, a new consolidation or a new collocation facility. Building 12-66 is currently being used for warehouse activities, and the use of it would not conflict with assembly and disassembly activities. Storage activities at Pantex are currently being done in Zone 4. Appendix Q has been added to the Final PEIS to describe storage of RFETS pits in Zone 4. Zone 4 has adequate capacity for pits currently at Pantex and RFETS.

11 00 08 Comment Number 11

For disposition without the conceptual design of a facility, there would not be a detailed estimate of the various effluent releases from the facility, and hence, no basis for a more detailed environmental impact analysis of the releases. For long-term storage, analysis of the existing and anticipated activities at each candidate site and the potential impacts of these activities on the various environmental resources at the site is given under the title *Cumulative Impacts* in Section 4.7 of the PEIS.

09 00 08 Comment Number 12

An evaluation of disposition alternatives was completed for representative sites. These representative sites have been identified for the analysis of the range of environmental consequences. These sites include Hanford, NTS, INEL, Pantex, ORR, and SRS. Additionally, some disposition facilities (specifically those involving the deep borehole complex, generic MOX fuel

since all water for construction and operation of any such facility at Pantex would come from the Ogallala aquifer, just as all water currently used at Pantex comes from Ogallala wells. | 16/09.04.04 cont.

* The accident analysis for various scenarios is seriously understated. For example, the evaluation basis accident in a MOX fuel fabrication facility is a 10-kilogram plutonium source at risk, with less than 1 gram released (p. M-289). Given the inexperience of U.S. workers, the uncertainties about design and handling, the lack of regulatory requirements, and the far larger quantities than 10 kilograms of plutonium that would be in the facility at any given time, a more severe accident scenario with a much larger source term and larger releases must be included. SRIC also does not feel that an adequate basis has been established to exclude several of the "beyond design basis accident scenarios" for a MOX facility (p. M-289). The analysis should be revised to include larger source term amounts and more severe accidents which release larger volumes of plutonium. | 17/09.09.08

Similarly, the same 10-kilogram plutonium source is used for accident scenarios for a plutonium conversion facility (p. M-369). Once again, SRIC does not agree that there is credible analysis to justify exclusion of "beyond evaluation basis" accident scenarios nor that more serious accidents are not credible.

* The positive environmental and nonproliferation effects of international inspection and other transparency measures are ignored in the draft PEIS. The document says that some of the materials included "may be subject" to bilateral or international inspection (p. 1-5). However, regular international inspection would dramatically increase the confidence of people worldwide regarding the status of surplus weapons-usable fissile materials and that the U.S. is not using such materials for weapons-related activities. | 18/01.06.00

* It contains no cost estimates and no detailed design information on buildings and facilities. Such information is necessary both to identify reasonable alternatives and their environmental impacts. But that information will not be available to the public until well after the public comment period on the draft PEIS ends. SRIC believes that such information is essential to the public discussion and must be made available with the revised draft PEIS. Indeed, in the Final EIS on Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel, the Department did analyze and compare costs of alternatives. Similarly, in the draft Stockpile Stewardship and Management PEIS, DOE/EIS-0236, February 1996, DOE used cost projections as a major determining factor in assessing alternatives. | 19/08.00.00

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fabrication, and use of existing or partially completed LWRs) do not lend themselves to specific site analysis at this time. Therefore, generic site characteristics have been developed for environmental evaluations of these facilities. DOE will conduct site-specific tiered NEPA analyses in the future, as required, that will utilize site-specific environmental characteristics before a disposition site is selected. Site-specific environmental analyses for Pu disposition will be addressed in the next tiered NEPA documents.

The National Laboratories, which developed the data reports that were used to develop the environmental impacts related to Pu conversion and MOX fuel facilities, did use previous Pu processing experience. Laboratory experts used their knowledge of the physical, chemical, and radiological properties of Pu to determine potential release fractions during normal and accident situations, and worker and population exposures. This knowledge also included process parameters such as the quantity of the material at risk, process flow rates (for example, the quantity of Pu that could be stabilized or converted into MOX per year), and the number of workers required.

09 11 08 Comment Number 13

The NAS report on the disposition of Pu was used in the screening evaluation process to form the basis for options evaluated for both long-term storage and disposition. The NAS report established a Stored Weapons Standard and Spent Fuel Standard used in the PEIS.

Appendix H of the PEIS provides a comparative analysis of the various Pu waste forms for potential disposal in an NWPA-HLW repository. This analysis includes the thermal characteristics of MOX versus uranium oxide fuel.

09 09 08 Comment Number 14

The event description, probability, source terms, and the human health impacts from the potential accidents for the evolutionary reactors using UO_2 fuels are presented in the PEIS. The similar analysis for the existing, partially completed and evolutionary LWRs with MOX fuels are conducted and included in the PEIS.

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* It neglects to provide any analysis of the proliferation impacts of the various alternatives considered for the long-term storage of plutonium and highly enriched uranium and the disposition options for plutonium. The proliferation impacts are crucial factors in any decisions to be made regarding these weapons-usable materials and, as such, they must be examined in the PEIS. Once again, DOE is ignoring its own NEPA precedents where proliferation has been a key element in NEPA documents. (Nonproliferation concerns were included in the Final PEIS for Tritium.) Here too, the DOE has failed to consider the issues raised in the 1994 and 1995 NAS studies on plutonium disposition. — 20/01.06.00

Further, the possibility of international verification (transparency) and conformity to international safeguards must weigh heavily in DOE's final decisions about storage and disposition. When the environmental impacts, proliferation risks, and the total costs of MOX are fully considered, we believe that the Department would reject that alternative. Since other means to safely handle excess plutonium exist, the proposed use of MOX as a means of plutonium disposition should be flatly rejected as unreasonable. — 21/08.03.01

III. Other comments

1. A positive comment is that the metric conversion chart (p. xxvii) and metric prefixes (p. xxviii) are helpful. They should be regularly included in other DOE documents. — 22/16.00.00

2. The numerous references cited in the text but not included in the reference list are a significant problem. SRIC had to make several calls to the Office of Fissile Materials and talk with a contractor before being informed that the reference cites were in error. Likewise, numerous references are several years old and obsolete. The fact that more recent analyses are being done and may be included in the final PEIS (as SRIC was informed) is not helpful in analyzing the draft PEIS. Since apparently additional time is needed to complete more up-to-date documents, revising and re-issuing a draft PEIS would allow those more recent documents to be used in the preparation of the draft PEIS. — 23/09.00.08

3. Another example of the sloppy work is in the table of contents of Volume 1, which omits more than 100 pages of the document! Section 2.5.2 on Disposition alternatives and its 119 pages is not even listed in the table of contents. And section 2.6, the preferred alternative is listed as being on p. 2-159, when in reality it is page 2-258. — 24/16.00.00

4. The draft PEIS should describe the size and subject matter contained in the classified appendix (pp. 4-771, 4-781) so that the interested reader could have a better idea of how essential it is to the overall understanding of the issues relevant to the draft PEIS. [illegible] the classified appendix is necessary to gain a — 25/10.03.00

F-057

01 00 00 Comment Number 15

The nonproliferation aspects of each alternative evaluated in the PEIS were addressed in a separate nonproliferation analysis issued by DOE in late 1996. If the use of MOX fuel in reactors is selected as the disposition approach, the MOX fuel fabrication plant would be shut down at the completion of the disposition mission. Furthermore, the spent fuel from the use of MOX would not be reprocessed; therefore, residual Pu would not be separated.

09 04 04 Comment Number 16

The statement cited concerns the perched aquifer beneath Pantex. It is correct in noting that no groundwater will be withdrawn from this aquifer. The text in Section 4.3.5.4.4 of the Final PEIS was changed from "near surface aquifer" to the "perched aquifer."

09 09 08 Comment Number 17

The accident scenarios for Pu storage and disposition, including the accident frequency and the source term released to environment, were developed based on the best available information. Although not all potential accidents were addressed, those that were postulated have consequences and risks that are expected to envelop the consequences and risks of an operating facility. Some of the "beyond evaluation basis" accidents were analyzed in the PEIS. It is believed that no other credible accidents with expected frequency of occurrence larger than 1.0×10^{-7} per year are anticipated that will have consequences and risks larger than those described in this PEIS. The background information for the accident scenario development is documented in the respective data reports prepared for the Pu storage and disposition program by National Laboratories.

01 06 00 Comment Number 18

Analysis of the Nonproliferation Policy impacts of all the PEIS alternatives, including international inspection, is presented in a separate document to support DOE's ROD. This document was available for public review in October 1996.

full understanding of the environmental impacts of any alternative, that should also be stated in the draft PEIS. 25/10.03.00 cont.

5. Since the draft PEIS does not contain preferred alternatives, it should fully describe the criteria that would be used to select such alternatives so that the public could comment on the appropriateness and weighting that should be given. 26/08.03.00

6. While real cost and design information is not available, the draft PEIS is sometimes breathtaking in the precision, without necessary statement of the uncertainties of its analysis. It is certain that the numbers used are wrong, but the document no where states that obvious point. For example, the socioeconomics analysis for Pantex (pages 4-202 to 4-206) makes a number of unqualified, and totally incredible, statements. Even though the actual jobs required for construction and the actual operational jobs are unknown, the draft PEIS includes precise numbers (a range for both direct and indirect jobs would be more technically appropriate). The draft PEIS also contains specific amounts about how the regional economy, including unemployment, would be affected by the upgrade, consolidation, and collocation alternatives. The statements in the draft PEIS are not qualified in any way as to the differing economic characteristics that will certainly exist in the future, the changing job market, technological changes that will affect employment, the fact that large construction projects frequently attract workers whether jobs are in fact available, among many other factors are not stated. 27/09.08.08

7. Even though the draft PEIS is supposed to discuss activities that will happen a decade or more in the future, it frequently ignores that reality. Among other things, it assumes current environmental and economic conditions. It also assumes current permitting requirements, even when permits have a considerably shorter lifetime. For example, the draft PEIS assumes continued open burning and discharges to playas even though those actions are extremely controversial and were contested in the most recent TNRCC permits by affected citizens who want to eliminate open burning and discharges to unlined ditches and playas. Moreover, DOE knows that it must look for alternate technologies to phase out open burning and discharges into unlined ditches and playas. However, no alternate scenarios are included in the draft PEIS. 28/09.00.08

IV. These concerns make clear that the Department has much work to do before it can produce even a minimally adequate Draft PEIS on the storage and disposition of weapons-usable fissile materials. Until a revised draft PEIS is issued for public comment, a final PEIS is issued, and a Record of Decision is released, the Department cannot make programmatic decisions regarding long-term storage and disposition of weapons-usable fissile materials.

F-057

08 00 00 Comment Number 19

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses along with the environmental analysis and public input will be integrated into DOE's decisionmaking process.

01 06 00 Comment Number 20

In addition to the environmental analysis of the storage and disposition alternatives identified in this PEIS, DOE conducted technical, schedule, cost and nonproliferation analyses to assure an adequate basis for a ROD. These analyses were published as separate documents and were made available to the public for review and comment beginning in July 1996 for the technical, cost, and schedule analyses and October 1996 for the nonproliferation analysis.

The United States has placed some of its weapons-usable materials under IAEA safeguards and is continuing efforts to make more available to IAEA. DOE is also assisting Russia with efforts to create new storage capacity and to establish new control and accountability capabilities for existing storage facilities. Through these efforts, there is hope to encourage greater international commitment to IAEA inspections.

08 03 01 Comment Number 21

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

16 00 00 Comment Number 22

Comment noted.

SOUTHWEST RESEARCH AND INFORMATION CENTER, ALBUQUERQUE, NM, DON HANCOCK
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However, SRIC urges DOE to continue activities which can prepare the Department to makes its best possible decisions. We want to be explicit that we do not believe our concerns need to delay the construction of a pilot plant for the immobilization of plutonium wastes by vitrification. Construction of a pilot plant is not programmatic, and therefore does not require NEPA analysis in a programmatic document. Moving forward with a pilot vitrification plant will signal the Department's resolve to disposition plutonium rather than to stockpile it, as well as to address some existing environmental, health, and safety issues. 29/08.03.00

Moving forward will also provide additional information about the particulars of immobilization of plutonium in glass; information that would be useful in preparing an adequate draft PEIS. And, since the Department already realizes that some of its plutonium will not be a candidate for conversion to MOX fuel under any circumstances, construction of a pilot vitrification plant will enable the Department to address at least some of this material in a timely and effective way.

Sincerely,

Don Hancock

F-057

09 00 08 **Comment Number 23**

The most current data available was used for the analyses and development of sections in the Draft PEIS prior to its publication. The Final PEIS has been revised to reflect updated data and additional information received since the publication of the Draft. References to this updated information are reflected in the reference chapter of the Final PEIS.

16 00 00 **Comment Number 24**

Comment has been noted. Changes were made to the Table of Contents and are reflected in the Final PEIS.

10 03 00 **Comment Number 25**

The foreword acknowledges the Classified Appendix and includes a brief description of its content. The technical factors discussed in the appendix are classified.

08 03 00 **Comment Number 26**

Between the issuance of the Draft and Final PEIS, DOE has obtained supplemental information from a variety of sources in addition to the environmental analyses. One of these sources is the public. Further information was obtained from technical, cost, schedule, and nonproliferation analyses performed separate from the environmental analysis. The information provided by all of these sources was used to determine the Preferred Alternative and will be integrated into DOE's decisionmaking process. The ROD will describe the basis for the decision.

09 08 08 **Comment Number 27**

The socioeconomic analysis is based on the best available data. DOE National Laboratories have developed manpower estimates for the construction and operation of each of the Proposed Alternatives. Employment multipliers from RIMS II, developed by BEA, are used to estimate total

employment impacts. The approach used in the Draft PEIS is a widely accepted methodology for estimating the potential impacts of public and private sector projects on regional economies. The job estimates are used to determine whether a project can be accommodated in a regional economy without stressing the available labor and housing markets. For Proposed Actions involving downsizing or termination of existing missions, the multipliers are used to estimate total job loss for the affected region.

09 00 08 **Comment Number 28**

Future activities in the PEIS are analyzed by projecting and modeling current environmental and economic conditions and data. This analysis does not project current permitting requirements nor postulate possible additional regulatory requirements which may arise that could have an affect on future programs at analyzed sites.

08 03 00 **Comment Number 29**

The Department of Energy recognizes the commentor's support for an immobilization pilot plant. However, the need for NEPA analysis of such a pilot plant will be determined dependent upon the disposition alternative selected.

SOUTHWEST RESEARCH AND INFORMATION CENTER, ALBUQUERQUE, NM, DON HANCOCK

Date Received: 06/12/96
Comment ID: P0049
Name: Don Hancock
Address:

Transcription:

This is Don Hancock at Southwest Research and Information Center in Albuquerque, New Mexico, my number is (505)262-1862. I have several pages of comments that I wanted to fax in, but this line doesn't seem to work as a fax line even though it was advertised and is included in the cover sheet of the PEIS as being a fax line as well. So, my comment is that it should also be a fax line, and I have faxed my comments to the Office of Fissile Materials Disposition at the 202 number and expect that they'll be fully considered. Thank you very much. 1/08.02.00

P-049

08 02 00 **Comment Number 1**

Comment noted.

SOUTHWESTERN PUBLIC SERVICE COMPANY, AMARILLO, TX,
WILLIAM T. CRENSHAW
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Comments of

SOUTHWESTERN PUBLIC SERVICE COMPANY

Amarillo, Texas

to

UNITED STATES DEPARTMENT OF ENERGY

Re: Drafts

Programmatic Environmental Impact Statement

for Stockpile Stewardship and Management, February 1996

Environmental Impact Statement

for Continued Operation of the Pantex Plant

and Associated Storage of Nuclear Weapon Components, March 1996

and

Storage and Disposition

of Weapons-Usable Fissile Materials, February 1996

May 7, 1996

F-037

SOUTHWESTERN PUBLIC SERVICE COMPANY, AMARILLO, TX, WILLIAM T. CRENSHAW
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Southwestern Public Service Company is the investor-owned electric energy provider to the Pantex Plant, near Amarillo, Texas, and to approximately 367,500 other customers (about one million persons) in the Panhandle and South Plains of Texas, eastern and southeastern New Mexico, the Oklahoma Panhandle, and southwestern Kansas. SPS through the past several years has been an attentive and active participant in United States Department of Energy public information/ participation activities related to DOE nuclear complex planning.

1. SPS actively supports the interests of Pantex and Pantex employees -- so long as those interests are coincident with protection and improvement of environmental conditions in the Pantex region of influence and with prudent and rational national defense policies and strategies.

2. At this juncture in the proposed and appropriate downsizing of the nuclear complex, we again strongly encourage the Department and Administration to predicate all actions related to the nuclear complex on the conservative assumption that at least rogue-state or terroristic nuclear aggression against the United States is probable.

U.S. vigilance and nuclear preparedness are key to coexistence with mad nations and persons.

In turn, the Pantex Plant is, uniquely, a key to economically efficient continuing nuclear preparedness.

SPS's further comments today on the three major draft environmental impact statements under review intentionally are brief. We forego repetition of comments filed with the Department in the past, and concentrate on issues of particular relevance to appropriate future missions for Pantex:

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SOUTHWESTERN PUBLIC SERVICE COMPANY, AMARILLO, TX,
WILLIAM T. CRENSHAW
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3. Fundamental to DOE's further consideration of the roles Pantex should play relative to the changing missions of the nuclear complex is the unequivocal recognition that even accumulatively, there would be NO significant adverse environmental impacts from retention and potential expansion of the variety of missions possible for Pantex. 1/08.03.01

The summaries of the relevant draft EISs do not report this fundamental conclusion explicitly; rather, in some instances, the summaries misrepresent that conclusion, reporting, instead, effectively minuscule environmental potentialities that are characterized as "adverse" only because they do not equate to measurable "benefits." We suggest the rote language of EISs should be expanded to recognize effectively neutral outcomes (not merely "beneficial" or "adverse" consequences). 2/09.00.08

However, the underlying draft statements themselves are conclusive in regards to the actual insignificance of "adverse" potential impacts of expanded missions at Pantex. Moreover, DOE and consultant representatives in public meetings in Amarillo publicly and explicitly acknowledged that fundamental conclusion (see, especially, transcript of April 23, 1996, morning discussions).

Because the Department, through its representatives in Amarillo on April 23, committed to highlighting, in the subject Final Environmental Impact Statements, this fundamental and irrefutable conclusion about the actual insignificance of any adverse environmental impacts of increased missions at Pantex, Southwestern will not enumerate and rebut the litany of potential environmental concerns reflected in the EISs.

5. (However, we do request that the Department include in the record "dockets" for these EISs the comments by SPS relative to listed potential environmental concerns recited in the draft Tritium Production-related EIS of 1995.

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08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 00 08 **Comment Number 2**

Based on comments received, the Summary of the Draft PEIS was revised. The bar charts providing the comparison of impacts for both storage and disposition were deleted from the Summary. The related text was revised to clarify the comparison of impacts and to delete reference to "adverse" impacts.

SOUTHWESTERN PUBLIC SERVICE COMPANY, AMARILLO, TX, WILLIAM T. CRENSHAW
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In those comments, SPS rebutted the overly sensitive, generally not really site-specific but knee-jerk and ill-informed, and frequently inaccurate characterizations of environmental "concerns" about expanded missions at Pantex. Clearly, those earlier characterizations of possibly "adverse" impacts, especially those related to uses of ground water, now are rejected by DOE. Nonetheless, a replete record supportive of the Department's April 23, 1996, publicly articulated conclusion that NO significant adverse impacts would result, is appropriate.)

2/09.00.08 cont.

6. Southwestern endorses the Department's "preferred alternative" for continuing assembly, disassembly, and pit reuse functions at Pantex. This "preferred alternative" is environmentally sound, and economically appropriate. Transferring these functions to the Nevada Test Site would be highly questionable in both regards.

7. We strongly encourage the Department to retain high explosives functions at Pantex (rather than relocating those functions to Los Alamos and Lawrence Livermore labs). There would be negative environmental impacts, of course, associated with transfer of those functions to the labs -- impacts related to construction and expansion of the labs' facilities, for instance. Those impacts would not occur at Pantex, where facilities already are available and in use for these very purposes. Additionally, there would be economic waste associated with such transfers; simply put, it would be more expensive -- by DOE's estimate, $50 million more expensive -- to move the functions than to retain them where they presently are performed.

3/15.00.00

Too, high explosives functions should be retained at Pantex because under the assembly/disassembly preferred alternative, Pantex would be required to continue to have high explosives capabilities sufficient to handle disposition and disposal of current inventories and those anticipated from near-term dismantling --

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15 00 00 Comment Number 3

Comment noted. However, this issue is addressed in the Stockpile Stewardship and Management PEIS.

again, retaining the high explosives functions at the present site would eliminate the necessity of duplicating them elsewhere.

Finally, high explosives functions should be retained at Pantex because, should future need arise for new weapons production, it will be critical to have the high explosives facilities at the weapons production/assembly site -- which site, demonstrably, should be the Pantex site.

8. The environmental and related socio-economic impacts of new storage and disposition functions at Pantex (as outlined in the Fissile Material programmatic EIS) certainly suggests Pantex in fact is the prime candidate for those functions -- especially the storage functions (both those related to reserve weapons grade plutonium and "excess" materials, for which Pantex already has facilities and demonstrated expertise).

1/08.03.01 cont.

Clearly, the facilities and expertise for storage are existent at Pantex: the site provides storage for over 8,500 pits, and has FONSI (Finding of No Significant Impact) authority to house 12,000 pits. With slight modifications, the site likely could "FONSI-out," following an environmental assessment for 20,000 pits. Equally clearly, Pantex is well prepared to store some 21.3 metric tons of the 38.2 tons of the nation's "excess" plutonium -- the 21.3 tons are in place at Pantex now. Apparently, only slight expansion would be necessary to securely store the remainder.

Fundamental to this conclusion, too, are the obvious synergies of collocation of assembly/disassembly activities with necessarily attendant, on-site storage.

In fact, as a result of the (altogether appropriate) decision to continue assembly *and disassembly* at Pantex, all plutonium functions, including storage and

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SOUTHWESTERN PUBLIC SERVICE COMPANY, AMARILLO, TX,
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disposition, logically flow to Pantex. Incurring extraneous and unnecessary, and high, costs for redundant activities at separate sites would be imprudent.

9. Pantex is the nation's premier nuclear complex production facility; it is imperative that the "production core competencies" presently at the site not be lost or diluted by transfer of management (or production) functions to the labs.

The Department indicates that "stewardship core competencies" must be preserved, perhaps at the laboratories -- and the Department seems to indicate that may mean sacrificing "core production competencies" existent at Pantex. It would make better sense to maintain the stewardship competencies by visits or residency at Pantex, than to lose the production competencies that have evolved there.

Transferring assembly and disassembly functions to any site inexperienced in weapons production and, likely, incapable of significant weapons production, could prove disastrous should the need for an augmented nuclear arsenal arise (or *when* such need arises). Please, do not eliminate or significantly diminish our nation's most effective weapons production facility's competencies.

Relative to disposition alternatives, Southwestern Public Service Company notes that electric power and energy that could be used in immobilization and vitrification, or in processing for oxide fuel, would be priced very competitively at Pantex. (We refer the Department again to our comments, relative to electric supply and costs, in the Tritium Production EIS inquiry.) We are confident that Southwestern's position as a low-cost producer will encourage the Department to choose Pantex as the most cost-effective site for disposition activities. 1/08.03.01 cont.

10. DOE always should seek the most cost-efficient alternatives for the nuclear complex's operations. Generally, the most cost-efficient alternatives, rather

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related to capital investments, transportation, training, security, energy utilities, etc., will be those available to the nation at Pantex. 1/08.03.01 cont.

We request -- we are tempted to demand -- that fair and open cost comparisons among the alternative sites for each function be used in analyzing sites, and that such accountings be shared with the publics that have demonstrated interest in the nuclear complex. 4/07.02.00

11. Southwestern must specifically reject the conclusion in the Storage and Disposition draft EIS, under Phaseout, page S-21 (emphasis supplied), as it would apply to the Pantex region of influence: "All of the regional economic areas surrounding the DOE sites would experience a loss in employment with phaseout. However, *compared to total employment in these areas, the loss of jobs would have no or negligible impacts* at all the DOE sites."

In fact, the impact of Pantex employment in the region of influence is highly significant to the region. Measured in terms of total payroll, Pantex is by far the area's largest employer. The reasonable job multiplier developed by Dr. Ray Perryman at Southern Methodist University, a multiplier of 3.87, applied to the some 3,500 employees at Pantex, suggests the site is responsible for a total of over 13,500 jobs. *Employment related to Pantex represents over 12% of the jobs in the Amarillo metropolitan area.* 5/09.08.04

Incidentally, the three subject EISs inconsistently analyze the indirect jobs created in the region by Pantex employment: The site EIS assumes 1.65 indirect jobs for each job at Pantex; the stewardship and management EIS assumes 1.16; the storage and disposition EIS, 3.51 (by far, the most consistent with Dr. Perryman's, which is the same, regional-experience-based multiplier employed by the Amarillo Economic Development Commission).

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07 02 00 Comment Number 4

The Department of Energy issued a Technical Summary Report in July 1996 that included cost comparisons of the disposition technologies evaluated in the PEIS. However, the report only provided generic costs for each technology rather than site-specific costs. The differences between sites for a particular technology are relatively small except where existing facilities are available that could be used to offset overall cost. Available facilities were taken into consideration in developing the Preferred Alternative in the Final PEIS and will be considered with other factors in the ROD.

09 08 04 Comment Number 5

Phasing out the storage facilities is the only Proposed Alternative that would eliminate jobs at Pantex. DOE estimates that only about five direct jobs would be lost due to the phaseout of the storage mission. Although any employment loss would be undesirable, the loss of five jobs would have no impact on the local or regional economy.

The number of indirect jobs generated or lost due to the Proposed Alternatives was estimated using the RIMS II model developed by BEA. The employment multipliers used in RIMS II are available for all of the candidate sites and lend consistency to the socioeconomic analyses.

The documents cited evaluate the impacts of different activities which would account for some of the difference in size of multipliers used. For example, this PEIS assesses the impacts of storage alternatives at Pantex, differs from the types of activities assessed in the Stockpile Stewardship and Management PEIS (for example, weapons assembly/disassembly). These activities require different supply and service inputs and rely on different support industries. Therefore, the employment multipliers are likely to be different. The Pantex EIS uses a slightly different methodology and analyzes activities not limited to the Fissile Materials Disposition mission. This difference would account for disparities in the size of multipliers used in the two documents.

SOUTHWESTERN PUBLIC SERVICE COMPANY, AMARILLO, TX, WILLIAM T. CRENSHAW
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Certainly, we consider a potential 10% to 12% reduction in metro-area employment a major loss, and by no means a "negligible" concern. We strongly urge the Department to correct the socio-economic impact portions of all three EIS documents to accurately reflect the impact of Pantex employment in its region of influence. 5/09.08.04 cont.

12. Unlike other nuclear complex sites, for instance the notorious Rocky Flats, Hanford, and Savannah River sites, and yes, Los Alamos, Pantex has not had radioactive materials contamination problems. The nuclear complex-related operations at Pantex, in fact, apparently are the best-managed, relative to protection of the environment, in the nuclear complex. Partially to reward the superior, environmentally benign, history of the site, and certainly to capitalize on superior environmental performance, the Department should retain and expand the technically competent operations at Pantex. 1/08.03.01 cont.

Public support for retention and expansion of the Pantex operations has been nurtured by the facility's performance over many decades. Just as the public here has respected that performance, so should the Department.

Moreover, the Department must surely recognize in the resounding public support Pantex enjoys still further advantages to retention and expansion of the missions at Pantex.

In summary, the criteria for evaluating the alternatives and arriving at the most suitable Record of Decision -- the criteria of environmental impact, cost, and technical feasibility -- support retention and expansion of nuclear complex missions at the nation's premier production site, Pantex Plant. 1/08.03.01 cont.

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Southwestern appreciates the opportunity to participate in this important decision making process, and welcomes questions and dialogue, directed to:

William T. Crenshaw
Environmental Issues Analyst
Southwestern Public Service Company
(806) 378-2120

F-037

SPEISER, JOSHUA, SEATTLE, WA
PAGE 1 OF 2

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): Joshua Speiser
Address (optional): 4039 9th Avenue NE
Seattle, WA 98105

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. Materials Immobilization/Vitrification - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

~~The~~ BEST OPTION: This should be THE OPTION chosen for disposing of weapons-usable fissile Materials. It is the most protective of public and worker health, the environment, would create the LEAST Nuclear waste and have the fewest cumulative impacts to the Nation. 1/08.03.01

2. Deep borehole disposal - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

This option sounds too risky, too expensive and is wrought with too many unknowns furthermore, there is little certainty that the geologic formation chosen (if this option is elected) will remain stable for 29,000+ years... the 1/2 life of plutonium 2/08.03.01

3. Reactor Options - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

~~The~~ WORST OPTION UNDER NO CIRCUMSTANCES should this option be chosen. This option will be incredibly costly, will produce a large volume of NEW HIGH LEVEL NUCLEAR WASTE, places the public, worker health and the environment in the greatest Peril → Any energy produced in the process is overshadowed by the incredible production costs. 3/08.03.01

4. Storage Options - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

This option does Nothing to solve the current storage dilemma. It also does little to protect the Plutonium from theft or sabotage. The DOE must ACT, AND NOT "continue ... existing storage practices." 4/08.03.01

M-093

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 4

The Department of Energy acknowledges the commentor's opposition to continuing or long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Please use this space to write down any additional comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

The Mox-fuel option only exacerbates the current plutonium problems our Nation faces. It creates MORE HIGH LEVEL WASTE, is INCREDIBLY COSTLY, and taking into account the high cost of the process, produces little energy / dollar invested. It is shortsighted, dangerous and will only increase / worsen the burden the DOE now has...

3/08.03.01 cont.

No on the Mox fuel Option !!!

Yes on Vitrification

M-093

SPIKE ENTERPRISES AND TABOR GROUP, SAN ANTONIO, TX, TADEO ZYWICKI
PAGE 1 OF 3

SPIKE ENTERPRISES
and
TABOR GROUP

The Center for Legal and Social Justice
2507 N.W. 36th Street
San Antonio, Texas 78228
Telephone: 210-431-5747 · Facsimile: 210-431-5700

April 29, 1996

TADEO "SPIKE" ZYWICKI

United States Department of Energy
Office of Fissele Materiels Disposition
P.O. Box 23786
Washington, DC 20026-3786

Sirs and Masdames;

Your responsibility to select the safest measures of our Nuclear sys tem to preserve our nation from dire consequences. 1/08.03.00

A most fundamental need as Water is in danger. The various aquerira are in danger even to the present generation. How clearly must you plan ahead for future dangers and needs. 2/09.04.04

I trust that the work of discovery is going to creative thinkers who must of necessity break the mold of past bungling and secure us the advanced clear thinking of community Service.

Thank you, Sincerely

Tadeo "Spike" Zywicki

1 encl.

M-130

08 03 00 **Comment Number 1**

Comment noted.

09 04 04 **Comment Number 2**

Based on comments received, the Summary was revised. The bar charts providing the comparison of impacts for both storage and disposition were deleted from the Summary. The related text was revised to clarify the comparison of impacts and to delete reference to "adverse" impacts.

SPIKE ENTERPRISES AND TABOR GROUP, SAN ANTONIO, TX, TADEO ZYWICKI
PAGE 2 OF 3

STAND FOR CHILDREN

This is a defining time for our children and for our nation. The choices we make now, as parents, as community leaders, and as citizens, will shape our children's future and our nation's future. On June 1, every American who cares about children must stand up and be counted.

The June 1 Stand for Children will be a day of family and community renewal, celebration, and commitment to children. It will be a day to dedicate ourselves to positive action, as families, citizens, and communities, and as a national community, to do more to make sure that no child is left behind.

Get Involved and Make History. We need your energy and commitment. Here's how you can join us:

1. **Come to Washington, DC, on June 1 with your family and friends and take a Stand for Children.**

2. **Spread the word.** The more people who stand together for children on June 1 in Washington, DC, the bigger the impact. So tell 10 friends. Make copies of this flier and distribute them in places where people go every day – grocery stores, barber shops, coffee shops, malls. Put an announcement in your congregation's bulletin, your school or organization newsletter, and the local paper.

3. **Volunteer.** Children's Action Teams are forming all over America to help people come together in Washington on June 1. Call or e-mail us to find out what's going on in your area.

4. **Bring a busload to Stand for Children.** Organize a bus or a van or a car convoy to bring your family, friends, neighbors, co-workers, and congregation members to Washington, DC, on June 1. Call 1-800-233-1200 or 202-234-0095, or e-mail us at standinfo@mailback.com to receive our Bus Captain's Guide.

5. **Organize a Children's Action Team.** Your team can be as small as four people or as large as four thousand. But your job is still the same: to inspire people to take a Stand for Children on June 1 and strengthen your community's commitment to improving our children's quality of life. Our national staff will work with your Children's Action Team to make sure your efforts are successful. Call us at 1-800-233-1200 or 202-234-0095, or e-mail us at standinfo@mailback.com to get started.

STAND FOR CHILDREN can help you get involved. Call 1-800-233-1200 or 202-234-0095, or e-mail us at standinfo@mailback.com to find out what's going on in your area or to receive Stand for Children materials.

Here are some of the resources we can provide to help you take a Stand for Children:

Bus Captain's Guide
Posters
Local Event Ideas
Postcards
Publicity Kits
Fliers
Local Fundraising Tips
Pledge Cards
Children's Fact Sheets
Celebrity Public Service Announcements

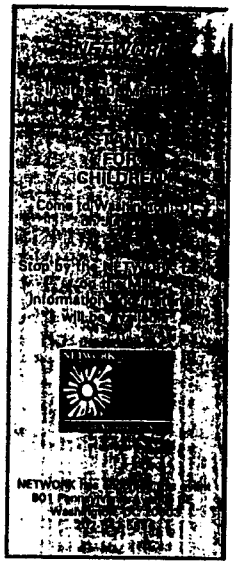
T-shirts and other merchandise will be available at a reasonable cost to help you raise funds for Stand for Children.

STAND FOR CHILDREN

1831 Connecticut Ave., NW
Washington, DC 20009
1-800-233-1200

M-130

SPIKE ENTERPRISES AND TABOR GROUP, SAN ANTONIO, TX, TADEO ZYWICKI
PAGE 3 OF 3



America isn't doing enough for our children.

On June 1, we can change that.

STAND FOR CHILDREN

June 1, 1996
Lincoln Memorial
Washington, DC

Make June 1 a national day of commitment to American children.

Our children's future and our nation's future are in our hands.

Every day in America:

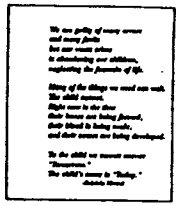
15	children are killed by firearms
2,660	babies are born into poverty
2,833	children drop out of school
8,493	children are reported abused or neglected

America ranks:

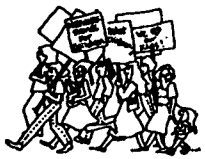
12th	among 15 nations in mathematics achievement of 13 year-olds
18th	among industrialized countries in the gap between rich and poor children
18th	in infant mortality
16th	in living standards of our poorest children

STAND FOR CHILDREN

is endorsed by more than 400 national, state, and local organizations, and the list continues to grow. For a complete list of endorsing organizations, call 1-800-233-1200.



Gathering will begin on the Mall at 10 AM with the formal program starting at 1 PM.



M-130

STAND OF AMARILLO, AMARILLO, TX, BEVERLY E. C. GATTIS
PAGE 1 OF 2

Statement of Beverly E.C. Gattis
President, STAND of Amarillo
April 22, 1996

Representatives of the Department of Energy are here for the next two days to educate the public about its plans for the future. There are voluminous documents which Panhandle citizens can read, if they so choose, and some of us have at least started that task. I will confess to a growing sense of anger at how deficient those documents are.

The Panhandle stands to be greatly affected by the choices the DOE will make about plutonium storage, processing and disposition, yet citizens are given documents which only talk in generalities about operations which can change Pantex into a plutonium processing site like Rocky Flats.

Pantex could become the site which blends plutonium and uranium together to make nuclear reactor fuel. It could even be the site for a new, experimental nuclear reactor. About none of this can we get sufficient information.

Technical analyses will be available later. Cost analyses will be available later. We do not have access to the information necessary to render an informed opinion, and the Department tells us that is how it will be. For instance, DOE defends the absence of cost information by stating that NEPA does not require a federal agency to supply cost analyses in a draft document. To that, I say "So what." Such information is necessary to the discussion and so must be made available.

The same applies to technical information. It is not possible that the Department has so little information that it can not give a clearer description of what the operations for dismantling pits and processing plutonium will involve. And no citizen should be satisfied with being put in the position of guessing. 1/08.00.00

All in all, the Department is wasting the time and good efforts of Panhandle citizens who care about their region. It is putting on a show of gathering public comment, but it is withholding information which the public needs and deserves. DOE is managing the public, not empowering it.

The decisions which these documents address are too important for us to allow the Department to go forward in this manner. Whether it is the case that the Department has the missing information yet is not revealing it, or whether the information is not complete, in either instance these draft documents are fundamentally deficient. The public deserves better. The law expects better. And the future must be based on something better.

There is difficult, important work which must be done with plutonium and highly enriched uranium if we are to control the theft of nuclear weapons-useable materials 2/13.00.00

TX-061

08 00 00 Comment Number 1

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses along with the environmental analysis and public input will be integrated into DOE's decisionmaking process.

13 00 00 Comment Number 2

Comment noted. DOE will implement the Proposed Action in compliance with all applicable environmental, safety, and health regulations, and will pursue external regulatory oversight to the extent practicable.

STAND OF AMARILLO, AMARILLO, TX,
BEVERLY E. C. GATTIS
PAGE 2 OF 2

and stop the spread of nuclear weapons. Unfortunately, it is the kind of work which has left trouble and contamination every place it has ever been done. 2/13.00.00 cont.

It is clear that the Department could name Pantex to do some of this processing and disposal work. It is STAND's position that the Panhandle is too valuable to be turned into a plutonium processor, fuel fabricator, nuclear reactor and nuclear waste handling site. But even more, it is STAND's position that no matter where this work is done, this time it must be well planned and executed. STAND will not accept anything less than forthright, complete information and good science for the sake not only of our region, but for the rest of the nation. 3/08.03.01

TX-061

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

STATE OF COLORADO, DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT, DENVER, CO, STEVE TARLTON

PAGE 1 OF 2

STATE OF COLORADO

Roy Romer, Governor
Patti Shwayder, Acting Executive Director
Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80222-1530
Phone (303) 692-2000

Laboratory Building
4210 E. 11th Avenue
Denver, Colorado 80220-3716
(303) 691-4700

Colorado Department of Public Health and Environment

May 7, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20024

FAX: 1-800-820-5156

Comments on the Draft PU PEIS

The PEIS approaches risk from a standpoint that DOE has adequate administrative and institutional controls to prevent accidental or catastropic releases of plutonium or other dangerous materials. Thus, the risk assessments prepared by DOE always conclude that there is no incremental risk from any given action.

In the approximately fifty years of operation at Rocky Flats, two fires breached the containment systems and released plutonium contamination into the environment. At the time of each incident, it was believed that administrative and institutional controls would prevent such an incident. 1/09.09.07

At Rocky Flats, plutonium and other materials are currently under the most dangerous conditions in the lifetime of the facility. In order to correct these conditions, actions will be taken that are non-routine and difficult to plan adequately. Thus, the overall risk at Rocky Flats will increase due to the uncertainty associated with these actions, and with the worsening conditions of the current storage

The area surrounding Rocky Flats is rapidly shifting from rural use to residential. The impacts of a release from Rocky Flats are significantly magnified over past conditions or the conditions at other DOE sites. Therefore, any alternative that delays the removal of plutonium from Rocky Flats has a significant increase in potential risk to the public.

Furthermore, projected delays in the removal of Rocky Flats plutonium have already impacted Site budgets. Uncertainties in the schedule for decision making and implementation of the PEIS have deflected funds for environmental cleanup and other risk reduction activities into projects related to additional plutonium storage at Rocky Flats. Some PEIS alternatives result in quicker decisions and/or plutonium removal from Rocky Flats, which allows storage funds to be allocated to other risk reduction activities. 2/07.00.00

M-174

09 09 07 **Comment Number 1**

For Pu storage at Rocky Flats, the PEIS analyzes No Action and phaseout of Pu storage at RFETS as part of each of the "action" storage alternatives. Under the No Action Alternative, Pu would continue to be stored at the site in existing facilities. The health risk from potential accidents from these storage facilities is assumed to be the same as the existing conditions, which is analyzed in this PEIS and, in addition, documented in a Safety Analysis Report. For phaseout, the health risk for potential accidents from these storage facilities should be better than the existing conditions.

The Department of Energy is currently pursuing stabilizing and repackaging of weapons-usable fissile materials (including those at RFETS) and placing them in safe, secure storage in accordance with the corrective actions identified in the *Plutonium Vulnerability Management Plan*. The RFETS mission is to transition from a production-dominated site to an environmental restoration, cleanup, and waste management-dominated site. DOE is committed to implementing all actions at RFETS in a safe and environmentally sound manner without delays which could create an increase in potential risk to the public and workers.

07 00 00 **Comment Number 2**

Comment noted. Decisions for projects related to additional Pu storage at RFETS will be integrated and coordinated with the ROD from this PEIS.

STATE OF COLORADO, DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT, DENVER, CO, STEVE TARLTON
PAGE 2 OF 2

CDPHE Comments
PU PEIS
Page 2

Thank you for the opportunity to comment on the PEIS for Storage and Disposition of Weapons-Usable Fissile Materials. You may direct comments or questions to: Steve Tarlton, Manager, Rocky Flats Program, Colorado Department of Public Health and Environment, 303-692-3015.

Sincerely,

For
Steve Tarlton
Manager
Rocky Flats Program

cc: file

M-174

STATE OF FLORIDA, DEPARTMENT OF COMMUNITY AFFAIRS, TALLAHASSEE, FL, RALPH CANTRAL
PAGE 1 OF 1

STATE OF FLORIDA
DEPARTMENT OF COMMUNITY AFFAIRS
EMERGENCY MANAGEMENT • HOUSING AND COMMUNITY DEVELOPMENT • RESOURCE PLANNING AND MANAGEMENT

LAWTON CHILES, Governor
JAMES F. MURLEY, Secretary

May 22, 1996

Mr. Bert Stevenson
U.S. Department of Energy
Office of Fissile Materials Disposition
1000 Independence Avenue SW
Washington, DC 20585-

RE: Nuclear Waste Disposal Siting - Storage and Disposition of Weapons - Usable Fissile Materials - Draft Programmatic Environmental Impact Statement - Statewide
SAI: FL9604090228C

Dear Mr. Stevenson:

The Florida State Clearinghouse has received your notification of the above-described project, and has forwarded it to the appropriate state agencies for review. In order to receive comments from all agencies, an additional fifteen days is requested for completion of the review. Therefore, the clearance letter due date for this project will be extended from May 24, 1996, to June 8, 1996. If all comments are received prior to the extended date, every effort will be made to forward the clearance letter to you at an earlier date. 1/08.01.00

Thank you for your understanding. If you have any questions regarding this matter, please contact Ms. Keri Akers, Clearinghouse Coordinator, at (904) 922-5438.

Sincerely,

Ralph Cantral, Executive Director
Florida Coastal Management Program

RC/cc

2740 CENTERVIEW DRIVE • TALLAHASSEE, FLORIDA 32399-2100

FLORIDA KEYS AREA OF CRITICAL STATE CONCERN FIELD OFFICE
SOUTH FLORIDA RECOVERY OFFICE
GREEN SWAMP AREA OF CRITICAL STATE CONCERN FIELD OFFICE

M-260

08 01 00 **Comment Number 1**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

STATE OF GEORGIA, DEPARTMENT OF NATURAL RESOURCES, ATLANTA, GA, HAROLD F. REHEIS
PAGE 1 OF 1

Georgia Department of Natural Resources

205 Butler St. SE , East Floyd Tower, Atlanta, Georgia 30334
Lenice C. Barnett, Commissioner
Harold F. Reheis, Director
Environmental Protection Division

May 6, 1996

Mr. Greg Rudy, Acting Director
Office of Fissile Materials Disposition
U. S. Department of Energy
P.O. Box 23786
Washington, D. C. 20026-3786

Dear Mr. Rudy:

In accordance with DOE public review and comment procedures we have completed an assessment of the Draft Programmatic Environmental Impact Statement on Disposition of Weapons - Usable Fissile Materials (DOE/EIS-0229-D). We appreciate the opportunity to provide input into this important decision.

The draft document contains a number of alternatives for the disposition, storage, and management of surplus plutonium. We note with a great deal of interest that DOE has not chosen a preferred alternative nor a facility for the implementation of a long term solution to the plutonium problem. This means that the Savannah River Site may be a future candidate for deep bore hole disposal or long term storage. Because of the complex geologic and hydrologic conditions at the Savannah River Site and the potential for contamination of groundwater that supplies all of Southeast Georgia, deep bore hole disposal and/or long term storage of plutonium at this facility is unacceptable. There may also be similar environmentally limiting conditions at other DOE facilities in the United States. 1/08.03.01

Our technical staff has reviewed the alternatives in the Draft Statement and concurs with the National Academy of Science (NAS) recommendation regarding the use of the spent fuel standard. In particular, it appears that a disposal system based on once-through irradiation of mixed oxide fuel in an existing light-water reactor, which is designed to accommodate this type of fuel, best meets the NAS standard. While we recognize that public concern will arise with the selection of any alternative, the use of plutonium in a reactor as fuel represents the best potential for protecting public health and safety in the long term. 2/08.03.01

In conclusion, we appreciate the opportunity to provide comments on this important national issue. We support the selection of an alternative that meets national security objectives in a safe and environmentally sound manner.

Sincerely,

Harold F. Reheis
Director

M-161

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at SRS. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

STATE OF IDAHO, OFFICE OF THE GOVERNOR, BOISE, ID,
GOVERNOR PHILIP E. BATT
PAGE 1 OF 5

OFFICE OF THE GOVERNOR
P.O. BOX 83720
BOISE 83720-0034

PHILIP E. BATT
GOVERNOR

(208) 334-2100

Testimony regarding the Draft Fissile Materials Disposition Programmatic Environmental Impact Statement

Monday, April 15, 1996
Idaho Falls, Idaho

As the Governor of the great state of Idaho, I appreciate the Department of Energy's efforts to come to grips with the by-products of the Cold War. To those of you who have traveled great distances to attend today's meeting, I extend to you my warm greetings.

This nation entered the nuclear age fifty years ago with big dreams, high hopes and in the case of nuclear weapons, horrible fears about what might some day be unleashed. At the same time we entered in the nuclear era, we were ill prepared for what to do with the final waste streams that come about through nuclear activity. .

The DOE is addressing these issues now through multiple environmental impact statements. Not all of them affect Idaho, but because the decisions DOE will make on the Draft Fissile Materials Disposition Programmatic Environmental Impact Statement will impact our state, it is important that DOE listen to what Idahoans have to say. Many fear what your decisions will do to the environment. Others fear what it will do to their pocketbook. Whatever decisions are made, it is important that DOE listen.

Although the EIS process DOE has undertaken is difficult and fraught with a certain degree of inevitable controversy, this process is an opportunity to peacefully decide what to do with what are essentially surplus war materials. Rather than using them in war, we now have the opportunity to calmly and rationally decide what to do with these surplus Cold War materials.

ID-002

STATE OF IDAHO, OFFICE OF THE GOVERNOR, BOISE, ID, GOVERNOR PHILIP E. BATT
PAGE 2 OF 5

The products under consideration in the Draft Fissile Materials Disposition Programmatic Environmental Impact Statement include plutonium and highly enriched uranium. As a nation, we must do something with these materials to make them safer and protect ourselves from the potential for misuse.

Under the draft PEIS, DOE officials are currently considering several options regarding what to do with these by-products. The draft PEIS identifies three long-term storage alternatives for plutonium and highly enriched uranium: upgrade facilities at multiple sites; consolidate the nation's plutonium at a single site; and co-locate plutonium and highly enriched uranium. The six candidate storage sites are: the Idaho National Engineering Laboratory, Hanford Site, Nevada Test Site, Oak Ridge Reservation, Pantex Plant and the Savannah River Site.

Let me make it perfectly clear to the DOE, media and citizens of Idaho: bringing nuclear waste material to Idaho for long term storage is not acceptable by either the letter or the spirit of the historic agreement reached last year.

Under the terms and principles of our agreement, transuranic waste material is specifically prohibited from entering Idaho until a treatment facility for that material is constructed and operating. Once the transuranic material is brought to Idaho, it has six months to be in Idaho before treatment and it must leave within six months after treatment. Transuranic waste is that waste contaminated with plutonium and other radioactive elements. 1/08.03.00

The state of Idaho considers any plutonium material brought to Idaho to be transuranic waste and therefore covered under the agreement.

Plutonium is a transuranic material because it contains more than 100 nanocuries of alpha-emitting transuranic isotopes with half-lives greater than 20 years per gram of waste.[1] Surplus plutonium is a waste because it is DOE's stated purpose and intent to treat this material so that it can be made proliferation resistant pending its ultimate disposition in a geologic repository. This EIS proposes to treat the plutonium by vitrification or MOX fuel fabrication. If DOE proposes to construct and operate either of these treatment facilities in Idaho, then Idaho will hold DOE to its obligation under the agreement – treatment within six months of receipt and shipment out of Idaho within six months of treatment. 1/08.03.00 cont.

Furthermore, if DOE decides to bring either plutonium or highly enriched uranium to Idaho for long term storage rather than treatment, Idaho will regard this as a direct violation of the spirit of our agreement. Both federal parties and Idaho agreed to act in good faith to effectuate and fully support this agreement. There was no doubt that the

[1] United States v. Philip E. Batt, Civil No. 91-0054-S-EJL, Oct. 17, 1995, definition section sites "transuranic waste as "defined as set forth in Spent Nuclear Fuel EIS, Volume 2, Appendix E.

ID-002

08 03 00 Comment Number 1

The *National Environmental Policy Act* requires that DOE consider a range of reasonable alternatives for the storage and disposition of weapons-usable fissile materials. The INEL and five other sites are being evaluated in the PEIS as potential storage sites and as representative sites for disposition alternatives.

Final decisions on materials storage and disposition will be based upon programmatic cost and policy considerations, as well as the environmental analysis. Consistent with efforts to foster the cooperative spirit that DOE wants to see continue to grow out of the agreement with the State of Idaho, DOE will not make final siting decisions regarding the storage or disposition of offsite weapons-usable fissile materials at INEL without first discussing the matter with the State of Idaho.

purpose of the agreement was to set the ground rules for how DOE would bring radioactive materials into Idaho and when these materials would leave.

Our agreement does allow DOE to request a modification of the agreement if a National Environmental Policy Act (NEPA) analysis results in the selection of an action that conflicts with the terms of the agreement. If Idaho doesn't agree with DOE, the court can decide whether DOE's proposal is reasonable. In this case, shipping large quantities of plutonium and highly enriched uranium for storage in Idaho makes little sense and is clearly unreasonable given DOE's other options. 1/08.03.00 cont.

Idaho has just 4.5% of the nation's plutonium and 10.1% of the nation's declassified highly enriched uranium. In contrast, Tennessee has 66.4% of the declassified highly enriched uranium and Texas has 66.4% of the nation's plutonium.[2] It would seem to make sense that if DOE wants to simply consolidate its holdings of these materials, there are places other than Idaho that are better suited for this purpose.

Idaho is no longer a nuclear dump site. Again, if DOE merely wants to bring plutonium and highly enriched uranium to Idaho for "long term storage" in violation of the agreement, that is unacceptable.

Idaho must be and will be ever vigilant. Under my administration, I assure every Idahoan that we will continue to hold INEL to the very highest standards. As part of that effort, the state of Idaho's Division of Environmental Quality recently issued 61 notices of violation at INEL.[3] Protecting Idaho's environment is an absolute must.

Having said that, let me add this. My administration still seeks new jobs and new missions for INEL. Just recently I came out in strong support of medical radioisotope production at Idaho's National Engineering Laboratory. I will continue, with others, including Idaho's Congressional Delegation, to seek new projects that provide quality jobs for eastern Idaho. I mention this because I believe that INEL scientists and engineers are some of the very best in the nation. I am confident that they can safely handle any material sent to them. 2/08.03.01

Radioactive material carries with it a lot of emotion. I believe the state's position addresses the fears of many. We want INEL to be clean. We want your operations to be safe. We want to see nuclear waste go to safe geologic repositories for permanent disposal. We also want good jobs at INEL, but simply bringing nuclear material to Idaho for indefinite "long term storage" does not achieve that objective and does not meet the spirit or letter of the agreement that was reached last year.

[2] Department of Energy National Governors' Association handout, "Department of Energy Nuclear Materials and Waste Status and Pending Decisions, March 19, 1996." Relevant graphs attached.

[3] For more information, contact Dave Pisarski, Bureau Chief, Enforcement Bureau, Idaho Division of Environmental Quality, 208-373-0502.

ID-002

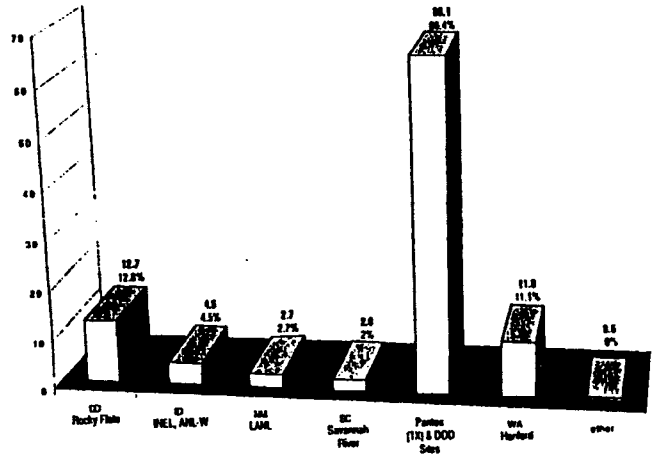
08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for additional missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

STATE OF IDAHO, OFFICE OF THE GOVERNOR, BOISE, ID,
GOVERNOR PHILIP E. BATT
PAGE 4 OF 5

Inventory Summary - Plutonium

(99.5 Metric Tons- MT)



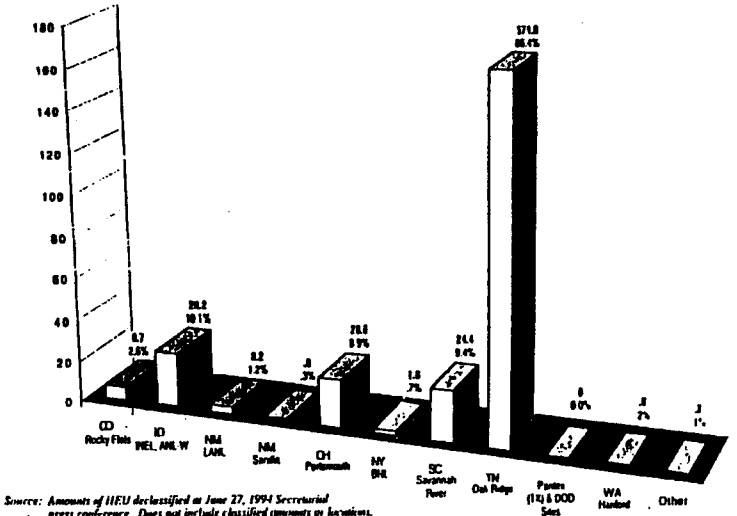
Source: Secretary O'Leary announced on February 6, 1996 that the actual inventory of Pu is 99.5 MT

Note: The Pantex (TX) and DOD Sites category includes Plutonium and excesses at Pantex. Specific amounts and locations are classified.

ID-002

Partial Inventory - Highly Enriched Uranium

(258.8 Metric Tons- MT)

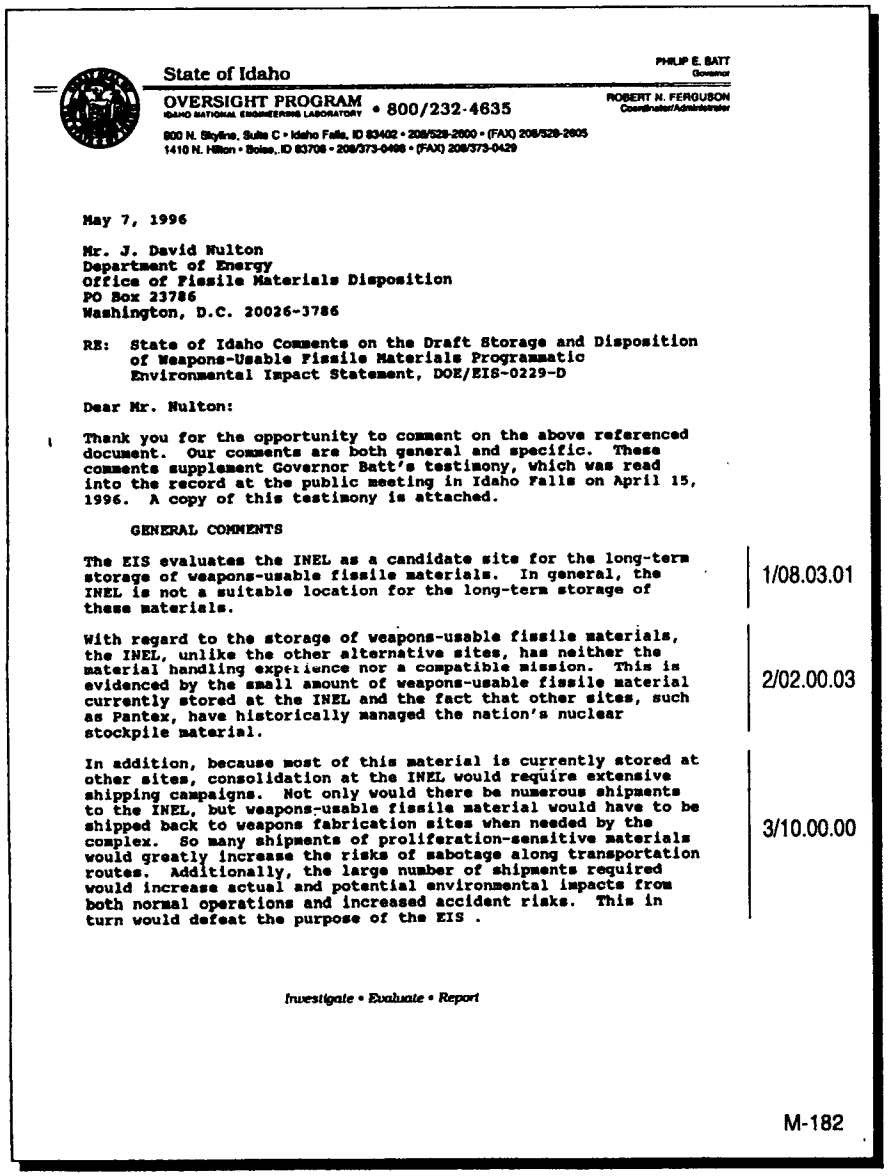


Source: Amounts of HEU declassified at June 27, 1994 Secretarial press conference. Does not include classified amounts or locations.

Note: The amounts and locations of HEU at Pantex (TX) and DOD Sites are classified. At the February 6, 1996 Press Conference, it was announced that there is 16.7MT of HEU at Pantex plus planned downblendings. Not all of the 16.7MT is currently at Pantex.

ID-002

STATE OF IDAHO, OVERSIGHT PROGRAM, BOISE, ID, ROBERT N. FERGUSON
PAGE 1 OF 10



State of Idaho

PHILIP E. BATT
Governor

OVERSIGHT PROGRAM • 800/232-4635
IDAHO NATIONAL ENGINEERING LABORATORY

ROBERT N. FERGUSON
Coordinator/Administrator

900 N. Skyline, Suite C • Idaho Falls, ID 83402 • 208/528-2600 • (FAX) 208/528-2605
1410 N. Hilton • Boise, ID 83706 • 208/373-0498 • (FAX) 208/373-0429

May 7, 1996

Mr. J. David Nulton
Department of Energy
Office of Fissile Materials Disposition
PO Box 23786
Washington, D.C. 20026-3786

RE: State of Idaho Comments on the Draft Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement, DOE/EIS-0229-D

Dear Mr. Nulton:

Thank you for the opportunity to comment on the above referenced document. Our comments are both general and specific. These comments supplement Governor Batt's testimony, which was read into the record at the public meeting in Idaho Falls on April 15, 1996. A copy of this testimony is attached.

GENERAL COMMENTS

The EIS evaluates the INEL as a candidate site for the long-term storage of weapons-usable fissile materials. In general, the INEL is not a suitable location for the long-term storage of these materials. 1/08.03.01

With regard to the storage of weapons-usable fissile materials, the INEL, unlike the other alternative sites, has neither the material handling experience nor a compatible mission. This is evidenced by the small amount of weapons-usable fissile material currently stored at the INEL and the fact that other sites, such as Pantex, have historically managed the nation's nuclear stockpile material. 2/02.00.03

In addition, because most of this material is currently stored at other sites, consolidation at the INEL would require extensive shipping campaigns. Not only would there be numerous shipments to the INEL, but weapons-usable fissile material would have to be shipped back to weapons fabrication sites when needed by the complex. So many shipments of proliferation-sensitive materials would greatly increase the risks of sabotage along transportation routes. Additionally, the large number of shipments required would increase actual and potential environmental impacts from both normal operations and increased accident risks. This in turn would defeat the purpose of the EIS . 3/10.00.00

Investigate • Evaluate • Report

M-182

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at INEL. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

02 00 03 **Comment Number 2**

The Department of Energy is considering several sites for the long-term storage of Pu and HEU. The decision on a site or sites will be based upon the results of environmental analyses, information from technical and economic studies, national policy considerations, and public input.

10 00 00 **Comment Number 3**

The human health risks of material transportations associated with the proposed Pu storage and disposition alternatives are evaluated and presented in Section 4.4 of the PEIS. The more detailed description of the methodology and supporting data for the analysis is presented in the Appendix G. Transportation of radioactive materials between sites includes health risks for both normal operations and accident conditions to the public and workers.

STATE OF IDAHO, OVERSIGHT PROGRAM, BOISE, ID,
ROBERT N. FERGUSON
PAGE 2 OF 10

With regard to the disposition of excess plutonium, the State endorses waste management approaches designed to put the excess plutonium into a form that is proliferation-resistant and that can eventually be disposed of in a geologic repository. As such, the State supports the alternatives for fabrication of mixed-oxide fuel and vitrification with high-level waste. 4/08.03.01

As stated in Governor Batt's testimony on this EIS, Idaho considers any plutonium transported to Idaho for long-term storage or disposition to be a transuranic waste. Therefore, any plutonium brought into the State would be subject to the terms of the October 17, 1995 settlement agreement between Idaho and the DOE. Accordingly, transuranic waste brought into the State must be treated within six months and taken out of the State within six months of treatment. 5/08.03.00

Even though the EIS did not evaluate specific sites for the deep borehole alternative, it is worth noting that the INEL would not be a suitable location. The INEL is situated over the Snake River Plain Aquifer, a sole source aquifer that supplies more than half the water used in the State. In addition, the Snake River Plain is volcanically active, with lava flows occurring as recently as 2000 years ago. The borehole alternatives would involve drilling through the aquifer and emplacing plutonium waste in the geologic strata beneath it. Because of the potential for contaminating the aquifer and because the underlying strata is not "...ancient, geologically stable rock..." as specified on page S-13, the State does not consider the INEL to be a reasonable site for such an alternative. 6/08.03.01 7/04.03.00

A final general comment regarding the Draft EIS is the need for more emphasis on pollution prevention and waste minimization. Because these measures reduce the environmental impacts of proposed actions and are required by law, the EIS should recognize and describe what will be done in this regard. It is suggested that the Final EIS contain a section describing pollution prevention and waste minimization techniques that will be adopted for each alternative. 8/09.00.08

SPECIFIC COMMENTS

P. 2-20, para. 2

This paragraph states that ANL-W "is the only INEL facility that currently stores weapons-usable Pu" and lists 4.5 t of Pu at the ZPPR and FMF facilities at ANL-W. "Plutonium: The First 50 Years", DOE, Feb. 1996, lists (p. 20) 4.0 t of Pu at ANL-W and 0.5 t at INEL (including [p. 76] 0.4 t of excess weapons grade Pu at the INEL). This apparent discrepancy should be clarified; is weapons-grade Pu stored at the INEL other than at ANL-W? If so, is all of the excess Pu at ANL-W, or is some of it elsewhere at the INEL? 9/02.01.03

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08 03 01 Comment Number 4

The Department of Energy acknowledges the commentor's support for the Reactor Alternatives using MOX fuel and Vitrification Alternatives. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 00 Comment Number 5

The Department of Energy acknowledges Governor Batt's position on the settlement agreement and his interpretation of its meaning. Any decision on storage or disposition of weapons-usable fissile materials in Idaho will include consideration of the Settlement Agreement along with the environmental analyses in the PEIS, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 6

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

04 03 00 Comment Number 7

Comment noted.

09 00 08 Comment Number 8

Waste minimization is the reduction, to the extent feasible, of radioactive and hazardous waste that is generated before treatment, storage, or disposal of the waste. Pollution prevention fully utilizes source reduction techniques in order to reduce risk to public health, safety, welfare, and the environment, and environmentally sound recycling to achieve these same goals. Each DOE site is required to have a *Waste Minimization and Pollution Prevention Awareness Plan.* To report progress towards their goals in the plan, each site prepares an

STATE OF IDAHO, OVERSIGHT PROGRAM, BOISE, ID, ROBERT N. FERGUSON
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P. 3-116 to 3-118 A discussion of groundwater contamination at TAN and vadose zone contamination at the RWMC should be added.	10/09.04.03
P. 3-140, para. 4; app. J This paragraph regarding spent nuclear fuel (and subsequent paragraphs on high level waste, transuranic waste, and mixed waste) and appendix J should be revised based on the 2/6/96 amendment to the Record of Decision for the Programmatic Spent Nuclear Fuel Management & INEL Environmental Restoration & Waste Management EIS reflecting the settlement agreement with the State of Idaho and the 10/17/95 federal court order.	11/09.11.03
P. 4-133 (tab. 4.2.3.3-1); p. F-10 (tab. F.1.2.4-1), p. F-21 (tab. F.1.3-2), p. F-23 (tab. F.1.3-3) Emission rates for SO_2 at INEL show increases (from the no action alternative) of 79 percent for consolidation and 99 percent for collocation, presumably due to potential increased coal combustion, as indicated in tab. 4.2.3.2-1 on p. 4-129. However, modeled 3-hour average ambient SO_2 concentrations show increases of only 18 and 22 percent, respectively (increases for longer averaging times are similar). How is this possible if all emissions were modeled as coming from a single point source, as described in the text accompanying these tables?	12/09.03.03
P. 4-777 to 4-784 (see also app. G) Only total potential fatalities from transportation activities are presented for each alternative. A breakdown between radiological and non-radiological, and between incident-free and accident scenarios would be useful in reviewing the analysis, in putting radiological impacts in perspective, and in assessing the effect on total predicted fatalities (and the uncertainty thereof) of various input parameters.	13/10.02.00
P. G-2, para. 6 Please provide references for the rates for nonradiological impacts.	14/10.00.00
Appendix M, General comment The final EIS should provide an explanation of the subtitle "Evaluation of Composite Set of Accidents." It is not clear what is actually meant by this category.	15/09.09.08
P. M-38, para. 2, line 1; p. M-39 to M-43 "Five" should be changed to "nine" to be consistent with the accompanying tables and figure M.2.6-1. Also, NRF is indicated	16/09.09.03

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Annual Report on Waste Generation and Waste Minimization Progress. When planning for the construction of facilities by 2010, it will be necessary to consider currently available technology while providing modular, flexible designs that can incorporate process improvements as they become available. In accordance with Executive Orders 12856 and 12873 and DOE policy, the facilities that would support the long-term storage or disposition of weapons-usable fissile materials would be designed for waste minimization with an overall operating philosophy of pollution prevention. This waste minimization program would contribute to decreases in waste treatment, storage, and disposal costs and lower health risks to workers and the public. Technical approaches are being sought to optimize the number of production operations required, increase the use of nonhazardous chemicals and environmentally benign waste-producing chemicals, increase the use of recyclable chemicals and materials, and implement the new design or redesign of existing processes and products. Some criteria useful in determining successful technology include improved processing yield, reduced quantities of scrap, reduced waste and processing of by-products, reduced use of hazardous chemicals, positive return on investment, and continued product quality. This information is contained in Section E.1.3 of the PEIS.

02 01 03 Comment Number 9

The Secretary's briefing states 4.0 t (4.4 tons) of Pu is at ANL-W and 0.5 t (0.55 tons) is at INEL. The PEIS was corrected to indicate that 4.0 t (4.4 tons) of Pu is at ANL-W in the Zero Power Physics Reactor and Fuel Manufacturing Facility (FMF) facilities and 0.5 t (0.55 tons) is at INEL at the ICPP facilities. There are 0.4 t (0.44 tons) of surplus Pu at the ICPP facilities as indicated on Figure 1.1.1–1. The remaining Pu is not considered surplus.

09 04 03 Comment Number 10

A discussion concerning the sources of contamination at these areas and remedial actions for the contaminated groundwater was added to Section 3.4.4 of the Final PEIS.

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ROBERT N. FERGUSON
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as a release point in fig. M.2.6-1 on p. M-41, but no NRF information is included in the tables; why? | 16/09.09.03 cont.

P. M-38, para 3

Why were 1986 meteorological measurements used? More recent GRID III data should have been available. | 17/09.09.03

P. M-51, para. 2, line 1; p. M-52 to M-54

"Four" should be changed to "six" to be consistent with the accompanying tables and figure M.2.7-1. | 18/09.09.04

P. M-174, tab. M.3.4-43

The exponent or power of 10 is missing from the total hazard index for a worker at 100 meters; it should be "-1."

P. M-207, tab. M.3.4-76

The exponent or power of 10 is missing from the total hazard index for a worker at 100 meters; it should be "-5." | 19/09.10.08

P. M-227 to M-228

No indication is given on the type of meteorology being used in the MACCS computer code. Does the meteorology meet 95% accident meteorology, and if so, what are the conditions? | 20/09.09.08

P. M-228, para 4

The uninvolved worker location is quite a distance (1 km) from the scene of the accidents. Uninvolved workers can be as close as 200 to 300 meters depending on the location of a building in relation to other facility structures. 1000 meters is a distance that could be related to collocation of facilities. Distances in closer proximity for uninvolved worker locations should be used. | 21/09.09.08

P. M-229 to M-276

Source terms released to the environment with up to four or five significant figures for imprecisely defined hypothetical accident scenarios (for example, "146.39 g Pu", last line in tab M.5.2.1.1-1; there are several other similar examples) imply a level of precision that would seem to be difficult to justify. These source terms are probably order of magnitude estimates at best. | 22/09.09.08

P. M-321, tab. M.5.3.5.1-5

Accident descriptions need to be provided for some of the postulated accidents listed in this table. | 23/09.09.08

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09 11 03 **Comment Number 11**

The appropriate sections within the PEIS have been revised to reflect the amended ROD that was published on March 8, 1996 (61 FR 9441).

09 03 03 **Comment Number 12**

Criteria pollutant emissions at INEL, including sulfur dioxide, were modeled from actual stack locations using operating permit data on stack height, stack diameter, exit velocity, and exit temperatures as presented in Section F.1.2.4. The facility emissions for the Consolidation and Collocation Alternatives were modeled from a centrally located single point source.

The pollutant concentrations presented in Table 4.2.3.3–1 were determined based upon the maximum annual average emission case. The emission rates presented in Table F.1.2.4–1 were changed to reflect the maximum annual average emission rates which correspond to the modeled concentrations. The emission rate for sulfur dioxide for the actual annual emission rate is 202,000 kilograms (kg)/yr (445,000 pounds [lb]/yr). The maximum annual average emission rate for sulfur dioxide is 1,700,000 kg/yr (3,880,000 lb/yr).

10 02 00 **Comment Number 13**

The human health risks from the transportation of radioactive materials between sites includes both radiological and nonradiological impacts to the public and workers. The categories of calculated risks include nonradiological accident impacts to the public and workers, nonradiological normal operation impacts to the public (air pollution), radiological accidents to the public, and radiological normal operation impacts to the public and workers. The transportation sections of the PEIS have been clarified to explain that many impacts are neither radiological nor cargo-related. The risk to the public for radiological accidents is an order of magnitude less than either nonradiological accidents or radiological exposures during normal operations.

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ROBERT N. FERGUSON
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Should you have any questions regarding the State's comments, please contact Alan Merritt of this office at (208) 528-2600.

Sincerely

Robert N. Ferguson
Administrator

enclosure

cc: Ann Dold, Manager
Alan Merritt, Environmental Scientist
Jerry Downs, Environmental Scientist
Richard Durante, Sr. Health Physicist
Doug Wells, Radiation Physicist
Kathleen Trever, Deputy Attorney General
Jeff Schrade, Special Assistant to the Governor
Senator Larry Craig
Senator Dirk Kempthorne
Representative Mike Crapo
Representative Helen Chenowith
Delbert Farmer, Chairman, Ft. Hall Business Council
Roger Twitchell, DOE-ID NEPA Compliance Officer
File- 2.0 NEPA-EIS miscellaneous

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10 00 00 **Comment Number 14**

Cashwell, J.W., K.S. Neuhauser, P.C. Reardon, and G.W. McNair, *Transportation Impacts of the Commercial Radioactive Waste Management Program*, SAND85-2715, U.S. Department of Energy, Sandia National Laboratories, NM, April 1986, pg. 167 (SNL 1986a:167).

09 09 08 **Comment Number 15**

The "evaluation of composite set of accidents" was included in the Draft PEIS with the intent of providing a more complete understanding of the accident analyses; however, public comments raised issues concerning confusion caused by this information, therefore the "evaluation of composite set of accidents" was deleted in the Final PEIS.

09 09 03 **Comment Number 16**

The text and tables in the Final PEIS have been modified to reflect the consistent case.

09 09 03 **Comment Number 17**

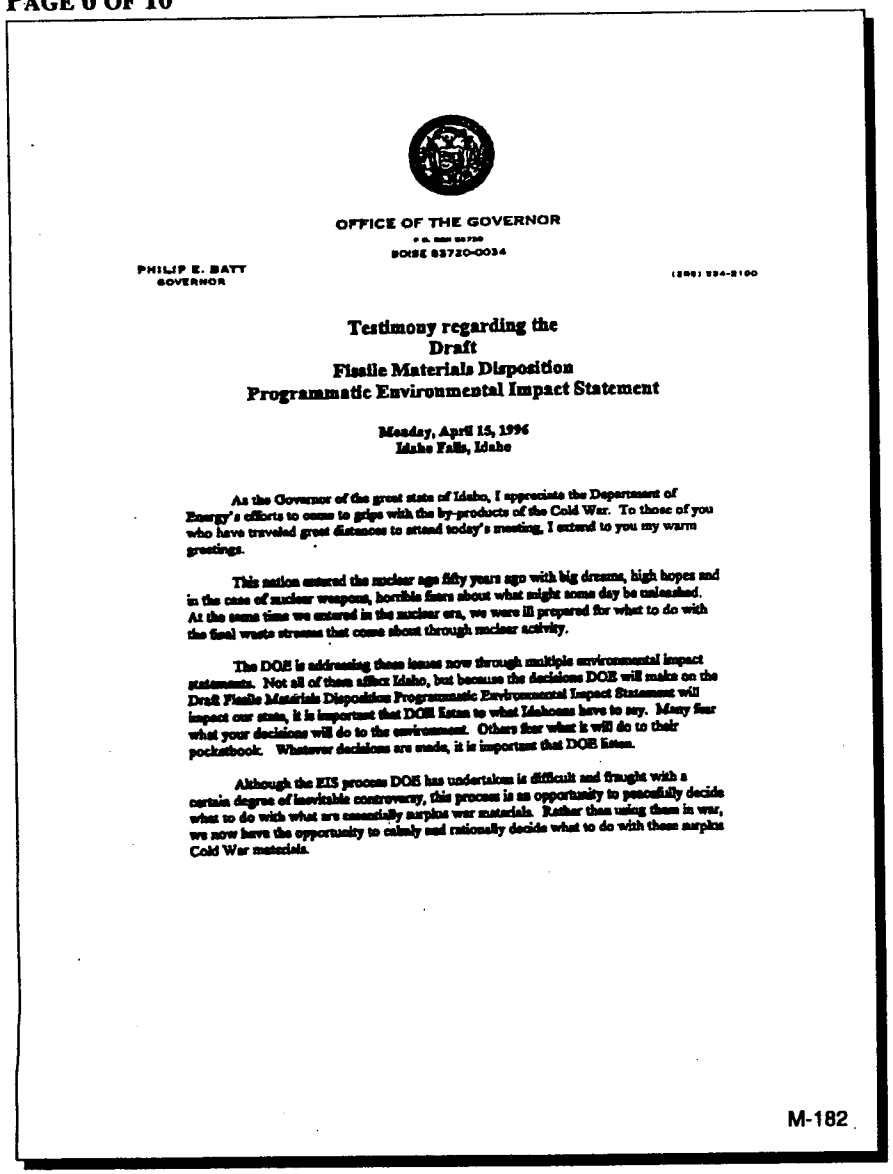
At the time the meteorological data was collected at the site, 1986 meteorological measurement data was the best available data to use in radiological assessment models. No significant change would be expected even if more current data were used.

09 09 04 **Comment Number 18**

The text and tables in the Final PEIS have been modified to reflect the consistent case.

09 10 08 **Comment Number 19**

The numbers are correct in the Final PEIS.



OFFICE OF THE GOVERNOR
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BOISE 83720-0034

PHILIP E. BATT
GOVERNOR

(208) 334-2100

Testimony regarding the
Draft
Fissile Materials Disposition
Programmatic Environmental Impact Statement

Monday, April 15, 1996
Idaho Falls, Idaho

As the Governor of the great state of Idaho, I appreciate the Department of Energy's efforts to come to grips with the by-products of the Cold War. To those of you who have traveled great distances to attend today's meeting, I extend to you my warm greetings.

This nation entered the nuclear age fifty years ago with big dreams, high hopes and in the case of nuclear weapons, horrible fears about what might some day be unleashed. At the same time we entered in the nuclear era, we were ill prepared for what to do with the final waste streams that come about through nuclear activity.

The DOE is addressing these issues now through multiple environmental impact statements. Not all of these affect Idaho, but because the decisions DOE will make on the Draft Fissile Materials Disposition Programmatic Environmental Impact Statement will impact our state, it is important that DOE listen to what Idahoans have to say. Many fear what your decisions will do to the environment. Others fear what it will do to their pocketbook. Whatever decisions are made, it is important that DOE listen.

Although the EIS process DOE has undertaken is difficult and fraught with a certain degree of inevitable controversy, this process is an opportunity to peacefully decide what to do with what are essentially surplus war materials. Rather than using them in war, we now have the opportunity to calmly and rationally decide what to do with these surplus Cold War materials.

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09 09 08 Comment Number 20

The MACCS code used 50-percent meteorology data for accident risk assessment. The reason to choose the 50-percent meteorology data was that no 95-percent data was available for some sites. To be consistent for all sites, the average (about 50 percent) meteorology data was used for all sites.

09 09 08 Comment Number 21

The 1,000-meter (m) (3,281-foot [ft]) distance of a noninvolved worker from the nearest release point of radioactive material is a representative distance which has been used in calculations at all sites. It provides a reasonable reference distance for calculations at both large and small sites. Estimating exposures from a release point at closer distances may not be very accurate because of building effects on dispersion (that is, wake-stream effects).

Also, more detail on how the MACCS code was applied is added to the Final PEIS, Appendix M, and Environmental Impact Methodology sections of Chapter 4. In addition, a topical report for the accident assessments was prepared and added to the current Health Risk Data topical report.

09 09 08 Comment Number 22

In order to provide information to the public and decisionmakers, the human health risk and latent fatal cancers are presented in the PEIS even though they are very small numbers. To aid the public understanding of the risk numbers, an explanation of how to interpret these risk numbers is also included in Section M.5. Due to the inherent uncertainties associated with risk assessment, the parameters related to human health risk assessment should be kept to two significant digits. Risk numbers that are more than two significant digits were modified in Chapter 4 of the Final PEIS. Presenting more significant digits does not affect the decisionmaking process, but artificially grouping ranges of numbers may disguise significant discriminators.

STATE OF IDAHO, OVERSIGHT PROGRAM, BOISE, ID,
ROBERT N. FERGUSON
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The products under consideration in the Draft Fissile Materials Disposition Programmatic Environmental Impact Statement include plutonium and highly enriched uranium. As a nation, we must do something with these materials to make them safer and protect ourselves from the potential for misuse.

Under the draft PEIS, DOE officials are currently considering several options regarding what to do with these by-products. The draft PEIS identifies three long-term storage alternatives for plutonium and highly enriched uranium: upgrade facilities at multiple sites; consolidate the nation's plutonium at a single site; and co-locate plutonium and highly enriched uranium. The six candidate storage sites are: the Idaho National Engineering Laboratory, Hanford Site, Nevada Test Site, Oak Ridge Reservation, Pantex Plant and the Savannah River Site.

Let me make it perfectly clear to the DOE, media and citizens of Idaho: bringing nuclear waste material to Idaho for long term storage is not acceptable by either the letter or the spirit of the historic agreement reached last year.

Under the terms and principles of our agreement, transuranic waste material is specifically prohibited from entering Idaho until a treatment facility for that material is constructed and operating. Once the transuranic material is brought to Idaho, it has six months to be in Idaho before treatment and it must leave within six months after treatment. Transuranic waste is that waste contaminated with plutonium and other radioactive elements.

The state of Idaho considers any plutonium material brought to Idaho to be transuranic waste and therefore covered under the agreement.

Plutonium is a transuranic material because it contains more than 100 nanocuries of alpha-emitting transuranic isotopes with half-lives greater than 20 years per gram of waste.[1] Surplus plutonium is a waste because it is DOE's stated purpose and intent to treat this material so that it can be made proliferation resistant pending its ultimate disposition in a geologic repository. This EIS proposes to treat the plutonium by vitrification or MOX fuel fabrication. If DOE proposes to construct and operate either of these treatment facilities in Idaho, then Idaho will hold DOE to its obligation under the agreement -- treatment within six months of receipt and shipment out of Idaho within six months of treatment.

Furthermore, if DOE decides to bring either plutonium or highly enriched uranium to Idaho for long term storage rather than treatment, Idaho will regard this as a direct violation of the spirit of our agreement. Both federal parties and Idaho agreed to act in good faith to effectuate and fully support this agreement. There was no doubt that the

[1] United States v. Philip E. Batt, Civil No. 91-0054-S-EJL, Oct. 17, 1995, definition section cites "transuranic waste as "defined as set forth in Spent Nuclear Fuel EIS, Volume 2, Appendix E.

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09 09 08 Comment Number 23

Section M.5.1.3.3 has been added in the Final PEIS to describe the methodology and techniques used in the analysis of facility accidents. The accident scenarios were developed to cover the full spectrum of potential accidents. The quantity of material at risk, radionuclide releases, probability of accidents, and input data have been estimated to calculate accident consequences.

For the disposition alternatives the accident descriptions are brief due to the conceptual nature of the design at this time. However, more detailed accident analyses will be included in site-specific tiered NEPA documentation for the disposition alternatives.

purpose of the agreement was to set the ground rules for how DOE would bring radioactive materials into Idaho and when these materials would leave.

Our agreement does allow DOE to request a modification of the agreement if a National Environmental Policy Act (NEPA) analysis results in the selection of an action that conflicts with the terms of the agreement. If Idaho doesn't agree with DOE, the court can decide whether DOE's proposal is reasonable. In this case, shipping large quantities of plutonium and highly enriched uranium for storage in Idaho makes little sense and is clearly unreasonable given DOE's other options.

Idaho has just 4.5% of the nation's plutonium and 10.1% of the nation's declassified highly enriched uranium. In contrast, Tennessee has 66.4% of the declassified highly enriched uranium and Texas has 66.4% of the nation's plutonium.[2] It would seem to make sense that if DOE wants to simply consolidate its holdings of these materials, there are places other than Idaho that are better suited for this purpose.

Idaho is no longer a nuclear dump site. Again, if DOE merely wants to bring plutonium and highly enriched uranium to Idaho for "long term storage" in violation of the agreement, that is unacceptable.

Idaho must be and will be ever vigilant. Under my administration, I assure every Idahoan that we will continue to hold INEL to the very highest standards. As part of that effort, the state of Idaho's Division of Environmental Quality recently issued 61 notices of violation at INEL.[3] Protecting Idaho's environment is an absolute must.

Having said that, let me add this. My administration still seeks new jobs and new missions for INEL. Just recently I came out in strong support of medical radioisotope production at Idaho's National Engineering Laboratory. I will continue, with others, including Idaho's Congressional Delegation, to seek new projects that provide quality jobs for eastern Idaho. I mention this because I believe that INEL scientists and engineers are some of the very best in the nation. I am confident that they can safely handle any material sent to them.

Radioactive material carries with it a lot of emotion. I believe the state's position addresses the fears of many. We want INEL to be clean. We want your operations to be safe. We want to see nuclear waste go to safe geologic repositories for permanent disposal. We also want good jobs at INEL, but simply bringing nuclear material to Idaho for indefinite "long term storage" does not achieve that objective and does not meet the spirit or letter of the agreement that was reached last year.

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[2] Department of Energy National Governors' Association handout, "Department of Energy Nuclear Materials and Waste Status and Pending Decisions, March 19, 1996." Relevant graphs attached.

[3] For more information, contact Dave Pisarski, Bureau Chief, Enforcement Bureau, Idaho Division of Environmental Quality, 208-373-0502.

STATE OF IDAHO, OVERSIGHT PROGRAM, BOISE, ID,
ROBERT N. FERGUSON
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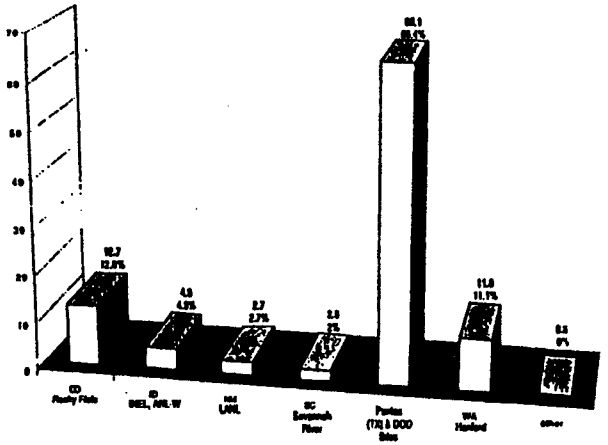
Inventory Summary - Plutonium

(99.5 Metric Tons- MT)



Source: Secretary O'Leary announced on February 6, 1996 that the actual inventory of Pu is 99.5 MT

Note: The Pantex (TX) and DOD Sites category includes Plutonium not currently at Pantex. Specific amounts and locations are classified.

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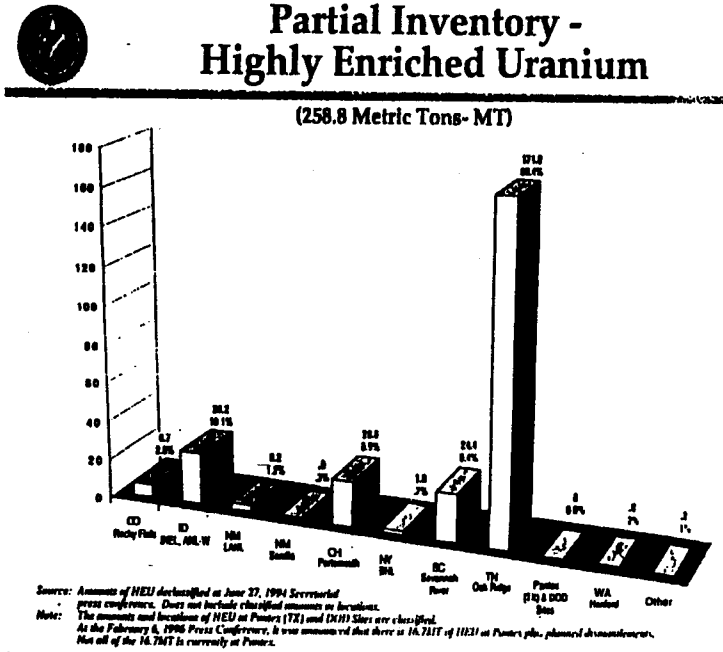

M-182

STATE OF MICHIGAN, STATE REPRESENTATIVE, LANSING, MI, KAREN WILLARD
PAGE 1 OF 2

HOUSE OF REPRESENTATIVES
LANSING, MICHIGAN

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ASSISTANT FLOOR LEADER
COMMITTEES:
AGRICULTURE AND FORESTRY
JUDICIARY
TOURISM AND RECREATION

April 26, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

REF: Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

I am writing to communicate my serious concerns regarding one of the options presented in the reactor category of disposition alternatives in the above-cited PEIS.

It is my understanding that one of the reactor sites being considered by the Department is the heavy water Canadian Deuterium Uranium (CANDU) reactors on the shore of Lake Huron near Kincardine, Ontario. It is also my understanding that the plutonium-based mixed oxide fuel used by these reactors may be refined in Washington state and transported to the CANDU site, possibly through the state of Michigan.

I represent the residents of Lapeer and St. Clair counties, located in the lower Thumb region of eastern Michigan. My district is in close proximity to the two sites in Michigan's lower peninsula which serve as ground transportation connections between the United States and Canada: The Blue Water Bridge between Port Huron, Michigan, and Sarnia, Ontario; and the Windsor Bridge/Tunnel system between Windsor, Ontario, and the City of Detroit. The two major highways into Port Huron, Interstates 69 and 94, each run through the area I represent.

My concerns lie primarily with the safety of transporting weapons-grade plutonium fuel, which is volatile and highly carcinogenic, over ground from Washington state through densely populated areas of the U.S. and, particularly, the state of Michigan. If nuclear fuel is to be transported through Michigan to Canada on our Interstate highways, it will have to travel through major metropolitan areas of the lower peninsula either along I-94 (Kalamazoo, Battle Creek, Jackson, Ann Arbor, Dearborn and the Detroit Metro area) or along I-69 (Lansing, Flint, Port Huron). Additionally, the I-69 corridor runs the length of my House district, through Lapeer and St. Clair counties.

1/10.00.00

M-056

10 00 00 Comment Number 1

Under NEPA, DOE is required to evaluate a range of alternatives for Pu disposition. In that regard, the disposition of Pu in a CANDU reactor is one of nine different disposition alternatives analyzed in the PEIS. Six specific sites and a generic site are evaluated for fabricating MOX fuel for Pu disposition. As a result, the transportation analyses performed in the PEIS consider multiple routes from potential fuel fabrication sites to potential reactor sites. Section G.6 provides a description of the DOE safe secure transport system. The design of vehicle and transportation operation procedures is classified. The selection of the routes and coordination with State and local governments are contained within these procedures. However, there has never been a failure of this system to provide safe secure transportation during more than 20 years in operation.

For emergency response circumstances, all shipments will be coordinated with appropriate State and local officials. If requested, DOE will assist appropriate officials with response plans and, if necessary, resources in accordance with guidelines established in DOE Order 5530.3. DOE has developed a Radiological Assistance Program, also outlined in DOE Order 5530.3, to provide assistance in all types of radiological accidents. Regional Radiological Assistance Program plans include coverage of the States and provide guidance for maintaining and executing emergency response plans.

STATE OF MICHIGAN, STATE REPRESENTATIVE, LANSING, MI, KAREN WILLARD
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Realizing that the CANDU option is one of just several the Department is considering, I would strongly urge the Department to consider the above described transportation routes through the U.S. to be unacceptable. Especially, I ask you to consider that from the Western U.S. there are many access points to Canada that do not involve international waterways, bridges or tunnels. The environmental and security risk factors involved in transporting this highly volatile nuclear fuel more than 2,000 miles over ground through some of the most densely populated areas of the U.S. and the state of Michigan are deeply concerning. I strongly recommend that the Department look carefully into alternative methods of transportation, including ground transportation from the processing site in Washington state through Canada to the Ontario reactor site.

1/10.00.00 cont.

Thank you for the opportunity to express my views on this important health and safety issue.

Sincerely,

Karen Willard

Karen Willard
State Representative, 82nd District

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STATE OF NEVADA, DEPARTMENT OF ADMINISTRATION, CARSON CITY, NV, JULIE BUTLER
PAGE 1 OF 14

BOB MILLER
Governor

STATE OF NEVADA

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June 7, 1996

J. David Nulton
Director, NEPA Compliance & Outreach
U. S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

Re: SAI# 96300140: State of Nevada Comments on the U.S. Department of Energy's Draft Programmatic Environmental Impact Statement on the Storage and Disposition of Weapons-Usable Fissile Materials

Dear Mr. Nulton:

Thank you for providing us the opportunity to review the Draft Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement (PEIS). As you might recall, in October 1994, the State of Nevada submitted detailed scoping comments on the Notice of Intent (NOI) for this PEIS.

The following comments on this Draft PEIS focus on national issues relevant to the storage and disposition of fissile materials, as well as on local issues pertinent to the Nevada Test Site. We conclude with a summary of these national and local issues.

NATIONAL PERSPECTIVE

Over the past six years, State of Nevada officials have consistently and deliberately participated in the review of Department of Energy (DOE) plans and programs concerning the management and disposition of DOE-controlled radioactive waste and fissile materials. We have offered substantive comments on a variety of proposed actions including the NOIs for the now defunct Reconfiguration PEIS and the "active" Pantex EIS, as well as lengthy comments on the Idaho Spent Fuel PEIS, the Environmental Management PEIS, the PEIS for Stockpile Stewardship, and the NTS Site-Wide EIS. In all of these comments, we have consistently tried to embrace a national perspective while acknowledging that DOE must address local issues and concerns in order to achieve workable decisions concerning the long-term management and disposition of nuclear wastes and fissile materials.

In previous comments, we have stated that the federal government must first develop a preferred alternative for the permanent disposition of special nuclear materials like plutonium and highly enriched uranium (HEU), before selecting sites for interim or long-term storage. Specifically, we stated that "DOE should link long-term materials consolidation and management with options for final materials disposition."[1]

In reference to surplus plutonium, we concur with the National Academy of Sciences' finding that disposition options for this long-lived material will take decades to carry out. Therefore, we believe that to reduce the risks of fissile material

1/01.00.00

[1] Letter dated October 29, 1993 from Robert R. Loux, State of Nevada, to Mr. Howard Canter, Deputy Assistant Secretary, Office of Weapons Complex Reconfiguration.

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01 00 00 Comment Number 1

Comment noted. Consideration will be given to the link between storage and disposition in the decisionmaking process.

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proliferation, a major policy concern for the country and the world, DOE must link plutonium storage and disposition functions at as few federal sites as possible. Taking such action would reduce the overall risks to public health and the environment. Linking plutonium storage and disposition functions would also diminish the socioeconomic impacts caused by risk and stigma issues typically associated with transporting nuclear materials and radioactive waste on public highways.

Given our recent participation in numerous briefings and meetings with Department officials, however, we believe that DOE will not seriously consider linking surplus plutonium storage with materials disposition. In essence, this means that DOE will likely segregate the decision process for long-term (50 year) plutonium storage from the nine separate plutonium materials disposition alternatives evaluated in the Storage and Disposition PEIS (*see attached*). Unfortunately, adopting such a strategy will result in the federal transportation of plutonium-bearing materials through cities and communities throughout the country. We contend that such a campaign will not be acceptable to the public.

1/01.00.00 cont.

For example, if DOE selects the "No Action Alternative" for long-term storage of surplus plutonium at the six existing DOE sites[2] assessed in the PEIS and then decides to adopt a plutonium disposition strategy such as Immobilization[3] and Reactor

[2] Hanford, WA; Los Alamos, NM; Rocky Flats, CO; Pantex, TX; Savannah, SC; and INEL, Idaho.

[3] Two primary immobilization technologies include vitrification (i.e., into glass) and ceramic immobilization. Vitrification is the technology of choice for treatment of the estimated 100 million gallons of defense high-level waste in storage at DOE's Hanford and Savannah River sites.

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Burn[4], surplus plutonium-bearing materials will be continuously transported for many years between several DOE sites. While DOE's risk analyses for the routine transportation of radioactive waste and fissile materials always seem to demonstrate little or no impact in terms of accident fatalities and latent cancer deaths, these analyses routinely fail to address the perceived risk issues which inevitably will result from these transportation activities. 2/10.00.00

Risk Perception: Large scale shipments of plutonium-bearing materials along the nation's highways and rail lines, especially through large urban areas, will cause significant adverse socioeconomic and cultural impacts even if no accidents occur. Typically these impacts will manifest as negative stigmatizing socioeconomic effects. Research[5] has demonstrated that nuclear-related activities such as radioactive material transportation have the potential to result in significant socioeconomic impacts. These impacts originate in intense negative perceptions and avoidance behaviors by the public. Public and media interest in "things nuclear" makes it almost certain that these negative perceptions will adversely affect a community's quality of life and subsequently its commercial, residential, and business investment opportunities. 3/09.08.08

[4] Reactor burn refers to "burning" surplus plutonium in one or more nuclear reactors. To achieve this, surplus plutonium must be converted into fresh fuel for use in one or more U.S. reactors or in one of the CANDU reactors owned and operated by the Canadian government. Using weapons-grade plutonium, primarily from DOE's Pantex plant in Texas, DOE would process or convert plutonium 'pits' into fresh fuel at a new Mixed Oxide (MOX) fuel fabrication facility to be located at one of the six DOE sites evaluated in the PEIS. This fresh fuel would in turn be burned at an existing commercial reactor, the Canadian CANDU reactors at the Bruce Power Station, or a newly constructed (or acquired) DOE reactor.

[5] State of Nevada, Nuclear Waste Project Office. Publication numbers NWPO-SE 022-89; 056-93; and 063-95.

10 00 00 Comment Number 2

Historically, the risk from transporting highly radioactive materials is low. This is because safety is built into the packaging. There has not been an accident release of radioactive material which has caused injury or death during more than 40 years of DOE shipment activity. Perceived risk is beyond the scope of this PEIS. The potential risks from the transportation of materials for each alternative are evaluated and presented in Section 4.4 and Appendix G.

09 08 08 Comment Number 3

The socioeconomic analysis estimates impacts to employment, income, housing, and community services. These impacts are estimated using standard methodology, and can be quantified and compared across sites. Addressing "risk perception" issues would be highly speculative and not quantifiable. Furthermore, it would not be possible to compare alternatives in a consistent manner.

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There is also considerable uncertainty about the federal government's ability to safely manage radioactive materials, and because of this, the public has developed a very strong aversion to "things nuclear." Given this legacy, along with the inevitability of associated negative risk perceptions caused by the transportation of nuclear materials, we are disappointed that this Draft PEIS fails to address risk perceptions issues and their relationship to potential negative socioeconomic impacts as part of the NEPA (National Environmental Policy Act) impact analysis process. 4/15.00.00

Accordingly, if DOE adopts a proposed action and implements a Record of Decision that results in a fragmented approach between the management of long-term plutonium storage and a final disposition strategy, then the Department should be prepared for widespread public controversy and litigation leading to additional and costly NEPA documentation. Such action, of course, will be driven by the public's aversion to the "excessive" transportation of plutonium-bearing materials on the nation's highways. And any accidents or incidents that occur during the shipping campaigns will only serve to exacerbate the situation. 5/10.00.00

Cumulative Impacts: If plutonium storage and disposition are not consolidated at one or more federal sites, DOE's decision process could result in a deficient analysis of cumulative impacts to the human and natural environments. This situation could intensify as other "programmatic," department-wide NEPA decisions are made that cover the treatment, storage, and disposal of other waste forms[6] at the same sites selected for long-term plutonium storage and disposition.

[6] Civilian and defense spent reactor fuel, mixed waste, low-level waste, special-case waste, etc..

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15 00 00 Comment Number 4

Risk perception is a subjective issue that varies from person to person. DOE does not attempt to quantify risk perception in order to provide an objective environmental impact analysis.

10 00 00 Comment Number 5

The maximum number of shipments of radioactive materials for an entire campaign, regardless of the alternative selected, is very small (about 0.03 percent per year) compared to the number of hazardous material shipments made nationally. Furthermore, the DOE safety history record is excellent. There have been no injuries or deaths caused by the release of radioactive materials in over 40 years of DOE shipments. While a transportation accident is possible, it is highly unlikely that there would be a release of radioactive material due to the stringent safety standards required for the packaging and operations.

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As DOE is aware, decisions concerning materials storage and disposition will play a key role in determining the potential cumulative environmental impacts and radiological human health risks at the federal sites selected for such activities. How DOE chooses to address the timing of these decisions in relationship to other department-wide programmatic NEPA decisions that pose similar risks is not at all clear. If political interests supersede environmental and radiological human health concerns in this uncertain decision process, then again we contend that such decisions will likely not be acceptable to the public. 6/11.00.08

Cost-Benefit Analysis: State officials also believe that a cost-benefit analysis should be developed to support a programmatic decision concerning which technology is eventually used for plutonium disposition. The National Environmental Policy Act requires federal agencies to balance the environmental costs of a proposed action against the action's economic and technological benefits.[7] According to the regulations of the Council on Environmental Quality concerning cost-benefit, "an environmental impact statement should at least indicate those considerations, including factors not related to environmental quality [cost-benefit], which are likely to be relevant and important to a decision."[8] Selecting a disposition option(s) for surplus plutonium is clearly a major programmatic decision that will have significant cost implications. 7/08.03.00

According to the analysis of socioeconomic "benefits" presented in the PEIS, it is clear that the Reactor Burn Alternative along with the need for developing a MOX

[7] 42 U.S.C. § 4332(2)(B)

[8] CEQ CFR Part 1502.23

11 00 08 Comment Number 6

Comment noted. The cumulative impacts of various potential actions at the DOE sites are analyzed in Section 4.7 of the PEIS. In response to public comment, the analysis of cumulative impacts has been expanded for the Final PEIS. The Final PEIS, including public comments and cumulative impacts, will be considered in the DOE decisionmaking process.

08 03 00 Comment Number 7

The Department of Energy is not required to prepare a cost-benefit analysis. However, if one is prepared and it can help differentiate between the alternatives, it would be included in the PEIS. DOE has determined that a cost-benefit analysis is not needed on the storage and disposition of weapons-usable fissile materials, since there are a number of factors that distinguish the alternatives from each other.

Cost data, along with technical and schedule data, was provided for public comment in Technical Summary Reports for both storage and disposition in the summer of 1996.

(Mixed Oxide) fuel fabrication facility will generate the greatest economic impact when compared to the other disposition alternatives under consideration. Yet, without a general assessment of comparative life-cycle costs for the various disposition technologies, the public is unable to determine the long-term costs/benefits of selecting one alternative over another. Because the Reactor Burn Alternative could have significantly different life-cycle costs impacts in comparison to the other disposition technologies, the Final PEIS should at least contain an informal cost-benefit analysis. The Final PEIS should also discuss the relationship between the cost-benefit analysis of the various disposition technologies and any unquantified environmental effects such as reactor decommissioning, the generation and disposal of mixed, low-level, and solid wastes, etc.

7/08.03.00 cont.

Under the current Administration's guidance, DOE has initiated several "openness initiatives" aimed at both expanding and soliciting public participation in the Department's decision making process. DOE has also demonstrated a certain sensitivity toward assessing the costs associated with other major programmatic decisions[9] involving the production of nuclear materials and/or disposition of nuclear waste. However, these analyses were specifically excluded from the formal NEPA documentation process and were generally reserved for internal use to support DOE's NEPA decision making process. While justification for excluding a cost-benefit analysis for these other actions remains questionable, because of the high cost associated with the Reactor Burn Alternative, there is a clear and obvious need to

[9] See U.S. Department of Energy, 1995. Technical Reference Report for Tritium Supply and Recycling, DOE/DP-0134, and U.S. Department of Energy, 1996, Analysis of Stockpile Management Alternatives, February 1996, Albuquerque Operations Office.

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provide a general analysis of costs and benefits of the nine disposition alternatives presented in this Draft PEIS. 7/08.03.00 cont.

In a related matter, State officials do acknowledge that a decision to adopt the plutonium burn option using any of the reactor alternatives will have certain national and international policy implications. On one hand, agreeing to participate in the "Plutonium Fuel Cycle" – albeit limited to defense related purposes – presents an obvious conflict with U.S. policies that support the non-proliferation of special nuclear materials.[10] Alternatively, by not choosing the plutonium burn-up option, the U.S. could undermine certain international objectives aimed at reducing the stockpile of weapons-grade plutonium held by Russia and other nuclear countries. In any event, while these national and international policy considerations cannot be ignored, neither can the selection of a plutonium disposition option that will "bust the budget," given other DOE program priorities that must compete in a time of no-growth budget cycles for the foreseeable future. 8/01.02.00

LOCAL ISSUES - NEVADA TEST SITE

On page S-20 of the PEIS, as well as in other sections of the document, it is stated that certain alternatives, such as consolidation of Highly-Enriched Uranium along with an estimated 38 tons of weapons-grade plutonium at the Nevada Test Site (NTS), would be *"inconsistent with the NTS withdrawal."* As you know, in comments on the NOI for this PEIS, we suggested that certain institutional constraints that 9/09.01.02

[10] Although reactor-based plutonium burn-up technologies will bind weapons-grade plutonium in a form that meets the Spent Fuel Standard, such technologies will not eliminate all of the plutonium isotopes, and a significant amount of plutonium will remain in a form that still requires final disposition.

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01 02 00 Comment Number 8

Comment noted. The purpose of the Proposed Action for Pu disposition is to convert the surplus weapons-usable Pu into a form that meets the Spent Fuel Standard. In the case of MOX fuel use for reactors, the fuel would be used in a once-through cycle without reprocessing. It is true that MOX fuel in reactors would not consume all the Pu. However, meeting the Spent Fuel Standard would make the residual Pu in the spent fuel as difficult to extract for weapons use as that in commercial spent fuel.

09 01 02 Comment Number 9

A review of the four Public Land Orders was conducted in 1983 by the Bureau of Land Management (BLM) in accordance with the *Federal Land Policy and Management Act* of 1976 (FLPMA). The BLM District Manager concurred with the conclusion of the review that NTS lands were still being used for the purpose for which they were withdrawn.

The Department of Energy is committed to ensuring that all future activities at NTS are conducted in compliance with FLPMA and Federal land withdrawal policies. DOE will consult with the Department of the Interior to ensure that the appropriate process is followed to enable DOE to fulfill this commitment.

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directly affect the Nevada Test Site should be analyzed if the NTS were to be considered for any major projects such as long-term storage and/or disposition of fissile materials. Specifically, we stated that "DOE must resolve certain administrative constraints that limit uses of the NTS [and that] such restraints are contained in the Public Land Orders that authorized the land withdrawal for the site." We are pleased that DOE has finally acknowledged that stipulated facility-use restrictions are contained in the Public Land Orders for the NTS withdrawal.

Because it appears that NTS will probably not be selected as a preferred alternative for either long-term storage or fissile materials disposition, we have purposely forgone a detailed review of the environmental impacts presented in the draft PEIS. However, if the final PEIS includes any proposed actions for the NTS, DOE must acknowledge that the Public Land Orders[11] for the NTS do in fact limit the use of the site to weapons testing and related research and development facilities only. When the Nevada Legislature ceded its jurisdiction to the public lands that now comprise the NTS, it did so on the basis of these stipulated uses. And, although many believe the lands comprising the NTS are federal lands, they are in fact public lands that have been withdrawn for a specific national defense purpose, and that purpose does not include long-term storage of fissile materials, nor development of any major disposition technologies such as plutonium immobilization and/or MOX fuel fabrication and reactor burn-up of fissile materials.

9/09.01.02 cont.

[11] Public Land Orders 805, 1662, 2568 and 3579. Bureau of Land Management (BLM), 1984. Continuation of Withdrawals, Department of Energy, Nevada Test Site 4310-84. (This file is located at the BLM State Office in Reno, Nevada.

If, in the unlikely event that DOE selects the NTS for one or more of these activities, then the Department must propose a path forward in the Final PEIS and Record of Decision that specifically addresses actions concerning altering the mission of the NTS. Formally altering that mission, moreover, must include a process for seeking approval from the Nevada Legislature to use the site for purposes other than nuclear testing. 10/08.03.00

CONCLUDING SUMMARY COMMENTS

As mentioned above, we are providing a list of specific summary comments that cover both national and local issues of concern. We would appreciate DOE's careful review of these comments and their consideration during preparation of the Final PEIS for storage and disposition of fissile materials.

- State officials in Nevada believe that DOE should link long-term fissile materials consolidation and storage with options for final materials disposition. This means that the proposed action presented in the Final PEIS should support a decision that co-locates long-term storage with one or more of the plutonium disposition/ treatment options. Linking long-term fissile materials storage and disposition will reduce risks and risk perception issues associated with the unnecessary transportation of fissile materials on public roads and highways throughout the country. 11/01.00.00

- A prolonged shipping campaign of plutonium-bearing materials along the nation's highways, especially through large urban areas, will cause significant adverse socioeconomic and cultural impacts even if no accidents occur. Hence, if a proposed action is put forth in the Final PEIS that results in prolonged shipments of fissile 2/10.00.00 cont. 4/15.00.00 cont.

08 03 00 Comment Number 10

It is recognized that the decision to locate any of the alternatives at a site would require coordination with State and local officials on a variety of areas including the mission of the site.

01 00 00 Comment Number 11

Comment noted.

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materials, then DOE must address risk perceptions issues and their relationship to potential negative socioeconomic impacts as part of the environmental impact analysis process (i.e., as per CEQ 1502.1 and 1502.16). 4/15.00.00 cont.

- Decisions concerning fissile materials storage and disposition will play a significant role in determining potential cumulative environmental impacts and radiological human health risks at the federal sites selected for such activities. Accordingly, in presenting a proposed action in the Final PEIS for long-term storage of surplus plutonium, DOE must address the impacts of such a decision on other existing and pending department-wide programmatic NEPA decisions that pose similar risks at the selected site(s); we also contend that such an analysis must apply to those sites where it is obvious that a decision will be implemented for one or more of the technologies being considered for materials dispositions (i.e., immobilization and/or reactor burn). 6/11.00.08 cont.

- State officials strongly believe that a cost-benefits analysis must be developed to support a programmatic decision concerning which technology is eventually selected for plutonium disposition. Clearly, under the regulations of the National Environmental Policy Act (CEQ 1502.23), DOE is authorized, and we believe obligated, to present an informal, balanced assessment of costs and benefits for the competing plutonium disposition technologies. Moreover, because the Reactor Burn Alternative will have significantly higher costs and potentially more profound environmental impacts than the other disposition technologies, a cost benefits analysis is clearly warranted and should be included in the Final PEIS. 7/08.03.00 cont.

- If DOE selects the Nevada Test Site for either long-term storage of surplus plutonium or the development of any new facilities to support plutonium disposition (e.g., MOX Fuel Fabrication), State officials contend that the Department must propose a path forward in the Final PEIS and Record of Decision that specifically addresses the facility-use restrictions contained in the Public Land Orders for the NTS withdrawal.

10/08.03.00 cont.

Again, we appreciate the opportunity to provide comments on the Draft Storage and Disposition PEIS. If you have any questions about these comments, please contact me or Mr. John B. Walker, Nuclear Waste Project Office at 702-687-3744.

Sincerely,

Julie Butler

Julie Butler, Coordinator
State Clearinghouse, DOA/SPOC

JB\jbw
cc: Governor Bob Miller
Nevada Congressional Delegation
Perry Comeaux, Dept. of Administration
Robert R. Loux, NWPO
Harry Swainston, Deputy Attorney General
Lew Dodgion, Nevada Division of Environmental Protection
Affected State Agencies
Leo Penne, State of Nevada, Washington Office
John Thomasian, NGA
Terry Vaeth, Joseph Fiore, Don Elle, DOE/NV
Carol M. Borgstrom DOEHQ\NEPA
Ann Morgan, State Director, BLM

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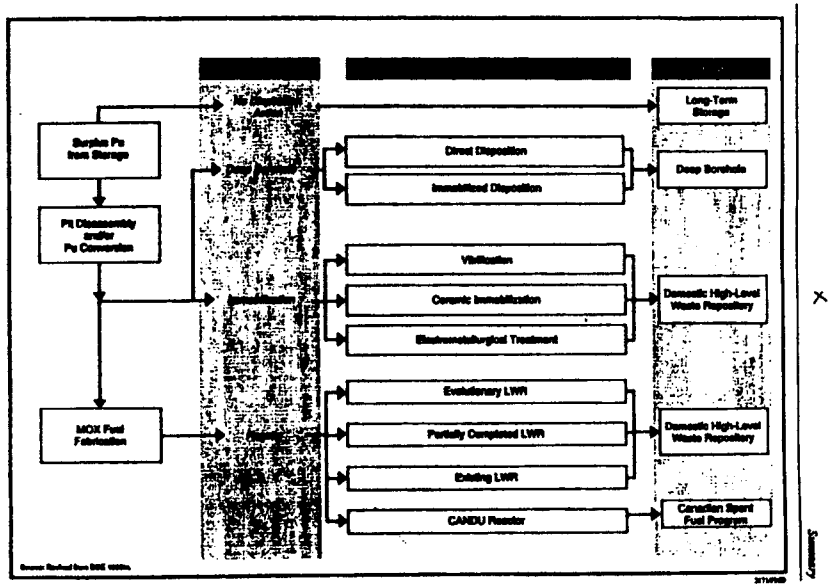

Figure S–3. Surplus Plutonium Disposition Alternatives.

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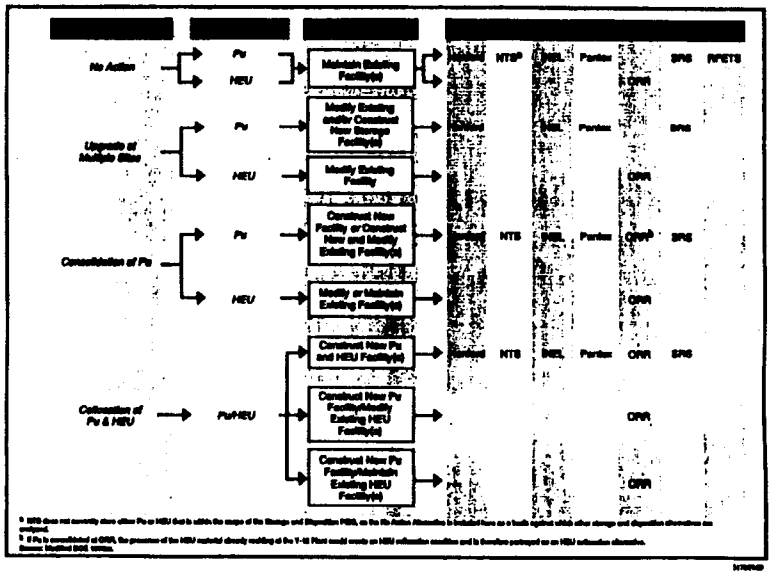

Figure S–2. Long-Term Storage Alternatives.

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Oregon

DEPARTMENT OF ENERGY

June 7, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

The Oregon Department of Energy appreciates the opportunity to comment on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (DOE/EIS-0229-D). Our detailed comments on the draft are attached.

Oregon opposes the use of Hanford for any aspect of the plutonium disposition effort, that will result in creating more waste at Hanford, or will delay Hanford cleanup. We recommend that the Final EIS consider only Deep Borehole, CANDU reactor and vitrification with cesium alone or vitrification with high-level waste using the "can in can" process. Support for this recommendation is included in the attachment. 1/08.03.01 2/01.04.00

One other substantive issue was raised by a broad cross section of Oregonians. That issue is that each of the potential sites be treated equitably. Our citizens expressed strong opinions that with Hanford, the Idaho National Engineering Lab, and nerve gas storage at the Umatilla Army Depot, the Pacific Northwest has already borne more than its share of potential exposures to government owned hazards.

Storage Options

We believe neither the Fuels and Materials Examination Facility (FMEF) nor the Plutonium Finishing Plant (PFP) are suitable facilities for the purpose proposed.

FMEF is proposed as one possible facility for expanded storage of plutonium and processing of the plutonium for use in mixed oxide fuels. There are multiple problems with this approach. FMEF cannot hold the entire inventory of plutonium. FMEF is currently an uncontaminated facility close to Richland. Prior experience with fuels manufacturing, and plutonium processing indicates contamination of surrounding areas will occur. Most of the Hanford site is contaminated. It is unacceptable to consider contaminating more of the site. 1/08.03.01 cont.

John A. Kitzhaber
Governor

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08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Hanford.

Funding for all alternatives under the Fissile Materials Disposition Program will be through the government budget process. This program will be funded independently of the Hanford cleanup activities. The Plutonium Finishing Plant (PFP) is only considered under the No Action Alternative in which Pu storage would continue at the current interim storage location in a stabilized form pursuant to DNFSB Recommendation 94-1 and the ROD for the *Plutonium Finishing Plant Stabilization Environmental Impact Statement* (PFP EIS) (DOE/EIS-0244-F).

The PFP EIS analysis concludes that PFP key facility buildings exceed the seismic design standards currently used at Hanford. Further, operation of systems and equipment with the PFP would not begin until a safety analysis has been completed.

01 04 00 **Comment Number 2**

Comment noted. Decisions will be based on the PEIS, among other things, which will include these comments from the Oregon DOE.

The Plutonium Finishing Plant (PFP) is also proposed for this mission. The existing structures at PFP are not designed to existing seismic criteria. The surrounding areas are extensively contaminated, and may never be adequately cleaned up to protect human health or the environment. Adding contamination to this already serious problem does not make sense. The unknown location of over one metric ton of plutonium which is unaccounted for at Hanford increases our concern that safety can be assured. 1/08.03.01 cont.

We believe the facilities at PFP do not meet industrial or nuclear safety standards for this process.

Disposal options

We considered several criteria for evaluating the merit of the various options:

1. The ability to permanently dispose of plutonium.
2. Speed of removal of the plutonium from potential reuse in weapons.
3. Cost.
4. Acceptability to other nations.
5. Security and degree of radiation protection.

In an ideal world, we would prefer complete destruction of the plutonium. None of the potential options will destroy most of the plutonium. 3/01.00.00

Deep Borehole emplacement could rapidly remove the plutonium from weapons usability. There are technical uncertainties with deep borehole which limit our ability to analyze potential consequences. The EIS makes no proposal for siting such a disposal facility. Finding an acceptable site will be difficult and time consuming. 4/04.03.00

The Canadians have expressed interest to act as an intermediary by using Canadian CANDU reactors to dispose both American and Russian plutonium. We believe this is a viable option which has merit. This option results in a net reduction in the amount of spent fuel created for disposal in the Canadian high level nuclear waste repository. This would represent a significant departure from the design basis for the CANDU reactors. The EIS does not provide sufficient analysis of the potential impacts to allow a definitive technical decision on this alternative. 5/06.05.08

We oppose completion of obsolete reactors. The control equipment design for these reactors is obsolete and will necessitate major redesign and upgrades. They will be costly to complete and will produce additional spent fuel requiring disposal. We oppose construction of new 6/08.03.01

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01 00 00 **Comment Number 3**

Comment noted.

04 03 00 **Comment Number 4**

Comment noted.

06 05 08 **Comment Number 5**

The PEIS does not intend to cover the entire range of issues to make definitive technical decisions on alternatives. A separate Technical Summary Report is available to describe the technical impacts of the CANDU Reactor Alternative more fully.

08 03 01 **Comment Number 6**

The Department of Energy acknowledges the commentor's concern about the disposition of Pu using the partially completed LWR (commercial). However, should this alternative be selected in the ROD, these reactors would be completed in accordance with current codes and standards with appropriate upgrades to equipment and systems. The analyses of the environmental impacts for completing these reactors and the fuel management (fresh MOX fuel and spent fuel) are included in this PEIS. Decisions on the disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

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reactors. They will be costly to complete and will produce additional spent fuel requiring disposal. Use of other reactors designed for mixed oxide fuel is feasible, but both deep borehole disposal and vitrification have greater merit and less apparent adverse impacts. | 7/08.03.01

The EIS lacks information on costs and detailed impacts of the various options. Without this information, it is not possible to select a final remedy. This is a major flaw in that technical and public commenters are faced with a huge gap in the information needed to adequately judge the tradeoffs between alternatives. | 8/08.00.00

We oppose vitrification directly with high level waste. Vitrification of high level waste alone is already extremely complex. Adding plutonium to this mix could greatly raises the risk of failure for both the waste and plutonium disposal missions. | 9/08.03.01

Recent successful demonstration runs at Savannah River offer an immediate solution which uses a "can in can" approach to vitrifying the plutonium and embedding it in vitrified high level nuclear waste. Hanfords cesium could readily be added to the Savannah River waste feed stock to increase the radiation barrier. | 10/08.03.01

The available lands at Hanford which could be selected for such a mission fall primarily in critical shrub-steppe habitat. These lands are already compromised by the cleanup mission. | 11/09.06.01

Electrometallurgical treatment is unproven technology and should not be selected. | 12/08.03.01

<u>Major Concerns about the EIS</u>

Summary:

♦ ODOE is concerned the EIS does not identify the proposed action, as required by the National Environmental Policy Act. Instead it identifies a range of potential actions. This does not allow the public to adequately assess what USDOE proposes. | 13/08.03.00

♦ The Oregon Department of Energy, the Oregon Hanford Waste Board and the public were troubled to find no discussion of the costs for each option and cost comparisons between options in the EIS. These cost comparisons should be included in the final EIS. | 8/08.00.00 cont.

♦ The EIS fails to analyze the environmental impacts for Hanford. It does make repeated references to the "Hanford Site Development Plan", and to the impacts being negligible. | 14/09.01.01

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08 03 01 **Comment Number 7**

The Department of Energy acknowledges the commentor's support for the Borehole and Immobilization Alternatives. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 00 00 **Comment Number 8**

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses, along with the environmental analysis, and public input will be integrated into DOE's decisionmaking process.

08 03 01 **Comment Number 9**

The Department of Energy acknowledges the commentor's opposition to the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 10**

The Department of Energy acknowledges the commentor's support for SRS. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 06 01 **Comment Number 11**

The importance of shrub steppe habitat is acknowledged in the PEIS. The analysis identifies how much of this type of habitat may be lost, both in terms of acreage and as a percentage of the site. The cumulative loss of shrub steppe

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Neither the plan, nor the conclusion that impacts are negligible have been accepted by the stakeholders or local communities. | 14/09.01.01 cont.

♦ The shrub-steppe habitat at Hanford is critical to many species on site. This habitat has been designated as critical for protection by the State of Washington. Many of the species that depend on this habitat are listed or under consideration for listing as rare threatened or endangered by the State and Federal governments. This EIS must analyze in detail the potential impacts from proposed actions and the cumulative impacts from all other projects proposed or considered which may impact the same habitats. | 11/09.06.01 cont.

♦ The EIS uses the urgency of securing the plutonium to drive the urgency for plutonium disposition. We believe these need not be so tightly linked. The security issues are paramount and must proceed immediately. The storage problems must likewise be solved in the very near term to allow us to comply with international disarmament treaties. | 15/01.00.00

Plutonium disposition is important to ensure the permanency of disarmament here and in Russia. However, some technical options may be feasible with more time for analysis, like disposal in zircon or other mineral waste forms. | 16/14.00.00

Public Involvement

Enclosed is a copy of "*The Oregon Approach: A Grassroots Method to Achieve Meaningful Public Involvement*", February 1996. This is our report on what we learned about Oregonians concerns about plutonium disposition and how to communicate with citizens on such issues. We believe it could serve as a model for USDOE public involvement.

Attached is a more detailed discussion of the draft EIS. If you have any questions in this regard, please contact Mary Lou Blazek at (503)378-5544 or Dirk Dunning at (503)378-3187.

Sincerely,

John Savage, Administrator
Oregon Department of Energy

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habitat was also determined. This loss will be considered, as will all other environmental impacts, during the decisionmaking process prior to issuance of the ROD.

The PEIS will support a siting decision for long-term storage and a technology decision for the disposition of Pu. The only storage alternatives that would result in additional land disturbance at Hanford would be the Collocation and Consolidation Alternatives. Any adverse impacts to biological resources resulting from siting decisions would be mitigated and addressed in site-specific environmental documentation. Mitigation measures could include minimizing the area disturbed and developing and implementing a vegetation plan that would lead to the establishment of sagebrush habitat on disturbed land.

08 03 01 **Comment Number 12**

The Department of Energy acknowledges the commentor's opposition to the Electrometallurgical Treatment Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 00 **Comment Number 13**

As stated in Chapter 1 of the PEIS, the basic action proposed by DOE is to place surplus weapons-usable fissile materials into long-term storage until dispositioned. There are a variety of materials involved, in form and type, a variety of material locations, and a range of techniques that could be implemented to accomplish this purpose. Based upon this situation, DOE decided to prepare a PEIS so that the environmental impacts of a very complex situation could be considered in a systematic manner.

09 01 01 **Comment Number 14**

The *Hanford Site Development Plan* dated May 1993 (DOE/RL-93-19) is Hanford's current land-use planning document. The PEIS analyzes potential impacts to onsite land use against this document. All storage and disposition

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Attachment A

Oregon Department of Energy
Detailed comments on the
Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Summary

1. Page S-2, second bullet. The EIS assumes and asserts without support that the assertion that the spent fuel standard is adequate to assure that the plutonium from weapons will be inaccessible to terrorists and other nations for the time it will have to be secure. The implicit assumption is that providing any greater degree of protection is futile, as large quantities of spent commercial nuclear fuel which contains larger quantities of plutonium will be accessible to many nations. The EIS asserts that this radiation barrier is necessary. It does not assess whether this barrier is sufficient. The EIS should be expanded to include this assessment. | 17/01.04.00

2. Page S-4, second paragraph. The EIS scope requires that it assess the cumulative environmental impacts in accordance with the requirements of the National Environmental Policy Act. The EIS fails to examine the cumulative impacts to the Hanford environment and habitats. The final EIS should. | 14/09.01.01 cont.

3. Page S-5, last paragraph before DEVELOPMENT OF ALTERNATIVES section. The Department is required by the National Environmental Policy Act to consult with and obtain the comments of other agencies which have regulatory authority or special expertise in the area in question. NEPA requires this consultation to be early in the development of the EIS and throughout its formulation so as to reach good decisions. A copy of these comments is required to be transmitted along with the EIS and to be made available to the public. We request all other agency comments on this EIS. | 18/08.02.00

4. Page S-5, development of alternatives, second paragraph. USDOE's criteria for evaluation of the various options include cost-effectiveness. We request all cost data considered for the EIS to allow us to evaluate this information. | 8/08.00.00 cont.

5. Page S-6, fourth paragraph. USDOE summarily eliminated the Rocky Flats site based on proximity to a major city and plutonium vulnerabilities. The Hanford site is upriver from a large population of Oregonians and Washingtonians which may be adversely effected by actions at Hanford. USDOE should similarly eliminate Hanford from consideration. Either Hanford should also be summarily eliminated from consideration, or Rocky Flats should be included and a thorough analysis performed equal to other sites. Also, citizen input to the Plutonium Vulnerability Assessment at Hanford was NOT included. The site assessment team met with a limited number of stakeholders. They heard, but appeared to disregard, their concerns and comments. The final report states that the citizens concerns were addressed. We believe they | 19/01.04.00 | 20/08.02.00

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alternatives proposed for Hanford would be in conformance with the *Hanford Site Development Plan*; therefore, no impact to land use would occur. DOE is currently preparing the *Comprehensive Land Use Plan* (CLUP) in conjunction with the *Hanford Remedial Action Environmental Impact Statement* (HRA EIS). The CLUP/HRA EIS is being prepared with stakeholder, governmental, and tribal input. Coordination of these documents with the NEPA process will allow DOE to codify the land use recommendations in a ROD. However, the PEIS references the current *Site Development Plan* (1993) since adoption of the CLUP/HRA EIS will occur beyond the PEIS timeline.

An analysis of cumulative impacts at Hanford is addressed in Chapter 4 of the PEIS.

01 00 00 Comment Number 15

The Department of Energy currently provides adequate security for its Pu activities. The purpose of the Proposed Action is to implement the President's Nonproliferation Policy in a safe, reliable, cost-effective, technically feasible, and timely manner. The storage and disposition alternatives are linked in order to accomplish this purpose. Cost data, along with technical and schedule data, was provided in Technical Summary Reports of both storage and disposition in the summer 1996. Results of the nonproliferation analysis were made available in the fall of 1996.

14 00 00 Comment Number 16

During the screening of alternatives for inclusion in the PEIS, various immobilization forms were considered. The decision was made to include immobilization in ceramic and glass waste forms. The specific ceramic form was not identified. Research and development is both on-going and planned to support a disposition alternative(s), which would include pilot facilities for processes and materials (and could include zircon), as necessary.

were not. Several stakeholders believe that the assessment at the Plutonium Finishing Plant understated the magnitude of the risks and likelihood of their occurrence. No resolution of this issue is apparent. | 20/08.02.00 cont.

6. Page S-6, last paragraph. An additional alternative was raised by Los Alamos National Labs; immobilization in artificial zircon. Oregon specifically and formally requested this alternative be analyzed. We find no discussion in the EIS of this alternative. Additionally, information presented at the National Academy of Sciences Symposium on vitrification of high level nuclear waste showed that high borate content glasses may fail completely and release plutonium in less than ten thousand years. USDOE should perform a detailed assessment of the zircon alternative. | 16/14.00.00 cont.

7. Page S-12. No Hanford site locations are acceptable for plutonium storage or processing. The Fuels Manufacturing and Examination Facility (FMEF) facility is too close to the city of Richland and the Columbia river. FMEF is currently uncontaminated. Prior experience with plutonium facilities and fuel manufacturing facilities at Hanford shows a high likelihood that such a facility would result in contamination of the land and groundwater. Neither facility is acceptable. | 1/08.03.01 cont.

A new facility in the 200 Areas would result in the destruction of shrub-steppe habitat. Any such destruction directly impacts the cleanup of the Hanford site. There is little shrub-steppe habitat left at Hanford. Many species at Hanford which rely on the shrub-steppe are under consideration for listing as rare, threatened or endangered. On-going cleanup actions will require the siting of several large processing facilities. These will destroy significant amounts of shrub-steppe. Additional habitat destruction should not be an option. | 11/09.06.01 cont.

8. Page S-14, first paragraph, last line states "All immobilized Pu would be encased in stainless steel canisters and would remain in on-site vault-type storage until a final HLW disposal site is operational." Hanford is familiar with temporary - turned long term storage, for liquid waste, buried wastes and cesium and strontium capsules. Hanford must not be used for additional "temporary" nuclear waste storage. | 21/09.11.01

9. Page S-14, Electrometallurgical Alternative. Development of this alternative raises new security risks. This is the reverse of the process developed to separate plutonium and uranium from spent fuel in a single step. The development of this prior capability provides evidence to other nations that it can be done, done safely, done in a small facility and with fairly simple technology. This raises the prospect of reprocessing fuel by small nations using this or similar technologies, combined with simple | 12/08.03.01 cont.

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01 04 00 Comment Number 17

The Department of Energy, considering the Spent Fuel Standard, evaluated the adequacy of the Standard versus the greater degree of destruction achievable with other options such as the Deep Burn Reactor Option and the Accelerator Option. It was judged that the Spent Fuel Standard is adequate since it would convert the weapons Pu to a form making it as difficult to retrieve and reuse in weapons as the Pu contained in the much larger existing volume of spent fuel from commercial nuclear reactors.

The Department of Energy concluded that the shorter disposition time achievable with more mature technologies was more desirable than the greater Pu destruction that could only be achieved over a much longer time period through the use of Deep Burn Reactors and Accelerators. The NAS also adopted the Spent Fuel Standard as the most acceptable form for conversion of weapons Pu.

08 02 00 Comment Number 18

The only cooperating agency with the DOE on this PEIS is the EPA. The EPA had not provided DOE with any written comments as of the release of the Draft PEIS. After the release, EPA provided DOE with a written evaluation of the draft rating it EC-2. This means that EPA has environmental concerns because of insufficient information in a certain area. After receipt of the evaluation, DOE met with EPA and provided the information and/or explained the area of concern in more detail. Appropriate changes were made in the Final PEIS. Other Federal, State, and local agencies contacted are listed in Chapter 9 of the PEIS.

01 04 00 Comment Number 19

The selection process for candidate sites for storage, including the selection criteria and reasons for elimination, is described in Chapter 2 of the PEIS.

chemical dissolution and separation of the plutonium. Electrometallurgical treatment should not be pursued and, work already done should remain classified. | 12/08.03.01 cont.

10. Page S-15, Reactor Category. Security concerns over the transport of weapons-usable fissile materials provide a strong argument that this operation should be conducted at the plutonium storage facility. | 22/06.06.08

11. Page S-15, Existing Light Water Reactors. The second paragraph states "A timely supply of MOX fuel would be needed for disposition of surplus Pu through use of existing LWRs. MOX fuel fabrication at an existing European facilities would be a viable option to meet the interim fuel needs of Existing LWR Alternative." No justification is provided for introduction of MOX fuel into U.S. LWRs earlier than would be available from a U.S. constructed MOX facility. | 23/06.01.08

12. Page S-15, Partially Completed Light Water Reactors. Completion of partly completed light water reactors poses several problems. First, the control systems and computers designed for these facilities are no longer manufactured. All of these systems will have to be replaced. The reactor systems may require extensive modification to meet MOX requirements. New reactors would generate additional spent nuclear fuel which would need to be disposed to a national high level waste repository. The first proposed repository at Yucca Mountain is over a decade late and may not have space for this material. All new reactor options should be discarded. | 24/08.03.01

13. Page S-16, Evolutionary Light Water Reactor Alternative. See comment 12.

14. Page S-16, Environmental Impact analysis. The environmental impact analysis excludes analysis of the environmental impacts associated with Tribal Treaty Reserved rights. If the lands are contaminated or destroyed, the Tribe is severely and permanently impacted. | 25/09.07.01

15. Page S-22, last paragraph (typical of each major alternative). Adverse environmental impacts at Hanford will likely also include severe impacts on cleanup of wastes and their resultant long term impacts on the site environment and the Columbia river. | 26/09.11.01

16. Page S-28, second paragraph (typical of the discussion of each of the options). This paragraph states "However, the annual radiological dose to on-site workers would be within radiological limits, and the dose to the population living within 80 km (50 mi) of the site would be within 100 person-rem per year." This exposure goal does not | 27/09.09.08

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08 02 00 **Comment Number 20**

The Department of Energy's *Plutonium Vulnerability Assessment* is not part of the PEIS. For this reason, this comment has been forwarded to the Office of Defense Programs who prepared the assessment, and EM who conducts actions to correct vulnerabilities.

09 11 01 **Comment Number 21**

Glass vitrification and ceramic immobilization are processes that put the weapons-usable fissile materials in a solid form that would not be readily dispersible into air or leachable into ground or surface water. The immobilized form would be stored at the glass vitrification facility or ceramic immobilization facility in compliance with all applicable Federal and State regulations and DOE Orders until availability of a mined geological repository. The NWPA enunciated the national policy that HLW be solidified and disposed of in a mined geologic repository.

06 06 08 **Comment Number 22**

The proliferation risks for transportation between facilities will be considered in selecting sites for pit disassembly, Pu conversion and MOX fuel fabrication. DOE has an impeccable history of monitoring security of special nuclear materials. This level of security would be expected to be retained throughout the disposition mission, including transportation.

06 01 08 **Comment Number 23**

The commentor is generally correct. However, as stated in the PEIS, the potential exists that MOX fuel may be needed earlier than could be supplied by a domestic MOX fuel fabrication facility.

08 03 01 **Comment Number 24**

The Department of Energy acknowledges the commentor's concern about the disposition of Pu using the partially completed LWR (commercial). Decisions on the disposition of weapons-usable fissile materials will be based on

meet the As Low As Reasonably Achievable (ALARA) regulatory approach to exposure control. | 27/09.09.08 cont.

17. Page S-46, Disposition Alternative, second paragraph states "Idaho National Environmental Laboratory, NTS and Hanford would be the least vulnerable to cumulative impacts form the disposition alternatives." We believe Hanford is the most vulnerable to cumulative impacts. The only way USDOE could conclude otherwise would be to assume that the problem is so big and so complex at Hanford and NTS that anything added by doing disposition there would not significantly change the damage. We believe USDOE has a clear obligation to cleanup Hanford and to protect the natural environment. | 28/09.00.08 | 29/01.00.00

18. Page S-48, fifth paragraph. For the upgrade alternative, Hanford would be heavily impacted. FMEF is unacceptable for use due to its proximity to the city of Richland and the Columbia river. The PFP does not meet seismic standards and is decrepit. A new facility adjacent to PFP would destroy shrub-steppe habitat. Any new facility at Hanford would lead to unacceptable additional contamination of lands. | 1/08.03.01 cont.

Volume I

The comments as noted for the Summary apply also to the various volumes as appropriate.

19. Page 3-22, section 3.2.1, first paragraph states "DOE intends to maintain active institutional control of the site in perpetuity." This is the subject of another EIS and is an open issue. Oregon opposes such control in perpetuity because it does not protect the public health, the environment or Tribal rights. Instead it leaves the problem to future generations to deal with. | 30/09.01.01

20. Page 3-22, section 3.2.1, fourth paragraph states "No prime farmlands exist onsite." Much of the site is potential prime farmland. This is not the highest and best use of the land, but it is arable. | 31/09.01.01

21. Page 3-26, last paragraph. The cleanout of PFP is the subject of another EIS. The proposed action here is duplicative of that EIS. The analysis in this EIS is inadequate to guide the cleanout actions at PFP. Also, PFP is not in acceptable condition to handle any waste from any other facility. It is processing its own waste only as a cleanout action. | 32/11.00.01

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environmental analyses, technical and economic studies, national policy considerations, and public input. However, should this alternative be selected in the ROD, these reactors would be completed in accordance with current codes and standards with appropriate upgrades to equipment and systems. The analyses of the environmental impacts for completing these reactors and fuel management (fresh MOX fuel and spent fuel) are included in this PEIS.

09 07 01 **Comment Number 25**

The Department of Energy recognizes that the Tribes consider traditional use areas to include the water, land, plants, and animals on Hanford, and that access to these resources is part of their reserved rights. Potential impacts to these resources are assessed in the cultural resources sections as well as land resources, water resources, geology and soils, and biological resources in Chapter 4 of this PEIS.

09 11 01 **Comment Number 26**

The conceptual designs for the storage and disposition facilities have, as part of their design, waste management facilities that would treat and package all waste generated into forms that enable long-term storage and/or disposal in accordance with RCRA and other applicable Federal and State statutes and DOE Orders. As noted in Section 4.1.10 of the PEIS, waste management activities that would support the long-term storage or disposition of weapons-usable fissile materials were assumed to be per current site practice. Thus, only LLW and possibly some solid nonhazardous waste was assumed to be disposed of onsite. Any future waste management facilities that may be required to support the long-term storage or disposition of weapons-usable material would be coordinated with any decisions in the waste-type-specific RODs resulting from the Waste Management PEIS and respective site-specific NEPA documentation. Therefore, no impacts are anticipated for Hanford or the Columbia River.

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22. Page 3-31, fifth paragraph. Fisheries is another primary use of the Columbia river. This use is now limiting dam operations, irrigation and potentially may limit river transport. — 33/09.04.01

23. Page 3-31, sixth paragraph. The flooding potential of the Hanford site has been extensively studied based on partial upstream dam failures. — 34/09.04.01

24. Page 3-34. The discussion of groundwater at the Hanford site does not begin to show the massive contamination of groundwater which already exists on the site. This contamination may get much worse over the next ten thousand years depending on "waste management" (sic) decisions. The map on the next page should also show the massive groundwater contamination plumes. Also, the map on page 3-35 does not show that groundwater flow from the northern half of the 200 west area flows northward to the Columbia river. — 35/09.04.01, 36/09.04.01

25. Page 3-37, sixth paragraph. Hanford is in a seismic zone 2B, not seismic zone 2. Also, Uniform Building Code construction requirements require the use of a 1.5 safety factor for extremely hazardous facilities. The seismic risk throughout this region may be greatly understated. There is a band of low seismic activity which runs from Puget Sound to the area of the INEL site. Many surface features on and near the Hanford site coincide with this band of activity. A recent earthquake on a previously unknown blind thrust fault in the Seattle area demonstrates the risk of underestimation. No site in a seismic zone 2, 3 or 4 should be considered for any of the plutonium disposition activities. — 37/09.05.01

Volume II

26. Page 4-24, third paragraph, land use. The *Hanford Site Development Plan* is the subject of ongoing site discussions. It has not been agreed to by stakeholders or the regulators. Future land use is constrained by many other documents, the Tri-Party Agreement, Tribal Treaty reserved rights and federal law. — 38/09.01.01

27. Page 4-47 and 4-48. Constructing a new Pu storage facility in or between the 200 areas would have major impacts to shrub-steppe habitat or would occur on highly contaminated soil within the PFP perimeter. Both are unacceptable. Impacts would not be minimal as stated in the EIS. The impacts would lead to direct competition for land with other facilities required to cleanup Hanford. No land is available on the central plateau for such a facility. — 1/08.03.01 cont.

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09 09 08 **Comment Number 27**

Proposed 10 CFR part 834 (see 58 FR 16268) would require an ALARA program and would generally limit the potential annual population dose to 100 person-rem/yr from all pathways combined for DOE activities. The radiation exposure to the public is limited by the maximum individual dose of 100 mrem/yr.

The Federal radiation exposure limit for an individual worker is set forth in the Federal Code (10 CFR 835) 5,000 mrem/yr. This is the basis for limiting the radiation exposure to workers on DOE sites. Furthermore, DOE has also established an administrative exposure level of 2,000 mrem/yr (DOE/EH-0256-T) for the workers. DOE requires all sites to maintain worker radiation exposure levels ALARA preferably below this administrative level.

09 00 08 **Comment Number 28**

Based on comments received, the language in the cumulative impacts section of the Summary has been revised to better reflect the impact analysis in Section 4.7 of the Final PEIS.

01 00 00 **Comment Number 29**

Comment noted.

09 01 01 **Comment Number 30**

The Department of Energy is currently preparing the HRA EIS to evaluate potential land-use scenarios and to select a Preferred Alternative for site cleanup.The CLUP is being prepared in conjunction with the HRA EIS. Together, these documents will identify long-term land use recommendations for Hanford. The identification of land to be transferred from Federal ownership is beyond the scope of the CLUP and HRA EISs.

Reference to DOE maintaining active institutional control of Hanford in perpetuity has been deleted from Section 3.2.1 of the Final PEIS.

28. Page 4-461 and remainder of this section. The fifth paragraph states "According to the *Hanford Site Development Plan*, 200 Area's land use identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). Therefore, direct impacts to land use would be negligible." This land is shrub-steppe habitat which is precious and rare. To state that a plan not approved by the stakeholders or regulators selected the land for waste management, and therefore there is no impact is inappropriate. The remaining shrub-steppe habitat must be protected. | 14/09.01.01 cont.

29. Page 4-525, page 4-569 and page 4-630 reiterate the same errors noted in the previous three comments.

30. Page 4-705 indicates that LLW would be shipped to a USDOE site for burial. Hanford is not acceptable for any of this waste. The Hanford site cleanup mission must take first priority. Any inputs of waste from other locations will likely directly conflict with and interfere with the site cleanup mission. | 1/08.03.01 cont.

31. Section 4.4.1, page 4-771. The draft PEIS states that "the health impacts from the transport of materials were estimated using a homogeneous population." Since the analysis is not route specific, the potential impacts cannot be accurately predicted. | 39/10.00.00

32. Section 4.4.2.1, page 4-772. The draft PEIS attempts to downplay the potential impact of the transportation of plutonium by comparing it to the number of hazardous material shipments now on the road. The draft PEIS estimates a maximum of 603 shipments per year of radioactive material would be generated for any alternative in this PEIS. For these types of shipments -- this is a significant increase. | 40/10.00.00

33. Section 4.4.3, page 4-777 and elsewhere. The draft PEIS states that transportation assessment is contained in a classified appendix. How are we to judge the potential impacts if the analysis is not disclosed? | 41/10.03.00

34. Section 4.4.3.3, page 4-781. The draft PEIS says up to 12 BUSS shipments of cesium capsules each year would be needed from Hanford to the immobilization site. Only one BUSS cask exists. If the transport is to occur cross-country, logistics may make one shipment per month impossible. | 42/10.00.00

35. Section 4.4.3.3, page 4-781. The draft PEIS again refers to the classified appendix. It mentions that the potential radiological and non-radiological health effects from transporting Cs-137 from Hanford to each of the immobilization sites analyzed is | 43/10.03.00

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09 01 01 **Comment Number 31**

The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) of Benton and Franklin Counties does not identify prime farmland at Hanford. However, the NRCS believes that some soil units onsite have the potential to be prime farmland soils if irrigated. Section 3.2.1 of the Final PEIS was revised to reflect this condition.

11 00 01 **Comment Number 32**

This paragraph describes the existing storage at the PFP. The PFP is not a candidate facility for the storage of weapons-usable fissile materials other than under the No Action Alternative, as described in this PEIS.

09 04 01 **Comment Number 33**

Section 3.2.4 of the Final PEIS was modified to indicate that fisheries is another primary use of the Columbia River.

09 04 01 **Comment Number 34**

The issue of partial dam failures is not addressed since all proposed locations for the alternatives analyzed in the PEIS are well above any areas potentially affected by any type of flooding of the Columbia River. The largest magnitude floods are introduced as a potential "worst-case" scenario.

09 04 01 **Comment Number 35**

The discussion of existing groundwater contamination mentions the various contaminants which have been detected at the site, including the tritium and nitrate plumes in the unconfined aquifer which is sufficient detail for a PEIS. The tritium and nitrate plumes in the unconfined aquifer is added to Figure 3.2.4–2 of the Final PEIS.

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contained in this classified appendix. USDOE is not justified to place this information in a classified appendix. Cesium is not a fissile material and this analysis should not be contained in a classified document. Cesium-137 capsules have been transported in considerable numbers in recent years. The most recent shipments were preceded by an Environmental Assessment. That information was not classified. | 43/10.03.00 cont.

36. General -- The Draft PEIS makes no mention of working with route states or Native American tribes to coordinate any of the transportation activities. DOE must work with the states and Native American tribes along the routes to ensure that local responders are aware of the shipments and the potential risks they present. It is critical that responders be appropriately trained and equipped to conduct an effective response to an accident involving any of these shipments. The ability of these response agencies to effectively respond to a transport accident directly impacts the potential consequences of an accident and therefore must be considered in the PEIS. | 44/08.03.00 | 45/10.01.00

Volume III

37. Page E-15 fifth paragraph. The SST wastes are scheduled under the Tri-Party Agreement to be retrieved and vitrified in the same manner as the DST wastes. As written, the paragraph might lead a reader to assume the tanks will be closed with the waste in-place in the tanks. Also, tank closure is now excluded from the Tank Waste Remediation System EIS and will be the subject of a separate EIS at a future date. This future EIS will also address leaked tank waste. | 46/09.11.01

38. Page E-15, bottom of page states "the low-level fraction will be vitrified for disposal onsite." This is incorrect. The low-level fraction will be vitrified and placed in retrievable storage on-site. | 47/09.11.01

39. Page M-7. The cancer risk assumed for radiation exposure relies on BIER V recommendations which is in turn based in large part on the study of the survivors of Hiroshima and Nagasaki. BIER V adjusts the slope factor for low dose exposure downward by an arbitrary factor of two based on a belief that cellular repair mechanisms are more effective at low doses, and that the linear slope factor extrapolated from the existing databases over estimates the actual risk. This has not been demonstrated in controlled studies. Lacking better information, the risk slope factors should be returned to their full values. (e.g. multiply the reported cancer risks throughout the report by a factor of two.) In addition, the factors used do not include multi-generational effects. An additional factor is needed to account for this risk. | 48/09.09.08

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09 04 01 **Comment Number 36**

The purpose of this map is to show the generalized, overall groundwater flow directions across the site. The northward flow component at the 200-West Area is stated in Section 3.2.4 of the PEIS.

09 05 01 **Comment Number 37**

According to the 1994 Uniform Building Code (UBC), Hanford is in Seismic Zone 2B. However for this PEIS, UBC Seismic Zones 2A and 2B were consolidated into Seismic Zone 2. Seismic Zones 2A and 2B differ only in that Zone 2B has the potential for slightly more damage than Seismic Zone 2A corresponding to an earthquake intensity VII on the Modified Mercalli Intensity (MMI) scale. Based on historical and recent seismic data, the seismic risk in eastern Washington appears to be properly classified as Seismic Zone 2B.

Hanford is located in the Columbia Plateau, a term used informally to designate the area within the Columbia Intermontane physiographic province that is covered by the Columbia River Basalt Group. Seismicity of the Columbia Plateau, as determined by the rate of earthquakes per area and the historical magnitude of these events, is relatively low when compared with other regions of the Pacific Northwest, the Puget Sound area, and western Montana/eastern Idaho (areas where several large earthquakes, Richter magnitude greater than 7, have occurred). Between 1870 and 1980, only five earthquakes occurred in the Columbia Plateau region that had MMI of VI or greater, and all these events occurred prior to 1937.

The largest known earthquake in the Columbia Plateau (magnitude 5.75 and maximum MMI of VII) occurred in 1936 around Milton-Freewater, Oregon, approximately 100 km (62 mi) southeast of Hanford. In the central portion of the Columbia Plateau, the largest earthquakes near Hanford occurred in 1918 and 1973. Each had an approximate magnitude of 4.5 and MMI V, and located north of Hanford.

Most of the earthquakes in the central Columbia Plateau occur north or northeast of the Columbia River as "earthquake swarms," which are clusters of low intensity earthquakes (MMI < V) occurring over a short period of time.

40. Page M-22, figure M.2.4-1 shows a source in the 600 Areas on the slopes of Rattlesnake Mountain. Table M.2.4.1-1 on page M-29 indicates this source is currently in existence at this location and is composed of plutonium 239,240 and strontium 90. Senior Hanford site personnel deny any knowledge of such a source on Rattlesnake Mountain. We have no knowledge of a source on Rattlesnake Mountain. What is this source? 49/09.09.01

41. Page M-234, Table M.5.2.1.2-1. The table is clearly in error. It indicates that the dose to a worker at 1,000 meters for a nuclear criticality would be 0.010 rem. This apparently assumes direct radiation exposure only and that a criticality would not lead to a release of radioactive materials from containment. Also, a criticality accident would lead to much greater consequences to nearby workers. The accident frequencies reported in table M.5.2.2.1-2 deviate greatly from USDOE experience. The fires at Rocky Flats and Los Alamos should be a clear indication that these are frequent and credible events, not incredible events. Similarly, their have been a large number of uncontrolled and unplanned criticalities at USDOE facilities. The consequences are understated and the potential range of complications and human factors are ignored. The accident risk assessments should be reevaluated. 50/09.09.01

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Regarding the comment "No site in a Seismic Zones 2, 3, or 4 should be considered for any of the Pu disposition activities," DOE's decision on surplus Pu disposition includes the impacts of earthquakes in the area as well as the impacts of other resources such as threatened and endangered species, Native American resources, and health effects on workers and the public. All of these impacts, including the seismic zone, will be considered in the decisionmaking process.

09 01 01 **Comment Number 38**

The *Hanford Site Development Plan* dated May 1993 (DOE/RL-93-19) is Hanford's current land-use planning document. The PEIS analyzes potential impacts to onsite land-use against this document. All storage and disposition alternatives proposed for Hanford would be in conformance with the *Hanford Site Development Plan*; therefore, no impact to land-use would occur. DOE is currently preparing the CLUP in conjunction with the HRA EIS. The CLUP/HRA EIS is being prepared with stakeholder, governmental, and tribal input. Coordination of these documents with the NEPA process will allow DOE to codify the land-use recommendations in a ROD. However, the PEIS references the current *Site Development Plan* (1993) since adoption of the CLUP/HRA EIS will occur beyond the PEIS timeline.

10 00 00 **Comment Number 39**

The transportation analysis is not route specific, but used a homogeneous population mix along the representative routes between the sites. This homogeneous population mix was 84 percent rural, 15 percent suburban, and 1 percent urban.

10 00 00 **Comment Number 40**

The human health risks of material transportations associated with the proposed Pu storage and disposition alternatives are evaluated and presented in Section 4.4 of this PEIS. The more detailed description of the methodology and supporting data for the analysis is presented in the Appendix G. Transportation of radioactive materials between sites includes health risks for both normal operations and accident conditions to the public and workers.

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Attachment B

Oregon Department of Energy
Discussion of public comments we received on the
Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

We met with over eight hundred Oregonians in person in twelve cities. We reached many more by video conference, cable television and mailings. During our public involvement effort with Oregonians, we gained new insights into plutonium disposition problems.

Oregonians were uniformly thoughtful in their discussions with us. They often expressed concerns early in the meetings about knowing or learning enough in a short time to make informed comment on USDOE's plans for fissile materials disposition. Within a short time, the participants in our focus groups and public meetings were comfortably involved in the technical aspects of plutonium disposition. By the end of the meetings, the public expressed gratitude for having access to such an important decision process. The illusion they could not make informed comment was shattered.

Conclusions

This public process was extremely valuable. It gave us insights into the conflicting tradeoffs involved and the public view of these tradeoffs. Oregonians were considerate and passionate in their discussions about the issues. Many of the public comments were in depth technical comments. We found it valuable and important for our technical staff to be directly involved in the discussion. However, we confirmed that technical staff must be able to speak in common language and be able to explain complex ides in simple terms. This process not only changed our conclusions, it changed the way we think about the problems.

Oregonians came away from the meetings with a deeper understanding of the tradeoffs involved in plutonium disposition. Many were excited to be involved in this way and expressed a desire that we keep them involved. Some used our discussions as a spring board in their own communities to continue the discussions.

Oregonians views:

1. Broad opposition for storage, processing or disposal at Hanford.
2. Broad opposition to any reactor option.
3. Limited support for vitrification.

1/08.03.01 cont.
24/08.03.01 cont.
7/08.03.01 cont.

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10 03 00 **Comment Number 41**

Specific risks analyses and potential routes for each of these alternatives are contained in the Classified Appendix. The total potential impacts for comparison are given in Section 4.4 and Appendix G for each of the storage and disposition alternatives.

10 00 00 **Comment Number 42**

Logistical planning is an important facet regarding all potential transportation options pursuant to the alternatives in this PEIS. During the final decisionmaking stage, if it is deemed that 12 BUSS shipments each year are required, then appropriate action will be taken to facilitate this action.

10 03 00 **Comment Number 43**

The quantity of Cs per package, quantity per year, number of shipments, and other information can be found in Table 4.4.2.2–1 of the Draft PEIS. All risk calculations are contained in the Classified Appendix because some data used for the calculations are classified. However, the total potential fatalities for alternatives requiring the transport of Cs are presented in Section 4.4.3.3 and Table 4.4.3.3–1.

08 03 00 **Comment Number 44**

Transportation of special nuclear materials would occur through DOE's SST transportation system. This system involves coordination with State and local municipalities along the transportation routes to ensure proper response as required. The actual shipment times and routes vary and are classified for security reasons.

4. Early opposition to borehole disposal, with limited support in the last focus group. | 51/08.03.01

These are some of the concerns we heard from Oregonians.

Themes from the public comments:

Reactors

A few people spoke and argued in favor of the reactor options. A greater number argued against any reactor option based on the operational history of reactors worldwide. Many commented that continued operation of civilian nuclear reactors would add to an already huge problem and make it worse. Many made little distinction between civilian and military uses of nuclear power. | 24/08.03.01 cont.

Many people raised concerns about the potential for development of a plutonium economy if any reactor option were selected. Most Oregonians viewed this as a security risk for the development of nuclear weapons by other nations. | 52/13.00.00

Deep Borehole

Deep Borehole was opposed by most Oregonians, but did receive some limited support in the discussion phase of the final focus group meeting in Portland. | 51/08.03.01 cont.

Vitrification

Vitrification was generally looked upon positively, but many were concerned about how well it might work. Many people expressed concerns that mixing plutonium with high-level waste was over complicating the process and that it could lead to failure of the glass. | 7/08.03.01 cont.

General

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10 01 00 **Comment Number 45**

Logistical planning and meteorological surveillance are standard concerns which normally receive a great deal of attention during transportation operations such as this; transfer of materials to Hanford will hold no exceptions. Emergency preparedness personnel (that is, Emergency Response Teams) will be supplied with the necessary equipment and training commensurate with DOT, DOE, and NRC regulations. Sufficient funding for these concerns will be available to satisfactorily ensure that potential contingencies be dealt with in an effective and timely manner. DOE provides liaison with appropriate agencies for special nuclear material shipments; however, due to their classified nature, specific information on times and dates cannot be provided.

09 11 01 **Comment Number 46**

Text highlighted by the commentor (Section E.2.1) has been expanded to clarify how the wastes in the single-shell tanks are planned to be managed per the *Tri-Party Agreement*, as amended.

09 11 01 **Comment Number 47**

According to the Draft EIS for the Tank Waste Remediation System (DOE/EIS-0189-D), DOE and the State of Washington, Department of Ecology, have identified a Phased Implementation Alternative as the Preferred Alternative for managing and disposing of tank waste. In this alternative low-activity waste "would be disposed of onsite in near-surface retrievable disposal vaults" covered with a thick earthen barrier following evaporation and vitrification. This is also the strategy reflected in the current *Tri-Party Agreement.* The text referred to by the commentor in Section E.2.1 was revised in the Final PEIS to reflect the use of "retrievable" disposal vaults.

09 09 08 **Comment Number 48**

The human health effects response to low-level radiation exposure is still disputed in the scientific community. The ICRP and NCRP, two widely respected and accepted scientific organizations, support using the linear-non-threshold approach for estimating human health risks for low-level radiation

STATE OF OREGON, DEPARTMENT OF ENERGY, SALEM, OR, JOHN SAVAGE
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The EIS examines the near term issues involved in plutonium disposition, but it does not address longer term issues. In particular, the EIS accepts the proposal by the National Academy of Sciences for reliance on the "spent fuel standard" as the acceptable benchmark for performance. The spent fuel standard is specified as placing the plutonium into a final form that is at least as radioactive as spent nuclear fuel. This is intended to provide a barrier to keep terrorists and even some nations from recovering the plutonium for use in weapons. USDOE estimates that within sixty years of leaving a reactor, spent nuclear fuel no longer meets this standard.

17/01.04.00 cont.

Our citizens questioned the adequacy of the protection provided by the "spent fuel standard" proposed by the National Academy of Sciences. Many felt the plutonium should be more highly protected than this, and that in a separate analysis, spent fuel should also be more highly protected. They were equally concerned that civilian plutonium might be converted to weapons use in other nations. This drove a largely supported position that nuclear power was dangerous because of its future risks to global security.

Most pubic commenters noted that nuclear power was not foremost in their minds, but in general the public opposed it for a wide variety of reasons. A small minority of technical commenters viewed nuclear in a positive light. Support for any reactor options was very weak, except for the technical commenters.

People in general expressed concerns over the accumulative harm they and their children and grand-children may suffer as a result of the decisions already made, and which may be made as the result of this EIS. They also spoke about concerns over the conditions at other USDOE sites and the need for all sites and people near them to be treated fairly.

A few commenters lamented the exclusion of the space disposal option. Many extolled the folly of the space disposal option.

53/01.05.00

Many people discussed the problems inherent in handling plutonium metal and the potential for fires.

Many people spoke or expressed concerns about Native American impacts.

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exposure. Some suggest that this estimation is too conservative while others believe that radiation effects would be greater at low-level radiation exposures. However, the ICRP and NCRP approach is the most widely used method to estimate the radiation health risk and has long been employed by regulatory agencies in the United States. It is appropriate to use this method in the PEIS.

09 09 01 Comment Number 49

The emissions data related to Hanford were taken from the latest available report, *Hanford Site Environmental Report for Calendar Year 1993*. This data was collected and reported by Hanford personnel.

09 09 01 Comment Number 50

The analysis considers a release of radioactive materials from containment for all of the accidents given in Table M.5.2.1.2–1. The dose to the noninvolved worker is correct. Updated doses, based on the most recent information, are presented in the Final PEIS. As stated on page 4–65 of the Draft PEIS, "Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new facility or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident." Chapter 3, which describes the affected environment, contains a review of accident history as it pertains to health and safety considerations at each of the sites of interest. The incidents occurring previously should not be confused with the beyond evaluation basis accidents in Table M.5.2.2.1–2. The accident frequencies and corresponding releases in the table are based on "sequences of events and models of effects that have not occurred. Significant changes exist between storage and disposition facilities and the current facilities design criteria and safety standards, which will reduce total risk to the public." (page M–226 of the Draft PEIS).

Most Oregonians expressed concern that Russia may be unable ability to secure its plutonium. Oregonians believe we should do everything possible to acquire Russian plutonium. Many people expressed concerns about trusting the Russians to carry through with weapons dismantlement and disposal of the plutonium. | 54/01.03.00

A majority of people wanted detailed information about the costs of the various options. Discussions showed that the cheapest option was not the top priority. Instead, Oregonians expressed a desire that the options considered be reasonably weighed between costs and benefits, and that the costs and benefits include non-financial costs and benefits, such as quality of the environment. | 8/08.00.00 cont.

Uniformly, Oregonians rejected the use of Hanford for any aspect of plutonium disposition, that would delay cleanup, or add waste to the site. The tally of our opinion gathering showed only vitrification to have any significant support, but not at Hanford. Many viewed vitrification with cesium as much more desirable than vitrification with high level waste. | 1/08.03.01 cont. 7/08.03.01 cont.

Many people expressed gratitude for having access to this decision process. A few were moved to tears that a government agency would actually discuss such an issue with them in such a forthright manner. | 55/08.02.00

Many people expressed concerns that we do not know enough collectively as a society to make this decision. They went on to clearly separate the security issues from the disposition issues. They recognized that we have a potential window of opportunity in which to remove large numbers of weapons permanently from the worlds arsenals. But, they also recognized that none of the proposed solutions can be fully implemented in less than a decade. They stated that as a consequence, this window is not so large or permanent as we imagine, and that though we should proceed, we should also continue to examine other potential solutions looking for better answers.

Several stated strongly that the scientists should make the decisions. A roughly equal number stated equally strongly that the scientists should not be allowed to make the decisions. Most agreed that politicians should not make the decision.

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08 03 01 **Comment Number 51**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

13 00 00 **Comment Number 52**

While the Pu is in the MOX fuel form, it is owned by the U.S. Government and would be subject to high standards of safeguards and security. Consistent with the President's Nonproliferation Policy, the surplus Pu would be inspectable by IAEA, as appropriate.

01 05 00 **Comment Number 53**

Comment noted.

01 03 00 **Comment Number 54**

Comment noted. DOE is encouraging the Russians to pursue timely Pu disposition by offering technical assistance, conducting joint assessments of the various disposition technologies, and planning joint demonstrations of some of the technologies to remove uncertainties in their viability.

08 02 00 **Comment Number 55**

Comment noted.

The Oregon Approach:

A Grassroots Method to Achieve Meaningful Public Involvement

Final Report

Oregon Department of Energy

and

Oregon Hanford Waste Board

February 1996

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STATE OF OREGON, DEPARTMENT OF ENERGY, SALEM, OR, MARY LOU BLAZEK
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Oregon

DEPARTMENT OF ENERGY

April 18, 1996

J. David Nulton
Director, NEPA Compliance & Outreach
Office of Fissile Materials Disposition
U.S. Department of Energy
Forrestal Building, MD-4
1000 Independence Avenue SW
Washington, D.C. 20585

Dear Mr. Nulton:

As promised, enclosed is a list of comments, statements, and concerns that we recorded on the flip charts at the Portland focus group meeting on plutonium disposition. Please take these comments into consideration as the U.S. Department of Energy continues its process to decide the ultimate fate of surplus weapons plutonium.

These comments will be included as an attachment to Oregon's formal comments on the Fissile Materials Draft Environmental Impact Statement.

If you have any questions, please call me at (503) 378-5544.

Sincerely,

Mary L. Blazek

Mary Lou Blazek, Administrator
Nuclear Safety Division

John A. Kitzhaber
Governor

625 Marion Street NE
Salem, OR 97310
(503) 378-4040
FAX (503) 373-7806
Toll-Free 1-800-221-8035

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STATE OF OREGON, DEPARTMENT OF ENERGY, SALEM, OR,
MARY LOU BLAZEK
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Plutonium Disposition
Portland Focus Group Comments - April 10, 1996

Concern that the decisions will be politicized. While the EIS process allows for public input -- there's concern expressed that other federal agencies such as departments of Defense and State and Congress may influence the decisions made outside of the public forum.	1/08.03.00
Concern about the cost involved -- consolidating the plutonium to one location vs. leaving the material at multiple sites.	2/07.02.00
Concern that the transportation of plutonium has not been factored into the costs.	3/07.00.00
Concern that Hanford may have to take surplus plutonium from Rocky Flats since Rocky Flats is not being considered for plutonium disposition activities.	4/01.02.00
Concern that if plutonium from Rocky Flats or some other facility goes to Hanford, Hanford cleanup will be negatively impacted.	
Concern about the safety measures and security of the material if the plutonium is consolidated to one site.	5/09.00.08
Question whether there was a formula to determine what percentage of material at each site was declared surplus, or whether it was assessed separately at each site.	6/01.00.00
Statement that declaring only 38 percent of the United State's plutonium inventory surplus is not enough.	
Concern that the draft Environmental Impact Statement fails to address in detail transportation issues like risk analysis, potential routes, and emergency preparedness and response plans in the event of an accident.	7/10.00.00
Concern about the form of the plutonium and the type of container or packaging the material will be transported in.	8/10.00.00
Concern that the technology for immobilization is not yet proven and may not work.	9/05.00.08
Statement that issues of this magnitude, USDOE needs to conduct more than just one meeting in each region.	10/08.02.00
Concern that the amount of plutonium destroyed in the reactor option (30 percent) is not worth the amount of high level radioactive waste it creates as a result of running that reactor.	11/08.03.01

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08 03 00 **Comment Number 1**

Comment noted.

07 02 00 **Comment Number 2**

Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in late July 1996.

07 00 00 **Comment Number 3**

Transportation costs were included in the cost evaluations for each storage and disposition alternative in the Technical Summary Reports issued by DOE beginning in late July 1996.

01 02 00 **Comment Number 4**

Comment noted. DOE acknowledges the concern about the potential effects that the selection of Hanford for new missions could have on the site's clean-up program. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input. The decision process will also give consideration to existing agreements between DOE, the State of Washington, and the EPA.

09 00 08 **Comment Number 5**

Potential impacts and risk to public and occupational health and safety from Pu consolidation are described in Chapter 4 of the Draft PEIS (Sections 4.2.1.9 and 4.2.2.9 to 4.2.6.9). Intersite transportation risks are presented in Section 4.4.3.2. The Pu Consolidation Alternative is considered a reasonable alternative since, during the screening process, it was rated high in resistance to theft or diversions to reflect the advantages in reducing the number of sites involved. The Pu Consolidation Alternative is also high in technical viability due to consolidation in a state-of-the-art storage facility where there would be little doubt that the facility would remain viable for the potential duration of long-term storage.

STATE OF OREGON, DEPARTMENT OF ENERGY, SALEM, OR, MARY LOU BLAZEK
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Concern that fabricating MOX fuel would still be more costly than uranium fuel.	12/08.03.01
Concern that Canadian reactors (CANDU) wouldn't burn MOX fuel any more effectively than U.S. reactors.	13/08.03.01
Concern that if a MOX fabrication facility is used, the facility could become privatized and create a commercial market for plutonium fuel.	14/01.00.00
Concern about the capacity of Yucca Mountain to store spent fuel generated from the reactor option.	15/12.00.00
Statement that since we already have problems with disposing of current high-level waste, we should oppose any option that would generate more high-level waste.	11/08.03.01 cont.
Concern that MOX fuel fabrication would create new waste streams.	16/06.01.09
Concern that using existing reactors would extend the operating life beyond the time these reactors could run safely.	17/06.00.09
Statement that the reactor alternative is totally unacceptable, because how the U.S. deals with surplus plutonium sets a standard for the rest of the world. The U.S. needs to declare this plutonium waste and not find a use for it.	18/01.00.00
Concern that the U.S. has the same problem as the Russians in that we continue to call the plutonium an asset, not waste.	
Questions about the status of Canada's, Germany's, France's, and Sweden's repository programs.	19/11.00.08
Concern about the possibility of a nuclear reaction or catastrophe with the borehole option.	20/09.09.08
Concern about borehole disposal in a region with volcanic activity.	21/09.05.08
Statement that the borehole option is a proven technology and the plutonium would be disposed of permanently.	22/08.03.01
Statement about the difficulty of predicting impacts far into the future.	23/01.00.00
Statement that public information efforts have not been adequate.	24/08.02.00
Concern that there is no financial table that compares all the costs of the different options included in this EIS. Concern that this draft cost report will not include long term costs into the next several hundreds of years.	25/07.02.00
Concern that USDOE's many EIS's are not all integrated.	26/01.00.00

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01 00 00 **Comment Number 6**

The declaration of surplus weapons-usable fissile materials is made by the President in response to recommendations from the Nuclear Weapons Council, composed of representatives from DOE, DoD, and the Joint Chiefs of Staff.

10 00 00 **Comment Number 7**

The human health risks of radioactive material transportations associated with the Proposed Pu storage and disposition alternatives are evaluated and presented in Section 4.4 of this PEIS. The categories of calculated risk include nonradiological accident impacts to the public and workers, nonradiological normal operation impacts to the public (air pollution), radiological accidents to the public, and radiological normal operation impacts to the public and workers. Specific risks analyses and potential routes for each of these alternatives are contained in the Classified Appendix. A description of the emergency response for each of the sites is included in Chapter 3 of the PEIS.

10 00 00 **Comment Number 8**

Transportation of materials will be performed as required by all Federal, State, and local regulations. Packaging will meet all applicable DOT and NRC requirements.

05 00 08 **Comment Number 9**

The immobilization technology was considered viable to the point that it was considered an alternative. DOE is currently in the process of demonstrating a number of these immobilization technologies at various sites.

08 02 00 **Comment Number 10**

To obtain public comments on the Draft PEIS, DOE held meetings near each of the potentially affected sites and a national meeting in Washington, DC. DOE also participated in meetings, open to the public, sponsored by different organizations at which the sponsor collected public comments which were

STATE OF OREGON, DEPARTMENT OF ENERGY, SALEM, OR, MARY LOU BLAZEK
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Concern that USDOE docs not currently have the technological capability of doing MOX fuel.	27/06.01.08
Concern that certain sites are implied by the selection of certain options and that these are not clearly explained in the EIS.	28/01.04.00
Concern that options like reactor or immobilization would implicate Hanford where as other options like deep borehole may not.	29/01.02.00

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forwarded to DOE. DOE created and advertised a number of methods for submitting comments for members of the public who could not attend a public meeting. These methods included fax, oral comments using a toll-free telephone number, mail, and the Internet.

08 03 01 **Comment Number 11**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 12**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 13**

The Department of Energy acknowledges the commentor's opposition to the use of the CANDU Reactor Alternative for the disposition of Pu. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input. This will include an appropriate level of analysis by Canada before any decision on burning Pu in a CANDU is implemented.

01 00 00 **Comment Number 14**

The Department of Energy is the owner of the MOX fuel containing surplus weapons Pu and would not create a commercial market for its use.

12 00 00 **Comment Number 15**

The PEIS does not assume the use of Yucca Mountain as a HLW repository for disposal of MOX spent nuclear fuel and/or immobilized materials. However, since Congress directed Yucca Mountain to be the only site considered for evaluation (site characterization) for the disposition of commercial spent nuclear fuel and HLW, data developed to date at this site have been used to evaluate the potential for disposing of Pu wastes.

06 01 09 **Comment Number 16**

The environmental impact of the MOX fuel waste streams is presented in Chapter 4 and Appendix H of this PEIS.

06 00 09 **Comment Number 17**

In relation to the existing reactors, all reactors are, and will continue to be, in compliance with all applicable NRC regulations. It is the position of DOE that the licenses for reactors not be extended solely for the Pu disposition mission. However, if the reactor owner chooses to seek plant life extension for his reactor, he may pursue this action under regulations promulgated by the NRC, irrespective of the Pu disposition mission.

01 00 00 **Comment Number 18**

In accordance with NEPA, the PEIS evaluates a range of reasonable alternatives for the disposition of weapons-usable Pu. The use of Pu in nuclear reactors as MOX fuel is a reasonable alternative under NEPA, and is therefore, considered in the PEIS.

11 00 08 **Comment Number 19**

Comment noted.

09 09 08 **Comment Number 20**

The human health impacts from potential accidents are presented in this PEIS for all of the proposed facilities including the facilities in the Borehole Option. For each of the anticipated accidents, the impacts analyzed include the cancer risk to workers and the MEI, as well as the potential cancer fatalities for the regional population up to 80 km (50 mi). The anticipated accidents analyzed cover a wide spectrum of the potential accidents including those that have large consequences but low probability, such as criticality accident (a nuclear reaction) and earthquake (catastrophe). The anticipated accidents include an analysis of the initiating events, materials at risk, source terms, probabilities, and consequences.

09 05 08 **Comment Number 21**

The deep borehole complex is not defined for a specific or representative site. Therefore, a limited assessment of the environmental impacts was done for the geological resources and other resources. Should either of the Deep Borehole Alternatives be selected, a siting study would be conducted in coordination with a site-specific discussion of environmental (including geological) conditions and impacts. The identification and acceptance of a site location would require extensive site characterization to ensure that the primary objective of the deep borehole complex, hydrologic isolation from the biosphere, would be met.

08 03 01 **Comment Number 22**

The Department of Energy acknowledges the commentor's support for the Borehole Alternatives. Decision on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 00 00 **Comment Number 23**

The Department of Energy agrees that there are uncertainties in the long-term. Every effort is being made to assess environmental impacts in the foreseeable future and decisions will be based on the best available

information. Implementation of decisions will be carried out consistently with applicable environmental safety and health, security, and environmental standards and requirements. Changes to storage and disposition activities will be made, as required, to ensure that these requirements and the overall mission of DOE is being met.

08 02 00 **Comment Number 24**

Comment noted.

07 02 00 **Comment Number 25**

Cost data, along with technical and schedule data, was provided in Technical Summary Reports of both storage and disposition in late July 1996. Cost data for the next hundreds of years would be highly speculative and is beyond the scope of this program.

01 00 00 **Comment Number 26**

The relationship of the Storage and Disposition PEIS with other EISs is described in Chapter 1 of the PEIS. Furthermore, DOE has an ongoing effort in program integration, including the internal review and concurrence of NEPA documents by all public organizations.

06 01 08 **Comment Number 27**

Fabrication and use of MOX fuel using reactor-grade Pu is a mature, industrial scale technology in Europe with at least three vendors actively fabricating MOX fuel. There are some differences introduced by the use of weapons-grade Pu, which DOE is addressing as part of an ongoing weapons-grade MOX fuel development program.

01 04 00 **Comment Number 28**

Some of the storage and disposition alternatives addressed in the PEIS involve existing facilities at DOE sites. To the extent that these alternatives and sites are included in the ROD, they will involve the use of an existing site

if the ROD includes the use of commercial reactors. However, in cases where new facility construction is required for either storage or disposition, the PEIS analyses and results are not intended to imply a preference for any particular site.

01 02 00 **Comment Number 29**

Comment noted.

STATE OF SOUTH CAROLINA, DEPARTMENT OF PARKS, RECREATION AND TOURISM, COLUMBIA, SC, JAMES E. NEWMAN
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South Carolina
Department of Parks, Recreation & Tourism
Engineering and Planning Office

May 6, 1996

Mr. J. David Nulton
Director, NEPA Compliance & Outreach
Office of Fissile Materials Disposition
United States Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Re DOE/EIS-0229-D
Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impact Statement

Dear Mr. Nulton:

We have briefly reviewed the above referenced subject and offer the following comments for consideration:

1. The Final Programmatic Environmental Impact Statement should include a cost/benefit analysis of the various alternatives. All revenues, processing expenses, research & development costs and design/ construction costs from activities should be included for each alternative in terms of present value. 1/08.00.00

2. The preferred alternative should weigh the costs of the alternatives with the associated risks of latent cancer fatalities and environmental impacts. 2/08.03.00

3. The design life of repositories (permanent storage) should be consistent with the radioactive emission life of the waste placed in the repository. 3/12.00.00

4. Radioactive and hazardous waste that will not be used in the foreseeable future should be placed in repositories for permanent disposition.

The South Carolina Department of Parks, Recreation and Tourism appreciates the opportunity to comment on this project and any other projects that could possibly affect tourism and existing and/or planned recreational facilities. Please call me at 734-0482 should you have any questions about these comments.

Sincerely,

James E. Newman, III
State Parks Engineer

cc: Beth McClure David Simms Amy Duffy
Marion Edmonds Charles Harrison Bob Liming
Rodney Grizzle (Office of the Governor-Grant Services)

1205 Pendleton Street Columbia, South Carolina 29201, USA (803) 734-0122, FAX (803) 734-1042

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08 00 00 Comment Number 1

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, was provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses, along with the environmental analysis and public input, will be integrated into DOE's decisionmaking process.

08 03 00 Comment Number 2

The financial cost of implementing all alternatives, for storage and disposition, have been included in separate Technical Summary Reports that were made available to the public in late July 1996. The environmental impacts of each of the alternatives have been analyzed in the PEIS.

12 00 00 Comment Number 3

Comment noted.

STATE OF SOUTH CAROLINA, OFFICE OF THE GOVERNOR, COLUMBIA, SC, RODNEY P. GRIZZLE
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State of South Carolina
Office of the Governor

April 12, 1996

Mr. J. David Nulton
Director, NEPA Compliance & Outreach
Office of Fissile Materials Disposition
U. S. Department Energy
1000 Independence Ave., SW
Washington, D.C. 20585

Project Name: Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement DOE/EIS-0229-D

Project Number: EIS-960309-009

Dear Mr. Nulton,

The Grant Services Unit, Office of the Governor, has conducted an intergovernmental review on the above referenced activity as provided by Presidential Executive Order 12372. All comments received as a result of the review are enclosed for your use.

The State Application Identifier number indicated above should be used in any future correspondence with this office. If you have any questions call me at (803) 734-0485.

Sincerely,

Rodney P. Grizzle
Grants Services Supervisor

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STATE OF SOUTH CAROLINA, OFFICE OF THE GOVERNOR, COLUMBIA, SC, RODNEY P. GRIZZLE
PAGE 2 OF 5

Office of the Governor • Grant Services
South Carolina Project Notification and Review
1205 Pendleton Street
Room 477
Columbia, SC 29201

State Application Identifier
E18-960309-009
Suspense Date
4/14/96

James Hugh Ryan
S. C. Forestry Commission

MAR 2 2 1996

ıe Grant Services Unit, Office of the Governor is authorized to operate the South arolina Project Notification and Review System (SCPNRS). Through the system e appropriate state and local officials are given the opportunity to review, mment, and be involved in efforts to obtain and use federal assistance, and to ess the relationship of proposals to their plans and programs.

ease review the attached information, mindful of the impact it may have on your ency's goals and objectives. Document the results of your review in the space ovided. Return your response to us by the suspense date indicated above. Your mments will be reviewed and utilized in making the official state recommendation ncerning the project. The recommendation will be forwarded to the cognizant deral agency.

ıould you have no comment, please return the form signed and dated.

you have any questions, call me at (803) 734-0495.

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1996
GRANT SERVICES

- ☐ Project is consistent with our goals and objectives.
- ☐ Request a conference to discuss comments.
- ☐ Please discontinue sending projects with this CFDA# to our office for review.
- ☐ Comments on proposed Application is as follows:

No Comments

Signature: Joe M. Blakely Date: 3-27-96

Title: Division Director-Administration Phone: 896-8800

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STATE OF SOUTH CAROLINA, OFFICE OF THE GOVERNOR, COLUMBIA, SC, RODNEY P. GRIZZLE
PAGE 3 OF 5

Office of the Governor • Grant Services
South Carolina Project Notification and Review
1205 Pendleton Street
Room 477
Columbia, SC 29201

State Application Identifier
EIS-960309-009
Suspense Date
4/14/96

Charles Kerekes
S.C. Jobs-Economic Development Authority

ıe Grant Services Unit, Office of the Governor is authorized to operate the South ırolina Project Notification and Review System (SCPNRS). Through the system ə appropriate state and local officials are given the opportunity to review, mment, and be involved in efforts to obtain and use federal assistance, and to ıess the relationship of proposals to their plans and programs.

ease review the attached information, mindful of the impact it may have on your ɛncy's goals and objectives. Document the results of your review in the space ovided. Return your response to us by the suspense date indicated above. Your mments will be reviewed and utilized in making the official state recommendation ncerning the project. The recommendation will be forwarded to the cognizant deral agency.

ɔould you have no comment, please return the form signed and dated.

you have any questions, call me at (803) 734-0495.

RECEIVED
Rodney Grizzle
APR 26 1996
GRANT SERVICES

- ☐ Project is consistent with our goals and objectives.
- ☐ Request a conference to discuss comments.
- ☒ Please discontinue sending projects with this CFDA# to our office for review.
- ☐ Comments on proposed Application is as follows: _____

Signature: Charles P. K. Date: 3/25/96

Title: Executive Vice President and Chief Operating Officer Phone: _____

M-243

Office of the Governor • Grant Services
South Carolina Project Notification and Review
1205 Pendleton Street
Room 477
Columbia, SC 29201

State Application Identifier
EIS-960309-009
Suspense Date
4/14/96

Bruce E. Rippeteau
South Carolina Archaeologist

ıe Grant Services Unit, Office of the Governor, is authorized to operate the South arolina Project Notification and Review System (SCPNRS). Through the system e appropriate state and local officials are given the opportunity to review, mment, and be involved in efforts to obtain and use federal assistance, and to sess the relationship of proposals to their plans and programs.

ease review the attached information, mindful of the impact it may have on your ency's goals and objectives. Document the results of your review in the space ovided. Return your response to us by the suspense date indicated above. Your mments will be reviewed and utilized in making the official state recommendation ncerning the project. The recommendation will be forwarded to the cognizant deral agency.

ıould you have no comment, please return the form signed and dated.

you have any questions, call me at (803) 734-0495.

RECEIVED
1996
Rodney Grizzle
STATE INFORMATION TECHNOLOGY SERVICES

- ☐ Project is consistent with our goals and objectives.
- ☐ Request a conference to discuss comments.
- ☐ Please discontinue sending projects with this CFDA# to our office for review.
- ☐ Comments on proposed Application is as follows:

Signature: [signature] Date: 3/26/96

Title: Underwater archeologist, review complete Phone: 803-777-8170

M-243

STATE OF SOUTH CAROLINA, OFFICE OF THE GOVERNOR, COLUMBIA, SC, RODNEY P. GRIZZLE
PAGE 5 OF 5

Office of the Governor • Grant Services
South Carolina Project Notification and Review
1205 Pendleton Street
Room 477
Columbia, SC 29201

State Application Identifier
EIS-960309-009
Suspense Date
4/14/96

Robert E. David
South Carolina Employment Security Commission

...e Grant Services Unit, Office of the Governor is authorized to operate the South ...rolina Project Notification and Review System (SCPNRS). Through the system ...e appropriate state and local officials are given the opportunity to review, ...mment, and be involved in efforts to obtain and use federal assistance, and to ...ess the relationship of proposals to their plans and programs.

...ease review the attached information, mindful of the impact it may have on your ...ency's goals and objectives. Document the results of your review in the space ...ovided. Return your response to us by the suspense date indicated above. Your ...mments will be reviewed and utilized in making the official state recommendation ...ncerning the project. The recommendation will be forwarded to the cognizant ...deral agency.

...ould you have no comment, please return the form signed and dated.

...you have any questions, call me at (803) 734-0495.

RECEIVED
Rodney Grizzle
... 5 1996
GRANTS SERVICES

1/08.00.00

- [x] Project is consistent with our goals and objectives
- [ ] Request a conference to discuss comments.
- [ ] Please discontinue sending projects with this CFDA# to our office for review.
- [ ] Comments on proposed Application is as follows:

Signature: Robert E. David Date: April 12, 1996

Title: Executive Director Phone: (803) 737-2617

M-243

08 00 00 **Comment Number 1**

Comment noted.

STATE OF TENNESSEE, DEPARTMENT OF ENVIRONMENT AND CONSERVATION, OAK RIDGE, TN, JUSTIN WILSON
PAGE 1 OF 8

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION

May 6, 1996

US Department of Energy
Office of Fissile Materials Disposition
PO Box 23786
Washington, D.C. 20026-3786

To Whom It May Concern:

As the Governor's Lead Contact for National Environmental Policy Act (NEPA) state reviews, I am responding on behalf of the State of Tennessee to the *Draft Programmatic Environmental Impact Statement (DPEIS) for Storage and Disposition of Weapons-Usable Fissile Materials; No. DOE/EIS-0229-D; February 1996.* Enclosed are comments from the TN DOE Oversight Division that now serve as state policy concerning the alternatives addressed in the above referenced PEIS.

Long standing policy dictates that the State of Tennessee does not support large scale waste storage facilities such as described in the "Consolidation of Pu" and "Colocation of Pu and HEU" alternatives. Attached is a letter from Governor Don Sundquist articulating this policy as it relates to similar concerns addressed in Draft PEIS for Waste Management. Given the connectivity of the "PEIS for Storage and Disposition . . ." and the "Draft PEIS for Waste Management", we expect the enclosed comments to be addressed in both documents. 1/01.01.00

Additional comments concerning other alternatives addressed in the "PEIS for Storage and Disposition . . ." are enclosed. If you have any questions please contact our NEPA staff coordinator at (615) 532-8545. Your consideration of our interests is greatly appreciated.

Sincerely,

Justin Wilson
Commissioner

Enclosures

c: Ken Bunting, Administrator (for WKS)
Earl Leming, DOE-Oversight
Dodd Galbreath (NEPA coordination file)
Jim Hall, Manager, DOE ORR

LET-JW1.DOC

M-177

01 01 00 Comment Number 1

The Department of Energy notes the commentor's opposition to the Consolidation and Collocation Alternative at ORR. Although the surplus and nonsurplus weapons-usable fissile materials that would not be stored under these alternatives are not wastes. DOE considered the alternative, because, under NEPA, all the alternatives must be analyzed. DOE will base its storage decision on public comments, environmental analyses, cost analyses, nonproliferation analyses, and policy considerations.

STATE OF TENNESSEE, DEPARTMENT OF ENVIRONMENT AND CONSERVATION, OAK RIDGE, TN, JUSTIN WILSON
PAGE 2 OF 8

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DOE OVERSIGHT DIVISION
761 EMORY VALLEY ROAD
OAK RIDGE, TENNESSEE 37830-7072

April 25, 1996

Mr. Justin Wilson, Commissioner
Tennessee Department of Environment and Conservation
c/o Tennessee Environmental Policy Office
14th Floor L&C Tower
401 Church Street
Nashville, Tennessee 37243 - 1553

Dear Commissioner Wilson

Document NEPA Review -- Draft Programmatic Environmental Impact Statement: Storage and Disposition of Weapons-Usable Fissile Materials, DOE/EIS-0229-D, February 1996

The Tennessee Department of Environment and Conservation, DOE Oversight Division has reviewed the above document for your concurrence and transmittal to the following DOE office:

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

The Division's review was conducted in accordance with the requirements of the National Environmental Policy Act (NEPA) and associative implementing regulations 40 CFR 1500 - 1508 and 10 CFR 1021.

The State has agreed to a maximum interim storage of 500 metric tons of HEU and 6 metric tons of low enriched uranium (LEU), as listed in the FONSI for "Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Level at the Y-12 Plant." Accordingly, the Division supports the storage alternative of "Upgrade at Multiple Sites," continuing to store highly enriched uranium (HEU) at the Y-12 facility. 2/08.03.01

M-177

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for new missions at the ORR. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

STATE OF TENNESSEE, DEPARTMENT OF ENVIRONMENT AND CONSERVATION, OAK RIDGE, TN, JUSTIN WILSON PAGE 3 OF 8

Justin Wilson, Commissioner
April 25, 1996
Page Two

The data provided in Attachment A, page S-117 "Summary Comparison of Environmental Impacts for the No Action and Long-Term Storage Alternatives" for "Collocation of Pu [plutonium] with HEU Storage Facilities Upgrade and/or New Facility", indicates that the Oak Ridge Reservation would have the highest "population cancer fatalities" among the six sites considered for this alternative. The sitting of large scale Pu storage facilities along with HEU storage at the Oak Ridge Reservation would result in a greater exposure risk to the off-site populations. For these and other reasons mentioned in the attached comments, the Division does not support the "Consolidation of Pu" at the Oak Ridge Reservation, which would create a collocation condition with HEU. In addition, the Division does not support the "Collocation of Pu and HEU" alternative at the Oak Ridge Reservation. 3/08.03.01

The Division supports the Mixed Oxide Fuel (MOX fuel) disposition alternative. It makes no economic sense to vitrify or place the material mixed with highly radioactive waste into deep bore holes, rendering the material irretrievable or useless. The European community uses MOX fuel in their commercial reactors and there are commercial nuclear utilities here in the United States interested in obtaining the plutonium for this purpose. 4/08.03.01

The Division is concerned with the overburden of numerous NEPA documents released for review at one time on local stakeholders. Within the window for review and comment on this document, the Division also has reviewed five other NEPA documents. 5/08.01.00

Also, we request the attached comments on the above document be given full consideration in the preparation of the Final Programmatic Environmental Impact Statement for Storage and Disposition of Weapons-Usable Fissile Materials.

If you have any questions, please contact Dale Rector at (423) 481-0995 or Steve Nisley at (423) 481-0163.

Sincerely

Earl Leming, Director

Attachment

cl219.99

M-177

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to the Collocation Alternative. Decisions on storage of fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 01 00 **Comment Number 5**

Comment noted.

STATE OF TENNESSEE, DEPARTMENT OF ENVIRONMENT AND CONSERVATION, OAK RIDGE, TN, JUSTIN WILSON
PAGE 4 OF 8

Tennessee Department of Environment and Conservation/DOE Oversight Division

Comments on Draft Programmatic Environmental Impact Statement, DOE/EIS-0229-D, February 1996, Storage and Disposition of Weapons-Usable Fissile Materials

GENERAL COMMENTS

During the public meeting, a DOE representative made a statement that new construction for some of the facilities needed would be done on "greenfields." Existing facilities on "brownfields" must be considered before DOE contaminates any new sites. DOE has demonstrated the cleanup process ranges from slow to nonexistent in dealing with legacy waste sites. Absolutely no greenfield should be considered for any project until brownfields are fully utilized. | 6/01.04.00

During the same public meeting, stakeholders were concerned with the amount of information presented for both the Weapons Usable Fissile Material and the Stockpile Stewardship Management projects. The DOE representative stated that each alternative site has no more than a hundred or so pages to review and the stakeholders should only be concerned with their specific site. If stakeholders are to gain a clear view to make rational decisions, the entire document should be reviewed. These two projects are directly linked to several other projects and the review time limit is not adequate for either. | 7/08.01.00

Throughout the Weapons-Usable Fissile Materials document, several references have been made to the Draft Waste Management Programmatic Environmental Impact Statement (PEIS), issued in September 1995. The Waste Management PEIS document is controversial because of the inaccuracies and it is doubtful the final document will be completed as expected later in 1996. References in the Weapons-Usable Fissile Material PEIS weigh heavily on information based on the draft Waste Management PEIS. Until the problems with the Waste Management PEIS are resolved, applicable information cannot be accepted as presented in the Fissile Material PEIS. | 8/11.01.08

Several references have also been made to the surplus and nonsurplus Highly Enriched Uranium (HEU) materials located at ORR. It should be clearly stated in the final PEIS that there is a maximum limit of 500 metric tons of HEU and six metric tons of Low Enriched Uranium (LEU) for interim storage as described in the FONSI for the proposed storage of enriched uranium above the maximum historical storage level at the Y-12 Plant. | 9/11.01.05

DOE has already committed to the upgrade of HEU storage facilities under other documents. These costs should not be included in the analysis for Weapons Usable Fissile Materials unless those buildings, such as Building 9995, are a first time consideration. | 10/11.00.08

M-177

01 04 00 **Comment Number 6**

The Department of Energy recognizes the need to utilize as much of its existing infrastructure as possible in dealing with materials storage and disposition. In this regard, the greenfield sites discussed in the PEIS include both existing DOE sites and new non-DOE sites (for a limited number of alternatives). Accordingly, the PEIS evaluates six DOE sites for storage and disposition. Under NEPA, DOE must consider all reasonable alternatives that include greenfield sites.

08 01 00 **Comment Number 7**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

11 01 08 **Comment Number 8**

As discussed in Chapter 1 of the PEIS, the waste volumes generated as a result of the long-term storage alternatives are not expected to raise significant waste management concerns. However, on a site-by-site basis, the selection of certain Pu disposition technologies may produce waste streams that could be difficult to manage at certain sites. Should any chosen alternatives result in waste generation not addressed in the Waste Management PEIS, DOE would prepare supplemental or project-specific NEPA documents tiered from the Waste Management PEIS.

11 01 05 **Comment Number 9**

Comment noted. Section 1.4 of the Final PEIS has been modified to include the maximum limit of 506 t (556.6 tons) of enriched uranium.

11 00 08 **Comment Number 10**

The upgrades referenced in the comment are not to support the alternative for the PEIS. As noted, these costs would not be included for storage alternatives.

STATE OF TENNESSEE, DEPARTMENT OF ENVIRONMENT AND CONSERVATION, OAK RIDGE, TN, JUSTIN WILSON
PAGE 5 OF 8

This document appears to be leaning towards borehole technology for storage/disposal as the preferred alternative. The borehole technology is not proven and will cost billions of dollars to properly site and place the canisters of plutonium. Also, as with the Waste Isolation Pilot Plant (WIPP) and the Nevada Test Site (NTS), the chosen site may not be ready for intended action for a long time to come. This is because groundwater will have to be monitored extensively prior to any emplacement to ensure background levels of radioactivity. In the 1970s, borehole technology was studied and discarded by DOE as a project with unattainable goals. — 11/04.04.00

Plutonium in its weapons-usable fissile form has a high cost factor associated with it. It should not be considered for immobilization alternatives and rendered practically useless or too expensive to be liberated at a later point. The material should be retrievably stored so it could be accessible in the event of an energy shortage, whether for power generation or weapons production. In this regard, part of it could be converted into for reactor fuel for sale. — 12/08.03.01

SPECIFIC COMMENTS

1. Volume I, Section 2.1.2 "Screening Evaluation Process," Page 2-1
The screening committee evaluated each option against "fatal flaws" in one or more of the screening criteria. The inability to meet standards, such as the Spent Fuel Standard, disqualified an option. These options ultimately will depend upon the disposal criteria in the unapproved Waste Management PEIS. Provide information showing why the use of an unapproved document as a basis for disposal is not considered a "fatal flaw." — 13/01.05.00

2. Volume I, Section 2.1.4 Reasonable Alternatives for the Disposition of Surplus Plutonium, Page 2-8
Please define the term "representative site" as used in the Electrometallurgical Treatment Alternative. — 14/05.03.08

3. Volume I, Oak Ridge Reservation, Page 2-49
"Under the Upgrade Alternative, nonsurplus HEU would be retained in long-term storage." Facilities on the ORR have been evaluated for interim storage. Please provide information on the evaluation process used for buildings slated for long-term storage. As stated in the environmental assessment for Y-12 (interim storage of enriched uranium above historical levels), several buildings did not meet DOE orders for interim HEU storage. Provide information for those buildings under the Weapons-Usable Fissile Materials draft PEIS that do not meet DOE orders for long-term storage of HEU. — 15/02.00.05

4. Volume I, Figure 2.3.1-9, Page 2-52
Provide information on Building 9995 considered for HEU storage upgrade. This building was not listed for HEU interim storage in Y-12's previous environmental assessments.

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04 04 00 **Comment Number 11**

Comment noted.

08 03 01 **Comment Number 12**

The Department of Energy acknowledges the commentor's opposition to the Immobilization Alternatives. Decisions on disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 05 00 **Comment Number 13**

All of the alternatives evaluated in the PEIS have associated waste forms and quantities identified. These wastes are being coordinated with DOE's Waste Management Program and will be included in the total waste volumes identified in the Final Waste Management PEIS. A ROD on the Waste Management PEIS is expected before any low-level, TRU, and mixed wastes will be produced from Pu disposition alternatives.

The Waste Management PEIS ROD will not decide "disposition criteria" for spent fuel or HLW; this will be part of the HLW program and will be included in the associated environmental analysis pursuant to the NWPA.

05 03 08 **Comment Number 14**

The term "representative site" refers to a site analyzed as an example of how a technology might be deployed at an existing site.

02 00 05 **Comment Number 15**

The Y–12 EA states that there are "eight facilities at the Y–12 Plant currently used to store enriched uranium or process it for storage. These facilities would be used for interim storage of enriched uranium above the historical maximum storage level." These eight buildings include 9204-2, 9204-2E, 9204-4, 9206, 9212, 9215, 9720-5, and 9998. The PEIS includes long-term storage of HEU material after the interim storage of materials consistent with

STATE OF TENNESSEE, DEPARTMENT OF ENVIRONMENT AND CONSERVATION, OAK RIDGE, TN, JUSTIN WILSON
PAGE 6 OF 8

5. Volume I, 3.6 Oak Ridge Reservation, Page 3-185 It should be clearly stated that the buildings slated for interim storage of HEU did not meet DOE orders and require upgrade. It should also be clearly stated that there is a maximum interim storage capacity of 500 metric tons of HEU and six metric tons of LEU.	16/11.01.05
6. Volume I, 3.6 Oak Ridge Reservation, Page 3-185 "These returned materials and components, as well as those currently located at Y-12, are safely and securely placed in short-term or long-term storage." Assuming the materials and components are made from HEU, the State of Tennessee has not agreed to host long-term storage of weapons grade fissile material. The State agreed to interim storage of 500 metric tons of HEU and six metric tons of LEU. Provide information on the decisions made for material currently in long-term storage, including the amount of material (kg), its form, and the storage buildings.	17/01.06.00
7. Volume I, 3.6.2 Site Infrastructure, Page 3-190 The facilities at Y-12 should clearly state which buildings do not meet DOE orders for storage, as well as the costs involved in the upgrade.	16/11.01.05 cont. 18/07.00.00
8. Volume II, 4.2.5.10 Waste Management, Page 4-273 Information presented on the High-Flux Isotope Reactor (HFIR) is erroneous. Utilizing the current spent fuel storage racks, the facility is now at full capacity for storage-not 40%. The total reracking project will increase the capacity of the spent fuel storage pool to 140 fuel elements. This will allow HFIR operation until the year 2004 to 2006. Please incorporate the correct information into the final PEIS.	19/09.11.05

M-177

the Y–12 EA. The Upgrade at Multiple Sites Alternative utilizes the long-term storage of HEU in some of these buildings. By then, the Y–12 storage facilities will have undergone the capital improvements required to ensure that all long-term HEU storage criteria are met. Existing facilities of the Y–12 Plant that will be used for the long-term HEU storage mission include 9204-2, 9204-2E, 9212, 9215, and 9998. Once ongoing expansions to Y–12 HEU storage areas have been completed, these five facilities will provide more drum storage capacity than the long-term storage mission will require. Other Y–12 facilities that currently store HEU are not planned for use in the long-term storage mission under the Upgrade Alternative. The storage of HEU remaining under IAEA safeguards will be in Building 9270-5 to provide safe and secure storage of HEU requiring international inspection. HEU chemical and isotopic analyses will be performed in the Plant Laboratory in Building 9995. Building 9995 will not be used for long-term storage of HEU (under any of the alternatives), but as a support facility for the mission.

A summary of the structural analyses, including Building 9995, is contained in Appendix G of the Y–12 EA. Building Complex 9212 consists of four different buildings, one of which is Building 9995. The description of the structural analysis needed for Building 9995 is contained under the Building 9212 Complex.

11 01 05 **Comment Number 16**

Comment noted. Information has been added to the Final PEIS to describe the results of the Y–12 EA, including the maximum storage capacity (Section 1.4) and structural upgrade requirements (Section 2.3.1).

01 06 00 **Comment Number 17**

Comment noted. Detailed information regarding DOE's decision will be provided in the ROD which is expected to be published in the *Federal Register* late this year.

STATE OF TENNESSEE, DEPARTMENT OF ENVIRONMENT AND CONSERVATION, OAK RIDGE, TN, JUSTIN WILSON
PAGE 7 OF 8

COPY

STATE OF TENNESSEE

DON SUNDQUIST
GOVERNOR

December 14, 1995

Secretary Hazel O'Leary
United States Department of Energy
1000 Independence Avenue, S.W.
Room 7A-257
Washington, D.C. 20585

Dear Secretary O'Leary:

Recently, agencies of the State of Tennessee submitted comments in accordance with the requirements of the National Environmental Policy Act (NEPA) for the ***Draft Waste Management Programmatic Environmental Impact Statement (D-PEIS) for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste, DOE/EIS-0200 D, August 1995.*** I have elected to communicate with you directly to insure that the State of Tennessee's policy interests concerning this important D-PEIS are clearly communicated.

My administration strongly opposes and will continue to oppose any attempt by DOE to "site" large waste deposition activities in Oak Ridge, Tennessee. It is disappointing to me that the United States Department of Energy (DOE) continues to seriously consider another short sighted option in a tiring string of waste deposition assessments for Oak Ridge. My administration views all of the alternatives in the current "Waste Management" D-PEIS that consider disposal of low level mixed waste and low level waste on the Oak Ridge Reservation as technically unsound.

It is commonly known, and widely supported inside and outside of Tennessee that Oak Ridge is one of several sites in the DOE complex that does not possess the appropriate geologic or hydrologic character for such large scale waste deposition activities as currently proposed in your D-PEIS. The National Governor's Association/DOE Disposal Working Group specifically recommended that the Oak Ridge complex be considered only for disposal of a very restrictive list of radionuclides due to an emphasis on protection of human health and the environment.

Your own agency's data summary for waste management sites in the current D-PEIS indicates that the Oak Ridge Reservation currently produces the highest "population dose" among the 54 DOE sites around the nation. We believe that a large scale low level mixed waste and low level waste disposal facility at Oak Ridge would add additional risk to an already unacceptable situation.

State Capitol, Nashville, Tennessee 37243-0001
Telephone No. (615) 741-2001

M-177

07 00 00 **Comment Number 18**

A brief summary of the Y–12 EA is provided in Section 1.4 of the PEIS, which includes the results of that analysis, identifying the need for structural upgrades to certain buildings.

09 11 05 **Comment Number 19**

According to the *Oak Ridge Reservation Waste Management Plan* issued January 1996, the High Flux Isotope Reactor pool in Building 7900 has 67 storage positions, of which 62 are presently occupied. The reracking of the storage will increase the number of storage positions to 143. The appropriate section was revised in the Final PEIS to reflect this information.

STATE OF TENNESSEE, DEPARTMENT OF ENVIRONMENT AND CONSERVATION, OAK RIDGE, TN, JUSTIN WILSON
PAGE 8 OF 8

Page Two
Secretary Hazel O'Leary
December 14, 1995

Despite our concerns, the State of Tennessee recognizes and appreciates the historic role Oak Ridge, Tennessee has played for the nation and the economic contributions DOE has made to the Oak Ridge community and Tennessee over the past 50 years. We will continue to promote and will accept our responsibility to the nation as a potential site for one or several of the complex suite of activities that DOE must perform. However, I believe that DOE's continued consideration of the most technically unsuitable disposal site in the DOE complex for large scale waste deposition is truly a waste of precious national and state resources. I urged you to invest your agency's energies in alternatives that better meet both the short and long term interests of waste storage.

Sincerely,

Don Sundquist

Don Sundquist

c: United States Representative Zach Wamp
United States Senator Fred Thompson
United States Senator Bill Frist
Commissioner Don Dills, Tennessee Department of Environment and Conservation
US DOE Headquarters PA Office
Mr. Greg Rudy, Acting Director, Office of Fissile Materials Disposition
NEPA File

STATE OF TEXAS, DEPARTMENT OF HEALTH, AUSTIN, TX,
JOSEPH A. MARTILLOTTI
PAGE 1 OF 3

Texas Department of Health

David R. Smith, M.D.
Commissioner

1100 West 49th Street
Austin, Texas 78756-3199
(512) 458-7111

Radiation Control
(512) 834-6688

Carol S. Daniels
Deputy Commissioner for Programs

Roy L. Hogue
Deputy Commissioner for Administration

May 6, 1996

Mr. J. David Nulton
Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
Washington, D.C. 20026-3786

Dear Mr. Nulton:

Enclosed are comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement. Under the Atomic Energy Act, the Department of Energy is not subject to external regulation of use and handling of Special Nuclear Materials. The Secretary of Energy has committed to determining the feasibility of external regulation by the Nuclear Regulatory Commission (NRC), the Defense Nuclear Facilities Safety Board and/or NRC Agreement States. We believe that some form of external oversight of DOE activities in the Long-Term Storage phase of this project is in the best interest of the Department and stakeholders, and encourage the Department to move ahead with this initiative without delay. 1/15.00.00

Any change in the mission or operations at Pantex resulting from this PEIS must be undertaken with maximum consideration given to full compliance with published standards for protection of the public and environment against the effects of radiation. Future management of Pantex is crucial to the future of the Texas Panhandle, not only in near term socioeconomic terms, but also in fulfilling responsible stewardship of the environment for our successors. Decisions made in this process should be made giving full consideration to the needs of local citizens as well as the nation. 2/01.00.00

We appreciate having been given the opportunity to participate in this process and sincerely hope that our efforts contribute to overall success in resolving the difficult issues.

Sincerely,

Joseph A. Martillotti
Pantex Special Project Coordinator
Division of Compliance and Inspection
Bureau of Radiation Control

F-022

15 00 00 **Comment Number 1**

The Department of Energy is considering the possible external regulation of its activities at this time; however, decisions on these issues are beyond the scope of this PEIS.

01 00 00 **Comment Number 2**

The Department of Energy is committed to operating its facilities in full compliance with applicable regulatory requirements.

STATE OF TEXAS, DEPARTMENT OF HEALTH, AUSTIN, TX, JOSEPH A. MARTILLOTTI
PAGE 2 OF 3

Storage and Disposition
DRAFT PEIS Comments

Summary, Page S-46 - Long-Term Storage Alternatives - The statements concerning land use appear to conflict with Volume II, Pages 4-175 and 4-191 text.	3/09.01.04
Summary, Page S-48 - Comparison of Sites Within Alternatives - The statements concerning environmental impacts do not appear to be supported by the text and appear to be in conflict with Volume II, Pages 4-175 and 4-191 text.	
Summary, Page S-67 - Facility Accidents - The statements do not provide any information or discussion upon which decisions might be based. A discussion of accident assessments previously documented would provide clarification. Volume I, Chapter 1.1.1, Page 1-2 "Materials Covered in This PEIS" describes the base condition and storage configuration from which decisions will be made. Discussion of the Plutonium Working Group findings, Defense Nuclear Facility Safety Board recommendations and the DOE standard for long-term storage of the fissile materials appears to be absent from the text. Provision of a general summary of the identified vulnerabilities or upgrades to storage conditions would be a useful addition to this table.	4/09.00.04
Summary, Page S-78 - Upgrade Existing Facility for Continued Storage - The "estimated impacts from a set of accidents that propagate radioactive releases" data appear to be a replica of Table 2.5.1, Volume I, Page 2-180. This is identical to "Beyond design basis earthquake" data contained in Table 4.2.3.9-4, Volume II, Page 4-160. Table M.5.2.5.2-1, Volume III, Page M-269, presents "Upgrade of Pantex Interim Storage" "Evaluation of a Composite Set of Accidents" impacts which are similar (within order of magnitude) but not totally consistent with the above information.	
Summary, Page S-96 - Consolidate all Pu Material at One Site - The "impacts from a set of accidents that propagate radioactive releases" data appear to be a replica of Table 4.2.4.9-6, Volume II, Page 4-218, "Beyond design basis earthquake" scenario. The Table on Page S-96 replicates Table 2.5.1, Volume I, Page 2-199. However, Table 5.2.1.2-4, Volume III, Page M-242 contains a summary entitled "Evaluation of Composite Set of Accidents" which presents conflicting information.	5/09.09.04
Summary, Page S-117 - Collocation of Pu with HEU Storage Upgrade and/or New Facility - The headers of data columns indicate that the projections reflect a "set of accidents that propagate radioactive releases." The data presented, with the exception of MEI statistics, match exactly with Table 4.2.4.9-7, Volume II, Page 4-222. The table on S-117 replicates Table 2.5-1, Volume I, Page 2-219. Table 5.2.2.2-4, Volume III, Page M-251 "Collocation Alternative" contains a summary entitled "Evaluation of Composite Set of Accidents" which presents conflicting information.	
Summary, Pages 149 and 150 appear to be out of order.	6/16.00.00

F-022

09 01 04 **Comment Number 3**

The Summary has been revised and is now consistent with the land-use impact analysis in Chapter 4 of the Final PEIS (page 4–175 of the Draft PEIS). Volume II, page 4–191 of the Draft PEIS addresses water resources, not land use.

09 00 04 **Comment Number 4**

Based on comments received, the Summary was revised. The bar charts providing the comparison of impacts for both storage and disposition were deleted from the Summary. The related text was revised to clarify the comparison of impacts and to delete references to "adverse" impacts.

09 09 04 **Comment Number 5**

In the Draft PEIS Summary tables (Attachments A and B) and Chapter 2 tables (Tables 2.5–1 and 2.5–2) of the Draft PEIS, the impacts from facility accidents are based on those scenarios that were estimated to have maximum impacts from the facility accidents analyzed for each respective alternative. For example, the number of cancer fatalities for the general population and the probability of the facility accident for Upgrade Alternative at Pantex presented in Attachment A (page S–78) of the Summary of Draft PEIS correspond to the "beyond design basis earthquake" which has the highest cancer fatalities among the accidents analyzed for this storage alternative. On the other hand, the "composite set of accidents" presented in the Section M.5 of the Draft PEIS is the weighted-average of all accidents analyzed for this alternative. To avoid confusion and in response to public comments the "composite set of accidents" has been deleted from Appendix M.

For the MEI, the probability of cancer risk from potential accident during 50 years storage facility operation and the cancer risk from the accident, pages S–78 and 2–181 of the Draft PEIS should correspond to the respective values for the beyond design basis earthquake in Chapter 4 and Section M.5.

The risk from potential accidents is the magnitude of the accident consequence (fatal cancer risk for MEI and non-involved worker and fatal cancers for population) multiplied by the probability that the accident will

occur. The summary tables in Section 2.5 of the Final PEIS present the accident impacts from the accident with highest risk (the product of the accident consequence and the accident frequency) within a storage or disposition alternative.

16 00 00 Comment Number 6

Pages are in correct order.

STATE OF TEXAS, OFFICE OF THE ATTORNEY GENERAL, AUSTIN, TX, ATTORNEY GENERAL DAN MORALES
PAGE 1 OF 2

Office of the Attorney General
State of Texas

DAN MORALES
ATTORNEY GENERAL

May 13, 1996

The Honorable Hazel R. O'Leary
Secretary of Energy
7A257 Forrestal Bldg.
1000 Independence Ave., S.W.
Washington, D.C. 20585

Re: COMMENTS REGARDING FUTURE ACTIVITIES AT PANTEX

Dear Secretary O'Leary:

Upon review of the three interrelated environmental impact statements ("EISs") regarding the reconfiguration and future of the Department of Energy's nuclear weapons complex,[1] I am becoming increasingly concerned that the Department of Energy ("DoE") may soon decide to process plutonium pits at the Pantex facility. I am furthermore concerned--once again--that the Texas Panhandle will become the *de facto* permanent dump for the nation's surplus plutonium supply. Given the 24,000 year half-life of plutonium and the distinct possibility that the environmental, political, and social issues surrounding any other permanent disposition of plutonium will not be resolved in the foreseeable future, this is an ominous development for Texas.

I have attached previous correspondence between DoE and my office dating back to 1991. As is readily apparent from that correspondence, I have long been firmly opposed to both propositions. Unfortunately, it now appears that we are moving closer to decisions by DoE that will unfairly burden Texans during the coming decades and needlessly impose risks on the farmers and ranchers who depend upon the Ogalalla Aquifer underlying Pantex.

A decision by DoE to begin plutonium reprocessing, with its attendant problems and risks for residents throughout the Panhandle, or a decision to store surplus plutonium (*i.e.*, nuclear waste) on a medium- or long-term basis, is unacceptable to this office. Accordingly, I have instructed my staff to renew its efforts to develop all available legal options to prevent DoE from turning the Texas Panhandle into a *de facto* nuclear waste dump, or another Rocky Flats. 1/01.06.00

I realize that you and your office have made great strides in incorporating the concerns of all stakeholders in your decision-making process. For that, you deserve much credit. Unfortunately, I do not believe that the

[1] The three EISs are: (a) the PEIS on Storage and Disposition of Weapons-Usable Fissile Materials (which discusses, *inter alia*, the mixed-oxide fuel option in the most detail and discusses the alternatives, including a facility to cut the pits in two and process them into metal or oxide; to process other types of plutonium; and to mix plutonium with uranium to make mixed oxide fuel (MOX) to be used in nuclear power plants); (b) the Site Wide EIS for Pantex (which discusses the Pit Reuse facilty in lesser detail); and (c) the PEIS on Stockpile Stewardship and Management.

512/463-2100 P.O. BOX 12548 AUSTIN, TEXAS 78711-2548

M-199

01 06 00 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. The utilization of MOX fuel for Pu disposition is not considered reprocessing and is consistent with the President's Nonproliferation Policy. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economical studies, national policy considerations, and public input.

solutions that DOE appears to be adopting solve the environmental and bureaucratic problems associated with storing and/or disposing of plutonium for decades, centuries, and even millennia.

Sincerely,

Dan Morales

Dan Morales
Attorney General

Enclosure

c: DOE-Office of Fissile Materials Disposition
c/o SAIC-PEIS
P.O. Box 23788
Washington, DC 20026-3786

Ms. Nanette Founds
U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, NM 87185-5400

Jay Rose
Office of Reconfiguration
1000 Independence Avenue, S.W.
Washington, D.C. 20585

STATE OF TEXAS, OFFICE OF THE GOVERNOR, AUSTIN, TX, GOVERNOR GEORGE W. BUSH
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STATE OF TEXAS
OFFICE OF THE GOVERNOR

GEORGE W. BUSH
GOVERNOR

May 6, 1996

The Honorable Hazel O'Leary
The Secretary of Energy
U.S. Department of Energy
Washington, D.C. 20585

Re: Comments on Stockpile Stewardship and Management and Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statements

Dear Madam Secretary:

The Pantex Nuclear Weapons Plant has been a key component in our nation's ability to achieve and maintain a strong national defense. The success at Pantex is a result of several factors, including good managers and dedicated, skilled, hard-working, efficient, and safety-conscious employees.

This nation continues to face an uncertain future with many risks. An effective strategy for diminishing those risks is to retain our core of expertise at the Pantex Plant. The Programmatic Environmental Impact Statements now being reviewed demonstrate that such a strategy is the best option for our nation's taxpayers.

1/08.03.01

The Pantex Plant enjoys broad community support because it has successfully demonstrated it can safely carry out its mission of assembling and disassembling nuclear weapons. That history of safety, success, and efficiency is the foundation for the future of the Pantex Plant.

The State of Texas is prepared to continue to assist Pantex with the significant role it plays in keeping the United States the defender of the free world.

Sincerely,

GEORGE W. BUSH

F-024

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

STATE OF TEXAS
OFFICE OF THE GOVERNOR

GEORGE W. BUSH
GOVERNOR

May 6, 1996

The Honorable Hazel O'Leary
Secretary of Energy
U.S. Department of Energy
Washington, D.C.

Dear Madam Secretary:

Enclosed are the comments from those individuals tasked by the State of Texas under the Agreement in Principle to evaluate the Draft Programmatic Environmental Impact Statements regarding Stockpile Stewardship and Management, and Storage and Disposition of Weapons-Usable Fissile Materials.

Pending before you is a request, from the Pantex Plant Citizens' Advisory Board and the Governor's Office, to extend the commenting period on the two documents to July 12, 1996. As was noted in that request, there is simply too much material to adequately review in such a short period of time. 1/08.01.00

Should the May 7, 1996 deadline be extended, the enclosed comments will be amended to include a more detailed and thorough analysis.

Sincerely,

Roger Mulder

ROGER MULDER
Director, Pantex

F-025

08 01 00 **Comment Number 1**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

STATE OF TEXAS, OFFICE OF THE GOVERNOR, AUSTIN, TX, ROGER MULDER
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STATE OF TEXAS
OFFICE OF THE GOVERNOR

GEORGE W. BUSH
GOVERNOR

May 6, 1996

U.S. Department of Energy
Office of Reconfiguration
P.O. Box 3417
Alexandria, Virginia 22302

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, D.C. 20026

Re: Comments on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statements (PEISs).

On behalf of the State of Texas, the Office of the Governor would like to thank you for the opportunity to comment on the U.S. Department of Energy's PEISs on Stockpile Stewardship and Management, and Storage and Disposition of Weapons-Usable Fissile Materials. Because those issues are so closely intertwined with the Pantex Site-Wide EIS, some of my comments may address that document as well.

First and foremost, the State of Texas would like to re-emphasize our insistence that all current and future missions at Pantex be conducted in a safe and environmentally sound manner. Pantex has a long history of being a good neighbor, and one of the primary reasons is because it believes in protecting human health and safety, and the environment.

Based upon a review of all of the PEIS volumes, and statements made during the public hearings in Amarillo by DOE officials on April 22 and 23, 1996, our conclusions were confirmed that all actions considered for Pantex will have no significant impact on the health of workers nor any significant adverse impacts on the environment in the Amarillo area.

P.O. Box 12428 Austin, Texas 78711 (512) 463-2000

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STATE OF TEXAS, OFFICE OF THE GOVERNOR, AUSTIN, TX,
ROGER MULDER
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DOE PEIS Comments
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Page Two

However, as stated numerous times in the public hearings, there is concern that this statement of no significant impact is not clear in the summary document of the Storage and Disposition PEIS.

Instead, what is stated numerous times is: "Adverse impacts to water resources at Pantex would result from the continued local draw down of the Ogallala Aquifer, but Pantex's contribution to this draw down is expected to continue to decrease due to a decrease in other DOE activities at Pantex. Neither surface or ground water resources at other DOE sites would be affected."

2/09.04.04

The State of Texas believes this statement inaccurately and incorrectly singles out Pantex as an unacceptable site for its existing mission, as well as for any future missions. We ask that this be corrected immediately.

In reference to the statements regarding adverse impacts, the Amarillo community was told by DOE officials during the public hearings that there were no significant impacts on the environment, safety, or health from current or future missions proposed at Pantex. Therefore, the inaccurate perception of adverse affects, noted in the summary S&D document, should be corrected in the final document.

Toward that end, the State of Texas requests that in the S&D PEIS summary document, a clear statement should be added that no significant environmental impact would result from any considered alternatives at Pantex. In addition, the ranking of sites based upon these insignificant impacts (found in the sections Long-Term Storage Alternatives (page S-46), Disposition Alternatives (page S-46), and Comparison of Sites Within Alternatives (page S-48)) should be removed from the final report.

3/09.00.08

If the DOE insists upon using the word *adverse* in the final document to denote any deviation from the "natural state" of the environment, it should be applied equitably among all sites and quantified with the level of significance, since any action that disturbs nature could be considered adverse and every site considered would have adverse impacts for all alternatives.

4/09.00.08

The State of Texas is pleased that DOE selected Pantex as the preferred alternative for assembly/disassembly, thereby abandoning earlier plans to transfer those functions to the Nevada Test Site.

F-025

09 04 04 **Comment Number 2**

Although Pantex is contributing to the depletion of the Ogallala Aquifer, additional groundwater drawdowns from the Proposed Actions for the various long-term storage alternatives are expected to be very small. The Summary was revised to emphasize that, under the No Action Alternative, Pantex's water use from the Ogallala Aquifer is expected to decrease significantly by the year 2005, and that additional withdrawals attributed to the Preferred Alternative are still expected to be less than what is currently being withdrawn.

09 00 08 **Comment Number 3**

The Department of Energy did not intend to give the perception that the sites were ranked. Based on comments received, the Summary of the Draft PEIS was revised. All revisions made to the PEIS text appear in the Summary of the Final PEIS.

09 00 08 **Comment Number 4**

Based on comments received, the Summary was revised. The related text was revised to clarify the comparison of impacts and to delete reference to "adverse" impacts.

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Page Three

The same factors that lead DOE to make the correct decision in assembly/disassembly activities, should be applied to the issue of moving the High Explosives production operations from Pantex. DOE's own estimate that such a move would cost at least $40-$50 million should make Pantex the only choice for those activities.

Another factor is the risk involved in transporting the material from Pantex. And finally, there is a significant technology risk, should the High Explosives production program leave Pantex, while the highly skilled, experienced workers choose to remain in the Amarillo area.

If the statement is made that there simply is not enough work to keep workers busy in both the New Mexico labs and Pantex, the obvious choice is to keep the work at Pantex and allow the lab personnel the opportunity to maintain their proficiency by visiting Pantex.

Since that work is done at Pantex today, how are the lab personnel currently maintaining the desired level of proficiency?

STORAGE OPTIONS

Pantex has a proven history of safely storing nuclear weapons over the past 40 years.

Pantex could continue to store plutonium which is already at the site and upgrade facilities for the storage options being considered by DOE with minimal cost and difficulty. Pantex currently safely houses more than 8,000 surplus pits. It makes little sense to re-create storage facilities at another site and then unnecessarily transport large amounts of plutonium across the country from Pantex. 5/08.03.01

Pantex has the necessary safety, security, and surveillance capabilities to accommodate an expanded role with minimal costs and it is the production site closest to Los Alamos, the planned pit fabrication site.

F-025

08 03 01 Comment Number 5

The Department of Energy acknowledges the commentor's support for the Upgrade Storage Alternative. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

DOE PEIS Comments
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Page Four

We believe any future missions at Pantex related to plutonium can be successfully carried out, provided the following three criteria are met:

1. Continued Local Support
2. Proven Technology
3. Independent Overhight

OFF-LINE ISSUES

During the public hearings in Amarillo, a number of comments were made from the audience requiring clarification from the DOE presenters.

Unfortunately, on more than one occasion, the response from the DOE official was that he and the questioner should "discuss that issue off-line."

Because the State of Texas believes that to be a totally inappropriate and unacceptable response to make, especially at a public hearing called for the sole purpose of discussing the issues contained in the PEISs, I attempted to capture as many of those questions in writing as possible.

STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS PEIS ISSUES

Comment:

Section 1502.1 of 40 CFR Parts 1500-1508, the regulations implementing the National Environmental Policy Act, states:

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STATE OF TEXAS, OFFICE OF THE GOVERNOR, AUSTIN, TX,
ROGER MULDER
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"The primary purpose of an environmental impact statement is to serve as an action-forcing device to ensure that the policies and goals defined in the Act are infused into the ongoing programs and actions of the Federal Government. It should provide full and fair discussion of significant environmental impacts and shall inform decision-makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment. Agencies shall focus on significant environmental issues. . . Statements shall be concise, clear and to the point, and shall be supported by evidence that the agency has made the necessary environmental analyses." (Emphasis added)

Question

In light of these very clear and concise instructions based in law, how does DOE rationalize that Pantex is identified as having: | 6/09.00.04

"the greatest potential to experience adverse cumulative impacts, particularly because of its relatively small, compact area. Water resources and biological resources would be vulnerable, and land resources . . . could be susceptible to adverse cumulative impacts " (p. S-46) (Emphasis added)

Comment

The Summary discusses three plutonium disposition categories (deep borehole, immobilization and reactor) consisting of nine alternatives, and ultimate high-level waste disposition.

Questions:

a. If the immobilization alternatives and reactor alternatives (except CANDU) result in the same ultimate disposition, i.e. a high-level waste repository, what is the cost/benefit of the reactor alternatives? | 7/07.02.00

b. Are the references to a high-level waste repository referring to DOE's Yucca Mountain project in Nevada? | 8/12.01.00

c. What would constitute ultimate disposition in the case of the CANDU reactor alternative? Would the Canadians be allowed to send the resultant high-level nuclear waste back to the U.S.? | 9/06.05.08

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09 00 04 **Comment Number 6**

Based on comments received, the Summary of the Draft PEIS was revised. There was no intention to portray Pantex, the Pantex region, or the Texas Panhandle region in a negative fashion. Each DOE site was analyzed and studied in the same manner and presented in the Draft PEIS per these analyses and studies. All revisions made to the PEIS text are reflected in the Summary of the Final PEIS.

07 02 00 **Comment Number 7**

Cost data, along with technical and schedule data, were provided in a Technical Summary Report for disposition beginning in late July 1996.

12 01 00 **Comment Number 8**

The Draft PEIS does not assume the use of Yucca Mountain as a HLW repository for disposal of MOX spent nuclear fuel and/or immobilized materials. However, since Congress directed Yucca Mountain to be the only site considered for evaluation (site characterization) for the disposition of spent nuclear fuel and HLW, data developed to date at this site has been used to evaluate the potential for disposing of surplus weapons-usable Pu.

06 05 08 **Comment Number 9**

No. The spent fuel would be retained within the Canadian spent fuel program.

DOE PEIS Comments
May 6, 1996
Page Six

Comment

The oft-repeated phrase appears in the Summary:

"Potential adverse intersite transportation impacts related to all DOE sites could occur because of the increased risk of traffic accident fatalities." | 10/10.00.00

Question:

Does any other site, except Pantex, have the capability to avoid the problem of having to ship the 21.8 metric tons of plutonium declared surplus by the President, since the material is already at Pantex? | 11/10.00.00

Is there no risk to human health associated with intersite transportation of radioactive materials? Has a dose risk assessment been made? | 10/10.00.00 cont.

Comment

In the Storage and Disposition Summary it is stated (page S-20) that "Potential adverse impacts to waste management would occur at Pantex, ORR (all three options), and SRS, because the construction of sanitary, utility, and process waste water treatment systems to treat non hazardous liquid wastes may be required." | 12/09.11.08

Question

How can the construction of facilities and systems to treat waste have the potential to adversely impact the *management* of waste? Is this a significant environmental impact as intended by Section 1502.1 of the NEPA regulations?

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10 00 00 Comment Number 10

The human health risks of material transportations associated with the proposed Pu storage and disposition alternatives are evaluated and presented in Section 4.4 of this PEIS. The more detailed description of the methodology and supporting data for the analysis is presented in Appendix G. Transportation of radioactive materials between sites includes health risks for both normal operations and accident conditions to the public and workers.

10 00 00 Comment Number 11

The Pu material at Pantex, as well as Pu and HEU at the other five sites, was assumed to be present for the transportation analysis. For the storage alternatives, Table 4.4.3.2–2 of the PEIS indicates Pantex would have the lowest number of potential fatalities. For disposition, almost all surplus pits were assumed to be at Pantex. This is indicated by Pantex having the lowest number of potential fatalities for pit disassembly in Table 4.4.3.3–1 of this PEIS.

09 11 08 Comment Number 12

The conceptual design for the consolidated and collocated storage facilities and the disposition facilities have, as part of their design, waste management facilities that would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with RCRA and other applicable Federal and State statutes and DOE Orders. The impacts of having to construct the waste management facilities are captured in other resource areas such as land use and air quality. The text referring to "potential adverse impacts" to waste management has been deleted.

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ROGER MULDER
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Page Seven

Comment

In Volume III of the Storage and Disposition PEIS (pp. M-131 through M-155), the chemicals used are as follows:

Hanford reports 3 chemicals, none with slope factors
NTS reports NO chemicals
INEL reports 28 chemicals, 12 with slope factors
Pantex reports 25 chemicals, 6 with slope factors
ORR reports 10 chemicals, none with slope factors
SRS reports 15 chemicals, 5 with slope factors
Rocky Flats reports 10 chemicals, 3 with slope factors. 13/09.10.08

These reported chemical usages present an erroneous comparison, as all sites under consideration will use similar chemicals. For example, benzene is a combustion product of both diesel fuel and gasoline, and would be common to all sites.

Question:

Was the manner by which the information was requested not specific enough to ensure accurate reporting or are the records at some sites incomplete? Please correct.

Comment

In the Summary (p. S-46), it is stated that "When the other DOE programs previously identified in this section are considered, the rank order of DOE sites in terms of their descending potential for cumulative impacts changes to SRS, INEL, Pantex, NTS, Hanford and ORR." A similar statement appears on p. S-47. 14/09.00.08

Question

What does this statement mean? It is obscure and demands an explanation that is concise, clear, and supported by evidence.

F-025

09 10 08 Comment Number 13

The data calls sent to each site contained the same information and requests. Under the No Action Alternative, the emissions data is from existing site facilities. Since each site has different existing facilities and operations, the chemicals emitted from these facilities are expected to be different. The cancer risk slope factors purely depend on the nature of the chemicals. For proposed new actions, the emissions data would be very similar among the sites. For detailed information on the emission data on each site, please refer to the respective data reports cited in the PEIS.

09 00 08 Comment Number 14

The Department of Energy did not intend to give the perception that the sites were ranked. Based on comments received, the Summary of the Draft PEIS was revised. All revisions made to the PEIS text appear in the Summary of the Final PEIS.

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Page Eight

STOCKPILE STEWARDSHIP AND MANAGEMENT PEIS ISSUES

Comment

Separation of the explosive fabrication and assembly/disassembly missions would require that explosives be transported over long distances in order to be mated with the physics packages. In the case of LLNL, the extensive winter fogs of the San Joaquin Valley that create near zero visibility, sometimes for weeks-on-end, should be considered in any safety analysis.

Question:

a. Has an analysis been made of the additional hazards of transportation of HE from either of the national laboratories to where it would be used?

b. What would be the increased costs of intersite transportation?

Comment: 15/15.00.00

NTS workers and their families associated with the 2,253 new jobs (SSM Summary p. S-32) would likely reside in Las Vegas, NV, which is one of the fastest growing areas in the country.

Question:

Has an analysis been made of the impact of these additional residents on the Las Vegas municipal water supply?

Comment:

The preferred alternative for the location of explosives development has not yet been determined. Moving HE production from Pantex to one of the laboratories is under consideration. Note that there have been attempts to develop the land right next to LLNL's Site 300 fence for new housing.

F-025

15 00 00 Comment Number 15

These comments were forwarded to the Stockpile Stewardship and Management Program for consideration in the Stockpile Stewardship and Management PEIS.

STATE OF TEXAS, OFFICE OF THE GOVERNOR, AUSTIN, TX,
ROGER MULDER
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May 6, 1996
Page Nine

Question:

a. If the operation is moved to either LLNL or LANL, where would the building be placed and the testing be done?

b. What is the current and projected land use around LANL and LLNL (particularly, Site 300)?

15/15.00.00 cont.

A number of questions were also raised during the April 22-25 hearings in Amarillo that were addressed specifically to the Pantex Site-Wide EIS. Those questions will be included when the State issues its comments on that document.

If you have any questions or need additional information, please write or call me at 512/463-2198.

Sincerely,

Roger Mulder

ROGER MULDER
Director, Pantex

F-025

Support Material

The major impact areas covered by the S&D PEIS focus on water, air, and land resources. Pantex was named 3 times with air impacts, 4 times with land impacts, 6 times with waste impacts, and at least 11 times with ADVERSE water resource impacts. The statements about air and land impacts may be reasonable because at least one other site was mentioned with similar impacts (i.e. Pantex was not singled out to a large extreme. However a more accurate picture would result if DOE stated that these impacts are not significant). The most inaccurate representation in the summary is the discussion of adverse water resource impact, for which Pantex was incorrectly singled out at least 11 times above the other sites. Details are provided below.

Water Resources

- Water Availability:

All comparisons on water resources were made relative to the NO ACTION ALTERNATIVE for each site, with no absolute basis among sites, and always expressed as a percentage of the NO ACTION ALTERNATIVE. Without an absolute basis among sites to ascertain the "true impact on the environment", no rank ordering of sites or preferred alternatives based upon environmental impact can be justified. However, contrary to logic, this was done in the sections titled *Long-Term Storage Alternatives* (page S-46), *Disposition Alternatives* (page S-46), and *Comparison of Sites Within Alternatives* (page S-48).

To make this point clear, for a site that has worked to conserve water in the past, and which has a small water demand, the percentage increase due to any increase in construction or operation activity are disproportionately large relative to a site which has not applied water conservation techniques and which has a large water usage at the NO ACTION ALTERNATIVE (see item #1 below). On the percentage basis used relative only to the NO ACTION ALTERNATIVE, sites which apply conservation techniques are unfairly singled out. 16/09.04.08

Second, relating everything to the NO ACTION ALTERNATIVE without an absolute basis, implies that the current water demand significantly impacts the available supply or is a significant part of the demand of the local community such that a large percentage increase in water demand detrimentally affects the amount of water available for the local community (i.e. farmers and ranchers). Contrary to that implication in the summary, the impact of any of these activities on the Amarillo area water consumption would be less than 1% (see item #2 below).

F-025

09 04 08 Comment Number 16

The use of percentage increases is simply a tool to put the additional water requirements in perspective to the ongoing, or No Action, usage at the sites. The impacts are based on the ability of the local water supply to support the requirements of the site and the Proposed Action, regardless of how large the percentage increase is. If a site's water requirements would affect the local water supply, this would be clearly stated in the PEIS. For example, at Hanford, the Columbia River is a particularly abundant water supply. If Hanford increased its water usage by several thousand percent, the effect on the availability of Columbia River water would be minimal. This would be reflected in the PEIS analysis. Conversely, Pantex is the only DOE site under consideration in this PEIS where water availability is a concern. Pantex's contribution to the depletion of the Ogallala Aquifer must be analyzed; any contribution to this depletion does affect the water resources of the area. However, for the storage alternatives, the impact to water resources at Pantex is expected to be minimal. The Summary of the Final PEIS was revised to indicate that Pantex's No Action (year 2005) water usage is considerably less than what is currently being withdrawn, and that minor impacts to water resources are expected from the various storage alternatives and the Preferred Alternative.

In regard to water conservation techniques, sites that apply these measures are generally ones where water supply may be a limiting factor. Sites having an abundant water supply do not necessitate water conservation techniques.

STATE OF TEXAS, OFFICE OF THE GOVERNOR, AUSTIN, TX, ROGER MULDER

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To put this issue in perspective, the baseline (NO ACTION ALTERNATIVE) water consumptions are summarized below taken from the Summary S&D PEIS in million liters per year (MLY) focused only on the ground water component:

NO ACTION ALTERNATIVE (MLY)

Hanford	NTS	INEL	Pantex	Oak Ridge	SRS	RFETS
13,511	2,400	7,570	249*	14,760	13,247	439

* note the water use at Pantex for 1994 was 836 MLY and is "expected" to decrease to 249 MLY by 2006 due to drawdown (a small baseline made smaller). Ref: Vol II, p 4-187.

Item #1: The PEIS quotes increases in ground water usage for Pantex for the various alternatives from 2.6% to 44.2% above the NO ACTION ALTERNATIVE (this percentage increase is based upon the projected baseline of 249 MLY for the year 2005, a decrease from the current use rate of 836 MLY). Taken out of context, these numbers seem extreme. Indeed, these percentages were incorrectly brought forward in the word summary using this statement repeatedly: *"Adverse impacts to water resources at Pantex would result from the continued local drawdown of the Ogallala Aquifer, but Pantex's contribution to this drawdown is expected to continue to decrease due to a decrease in other DOE activities at Pantex. Neither surface or ground water resources at other DOE sites would be affected."* This causes the inaccurate perception that the large projected percentage increase in water use would be detrimental to the welfare of the local community. This might have been true if indeed the absolute demand placed on the available resources was significant. But, the maximum estimated increase is less than 1% of the water use in the area and a 44% increase of 1% is only 0.4% absolute increase (and this was based upon the 2005 projection, relative to current operations it would be a 57% decrease in water usage).

Item #2 (Ref: Vol 1, p 3-159 to 3-162):

- A: In 1994 while Pantex was drawing 836 MLY (836×10^6 L), the city of Amarillo pumped 23.9 BLY (23.9×10^9 L), from the Carson County well field. Using the PEIS number of 249 MLY in 2005, this equates to about 1% of the Town's water use. If water pumped directly by agriculture (which does not go through the Amarillo's water plant) were included this figure the relative demand by Pantex on the water drawn from the Ogallala Aquifer would be well below 1%.
- B: The recoverable water volume in storage and available for use in the Ogallala Aquifer in the High Plains Aquifer system is estimated at 5.15×10^{14} L. At this rate, if Pantex were operated for 1000 years using the highest water demand of all alternatives (Collocation - 379 MLY), Pantex would use less than 7/100% of the available water.

In summary, the repeated statements of adverse impacts on groundwater resources for any and all alternatives is based upon an inaccurate reference point and the actual impact brought out in the draft summary has no basis. To satisfy the requirement to make comparisons of water usage against the no action alternative, we suggest that the no action alternative be place on a percentage basis of actual area water usage to allow for an equitable and objective comparison between sites. For any sites where this percentage increase is insignificant, the PEIS and its Summary should state that fact clearly.

16/09.04.08 cont.

F-025

STATE OF TEXAS, OFFICE OF THE LIEUTENANT GOVERNOR, AUSTIN, TX, LIEUTENANT GOVERNOR BOB BULLOCK
PAGE 1 OF 6

Bob Bullock
Lieutenant Governor of Texas
President, Texas Senate

The Capitol
Austin, Texas 78711-2068
(512) 463-0001

1-800-441-0575
(512) 475-5758 TDD

March 28, 1996

The Honorable Hazel O'Leary
Secretary of Energy
c/o Mr. Bruce G. Twining
U.S. Department of Energy
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

Dear Madam Secretary:

It has come to my attention that you are scheduled to hold public hearings in Amarillo on April 22 and 23, regarding the future role of the Pantex facility located in Amarillo, Texas.

The people of Pantex and the Amarillo area have for decades made an invaluable contribution to the security of our nation. Texas and the communities in that area have long provided strong public and political support, as opposed to the hostile environment that faced other nuclear facilities in the past.

Even though the threat of war has lessened, we cannot afford to relax our defense policies. By maintaining our nuclear superiority, we can assure the safety of our country. Consequently, maintaining what has been achieved through the work and dedication of the people of Pantex is as important today, and for the future, as it was in recent decades.

1/08.03.01

While Pantex is important to the economy of Texas and the Amarillo area, the federal government also benefits from this arrangement. Economically, the existence of Pantex is in the best interest of the federal government and the taxpayers who support it. Pantex is already established as a first-rate facility and is willing and able to accommodate any new functions which may be assigned to it. Give us the task, and we will keep getting it done.

By any measure, Pantex is the best choice for the present and future nuclear needs of our country.

Sincerely,

BOB BULLOCK
Lieutenant Governor

BB:sde

cc: U.S. Department of Energy, Office of Reconfiguration
U.S. Department of Energy, Office of Fissile Materials

M-005

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

STATE OF TEXAS, OFFICE OF THE LIEUTENANT GOVERNOR, AUSTIN, TX, LIEUTENANT GOVERNOR BOB BULLOCK
PAGE 2 OF 6

LAW OFFICES OF RANDALL H. ERBEN
807 Brazos, Suite 402
Austin, Texas 78701
(512) 472-1682
FAX (512) 477-9029

RANDALL H. ERBEN

Tony - Governor Bullock wrote a similar letter last year (see enclosed) for a similar hearing. I'd be grateful if you'd consider doing something like this 8/95 letter, or this one. Thanks - call if you have questions.

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le Stewardship and
D), and is planning
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Pantex site-specific
es in the other EIS

these questions, and the hearing thereon, are critical for the future of Pantex. While the Draft of the SSM PEIS has abandoned DOE's plan to transfer all weapons-related functions *from* Pantex *to* the Nevada Test Site and the national laboratories, Pantex is expected to lose more than half its workforce beginning in 1998 under contemplated downsizing of the plant. This is possible in spite of the fact that Pantex is by far the most cost-effective site for these functions and makes the most sense from a national security perspective to maintain our nuclear deterrent.

The process which DOE is undergoing is akin to base closures. While we are playing a "less-than-zero-sum-game"; the pie is shrinking, and continued "phase-out" of Pantex and many of its 3,500 jobs is a still a *very realistic option* unless we position Pantex both to (1) retain as much of the stewardship and management activities as possible (e.g. high explosives fabrication) and (2) become the focal point of the transition from military applications to "civilian" stewardship of special nuclear materials, as well as other new missions. Also at stake is the new Amarillo National Resource Center for Plutonium (ANRCP), operated by The Texas A&M University System, Texas Tech University, and The University of Texas System, on behalf of the State of Texas.

The first step in defending Pantex from significant and unwarranted downsizing is participation at the April 22 and 23 public hearings. Therefore, I would request that you seriously consider presenting oral and/or written comments at the upcoming DOE hearings. On these dates, DOE will conduct joint meetings to receive public testimony

M-005

and comments at the Radisson Inn Amarillo Airport, 7909 I H 40 East at Lakeside, Amarillo 79104. The workshop format of this meeting (which is different from the more formal hearings used in the past by DOE) has the stated purpose of allowing the public to interact directly and exchange information with DOE representatives.

Because of this alteration from prior practice, formal oral testimony will probably not be accepted (though your attendance and participation in the discussions would be appreciated and DOE would certainly make any necessary arrangements to ensure you had an opportunity to make a statement). Accordingly, making the submission of formal written testimony is the best (and most time-efficient) avenue for expression of your views. Written testimony should be sent to.

For SSM: U.S. Department of Energy
Office of Reconfiguration
P.O. Box 3417
Alexandria, Virginia 22302

For S&D: U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, DC 20026

Comments must be received prior to May 7, 1996.

For your convenience, I have enclosed some material to assist you in the preparation of your testimony. The enclosed text is appropriate for both environmental impact statements. Therefore, a convenient solution would be to draft a letter to both offices (using dual addresses) and mailing an identical letter to both. If you desire, you can forward me your letter and I would be happy to send it to both offices if that is more convenient. I am happy to assist in the submission of your comments and with further briefing materials to help in the drafting of any testimony.

Please call me if you have questions, desire assistance with arrangements to attend any of these events, or to testify or submit comments for the April 22nd and 23rd hearings. If you do plan to attend, I would be happy to also assist in making arrangements with DOE to ensure you are recognized for an oral statement at a time convenient to you. Thank you for your interest.

Best regards,

Randall H. Erben

Enclosures

M-005

STATE OF TEXAS, OFFICE OF THE LIEUTENANT GOVERNOR, AUSTIN, TX, LIEUTENANT GOVERNOR BOB BULLOCK
PAGE 4 OF 6

People™ brand fax transmittal memo 7671 | # of pages ▸ 1

To Randy Erben	To Steve Brenner
Co.	Co.
Dept.	Phone #
Fax # 477-9029	Fax # 463-0039

Bob Bullock
Lieutenant Governor of Texas
President, Texas Senate

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(512) 475-3758 TDD

August 8, 1995

The Honorable Hazel R. O'Leary
Secretary of Energy
c/o Mr. Stephen M. Schinki
U.S. Department of Energy
P.O. Box 3417
Alexandria, Virginia 22302

Dear Madam Secretary:

The Department of Energy is in the process of determining the future role of the Pantex facility located in Amarillo, Texas.

The people of Pantex and the Amarillo area have for decades made an invaluable contribution to the security of our nation. Texas and the communities in that area have long provided strong public and political support, as opposed to the hostile environment that faced other nuclear facilities in the past.

Pantex and its people did their jobs when achieving peace through strength and avoiding war on an unprecedented scale were the nation's top priorities. Maintaining what has been achieved through the work and dedication of the people of Pantex is every bit as important in this post-Cold War era as our defense objectives of recent decades.

It would be strange indeed if Pantex was to be abandoned when its mission is, so to speak, only half completed.

Yes, keeping Pantex is in the economic interest of Texas. But, keeping future nuclear weapons programs at Pantex is also in the best interest of the federal government and the taxpayers who support it. Others have and will argue the numbers supporting Pantex. I want to emphasize that the people of Texas and the Amarillo area are cleverly focused on and accepting of the nation's need for Pantex and its continuing mission. Give us the task, and we will keep getting it done.

By any measure the wisest choice for the Department's Stockpile Stewardship and Management Program is Pantex.

Sincerely,

BOB BULLOCK
Lieutenant Governor

BB:nbm

bcc: Mr. Randy Erben

M-005

DRAFT

April __, 1996

U.S. Department of Energy
Office of Reconfiguration
P.O. Box 3417
Alexandria, VA 22302

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, DC 20026

Re: Comment on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statements (PEISs).

Thank you for the opportunity to comment on the U.S. Department of Energy's (DOE) Programmatic Environmental Impact Statements (PEISs) on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials. Please also consider this my comment on the Pantex Site-Wide Draft Environmental Impact Statement, since most of the issues addressed in these documents are identical.

First and foremost, I am adamant that any current and future functions at Pantex will be conducted in a safe and environmentally sound manner. Our first priority is to ensure any expansion at Pantex be implemented in a way that does not impair the health or safety of area residents or have an adverse affect on the environment. These goals serve as a prerequisite to any current or future activities at Pantex, including expansion.

I. Generality. I am pleased that DOE selected Pantex as the preferred alternative for assembly/disassembly, thereby abandoning earlier plans to transfer those functions to the Nevada Test Site (NTS) which would have been cost prohibitive and never been adequate to meet future needs. However, by failing to recognize Pantex as the preferred candidate site for new and/or consolidated stockpile management facilities, the DOE overlooks the best site for maintaining the integrity of the U.S. nuclear stockpile and attaining maximum efficiencies and cost savings.

II. SSM PEIS:

1. Pantex is the best place to site new construction/stewardship activities. Pantex is perhaps the most cost-effective alternative for any new construction of SSM facilities. First, labor costs, utility rates, and water and land availability at Pantex, as well as public and political support, are more amenable than those at any other Complex site. It is appropriate to consider Pantex as an alternative site for all future defense-related facilities to complement activities at the national labs (such as the planned Atlas Facility and plutonium pit fabrication site at Los Alamos National Laboratory [LANL]). DOE makes no mention of a strategic plutonium reserve that is necessary to meet future national security needs, even though the PEIS mentions that strategic storage should be co-located with disassembly. Pantex should be the preferred site for such a mission in coordination with its management functions. The location of additional defense-related

M-005

activities at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost to the American people. In its deliberations, *DOE should insist that budgetary comparisons between Pantex and other sites are accurate, and include capital, transportation, training, remediation, and other costs.*

2. Pantex is the best site to continue High Explosives fabrication. Consistent with the strengths identified above for increased stewardship and management duties, the high explosives (HE) functions should also remain at Pantex. Because the production assembly/disassembly functions remain at Pantex, the HE fabrications duties should be present at the corresponding site. After all, the SSM Draft admits that Pantex must retain HE capabilities to process the inventories already on site from dismantling. Therefore, the least expensive alternative is to maintain HE functions at Pantex. I adamantly disagree with the statement in the draft PEIS that there are no advantages to siting high explosives at Pantex as opposed to the national labs. The capital outlay alone necessary for transfer is cost prohibitive. In addition, should future need arise for new weapons production, it will be critical to have the HE facilities at the weapons production/assembly site.

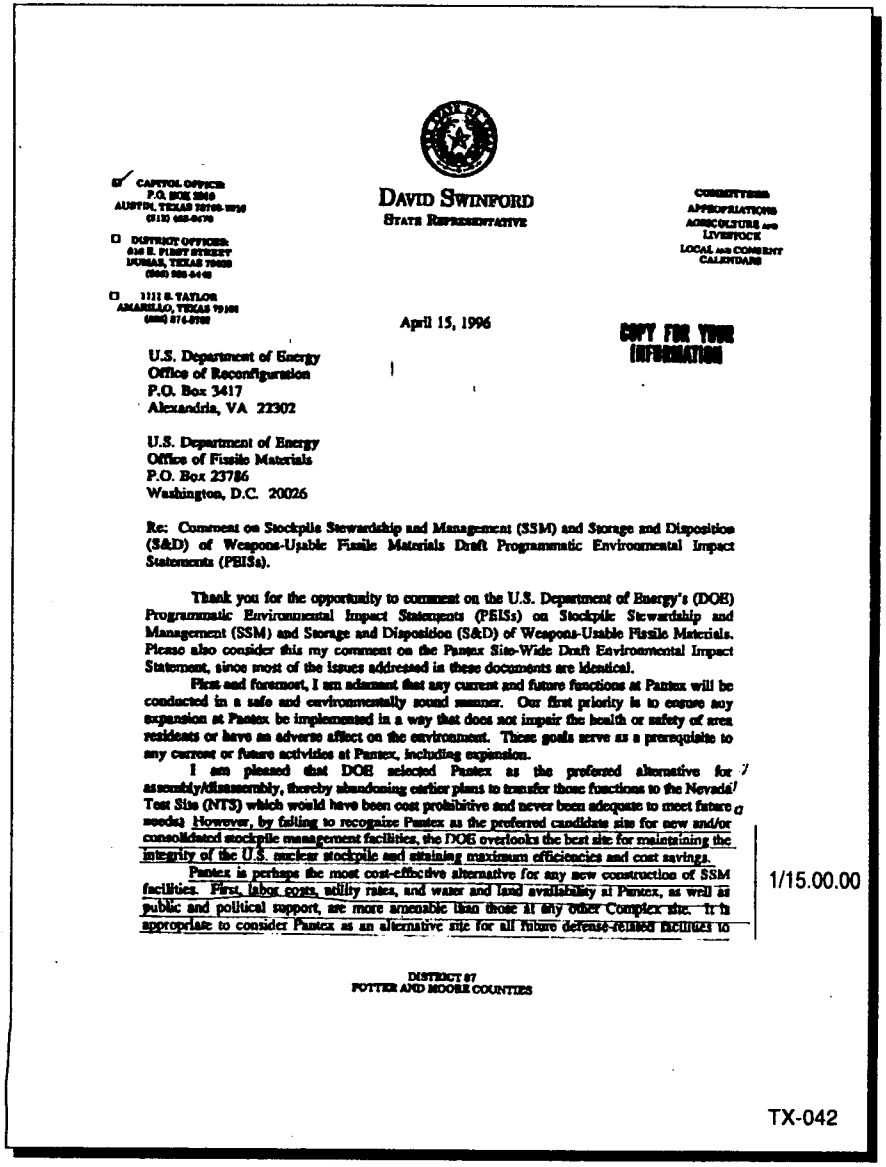
III. Fissile Materials (Plutonium) Storage and Disposition PEIS. As the sole DOE-authorized facility for assembly and disassembly of nuclear weapons, Pantex has historically handled these functions in a safe an efficient manner for more than 40 years. One of the challenges faced after dismantling a significant portion of the nuclear stockpile is processing or disposal with the materials that remain. The DOE is considering several options. Once again, acknowledging cost savings considerations, Pantex could continue to store plutonium which is already at the site and upgrade facilities for any and all storage options being considered by DOE with minimal cost and difficulty. Pantex currently safehouses more than 8,000 surplus pits and plans are being made to ship additional pits from Rocky Flats to Pantex. It makes little sense to re-create storage facilities at another site and then unnecessarily transport large amounts of plutonium across the country from Pantex. The budgetary and political costs for such a decision would be enormous. Because of these costs, Pantex also should be designated the preferred site for any disposition options and related functions. It makes budgetary and policy sense to site disposition where storage already exists. Furthermore, it makes no sense from any perspective, budget or otherwise, to site strategic storage at one site and surplus at another. Pantex should be selected for both storage functions. Pantex has the necessary safety, security, and surveillance capabilities to accommodate an expanded role with minimal costs and it is the production site closest to Los Alamos, the planned pit fabrication site.

IV. Conclusion. Based upon these reasons, I respectfully urge DOE to designate Pantex as the preferred alternative site for all existing and new stockpile management and stewardship functions as well as consolidation of all plutonium storage and disposition and any related functions. Thank you for the opportunity to comment on these documents.

Yours truly,

M-005

STATE OF TEXAS, STATE REPRESENTATIVE, AUSTIN, TX, DAVID SWINFORD
PAGE 1 OF 2



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DAVID SWINFORD
STATE REPRESENTATIVE

COMMITTEES
APPROPRIATIONS
AGRICULTURE AND LIVESTOCK
LOCAL AND CONSENT CALENDARS

April 15, 1996

COPY FOR YOUR INFORMATION

U.S. Department of Energy
Office of Reconfiguration
P.O. Box 3417
Alexandria, VA 22302

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, D.C. 20026

Re: Comment on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statements (PEISs).

Thank you for the opportunity to comment on the U.S. Department of Energy's (DOE) Programmatic Environmental Impact Statements (PEISs) on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials. Please also consider this my comment on the Pantex Site-Wide Draft Environmental Impact Statement, since most of the issues addressed in these documents are identical.

First and foremost, I am adamant that any current and future functions at Pantex will be conducted in a safe and environmentally sound manner. Our first priority is to ensure any expansion at Pantex be implemented in a way that does not impair the health or safety of area residents or have an adverse affect on the environment. These goals serve as a prerequisite to any current or future activities at Pantex, including expansion.

I am pleased that DOE selected Pantex as the preferred alternative for assembly/disassembly, thereby abandoning earlier plans to transfer those functions to the Nevada Test Site (NTS) which would have been cost prohibitive and never been adequate to meet future needs. However, by failing to recognize Pantex as the preferred candidate site for new and/or consolidated stockpile management facilities, the DOE overlooks the best site for maintaining the integrity of the U.S. nuclear stockpile and attaining maximum efficiencies and cost savings.

Pantex is perhaps the most cost-effective alternative for any new construction of SSM facilities. First, labor costs, utility rates, and water and land availability at Pantex, as well as public and political support, are more amenable than those at any other Complex site. It is appropriate to consider Pantex as an alternative site for all future defense-related facilities to

1/15.00.00

DISTRICT 87
POTTER AND MOORE COUNTIES

TX-042

15 00 00 **Comment Number 1**

These comments were forwarded to the Stockpile Stewardship and Management Program for consideration in the Stockpile Stewardship and Management PEIS.

STATE OF TEXAS, STATE REPRESENTATIVE, AUSTIN, TX, DAVID SWINFORD
PAGE 2 OF 2

complement activities at the national labs (such as the planned Atlas Facility and plutonium pit fabrication site at Los Alamos National Laboratory. Doe makes no mention of a strategic plutonium reserve that is necessary to meet future national security needs, even though the PEIS mentions that strategic storage should be co-located with disassembly. Pantex should be the preferred site for such a mission in coordination with its management functions. The location of additional defense-related activities at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost to the American people. In its deliberations, DOE should insist that budgetary comparisons between Pantex and other site are accurate, and include capital, transportation, training, remediation and other costs.

Consistent with the strengths identified above for increased stewardship and management duties, the high explosives functions should also remain at Pantex. Because the production assembly/disassembly functions remain at Pantex, the high explosives fabrications duties should be present at the corresponding site. After all, the SSM Draft admits that Pantex must retain High explosives capabilities to process the inventories already on site from dismantling. Therefore, the least expensive alternative is to maintain these functions at Pantex. I adamantly disagree with the statement in the draft PEIS that there are no advantages to siting high explosives at Pantex as opposed to the national labs. The capital outlay alone necessary for transfer is cost prohibitive. In addition, should future need arise for new weapons production, it will be critical to have the high explosives facilities at the weapons production assembly/disassembly site.

As the sole DOE-authorized facility for assembly and disassembly of nuclear weapons, Pantex has historically handled these functions in a safe an efficient manner for more than 40 years. One of the challenges faced after dismantling a significant portion of the nuclear stockpile is proce..sing or disposal with the materials that remain. The DOE is considering several options. Once again, acknowledging cost savings considerations, Pantex could continue to store plutonium which is already at the site and upgrade facilities for any and all storage options being considered by DOE with minimal cost and difficulty. Pantex currently safehouses more than 8,000 surplus pits and plans are being made to ship additional pits from Rocky Flats to Pantex. It makes little sense to re-create storage facilities at another site and then unnecessarily transport large amounts of plutonium across the country from Pantex. The budgetary and political costs for such a decision would be enormous. Because of these costs, Pantex also should be designated the preferred site for any disposition options and related functions. It makes budgetary and policy sense to site disposition where storage already exists. Furthermore, it makes no sense from any perspective, budget or otherwise, to site strategic storage at one site and surplus at another. Pantex should be selected for both storage functions. Pantex has the necessary safety, security, and surveillance capabilities to accommodate an expanded role with minimal costs and it is the production site closest to Los Alamos, the planned pit fabrication site.

Based upon these reasons, I respectfully urge DOE to designate Pantex as the preferred alternative site for all existing and new stockpile management and stewardship functions as well as consolidation of all plutonium storage and disposition and any related functions. Thank you for the opportunity to comment on these documents.

Sincerely,

David Swinford

COPY FOR YOUR INFORMATION

2/08.03.01

TX-042

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

STATE OF TEXAS, STATE REPRESENTATIVE, AUSTIN, TX, JOHN HIRSCHI
PAGE 1 OF 2

John Hirschi
State Representative
District 81

May 28, 1996

To the United States Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

As a concerned citizen as well as a Texas Legislator I am disturbed by the Programmatic Environmental Impact Statement prepared for the Department of Energy regarding Storage and Disposition of Weapons-Usable Fissile Materials.

While I recognize the need to assure safe, secure, long-term storage and disposition of the significant quantities of surplus fissile materials, which include plutonium (Pu) and highly enriched uranium (HEU), I believe this document fails to address very critical human issues.

In reviewing the alternative for the possible future of Pantex, it becomes very evident that all of the nation's weapons-usable plutonium not active warheads would be stored at Pantex - 20,000 pits, plus much of the plutonium now at Rocky Flats Plant, CO; Hanford, WA; Los Alamos, NM; Savannah River, SC; and the Idaho National Engineering Laboratory.

Before 1989, plutonium pits were never stored at Pantex. However, with the closing of Rocky Flats, Pantex is the interim storage site for at least 12,000 pits. Now this document proposes not only storing plutonium pits, but other more undesirable forms of plutonium.

Once stored at Pantex, this site is being considered for a plutonium pit disassembly/conversion facility to cut the pits and process them into metal or oxide; a plutonium conversion facility to process other types of Pu; a facility to mix plutonium with uranium to make mixed oxide fuel (MOX); nuclear power reactors to use the MOX fuel, plus storage of the spent fuel from the reactors, as well as storage of all the mixed waste generated from all these processes. It is processing of plutonium which has contributed to the national environmental degradation which saddles our nation with a $300 billion dollar cleanup problem.

1/09.08.04

This document states there would be few negative effects from doing any and all of those activities at Pantex. What the document fails to address is the impact on the good reputation of our agricultural products. Agriculture is the one industry which has consistently sustained the Panhandle for decades.

The food chain begins here in the prime agricultural farmland of the Texas Panhandle. The meat products and cereal grains produced here are shipped throughout the world; 25% of the Nation's beef is produced and processed here. The quality and wholesomeness of these products would be placed in jeopardy with the siting of these processes at Pantex. Without production agriculture

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M-249

09 08 04 **Comment Number 1**

The Proposed Alternatives for Pantex would be performed on existing DOE land and would not disturb any prime farmland. Furthermore, because the Proposed Alternatives would operate in full compliance with all Federal, State, and local environmental regulations, the operations would have no adverse impact on grain production. Thus, there would be no impact on the agricultural economy of the Panhandle/Amarillo area.

STATE OF TEXAS, STATE REPRESENTATIVE, AUSTIN, TX, JOHN HIRSCHI
PAGE 2 OF 2

this part of Texas would cease to exist. When one of every four people is employed in an agriculture related job, the loss to this High Plains trade area of those jobs would create untold problems. 1/09.08.04 cont.

A second issue the document fails to address is the location of Pantex above the Ogallala aquifer, the source of groundwater for the plains of Texas and seven other Midwestern food producing states. With high explosives, chemicals, solvents, and radionuclides, Pantex has contaminated the fine grained layer of water bearing sands above the Ogallala aquifer. With the downward migration of the recharging waters how long will it be before the Ogallala itself will be contaminated? 2/09.04.04

Water and agriculture are the real wealth of the Texas Panhandle. Without them there would be no "Texas Panhandle." We cannot stand by and allow these resources to be compromised in any way. Food is the most important commodity we have - it must be protected.

Not all alternatives for siting these processes at other sites were analyzed in this document. Before choosing a preferred alternative, other options need to be considered. The siting of these missions at Pantex seems shortsighted and ill-conceived. The environmental impact in conjunction with these processes has the potential to devastate this food producing region. 3/08.03.01 1/09.08.04 cont.

The Panhandle is too valuable to be used as a plutonium storage, processing and waste facility.

Sincerely,

John Hirschi

John Hirschi
State Representative

M-249

09 04 04 **Comment Number 2**

Current and future operations at Pantex are not expected to affect the water quality of the Ogallala Aquifer. However, since this aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge), Pantex operations contribute to the depletion of the Ogallala Aquifer and are analyzed in the PEIS.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

STATE OF TEXAS, STATE SENATOR, AUSTIN, TX, SENATOR TOM HAYWOOD

PAGE 1 OF 4

TOM HAYWOOD
STATE SENATOR
DISTRICT 31

Committees
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EDUCATION
NATURAL RESOURCES
SUBCOMMITTEE ON AGRICULTURE

The Senate of
The State of Texas

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April 19, 1996

U.S. Department of Energy
Office of Reconfiguration
P.O. Box 3417
Alexandria, VA 22302

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, DC 20026

RE: Comment on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons Useable Fissile Material Draft Programmatic Environmental Impact Statements (PEIS)

To Whom It May Concern:

As the Texas State Senator representing 36 Northern Texas Counties, including Carson County in which the Pantex facility is located, I want to thank you for the opportunity to provide comment on the United States Department of Energy's (DOE) Draft Programmatic Environmental Impact Statements (PEIS) on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons Usable Fissile Materials. This letter will also serve as my comment on the Pantex Site-Wide Draft Environmental Impact Statement, as most of the issues addressed in that document are identical to the issues addressed in the SSM and S&D PEISs.

I want to stress my support for DOE's earlier decision to abandon plans to transfer assembly/disassembly function to the Nevada Test Site. Your decision to select Pantex as the preferred alternative for those functions recognizes that transfer to Nevada would have been cost prohibitive, and would not have provided adequate facilities to meet future needs. However, the failure to recognize Pantex as the preferred site for new and/or consolidated stockpile management facilities has overlooked the best site for maintaining the integrity of the United States nuclear stock-

M-046

STATE OF TEXAS, STATE SENATOR, AUSTIN, TX, SENATOR TOM HAYWOOD
PAGE 2 OF 4

pile and attaining maximum efficiencies and cost savings.

Before addressing the two Impact Statements individually, I want to stress that any current or future Department of Energy functions at Pantex must be conducted in a safe and environmentally sound manner. While I am confident that current procedures are more than adequate, I also am adamant that any expansion at Pantex be implemented in the same fashion. The residents of the Texas Panhandle have come to expect Pantex operations to be handled in a way that does not impair their health or safety, and future plans should recognize that necessity.

Stockpile Stewardship and Management PEIS

Pantex is the most cost effective alternative for any new construction of SSM facilities. Labor costs, utility rates, and water and land availability at Pantex, as well as public and political support in the surrounding community, are more amenable to DOE needs than at any other site.

Pantex should be considered as a site for all future defense related programs to complement activities at the national laboratories, including the planned Atlas Facility and the plutonium pit fabrication site at Los Alamos National Laboratory. The location of additional defense related programs at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost.

While the Department of Energy makes no mention of a strategic plutonium reserve to meet future national security needs, the PEIS mentions that strategic storage should be co-located with disassembly. Pantex should clearly be the preferred site for such a mission in coordination with its management functions.

The strengths identified above supporting increased stewardship and management for Pantex also support the continuation of High Explosives (HE) fabrication at that site. Just as strategic and surplus storage should remain with disassembly, HE functions should remain co-located with assembly. The DOE SSM draft indicates that Pantex should retain HE capabilities on site to process inventories accrued from dismantling; therefore the continuation of HE functions at Pantex is clearly the least expensive alternative available to DOE. I strongly disagree with the draft PEIS statement that siting HE activities at Pantex offers no advantages over the national labs. The cost of transferring such functions is cost prohibitive, and such plans ignore the possibility of future weapon production activities, which would require a full HE capability at Pantex, and ignore the admitted necessity of continued limited HE activity at Pantex.

M-046

I believe that many factors argue for the continued operation of HE activities at Pantex, in addition to an expansion of its existing stewardship and management activities. In all of the above cases, I want to stress that the Department of Energy should insist that budgetary comparisons between Pantex and other sites are accurate and include capital, transportation, training, remediation, and other costs.

Fissile Materials (Plutonium) Storage and Disposition PEIS

As the sole Department of Energy authorized facility for assembly and disassembly of nuclear weapons, Pantex has served our country for more than 40 years. It has handled these functions in a safe and efficient manner, and should continue to do so.

As our nation continues its program of dismantling a large portion of our nuclear deterrent, one of the challenges we face is processing, storing, or disposing the fissile materials that remain. Pantex clearly offers the best solution to this vexing problem.

Acknowledging the importance of cost savings, Pantex has the existing capability to store the plutonium already at the site, and could easily expand and upgrade existing facilities to meet any or all of the storage options being considered by DOE. For the reasons identified in the SSM PEIS, the Pantex facility could accomplish this with minimal cost and difficulty.

Pantex already houses more than 8,000 surplus pits, with more pits scheduled for transfer from the Rocky Flats facility. The re-creation of storage facilities at another site, and the costs and dangers associated with transporting large amounts of plutonium across the country, makes little sense budgetarily or politically. The common sense solution to this problem is to site strategic storage and surplus functions at the same place as disassembly. Since facilities for all three functions already exist at Pantex, this common sense solution is practical, reasonable, and unarguable.

All possible factors argue for Pantex's continued and expanded role in storage of disassembled fissile material. It has the necessary safety, security, and surveillance, it has the most cost efficient operations, it has existing structures and facilities, and it is the closest production site to Los Alamos, the planned pit fabrication site. 1/08.03.01

Based on the reasons outlined in the above two comments on the draft Programmatic Environmental Impact Statements, I urge the Department of Energy to designate Pantex as the preferred alternative site for all existing and new stockpile management and stewardship functions, as well as consolidation of all plutonium storage, disposition, and related functions.

M-046

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

STATE OF TEXAS, STATE SENATOR, AUSTIN, TX,
SENATOR TOM HAYWOOD
PAGE 4 OF 4

Thank you for the opportunity to comment on these documents.

Sincerely,

Tom

Tom Haywood

TH/jai

M-046

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, KENNEWICK, WA, MAX S. POWER
PAGE 1 OF 3

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
1315 W. 4th Avenue • Kennewick, Washington 99336-6018 • (509) 735-7581

Comments on Plutonium PEIS
April 11, 1996
Presented by Max S. Power
Nuclear Waste Program

My name is Max Power. I represent the Washington State Department of Ecology, and I am presenting the agency's comments.

I want to begin by stressing three basic points, based on positions taken by Governor Lowry at the time of scoping (August 1994) and the Plutonium Roundtable (October 1995):

- Nonproliferation: Action to convert weapons usable plutonium to form that discourage weapons use is urgent. The United States needs to be seen to be acting forcefully and with public support to assure that this material is not available for reuse in nuclear weapons. The consequences of *not* acting are immense.

- Equity. All the states and regions of the country benefited from the defense provided by nuclear weapons. Now all need to share in an equitable way in the overall costs and risks of closing the circle on production of nuclear weapons material. Washington State has borne more than its share of the costs and risks in the past. We have both expertise and facilities that can help deal with plutonium and radioactive wastes, but we are only willing to play a role if others assume their fair share of the burdens.

- Cleanup commitments. Washington will not accept additional burdens on Hanford that detract from or delay commitments to cleanup the legacy of past contamination.

Within this context, we offer these specific comments on the PEIS:

1. We appreciate the effort USDOE has made to provide public discussion on complex issues. As selection of disposition options proceeds, DOE should use information such as that developed in the draft PEIS to inform a broader national equity dialogue. Decisions about plutonium storage and disposal must be made in the broader context of such a dialogue, dealing with treatment storage and disposal of all surplus nuclear materials and wastes. 1/01.06.00

WA-020

01 06 00 **Comment Number 1**

Efforts are being coordinated within DOE to assure that decisions involving related programs and sites are made on an integrated basis. For example, decisions involving Pu storage and disposition, stockpile stewardship and management, environmental restoration, and specific activities at given sites are being coordinated. DOE has initiated a national dialogue that will involve State and local governments, Indian tribes, other interested groups, and the general public to provide a forum for these groups to give input on a continuing basis regarding Proposed Actions and decisions.

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, KENNEWICK, WA, MAX S. POWER
PAGE 2 OF 3

2. We encourage DOE to take a conservative approach on storage options. It does not make sense to ship significant quantities of plutonium to a consolidated or collocated storage site, only to have to ship most of it again to yet another site for disposition. Near-term emphasis should be on selection of a disposition approach; long-term storage decisions can then be linked to the configuration of the disposition system. — 2/08.03.01, 3/08.03.01

3. Ecology commends DOE for the level of analysis and documentation in the PEIS:
   - a good basis for assessing generic disposition alternatives
   - recognizes need for additional NEPA documentation to select disposition sites
   - sufficient analysis to evaluate storage options once disposition path selected

4. We also emphasize the need to identify the full extent of risks, costs, technology development needs, and further requirements for public decision-making. This should be an important document contributing to public awareness and national equity dialogue. — 4/08.00.00
   - The PEIS includes information that puts plutonium disposition in context of the legacy of weapons production. E.g. substantial information about wastes, storage facilities, etc. at candidate sites. — 5/01.00.00
   - The PEIS makes reasonable efforts to identify emissions and waste streams from proposed storage, treatment, and disposal facilities. DOE is to be commended for using appropriate site-specific data in the conceptual analysis of the disposition options.
   - However, we are concerned that some materials may not be covered in this PEIS or others — 5/01.00.00 cont.

5. Therefore, we ask DOE to clarify how--and how much of--Hanford plutonium stock is included.
   - Fig. 1.1.1-1 indicates 1.7 t. of Hanford Pu identified as "surplus" There is approximately another 2.1 t. in forms other than spent fuel. Some may be concentrated and become surplus; some may become waste. It is not clear that the latter category, which is explicitly beyond the scope of this PEIS, is included in other programmatic documents. — 6/01.00.00
   - The PEIS needs more explicit discussion about the implications of non-pit forms of plutonium for the configuration of storage, treatment, and disposal options. — 7/01.00.00

In conclusion, the disposal option , or combination of options, selected should:
- minimize overall risk to public and worker health, and to the environment;
- take account of equity among sites and regions;
- not divert resources from or delay cleanup of past contamination at nuclear weapons production sites; — 8/08.03.00
- have a clear and reasonable path forward to develop and implement the technology; and
- accommodate the plutonium metal scrap and other forms that could nonetheless be used in weapons.

WA-020

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the continued storage of surplus Pu (No Action Alternative). Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 3

Comment noted.

08 00 00 Comment Number 4

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses along with the environmental analysis and public input will be integrated into DOE's decisionmaking process.

01 00 00 Comment Number 5

A description of all DOE's environmental analyses for weapons-usable fissile materials to comply with NEPA is given in Chapter 1 of the Final PEIS.

01 00 00 Comment Number 6

The Draft PEIS used 4 t (4.4 tons) as a bounding number for Hanford to analyze the environmental impacts. Of the 4 t (4.4 tons), 1.7 t (1.9 tons) has been declared surplus, and the remainder is largely nuclear energy program materials that are considered weapons-usable.

Weapons-usable fissile materials are not wastes, as defined in the *Solid Waste Disposal Act*, Sections 1004 and 1006. Stabilization and concentration of the Pu residue materials at various sites would be covered under separate NEPA documents, if necessary, as part of the stabilization program under EM.

01 00 00 **Comment Number 7**

The non-pit materials containing Pu came mainly from chemical and thermal processes that were used to separate and purify Pu. As described in Chapter 1 of the PEIS, DOE has an ongoing program to stabilize these materials to meet the requirements of its *Plutonium Vulnerability Management Plan*. The NEPA coverage for stabilization of the weapons-usable fissile materials is beyond the scope of this PEIS. Since the PEIS addresses only separated materials, the management of materials stabilization activities including any NEPA analyses that might be required is being conducted under DOE's Environmental Management Program.

08 03 00 **Comment Number 8**

The Department of Energy acknowledges the commentor's suggestion regarding the criteria that should be used in determining the Preferred Alternative for the storage and disposition of weapons-usable fissile materials. This criteria, along with other input, provided through the public review process, will be presented to the decisionmaker to support the ROD.

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, OLYMPIA, WA, MARK WALLACE
PAGE 1 OF 7

Date: Mon, 6 May 1996

Subject: FORUM Form - incoming

scrial_no = 168
MailTitle = FORUM Form - incoming

name = Mark Wallace
title = Public Involvement Officer
company = Washington Dept. of Ecology
addr1 = P.O. Box 47600
addr2 =
city = Olympia
state = Washington
zip = 98504
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fax = (360) 407-7151
email = MAWA461@ecy.wa.gov
ctype = public
subject =

** The following is the text of the Author's Comment.

Spoken comments on the

Storage and Disposition of Weapons-Usable Fissile Materials
Draft Programmatic Environmental Impacts Statement

Recorded during a public meeting
Co-sponsored by the Plutonium Roundtable at
The University of Washington Center for Urban Horticulture
3501 N.E. 41st Street
Tuesday, April 30, 1996.

Hearing officer: Patricia Boiko, Physicians for Social Responsibility:

First commentor:

My name is Tom Carpenter.
I:m with the Government Accountability Project.
My address is:
1402 Third Avenue, Suite 1214
Seattle, Washington 98101
(206) 292-2850

E-006

TOM CARPENTER: Comment that I would like to give to the Department of Energy is that burning plutonium in the reactors as an option is not a good option, in my opinion, because it creates an additional waste stream. And it raises safety issues, and it sh ould be rejected as an option. That the tradeoff of destroying a small amount of the plutonium is not worth it, but creating a whole new waste stream and a additional safety hazard. 1/08.03.01

It appears from the information available that the immobilization technology is the preferred alternative. I have very, very strong concerns about the ability -- the technical ability and the managerial ability -- of the current structures to be able to h andle an undertaking of this sort, especially within the Department of Energy. And those are my key concerns about -- they l re technical in nature, and they l re managerial in nature, as well -- is that there l s, overall, a lack of oversight and a lack of reg ulatory integrity, I guess. And it is a concern that is, I think, kind of overlooked in the whole process. And there l s symptoms of that throughout the management, for instance, of the Hanford Site, or the Pantex Plant, where important safety issues are ov erlooked, or ignored, or buried. That concerns me greatly when it comes to an issue like plutonium disposition. So a larger look at this, a national dialogue of the type that Tim Takaro was suggesting tonight, I think is urgently needed. 2/05.00.08

There is way too much going on to make an intelligent decision without looking at the whole picture. I agree with the Physicians for Social Responsibility that it l s hard to follow all the EIS l s and PEIS's l s. As a professional activist, I don l t keep track of them all. I have no idea what l s going on with some of those. That, of course, concerns me greatly. So a national dialogue is greatly needed. And finally, I would like to agree that we need more information, more analysis about what, exactly, the im pacts would be from immobilization technologies. I feel that there is not enough information to go on to make an intelligent decision. And so I would like to see the Department of Energy step back, do a better job, do more stakeholder participation, so t hat the right decision is made, since the impacts are so far reaching and so potentially severe. 3/08.02.00

Second commentor:

My name is Rosemary E. Brodie
My address is 3842 N.E. 90th St.
(Seattle, WA 98115-3745)
I l m a co-chair of Seattle Women Act for Peace

ROSEMARY BRODIE: First of all, I would like to give a little background in

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08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

05 00 08 Comment Number 2

The Department of Energy is committed to safe and effective management of all of its Pu-related missions.

08 02 00 Comment Number 3

The Department of Energy acknowledges the commentor's support for coordination and increased understanding on the decisions to be made on the storage and disposition of weapons-usable fissile materials. However, the National Dialogue Project is beyond the scope of this PEIS.

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, OLYMPIA, WA, MARK WALLACE
PAGE 3 OF 7

terms of the Plutonium Disposition PEIS issues and concerns. The U.S. Department of Energy is conducting a programmatic environmental impact statement to determine what to do with the surplus plutonium taken from dismantled weapons. DOE is considering alternatives for the storage -- the storage alternatives are not addressed in this statement, here, but -- and disposition of plutonium and has agreed to take comment and discuss th e PEIS at the Plutonium Roundtable in Seattle on April 30th.

The good news is that plutonium is being removed from weapons. The process of disarmament has begun. The bad news is that keeping plutonium out of weapons and the environment is a formidable task. If we are going to meet our obligations under the NPT t reaty to work towards disarmament, the plutonium stockpile from dismantled weapons will grow, so we must analyze how to effectively deal with plutonium. Unfortunately, this PEIS so far, is an inadequate analysis that does not facilitate informed public p articipation and openness principles. DOE is also considering alternatives that exacerbate plutonium disposition problems. It is very important that everyone concerned about nuclear proliferation, Hanford, or the environment participate in this process. 4/08.02.00

The problems with MOX:
The use of plutonium in nuclear reactors is one of the disposition alternatives considered in the PEIS. First, the plutonium would be blended into a mixed plutonium dioxide and uranium dioxide, or MOX, and then reactors could use the MOX to generate ele ctricity. This alternative is strongly opposed by many people concerned with nuclear weapons material proliferation. Plutonium in MOX can still be diverted into nuclear weapons. The International Atomic Energy association consideration MOX to be of ffdi rect use¶ in nuclear weapons. This means that in the storage and transport and use in reactors, MOX must be secured and handled as a weapons material. Using MOX in reactors is against stated U.S. non-proliferation policy. President Clinton has stated t hat, ffThe United States does not encourage the civil use of plutonium, and accordingly, does not, itself, engage in plutonium reprocessing for either nuclear power, or nuclear explosive purposes.¶ This is September 1993. Developing MOX would drastic ally alt
er this policy and encourage other countries to further develop plutonium use in reactors. 5/01.06.00

The United States has no facility to develop a MOX fuel that could be run in a commercial reactor. A MOX fabrication facility would have to be built, or a current facility adapted. This could be done at Hanford at a cost as yet undisclosed. Potentially , plutonium from around the country would be brought to a Hanford MOX fabrication facility. Also, there is currently no U.S. MOX fabrication facility. The PEIS assumes that if an existing light water reactor in the United States were to use MOX fuel, th en a timely supply -- in quotes

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08 02 00 **Comment Number 4**

Comment noted.

01 06 00 **Comment Number 5**

The President's Nonproliferation Policy says the United States will not recycle Pu. Burning weapons Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this will not be extracted for reuse. The Reactor Alternatives will utilize a once-through fuel cycle. Spent fuel will be disposed of with other commercial reactor spent fuel. This is not inconsistent with U.S. policy since no Pu is being recycled.

-- of MOX fuel would have to be sought, while a U.S. fabrication facility is developed. This means that the DOE would send United States1 plutonium to Europe, where MOX fuel would be developed, and then send it back to the United States1 reactors. Because MOX is a direct-use weapons grade fuel, it1s use in commercial reactors would turn many utility nuclear energy plants into de facto weapons facilities. Increased security to prevent diversion of plutonium would be
requi red

5/01.06.00 cont.

High level waste generated from MOX is likely to be a serious problem. Commercial spent fuel generated from MOX reactors is supposed to go to a waste repository. The development of a repository has been fraught with difficulty. There is no guarantee th at a suitable repository will exist for even more high level waste generated from MOX reactors. Simply stating that it will go to a repository which does not yet exist is not good enough. Hanford, as well as other sites in the nuclear weapons complex, m ay end up with this waste if a repository is not available. One alternative in the PEIS is to use Canadian CANDU reactors -- that1s an acronym. According to the PEIS, Canada would then be responsible for the waste generated from the reactors. This enco urages international commerce in plutonium, as does any alternative calling for plutonium, or MOX shipment, to and from Europe. It may also set a dangerous precedent for the United State to give up control of weapons material to other countries. An
d it bri
ngs up a question of fairness. Why should Canadian citizens take plutonium and waste that they did not develop?

Instead of MOX, plutonium should be declared a waste and immobilization alternatives developed. We should declare plutonium a waste and insure that it is not used in weapons, or in reactors. By doing this in the United States, we can also take a leaders hip role in preventing an international industry in commerce in plutonium that would be increasingly difficult to control. Immobilization technologies should be vigorously pursued because these technologies provide the greatest ability to isolate plutoni um from the environment and prevent the proliferation of weapons material. Immobilization technologies should be developed and shared with other countries. Meanwhile, storage of plutonium should maintain plutonium so as to prevent harm to the environmen t and diversion into weapons. This means that risks involved in transport should avoided.

6/08.03.01

7/08.03.01

Public participation and openness in the PEIS process:
The PEIS lacks credibility because DOE has not furthered informed public participation in the process, or adhered to basic principles of openness. DOE secretively solicited the nuclear industry in pursuit of MOX in December 1995.

8/08.02.00

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08 03 01 Comment Number 6

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 7

The Department of Energy acknowledges the commentor's support for the continued storage of surplus Pu (No Action Alternative). Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 02 00 Comment Number 8

The Department of Energy's request for "Expressions of Interest" was announced in the *Commerce Business Daily* which is the normal public process in potential contractual matters. The meeting held to explain DOE's position was open to the public and attended by several public interest groups. This request for information from the commercial nuclear power utilities was based upon a need by DOE to determine if the Existing LWR Alternatives were chosen, would any utility be willing to do the work. This was of concern because of the traditional separation between the commercial utilities and nuclear contractor involved in national security work. This same situation is not true for the potential contractors who would be solicited to implement the Immobilization and Borehole Alternatives, if chosen.

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, OLYMPIA, WA, MARK WALLACE
PAGE 5 OF 7

DOE included a request for, excuse me, in December 1995, DOE included a request for expressions of interest for tritium production, a solicitation in pursuit of commercial reactors that would like to use MOX. This action, taken between the plutonium disposition PEIS scoping he arings and the draft PEIS was done without notice to the public, or incorporation into the PEIS. Not until March 29, 1996, were expressions of interest, known as EOIs, released. This solicitation indicates a substantial furtherance of MOX despite the fa ct that DOE has not chosen a preferred alternative. No EOI process has been followed for any of the other disposition alternatives. Among EOI responses from utilities interested in MOX was one from the Washington Public Power Systems, is it Supply
Syste m,
known as Whoops, to use MOX at the WNP 2 reactor sited at Hanford. — 8/08.02.00 cont.

DOE is not including cost studies and non-proliferation studies for public scrutiny along with the PEIS. Cost studies and non-proliferation studies are going on outside of this PEIS process. Since these studies will affect the outcome of the PEIS, they must be made public, publicly available so that citizens can make informed comments on the PEIS. Given that the need for action on plutonium disposition is based upon proliferation concerns, there is an appalling lack of consideration of proliferation im pacts throughout this PEIS. Also, a full cost analysis of MOX, including a cleanup, clean-up costs of a MOX fabrication facility and MOX reactor sites, and the costs of a suitable repository should be done and available public comment, as should cost est imates for all other alternatives. DOE should extend the comment period and hold hearings in additional locations. Additional time is needed for the public to fully consider the PEIS, especially with additional cost and non-proliferation informatio
n. H ear
ings ought to held in additional locations. For example, actions at Hanford should require hearings throughout the Northwest, Seattle, Portland, Spokane, etc. Now that some of the potential reactor sites for MOX are known, hearings in those areas should be considered.
Thank you.

- 9/08.00.00
- 10/01.06.00
- 9/08.00.00 cont.
- 11/08.01.00
- 12/08.02.00

Third commentor:

Barbara Zepeda
I live at: 1937 25th East
Seattle, 98112

BARBARA ZEPEDA: And I'm very interested in the fact that we are supposedly cooperating with IAEA at Hanford, but we aren't even funding our UN obligations, so how can the International Atomic Energy Agency have the money to do the — 13/15.00.00

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08 00 00 Comment Number 9

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, was provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses, along with the environmental analysis, and public input will be integrated into DOE's decisionmaking process.

01 06 00 Comment Number 10

The purpose of the Proposed Action is, in part, to establish the technical and program infrastructure that will enable the United States to take unilateral action or negotiate reciprocal actions with other nations for the disposition of surplus weapons-usable Pu. This PEIS addresses the environmental impacts of the reasonable alternatives for DOE's Proposed Action. Analyses of the cost, schedule, technical, and Nonproliferation Policy impacts are described in separate documents to support DOE's ROD. These documents were made available for public review beginning in late July 1996. DOE also conducted a series of public meetings, prior to the issuance of the Final PEIS, to discuss the analysis of the Nonproliferation Policy as it relates to the proposed action and alternatives.

08 01 00 Comment Number 11

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

08 02 00 Comment Number 12

To obtain public comments on the Draft PEIS, DOE held meetings near each of the potentially affected sites and a national meeting in Washington, DC. DOE also participated in meetings, open to the public, sponsored by different organizations at which the sponsor collected public comments which were forwarded to DOE. DOE created and advertised a number of methods for submitting comments for members of the public who could not attend a

monitoring that it shoul d? We could set an example by full funding of the United Nations, and the IAEA should be an example of not the United States pushing international agencies around, but actually strengthening 4em. We have a history of private corporations making money at Hanford by making mistakes. We can1t afford this in the future. And the mere fact that they brought up the suggestion that private corporations would be able to take the fuel and use it for a fast breeder reactor to produce electricity is just outrageou s. Seems as those same corporations are refusing to pick up any obligation they have to the WPPSS1 bonds that are still outstanding and costing Seattle City Light hundreds of millions of dollars every year. I know the City of Seattle exists to unde
rwrit e n
uclear weapons, nuclear power and municipal bonds for the whole Northwest, but it1s an outrageous use of our taxing and our bonding authority, and it1s an outrageous betrayal of the people who built City Light to serve the people rather than the multi-nat ional corporations that make money by impoverishing the rest of the world. 13/15.00.00 cont.

Mark Wallace, Washington Department of Ecology is now the hearing officer

Fourth commentor:

My name is: Sidney Stock S-T-O-C-K,
address: 6023 Hazelwood Lane South East
Bellevue, Washington 98006-2615

SIDNEY STOCK: And I think it1s unconscionable that the DOE would propose to limit the public response to May 7 when such a tiny, tiny fraction of the U.S. public has any knowledge, or information -- I, as a semi-informed person following this much more cl osely than the average person, but not highly informed, know next to nothing about this. I guess that will do it. 11/08.01.00 cont.

Mark Wallace: Can I take that as an official request for an extension of the comment period?

Sidney Stock: It sure is.

Fifth commentor:

My name is: Joshua Speiser, S-P- as in Paul -E-I-S-E-R
I live at: 4039 Ninth Avenue North East
Seattle, Washington 98105

JOSHUA SPEISER: And I1d simple like to say that I believe that the Programmatic Environmental Impact Statement, as written right now, is 14/01.04.00

E-006

public meeting. These methods included fax, oral comments using a toll-free telephone number, mail, and the Internet.

15 00 00 **Comment Number 13**

Comment noted.

01 04 00 **Comment Number 14**

One of the screening criteria used for selection of reasonable alternatives to be analyzed in the PEIS is technical feasibility. To the extent possible, DOE will use existing and proven technologies for construction and operation of the storage and disposition facilities in the Proposed Action. Should new technologies be chosen for Pu disposition, DOE will demonstrate them prior to their implementation.

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, OLYMPIA, WA, MARK WALLACE
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incomplete, the time period should be extended, there should be much more research done on all the options. Further m ore, I would demand that the MOX option not be pursued. It is a wasteful option, both economically; furthermore, it will create much more nuclear waste than we re currently dealing with in many forms. Why complicate a problem, which is already complicate d. In addition, I would suggest when the Department (inaudible word) environmental safety and health issues that they try to look to those officials and scientists who do not have a vested interest, who are not working for industry, or with industry, so they can get a clearer point of view.

14/01.04.00 cont.
1/08.03.01 cont.

Thank you very much.

End of spoken comments

END comment

E-006

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, OLYMPIA, WA, MARY RIVELAND
PAGE 1 OF 4

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

June 7, 1996

U.S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

Dear Sir or Madam:

Thank you for the opportunity to comment on the draft Programmatic Environmental Impact Statement (PEIS) for the Storage and Disposition of Weapons-Usable Fissile Materials (DOE/EIS-0229-D). We have reviewed the document and have the following comments. Our general comments are essentially the same as those presented at the Richland hearing, April 11, 1996, by Max Power, on behalf of Washington Department of Ecology (Ecology).

Governor Mike Lowry set forth five key points during scoping for the PEIS and in the Plutonium Roundtable Forum held in Seattle, October 6, 1995. The five key points were as follows:

- Nonproliferation - Action to convert weapons usable plutonium to forms that discourage weapons use is urgent. The United States needs to be seen as acting forcefully and with public support to assure that this material is not available for reuse in nuclear weapons. The consequences of *not* acting are immense.

- Equity - All the states and regions of the country benefited from the defense provided by nuclear weapons. Now all need to take an equitable share in the overall costs and risks of closing the circle on production of nuclear weapons material. Washington State has borne more than its share of the costs and risks in the past. We have both expertise and facilities that can help deal with plutonium and radioactive wastes, but we are only willing to play a role if others assume their fair share of the burdens.

- Cleanup Commitments - Washington will not accept additional burdens on Hanford that detract from commitments made or delay the cleanup of the legacy of past contamination.

- Protection of Public Health and Safety - Any action to deal with plutonium must protect the peoples' safety and security as well as the environment, and must minimize risks to workers and the public.

F-065

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, OLYMPIA, WA, MARY RIVELAND
PAGE 2 OF 4

Office of Fissile Materials Disposition
June 7, 1996
Page 2

- **Public Involvement.** It is critical to involve the public in examining all alternatives and coming to conclusions about choices and the tradeoffs involved. Public trust and confidence in the decisions made is imperative if we are to provide the strong international leadership needed to permanently remove these materials from weapons use.

Our general comments on the PEIS reflect these principles:

1. We appreciate the effort the United States Department of Energy (USDOE) has made to provide public discussion on complex issues. As selection of disposition options proceeds, USDOE should use information such as that developed in the draft PEIS to contribute to a broader national equity dialogue. Decisions about plutonium storage and disposal must be made in the broader context of such a dialogue, dealing with the treatment, storage, and disposal of all surplus nuclear materials and wastes. 1/08.02.00 2/01.04.00

2. We encourage USDOE to take a conservative approach on storage options. It does not make sense to ship significant quantities of plutonium to a consolidated or collocated storage site, only to have to ship it again to yet another site for disposition. Near-term emphasis should be on selection of a disposition approach; long-term storage decisions can then be linked to the configuration of the disposition system. 3/01.01.00

3. Ecology commends USDOE for the level of analysis and documentation in the PEIS, which:
   - provides a good basis for assessing generic disposition alternatives;
   - recognizes the need for additional NEPA documentation to select disposition sites; and
   - includes sufficient analysis to evaluate storage options once a disposition path is selected.

4. We also emphasize the need to identify the full extent of risks, costs, and technological development needs. Some of this information will be covered in separate documents, which must be available to enable the public to have a proper role in decision-making. All this information will contribute to public awareness and to a meaningful national equity dialogue.
   - The PEIS includes information that puts plutonium disposition in context of the weapons production legacy, e.g. substantial information about wastes, storage facilities, etc. at candidate sites.
   - The PEIS makes reasonable efforts to identify the emissions and waste streams from proposed storage, treatment, and disposal facilities. USDOE is to be commended for using appropriate site-specific data in the conceptual analysis of the disposition options.
   - However, we are concerned that some materials may not be covered in this PEIS or other EIS's. 4/11.01.08

F-065

08 02 00 **Comment Number 1**

Comment noted.

01 04 00 **Comment Number 2**

Efforts are being coordinated within DOE to ensure that decisions involving related programs and sites are made on an integrated basis. For example, decisions involving Pu storage and disposition, stockpile stewardship and management, environmental restoration and specific activities at given sites are being coordinated. DOE has initiated a national dialogue that will involve State and local governments, Indian tribes, other interest groups, and the general public to provide input on a continuing basis regarding proposed actions and decisions.

01 01 00 **Comment Number 3**

Comment noted. The PEIS analyzes the environmental impacts of various storage and disposition alternatives. Analyses of the cost, schedule, policy, and technology impacts are also being done to support DOE's ROD. DOE's decision will address the overall strategy and path forward for storage and disposition of the various weapons-usable fissile materials.

11 01 08 **Comment Number 4**

A description of DOE's environmental analyses for weapons-usable fissile materials to comply with NEPA is given in Chapter 1 of the PEIS.

5. Therefore, we ask USDOE to clarify how--and how much of--Hanford plutonium stock is included.
   - Fig. 1.1.1-1 indicates 1.7 metric tons of Hanford plutonium identified as "surplus." There is approximately another 2.1 metric tons in forms other than spent fuel. Some may be consolidated and become surplus; some may become waste. It is not clear if the latter category, which is explicitly beyond the scope of this PEIS, is included in other programmatic documents.
   - The PEIS also needs more explicit discussion about the implications of non-pit forms of plutonium for the configuration of storage, treatment, and disposal options.

5/01.00.00

In conclusion, the disposal option, or combination of options, selected should:
- minimize overall risk to public and worker health, and to the environment;
- take account of equity among sites and regions;
- not divert resources from or delay cleanup of past contamination at nuclear weapons production sites;
- have a clear and reasonable path forward for the development and implementation of technology; and
- accommodate the plutonium metal scrap and other forms that could nonetheless be used in weapons.

6/01.04.00

Our specific comments relate especially to points 4 and 5, above. There is considerable need for USDOE to clarify what materials are included in the scope of the PEIS, how these materials will be handled as they come into the "surplus" stock to be stored and disposed, and what regulatory regime will govern their transition.

Regulatory Applicability:

Washington State Department of Ecology has concluded that materials which contain Special Nuclear Material (SNM) may be regulated under the Washington Hazardous Waste Management Act (HWMA), under certain conditions. Ecology, therefore, requests further clarification as to the regulations that will govern surplus plutonium and plutonium residues, given that they are no longer needed for their original purposes and have no clearly identified future use.

1. Volume I, Section 1.1.1, and Volume III, Appendix J: USDOE is proposing to immobilize (thermally treat) plutonium (Pu) residues (less than 50% by weight) and transfer those residues to the Hanford Site Solid Waste Management Facilities. The PEIS does not describe the stabilization, concentration, treatment, and storage of Pu residues in sufficient detail to show how USDOE will comply with the state's HWMA. The PEIS should more fully describe USDOE's regulatory approach for Pu residues that are considered waste.

7/09.11.01

F-065

01 00 00 **Comment Number 5**

The Draft PEIS used 4 t (4.4 tons) as a bounding number for Hanford to analyze the environmental impacts. Of the 4 t (4.4 tons), 1.7 t (1.9 tons) has been declared surplus, and the remainder is largely nuclear energy program materials that are considered weapons-usable.

Weapons-usable fissile materials are not wastes, as defined in the *Solid Waste Disposal Act*, Sections 1004 and 1006. Stabilization and concentration of the Pu residue materials at various sites would be covered under separate NEPA documents, if necessary, as part of the stabilization program under EM.

01 04 00 **Comment Number 6**

Comment noted.

09 11 01 **Comment Number 7**

The stabilization of Pu residues is not within the scope of this PEIS. As noted in Section 1.1.1 of the Draft PEIS, the stabilization, concentration, and storage of Pu residues, as well as disposal of non-weapons-usable waste, is covered in other existing and future environmental documents, as appropriate. These include the *Interim Storage of Plutonium at the Rocky Flats Environmental Technology Site Environmental Impact Statement*, the *Interim Management of Nuclear Materials Environmental Impact Statement* (Savannah River Site), the *Plutonium Finishing Plant Stabilization Environmental Impact Statement* (Hanford), the *Solid Residues Treatment, Repackaging, and Storage at the Rocky Flats Environmental Technology Site Environmental Assessment*, and the *Waste Management Programmatic Environmental Impact Statement* (RFETS residues only).

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, OLYMPIA, WA, MARY RIVELAND
PAGE 4 OF 4

Office of Fissile Materials Disposition
June 7, 1996
Page 4

2. Volume I, Section 2.2.1, Hanford Site: The PEIS should discuss the status of the standard being developed for materials that are less than 50% by weight. It is important to know whether USDOE intends to claim the Atomic Energy Act (AEA) exemptions for SNM to exempt this material from being designated as a mixed waste and therefore from external regulation. — 8/09.11.01

3. Volume I, Section 2.2.1, Hanford Site: Further discussion is needed of the Hanford criteria for stabilization of Pu residues and how it differs from the USDOE standard *Criteria for Safe Storage of Pu Metals and Oxides* (DOE-STD-3013-94). — 9/11.01.01

4. Volume I, Section 2.2.1, Hanford Site: No date is given for completion and review of the draft document for *Criteria For Interim Safe Storage of Pu-Bearing Solid Materials* for materials with less than 50% by weight of Pu. — 10/11.01.01

Stabilization, Current Storage and Future Interim Storage of Pu Residues:

In the near term, the highest environmental and public/worker exposure risks related to this proposal would result from stabilizing unstable forms of plutonium bearing residues in various facilities throughout the USDOE complex.

1. It is not specifically clear in the PEIS as to how and when these risks are to be addressed under each option. Please provide upgrade costs and schedules for modifications of existing facilities. — 11/07.01.00

2. The Defense Nuclear Facilities Safety Board's (DNFSB) Recommendation 94-1, outlined an aggressive schedule to stabilize these materials in eight years throughout the USDOE complex. The PEIS should address the interaction of the costs and effort needed to prepare and upgrade existing facilities and infrastructure to meet DNFSB 94-1 and additional storage and disposition actions delineated in the PEIS.

3. The PEIS does not fully address the risks to the public, workers, and the environment resulting from the dangerous condition many existing facilities, such as the Plutonium Finishing Plant, are in. — 12/01.00.00

If you have any questions, please call Mr. Max Power with our Nuclear Waste Program at (360) 407-7118, or Mr. Tom Tebb at (509) 736-3020.

Sincerely,

Mary Riveland

Mary Riveland
Director

F-065

09 11 01 **Comment Number 8**

The Criteria for Interim Storage of material with less than 50-percent Pu was completed in November 1995. This is not a standard, like DOE-SOD-3013-94, which applies to material with greater than 50-percent Pu, but is a criteria for the containers to be used for interim storage. Since the material is not considered weapons-usable, it is not within the scope of this PEIS. It is not waste as it does not meet any of the radioactive waste definitions cited in Section E.1.1 of the Draft PEIS or in 40 CFR 261.4a(4) "Source, special nuclear or by-product material as defined by the AEA, as amended, 42 U.S.C. 2011 et. seq." is not solid waste. DOE/EM is currently conducting a number of trade studies to determine the best course of action for the material that does not fall within the scope of this PEIS and does not meet one of the radioactive waste definitions.

11 01 01 **Comment Number 9**

The stabilization of various nuclear materials at DOE sites is under DOE's Environmental Management Program and covered by separate NEPA documents.

11 01 01 **Comment Number 10**

The Criteria for Interim Storage was completed in November 1995 as an addendum to the *DOE Implementation Plan for DNFSB Recommendation 94-1*. Unlike the long-term storage standard, DOE-STD-3013-94, this is not a DOE standard, but criteria for the containers to be used for interim storage of Pu. The criteria applies to the interim storage of material both above and below 50-percent Pu.

07 01 00 **Comment Number 11**

Cost data, along with technical and schedule data, was provided in Technical Summary Reports of both storage and disposition beginning in late July 1996.

01 00 00 **Comment Number 12**

The PFP is included in the PEIS under the No Action Alternative for storage. Hanford has an on-going clean-up program for this facility under EM, and the activities are described in the PFP EIS.

STATE OF WASHINGTON, STATE REPRESENTATIVE, RICHLAND, WA, SHIRLEY HANKINS
PAGE 1 OF 1

Prepared Comments
Shirley Hankins
Washington State Representative
8th District
April 11, 1996
Richland, Washington

I'd like to thank the Department of Energy for providing this opportunity to deliver comments on the Programmatic Environmental Impact Statement for Storage and Disposition of Weapons-Usable Fissile Materials. Clearly, this is an issue of great magnitude for all citizens of the United States, and especially for residents of the Tri-Cities because of the potential we have for direct involvement with this program.

I'm pleased to be able to provide comments on the management of material that previously had one use, that of nuclear weapons and weapons capability. What a positive course of action for both the United States, the Russian, and other former Soviet Union governments to put this material to a productive use.

With respect to the three options the Department of Energy is analyzing for disposition of surplus plutonium, I would urge the Department to select in whole or part the Reactor Irradiation option.

- This option, which is heavily endorsed by the National Academy of Sciences, offers the most timely method for rendering this material non-usable to terrorist or other threatening countries or organizations.
- Disposal of the surplus plutonium, through the form of Mixed Oxide Fuel, is a proven technology, already used in many reactors throughout the world.
- The use of MOX fuel in U.S. nuclear reactors would allow for the generation of valuable electricity. Imagine, actually putting material once packaged into nuclear weapons to productive use for generating electricity. Government regulation of MOX fuel use would ensure the material is used in a way so that public health and safety are optimally protected.
- Through the DOE's Hanford Site, and the Washington Public Power Supply System, we have the needed infrastructure and capability to fabricate and consume MOX fuel right here, offering the Department of Energy a timely, comprehensive, and efficient manner in which to dispose of surplus plutonium.

I hope the Department of Energy will give serious thought to the reactor irradiation option, and when it comes time to deliver the Record of Decision, that this option will be selected.

Thank you.

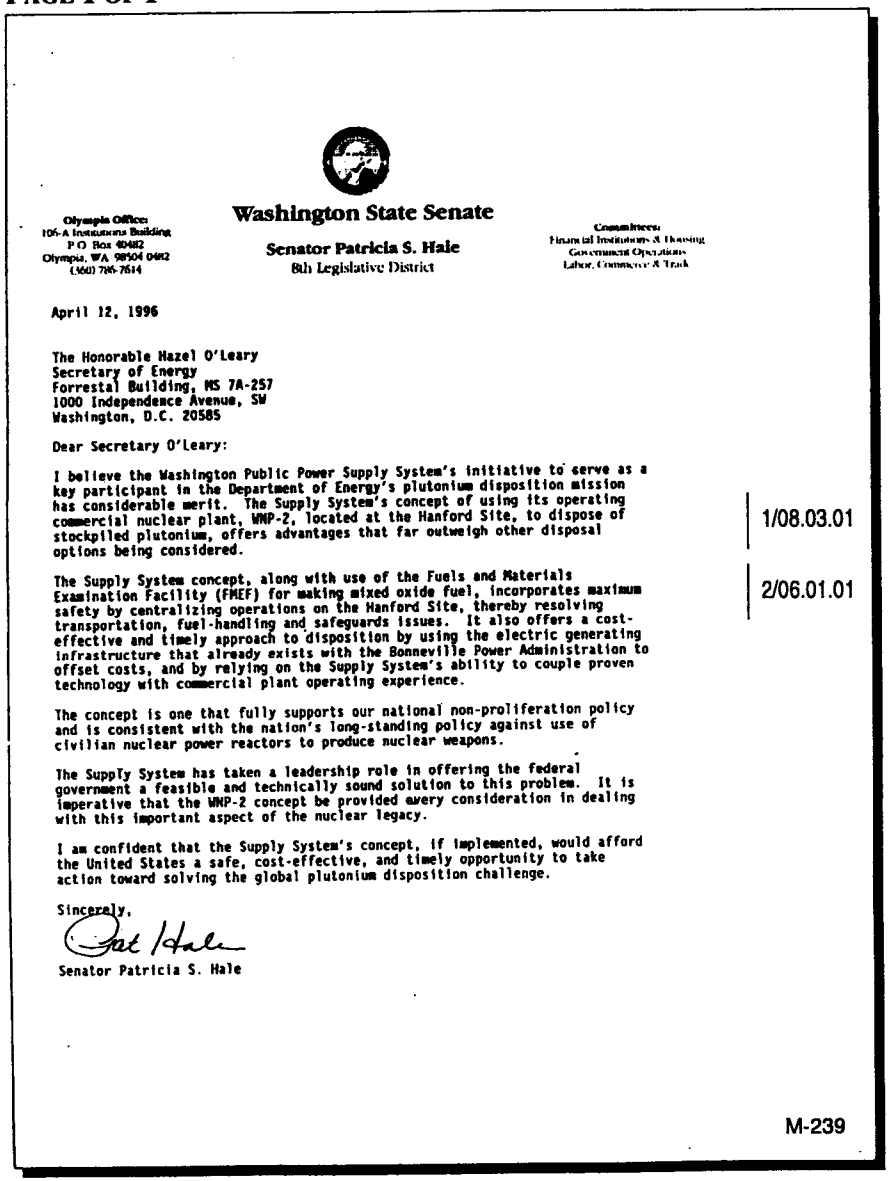
1/08.03.01

WA-017

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

STATE OF WASHINGTON, STATE SENATOR, OLYMPIA, WA, PATRICIA S. HALE
PAGE 1 OF 1



Washington State Senate

Olympia Office:
105-A Institutions Building
P O Box 40482
Olympia, WA 98504 0482
(360) 786-7614

Senator Patricia S. Hale
8th Legislative District

Committees:
Financial Institutions & Housing
Government Operations
Labor, Commerce & Trade

April 12, 1996

The Honorable Hazel O'Leary
Secretary of Energy
Forrestal Building, MS 7A-257
1000 Independence Avenue, SW
Washington, D.C. 20585

Dear Secretary O'Leary:

I believe the Washington Public Power Supply System's initiative to serve as a key participant in the Department of Energy's plutonium disposition mission has considerable merit. The Supply System's concept of using its operating commercial nuclear plant, WNP-2, located at the Hanford Site, to dispose of stockpiled plutonium, offers advantages that far outweigh other disposal options being considered. 1/08.03.01

The Supply System concept, along with use of the Fuels and Materials Examination Facility (FMEF) for making mixed oxide fuel, incorporates maximum safety by centralizing operations on the Hanford Site, thereby resolving transportation, fuel-handling and safeguards issues. It also offers a cost-effective and timely approach to disposition by using the electric generating infrastructure that already exists with the Bonneville Power Administration to offset costs, and by relying on the Supply System's ability to couple proven technology with commercial plant operating experience. 2/06.01.01

The concept is one that fully supports our national non-proliferation policy and is consistent with the nation's long-standing policy against use of civilian nuclear power reactors to produce nuclear weapons.

The Supply System has taken a leadership role in offering the federal government a feasible and technically sound solution to this problem. It is imperative that the WNP-2 concept be provided every consideration in dealing with this important aspect of the nuclear legacy.

I am confident that the Supply System's concept, if implemented, would afford the United States a safe, cost-effective, and timely opportunity to take action toward solving the global plutonium disposition challenge.

Sincerely,

Pat Hale

Senator Patricia S. Hale

M-239

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for new missions at Hanford and the potential utilization of the Washington Nuclear Power (WNP)-2 for Pu disposition. Decisions on storage and disposition of weapon-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

06 01 01 **Comment Number 2**

The FMEF is considered for use as a long-term storage facility for Pu, and the impacts are included in Section 4.2.1 of the PEIS. For the production of MOX fuel, a generic facility was considered for all six DOE sites. At Hanford, the MOX fuel fabrication facility would be located in the 200-Area adjacent to 200-East. The utilization of the FMEF would be a variant for MOX fuel fabrication at Hanford, which is bounded by the environmental analysis for the MOX fuel fabrication facility located in the 200-Area. Table 2.4–1 of the PEIS provides a brief description for variants which includes "Modification/ Completion of existing facilities for MOX fabrication." The storage options for Hanford also include constructing a new facility. Utilization of FMEF for the Upgrade Alternative would not preclude its use to also support Pu disposition activities for either Reactor or Immobilization Alternatives.

STEIN, JERRY, HAPPY, TX
PAGE 1 OF 1

Comment ID: P0039
Date Received: May 8, 1996
Name: Father Jerry Stein
Address: Box 128
Happy, TX
Phone: (806) 558-2871

Transcription:

I want to say very strongly that I disagree that we should have plutonium storage here at Pantex. This is really wrong for the area. It's really wrong for the country. We've got to be making peace with the whole world and not more dangerous material that could make other countries want to build them too, and this agricultural area - an area that water and food - reputation needs to be kept high. Plus needs to be kept clean - all those things. Far into the future, we need to think of the future and future generations of our children and not give them waste - long-term waste - to deal with in an area that's going to be very difficult to do it with winds and strong storms and everything else here. This is not the place and no place needs to have any more of it, so we've got to stop making the stuff. Please for the sake of future generations for the good honor and reputation of our own country, let's stop this now. Thank you. 1/08.03.01

P-039

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to new missions at Pantex. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

STOCK, SIDNEY, BELLEVUE, WA
PAGE 1 OF 1

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): SIDNEY STOCK
Address (optional): 6033 NORTHWOOD LANE S.E.
BELLEVUE, WA 98006-2611

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. Materials Immobilization/Vitrification - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

APPEARS MOST REASONABLE - NEED MORE INFO. | 1/08.03.01

2. Deep borehole disposal - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

3. Reactor Options - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

ARE YOU KIDDING? NO PUBLIC INTEREST GROUP SUPPORTS IT. ONLY VESTED INTEREST GROUPS SUPPORT IT. | 2/08.03.01

4. Storage Options - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

M-233

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives, and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Date: Thu, 2 May 1996

Subject: FORUM Form - incoming

serial_no = 166
MailTitle = FORUM Form - incoming

name = Rich Szempruch
title =
company =
addr1 = 5513 West Sixth Avenue
addr2 =
city = Kennewick
state = WA
zip = 99336
phone = 509 783-3080
fax =
email = richszem@aol.com
ctype = public
subject = Request for Extension of Comment Period

** The following is the text of the Author's Comment.

Based on issues and concerns raised at recent public comments meetings on the PEIS, I too have to voice my opinion that the public comment period is too short. I request that a minimum of 30 days be added to the comment period. | 1/08.01.00

Thank you,
Rich Szempruch
END comment

** The folloing is the space reserved for an Offical Reply. If you
** do not wish to reply to this comment then do not change it.
** If you wish to leave a comment then enter it here in the REPLY
** area

End Reply

E-002

08 01 00 **Comment Number 1**

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

SZEMPRUCH, RICH, KENNEWICK, WA
PAGE 1 OF 2

Comment on Storage and Disposition EIS:

The scope as defined in the EIS is confusing and appears incomplete. Correcting this may allow individuals to better judge the potential impacts to themselves and potentially involved sites and communities so that intent of the NEPA can be fulfilled. To that end I suggest information regarding the quantities and locations of plutonium addressed in the EIS (and perhaps more important that excluded from this EIS) be included in the EIS, particularly the Summary, and the document be revised to correctly address the scope.

1/01.00.00

The attached figure is a suggested way to accomplish this if the quantities are added to it and scope definitions keyed to the figure. Information on quantities and locations were provided in documents available at public meetings. As a minimum, the lower right hand boxes (locations and surplus, programmatic, and strategic reserve quantities) need to be provided. A cursory examination of this figure shows that LANL has significant plutonium but is not addressed in this EIS even in the No Action alternative. Other flaws in scope logic and completeness exist in this document and are not included in other EIS efforts of the DOE.

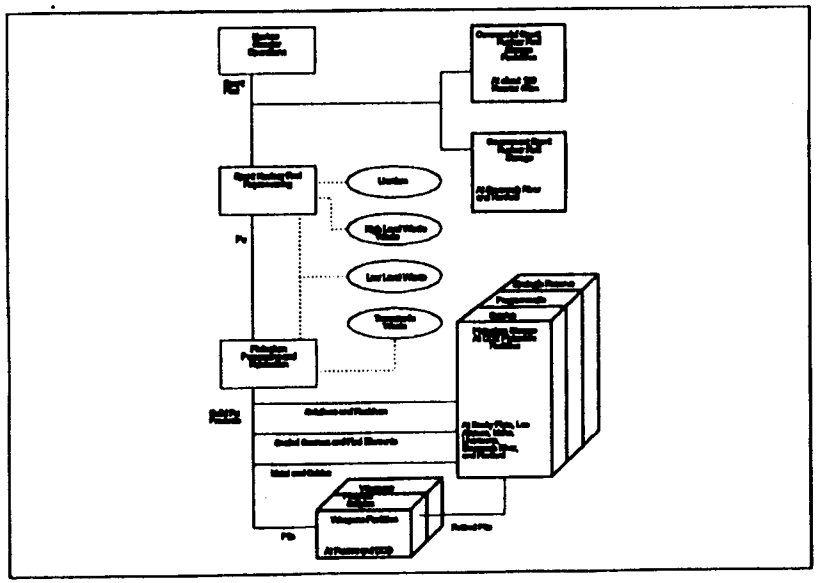
Thank you for consideration of the matter. Should you desire clarification of these comments please feel free to contact me.

Rich Szempruch
5513 West Sixth Avenue
Kennewick, WA 99336
(509) 783-3080

F-059

01 00 00 **Comment Number 1**

Information on the quantities of some weapons-usable fissile materials at various DOE sites is classified. To overcome this problem, the PEIS analyses assumed that the design of storage facilities would accommodate all existing weapons-usable fissile materials. Similarly, the design of Pu disposition facilities would be based on their annual throughput, so that the length of time these facilities are in operation could be adjusted based on the quantities of Pu being processed.



F-059

TENNESSEE VALLEY AUTHORITY, HOLLYWOOD, AL, NICHOLAS C. KAZANAS

PAGE 1 OF 5

Tennessee Valley Authority, Post Office Box 2000, Hollywood, Alabama 35752

May 3, 1996

Mr. J. David Nulton, Director
U.S. Department of Energy
DOE-Office of Fissile Materials Disposition
SAIC-PEIS
P.O. Box 23786
Washington, DC 20026-3786

Dear Mr. Nulton:

Reference: Comments to the Storage and Disposition of Weapons-Useable Fissile Materials Draft Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) dated February 1996

The Tennessee Valley Authority (TVA) has reviewed the Draft Programmatic Environmental Impact Statement (PEIS) for the Storage and Disposition of Weapons-Usable Fissile Materials. (Storage and Disposition PEIS). Our comments on the various volumes of this document are enclosed and primarily pertinent to partially completed LWR alternatives for the model plant used in the study. In general, we found this document to be well written and informative. Feedback on our comments should be forwarded to Mr. James S. Chardos, P.O. Box 2000, Hollywood, Alabama 35752.

Sincerely,

Nick

Nicholas C. Kazanas
General Manager
Bellefonte Nuclear Plant

Enclosures

M-164

Draft PEIS - Volume I

- **Page 2 - 145**

  Why is the number of potential intersite transportation fatalities for the existing LWR a factor of around three less than the other reactor alternatives? Given the information stated, it would appear they would all be equal. Also, see comments for Page 2-257. — 1/10.02.00

- **Figures 2.5.2-3 and 2.5.2-4 (Water Use and Operation Fatal Cancers)**

  Why are the values for the partially complete reactors so much higher than the similar existing LWR's? All LWR's require the same cooling levels and have similar risks for fatal cancer. — 2/09.04.08, 3/09.09.08

- **Figures 2.5.2-8 and 2.5.2.1-13**

  These figures do not agree in terms of values of solid waste. (Disposition Alternative vs Reactor Alternative) Also, the existing LWR value of zero hazardous waste is not realistic. (Figure 2.5.2.1-13) The stage of construction for the partially completed model used in this study is not properly reflected. (i.e., - concrete work complete) — 4/09.11.08

- **Figure 2.5.2.1 - 10 (Workforce Cancers)**

  Why is incremental workforce fatal cancers for the partially complete LWR almost a factor of four times greater than the existing LWR's? Since both options operate similarly and for the same mission length, the partially complete LWR should be same as existing LWR's. Also, this figure has different values than Table 4.3.5.3.9-2. — 3/09.09.08 cont.

- **Table 2.5 - 2**

  Page 2 - 239

  For the partially complete model used in this study, there should be no salt drift. — 5/09.06.08

  Page 2 - 241

  There is no impact to Native American resources for the partially completed model studied similar to the existing complete LWR's . — 6/09.07.08

- **Table 2.5 - 2a**

  Page 2- 245 (Normal Radiological Impacts)

  The annual dose and the number of fatal cancers to the total public should be same for both existing and partially complete LWR's. These reactors operate in the same — 3/09.09.08 cont.

M-164

10 02 00 **Comment Number 1**

The transportation risk presented in this PEIS is the incremental impacts over current conditions. For existing LWRs, only health risks from the transportation of material to the MOX fuel fabrication site is included since transportation from the fuel fabrication site and spent fuel transportation are already occurring. For the partially completed and evolutionary LWRs, all three transportation steps are included (to the MOX fuel fabrication site, to the reactor, and to the repository). This information is located in Footnotes b and c in Table 4.4.3.3–5 of the PEIS. The PEIS has been modified to show transportation impacts for the MOX fuel to the existing LWRs and not just the increment.

09 04 08 **Comment Number 2**

The partially completed LWR currently uses no water (nonoperational) and so the increase is much larger than the existing LWR which has no incremental change due to the use of MOX fuel. The absolute water used by the two reactors will be similar but the increment will be much different. The same is true for the radiological impact. However, the increased use of MOX fuel is slight for the radiological impact. The PEIS has been modified to show the absolute values as well.

09 09 08 **Comment Number 3**

When assessing human health risk, the following are two differences between the partially completed reactors and the existing LWRs:

1) The existing LWRs are already in operation. Any radionuclide releases and radiation exposures for existing LWRs are taken from reactor operating histories. However, the partially completed reactor has never been in operation. Actual radionuclide releases or radiation exposures are not available. Conservatively calculated radionuclide releases and radiation exposures for the partially completed LWR are taken from reactor licensing documents. Compared to the conservative release and radiation exposure estimates in the licensing documents, the actual releases and exposures should be lower.

TENNESSEE VALLEY AUTHORITY, HOLLYWOOD, AL,
NICHOLAS C. KAZANAS
PAGE 3 OF 5

Draft PEIS - Volume I
(Continued)

- **Page 2 - 257 (Interstte Transportation)**

  The difference between incremental potential for existing and maximum potential for partially complete does not make any sense. Since there are currently no transports to any facility whether existing or partially complete, why are the potential fatalities so much higher for partially complete LWR? (5.49 vs 1.39) It would appear that the value for existing and partially complete LWR's should be the same.

  1/10.02.00 cont.

- **Page 3 - 370 (Water Resources)**

  Strike the word "likely" in the fifth line and add "via Town Creek" at the end of the 6th line.

  7/09.04.08

M-164

2) For incremental latent cancer fatalities, the existing LWR is already in operation without regard to the Pu disposition program. The incremental impact is the difference between the potential latent cancer fatalities of existing conditions (operating with UO_2 fuels) and the new actions (continue to operate the existing LWRs with MOX fuels). Section 4.3.5.2.9 of the Final PEIS has been updated to show the incremental and total impact using MOX fuel. For the partially completed LWR, the reactors are not yet in operation. Therefore, there are no radiation exposures from these facilities. Also, if the partially completed reactors are not used for the Pu disposition, the facilities would never be completed. The baseline for the partially completed reactors assumes no radionuclide releases nor radiation exposures. Therefore, partially completed reactors will have a larger incremental health impact relative to operating reactors. The PEIS has been modified to show the projected impacts as well as the incremental impacts for existing LWRs.

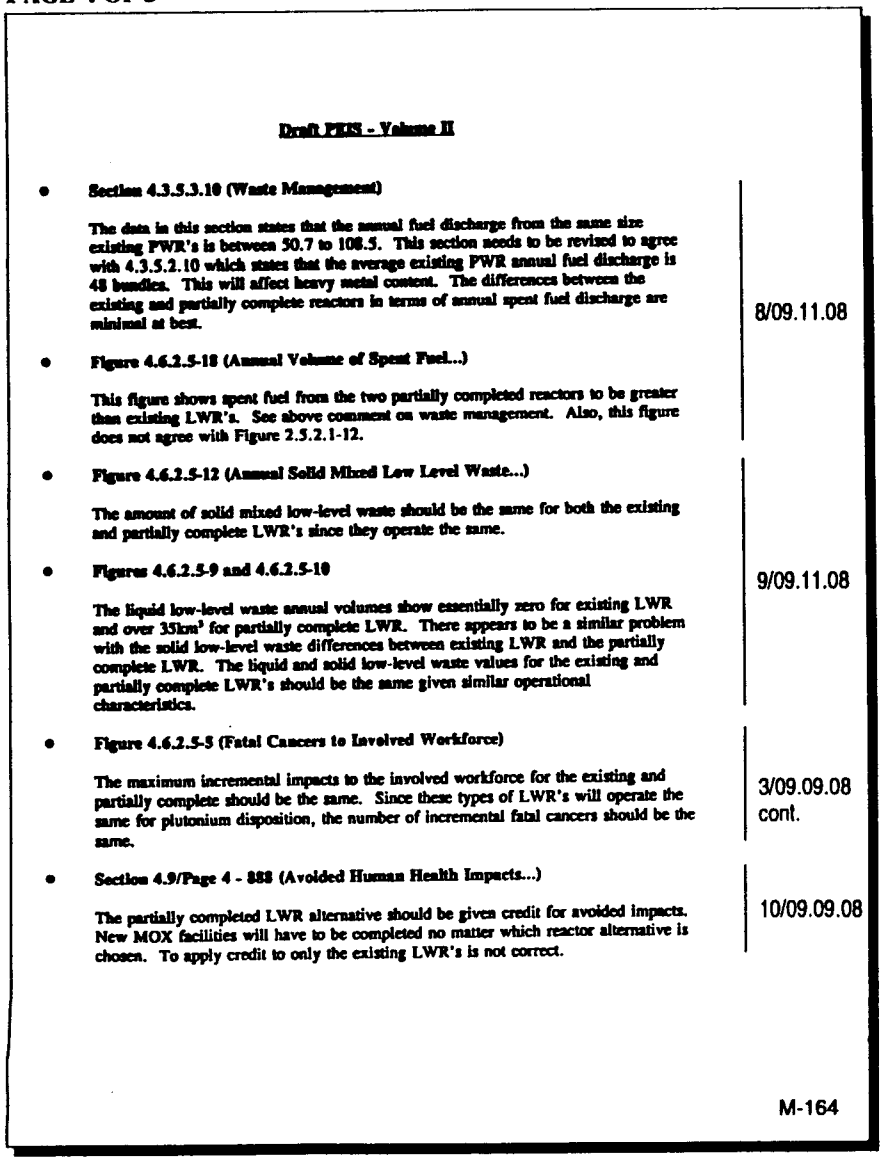
These two major factors contribute to the higher latent fatal cancers for partially completed reactors compared to the existing LWRs.

09 11 08 Comment Number 4

Figure 2.5.2.1–13 of the Draft PEIS does not include MOX fuel fabrication facility generated waste since it is only comparing reactors that all use MOX fuel. Figure 2.5.2–8 of the Draft PEIS includes the waste generated from the MOX facility since the comparison is being done to other alternatives that do not use the MOX fuel fabrication process. The zero hazardous waste for the existing LWR in Figure 2.5.2.1–13 of the Draft PEIS is the incremental change for using MOX fuel. None of the figures contain information on the construction impacts. Construction impacts information is presented in Chapter 4. The PEIS has been modified to show the projected waste quantities as well as the incremental quantities for using MOX fuel, and based on comments received, the comparison figures in Section 2.5 of the Draft PEIS have been removed.

09 06 08 Comment Number 5

Information presented on page 2–130 of the Draft PEIS indicates that the Bellefonte Nuclear Power Plant was selected for inclusion as a typical partially completed power plant. The Bellefonte Final EIS (pages 2.5–3 and



Draft PEIS - Volume II

- **Section 4.3.5.3.10 (Waste Management)**

  The data in this section states that the annual fuel discharge from the same size existing PWR's is between 50.7 to 108.5. This section needs to be revised to agree with 4.3.5.2.10 which states that the average existing PWR annual fuel discharge is 48 bundles. This will affect heavy metal content. The differences between the existing and partially complete reactors in terms of annual spent fuel discharge are minimal at best. — 8/09.11.08

- **Figure 4.6.2.5-18 (Annual Volume of Spent Fuel...)**

  This figure shows spent fuel from the two partially completed reactors to be greater than existing LWR's. See above comment on waste management. Also, this figure does not agree with Figure 2.5.2.1-12.

- **Figure 4.6.2.5-12 (Annual Solid Mixed Low Level Waste...)**

  The amount of solid mixed low-level waste should be the same for both the existing and partially complete LWR's since they operate the same.

- **Figures 4.6.2.5-9 and 4.6.2.5-10** — 9/09.11.08

  The liquid low-level waste annual volumes show essentially zero for existing LWR and over 35km³ for partially complete LWR. There appears to be a similar problem with the solid low-level waste differences between existing LWR and the partially complete LWR. The liquid and solid low-level waste values for the existing and partially complete LWR's should be the same given similar operational characteristics.

- **Figure 4.6.2.5-5 (Fatal Cancers to Involved Workforce)** — 3/09.09.08 cont.

  The maximum incremental impacts to the involved workforce for the existing and partially complete should be the same. Since these types of LWR's will operate the same for plutonium disposition, the number of incremental fatal cancers should be the same.

- **Section 4.9/Page 4 - 888 (Avoided Human Health Impacts...)** — 10/09.09.08

  The partially completed LWR alternative should be given credit for avoided impacts. New MOX facilities will have to be completed no matter which reactor alternative is chosen. To apply credit to only the existing LWR's is not correct.

M-164

2.5–4) states that essentially all of the salt drift is expected to fall within 914 m (2,998 ft) of the cooling towers.

09 07 08 **Comment Number 6**

Because the existing LWR is in use, its effects are known. Effects of the partially completed LWR are not. There is a potential for impacts to Native American resources under this alternative associated with infrastructure improvements and facility operation. Although such impacts are unlikely, they cannot be ruled out at this programmatic level of analysis.

09 04 08 **Comment Number 7**

Comment was incorporated.

09 11 08 **Comment Number 8**

The number of fuel assemblies with UO_2 fuel discharged for seven different existing LWR types is 48 assemblies per year (21 t [23.1 tons]). Using MOX fuel increases the number of assemblies by an average of 32 assemblies (14 t [15.4 tons]) as an average of 33, 61, and 3 more assemblies for a CE-R1, CE-R2, and W-ER, respectively. This gives a total of 80 fuel assemblies discharged per year using MOX fuel. For the partially complete LWRs using MOX fuels, the number of fuel assemblies discharged is 81, 109, and 51 for a CE-R1, CE-R2, and W-ER, respectively. Therefore, the range in Section 4.3.5.3.10 is 50.7 assemblies (22 t [24.2 tons) to 108.5 assemblies (47 t [51.7 tons]) but the average is 80 assemblies discharged similar to the existing LWR. Additional information is contained in Data Report *FMDP LWR PEIS*, Rev 3, December 21, 1995.

09 11 08 **Comment Number 9**

Figures 4.6.2.5–9, 4.6.2.5–10, and 4.6.2.5–12 of the Draft PEIS include the incremental low-level and mixed LLW generated by replacing UO_2 fuel with MOX fuel. As stated in Section 4.3.5.2.10, the use of MOX fuel versus UO_2 fuel would not increase the waste generation rate at existing LWR site. The

partially completed LWR using MOX fuel would generate even more waste since none is currently being generated (nonoperational). The PEIS has been modified to show the projected waste quantities as well as the incremental quantities for using MOX fuel.

09 09 08 Comment Number 10

The avoided environmental impacts for the partially completed LWRs were analyzed and documented in the Final PEIS.

TETON TECHNOLOGIES, INC., IDAHO FALLS, ID,
BILL QUAPP
PAGE 1 OF 9

Teton Technologies, Inc.

860 W. Riverview Dr.
Idaho Falls, ID 83401
Phone 208-535-9001
Fax 208-529-3955

Email wjq@srv.net

Notegram from
Bill Quapp

Please Deliver To: Public Comment Office **Date:** June 7, 1996

I recommend that the DOE consider a passive safety storage system such as described on the attached slides. I have conceived and evaluated such project while at the INEL about 1.5 years ago. I believe that the concept has merit and provides unique and substantial safeguards.

Since the presentation slides do not tell the story by themselves, I will be happy to convey additional information as requested. Feel free to call me at the above number.

1/14.00.00

Sincerely,

Bill Quapp

F-056

14 00 00 **Comment Number 1**

Comment noted.

TETON TECHNOLOGIES, INC., IDAHO FALLS, ID,
BILL QUAPP
PAGE 2 OF 9

Passively Secure Plutonium Storage Concept

W. J. Quapp
J. W. Sterbentz
E. L. Shaber
E. P. Stroupe

October 1994

Plutonium:

If you can't move it - it can't be used to produce weapons

F-056

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PAGE 3 OF 9

Plutonium Storage Has Specific Functional Requirements

- Safe from diversion risks
- Chemically inert storage environment
- Critically safe under all postulated conditions
- Safe from external events (fire, flood, tornado, earthquake)

Desirable Features of Storage System

- Available technology
- Easily demonstrated
- Low cost
- Easily implemented

Conventional Storage Uses Active Protection to Keep Secure

Based on:
- Need for material accessibility
- Short term storage requirements
- Used temporary storage containers

Focusing on Functional Requirements Can Lead to Other Solutions Which May Be Passively Secure

- Cast cylinders
- Formed wafers

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BILL QUAPP
PAGE 4 OF 9

INEL Has Conceived A Passively Secure System that Uses A Massive Container for the Long Term Storage of Weapons Grade Plutonium

- System consists of critically safe, heavy wall, cylinders of borated steel with a cast Pu core
- Cylinders assembled into a robust steel overpack
- The total system is engineered to weigh 50 to 100 tons
- Facilities needed for a process demonstration are already in the DOE complex

INEL Has Performed Nuclear Design Calculations to Determine Criticality Control Requirements

- System will use passive criticality control methods built into crucible alloy
- Container and subassemblies are designed to be subcritical in an infinite lattice
- Vulnerability to physical penetration will be assured by design
- Concept allows storage of Pu in any of several physical or chemical forms

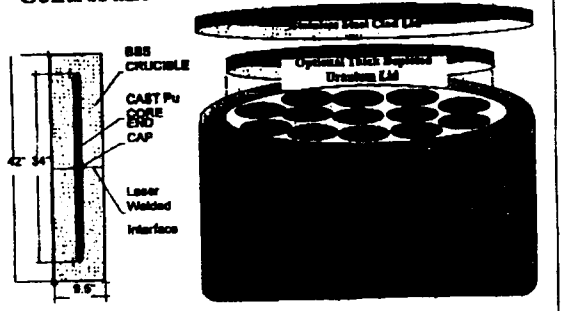
F-056

Preliminary Design Concept for a 50 Ton Inventory

[redacted]

Assembly Diameter (ft)	Number of Subassy's	Assembly Mass (ton)	No of Assemblies
8	80	52	29
10	125	79	19
12	180	110	13

Concept Uses a Critically Safe Cylinder of Borated Steel for both Nuclear Criticality Control and Diversion Resistance



F-056

TETON TECHNOLOGIES, INC., IDAHO FALLS, ID,
BILL QUAPP
PAGE 6 OF 9

Passively Secure Plutonium Storage Area Provides Physical Security and Satellite Surveillance Access

Storage Concept Provides Security and Safeguards Auditability

- Security is achieved through large mass and robust structure
- Storage can be in open area since diversion would require massive lifting capability or heavy machine tooling
- Open storage allows safety inspections, public scrutiny, and satellite surveillance for compliance with international treaties and safeguards requirements
- Open concept reduces the mystique of plutonium storage
- If activities are initiated to move containers, warning can be assured using satellite surveillance

F-056

International Implementation Offers Substantial Benefits and Ease of Treaty Verification

- Concept does not require any irreversible decision such as mixing Pu with fission products or depleted uranium
- Storage configuration provides security against internal diversion
- Eventual use in power reactors is feasible
- Only the Pu casting requires high technology facility
- Steel components could be fabricated in Russia and create jobs and exportable products

Process Can Be Accomplished on a Timely Basis

- In the U.S. most or all the facility infrastructures are in existence
- Steel for crucibles can be obtained from industry
- Alternatively, recycled steel from low level waste could be used -- probably resulting in a cost reduction
- Demonstration of concept can be performed with minimal development costs and facility preparations

F-056

TETON TECHNOLOGIES, INC., IDAHO FALLS, ID,
BILL QUAPP

In Summary

- Storage concept replaces guards with mass
- Provides intermediate to long-term storage in chemically stable environment
- Requires only moderate facility upgrades to accommodate process demonstration
- Makes Pu recovery difficult and easily detectable
- Can be implemented on an international basis to provide secure storage for all sources of plutonium

INEL Would like to Conduct Preconceptual Design Studies

- Develop preliminary design details and perform design optimization studies
- Obtain vendor material and equipment costs
- Evaluate modifications for ANL-West facilities
- Develop unit costs ($/kg-Pu) for various options
  - Cast Pu cylinders
  - Forged wafers
  - Other
- Evaluate vulnerability

F-056

Storage System Components Can Be Demonstrated Using INEL Facilities

- Purchase forged & machined borated steel crucibles
- Melt and cast Pu into crucibles at ANL West
- Seal weld crucibles
- Weld two crucibles together to form large subassembly
- Load subassemblies into storage container
  - weld subassemblies in place
  - weld cover on assembly
- Moved to long term storage area

F-056

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION, AUSTIN, TX, DAN PEARSON
PAGE 1 OF 6

Barry R. Mcbee, Chairman
R. B. "Ralph" Marquez, Commissioner
John M. Baker, Commissioner
Dan Pearson, Executive Director

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

May 7, 1996

Mr. T.C. Adams
Governor's Office of Budget and Planning
P.O. Box 12428
Austin, Texas 78711

Re: U.S. Department of Energy
Draft Programmatic Environmental Impact Statement(PEIS)/
Storage and Disposition of Weapons-Usable Fissile Materials
TX-R-96-03-28-0002-50-00
Draft PEIS/Stockpile Stewardship and Management/
TX-R-96-03-28-0001-50-00

Dear Mr. Adams:

The Texas Natural Resource Conservation Commission (TNRCC) has reviewed the above-referenced Draft PEISs, and our technical review comments are enclosed. The joint comments of the State natural resources trustees are also enclosed.

The TNRCC is concerned that both PEISs should include greater evaluation of risks posed by the alternatives proposed. The PEIS addressing the storage and disposition of weapons does not, but should, consider migration of liquid or solid contaminants and a general worst-case release scenario in case of an accident. The PEIS addressing stockpile stewardship and management does not consider risks from exposure to hazardous chemical releases to water and soils or from a complete phase-out of the Pantex facility. The TNRCC also recommends that the Department of Energy (DOE) share regulatory oversight with another federal or state agency, to minimize the management problems that have caused problems at DOE facilities in the past.

Thank you for the opportunity to participate in this review process. I believe these comments will assist the DOE in considering use of the Pantex facility. If you have any questions regarding these comments, please feel free to contact Mr. David Duncan, Director, Intergovernmental Relations Division, at (512) 239-3510.

Sincerely,

Dan Pearson
Executive Director

F-039

REVIEW COMMENTS
STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS
DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT (EIS)
TEXAS NATURAL RESOURCE CONSERVATION COMMISSION (TNRCC)
OFFICE OF WASTE MANAGEMENT
April 29, 1996

Exposure Modeling -
The MELCOR Accident Consequences Code System (MACCS) model was limited to examining containment transport and exposure via atmospheric dispersion. No exposure modeling was conducted for migration of contaminants in liquid and/or solid phases. For instance, the perched aquifer has been contaminated as a result of wastewater discharges to the ditches and playas, not by air emissions. In addition, the accident scenarios do not account for management error, although human error is identified by DOE as a hazard during the safety design process, or for accidental release of hazardous and/or radiological wastes. 1/09.09.04

Accident Impacts
Considering the value of the Ogallala aquifer, the TNRCC requests that DOE include in its evaluation the impacts/risks of a worst case release to the environment and the state's ability to recover, should such an accident occur. As presented in the PEIS, DOE has diluted the stated risks by factoring in the probability of the accident occurring. The TNRCC requests that the accident probability not be factored into the risk. 2/09.09.04

Regulatory Oversight of Radioactive Constituents -
Although all surface water discharges will reportedly be monitored and subject to NPDES requirements, the TNRCC notes that no radiological water quality parameters are specified in TNRCC Permit No. 02296, which corresponds to NPDES Permit No. TX0107107. These parameters are of particular interest to the state, considering the potential for waste releases from the proposed Pu conversion processes. The TNRCC requests that DOE take action which will enable the State of Texas to legally monitor and regulate radioactive constituents.

The TNRCC would be more willing to accept plutonium conversion processes within the State of Texas if DOE would actively champion external regulatory oversight for radioactive source, special nuclear or byproduct material. It is our understanding that many of the serious problems DOE facilities are facing today occurred as a result of management problems and conflicting missions, rather than lack of technical expertise. It is our opinion that these sorts of errors can best be minimized if the oversight is shared with a regulatory agency outside of DOE. 3/01.00.00

If you have any questions regarding these comments, please contact Mr. Geoffrey Meyer, Industrial and Hazardous Waste Division, Federal Facilities Team, at (512) 2577.

F-039

09 09 04 Comment Number 1

The MACCS code does not calculate water-pathway exposures. However, if an accident occurs, radioactive air emissions would be the immediate concern and dominate the human health impact. Other pathways such as a liquid release may be a concern after an accident. However, the potential impacts are delayed and the magnitude of the impacts is smaller since it takes time for radioactivity to reach to an aquifer, following a release, and be consumed by or exposed to humans, animals, or plants. This is particularly true for Pu, which has slower migration characteristics in unsaturated and saturated soils, delaying its transport to an aquifer.

The accident scenarios were developed based on applicable information including Safety Analysis Reports, NEPA documents and related backup information, DOE's safety surveys, and discussions with experts familiar with potential accidents for facilities and operations evaluated in this PEIS. The accident scenarios were developed to yield the maximum, or bounding, consequences to cover all potential accidents initiating events.

09 09 04 Comment Number 2

If an accident were to occur, radioactive air emissions would be an immediate concern and would be closely monitored to determine the potential for any human health impacts. Although other pathways such as liquid releases are also a concern, they may not be apparent until some time after an accident. As a result, their impacts would be delayed. There would be more time to take corrective action, and the magnitude of the impacts would be much smaller. This is because it takes substantially more time for contaminated liquids to reach an aquifer and then be consumed or come in contact with humans, animals, or plants. This is particularly true for Pu which has slow migration characteristics into unsaturated soils, thereby further contributing to a long delay of a liquid release reaching an aquifer.

When analyzing an anticipated accident, both the consequences and the frequency of the accident occurrence are considered. If an accident occurs, the consequences include the identification of potential human impacts. The accident frequency reflects the probability that an accident will occur. Both the consequences and the probability need to be presented in the PEIS so that

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION, AUSTIN, TX, DAN PEARSON
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REVIEW COMMENTS
ADDENDUM
STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS
DRAFT PROGRAMMATIC EIS
Geoffrey Mayer
May 3, 1996

The acceptable lifetime cancer risk under the TNRCC corrective action process is between 1x10-6 and 1x10-4 (one in one thousand and one in a million). According to Table 4.3.4.9-1, the estimated risk of cancer fatalities for the public under the No Action and Storage Scenarios is between 7.9x10-6 and 2.4x10-11. The following plutonium disposition alternatives/subalternatives have estimated cancer risks for the public that exceed the maximum risk of 1x10-4 under normal operations at Pantex (Chapter 4):

Direct Disposition - Deep Borehole
MOX Fuel Fabrication Facility

The following plutonium disposition alternatives/subalternatives have estimated cancer risks for the site workers that exceed the maximum risk of 1x10-4 under normal operations at Pantex (Chapter 4): 4/09.09.04

Pit Disassembly/Conversion Facility
Plutonium Conversion Facility
Deep Borehole Complex
Ceramic Immobilization
Vitrification
Electrometallurgical Treatment
MOX Fuel Fabrication Facility
Evolutionary Light Water Reactor

Workers involved in the storage of plutonium at upgraded facilities, consolidated plutonium storage facilities, and facilities that collocate plutonium with HEU have an estimated fatal cancer risk on 5.0x10-5.

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the public and the decisionmaker can put the risk of each alternative into proper perspective.

01 00 00 Comment Number 3

Comment noted. DOE is committed to operating its facilities in full compliance with applicable regulatory requirements.

09 09 04 Comment Number 4

The cancer risks for the MEI of the public for the deep borehole and MOX fuel fabrication facility are 3.1×10^{-10} to 1.6×10^{-5} (generic site) and 5.6×10^{-8} (Pantex) during facility lifetime normal operation. However, worker radiological exposures are regulated by annual dose limits. For the workers involved in the proposed disposition actions, the maximum radiation dose is 810 mrem/yr (large evolutionary LWR). This dose is below DOE's administrative control limit of 2,000 mrem/yr (DOE/EH 0256T) and the Federal limit of 5,000 mrem/yr (10 CFR 835). It is DOE's policy to practice ALARA and keep worker exposures below their administrative control limit.

REVIEW COMMENTS
STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS
DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT (EIS)
Texas Natural Resource Conservation Commission (TNRCC)
Office of Air Quality
April 30, 1996

Our review was limited to Pantex Plant and only with regard to air quality impacts of nonradiological pollutants:

- There is no significant difference in the No Action Alternative and Storage at Pantex Alternative.
- No increase in toxic/hazardous air pollutants is anticipated under the no action alternative..
- Estimated operational concentrations of pollutants are provided in Table 4.2.4.3-1 in the PEIS. It is not clear how the emissions were estimated. Neither TNRCC nor the DOE operates monitors at Pantex for criteria pollutants (Ozone, Carbon Monoxide, Sulfur Dioxide, Nitrogen Dioxide, and Lead), except for respirable particulates of 10 microns or less in diameter (PM10). — 5/09.03.04
- Table 4.2.4.3-1 provides an annual average value of 8.73 micrograms/m3 and 24 hour average of 88.5 micrograms/m3 as estimated concentrations of PM10 for No Action Alternative. Storage alternative increases both values slightly. These numbers vary considerably from monitored levels. The highest annual average of monitored values is 22 micrograms/m3 (versus 50 micrograms/m3 standard), and the highest 24-hour average of monitored values is 270 micrograms/m3 (versus 150 micrograms/m3). — 6/09.03.04
- Since TNRCC started monitoring at Pantex in September 1992, we have recorded five exceedances of the PM10 24-hour standard at Pantex, the highest of which was 353 micrograms/m3 in January 1996.
- The same holds true for Total Suspended Particulates (TSP). The table indicates that no sources are indicated for TSP. However, we recorded two very high readings in 1993 at 650 and 461 micrograms/m3. Since there are no national standards for TSP, TNRCC has stopped analyzing filters for TSP. — 6/09.03.04 cont.
- Methylene Chloride is the only toxic pollutant that exceeded the effects screening levels established by the TNRCC Toxicologists. However, it was determined that no long-term health impacts are to be expected from this one time event.
- It is to be noted that the PM10 exceedances were recorded on days when blowing dust was present or some dirt moving activity was taking place close to the monitoring station. In the Consolidation Alternative, the PEIS makes a statement that appropriate control measures would be followed to minimize pollutant concentrations (PM10 and TSP) during construction. This should satisfy TNRCC requirement for protecting public health and welfare. — 7/09.03.04

If you have any questions regarding the above comments, please contact Mr. Joe Pankrath, Office of Air Quality, Ambient Monitoring Section, at (512) 239-1656.

F-039

09 03 04 Comment Number 5

Concentrations of air pollutants for the No Action Alternative presented in Table 4.2.4.3–1 are provided by Pantex. These concentrations are based on modeling of recent emissions data. Emission data is routinely assembled by Pantex and presented to the Texas Natural Resources Conservation Commission (TNRCC) in the quarterly *Air Quality Assessment Program-Pantex Nuclear Facility Ambient Air Monitoring Quarterly Report.* As described on page 3–6, the baseline air quality of the affected environment is based on model-predicted pollutant concentrations for existing sources using concentrations presented or by modeling recent emission data. The emissions data for Pantex are from an inventory completed in 1994 for DOE. TNRCC, in cooperation with DOT, operates several air quality monitoring stations at Pantex. The measured pollutants include particulate matter less than or equal to 10 microns (PM_{10}), hydrogen fluoride (HF), and organic pollutants such as volatile organic compounds (VOCs).

09 03 04 Comment Number 6

Concentrations of air pollutants for the No Action Alternative presented in Table 4.2.4.3–1 are provided by Pantex. These concentrations are based on modeling of recent emissions data. Emissions data is routinely assembled by Pantex and presented to TNRCC in the quarterly *Air Quality Assessment Program-Pantex Nuclear Facility Ambient Air Monitoring Quarterly Report.* The emissions data for Pantex are from an inventory completed in 1994 for DOE. The PM_{10} concentrations represent the maximum estimated concentration of PM_{10} based on a 500, 1,000, and 2,000 weapons level of activity and scenarios which include the burning of 45.36 kg (100 lb) and 362.88 kg (800 lb) of high explosives. The PM_{10} monitoring data from TNRCC monitors at Pantex were not used since these data do not reflect the anticipated future level of activity at the site.

09 03 04 Comment Number 7

It is assumed in the PEIS, that all Federal, State, and local environmental regulations and guidelines would be met during construction and operation of the various facilities, and that standard industry-accepted mitigation control measures would be utilized. Particulate matter control measures may include watering of exposed areas and roads as may be required by TNRCC.

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION, AUSTIN, TX, DAN PEARSON
PAGE 5 OF 6

Texas Natural Resource Conservation Commission

TO: Sidney Wheeler, Intergovernmental Relations DATE: May 3, 1996

FROM: Ginny King, TNRCC Natural Resource Trustee Program (NRTP)

SUBJECT: Joint Trustee Comments to the "Stockpile Stewardship and Management" and "Disposal of Weapons-Usable Fissile Materials" Environmental Impact Statements for the Pantex Superfund Site

As Lead Administrative Trustee (LAT) on behalf of the State Trustees, Texas General Land Office (TGLO), Texas Parks and Wildlife (TPWD), and Texas Natural Resource Conservation (TNRCC), this memo is written to provide the State Trustees' comments on the "Stockpile Stewardship and Management EIS " and the "Storage and Disposal of Weapons-Usable Fissile Materials EIS" for the Pantex Superfund Site.

The Trustees for the State of Texas strongly support the President of the United States and the Department of Energy (DOE) in the unilateral efforts to reduce the number of armed nuclear warheads worldwide. We further recognize the difficult responsibility of storing and stockpiling the Nation's disassembled nuclear weaponry. However, the DOE is one of the Federal Trustees for natural resources and has the responsibility of protecting these natural resources from injury on behalf of the public.

The Trustees have concerns with the Storage and Disposition of Fissile materials at the Pantex Superfund site due to the natural resources associated with this site. The Pantex site overlies one of the most pristine groundwater resources in the United States, the Ogallala aquifer. As a pristine natural resource, it is worthy of much protection. Former waste management practices at the Pantex facility have generated a perched aquifer that is not consistent across the site but is present in the Zone 11 and 12 areas. The Trustees understand that to date, the extent of the perched aquifer has not been determined. We further understand that discharges of wastewater are not directly discharged into the perched aquifer; however, the connection of the discharge areas to the perched aquifer and eventually to the Ogallala has not been established. This perched aquifer is contaminated with several hazardous substances. The proposed constructions of the Pit Disassembly Conversion facility, Plutonium (Pu) conversion facility and MOX fuel facility cause great concern among the Trustees. The proposed locations for these facilities are all within Zones 11 and 12 which overlie the perched aquifer. The potential for this perched aquifer to be further contaminated exists as a result of these proposed operations, which increases the potential for injury to the Ogallala. 8/09.04.04

The potential for Playa 1 to be further contaminated is another concern. The Playas may be a potential recharge source for the perched aquifer which may be a source of recharge for the Ogallala. In addition, the Playas are surface water resources for many aquatic and terrestrial, vertebrate and invertebrate species. Therefore, the Pantex site contains many natural resources that have the potential to be injured as a result of the proposed DOE practices. 9/09.04.04

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09 04 04 Comment Number 8

Waste/hazardous material treatment/handling operations are regulated to minimize the potential for releases of hazardous substances to the soil or surface water which could then migrate to the groundwater.

09 04 04 Comment Number 9

Wastewater discharge to Playa 1 is regularly monitored for specific parameters under a National Pollutant Discharge Elimination System (NPDES) permit issued by the TNRCC. The actions proposed in the PEIS are not expected to have an effect on the quality of wastewater discharged to Playa 1 and, therefore, are not expected to have an effect on the perched or Ogallala Aquifer.

Memo Re: Joint Trustee Comments to the Pantex Draft EIS
Page 2

Although the surface water discharges will reportedly be monitored and subject to NPDES permit requirements, the Trustees note that no radiological water quality parameters are specified in the TNRCC permit no. 02296, which corresponds to NPDES Permit NO. TX0107107. These parameters are of particular interest to the Trustees, considering the potential for waste releases from the proposed Pu conversion processes. The Trustees understand that many of the serious problems DOE facilities are facing today are as a result of management problems and conflicting missions rather than lack of technical expertise. It is the opinion of the Trustees that errors of this nature can be minimized if the oversight is shared with a regulatory agency outside of DOE. The Trustees request that DOE initiate action which will enable the State of Texas to legally monitor and regulate radioactive constituents.

Considering the value of the Ogallala aquifer, the Trustees request that DOE include in its evaluation, the impacts of a worst case release to the environment and the ability of the Panhandle of Texas to recover, should such an accident occur. Under this scenario, the accident probability would be set at one, rather than the typical one in 10,000 or 10,000,000. | 2/09.09.04 cont.

It is the understanding of the Trustees that a Treatability study of the contaminated perched aquifer is ongoing at the Pantex site. We further understand that this study has been successful and several thousand gallons of "clean water" are being generated as a result of this treatment. If the new Pu facilities are constructed in Zone 12, the Trustees recommend the utilization of this treated water for the Pu process rather than impact the water supply of the Ogallala. This would insure further protection of a natural resource on behalf of the public. | 10/09.04.04

The DOE should consider both short term and long term protection strategies for the Ogallala aquifer. The Trustees recommend that DOE include the natural resource Trustee agencies in the evaluation of minimizing injuries to natural resources and potential candidate areas for restoration when residual injury remains. | 11/09.04.04

cc: Richard Seiler, Manager, NRTP TNRCC
Don Pitts, TPWD
Diane Hyatt, TOLO
Bob Short, USFW Arlington
Steve Spencer, DOI
Ron Gouguet, NOAA CRC Region 6
Geof Meyer, RCRA TNRCC

F-039

09 04 04 Comment Number 10

The Department of Energy will consider reuse of this treated groundwater for any potentially beneficial uses. However, re-injection (to the perched aquifer) of this treated water may be necessary for optimal performance of the groundwater treatment system.

09 04 04 Comment Number 11

It is DOE's opinion that the opportunity to comment on this and other documents relating to potential activities at Pantex includes the Trustee agencies in the evaluation of potential environmental impacts. DOE will continue to work with the State Trustee agencies on compliance and restoration activities, and protection strategies for the Ogallala Aquifer.

TEXAS TECH UNIVERSITY HEALTH SCIENCES CENTER, AMARILLO, TX, ARTHUR A. NELSON
PAGE 1 OF 2

TEXAS TECH UNIVERSITY HEALTH SCIENCES CENTER at AMARILLO

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April 10, 1996

U.S. Department of Energy
Office of Reconfiguration
P.O. Box 3417
Alexandia, Virginia 22302

U.S. Department of Energy
Office of Fissle Materials
P.O. Box 23786
Washington, DC 20026

RE: Comment on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissle materials Draft Programmatic Environmental Impact Statements (PEISs)

Thank you for this opportunity to comment on the U.S. Department of Energy's (DOE) Programmatic Environmental Impact Statements (PEISs) on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials. These comments are also directed toward the Pantex Site-Wide Draft Environmental Impact Statement, as most issues addressed in both these documents are identical.

Texas Tech University Health Sciences Center School of Pharmacy fully supports the retention and expansion of the Pantex facility as a storage, processing and component fabrication complex with capabilities for non-nuclear manufacturing and also research, development and testing. Pantex has been an integral part of this community for more than forty years, and has done so as a safe and environmental "clean" complex. There is every reason to believe that the facility would continue operating in such a manner. Pantex has been a pivotal force in expanding the economic base of the Panhandle from agrarian to industrial. As part of the community of Amarillo, we at Texas Tech University Health Sciences Center at Amarillo, depend on the socio/economic impact Pantex provides our area.

1/08.03.01

I am pleased that the DOE selected Pantex as the preferred alternative for assembly/disassembly. It is hopeful that Pantex will also be recognized as the preferred candidate site for new and/or consolidated stockpile management facilities. Pantex is the best site for maintaining the integrity of the U.S. nuclear stockpile because of maximum efficiencies and cost savings.

Labor cost, utility rates and water and land availability at Pantex make it the best site and perhaps the most cost-effective alternative for any new construction of SSM facilities. As an alternative site for all future defense-related facilities, Pantex would complement activities at the national

M-041

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

TEXAS TECH UNIVERSITY HEALTH SCIENCES CENTER, AMARILLO, TX, ARTHUR A. NELSON
PAGE 2 OF 2

labs (such as the planned Atlas Facility and plutonium pit fabrication site at Los Alamos National Laboratory). Additional defense-related activities at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost. The DOE should insist that, in its deliberations, budgetary comparisons between Pantex and the other sites are accurate and include capital, transportation, training, remediation and other costs.

The high explosives (HE) functions should also remain at Pantex in conjunction with the assembly/disassembly functions. HE capabilities must be retained to process the inventories on site from dismantling. This is also the least expensive alternative. Transfer of HE functions away from Pantex would cost between $40 and $50 million. Should future need arise for new weapon production it would be critical to have the HE facility at the weapons production/assembly site.

Pantex currently safely stores more than 8,000 surplus pits and plans are being made to ship additional pits from Rocky Flats to Pantex. I does not make sense to re-create storage facilities at another site and transport large amounts of plutonium across the country.Pantex should be designated the preferred site for any disposition options and related functions. Pantex could continue to store plutonium which is already on site and upgrade facilities for any and all storage options by DOE with minimal cost. It makes budgetary and policy sense to site disposition where storage already exists. Pantex already has the necessary safety , security and surveillance capabilities to accommodate an expanded role and is the production site closest to Los Alamos, the planned pit fabrication site.

1/08.03.01
cont.

I respectfully request DOE to designate Pantex as the preferred alternative site for all existing and new stockpile management and stewardship functions as well as consolidation of all plutonium storage and disposition and any related functions.

Thank you for the opportunity to comment on these documents.

Sincerely,

Arthur A. Nelson, R.Ph., Ph.D., Dean

M-041

THOMAS J. WATSON RESEARCH CENTER, YORKTOWN HEIGHTS, NY, RICHARD L. GARWIN

PAGE 1 OF 2

From rsa@watson.ibm.com Mon Apr 8 14:21:26 1996
Date: Mon, 08 Apr 1996 14:18:52 -0400 (EDT)
From: "Jean Hernandez (Secretary to R.L. Garwin)" <rsa@watson.ibm.com>
Subject: 04/08/96 Letter R.L. Garwin to President Bill Clinton.
To: president@WhiteHouse.GOV
Reply-to: RSA@watson.ibm.com
Message-id: <01I3AVOOVFZ800007K@STORM.EOP.GOV>

Richard L. Garwin
IBM Fellow Emeritus
Thomas J. Watson Research Center
P.O. Box 218
Yorktown Heights, NY 10598-0218
(914) 945-2555
FAX: (914) 945-4419
INTERNET: RLG2 at watson.ibm.com

April 8, 1996

President Bill Clinton
The White House
1000 Pennsylvania Avenue
Washington, DC 20500

Dear Mr. President:

I am writing to support enthusiastically the letter to you of 03/19/96 from John Ahearne, Floyd Culler, Paul Doty, Richard Kennedy, Pief Panofsky, and Nobel Prize winner Glenn T. Seaborg to hasten and reinforce the program for protection and disposition of excess weapon-usable fissile materials.

At Los Alamos during the 1950s and 60s I helped design, build, and test nuclear and thermonuclear weapons. Over the decades, I have also been a member of U.S. teams and backup groups for the negotiation of limitations on nuclear weapons and on their testing.

Now at a time of historic agreement with the Russian state, we are frittering away a golden opportunity not only to get rid of vast numbers of Russian nuclear weapons, but also of the material to make them. What we need now is Presidential leadership that will

1. Inspire DOE to move forward with actual project-oriented programs to burn excess plutonium in existing U.S. reactors (without endorsing the reprocessing of nuclear fuel to obtain further plutonium) as well as to vitrify a portion of the excess weapon plutonium.

1/08.03.01

E-008

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support of the Reactor and Immobilization Alternatives. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

2. Establish in law a national priority to proceed with plutonium disposition, making an explicit statement to utilities, regulatory authorities, and others that this is the policy of the United States, in the interests of U.S. national security.

3. Support DOE's request for plutonium disposition activities, while directing that at least 15% of the

total should be expended on programs in Russia, to ensure that disposition of Russian excess weapon plutonium can be accomplished together with disposition of U.S. plutonium.

4. Increase funding for material protection, control, and accounting.

5. Lead a Comprehensive approach to controlling nuclear smuggling.

6. Redouble the focus on nuclear transparency to ensure that the U.S. has an insight into actual Russian activities, and that Russia has similar insight into U.S. stockpiles and disposition activities, in order to quell Russian internal propaganda.

7. Show that reinventing government works in DOE in going beyond openness to effective action.

I was in Beijing in February and Moscow in March, and I know how much U.S. leadership is necessary in this field. We are way behind where we should be in avoiding this threat to our national and international security, and I urge you to act both in Washington and at the nuclear summit in Moscow.

Sincerely yours,

Richard L. Garwin

cc:
B. Clinton, DC. (Via Email to president at whitehouse.gov)

RLG:jah:V099BC:040896..BC

E-008

2/15.00.00

3/01.03.00

2/15.00.00 cont.

3/01.03.00 cont.

15 00 00 **Comment Number 2**

Comment noted.

01 03 00 **Comment Number 3**

Comment noted.

THOMAS, ANITA, POCATELLO, ID
PAGE 1 OF 1

Comment ID: P0021
Date Received: April 18, 1996
Name: Anita Thomas
Address: 3559 Conlin Road
Pocatello, ID
Phone: 208-238-1696

Transcription:

I believe that it would be a very good idea to use the plutonium to generate energy in a nuclear reactor before disposing of it. Thanks. | 1/08.03.01

P-021

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

To Whom It May Concern
(1-800-820-5156)

May 6, 1996

From L.B. Thomas
3409 Pickard Ave. NE
Albuquerque, NM 87110

Subject: Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement Comments

I wish to present the following comments:

1) What is the legal reason HEU and Pu pits are not considered a solid waste under 40 CFR 261.2 (a)(1), (a)(2), (a)(2)i, (a)(2)ii, (a)(2)iii, (2)(b), (2)(b)1, (2)(b)2, (2)(b)3, (2)(c), (2)(c)(1), (2)(c)(2), 2(d), or 2(e).

2) When do HEU and Pu pits become a solid waste under comment #1's citations.

3) Please provide EPA's opinion on the issue in comment #1.

4) Please provide the US Justice Department's opinion on the issue in comment #1. Further provide State RCRA program opinions of the respective sites. — 1/01.00.00

5) If HEU and Pu pits become solid waste at some point, would the waste be hazardous waste because of lead (Pb) content, D001, and or D003? Or other?

6) If surplus HEU and Pu are not considered solid waste because of the value and potential use in a nuclear weapon or other reason covered under the Atomic Energy Act, what proof does DOE provide that a strategic or surplused HEU or Pu pits can pass recertification back into the stockpile. This EIS does not prove DOE possesses the capability of recertifying HEU and Pu pits during a crisis. Nor does DOE prove recertification and reassembly does not pose a greater risk to workers because of changes to the aging pits through increased radiation output, material fatigue of the casing, or other material related problems. Further since one of DOE's missions includes providing safe and reliable weapons, what proof does DOE have that a recertified HEU and Pu pit from storage can be safe and reliable? Request DOE be prudent and provide proof or bound the impacts. This issue of DOE's recertification capability is a fatal flaw of this EIS because the DOE lack a "technical maturity" in this area. Further, DOE has not assessed this weakness. — 2/01.00.00

7) DOE's response to Comment #6 should be independently confirmed by EPA, NRC, or other agency.

8) Global comment. DOE states throughout the document the word disposition. I would argue the word should be disposal. Legally speaking isn't the definition of the word disposition defined as the act or the power of disposing or the state of being disposed? If DOE believes what it is doing is not management of a solid waste as defined in 40 CFR 261, and therefore not a hazardous waste, then DOE should state that RCRA does not apply. Further, one of NEPA's purposes is to provide the public with the best available information in plain language. This hopefully allows for easy understanding by the public in complicated actions. Use of the word disposition is not plain language and thus not meeting one of the basic requirements of NEPA. One has to question DOE objectiveness on this issue since declaring pits a solid waste would result in massive non-compliance with RCRA. — 3/01.02.00; 1/01.00.00 cont.; 3/01.02.00 cont.; 1/01.00.00 cont.

9) To further argue the point in comment #8 that DOE plans to do disposal while avoiding requirements under RCRA please note the choice of words used on page 1-3. DOE states "Examples of residue forms — 4/01.02.00

1

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement-Comments

F-011

01 00 00 Comment Number 1

The *Atomic Energy Act* materials (including special nuclear materials such as weapons-usable fissile materials) are excluded from the definition of solid waste under RCRA and its implementing regulations, as stated in the *Solid Waste Disposal Act*, Section 1004. Furthermore, Section 1006 also states that RCRA does not apply to any materials that are subject to the AEA.

All reasonable alternatives for Pu disposition analyzed in the PEIS would generate wastes. The environmental impacts of the various wastes are discussed in Section 4.3 and Appendix E of the PEIS.

01 00 00 Comment Number 2

The purpose and need of the PEIS is to disposition surplus Pu, and under the HEU EIS and ROD, to disposition surplus HEU consistent with the President's Nonproliferation Policy. There is no intent or proposal to "recertify" or convert the materials into weapons once the surplus weapons-usable materials has been dispositioned.

01 02 00 Comment Number 3

The Department of Energy has considered your comment, but believes that "disposition" is plain English, and that "disposal" would be misleading for most disposition alternatives because it connotes direct discard of the material.

01 02 00 Comment Number 4

As explained in the PEIS, some residues after appropriate stabilization will be dispositioned through one of the disposition alternatives. Pu is special nuclear material that is not subject to RCRA as explained in the response to Comment Number 1. Any necessary stabilization or treatment is or will be covered by other DOE NEPA reviews. Treatment or stabilization could result in Pu which would be covered by this PEIS and, as explained above, such Pu is not subject to RCRA.

include some impure oxides & metals, halide salts, combustibles, ash, sludges, and contaminated glass." These terms are clearly wastestreams. What is DOE's position?

10) To further argue the point in comment #8 please again note the wording on page 1-3. DOE states "portion of the residues will potentially be declared non-weapon-usable waste." This suggests DOE does not know whether it currently manages a solid waste. Thus DOE does not have a good handle on the material because it has not determined certain residues under its management are wastes. What is DOE's position? — 4/01.02.00 cont.

11) Legally what is DOE's position as to why Pu residue stabilization isn't considered RCRA treatment? Please provide the legal citations to defend position. What are the impacts of Pu residue stabilization if it is considered RCRA treatment?

12) Legally what is DOE's position regarding why HEU and Pu is not considered a "scrap metal" or "precious metal" as defined and managed under RCRA? Please provide the legal citations to defend position. — 1/01.00.00 cont.

13) Is it not conceivable that certain HEU and Pu weapon-usable fissile material currently in storage would not meet the current, scientifically prudent, and safety based QA/QC criteria for actual use on a nuclear weapon? Is it not true that this is partially because the DOE regards *safety* and reliability of utmost importance? A reasonable person could conclude that with or without expensive research into the recertification of old pits or a reduction in the safety and reliability QA/QC criteria, DOE would not successfully recertify dispositioned HEU and Pu pits back into the stockpile. Is it not reasonable to assume DOE would need to totally reprocess the pits or start from scratch (e.g. new production) to assure safety and reliability currently expected by the people of the United States? — 2/01.00.00 cont.

14) When does the storage of HEU and Pu meet the definition of "accumulated speculatively" and "inherently waste-like" occur? Please provide written defense of the position utilizing regulatory citations. — 1/01.00.00 cont.

15) To provide a reasonable response to comment #13. Yes or No, has DOE successfully tested dispositioned pits? For all current programs? Please respond in a classified appendix if necessary.

16) Since DOE does not prove in this EIS that it currently possesses an infrastructure to recertify dispositioned pits, then how can the decision maker effectively address where to put the pits? What proof does DOE provide in this document it has the ability to recertify? Further this connected action of recertification has not been analyzed for impacts to the storage and disposition EIS. Please assess impacts of this connected action? A reasonable person would believe the lack of discussion about the recertification capabilities current and future is a fatal flaw in the document. Also the impacts of restarting a production program has not been addressed (also a connected action) by this EIS should the recertification process fail. Please analyze and discuss the impacts to a new production program restart after a failed recertification program. DOE appears to be placing all its eggs in one basket without recognizing that once it selects storage and disposition there is no way back. — 2/01.00.00 cont. / 5/11.00.08

17) When does surplus fissile material meet the definition of a "solid waste"? Never? — 1/01.00.00 cont.

18) Clearly DOE knows certain HEU and Pu materials are not worth making strategic, what proof does DOE have that strategic reserves could be placed back into the stockpile during a time of crisis? The decision maker needs to know. The free people of the United States need to know whether our freedom is at risk because DOE plans to reduce the deterrence factor without a proven capability of restoring the deterrence if threatened. — 5/11.00.08 cont.

F-011

11 00 08 Comment Number 5

The Stockpile Stewardship and Management PEIS, which is referenced as related document in Chapter 1 of this Storage and Disposition PEIS, assesses pit refurbishment, stockpile management, and pit production capabilities.

19) DOE and EPA, What if I just surplused lead-acid batteries to the ground (a form of land disposal like storage) why is my activity considered a violation of RCRA but storage and disposition of HEU and Pu is not? Please provide written defense of your position. — 1/01.00.00 cont.

20) DOE and EPA, If Pu were considered a solid waste would one or all of the following apply: 40 CFR 261.21 (a)(2), 261.21 (a)(4), 261.23(a)(1), 261.23(a)(2), 261.23(a)(3), 261.23(a)(4), 261.23(a)(6)?

21) Why isn't deep borehole and immobilization RCRA treatment/disposal? Please provide a written position using regulatory citations.

22) What is EPA's position on comment #21? — 6/04.00.00

23) Does deep borehole meet the definition of an injection well? Has DOE considered this in the impacts?

24) Reconsider underground nuclear detonation. The test ban treaty might allow the disposition of warheads if no data is collected. Plus one detonation could be used to destroy multiple warheads or even pits. I would believe that Russian verification could be relatively easy.

25) Should consider underground nuclear detonation in Russia as an alternative. — 7/01.05.00

26) Question the accuracy of the DOE statement that underground nuclear detonation might result in a violation of regulatory and licensing requirements? Please tell me what regulatory and licensing requirements would be needed by DOE to disposition pits?

27) Reconsider R12 since the surplus of helium exists. The helium surplus is located near Amarillo-thus a synergistic factor exists that the selection committee was not unaware of. Further, the US government is responsible for the helium reserve and bring a lower solution to DOE.

28) I believe the requirement sections in 2.3.2 and associated subsections neglect a requirement of protecting the HEU and Pu repository from a large meteor and a kook's nuclear bomb. I am concerned DOE would store all the eggs in one basket without a highly protective configuration. Please all consider that the US stores patent documentation in a bomb proof repository. HEU and Pu should be equally protected. — 8/02.00.08

29) At a minimum, please use this material as a fuel for energy recovery, desalination of seawater, or desalination of brine for use in the arid Southwest. — 7/01.05.00 cont.

30) Assess an alternative for desalination of salt water with weapon useable fissile material as a source of energy.

31) Specifically, under what NEPA documentation is the storage and disposition of other materials not included in this EIS covered? How does that relationship impact this document?

32) Assess which facility would be best suited for recertification of fissile material taking into account assembly experience, security infrastructure, storage capabilities, nonproliferation track record, etc. — 5/11.00.08 cont.

33) Please sent me a copy of the Final.

F-011

04 00 00 **Comment Number 6**

The Department of Energy recognizes that legislative and regulatory clarification may be required. The alternative was assessed even though legal clarification may be required, because the CEQ regulations that implement NEPA require consideration of a range of all reasonable alternatives.

01 05 00 **Comment Number 7**

The screening process and criteria used by DOE to identify reasonable alternatives are summarized in Chapter 2 and in a separate document entitled *Report of the Screening Process to Determine Reasonable Alternatives for Long-Term Storage and Disposition of Weapons-Usable Fissile Materials.* The NEPA coverage of storage and disposition of other materials is described in Section 1.4 of the PEIS. DOE continues to believe that underground detonation is an unreasonable alternative for disposition of fissile materials. Although DOE has considered your comment regarding desalination, the use of fissile materials as an energy source for desalination is indirectly included in the evolutionary LWR technology. The evolutionary LWR could be used for electricity generation or for some other heat or power source for a process such as desalination. Use of Pu for energy is evaluated in the PEIS in the Reactor Alternatives and, if selected in the ROD, licensing and further tiered NEPA analyses would be required.

02 00 08 **Comment Number 8**

Section 2.3.3.1 of the PEIS discusses security for the Collocation Alternative. Under the Collocation Alternative, material storage, material handling, and storage support would be located in a high security, protected area.

THOMPSON, GARY
PAGE 1 OF 2

Comment ID: P0044
Date Received: May 8, 1996
Name: Gary Thompson
Phone: (303) 966-6419

Transcription:

I had planned on faxing this, but I'll try to read it rapidly. First General Comment - We seem to be determined to eliminate our surplus materials, unilaterally if need be, in order to serve as an example to Russia and other nations. We are willing to do so whether or not Russia and other countries follow suit, and I've said this is our intention. We may expect other countries to do what they have said they will do. Keep materials in excess of those amounts needed for defense for use in reactors. Comments on the disposition alternatives - Deep borehole - Considering the amount of money already spent in digging holes in salt into salt and the citizens of the involved states dislike for accepting anything other than the money in creating the holes, this seems to be scant reason to spend time and money on the borehole option. Plutonium immobilization - Most anti-nuclear activists and pacifists see vitrification as a way of preventing the fabrication of nuclear weapons components by the U.S. and weapons proliferation in other nations. While preventing proliferation is an admirable goal, our electing to immobilize plutonium in the hope that others will follow suit is naive. It is every bit as naive as President Carter's decision not to permit reprocessing spent fuel in the United States for the same reason - to serve as a good example to other nations. The United States is the only nuclear power that intends to dispose of plutonium in a waste, rather than use it as fuel. Once again, everyone is out of step in the nuclear parade except Uncle Sam. You can expect the same response from those whom we intend to influence, as they gave before. It would seem that it is too soon for us to rush to dispose of our plutonium in this manner. It would be more appropriate to recover and store it in 50 year cans. To borrow a phrase from our environmentalists and anti-nuclear friends, when any suggestion to do something in the near future with nuclear materials is made, why don't we wait for 20 years, until the new technology has been developed. If we are determined to treat plutonium as waste, it might be worth while to consider the option of immobilizing it perhaps by vitrification and placing it in the ocean in areas so deep that nothing save sediment exists and there's no evidence of life now or in ages past. Among other references, this subject is discussed in the book "Trashing the Planet" by Dick Siluray and Lou Guzo. Given the undying opposition to dispose in New Mexico and Nevada and the fact that only one fourth of the earth is land, sea disposal should be at least worthy of consideration. It would also truly make the plutonium non-retrievable, since finding it and recovering it would be virtually impossible. Mixed Oxide Fuel - The point is often made that the MOX fuel option may not be cost-effective for us now, since we didn't develop fuel reprocessing technology. But what may happen in the future is another matter. Again, it seems to early to transmogrify this element made and recovered at great expense from treasure into trash. Burning it in a reactor would provide energy and transmute the plutonium into shorter lived actinides and fission products. Transmutation is the only way we have at this time to really "get rid of" plutonium. Final Comment - There is no decision that is acceptable to the public. That minuscule number of citizens who care for whatever reason. I would suggest abandoning work on any waste form of surplus fissile material other than vitrification. Properly formulated glass is an excellent waste form and has low leechability and

1/08.03.01

2/01.06.00

3/01.04.00

4/08.03.01

5/08.03.01

P-044

08 03 01 **Comment Number 1**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 06 00 **Comment Number 2**

Comment noted.

01 04 00 **Comment Number 3**

The process and justification for selection of technologies evaluated in the PEIS are described in a separate Screening Report prepared by DOE. A number of alternatives involving placement of materials below the earth's surface were considered, including emplacement in the sub-seabed and injection into the earth's magma. There is little data available to support these options and the retention of Pu in these media is questionable. A major concern would be the environmental impacts of any release of Pu materials following emplacement. Furthermore, the time and cost of developing these technologies would be significant and the outcome uncertain. It is expected that regulatory requirements would be extremely difficult to achieve, particularly if international waters were involved. Therefore, these types of technology were eliminated from consideration.

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 5**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

dispersibility, and if vitrification is the only politically-correct option, let's stop wasting money digging holes that will not likely be filled and evaluating other unacceptable techniques. Vitrification is expensive, but so is this vacillation from one untenable position to another. Thank you again for this opportunity to comment.

5/08.03.01 cont.

P-044

THORPE, MIGNON S., UPPER MONTCLAIR, NJ
PAGE 1 OF 1

June 5, 1996

U. S. DOE
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

Storage and Disposition of Weapons Usable Fissile Materials: MOX

I most strongly oppose the DOE plan to permit commercial nuclear reactors to use MOX, "mixed oxide", which is largely plutonium and uranium.

MOX presents such dangerous proliferation problems when used in commercial nuclear power plants. The plutonium in MOX can be rather easily separated from its other constituents. The extensive transportation to many parts of the United States and Canada presents many hazards beyond those of accidents releasing radioactivity. It should certainly necessitate military protection as should the fuel while in storage. Terrorism is an escalating problem. There are many groups who would want to acquire MOX or the plutonium separated from it.

Furthermore, the use of MOX as fuel in commercial reactors would substantially increase the volume and the radioactivity of the nuclear waste. 1/08.03.01

The cost of one, possibly two, new plants to process the MOX would be $1 billion or more.

These dangers and expenses are inexcusable when there are at least two options already identified for plutonium: continued storage and vitrification.

Please do not make permit these long-term dangers, inherent in the use of MOX in commercial nuclear reactors, to be authorized. The world has already had too many accidents and near accidents, and exposure to low-level radiation continues to increase. Don't add this totally unnecessary new threat to our health and safety.

Sincerely yours,

Mignon S. Thorpe

128 Norwood Ave.
Upper Montclair
NJ 07043

M-262

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Charles W. Turner
6323-5th Ave. N.E.
Seattle, WA 98115-0517

Telephone 206-525-0168

May 2, 1996

U.S. Dept. of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, DC 20026-3786

To Whom It May Concern:

Starting in 1970, I decided to try to find out what elements were abundant in the earth's crust in the Pacific Northwest, at least in the part of the world from which I could conveniently collect my own rock samples.

As a result of having collected several hundred samples (of rocks, sands, clays, and a few other materials of geologic origin), and after analysing a number of these samples, I realized that stable, non-radioactive isotopes of the actinide elements did indeed exist, and in some places were very abundant, and easy to get.

I attended a Plutonium Forum, sponsored by nine different organizations, one of which was the U.S. Dept. of Energy, on Tuesday evening, April 30, in Seattle. All of those attending were asked to submit comments on a blue form (one of which is enclosed).

In view of the existence of stable, non-radioactive isotopes of the actinide elements, I believe that now the first two options listed can be modified to facilitate the safer disposal, or even make possible a safer storage of radioactive materials of all kinds.

I propose that the radioactive Plutonium be dissolved in hydrochloric acid, adding a minimum quantity of nitric acid, if necessary, and adding the resulting solution to a hydrochloric acid solution of non-radioactive actinide elements, and adding oxalic acid and then sodium hydroxide or sodium carbonate to precipitate the oxalates. 1/14.00.00

(Unless you already have sufficient data, the relative amounts of radioactive and non-radioactive elements to prevent the accumulation of any dangerous critical mass of radioactive elements would have to be determined by experiment.)

The oxalates, after being removed from the solution, can be either stored as such safely enough in drums, or they can be heated to form oxides, which can either be stored as such, or can be vitrified with other constituents to form a glass or a ceramic.

M-126

14 00 00 **Comment Number 1**

Comment noted.

TURNER, CHARLES W., SEATTLE, WA
PAGE 2 OF 3

(2)

If you feel that my proposal makes sense, and that you would like to have a small amount of some of these non-radioactive actinide elements, I would be glad to give you a few hundred grams of a few of these elements, in the form of oxides or hydroxides.

There would be no charge for a small quantity for testing and evaluation.

Very truly yours,

Charles W. Turner

M-126

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): Charles W. Turner
Address (optional): 6727 54th Ave. N.E.
Seattle, WA 98115-6517

See enclosed letter.

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. **Materials Immobilization/Vitrification** - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

2. **Deep borehole disposal** - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

3. **Reactor Options** - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

4. **Storage Options** - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

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NUCLEAR SAFEGUARDS AND TECHNOLOGY DIVISION
BUREAU OF NONPROLIFERATION POLICY

UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY
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FAX COVER SHEET

TO: DOE/MD-1 -- David Multon

FAX NUMBER: 586-4078

DATE: May 7, 1996

****

FROM: Dan Fenstermacher

FAX NUMBER: (202) 647-4467 (fax)

PHONE NUMBER: 647-2833 (direct line/audix) -1140 (secretary)

****

MESSAGE:

COMMENTS ON DRAFT PEIS ON DISPOSITION

Attached are written comments and selected pages with comments in the margins. These are preliminary comments only, and not meant to imply ACDA concurrence with the entire Draft PEIS.

****

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IF PAGES ARE NOT RECEIVED, PLEASE CALL: (202) 647-2833.

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1. One point stands out in particular -- the phrase "peaceful beneficial reuse whenever possible" on p. S-5 must be deleted.

Since disposition of surplus HEU is covered in a separate PEIS, this phrase directly implies that re-use of Pu is in our interest "whenever possible," which is in direct contradiction to our national policy (cf. p. A-2 for U.S. policy on non-encouragement of civil use of Pu). The criteria listed on pp. 2-6 and 2-7 correctly make no mention of "re-use" of Pu as a desirable, but the language on p. S-5 is incorrect. 1/01.04.00

2. Conceptually, there is also a confusion with the formulation of the MOX option on p. S-7.

If that box is meant to describe MOX as it relates to the "disposition alternative," then it must add the phrase "and subsequent use of that fuel in a reactor." Otherwise, it implies that fresh MOX is a suitable endpoint that meets the spent fuel standard, which it does not. 2/06.01.08

3. Finally, the "destinations" at the end of the disposition alternatives in the figure on p. S-11 are confusing.

Since the figure gives the destination "Domestic High Level Waste Repository" for Immobilization and Reactor options, but "Deep Borehole" for the deep borehole option, it implies that the PEIS is comparing the immobilization and reactor options *all the way through to the final repository*. I had understood this not to be the case, but rather that the options were being compared only through the achievement of the "spent fuel standard," which is achieved during "interim" storage of the vitrified forms or in spent fuel pools (or dry storage) for the reactor options. This figure should not imply that the more difficult problem of ultimate repositories is being addressed in the comparison as well. I've proposed a wording fix in the margins. 3/12.00.00

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01 04 00 Comment Number 1

The Department of Energy agrees that this phrase is inaccurate. It has been removed from the PEIS.

The specific purpose of DOE's PEIS effort is to evaluate alternatives for the disposition of surplus weapons-usable Pu that would render the Pu as inaccessible and unattractive for reuse in nuclear weapons as the much larger and growing quantity of Pu that exists in spent nuclear fuel from commercial power reactors. This condition is referred to as the Spent Fuel Standard. If an alternative using MOX fuel in reactors is selected, the surplus Pu would eventually be contained in spent fuel and, by definition, the Spent Fuel Standard would be achieved.

While the PEIS discusses the generation of spent fuel as an indirect result of potential disposition actions, any subsequent reprocessing and extraction of Pu from that spent fuel is beyond the scope of the PEIS and the fundamental nonproliferation purpose of the disposition effort. The fact that the PEIS evaluates disposition of surplus weapons Pu through use in MOX fuel, but does not further evaluate reprocessing of the spent fuel, does not foreclose policy or technology options, nor does it prejudice further decisions regarding the management or disposition of the spent fuel.

06 01 08 Comment Number 2

Comment noted. It is DOE's intent to use the MOX fuel in a reactor to achieve the Spent Fuel Standard. Also, in the cases of the Reactor Alternatives and the Immobilization Alternatives, DOE would process the material to the Spent Fuel Standard, but would not include geologic emplacement as a part of the material disposition program. Geologic emplacement of the material forms for these alternatives in the NWPA-HLW management system could be subsequently implemented.

12 00 00 Comment Number 3

Comment noted. This figure has been modified to clarify that the NWPA-HLW repository is not included in the scope of the environmental analysis.

result of the NEPA process will identify plans for fulfilling the Nation's weapons-usable fissile materials storage needs well into the next century. These decisions are as follows:

For storage:

- The strategy for long-term storage of weapons-usable Pu and nonsurplus HEU
- The storage site(s)

For disposition:

- The strategy and technologies for disposition of surplus weapons-usable Pu

The Department, with interagency coordination, will then issue the ROD. Following the ROD, tiered project-specific NEPA documents will be prepared, as necessary.

DEVELOPMENT OF ALTERNATIVES

This PEIS analyzes a number of reasonable alternatives for storage and disposition, in addition to the No Action Alternative. The Department used a screening process along with public input to identify a range of reasonable alternatives for the storage and disposition of weapons-usable fissile materials. The process was conducted by a screening committee that consisted of experts from DOE assisted by technical advisors from the Department's national laboratories and other support staff. The committee was responsible for identifying the reasonable alternatives to be evaluated. It compared alternatives against screening criteria, considered input from the public, and utilized technical reports and analyses from the national laboratories and industry to develop a final list of alternatives.

public + institutional acceptance; and possible additional benefits.

The first step in the screening process was to develop criteria against which to judge potential alternatives. The criteria were developed for the screening process based on the President's Nonproliferation and Export Control Policy of September 1993, the *Joint Statement Between the United States and Russia on Non-proliferation of Weapons of Mass Destruction and the Means of Their Delivery* of January 1994, and the analytical framework established by the NAS in its 1994 report, *Management and Disposition of Excess Weapons Plutonium*. The criteria include nonproliferation; security; environment, safety, and health; timeliness and technological viability; cost-effectiveness; international cooperation [illegible]. The criteria were discussed at the public scoping workshops, and participants were invited to comment further using questionnaires. The questionnaires allowed participants to rank criteria based on relative importance, comment on the appropriateness of the criteria, and suggest new criteria. Details on how the screening process was developed and applied, and the results obtained from the process, were published in a separate report (*Summary Report of the Screening Process to Determine Reasonable Alternatives for Long-Term Storage and Disposition of Weapons-Usable Fissile Materials*, DOE, March 1995).

No! see PEIS pg. 2-6 and 2-7; [illegible] of "[illegible]" and [illegible] not [illegible] possible

Development of Long-Term Storage Alternatives

For long-term storage, DOE began with five potential action alternatives (see Figure S-2), as well as the No Action Alternative. The screening process identified two action alternatives as reasonable: (1) upgrade interim storage facilities and (2) consolidate storage at DOE sites. The second alternative was later refined and converted into two alternatives: consolidate Pu storage at one site (while HEU storage remains at Oak Ridge Reservation [ORR]), and collocation of Pu and HEU storage at one site. Each action alternative was further refined by dividing storage of the nonsurplus material (excluding materials in use) into two subcategories for analysis. One subcategory for each action alternative includes storage of strategic reserves, programmatic

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materials, and spent nuclear fuel—that is, the combined storage of the nonexplosive materials (excluding materials in use). Another subcategory includes spent nuclear fuel, but excludes the strategic reserves and defense-related programmatic materials that are being analyzed in the *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (Stockpile Stewardship and Management PEIS). In this way, a full range of reasonable storage alternatives is analyzed. Therefore, a total of three reasonable long-term storage alternatives (with subalternatives and options), in addition to the No Action Alternative, were selected for analysis in the PEIS.

To select candidate sites for long-term storage, DOE used a separate set of siting criteria consistent with those used in the evaluation of sites for reconfiguration of the Nuclear Weapons Complex in February 1991. The siting criteria included population; environment, safety, and health; socioeconomics; transportation; and site availability and flexibility. The process resulted in six candidate storage sites: Hanford Site (Hanford), Nevada Test Site (NTS), Idaho National Engineering Laboratory (INEL), Pantex Plant (Pantex), ORR, and Savannah River Site (SRS).

Development of Long-Term Storage Subalternatives

With the exception of weapons-grade materials in use, this PEIS analyzes the environmental impacts of reasonable alternatives for long-term storage of all surplus and nonsurplus weapons-usable fissile material categories (see Figure S–3). In DOE's Stockpile Stewardship and Management PEIS, a portion of the nonsurplus weapons-usable fissile materials, namely the strategic reserve materials and the Pu-242 materials used for weapons R&D, is being analyzed for long-term storage at only ORR, Pantex, and NTS. For this reason, the Storage and Disposition PEIS includes a subalternative analyzing the environmental effects of each long-term storage alternative without this portion of the materials. Both documents are analyzing the same resources and environmental issues affected by the proposed actions. Recommended preferred alternatives will be presented to the Secretary on both PEIS's before the Secretary's decisions and the publication of the RODs.

Because of mission changes, the proximity of Rocky Flats Environmental Technology Site (RFETS) to the Denver metropolitan area, and the fact that three out of the top five facilities identified in DOE's *Plutonium Working Group Report on Environmental, Safety, and Health Vulnerabilities Associated With the Department's Plutonium Storage* (November 1994) are located at the site, RFETS is considered as a storage site only under the No Action Alternative in the Storage and Disposition PEIS. For other long-term storage alternatives, existing Pu stored at RFETS would be moved to one or more other Pu storage sites.[5] Therefore, DOE developed a subalternative under the Upgrade at Multiple Sites Alternative to analyze the storage of all or some Pu from RFETS at each candidate site.

Development of Disposition Alternatives

For disposition, DOE began with 37 potential action alternatives (see Figure S–3), as well as the No Action Alternative. Using the same criteria as for long-term storage, DOE identified 11 reasonable alternatives for surplus Pu disposition: (1) deep borehole (immobilization), (2) deep borehole (direct emplacement), (3) borosilicate glass immobilization, (4) ceramic immobilization, (5) electrometallurgical treatment, (6) borosilicate glass ceramic/glass-bonded, (7) Russian mixed oxide (MOX) fuel fabrication/reactor burning, (8) existing light water reactors (LWRs), (9) partially completed LWRs, (10) evolutionary or advanced LWRs, and (11) Canadian Deuterium Uranium (CANDU) reactors. Upon further study of supply/demand conditions for Russian MOX fuel and due to lack of maturity of the technologies for borosilicate glass ceramic/glass-bonded, DOE deleted alternatives (6) and (7). However, MOX fuel fabrication (but not reactor burning) at European

[5] Small quantities of weapons-usable fissile material from two additional sites, Los Alamos National Laboratory and Lawrence Livermore National Laboratory, will be analyzed in the Final Storage and Disposition PEIS. The materials at these sites consist of small amounts of recently declared surplus Pu and Pu materials currently in active programs use. The Draft Storage and Disposition PEIS only analyzes the transportation impact of these materials to other storage sites.

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facilities requires a reasonable short-term alternative to the Existing LWR Alternative. Therefore, a total of nine reasonable disposition alternatives, in addition to the No Action Alternative, were selected for analysis in the PEIS. These alternatives were grouped into three alternative categories: Deep Borehole, Immobilization, and Reactor.

Facilities under each alternative within the Immobilization and Deep Borehole Categories could be designed such that they could process all the surplus Pu over their operating lives. Each disposition alternative under the Reactor Category would consist of reactors that could consume all the MOX fuel produced from surplus Pu. However, because existing surplus Pu occurs in various forms, and some of these forms may not be suitable for conversion to MOX fuel, the ultimate disposition of surplus weapons-usable Pu may involve a combination of disposition alternatives.

Deep Borehole

A borehole extended several kilometers below the water table into ancient, geologically stable rock formations.

Pu Immobilization

A process that immobilizes Pu to create a chemically stable form for disposal.

Mixed Oxide Fuel

A blend of uranium dioxide (UO_2) and plutonium dioxide (PuO_2) that produces a fuel suitable for use in a nuclear reactor to generate electric power, and subsequent use of the fuel in a reactor.

This Storage and Disposition PEIS identifies the reasonable long-term storage and disposition alternatives as follows:

Long-Term Storage

- Long-Term Storage Alternatives
  - Upgrade at Multiple Sites Alternative
  - Consolidation of Pu Alternative
  - Collocation of Pu and HEU Alternative
- Candidate Storage Sites
  - Hanford
  - NTS
  - INEL
  - Pantex
  - ORR
  - SRS

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Summary

A preferred alternative has not yet been identified. Upon consideration of comments on this draft document and after completion of technical, schedule, cost, and policy assessments, DOE will identify a preferred alternative in the Final Storage and Disposition PEIS.

NO ACTION AND LONG-TERM STORAGE ALTERNATIVES

No Action Alternative

The No Action Alternative for storage and disposition of weapons-usable fissile materials consist of two parts: (1) no change in current storage location for Pu and HEU and (2) no disposition of surplus Pu. DOE may choose part one, part two, or both parts of the No Action Alternative. If only part one is chosen, no change in current long-term storage will take place, other than environmental and safety upgrades. Therefore, existing storage facilities at DOE sites would be used for continued storage of HEU and nonsurplus Pu (the No Action Alternative for these materials), while decisions would be made for surplus Pu disposition. If only part two is chosen, disposition of surplus Pu will not occur, and this material would remain in storage. Therefore, decisions on long-term storage would become the "No Disposition Action" for surplus Pu. If both parts are chosen, no Pu disposition and no change in current storage of Pu and HEU will occur. This case is being analyzed in the Storage and Disposition PEIS as the baseline case for the No Action Alternative.

Under the No Action Alternative, all weapons-usable fissile materials would remain in existing storage facilities. Maintenance at existing storage facilities would be done as required to ensure safe operation for the balance of the facility's useful life. Sites covered under the No Action Alternative include Hanford, INEL, Pantex, ORR, SRS, and RFETS. Although there are no weapons-usable fissile materials within the scope of this PEIS stored currently at NTS, NTS is analyzed under No Action to provide an environmental basis against which impacts of the storage and disposition alternatives are analyzed.

Upgrade at Multiple Sites Alternative

Under this alternative, DOE would either modify certain existing facilities or build new facilities, depending on the site's requirements to meet standards for nuclear material storage facilities, and would utilize existing site infrastructure to the extent possible. These modified or new facilities would be designed to operate for up to 50 years. Pu materials currently stored at Hanford, INEL, Pantex, and SRS would remain at those four sites, and HEU would remain at ORR. Currently, NTS does not store weapons-usable fissile materials that are within the scope of this PEIS and, therefore, it is not a candidate site for this alternative.

A subalternative of relocating the Pu inventory (approximately 12.7 t [14.0 tons], as stated in the DOE's Openness Initiative of February 6, 1996) from RFETS to one or more of the four existing Pu storage sites is analyzed. Storage without strategic reserve and weapons R&D programmatic materials is also included as a subalternative to coordinate with analysis in the Stockpile Stewardship and Management PEIS.

Within each of the five candidate storage sites under this alternative, there are one or more storage options. A summary of these options is presented in Table S–1.

Consolidation of Plutonium Alternative

Under this alternative, Pu materials at existing sites would be removed, and the entire DOE inventory of Pu would be consolidated at one site, while the HEU inventory would remain at ORR. Again, the four sites with existing Pu storage are candidate sites for Pu consolidation. In addition, NTS and ORR are candidate sites for this alternative. Consolidation of Pu at ORR would result in a situation in which inventories of Pu and HEU are collocated at one site.

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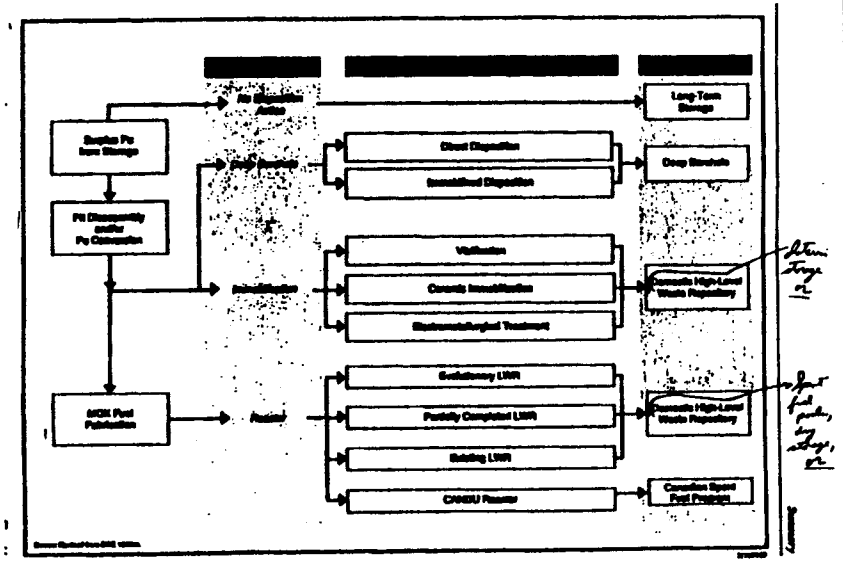
Long-Term Storage
Direct Disposition
Immobilized Disposition
Deep Borehole
Vitrification
Ceramic Immobilization
Electrometallurgical Treatment
Evolutionary LWR
Partially Completed LWR
Existing LWR
CANDU Reactor
Geologic High-Level Waste Repository
Commercial Spent Fuel Programs
Actinides
MOX Fuel Fabrication
Surplus Pu from Storage
Pit Disassembly and/or Pu Conversion
Pit Disposition Action
Pu Disposition Action
Actinide Action
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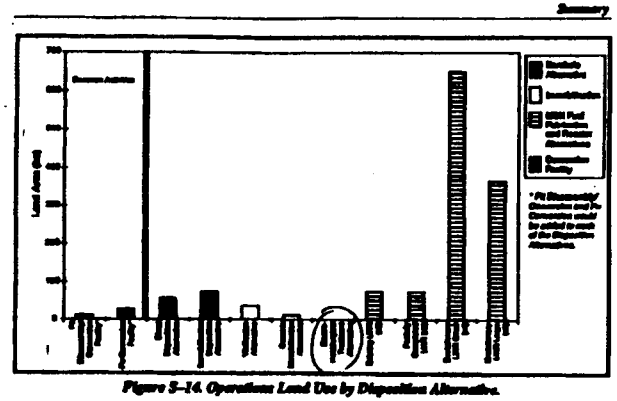

Figure 5–14. Operations Land Use by Disposition Alternative.

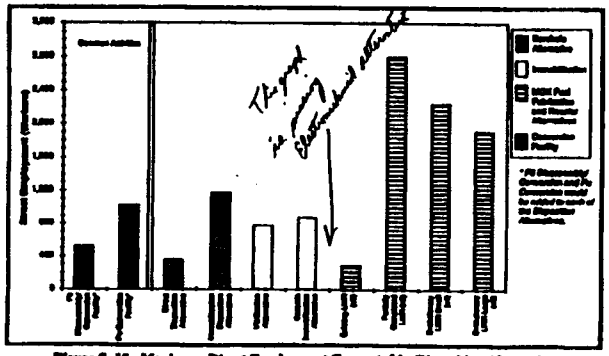

Figure 5–15. Maximum Direct Employment Generated by Disposition Alternative.

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paleontological resources, public and occupational health and safety, and intersite transportation could be susceptible to adverse cumulative impacts. At SRS, waste management and public and occupational health and safety would be vulnerable, and air quality, cultural and paleontological resources, environmental justice, and intersite transportation could be susceptible to adverse cumulative impacts.

Idaho National Engineering Laboratory, NTS, and Hanford would be the least vulnerable to cumulative impacts from the disposition alternatives. At INEL, waste management and socioeconomics (local transportation) would be vulnerable, and air quality, biological resources, cultural and paleontological resources, public and occupational health and safety, and intersite transportation could be susceptible to adverse cumulative impacts.

At NTS, waste management would be vulnerable, and air quality, biological resources, cultural and paleontological resources, public and occupational health and safety, and intersite transportation could be susceptible. At Hanford, waste management would be vulnerable, and air quality, biological resources, cultural and paleontological resources, public and occupational health and safety, and intersite transportation could be susceptible to adverse cumulative impacts.

When the other DOE programs previously identified in this section are considered, the rank order of DOE sites in terms of their descending potential for cumulative impacts changes to SRS, Pantex, ORR, INEL, Hanford, and NTS. More detailed, site-specific, cumulative impact analysis will be provided in subsequent tiered NEPA documentation once the disposition strategy and technology has been selected.

COMPARISON OF ALTERNATIVES

The environmental impacts of the storage and disposition alternatives are presented in comparative form in this section. The emphasis is on those environmental resources and issues of interest to the public that discriminate between the alternatives and provide a clear basis for choice by the decisionmaker. Data for the key discriminators are presented in the Figures 5-32 through 5-44, with the exception of visual resources, which are not presented graphically.

many of which simply duplicate graphs 5-14 to 5-31 — why?

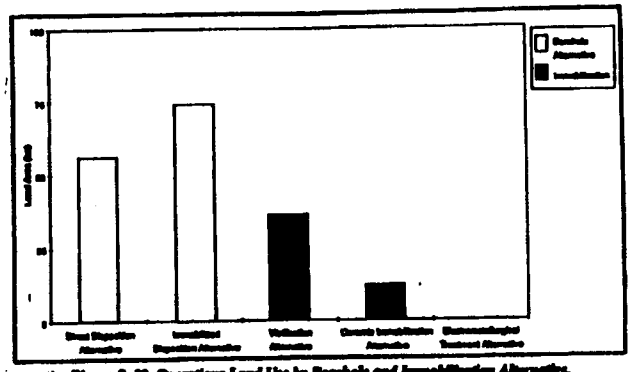
Long-Term Storage Alternatives

The impact analysis presented in this Storage and Disposition PEIS indicates that the three long-term storage alternatives would have no or negligible impacts to site infrastructure, noise, and geology and soils.

Potential impacts to cultural and paleontological resources exists for all alternatives whenever there is ground disturbance for construction, with no real differences among the three alternatives other than greater land disturbance for the Consolidation and Collocation Alternatives.

Impacts to air quality, although the potential exists, would similarly be minor and limited to the construction period, with no real differences among the three alternatives. While there would be no or negligible impacts to community services, there would be some loss of service on local roads during construction for all three alternatives; the additional employment and income generated by each alternative would be positive, with the most employment generated by the Collocation Alternative. There would be potential adverse impacts to land-use, because conflicts exist with existing site land-use plans, policies, and controls at several of the DOE sites for the Consolidation and Collocation Alternatives, but not for the Upgrade Alternative. The Collocation Alternative is the only long-term storage alternative that would have adverse visual resource impacts (at ORR). For all of these resources, the No Action Alternative would have the least impact, because no site disturbance is involved.

The water resource requirements for the Consolidation and Collocation Alternatives are greater than for the Upgrade Alternative, both in terms of water consumption and water discharges. Water resource requirements are the greatest for the Collocation Alternative at all DOE sites. The No Action Alternative would have the least



pg 1 para of S-19 *Figure S-32. Operations Land Use by Borehole and Immobilization Alternative.*

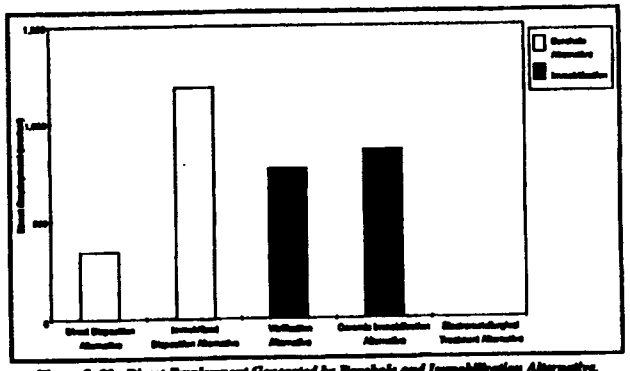


Figure S-33. Direct Employment Generated by Borehole and Immobilization Alternative.

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As in the case of temporary pit storage, the materials to be placed in long-term storage include Pu pits. However, they also include oxides and other dispersible material forms that may require treatment and repackaging not needed for pits. There are ES&H concerns associated with locating these operations in proximity to the metropolitan Albuquerque area. Furthermore, there is insufficient land area available to construct the necessary direct support facilities needed for analysis, repackaging, accounting, and waste management.

The Manzano storage area would also create a new non-DOE nuclear material storage site when a number of DOE sites are already available. The Screening Committee report (DOE 1995m) concluded that it is not cost-effective to establish a new site infrastructure that would increase investment, startup, and lifecycle costs for handling, training, and safeguarding these Pu materials. Therefore, Manzano is not analyzed as a reasonable alternative for long-term storage of either metal or non-metal Pu forms.

The utilization of nondomestic sites for long-term storage was proposed, but was eliminated from further consideration because it was not able to address all of the long-term storage requirements. These requirements include the storage of the materials set aside as strategic reserve for defense purposes, which are not appropriate to locate outside the United States. This option was disqualified in the screening process because the risk of theft or diversion by unauthorized parties would be greater than those involved in the utilization of domestic sites. Safeguard and security of nuclear materials are also enhanced by the domestic law enforcement infrastructure, which would not be easily coordinated outside the United States. Figure 2.1.3–2 shows the long-term storage options that were considered and rated based on the seven screening criteria and the principal reasons for disqualification or elimination.

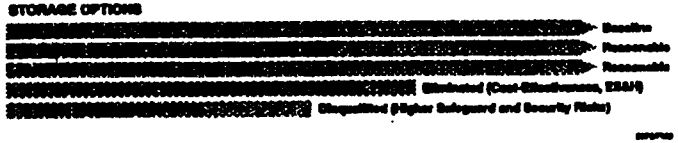

Figure 2.1.3–2. Results of the Screening Process—Long-Term Storage Options.

2.1.4 REASONABLE ALTERNATIVES FOR THE DISPOSITION OF SURPLUS PLUTONIUM

Screening Criteria for Disposition Options

Resistance to Theft and Diversion by Unauthorized Parties. Each step in the disposition process must be capable of providing for comprehensive protection and control of weapons-usable fissile materials.

Resistance to Retrieval, Extraction, and Reuse by Host Nation. The surplus material must be made highly resistant to potential use in weapons to reduce reliance on institutional controls and demonstrate that the arms reductions will not be easily reversed.

Technical Viability. There should be a high degree of confidence that the alternative will be technically successful.

Environmental, Safety and Health Compliance. High standards of public and worker health and safety, and environmental protection must be met, and significant additional ES&H burdens should not be created.

Cost-Effectiveness. Disposition should be accomplished in a cost-effective manner and be compatible with reasonable long-term storage alternatives.

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Timeliness. There is an urgent need to begin Pu disposition and to minimize the time period that surplus fissile materials remain in weapons-usable form.

Future Progress and Cooperation With Russia and Other Countries. The alternative must establish appropriate standards for the disposition of surplus weapons-usable fissile material inventories and support negotiations for bilateral or multilateral reductions in these materials, and each step in the disposition process must allow international inspections.

Public and Institutional Acceptance. An alternative should be able to muster a broad and sustainable consensus on the manner in which disposition is accomplished.

Additional Benefits. The ability to leverage government investments for disposition of surplus materials to contribute to other national or international initiatives should be considered.

Results of the Screening Process: Reasonable Alternatives for Surplus Plutonium Disposition

As a result of the screening process for surplus Pu disposition, three alternative categories containing of nine alternatives are considered reasonable. The alternative categories for further evaluation are the deep borehole category, the immobilization category, and the reactor category.

Deep Borehole Category. Within this category, surplus weapons-usable Pu would be emplaced in a deep borehole several kilometers below the water table into ancient, geologically stable rock formations. The borehole would be sealed to isolate the Pu from the accessible environment.

Two deep borehole alternatives were analyzed for this PEIS:

- Direct Disposition Alternative—direct emplacement of canisters containing Pu forms that have not been immobilized
- Immobilized Disposition Alternative—Pu immobilized in ceramic pellets (without the addition of high-energy, gamma-emitting radionuclides) will be mixed with grout and emplaced without canisters

In the first borehole alternative, surplus weapons-usable Pu would be encapsulated directly in suitable canisters without any immobilization processing of Pu material and the canisters would be placed in a deep borehole. The hole would then be plugged after completion of the emplacement. In the second borehole alternative, surplus weapons-usable Pu would be converted to an immobilized form. The immobilized Pu form then would be emplaced in a deep borehole, and the hole would be plugged after completion of the emplacement. Under both alternatives, emplacement in a deep borehole would provide a geologic barrier to proliferation that is considered to be at least as effective as achieving the spent fuel standard. The Pu would not need to be mixed with HLW or other radioactive materials.

Immobilization Category. Within this category, surplus Pu would be immobilized in an acceptable matrix to create a chemically stable form for disposal in an HLW repository. The immobilized Pu would be mixed with HLW or other radioactive isotopes to create a radiation field that enhances proliferation resistance to meet the Spent Fuel Standard.

Three immobilization alternatives were analyzed for this PEIS:

- Vitrification Alternative—building a new facility to produce a glass waste form that embeds Pu and radioisotopes within the glass form

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Conventional Arms Transfers

"We will actively seek greater transparency in the area of conventional arms transfers and promote regional confidence-building measures to encourage restraint on such transfers to regions of instability. The U.S. will undertake a comprehensive review of conventional arms transfer policy, taking into account national security, arms control, trade, budgetary and economic competitiveness consideration.

A.3 This is only the 1st of 4 pgs, and Pg 2 is very relevant to the PEIS! (non-accountable, joint WG, transparency + irreversibility, etc. are all missing here)

JOINT STATEMENT ON NONPROLIFERATION OF WEAPONS OF MASS DESTRUCTION AND THE MEANS OF THEIR DELIVERY

THE WHITE HOUSE

Office of the Press Secretary

JOINT STATEMENT
BY THE PRESIDENT OF THE RUSSIAN FEDERATION
AND
THE PRESIDENT OF THE UNITED STATES OF AMERICA
ON NON-PROLIFERATION OF WEAPONS OF MASS DESTRUCTION
AND THE MEANS OF THEIR DELIVERY

President Clinton and President Yeltsin, during their meeting in Moscow on January 14, 1994, agreed that the proliferation of weapons of mass destruction and their missile delivery systems represents an acute threat to international security in the period following the end of the Cold War. They declared the resolve of their countries to cooperate actively and closely with each other, and also with other interested states, for the purpose of preventing and reducing this threat.

The Presidents noted that the proliferation of nuclear weapons creates a serious threat to the security of all states, and expressed their intention to take energetic measures aimed at prevention of such proliferation.

- Considering the Treaty on the Non-proliferation of Nuclear Weapons as the basis for efforts to ensure the nonproliferation of nuclear weapons, they called for its indefinite and unconditional extension at conference of its participants in 1995, and they urged that all states that have not yet done so accede to this treaty.

- They expressed their resolve to implement effective measures to limit and reduce nuclear weapons. In this connection, they advocated the most rapid possible entry into force of the START I and START II treaties.

- They agreed to review jointly appropriate ways to strengthen security assurances for the states which have renounced the possession of the nuclear weapons and that comply strictly with their nonproliferation obligations.

- They expressed their support for the International Atomic Energy Agency in its efforts to carry out its safeguards responsibilities. They also expressed their intention to provide assistance to the Agency in the safeguards field, including through joint efforts of their relevant laboratories to improve safeguards.

- They supported the Nuclear Suppliers Group, and agreed with the need for effective implementation of the principle of full-scope International Atomic Energy Agency safeguard as a condition for nuclear exports with the need for export controls on dual-use materials and technology in the nuclear field.

- They reaffirmed their countries' commitment to the conclusion as soon as possible ... to CTBT.

A-4 → next 3 pgs missing from PEIS

F-042

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, DENVER, CO, C. MARK AGUILAR
PAGE 1 OF 2

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

Ref: 8EPR-F

J. David Nulton
Director, NEPA Compliance & Outreach
Office of Fissile Materials Disposition
Forrestal Building
1000 Independence Ave., SW
Washington, D.C. 20585

SUBJECT: ROCKY FLATS COMMENTS - STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT (PEIS)

Dear David:

As requested, we are providing you with our written comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS). These comments will be general in nature but reflect specific sections within the document.

General Comments:

EPA has two primary concerns that we feel must be strongly addressed and they are as follows:

1) I am aware that the "no action alternative" is used in all remedial actions as a base line for other alternatives. But in the case at Rocky Flats that alternative can not be considered based on promises by EPA, CDPHE, and DOE to the public that PU will be removed from Rocky Flats starting no later than 2010 and completing no later that 2015. | 1/01.06.00

2) It is strongly recommended that DOE be focused on reducing the processing and handling of fissile materials. This recommendation has multiple benefits, it protects the health and safety of the workers and the public, as well as the integrity of the environment at the site(s). | 2/01.00.00

F-045

01 06 00 **Comment Number 1**

The Council on Environmental Quality regulations implementing NEPA require DOE to analyze the No Action Alternative.

01 00 00 **Comment Number 2**

Comment noted. Your comment, along with public comments, the PEIS, cost information, nonproliferation analysis and policy analysis will be considered by DOE in the ROD for the storage and disposition of weapons-usable fissile materials.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, DENVER, CO, C. MARK AGUILAR
PAGE 2 OF 2

Again, it is strongly recommended that DOE implement the U. S. non-proliferation policy to include other countries. Additionally, DOE should be subject to external and independent regulations which could justify further funding for these efforts. 3/01.06.00

If you have an questions please feel free to contact me at (303) 312-6251.

Sincerely,

C. Mark Aguilar
Remedial Project Manager

F-045

01 06 00 **Comment Number 3**

Comment noted. As noted in the PEIS, DOE is proposing to implement the U.S. Nonproliferation Policy and set and example for other countries. The various action alternatives for disposition would implement the U.S. Nonproliferation Policy by disposing of surplus weapons-usable Pu, so as to encourage similar actions by other countries. Various activities under the storage and disposition alternatives would be subject to "independent" IAEA inspections, and, under the Reactor Alternatives, domestic reactors would be subject to "external" NRC licensing. Certain wastes generated by the various alternatives would also be subject to "external" regulations by EPA or State regulators.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC, RICHARD E. SANDERSON
PAGE 1 OF 5

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C 20460

OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

Mr. J. David Nulton
U. S. Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

Dear Mr. Nulton:

The Environmental Protection Agency (EPA) has reviewed the Department of Energy's (DOE) Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS). Our review is provided pursuant to the National Environmental Policy Act and Section 309 of the Clean Air Act.

The proposed action is long-term storage of weapons-usable plutonium and highly enriched uranium, and the disposition of surplus weapons-usable plutonium. The draft PEIS analyses the potential environmental effects of four long-term storage alternatives at six potential sites, and ten plutonium disposition technology alternatives. EPA has rated the document EC-2, environmental concerns - insufficient information. We recommend that the DOE provide additional information and clarity concerning several issues common to all the alternatives including: accident risk analysis, cumulative impacts, and environmental justice. In particular, more information on the assumption inputs to the MELCOR Accident Consequence Code System model could greatly enhance the public's understanding of the differences in safety risk between alternatives if an accident were to occur. Currently, the PEIS provides only limited review of the model but relies heavily on it to conclude that there is little danger to the public from accidents and little difference in accident risk among the alternatives considered. Further discussion could strengthen the credibility of these conclusions. An explanation of EPA's ratings is provided in Enclosure 1. Detailed comments are provided for your consideration in Enclosure 2.

1/09.09.08

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M-179

09 09 08 Comment Number 1

More explicit information of the assumptions and the sources of input data for the MACCS code is in the Final PEIS. Information and clarification on cumulative impacts and environmental justice have been added to the PEIS, and the accident analysis has been expanded.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC, RICHARD E. SANDERSON
PAGE 2 OF 5

Thank you for the opportunity to comment. If you have any questions, please contact Susan Offerdal at (202) 564-7158.

Sincerely,

Richard E. Sanderson
Director
Office of Federal Activities

Enclosures

M-179

SUMMARY OF THE EPA RATING SYSTEM
FOR DRAFT ENVIRONMENTAL IMPACT STATEMENTS:
DEFINITIONS AND FOLLOW-UP ACTION *

Environmental Impact of the Action

LO--Lack of Objections

The EPA review has not identified any potential environmental impacts requiring substantial changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC--Environmental Concerns

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA intends to work with the lead agency to reduce these impacts.

EO--Environmental Objections

The EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no-action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU--Environmentally Unsatisfactory

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

Adequacy of the Impact Statement

Category 1--Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis of data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2--Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

Category 3--Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and that should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

* From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment

February, 1987

M-179

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC, RICHARD E. SANDERSON
PAGE 4 OF 5

1 Enclosure 2

EPA COMMENTS ON THE STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Radiation: In general, it appears that the conclusion drawn in the programmatic environmental impact statement (PEIS) to the effect that there are no major radiological consequences of any of the alternatives is reasonable. Both the doses modeled and the probability of these doses are small. This conclusion seems particularly warranted in the case of routine operations.

In the case of accidents, while the conclusion of little or no risk is still plausible, some questions do arise. The PEIS does not clearly differentiate the safety risks associated with each alternative if an accident were to occur. This is of some note because, as the PEIS notes, accidents are of major concern to the public and the decisionmaker. For example, based upon the information presented it is unclear why a decisionmaker would choose vitrification as a preferred technology since it is more costly, requires an additional processing step, and produces more waste. The increased safety of this alternative, in case of accident, is not transparent in the analysis. We recommend that the final document contain more explicit accident risk information for the alternatives. The accident scenarios assume a worker a kilometer away from the accident site. Is this a reasonable assumption? What is the basis for this? At least in the case of Hanford, the effect of a facility accident on the maximally exposed individual in the general population is a hundredfold less than the worker already a kilometer away. What assumptions produce this result? Again, more discussion of how the MELCOR Accident Consequence Code System (MACCS) model is applied would add to the confidence one has in the results. It is clear that given the small dose the model predicts and the very low assumed probability of the more serious accidents (a severe earthquake has a one-in-ten million chance of occurring) the resulting risk is small and not of concern. The EIS needs to document more fully why these assumptions and others associated with the accident scenario are reasonable, and how these and other inputs are used by the MACCS model. 2/09.09.08 3/09.09.08 1/09.09.08 cont.

Cumulative Impacts: The handling of the discussion of cumulative effects leaves questions unanswered. For example, in discussing Pantex (Vol II, pg 4-860), which the PEIS notes may have the most severe problems associated with cumulative effects, the number of fatal cancers is not added because the exact locations of facilities has not been determined, and therefore summing may be "conservative". Surely, the initial estimation of effects in each of the various environmental impact statements (EISs) must have assumed some location. If these locations are different from EIS to EIS the risks could be summed. If one or more of the potential functions occupy the same land, the issue might arise as to whether there is sufficient desirable/suitable land at the site to accommodate the multiple intended uses, even if the total acreage seems adequate. What is the real saturation point of highly utilized facilities such as Savannah River Site and Pantex? The discussion of cumulative impacts begs the question. Notwithstanding this issue, and given the general claim in the PEIS to be conservative, it would seem that adding radiation risks would be warranted. A further issue is the cumulative effect of several new activities on the accident scenario. Would accidents at one co-located facility result in damage to and exposure 4/09.09.08 5/09.01.01 6/09.09.08

M-179

09 09 08 Comment Number 2

In the Draft PEIS, there is more detailed information on the health risk assessment for normal operation and anticipated accidents in Section M.5, and a technical report prepared exclusively for this project, *Health Risk Data for Storage and Disposition of Weapons-Usable Fissile Materials PEIS*, November 1996, referenced in the PEIS as HNUS 1996a. The information included in the appendix and technical report includes a brief description of accident scenarios, health risks for involved workers, the MEI, and the potential cancer fatalities for the general population in the region (up to 80 km [50 mi]).

More explicit accident risk information was added to the environmental consequences (Chapter 4), including explanations of the location of the MEI and the relationship (relative distances) to the noninvolved workers.

09 09 08 Comment Number 3

The 1,000-m (3,281-ft) distance of a noninvolved worker from the nearest release point of radioactive material is a representative distance which has been used in calculations at all sites. It provides a reasonable reference distance for calculations at both large and small sites. Estimating exposures from a release point at closer distances may not be very accurate because of building effects on dispersion (that is, wake-stream effects).

Also, more detail on how the MACCS code was applied is added to the Final PEIS, Appendix M, and Environmental Impact Methodology sections of Chapter 4. In addition, a topical report for the accident assessments was prepared and added to the current Health Risk Data topical report.

09 09 08 Comment Number 4

The impacts of these actions have not been summed because the exact locations of the facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC, RICHARD E. SANDERSON
PAGE 5 OF 5

2 Enclosure 2

from other facilities? How does this affect the total risk from a site? | 6/09.09.08 cont.

Plutonium Disposition Technology Alternatives (S-13 to S-16 and S-22 to S-36): Although there is a detailed explanation of the environmental impacts for the various technical alternatives for plutonium disposition in the text and in the summary tables, there is no discussion of the level of knowledge and applications experience with fissile materials of the Department of Energy (DOE) or other parties with the various technologies. There is no discussion of the level of uncertainty associated with the proposed alternatives, and what this uncertainty would mean in terms of potential environmental impacts. In summary, it would help the reader to know the feasibility of the technologies (e.g., which technologies are experimental or pilot projects) and the timeframe for development (e.g., short or long-term feasibility). | 7/01.04.00

Environmental Justice: Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires special attention to be given to subsistence consumption of fish and wildlife. "Federal agencies, whenever practicable and appropriate, shall work in a coordinated manner to publish guidance reflecting the latest scientific information available concerning methods for evaluating the human health risk associated with the consumption of pollutant-bearing fish and wildlife. Agencies shall consider such guidance in developing their policies and rules." Recent studies show that the Indian people at the Columbia River Basin practiced traditional patterns of life that may have affected their exposure to radioactive releases from Hanford. Traditional activities such as hunting, fishing, food gathering and cultural activities may have affected tribal members' exposure to Hanford's releases. DOE is initiating a study at the Savannah River Site to analyze the types and amounts of Savannah River fish consumed since it recognizes that some people eat fish caught near and downstream from the Savannah River Site and that those fish may be contaminated. Consumption issues are important to address in this PEIS because of their uniqueness in minority and low-income populations and the detrimental range of impacts they may have. | 8/09.12.06

M-179

09 01 01 Comment Number 5

Cumulative impacts at each analysis site were revised in the Final PEIS to include the total land area required by the other DOE programs. This land area is compared to total site area.

09 09 08 Comment Number 6

It is DOE's requirement for collocated facilities that the facility design preclude an accident at one facility from damaging another nearby facility on the same site. Such protective designs include physical isolation measures, such as a buffer zone, between the facilities. Using protective measures, the probability of having such accidents severe enough to damage a nearby facility would be extremely small (less than 1.0×10^{-8}/yr). Based on the DOE's *Recommendations for the Preparation of Environmental Assessments and Environmental Impacts Statements*, May 1993, such low probability accidents rarely need to be examined in this PEIS.

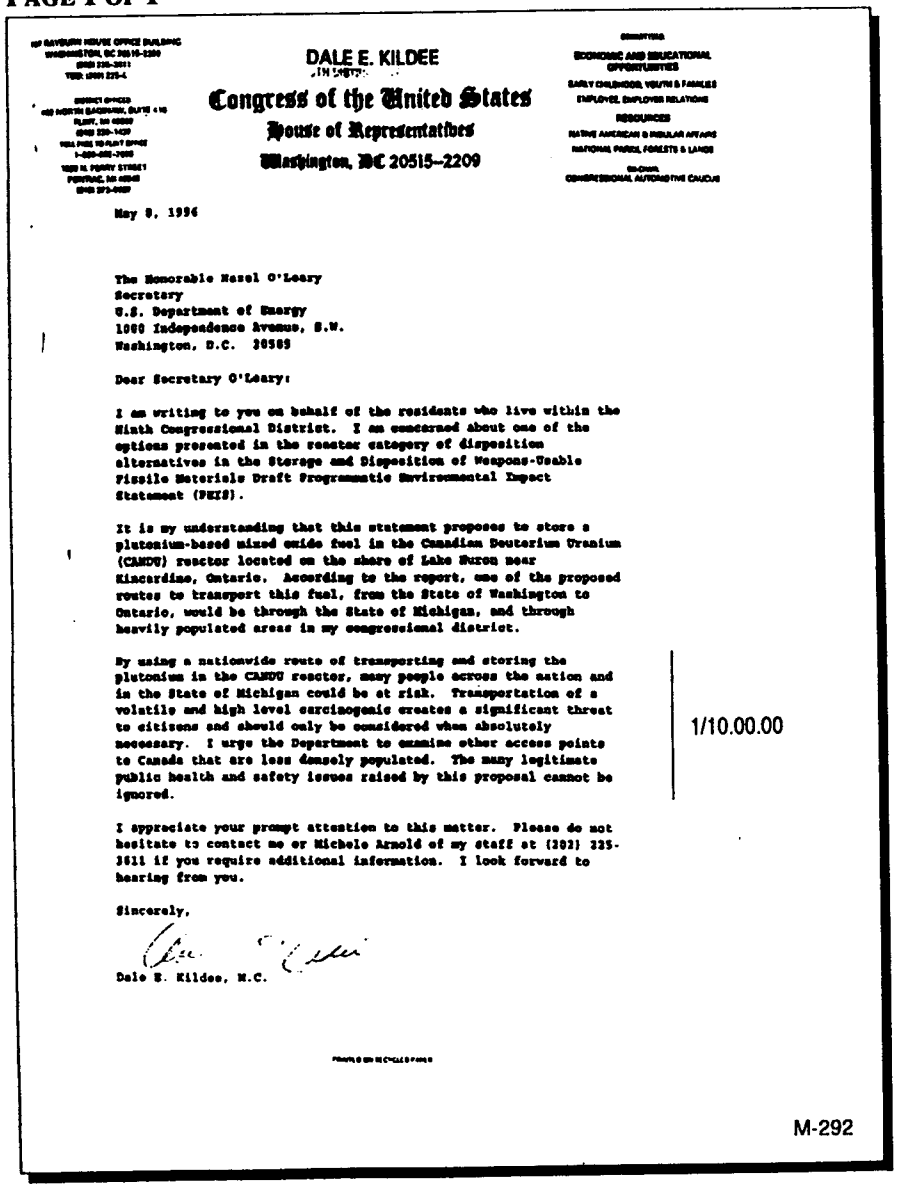
01 04 00 Comment Number 7

The PEIS evaluates the environmental impacts of a range of alternatives for materials storage and disposition. A more detailed technical discussion of these alternatives, along with related cost and schedule requirements, was provided in a Technical Summary Report issued by DOE in July 1996. The report provides further details on the feasibility of the technologies and the timeframe for development.

09 12 06 Comment Number 8

The potential environmental impacts of DOE activities on populations engaging in subsistence consumption could vary greatly depending on the precise location of a storage or disposition facility at a particular site, and the technology employed for the treatment or disposal of wastes at such a facility. In a prior NEPA review, incorporated herein by reference, DOE reviewed fish and wildlife consumption at Hanford, INEL, NTS, ORR, and SRS. At these sites, DOE found the potential impacts associated with the consumption of fish and wildlife to be small or to be no different than the potential impacts on the general population (DOE 1995v: 5.20-11). Section 4.5 of the Final PEIS has been modified to include this information.

UNITED STATES HOUSE OF REPRESENTATIVES, FLINT, MI,
CONGRESSMAN DALE E. KILDEE
PAGE 1 OF 1



DALE E. KILDEE
...TH DISTRICT...

Congress of the United States
House of Representatives
Washington, DC 20515–2209

...ECONOMIC AND EDUCATIONAL OPPORTUNITIES
...EARLY CHILDHOOD, YOUTH & FAMILIES
...EMPLOYER, EMPLOYEE RELATIONS
...RESOURCES
...NATIVE AMERICAN & INSULAR AFFAIRS
...NATIONAL PARKS, FORESTS & LANDS
...CONGRESSIONAL AUTOMOTIVE CAUCUS

May 8, 1996

The Honorable Hazel O'Leary
Secretary
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Dear Secretary O'Leary:

I am writing to you on behalf of the residents who live within the Ninth Congressional District. I am concerned about one of the options presented in the reactor category of disposition alternatives in the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS).

It is my understanding that this statement proposes to store a plutonium-based mixed oxide fuel in the Canadian Deuterium Uranium (CANDU) reactor located on the shore of Lake Huron near Kincardine, Ontario. According to the report, one of the proposed routes to transport this fuel, from the State of Washington to Ontario, would be through the State of Michigan, and through heavily populated areas in my congressional district.

By using a nationwide route of transporting and storing the plutonium in the CANDU reactor, many people across the nation and in the State of Michigan could be at risk. Transportation of a volatile and high level carcinogenic creates a significant threat to citizens and should only be considered when absolutely necessary. I urge the Department to examine other access points to Canada that are less densely populated. The many legitimate public health and safety issues raised by this proposal cannot be ignored.

I appreciate your prompt attention to this matter. Please do not hesitate to contact me or Michele Arnold of my staff at (202) 225-3611 if you require additional information. I look forward to hearing from you.

Sincerely,

Dale E. Kildee, M.C.

...PRINTED ON RECYCLED PAPER

M-292

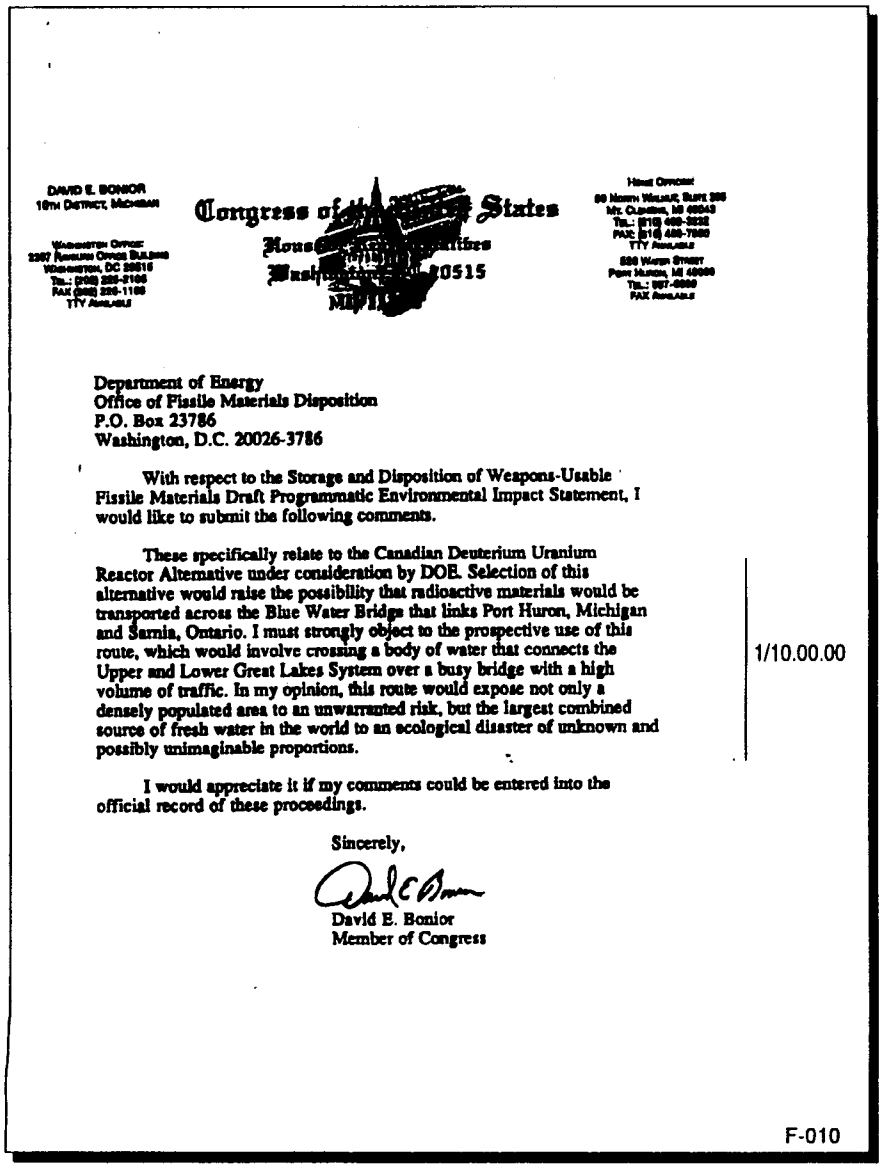
1/10.00.00

10 00 00 Comment Number 1

Under NEPA, DOE is required to evaluate a range of alternatives for Pu disposition. In that regard, the disposition of Pu in a CANDU reactor is one of nine different disposition alternatives analyzed in the PEIS. Six specific sites and a generic site are evaluated for fabricating MOX fuels for Pu disposition. As a result, the transportation analyses performed in the PEIS consider multiple routes from potential fuel fabrication sites to potential reactor sites. Section G.6 provides a description of the DOE safe secure transport system. The design of the vehicles and the transportation operation procedures are classified; the selection of the routes and coordination with State and local governments are contained within these procedures. However, there has never been a failure of this system to provide safe secure transportation during more than 20 years in operation.

For emergency response circumstances, all shipments will be coordinated with appropriate State and local officials. If requested, DOE will assist appropriate officials with response plans, and, if necessary, with resources in accordance with guidelines established in DOE Order 5530.3. DOE has developed a Radiological Assistance Program, also outlined in DOE Order 5530.3, to provide assistance in all types of radiological accidents. Regional Radiological Assistance Program plans include coverage of the States and provide for maintaining and executing emergency response plans.

UNITED STATES HOUSE OF REPRESENTATIVES, MT. CLEMENS, MI,
CONGRESSMAN DAVID E. BONIOR
PAGE 1 OF 1



DAVID E. BONIOR
10TH DISTRICT, MICHIGAN

Congress of the United States
House of Representatives
Washington, DC 20515

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

With respect to the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement, I would like to submit the following comments.

These specifically relate to the Canadian Deuterium Uranium Reactor Alternative under consideration by DOE. Selection of this alternative would raise the possibility that radioactive materials would be transported across the Blue Water Bridge that links Port Huron, Michigan and Sarnia, Ontario. I must strongly object to the prospective use of this route, which would involve crossing a body of water that connects the Upper and Lower Great Lakes System over a busy bridge with a high volume of traffic. In my opinion, this route would expose not only a densely populated area to an unwarranted risk, but the largest combined source of fresh water in the world to an ecological disaster of unknown and possibly unimaginable proportions.

1/10.00.00

I would appreciate it if my comments could be entered into the official record of these proceedings.

Sincerely,

David E. Bonior
Member of Congress

F-010

10 00 00 Comment Number 1

Under NEPA, DOE is required to evaluate a range of alternatives for Pu disposition. In that regard, the disposition of Pu in CANDU reactors is one of nine different Disposition Alternatives analyzed in the PEIS. Six specific sites and a generic site are evaluated for fabricating MOX fuels for Pu disposition. As a result, the transportation analyses performed in the PEIS consider multiple routes from potential MOX fuel fabrication sites to potential reactor sites. Although the Port Huron/Sarnia border crossing is mentioned in the PEIS as a convenient point for the CANDU fuel shipments to pass from the United States to Canada, our analysis also reflects other possible routes.

The Draft PEIS did not identify a Preferred Alternative for Pu disposition. A Preferred Alternative is identified in the Final PEIS and a disposition decision is expected to be made by the end of the year. The decision will take into account environment, safety (including transportation), and health factors as well as technical, cost, schedule, and nonproliferation considerations. After the ROD (which will include technology approaches) is expected to be reached in late 1996, follow-up analyses, negotiations, and specific agreements over several years will be required before implementation.

UNITED STATES HOUSE OF REPRESENTATIVES, AMARILLO, TX,
CONGRESSMAN WILLIAM THORNBERRY
PAGE 1 OF 5

Thank you for allowing me the opportunity to make a few remarks.

Many of the others who will testify
will discuss the outstanding record of the Pantex plant,
the unparalleled level of community support which the plant enjoys,
and the willingness to consider other missions
as we sort out the nuclear weapons complex after the Cold War.

I'm going to focus on some broader questions
which certainly affect Pantex
but also the larger security needs of the country.

I do so not because I disagree with the other points
or because I don't think they are important.
Pantex's record, its people, its community support,
and its openness to other possibilities are its key strengths
and no one else can match them.

But during my tenure in Congress, as a member of the Nat Sec. Cmte. which oversees DOE weapons programs,
I have attempted to make a serious study
of our nuclear weapons complex,
in part because I represent one of its crown jewels
and in part because I believe
that a modern, effective nuclear capability
is absolutely necessary to our national security.

I won't say that I have learned all I can or intend to,
and I won't represent to you that I know all the answers
during this time of change and turmoil.

But I am confident that I know enough to raise some serious questions
that relate to the subject today and to our children's security.

TX-040

This is, of course, a time of great change
brought about by the end of the Cold War,
by the fact that the DOE was not as careful
in the past as it should have been,
and by this administration's decision to stop all nuclear testing.

Stockpile Stewardship and Stockpile Management

In my view, stockpile stewardship and stockpile management
are important for the nation
regardless of whether we conduct nuclear tests or not.

We should use a number of methods to make as sure as we can
that our nuclear weapons are safe and reliable.
In doing so, we are making a serious mistake
if we neglect to factor in the importance
of highly skilled workers at production plants.

I tend to agree with those who argue that we need smart people in labs
and maybe even that we need smart people at two labs
to compete against one another.

But every bit as much as we need smart people in labs,
we need experienced, knowledgeable people in production plants
who know how to take a design or a procedure
and produce a product that meets the requirements
safely and efficiently
time after time
so that we have weapons that are safe and reliable
on which we can stake our children's freedom.

That's what people at plants like Pantex do.

TX-040

UNITED STATES HOUSE OF REPRESENTATIVES, AMARILLO, TX,
CONGRESSMAN WILLIAM THORNBERRY
PAGE 3 OF 5

It's like if you're building a house,
you need architects to draw up the blueprints and to consult with,
but there is absolutely no substitute
for skilled carpenters, and plumbers and painters
who know how to get the work done,
who know what problems there may be
in translating the blueprints and procedures into precise components;
and who have a proven track record
of having done it --- time after time.

I am afraid that an undercurrent in DOE today,
that sometimes even rises to the surface,
is a lack of appreciation
for the importance of those workers on the assembly line
at Pantex and elsewhere.

If we lose them, we are a weaker nation
and no number of PhD's at the labs
will replace what we've lost.

I find it incredible that DOE would ask more and more
of at least one of our production plants
and yet allocate less money for it to fulfill its mission.

If we can't keep the trained, experienced personnel at Pantex,
the country won't reach its goals for Stockpile Stewardshp and Mgmt
We will begin to lose confidence in our nuclear deterrent,
and we will have been penny wise and pound foolish.

I am also concerned
that we are just focusing on dragging out the life
of current weapons
without taking positive steps

TX-040

toward replacing our existing weapons
which will all too soon be at the end of their intended design life.

A real question is whether we will be able to build nuclear weapons again
and how.
There are many improvements which could be made now,
others which we will want to make in the near future,
and all the while we have to be prepared
to deal with changes in Russia, China and elsewhere.
I'm not sure we're ready.

<u>High Explosives</u>

Let me address the one issue in the PEIS
for which no preferred alternative was included,
that is high explosives.

When you compare apples to apples,
no one seriously disputes
that the most cost effective option
is retaining the existing mission at Pantex.

The sole justification to moving high explosives
to Los Alamos and Livermore
is that we need to keep knowledge and competence
of high explosives in the Labs.
OK - but we need to keep it at the production level too.

You can do all the research you want
and have all the knowledge you can handle,
but if you can't reliably and safely translate that knowledge
into real production,
you have nothing.

TX-040

UNITED STATES HOUSE OF REPRESENTATIVES, AMARILLO, TX,
CONGRESSMAN WILLIAM THORNBERRY
PAGE 5 OF 5

There is no reason in the world
that the Labs can't continue to send people to Pantex as needed
for the manufacture of high explosives,
but to remove high explosives
completely out of the production complex
would be a big mistake.

Disposition -

The issue of what we're going to do
with the excess plutonium and uranium is of key concern here.

As you know, we've got several thousand pits stored here
with more being added every day.
I am disappointed that the PEIS gives so little guidance
on what's to be done. 1/08.03.00

We need to get on with making these key decisions.
Two weeks ago at Los Alamos,
I was able to see firsthand some of the work involved in the Aries project.

We have some very promising technologies,
but the country needs leadership.
and our area needs confidence that DOE knows what it is doing
and is doing the right thing.

As long as I am in the Congress,
I will be involved in making these decisions
and I will do everything I can
to see that our area is protected,
to see that our nation is secure,
and to see that our children have the opportunity to live in freedom.

TX-040

08 03 00 Comment Number 1

The PEIS is an analysis of the environmental impacts that could occur if DOE implemented a Proposed Action, in this case, storage and disposition of weapons-usable fissile materials. The PEIS is used by the decisionmakers along with other information to make the best possible decision on which of the alternatives, if any, should be taken to accomplish the Government's goals and needs.

UNITED STATES SENATE, STATE OF TEXAS,
SENATORS PHIL GRAMM AND KAY BAILEY HUTCHISON
PAGE 1 OF 2

PHIL GRAMM
TEXAS

United States Senate
WASHINGTON, D.C. 20510-4302

May 5, 1996

The Honorable Hazel O'Leary
Secretary
U.S. Department of Energy
Forrestal Building
1000 Independence Avenue, S.W.
Washington, DC 20585

Dear Secretary O'Leary:

Thank you for the opportunity to comment on the U.S. Department of Energy's (DOE) Programmatic Environmental Impact Statements (PEISs) on Stockpile Stewardship and Management (SSM) and Storage and Disposition (S&D) of Weapons-Usable Fissile Materials. Please also consider this our comment on the Pantex Site-Wide Environmental Impact Statement, since most of the issues addressed in these documents are identical.

First and foremost, we are adamant that any current and future functions at Pantex be conducted in a safe and environmentally sound manner. Our first priority is to ensure that any expansion at Pantex be implemented in a way that does not impair the health or safety of area residents or have an adverse effect on the environment. These goals serve as a prerequisite to any current and future activities at Pantex, including expansion.

1/09.00.04

We are pleased that DOE selected Pantex as the preferred alternative for assembly/disassembly, thereby abandoning earlier plans to transfer those functions to the Nevada Test Site (NTS). However, by failing to recognize Pantex as the preferred candidate site for new and/or consolidated stockpile management facilities, the DOE overlooked the best site for maintaining the integrity of the U.S. nuclear stockpile and attaining maximum efficiencies and cost savings.

Pantex is perhaps the most cost-effective alternative for any new construction of SSM facilities. First, labor costs, utility rates, and water and land availability at Pantex, as well as public support, are more amenable than those at any other Complex site. It is appropriate to consider Pantex as an alternative site for all future defense-related facilities to complement activities at the national labs (such as the planned Atlas Facility and plutonium pit fabrication site at Los Alamos National Laboratory [LANL]) DOE makes no mention of a strategic plutonium reserve that we believe is important to our future national security needs, even though the PEIS mentions that strategic storage should be co-located with disassembly. We believe Pantex should be the preferred site for such a mission in coordination with its management functions. The location of additional defense-related activities at Pantex would ensure that core technical capabilities are preserved at a location that can secure them at the most efficient cost to the American people. In its deliberations, DOE should insist that budgetary comparisons between Pantex and other sites are accurate, and include capital, transportation, training, remediation, and other costs.

M-236

09 00 04 **Comment Number 1**

Potential environmental consequences of each Pantex alternative were analyzed in the PEIS. Results of these environmental analyses will be given full weight, along with other factors such as cost, technical risk, schedule, and national security requirements, in the process of selecting the storage strategy and site and disposition strategy and technology for the Fissile Materials Disposition Program. Pantex will continue to operate in compliance with all Federal, State, and local requirements.

UNITED STATES SENATE, STATE OF TEXAS,
SENATORS PHIL GRAMM AND KAY BAILEY HUTCHISON
PAGE 2 OF 2

Consistent with the [illegible]s identified above for increased stewardship and management duties, the high explosives [illegible] functions should also remain at Pantex. Because the production assembly/disassembly functions remain at Pantex, the HE fabrication duties should be present at the corresponding site. After all, the SSM draft admits that Pantex must retain HE capabilities to process the inventories already on site from dismantling. Therefore, the least expensive alternative is to maintain HE functions at Pantex. We adamantly disagree with the statement in the PEIS that there are no advantages to siting high explosives at Pantex rather than the national labs. The capitol outlay alone necessary for transfer is cost prohibitive. In addition, should future need arise for new weapons production, it will be critical to have the HE facilities at the weapons production/assembly site.

As the sole DOE-authorized facility for assembly and disassembly of nuclear weapons, Pantex has historically handled these functions in a safe and efficient manner for more than 40 years. One of the challenges faced after dismantling a significant portion of the nuclear stockpile is the processing or disposal of the materials that remain. In meeting this challenge, Pantex could continue to store plutonium which is already at the site and upgrade facilities for any and all storage options being considered by DOE with minimal cost and difficulty. Pantex currently safehouses more than 8,000 surplus pits, and plans are being made to ship additional pits from Rocky Flats to Pantex. It makes little sense to re-create storage facilities at another site and then unnecessarily transport large amounts of plutonium across the county from Pantex.

We also believe Pantex should be designated the preferred site for any disposition options and related functions. It makes budgetary and policy sense to site disposition where storage already exists. Furthermore, it makes no sense from any perspective, budget or otherwise, to site strategic storage at one site and surplus at another. Pantex should be selected for both storage functions. Pantex has the necessary safety, security, and surveillance capabilities to accommodate an expanded role with minimal costs and it is the production site closest to Los Alamos, the planned pit fabrication site. 2/08.03.01

Based upon these reasons, we respectfully urge DOE to designate Pantex as the preferred alternative site for all existing and new stockpile management and stewardship functions as well as consolidation of all plutonium storage and disposition and any related functions. Thank you again for the opportunity to comment on these documents.

Yours respectfully,

Phil Gramm
PHIL GRAMM
United States Senator

Kay Bailey Hutchison
KAY BAILEY HUTCHISON
Untied States Senator

M-236

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentors' support of Pantex. Decisions related to future missions at Pantex will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

UNIVERSITY OF TEXAS, AUSTIN, TX,
THOMAS C. GUSTAVSON
PAGE 1 OF 4

BUREAU OF ECONOMIC GEOLOGY
THE UNIVERSITY OF TEXAS AT AUSTIN

University Station, Box X • Austin, Texas 78713-8924 • (512) 471-1534 or 471-7721 • FAX 471-0140
10100 Burnet Road, Bldg. 130 • Austin, Texas 78758-4497

April 28, 1996

U.S. Department of Energy
Office of Fissile Materials
P.O. Box 23786
Washington, DC 20026

Dear Sir or Madam:

The following are review comments on the "Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement" from staff at the Bureau of Economic Geology of The University of Texas at Austin.

General Comment:

Sections 3.5.4. and 3.5.5., which describe water resources and geology and soils, do not provide adequate information for the reader to determine if environmental impacts could result from proposed alternative actions at Pantex. 1/09.00.04

Specific Comments:

Page 546, para. 3. Potential impacts of the long-term storage alternative at Pantex depend greatly on waste disposal practices in addition to the natural characteristics of the site. Although the Ogallala is a valuable and critically important ground-water resource, the presence of the resource does not necessarily make it vulnerable to impacts of waste storage. Detailed studies by the Bureau of Economic Geology and other entities have shown that recharge to the perched and Ogallala aquifers is focused through playas or artificially ponded areas such as ditches and that recharge in upland or interplaya areas is negligible. Recharge occurs where surface water accumulates and develops sufficient hydraulic head over sufficient time to drive waters below the zone of evapotranspiration. Recharge of water or contaminants may also occur beneath manmade excavations such as ditches and landfill sites where runoff can accumulate (these are roughly analogous to playas) or as the result of leaking underground storage tanks. Appropriate engineering practices to prevent releases from storage sites and placement of storage facilities in upland (interplaya) areas at the Pantex Plant should limit the potential for adverse impacts to water resources at Pantex. As long as no wastes are introduced into the playas, buried on site, or placed in an area where water can flow through the wastes or pond in contact with the wastes, contaminants should not be transported into the subsurface and the Ogallala should not be impacted by Pantex activities. Proper engineering and adequate monitoring and maintenance would, however, minimize impacts of long-term storage on the Ogallala at the Pantex Plant. 2/09.04.04

F-026

09 00 04 Comment Number 1

The information provided in the PEIS provides the decisionmaker with adequate information to select a site-specific, long-term storage alternative. This is particularly true considering the programmatic nature of this document and the fact that neither of these resources is considered to be a key discriminator in the long-term storage decision.

09 04 04 Comment Number 2

Current and future operations at Pantex are not expected to affect the water quality of the Ogallala Aquifer. However, since this aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge), Pantex operations contribute to the depletion of the Ogallala Aquifer and are analyzed in the PEIS.

UNIVERSITY OF TEXAS, AUSTIN, TX,
THOMAS C. GUSTAVSON
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U.S. Department of Energy
Office of Fissile Materials
May 3, 1996
Page 2

Figures 3.5.4-1 and 3.5.4-2. Playas are incorrectly labeled as dry lakes on these maps. Playas should be described as ephemeral lakes, as they are in Figure 3.5.1.-1. Most playas, including playas 2, 3, 4, 6, and Pantex Lake, hold water for 1 to 3 months per year. Playa 1 holds water throughout the year because it receives discharge from the Pantex waste water treatment plant.	3/09.04.04
Figures 3.5.4-1 and 3.5.4-2. These maps indicate that the southern boundary of the Pantex site includes the rights-of-way for both U.S. Highway 60 and the Burlington Northern and Santa Fe Railroad. Compare with figure 3.5.1-1 where the southern boundary is shown correctly.	4/09.04.04
Page 3-164, para. 2. Data from seismic surveys and playa basin cores acquired by the Bureau of Economic Geology suggest that playas 3 and 5 and Pantex lake are surface expressions of local subsidence related to dissolution of underlying Permian salt beds.	5/09.05.04
P. 3-164, para. 1. All playas shown in figures 3.5.1-1, 3.5.4-1, and 3.5.4-2 except playa 3 are approximately 900 to 1000 m in diameter.	6/09.05.04
P. 3-164, para. 2. The lithology of the Ogallala Formation is not described. The description should include a brief discussion of the complex heterogeneity of the Ogallala because the variation in sediment types controls ground water flow in the formation. The significance of the fine-grained zone as well as gravels in buried channels beneath the plant should be explained.	7/09.05.04
P. 3-164, para. 2 or 3. No attempt is made to describe the role of salt dissolution and subsidence in the formation of playa basins. High solute loads in streams draining the region indicate that these processes are active regionally. No mention is made of the potential effects, if any, of dissolution-induced subsidence at the plant.	5/09.05.04 cont.
P. 3-164, para. 5. No attempt is made to point out that Randall clay soils are Vertisols and that deep desiccation cracks and root tubules, which are potential pathways for recharge, are characteristic of these soils. Furthermore, these soils have a udic moisture regime, which means that water moves down through the soil at some time in most years. That is, recharge occurs through even these clay soils.	8/09.05.04
Page 4-187, para. 1. It is stated that the TNRCC projects that there will be adequate water until the year 2040. In fact this projection is probably from a Texas Water Development Board report from the early or mid-1980's.	9/09.04.04
Page 4-187, para. 3. It is stated that "No additional impacts to groundwater quality are anticipated because there are no direct discharges to groundwater". This seems at least a little misleading in two areas. First, exactly how does one define direct discharge? The contaminants east of Zone 12 south document a fairly direct pathway for recharge water from the surface to the aquifer. Second, the current plans for treating contaminated water at the plant rely on the reinjection	10/09.04.04

F-026

09 04 04 **Comment Number 3**

Figures 3.5.4–1 and 3.5.4–2 were corrected in the Final PEIS show playas as ephemeral lakes.

09 04 04 **Comment Number 4**

Figures 3.5.4–1 and 3.5.4–2 were corrected in the Final PEIS.

09 05 04 **Comment Number 5**

Considerable attention has been given to the possible origin of playas. Gustavson et. al. summarized playa development as follows: "These landforms are the result of a series of intermittently active processes, including wind, fluvial erosion and lacustrine deposition, pedogenesis, dissolution of soil carbonate, salt dissolution and subsidence, and animal activities, that collectively produced the typically shallow and roughly circular playa basis on the High Plains. We infer that playa basins are stable landforms that, once initiated, remain as part of the landscape." Recent work in Pain 1994 using shallow seismic data has determined that the structure beneath the playas at Pantex shows displacement of Ogallala strata attributed to dissolution of underlying salt beds.

Salt dissolution is a process that has resulted in major post-Permian structures. In Carson County, a large depression is filled with sediment of the Ogallala Formation. Presence of the Ogallala deposits in the depression indicates that the basin existed prior to Ogallala time and that the local dissolution was underway prior to or during the deposition of the Ogallala Formation.

The following text has been added to Section 3.5.5 of the Final PEIS: "Recent work using shallow seismic data has determined that the structure beneath the playas on Pantex and adjacent areas shows displacement of Ogallala strata. This displacement is attributed to the dissolution of underlying salt beds." With this addition, the discussion of salt dissolution in the PEIS is considered adequate considering the programmatic nature of this document and the fact that this resource is not considered to be a key discriminator in the long-term storage decision.

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Page 3

of treated water into the aquifer. This injection would also qualify as direct discharge to the aquifer. 10/09.04.04 cont.

Page 4-194, para. 1. Data from seismic surveys and playa basin cores acquired by the Bureau of Economic Geology suggest that playas 3 and 8 and Pantex lake are surface expressions of local subsidence related to dissolution of underlying Permian salt beds. Estimated average subsidence rates are low (about 0.01 mm/yr), but vertical movement may be episodic. 5/09.05.04 cont.

Page 4-859. The amount of ground-water decline that will result from projected production rates is given as 1.5 in/yr. What is the source of this number. The writer also fails to mention that this incremental increase will be in addition to the drawdowns resulting from the Amarillo well field. Current rates of decline in the area of the Pantex well field are approximately 2 ft/yr. It would seem appropriate in a discussion of ground-water resources to include the impact of the Amarillo well field on the ground-water resources at the Pantex Plant. 11/09.04.04

If you have any questions concerning these comments please call me at (512) 471-0232.

Sincerely yours,

Thomas C. Gustavson
Senior Research Scientist

TCGdb

cc: R. Mulder, Governor's Office
T. Grimshaw, BEG
J. Raney, BEG
D. Ratcliff, BEG

F-026

The potential effects, if any, of dissolution-induced subsidence at Pantex is addressed in Section 4.2.4.5 of the Final PEIS. The potential impacts due to subsidence (resulting in sinkholes and/or surface rupture) at Pantex are considered negligible since salt dissolution is a slow process relative to human activities and most active salt dissolution in the region is concentrated near the Eastern Caprock and at the Canadian River Escarpments.

09 05 04 Comment Number 6

The Department of Energy concurs with the commentor. As a result, the text in Section 3.5.5 of the PEIS has been modified as follows: "The playas are about 500 to 1,000 m (1,640 to 3,280 ft) across with clay bottoms and depths to 9 m (30 ft)."

09 05 04 Comment Number 7

The following text has been added to Section 3.5.5 of the Final PEIS to provide a very general description of the Ogallala Formation lithology: "consists of interbedded sands, silts, clays, and gravels." A more detailed discussion of the lithology of the Ogallala Formation is more information than necessary to evaluate impacts for a programmatic review. The geology and soils section (Section 4.5) and the groundwater section (Section 4.6) of the Draft Pantex EIS (DOE/EIS-0225 D, March 1996) has a more detailed discussion of the lithology and groundwater flow characteristics of the Ogallala Formation.

09 05 04 Comment Number 8

The Randall clay soils are generally found in the bottom of the playas. The playas are a significant part of the surface and subsurface hydrologic system at Pantex. The fact that Randall clay soils at Pantex contain potential pathways for groundwater recharge is considered in the estimates of annual recharge rates to the Ogallala Aquifer. Discussion of aquifer recharge is contained in Section 3.5.4 of the PEIS.

UNIVERSITY OF TEXAS, AUSTIN, TX,
THOMAS C. GUSTAVSON
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09 04 04 Comment Number 9

The projection is from a 1993 draft of the document entitled *High Plains Aquifer System of Texas - 1980 - 1990 Overview and Projections*. The authors are Ashworth and Peckham of the Texas Water Development Board, which has since been renamed the TNRCC. In the context used in the Draft PEIS, it is appropriate to refer to the current name of the organization.

09 04 04 Comment Number 10

For the purposes of this PEIS, a direct discharge to groundwater would be injection of water to the aquifer via a well; recharge pathways are not considered to be direct discharges. The plans to re-inject treated groundwater to the perched aquifer would qualify as a direct discharge to groundwater. The text in the No Action Alternative section (Section 4.2.4.4) has been modified to reflect this planned activity.

09 04 04 Comment Number 11

As discussed in Chapter 4 of the PEIS, the groundwater decline estimates were based on a previous study of the Amarillo well field which documented a 1.8-m/yr decline when withdrawals averaged 18.5 billion liters (l)/yr. Assuming a linear relationship (which is valid to obtain estimates for use at the programmatic level), a 0.0001-m/yr decline could be expected for each million liters withdrawn.

The PEIS analyzes the impacts from the Proposed Actions at Pantex and not those from other local uses. Pantex operations contributing to the depletion of the Ogallala Aquifer are analyzed in the PEIS.

Comment ID: P0010
Date Received: April 18, 1996
Name: Lila Wakely
Address: Lava Hot Springs

Transcription:

I do not want more waste stored in Idaho. No more. We've got too much. | 1/08.03.01

P-010

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at INEL. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

WALLIS, WALTER, PALO ALTO, CA
PAGE 1 OF 1

To: disposal fissile materials department of energy/From: Walter Wallis, P.E. 415 321-4748 3/8/96 8:45:44 Page 1 of 1

Walter E. [Gene] Wallis
2844 WAVERLEY STREET, PALO ALTO, CA 94306-2442
(415) 321-GRIT (4748) FAX & VOICE
E-MAIL - UNCLEGENE@MSN.COM

Department of Energy
Fissile Material Disposal

March 8, 1996

Gentlefolk:

If an asteroid is detected in a collision course with the Earth, it is almost certain that any plan to divert will require forces in the nuclear range, and that there will be very little time to assemble the material required.

I suggest that consideration be given to establishing, under multi-national monitoring, a repository of bomb-grade material determined to be sufficient both for the propulsion and for the demolition or diversion of an asteroid. If we need it and yet we have already made it unavailable as some plans now suggest, we will kick ourselves until the day we die, especially if that death could have been avoided. 1/01.04.00

Walter E. Wallis

F-001

01 04 00 **Comment Number 1**

Comment noted.

627 Rowell Lane
Pleasanton, CA 94566

May 2, 1996

J. David Nulton
Director, NEPA Compliance and Outreach
Department of Energy
Office of Fissile Materials Disposition
P. O. Box 23786
Washington, DC 20026-3786

Dear Mr. Nulton: Dave

Thank you for the opportunity to comment on your 15-cm-thick(!) PEIS compendium on the various ways that you have considered for storing, dispositioning, or doing nothing about various kinds of DOE-owned fissile materials. I will restrict my response to only a few salient comments with respect to excess weapon plutonium disposition in the hope that they are sufficiently concise that you read them, and more hopefully, that you consider them positively and take the appropriate action.

- The most serious flaw in the PEIS is the almost absolute disconnection from the real issue, the "clear and present danger" represented by abundant excess weapon plutonium in Russia. [*See last sentence, p. S-1*]. This is a fatal flaw. As I pointed out in my comments (October 1994, copy attached) to the DOE Notice of Intent to engage in this PEIS, it is not consistent to consider excess weapon plutonium to be a "clear and present danger" and at the same time engage in the bureaucratic morass of a formal PEIS exercise. PEIS efforts were not expended for the Persian Gulf War, The Haiti Occupation, the Somalia Intervention, the on-going Bosnia Peacekeeping, etc. None of these major Federal actions has constituted a "clear and present danger" to the national security of our country. Disposition of excess weapon plutonium in Russia, on the other hand, is a serious national security issue for Americans. We have already allowed valuable time to slip away. We must begin bilateral efforts at once (certainly not unilateral efforts as indicated in the PEIS, p. S-1), even if it means spending U. S. money in Russia to accomplish this international plutonium disposition mission. — 1/13.00.00

- The complete absence of quantitative schedule considerations (except for a 50-year temporary storage criterion) does not provide a basis for either distinguishing between alternatives or assessing the endurance of the "clear and present danger" represented by excess weapon plutonium. — 2/07.00.00

- The National Academy of Sciences has suggested that the cost of disposition of excess weapon plutonium should be considered in the context of our national security budget. However, the PEIS does not provide comparative costs of the alternatives. In fact, screening criteria are only listed for long-term storage! With no cost data to evaluate, how is the public (or DOE) to assess the viability of the various alternatives? On the other hand, the fast reactor alternative (see below) was summarily ruled out in the PEIS because it would be more costly. — 3/07.02.00

M-136

13 00 00 **Comment Number 1**

The Department of Energy has an ongoing effort to assist the Russians in dealing with the "clear and present danger," including a joint study to assess Pu disposition technologies, and plans for joint demonstrations of some of these technologies to remove the uncertainties of their viability. At the same time, DOE also has the responsibility to comply with NEPA and prepare environmental analyses of the various reasonable alternatives for public review and comment. Analyses on the cost, schedule, technical, and Nonproliferation Policy impacts are presented in separate documents. Taken together, these analyses will support DOE's ROD on the path forward for implementation of the President's Nonproliferation Policy.

07 00 00 **Comment Number 2**

Schedule data, along with technical and cost data, were provided in Technical Summary Reports of both storage and disposition beginning in late July 1996. The cost data provided in these reports included estimated transportation costs.

07 02 00 **Comment Number 3**

Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition beginning in late July 1996.

WALTER, CARL E., PLEASANTON, CA
PAGE 2 OF 6

- A considerable amount of effort was expended by DOE (over thirty million dollars) in the 1992-95 time period to assess the capability of reactor alternatives for disposition of excess weapon plutonium. Work was performed by the major reactor designers under contract to DOE. This work was subsequently evaluated by DOE in the Plutonium Disposition Study. A report on Phase 1 of the Study was published in July 1993, and the report on Phase 2 was to have been published in October 1994. The PEIS includes a 58-page listing of references, however neither of the DOE Study evaluations (in which I participated) are included. I understand that the Phase 2 Study evaluation exists as a draft report, but has been held back to insure its political correctness. Another good reference is the summary prepared by Ron Omberg and myself in February 1993 of the work performed by the DOE Plutonium Disposition Task Force. In the spirit of DOE "openness", the availability of this information should be made known to the public. 4/08.00.00

- Despite the absence of quantitative schedule considerations, the fast reactor (among others) was discounted as a comparative alternative for disposition, on the basis that it would be more time-consuming. The PEIS does not reference any of several published papers by MINATOM and other Russian officials that state that a fast reactor is Russia's only acceptable alternative for disposition of their excess weapon plutonium while *producing valuable power*. Russia has made it very clear that is the approach they will take. Why then would disposition of U. S. plutonium in a fast reactor not be a timely approach? 5/01.03.00

It is apparent that my comments on the NOI had no implicit or explicit effect on the PEIS process. Is there a record of the official action taken with respect to my NOI comments? May I expect to hear from you, or otherwise receive a reply to this present letter? Again, thanks for the opportunity to comment. I believe that Americans would be forever thankful that excess weapon plutonium were dispositioned in Russia during the next ten years. This could be, if in fact we consider their inventory to be a clear and present danger and a threat to our national security. Otherwise, our debtor government should stop borrowing additional money to waste on more studies and the execution of bureaucratic procedures. 6/08.02.00

Sincerely,

Carl E. Walter

M-136

08 00 00 **Comment Number 4**

All of the source documents used in preparing the PEIS are available to the public in DOE Public Reading Rooms or upon request to DOE. DOE has used open, publicly available information to the maximum extent possible. No commercial organization's proprietary information was used in preparing the PEIS.

01 03 00 **Comment Number 5**

The Integral Fast Reactor concept uses a reactor fuel cycle design still under development; however, the development program was recently terminated by the Administration and Congressional action. Since Pu disposition can be accomplished using existing technologies, there is no justification for developing this advanced technology.

08 02 00 **Comment Number 6**

The comment on the NOI was reviewed as part of the scoping process on this PEIS. The acceptance of the comment is noted in DOE's *Scoping Meeting Comment Summary Report* (DOE/MD-001) and the resolution of that comment is reported in the PEIS *Implementation Plan* (DOE/EIS-0229-IP).

827 Rowell Lane
Pleasanton, CA
94566

October 12, 1994

U.S. Department of Energy
c/o Oak Ridge Institute for Science and Education
P. O. Box 117
Oak Ridge, TN 37831-0117

Attention: Robert Menard, EESD

Dear Mr. Menard:

Following are my comments on "The Notice of Intent (NOI) to prepare a Programmatic Environmental Impact Statement (PEIS) titled 'Storage and Disposition of Weapons-Usable Fissile Materials'. These comments were solicited concurrently with publication of the NOI in the Federal Register, v. 59, n. 118, p. 31985, June 21, 1994.

I offer these comments as an informed private citizen and a registered nuclear engineer in the State of California. I have over 38 years of engineering experience dealing with nuclear materials and systems. For the past three years I have participated in various studies concerning disposition of excess weapon plutonium. I have four concerns with respect to the approach to disposition of excess weapon plutonium that is outlined in this NOI.

1. PEIS: An Unnecessary Delay
At the highest level of my concerns is the considered necessity by DOE to invoke the NOI/PEIS/ROD procedure in the matter of disposition of excess weapon plutonium. DOE cites the recent NAS study on management and disposition of excess plutonium as the basis for the action they propose. Yet the NAS admonition of a "clear and present danger" posed by excess weapon plutonium, while explicitly cited, is implicitly ignored by DOE. The danger to the U.S., of course, is the presence of plutonium in Russia. If in fact there is a "clear and present danger", then a major Federal action such as disposition of plutonium in the U.S. (and more importantly to instill in Russia a sense of urgency) should be exempt from the time-consuming NOI/PEIS/ROD process. A responsible government cannot on the one hand proclaim danger, and on the other hand proceed with "business as usual". It is important to begin at once to prudently dispose of our excess plutonium so that we may, through negotiation and treaty, exact similar actions in Russia at once, while a presumably receptive Russian government is in place. There is no mention in the NOI about how disposition of U.S. excess weapon plutonium would be tied to actions taken by Russia with their excess weapon plutonium. Time is of the essence to get agreement with Russia and commence disposition there as well as in the U.S. I note that, while the recent Persian Gulf War would appear to have been a major

Federal action, NOI/PEIS/ROD procedures were circumvented even in the absence of a clear and present danger to the U.S. but with an assured negative impact on the human environment. If Russia also adopts a "business as usual" attitude about disposition, should this be a worry to the U.S.? I think so.

2. Storage: Distraction from Disposition
But if no urgency is perceived (i.e. there is no clear and present danger), and the DOE is not deterred from proceeding with the NOI/PEIS/ROD process, I am concerned that the PEIS includes in its title "Storage". In the text, storage generally is long-term storage (duration undefined) unless it is interim storage, which is defined to apply in the "near-term" (duration also undefined). DOE's expressed interest in storage of all kinds associated with disposition is in direct conflict with the policy promulgated in the Presidential Decision Directive (PDD-13) of last September that states: "...eliminate where possible the accumulation of stockpiles of...plutonium...", even though this policy is explicitly referenced in the NOI. This storage issue forms the next level of my concerns. It is abundantly clear that "interim storage" and "long-term storage" are included in the "no-action" alternative that would normally be addressed in a PEIS relating to the Defense Program and does not need to appear in the title of a PEIS relative to a Disposition Program. Certainly, storage is not a new requirement for the Defense Program. Storage is an existing Defense Program responsibility, that was incurred some fifty years ago when we started making weapon plutonium and continued to aggregate until we stopped making it recently. Excess weapon plutonium is a new topic.

What is new, is disposing of the U.S. weapon plutonium that is now considered excess in concert with similar action by Russia. Clouding the issue of "disposition" by including "storage" in the title of the NOI (as a matter of fact in the lead position in the title) stimulates the perception that storage is the more important topic and disposition may not ever occur. (For example, consider the perception of a local news reporter to the advertisement for the local public workshop - article attached). My concern is that actual disposition of weapon plutonium will be delayed indefinitely, or at best tens of years, in the U.S. and in Russia as a result of DOE's fixation on long-term storage as a viable solution, or at least a necessary intermediate step to disposition. The NOI statement "Because disposition options will take decades to carry out...." implies that the duration of the disposition process is not a subject for negotiation or determination -- that it is not a variable that can be adjusted. But this is false. With apppropriate negotiations between U.S. and Russia, disposition could begin now, and be completed within ten years. The "will take decades " attitude toward disposition will become a self-fulfilling prophecy. Following our lead, disposition in Russia might also take the form of long-term storage. In view of the conditions in Russia, this is not a desirable outcome. So if the NOI/PEIS/ROD process continues, at least the emphasis of the process should be only on disposition and not also on long-term storage. With regard to disposition, there should be a strong tie to a negotiated similar program in Russia. The NOI does not address how this will be accomplished.

3. Action: Not Convoluted Management and Study, Study....
I believe that the excess weapon plutonium disposition program is being poorly managed by DOE. This was a major concern of the Office of Technology Assessment (OTA) in their September 1993 report "Dismantling the Bomb and Managing the Nuclear Materials". OTA concluded that ultimate disposition of excess plutonium from dismantled warheads is essentially a civilian mission and that "...the DOE organization that has been carrying out the weapon production mission (Defense Program) is not well suited to take on the new material disposition mission". Disposition of excess weapon plutonium should be tied to the Defense Program of DOE only at an interface that makes the excess material available to the Disposition Program. OTA suggested that a new organization outside of DOE manage excess materials or that a new organization within DOE be established. DOE quickly did the latter (but staffed the new organization with a number of Defense Program personnel and assigned to it responsibility for storage of all weapon-usable fissile material, not just excess material), and started the third study on disposition in as many years. DOE must take action, not engage in yet another study.

4. Best Disposition Method: Obviously Fission
The best method for plutonium disposition is already clear to those who have considered the issues. Only the fission process can be used to practically irreversibly alter the isotopic composition of weapon plutonium. Only in this way is the risk of diversion of this material reduced to that already present in commercial spent fuel. Also, plutonium contains a large amount of energy, which only a derilect or misinformed DOE would not utilize. One cannot throw away energy on the one hand and on the other hand claim to nurture a philosophy of conservation of energy. One cannot on the one hand use electricity and champion the environment, and on the other hand bury plutonium. Certainly, Russia will not bury their weapon plutonium, but will eventually burn it in nuclear reactors. We should help as we can to insure that this "happens sooner rather than later", to borrow a term from the NAS study. It is also abundantly clear from recent presentations by various knowledgable speakers from France, England, and Japan that they will use their plutonium beneficially. We should recover plutonium from the excess weapon plutonium inventory for feed material for reactor fuel as soon as possible. We should initiate fabrication and testing of MOX fuel elements in existing reactors as soon as possible. We should already have started these actions two years ago. No wonder OTA lacks confidence in DOE!

Thank you for the opportunity to comment. I look forward to your response.

Sincerely,

Carl E. Walter

THE VALLEY

Feds to address storage

By Paul Elias
STAFF WRITER

LIVERMORE — Federal officials touring the country in search of a final resting place for most of the nation's nuclear bomb-making material will hold a public meeting here Wednesday.

The Lawrence Livermore National Laboratory has 880 pounds of plutonium and 400 pounds of highly enriched uranium President Clinton has declared "surplus" and now the question is where to store it.

"We're essentially talking about all of our weapons material," lab spokesman David Schwoegler said.

Long-range storage options range from keeping the material at the lab to burying it. Eight nuclear testing sites have also been identified as potential storage sites for the nuclear bomb material, including the Nevada Test Site. No disposal sites have been identified in California.

Other options include diluting the highly enriched uranium with lower grade commercial uranium and using it in nuclear reactors. Irradiating the plutonium in a reactor or using it as nuclear fuel as well are also options being considered.

"This is why the public is involved," U.S. Department of Energy spokesman John Belluardo said. The federal government is preparing an environmental im-

LPD

Tri-Valley Herald

Page A-9
Tuesday
September 27, 1994

# of lab nuclear material

pact report designed to weigh the pros and cons of the storage options, Belluardo said. By law, public testimony must be considered before the report is prepared.

The public workshop will be held at the Livermore Holiday Inn, 720 Los Flores Road, from 1 to 9 p.m. It is divided into two sessions with a two-hour break starting at 4:30 p.m.

"There are more than 40 people signed up to speak," Schwoegler said

Wednesday's meeting is designed more as a workshop than a formal public hearing, Belluardo said. Energy officials will give a presentation followed by a question-and-answer session. Each session then will be divided into two small group discussions, one dealing with storage the other with disposition.

Written comment will also be accepted and weighed equally to public testimony, Belluardo said. Written comments should be mailed to the U.S. Department of Energy, c/o Oak Ridge Institute for Science and Education, P.O. Box 117, Oak Ridge, Tenn. 37831-0117; attention Robert Menard EESD. Written comments have to be postmarked by Oct. 17 to be considered.

Belluardo said the environmental report process is expected to take more than a year to complete. Once a report is submitted and accepted, the disposal will take up to 50 years to complete.

WALTON, BARBARA A., OAK RIDGE, TN
PAGE 1 OF 3

85 Claymore Lane
Oak Ridge, TN 37830
June 3, 1996

To: DOE-Office of Fissile Materials Disposition
From: Barbara A. Walton
Subject: Draft Programmatic Environmental Impact Statement (PEIS), Storage and Disposition of Weapons-Usable Fissile Materials

General Comments:

1. The release of this Draft PEIS at the same time as the Stockpile Stewardship and Management Draft PEIS is unfortunate. Holding concurrent public hearings is unacceptable. | 1/08.02.00
2. Fig. S-15, on page S-37, is missing the Electrometallurgical Treatment Alternative. | 2/16.00.00
3. The locations chosen for ORR on pages 2-38 and 2-81 are extremely bad; I hope the other potential sites have not been similarly treated. | 3/01.00.00

Preferred Alternatives:

1. I was encouraged by the lack of preferred alternatives in this draft PEIS; this encourages public input and indicates an open mind on the part of DOE. | 4/08.02.00
2. I support the Upgrade at Multiple Sites Alternative for Long-Term Storage. I do, however, have a reservation about the potential environmental impact, at Pantex, on the Ogalalla aquifer and would be supportive of some consolidation at NTS using the P-Tunnel. This may also enable inclusion of the RFETS material. | 5/08.03.01 | 6/08.03.01
3. I am unequivocally opposed to the collocation of Pu and HEU. | 7/08.03.01
4. A preferred alternative for disposition is much more problematic; it may be desirable to separate it from the process, as was done with the Disposition of HEU, in order to reach a timely decision on the Long-Term Storage. | 8/01.00.00

Discussion of Disposition Alternatives:

1. No Action would, in effect, make long-term storage indefinite, difficult and costly. This is not acceptable. | 9/08.03.01
2. The Deep Borehole needs more study on geological consequences. Immobilized Disposition may be a viable alternative, but not by the DOE's scheduled ROD for this PEIS of late 1996. | 10/09.05.08 | 11/08.03.01
3. Immobilization, especially Electrometallurgical Treatment, appears promising, BUT MERELY CREATES HIGH-LEVEL WASTE, which has not yet been addressed (it was outside the scope of the Draft Waste Management PEIS). Therefore, I consider this option not viable at this time. | 12/08.03.01
4. Reactor options in the US are not politically acceptable at this time. I believe this may change in the long run, as global impacts of fossil fuel usage become better understood by the US public. It is also not economically viable; the blending of HEU will provide domestic reactors with ample fuel in the near term. I suggest quietly pursuing the CANDU Reactor option for political viability. | 13/08.03.01

Barbara A. Walton

M-254

08 02 00 **Comment Number 1**

The Department of Energy acknowledges the commentor's concern about the integration of public meetings on draft EISs. The joint meetings on the Storage and Disposition PEIS, the Stockpile Stewardship and Management PEIS, and the Pantex EIS were held using a integrated format at the request of several organizations and citizen advisory boards. They stated that such meetings "would be more convenient and provide a less confusing format for public participants. It would avoid duplication, permit a much more efficient use of the public's time and allow a more informed decision about the issues."

16 00 00 **Comment Number 2**

Based on comments received, the Summary of the Draft PEIS was revised. All revisions made are included in the Summary of the Final PEIS.

01 00 00 **Comment Number 3**

Comment noted.

08 02 00 **Comment Number 4**

Comment noted.

08 03 01 **Comment Number 5**

The Department of Energy acknowledges the commentor's support for the Upgrade Storage Alternative. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 6**

The Department of Energy acknowledges the commentor's support for new missions at the NTS. Decisions on storage and disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 7**

The Department of Energy acknowledges the commentor's opposition to the Collocation Alternative. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 00 00 **Comment Number 8**

Separating storage from disposition would not effectively meet the purpose of and need for the Proposed Action. Planning for storage of the surplus Pu pending disposition is closely related to that for the disposition activities and would be affected by the technology(ies) selected to implement the Proposed Action. DOE is confident that a decision can be made on disposition technologies at this time, and is continuing to expand a range of small scale tests and demonstrations of some Pu disposition technologies to remove uncertainties in viability.

08 03 01 **Comment Number 9**

The Department of Energy acknowledges the commentor's opposition to continuing or long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 05 08 **Comment Number 10**

The deep borehole complex is not defined for a specific or representative site. Therefore, a limited assessment of the environmental impacts was done for the geological and other resources. Should either of the Deep Borehole Alternatives be selected, a siting study would be conducted in coordination with a site-specific discussion of environmental (including geological) conditions and impacts. The identification and acceptance of a site location would require extensive site characterization to ensure that the primary objective of the deep borehole complex, hydrologic isolation from the biosphere, would be met.

08 03 01 **Comment Number 11**

The Department of Energy acknowledges the commentor's opposition to the Immobilization Alternatives. Decisions on disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 12**

The Department of Energy acknowledges the commentor's opposition to the Electrometallurgical Treatment Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 13**

The Department of Energy acknowledges the commentor's support for the CANDU Reactor Alternative. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM, RICHLAND, WA, J. V. PARRISH

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WASHINGTON PUBLIC POWER SUPPLY SYSTEM

P.O. Box 968 • 3000 George Washington Way • Richland, Washington 99352-0968 • (509) 372-5000

May 7, 1996

Gregory P. Rudy, Acting Director
Office of Fissile Materials Disposition
Department of Energy
P.O. Box 23786
Washington, D.C. 20026-3786

Re: Comments on Draft PEIS on Storage and Disposition of Weapons Usable Fissile Materials

Dear Mr. Rudy:

On March 8, 1996, the Department of Energy ("Department" or "DOE") published in the Federal Register a notice of availability of a draft Programmatic Environmental Impact Statement ("draft PEIS") on the potential environmental impacts of various alternatives for the storage and disposition of surplus weapons-usable fissile materials. 61 Fed. Reg. 9443 (March 8, 1996). The notice also announced a series of public meetings to discuss and receive comments on the draft PEIS and an opportunity for written public comment on the draft PEIS.

The Washington Public Power Supply System ("Supply System") is interested in this matter as it relates to the use of existing commercial light water reactors for the disposition of surplus weapons plutonium. The Supply System has submitted responses to the Department's request for expressions of interest in plutonium disposition (60 Fed. Reg. 64,104 (Dec. 13, 1995)) and an unsolicited proposal to use the Supply System's operating WNP-2 reactor to conduct a lead use assembly MOX fuel program,[1] and has had numerous other interactions with the Department in furtherance of the Supply System's willingness to assist the Department with its plutonium disposition mission. Most recently, the Supply System participated in the public meetings on the draft PEIS which were held in Richland, Washington; Las Vegas, Nevada; Amarillo, Texas; and Washington, D.C.. In addition to comments made by Supply System representatives at these several public meetings, the Supply System offers the following written comments on the draft PEIS.

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[1] See Letter to Mr. Howard Canter from Mr. William G. Counsil dated August 25, 1995, with enclosure.

F-035

Comments on the Draft PEIS

The Supply System commends the Department on the thorough and detailed consideration of potential environmental impacts of various plutonium disposition options in the draft PEIS. We believe that the draft PEIS generally gives appropriate treatment to the environmental impacts of the several technologies being seriously considered by the Department for plutonium disposition, and that the draft PEIS clearly demonstrates that the option of using existing commercial light water reactors poses the fewest incremental environmental impacts of any of the options considered. To further increase the usefulness of the PEIS in support of the expeditious implementation of a plutonium disposition program, the Supply System offers the following specific comments:

- The Supply System urges the Department to finalize the PEIS promptly and to move to a Record of Decision and Request For Proposals in an expeditious manner.

  As the draft PEIS recognizes, a plutonium disposition program is necessary to implement the President's Nonproliferation and Export Control Policy in a safe, reliable, cost-effective, technically feasible, and timely manner. Draft PEIS at 1-5. Prompt action is necessary to demonstrate the United States' commitment to these objectives which will, as the draft PEIS notes, "set[] a model for proliferation resistance" and "enable the United States to . . . negotiate reciprocal actions with other nations for the disposition of surplus weapons-usable Pu." Draft PEIS at 1-5. Indefinite storage of this material, or pursuit of options which cannot be implemented for many years, will not satisfy these objectives. The option of using existing commercial light water reactors, on the other hand, is safe, reliable, and cost-effective, is the only technically proven disposition option, and can be implemented in the most timely manner. 1/08.03.01 2/08.03.01

- The Supply System encourages the Department to go beyond "technology selection" and to include (or reference), to the extent possible, readily available environmental data and analyses associated with project-specific options.

  To some extent, the Department has already addressed this issue, by including "representative" site-specific data on siting and operating characteristics of existing reactors (derived from actual plant data, including WNP-2 information (Draft PEIS at J-345)) and similar data for at least one partially completed reactor. The Department makes it clear that these sites are being considered "for analysis only" and 3/01.04.00

F-035

08 03 01 **Comment Number 1**

Comment noted.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for the Existing LWR Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 04 00 **Comment Number 3**

Comment noted. The decision will be based not only on environmental analyses, but also on analyses of technical, cost, schedule, and policy aspects of the reasonable alternatives as reflected in the Technical Summary Report issued by DOE beginning in late July 1996 and the Nonproliferation Report in the fall of 1996. Should the Existing LWR Alternative be selected, DOE would issue a public notice to solicit proposals for implementing this alternative. The information the commentor describes would be very useful should this alternative be selected.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM, RICHLAND, WA,
J. V. PARRISH
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that their consideration does not represent a DOE proposal or preference. Draft PEIS at S-17. The Supply System encourages the Department to include any additional environmental data which would support subsequent consideration of a site-specific or project-specific option, such as, for example, references to existing NEPA analyses for operating nuclear reactors, especially for reactors whose licensees have expressed interest to DOE in participating in the plutonium disposition mission. While we recognize that the Department does not intend to select a specific project or site in the PEIS, such project-specific or site-specific information could conceivably be sufficient to support such a decision in the future, without the need for another (e.g., "tiered") EIS, or to narrow the scope (and hence speed the completion) of any such EIS. 3/01.04.00 cont.

- In a similar vein, the PEIS should expressly recognize that for certain site-specific or project-specific options, such as use of the WNP-3 reactor, many of the project-specific environmental impacts are <u>already</u> considered in the draft PEIS.

  With respect to WNP-3, the draft PEIS already analyzes the environmental impacts of a pit disassembly/conversion facility and a fuel fabrication facility at the Hanford site (where WNP-2 is located). In addition, the draft PEIS considers cumulative environmental impacts of such a program at Hanford (and finds Hanford second only to the Nevada Test Site in terms of desirability on this point). The draft PEIS also incorporates data on the environmental setting at WNP-2. Draft PEIS at 3-345. The PEIS should recognize that these elements, when combined and added to the existing EIS for WNP-2 operation, constitute an essentially complete consideration of the environmental impacts of a WNP-2 MOX fuel use program.

  The PEIS should also recognize that WNP-2 is the <u>only</u> operating commercial reactor located at one of the representative sites for which environmental impacts of a MOX fuel cycle have already been analyzed in the draft PEIS. Recognition of this fact in the PEIS need not be viewed as a DOE expression of preference but merely "for analysis only," in the same manner that the draft PEIS treats data on the partially completed Bellefonte plant. As discussed above, however, the analysis could conceivably be used at some later date to support, or simplify environmental analysis of, a site-specific or project-specific decision. 4/01.02.00

F-035

01 02 00 **Comment Number 4**

Comment noted.

- The Department's choice of a technology or technologies for plutonium disposition, which is to be made in the final PEIS, should be informed by consideration of the practical availability of, and the sufficiency of existing environmental analyses of, site-specific or project-specific options.

  In drawing on environmental information and analyses for existing reactors such as WNP-2, the Department need not express a preference in the PEIS but rather could simply acknowledge the existence of environmental analyses for certain site-specific options in order to reach a more fully informed decision on the most desirable plutonium disposition technology or technologies. The fact that the analysis in the draft PEIS and other NEPA documents already addresses virtually all environmental impacts of a particular technology at the site-specific or project-specific level (as it does for use of MOX fuel at WNP-2) should enhance the desirability of the reactor-use technology in general. A choice of technology should be based not only on comparison of representative generic environmental impacts, but rather should also involve consideration of the practical issue of whether and when a particular technology can be implemented. For the reactor-use option, unlike the other technologies being considered, the site-specific environmental impacts have been largely evaluated (since they are not expected to differ significantly from the environmental impacts of current operations), and the technology has been proven and is available for implementation as soon as the supporting facilities are completed. 3/01.04.00 cont.

  In its analysis of the reactor-use option in the final PEIS, the Department should utilize the most current available data on the throughput capability of boiling water reactors. Current data show greater throughput capability than is assumed in the draft PEIS, and hence would support either a more expedited plutonium disposition schedule or a program requiring less reactor capacity. 5/06.02.09

- The draft PEIS should include environmental data on the Fuels and Material Examination Facility ("FMEF") which is located on the Hanford Reservation and should seriously consider use of the FMEF as a MOX fuel fabrication facility in support of the reactor-use option.

  The FMEF presents several key advantages over construction of new MOX fuel fabrication capability: it is essentially complete and would require relatively little capital investment to provide near-term MOX fuel fabrication capability; it is located on the Hanford Reservation, which 6/01.02.00

F-035

06 02 09 Comment Number 5

The throughput capabilities reflected in the PEIS for both PWRs and BWRs are conservative MOX core designs. More advanced core designs exist that can accommodate higher throughputs. The PEIS fuel cycles are idealized designs which bound environmental impacts.

01 02 00 Comment Number 6

The FMEF is considered for use as a long-term storage facility for Pu and the impacts are included in Section 4.2.1 of the PEIS. For the production of MOX fuel, a generic facility was considered for all six DOE sites. At Hanford this MOX fuel fabrication facility would be located in the 200-Area adjacent to 200 East.

The utilization of the FMEF would be a variant for MOX fuel fabrication at Hanford, which is bound by the environmental analysis for the MOX fuel fabrication facility located in the 200-Area. Table 2.4–1 of the PEIS provides a brief description for variants which includes "Modification/completion of existing facilities for MOX fabrication."

Utilization of FMEF for the Upgrade Alternative would not preclude its use to also support Pu disposition activities, for either Reactor or Immobilization Alternatives.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM, RICHLAND, WA, J. V. PARRISH
PAGE 5 OF 6

would minimize transportation, handling, and security costs if other disposition facilities were co-located at Hanford; and, perhaps most importantly, the FMEF could be utilized as a "glove box" facility, which could be used to fabricate MOX fuel from the output of the MOX disassembly/conversion facility, but, unlike a typical "canyon"-type MOX fuel fabrication facility, would not be capable of reprocessing spent MOX fuel. Therefore, the facility could support a MOX fuel plutonium disposition program without being able to be characterized as a vehicle for domestic reprocessing. 6/01.02.00 cont.

- The Department's preliminary observations regarding the possible need to utilize both the reactor-use and vitrification options support a decision to centralize the plutonium disposition program on the Hanford Reservation.

The Supply System agrees with the statement in the draft PEIS that some forms of plutonium may not be suitable for MOX fuel use, such that the disposition program may best be accomplished using a combination of the reactor-use and vitrification alternatives (Draft PEIS S-7). In view of this conclusion, the Department should recognize the efficiencies of co-locating the two technologies near the source of much of the in-process plutonium (i.e., at Hanford) where the two disposition processes (with one using the WNP-2 reactor for MOX fuel consumption) and their waste streams could be treated in an integrated fashion. 7/08.03.01

- The Supply System encourages the Department to establish, at the outset, a detailed program for treatment of all waste streams associated with the plutonium disposition program.

The Department should anticipate and fully address cleanup and waste disposal issues associated with the plutonium disposition program. The waste streams for plutonium conversion and fuel fabrication and/or vitrification facilities should be fully characterized and specified, and a facility for treatment of those waste streams should be included in the program. The Supply System envisions a waste treatment facility which is co-located with the disassembly/conversion, conversion, and fuel fabrication facilities on the Hanford reservation. The facility could be constructed at the outset of the disposition program. The facility could then be used in part to process existing Department wastes unless and until its full capacity was needed to process disposition wastes, and then again once the disposition mission was completed. In this way, the plutonium disposition program would be fully integrated into the 8/01.02.00

F-035

08 03 01 **Comment Number 7**

The Department of Energy acknowledges the commentor's support for new missions at Hanford. Decisions on storage and disposition of weapon-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

01 02 00 **Comment Number 8**

The design of facilities for the selected Pu disposition alternatives will include consideration of waste minimization and treatment of the associated waste streams.

Department's defense cleanup program in a timely and cost-effective manner. 8/01.02.00 cont.

- To support the process of selecting a disposition technology or technologies, the Department should proceed with activities which would further confirm the relative desirability and near-term availability of the reactor-use option, including (1) implementation of a mixed oxide ("MOX") fuel lead use assembly program in a commercial reactor and (2) use of a commercial reactor as the lead plant to commence the NRC licensing process for use of MOX fuel in a commercial reactor.

These actions would provide additional information on the time required for implementation of a MOX fuel use program and would identify any unanticipated technical or licensing issues, which would further inform a decision on the relative desirability of the reactor-use option, without prejudicing the technology selection decision or overcommitting to the reactor-use option prior to the time of technology selection. The information gained through these actions would also support prompt implementation of the reactor-use option, if ultimately selected. 9/08.03.00

We appreciate the opportunity to comment on these matters of extreme importance to global nuclear non-proliferation. We look forward to the issuance of the final PEIS and to further opportunities to assist the Department in prompt implementation of a plutonium disposition program.

Respectfully yours,

J.V. Parrish
Chief Executive Officer

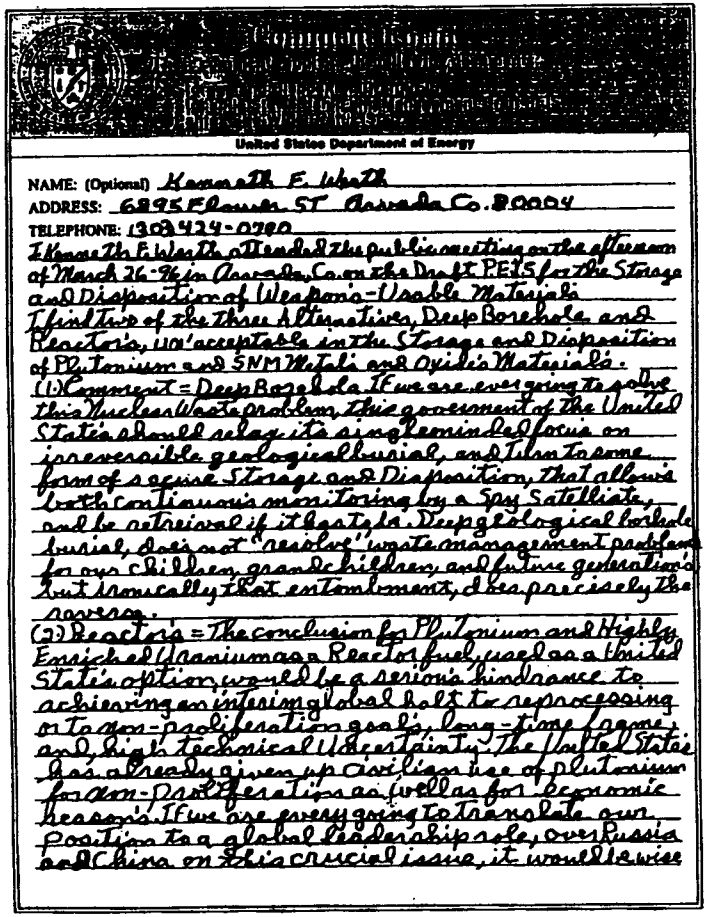
WASHINGTON PUBLIC
POWER SUPPLY SYSTEM

F-035

08 03 00 Comment Number 9

The Department of Energy is, or will soon start, conducting a series of technical demonstrations on certain aspects of some alternatives for the purpose of verifying technical parameters and information. This information will be used in the decisionmaking process and implementation of an alternative if it is selected.

WERTH, KENNETH F., ARVADA, CO
PAGE 1 OF 3



United States Department of Energy

NAME: (Optional) Kenneth F. Werth
ADDRESS: 6895 Flower ST Arvada Co. 80004
TELEPHONE: (303) 424-0780

I Kenneth F. Werth attended the public meeting on the afternoon of March 26-96 in Arvada, Co. on the Draft PEIS for the Storage and Disposition of Weapons-Usable Materials.
I find Two of the three Alternatives, Deep Borehole and Reactors, UNacceptable in the Storage and Disposition of Plutonium and SNM Metals and Oxides Materials.
(1) Comment = Deep Borehole If we are ever going to solve this Nuclear Waste problem, this government of the United States should relay it's single minded focus on irreversible geological burial, and Turn to some form of a equine Storage and Disposition, that allows both continuous monitoring by a Spy Satellites, and be retrieval if it beats us. Deep geological borehole burial, does not "resolve" waste management problems for our children, grandchildren, and future generations but Ironically that entombment, does precisely the reverse.
(2) Reactors = The conclusion of Plutonium and Highly Enriched Uranium as a Reactor fuel, used as a United States option, would be a serious hindrance to achieving an inferring global halt to reprocessing or to non-proliferation goals, long-time frame, and, high technical Uncertainty. The United States has already given up civilian use of plutonium for non-Proliferation as well as for economic reasons. If we are ever going to translate our position to a global leadership role, over Russia and China on this crucial issue, it would be wise

F-003

1/14.00.00

2/01.06.00

14 00 00 **Comment Number 1**

While there may be certain advantages to surface storage, geologic disposal of HLW is the focus of Federal waste management programs both here (the NWPA as amended) and abroad (Collective Opinions in 1985, 1991, and 1995 by the Radioactive Waste Management Committee of the Nuclear Energy Agency [in cooperation with the IAEA]). Since most of the Pu disposition alternatives result in a material form destined to be transported to a domestic NWPA-HLW repository (exceptions include the CANDU Reactor and Borehole Alternatives), DOE included comparability analyses in Appendix H of the PEIS to illustrate that these alternatives have the potential to be accepted at such a repository. Any alternatives which were determined to significantly exceed (or fall short of) the Spent Fuel Standard were eliminated during the screening process which produced the PEIS reasonable alternatives.

01 06 00 **Comment Number 2**

Comment noted.

april 1, 1996

for the United States, To look at Security Concerns, that leave us currently feasible solutions, To rid these materials for good, that present problems of potentially increasing proliferation threats, Creating new environmental problems, and/or aggravating old ones, at high costs in the billions of Dollars. I would then suggest that the United States should formally declare excess plutonium a security, economic, and environmental liability, and forever retire its use in weapons.

(3) I would support two concepts that I have proposed one is in the building of a Flat top Pyramid type facility above ground" that would encapsulate all of the Plutonium and Highly Enriched Uranium Materials, by a Vitrification process in glass, or Ceramic immobilized, that would be fused in the 6 to 8 hollowed out Cores of the 40 Ton blocks of (Granite) that then would be placed in the center of the Flat top Pyramid Type Facility For Spent Nuclear Waste, that every site in the United States has millions of Cubic yards of, that will have to be dealt with, if we a going to solve this Nuclear Waste problem, that has plagued our nation for the last 50 years.

Second = Criteria a Concept for the complete Storage, Disposition, Containment, and Transportation of Plutonium and Highly Enriched Uranium, Vitrified in borosilicate glass, or Ceramic immobilized in 6 to 8 hollowed out Cores of 40 Ton blocks of (Granite).

This concept would solve all of the Storage Disposition and Containment problems, and then be transported by rail or truck, to remote areas of the southwestren desert regions, or the

2/01.06.00 cont.

1/14.00.00 cont.

F-003

aprie 1, 1996

salt flats of Utah, stacked 5 or 6 high, would provide a low cost, low maintenance, and long-term Storage, Disposition, and Containment method for all Nuclear Waste, excluding spent Nuclear Fuel Rods, it would then be monitored by a stationary spy satellite, that would be placed in orbit 22,000 miles above the earth.

This Nuclear Waste, could be monitored by one centerlized station that would be controled by the United States government, this concept would also be a addid barrier against theft, and terrorism.

This proposal for these two concepts, has taken alot of thought from me, one person, in trying to solve this Nuclear Waste problem, that has plaged the United States, and the rest of the world for the last 50 years.

"Please Response" Sincerely
Kenneth F. Werth

P.S. You have already taken my Concept for the Flat top Pyramid Type Facility

1/14.00.00 cont.

F-003

March 25, 1996

Kenneth F Werth
(303) 424-0790

A State-of-the-Art alternative for long-term Storage and Disposition of Fissile Materials and Low Level Nuclear Waste, in a six year staged Construction Sequence.

My concept is in the building of a flatop Pyramid type facility, that could be Utilized at a number of sites across our nation, in the Storage and Disposition of all Low Level, Low Level Mixed, Rubble, and Encapsulated Plutonium and SNM Metal and Oxide Materials.

The construction, on 18 acres, of a 900'x868' Cubic foot above ground Flatop Pyramid type facility, would incorporate, (35,684) 40 Ton blocks of (Granite) cut 10 feet in length, 7 feet in width, and 6 feet in height, that would hold all of the Nuclear Waste, (1,968,237) Cubic yards, on each site, as a Monitored and Retrievable, intern Storage Facility, or for long-term, if no other sites are found.

All of the Plutonium and SNM metals and Oxides materials, would be Vitrified in glass, or be Ceramic immobilized and encapsulated in 40 ton blocks of (Granite) and placed in the center of all the Low Level Nuclear Waste, sourrounded by a large number of soled 40 ton blocks of (Granite).

1. My Conceptual Vision is in a statement about the Treatment, Disposal, and Storage of Nuclear Waste that has been a problem that has not been properly handled since the inception of the Nuclear age, an should not be left as a legacy for our Children, and grandchildren, or future generations.

1/14.00.00

CO-001

14 00 00 **Comment Number 1**

The Department of Energy applied a screening process along with public input to identify a range of reasonable alternatives for analysis in the PEIS, and utilized technical reports and analyses from national laboratories and industry to develop a final list of alternatives. Details were published in a separate report, *Summary Report of the Screening Process to Determine Reasonable Alternatives for Long-Term Storage and Disposition of Weapons-Usable Fissile Materials* (DOE, March 1995).

March 25, 1996

(2) Unmonitored and retrieveable disposal of Nuclear Waste plays on the "out of sight, out of mind" theme and is neither morally nor technically acceptable, leaveing citizen's to beleive that the site has been cleaned up of all Nuclear Waste.
(3.) All Low Level, Plutonium and S.N.M Metals and Oxide's Materials will be stored in a manner that allows for continuous monitoring and retrieval.
(4.) An above ground Flatop Pyramid Type facility will provide Storage and Disposition of all Low Level, Plutonium and S.N.M Metals and Oxide Materials, and will be seen as the first "State-of-The Art" on-site Storage and Disposition facility in the world.
(5.) (Granide) is readily available nation wide, and its use will save billions of dollars, without diverting construction materials, such as concrete from traditional use's, in continuing development on our infrastructure. Work could begin almost immediately in one or more location's, and be completed in a shorter period of time than with conventional methods and materials.
(6.) Onsite above ground Flatop Pyramid Type Facilities for Storage and Disposition of Nuclear Waste, could easily be monitored by a spy satellite placed in a stationary orbit 22,000 miles above the earth.
(7.) Interstate transportation of Nuclear Waste will be eliminated across, other state's borders.
(8.) The 900'X 868' cubic foot above ground Flatop Pyramid type Facility, on 18 acres of land

1/14.00.00 cont.

CO-001

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versus the more than 120 acre's, estimated to be needed for an underground waste dump. If estimate's of waste quanity are not accurate at each site, the Flatop Pyramid type Facility, can be built on less land use, and capped at a lower level, or additional level's can be added. Flatop Pyramid's can be sized for each site based on the estimated quantities of Waste to be stored. 1/14.00.00 cont.

(9.) The W.I.P.P. site in New Mexico will be stalled for year's of public outcry, litigation concerning over border transporation, limited Storage space, and other issues will doom this project, if it hasn't done so already.

(10.) If we are ever going to solve this Nuclear Waste P.roblem, this government of the United States should relax it's singleminded focus on irreversible geological burial and turn to some form of secure Storage and Containment, that allows both Continuous monitoring by a spy satelliate, and be retreival if it had to be. Deep geological borhole burial, does not "resolve" Waste management problem's for our Children, grandchildren, and future generation's, but ironically that entombment does precisely the reverse. 2/08.03.01

My proposal, for this concept is the "Questionnaire" regarding Criteria for screening Storage and Disposition Alternatives.

"Please Respound"

Sincerely
Kenneth F Werth
6895 Flower ST
Arvada Co 80004

CO-001

08 03 01 **Comment Number 2**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

WERTH, KENNETH F., ARVADA, CO
PAGE 4 OF 6

DESIGNED BY
Kenneth F. Werth
(303)424-0790

L-W-H
900'x868' Pyramid constructed of 10'x7'x8' blocks of (GRANITE)

Level	X Blocks	Y Blocks	No. Blocks	Total Blocks	CY Enclosed	Total CY	Elev	Comments
1	90	122	10980	10980	0	0	6	Solid Blocks
2	90	122	10980	21960	0	0	12	Solid Blocks
3	89	121	420	22380	180,472	180,472	18	
4	88	120	416	22796	157,294	337,766	24	
5	87	118	412	23208	154,148	491,913	30	
6	86	116	408	23616	150,784	642,697	36	16 Capsules
7	85	117	404	24020	147,700	790,397	42	16 Capsules
8	84	118	400	24420	144,894	935,291	48	
9	83	115	396	24816	141,372	1,057,163	54	
10	82	114	392	25208	138,880	1,196,042	60	
11	81	113	388	25596	135,620	1,331,662	66	
12	80	112	384	25980	132,890	1,464,552	72	
13	79	111	380	26360	130,682	1,595,043	78	
14	78	110	376	26736	127,324	1,722,367	84	
15	77	109	372	27108	124,588	1,846,855	90	
16	76	108	368	27476	121,862	1,968,237	96	
Top	76	108	8208	35684	0	1,968,237	102	Solid Blocks
		Land Area of Base = Approx 18 Acres						

SIX YEAR STAGED CONSTRUCTION SEQUENCE

YEAR ONE AND TWO
MOBILIZE = SITE PREPARATION, ACCESS ROADS, RAMPS EXPAND AND INCREASE CAPACITY OF QUARRY BEGIN QUARRYING AND SHAPING BLOCK'S, BEGIN PLACING LEVEL ONE BLOCK'S (10,900 BLOCK'S)

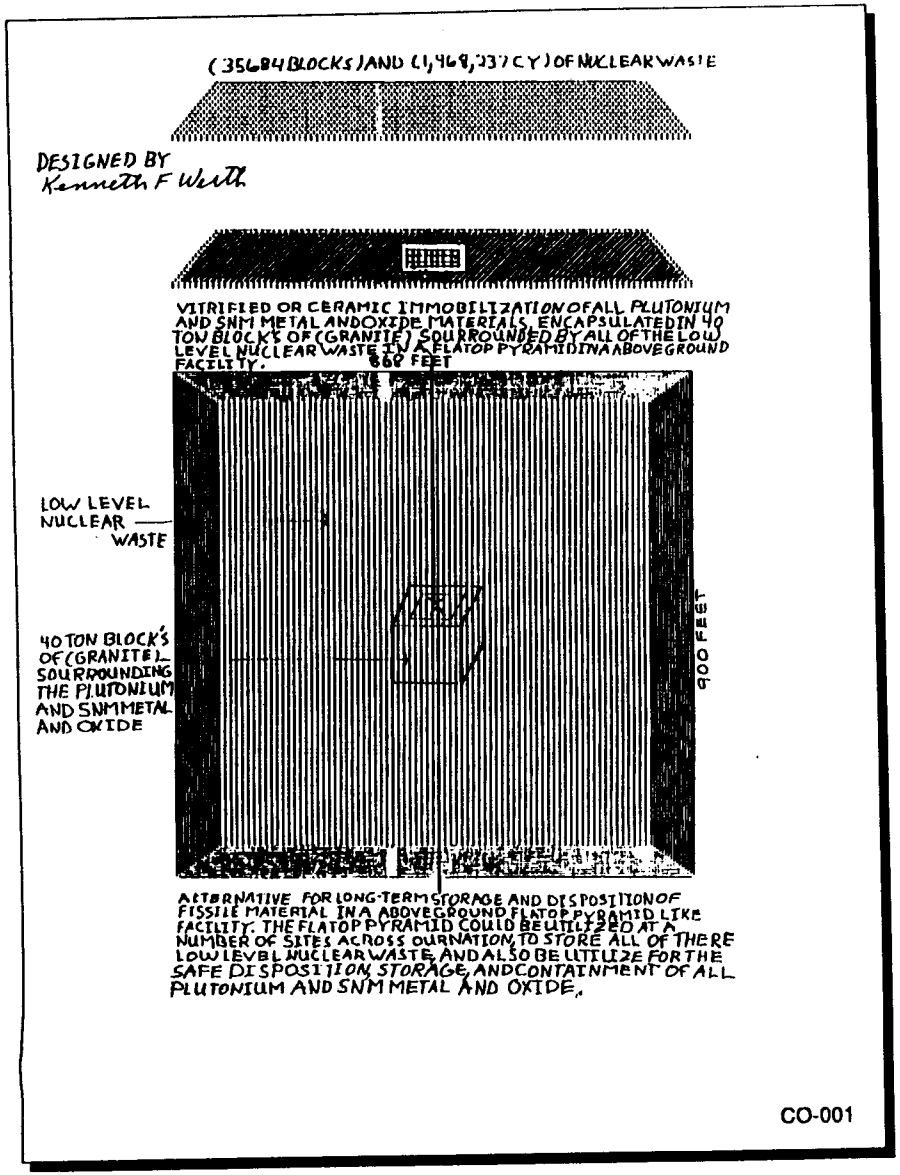
YEAR THREE = PLACE SECOND LEVEL BLOCK'S (10,900 BLOCK'S) PLACE THIRD LEVEL BLOCK'S (420 BLOCK'S) BEGIN DEMOLISHING CONTAMINATED FACILITIES, PLACE AND COMPACT RUBBLE AND LOW LEVEL NUCLEAR WASTE (160,472 CY) PLACE FOURTH LEVEL (416 BLOCK'S) AND PLACE AND COMPACT RUBBLE AND LOW LEVEL NUCLEAR WASTE IN LEVEL FOUR (157,294 CY)

YEAR FOUR = PLACE BLOCK'S AND COMPACT RUBBLE AND LOW LEVEL NUCLEAR WASTE IN LEVELS FIVE AND SIX (820 BLOCK'S) AND (304,932 CY) PLACE BLOCK'S OF ENCAPSULATED PLUTONIUM AND SNM METAL AND OXIDE IN LEVELS SEVEN AND EIGHT OF (64 BLOCK'S) CONTAINING (200 CY) OF HIGH LEVEL WASTE PLACE BLOCK'S AND COMPACT RUBBLE AND LOW LEVEL NUCLEAR WASTE IN LEVEL'S SEVEN AND EIGHT (804 BLOCKS) AND (297,594 CY)

YEAR FIVE = PLACE BLOCK'S AND COMPACT RUBBLE AND LOW LEVEL NUCLEAR WASTE IN LEVEL'S NINE, TEN, ELEVEN, TWELVE, AND THREETEEN (1940 BLOCK'S) AND (679,764 CY)

YEAR SIX = PLACE BLOCK'S AND COMPACT RUBBLE AND LOW LEVEL NUCLEAR WASTE IN LEVEL'S FOURTEEN, FIFTEEN, AND SIXTEEN LEVEL (1116 BLOCK'S) AND (372,194 CY) PLACE TOP LEVEL (8208 BLOCKS) FOR A TOTAL OF (35684 BLOCKS) AND (1968,237 CY) TOTAL

CO-001


(35684 BLOCKS) AND (1,969,237 CY) OF NUCLEAR WASTE
DESIGNED BY
Kenneth F Werth
VITRIFIED OR CERAMIC IMMOBILIZATION OF ALL PLUTONIUM AND SNM METAL AND OXIDE MATERIALS, ENCAPSULATED IN 40 TON BLOCKS OF (GRANITE) SOURROUNDED BY ALL OF THE LOW LEVEL NUCLEAR WASTE IN A FLAT OP PYRAMIDIN A ABOVE GROUND FACILITY.
660 FEET
LOW LEVEL NUCLEAR WASTE
40 TON BLOCK'S OF (GRANITE) SOURROUNDING THE PLUTONIUM AND SNM METAL AND OXIDE
900 FEET
ALTERNATIVE FOR LONG-TERM STORAGE AND DISPOSITION OF FISSILE MATERIAL IN A ABOVE GROUND FLAT OP PYRAMID LIKE FACILITY. THE FLAT OP PYRAMID COULD BE UTILIZED AT A NUMBER OF SITES ACROSS OUR NATION, TO STORE ALL OF THE RE LOW LEVEL NUCLEAR WASTE, AND ALSO BE UTILIZE FOR THE SAFE DISPOSITION, STORAGE, AND CONTAINMENT OF ALL PLUTONIUM AND SNM METAL AND OXIDE.
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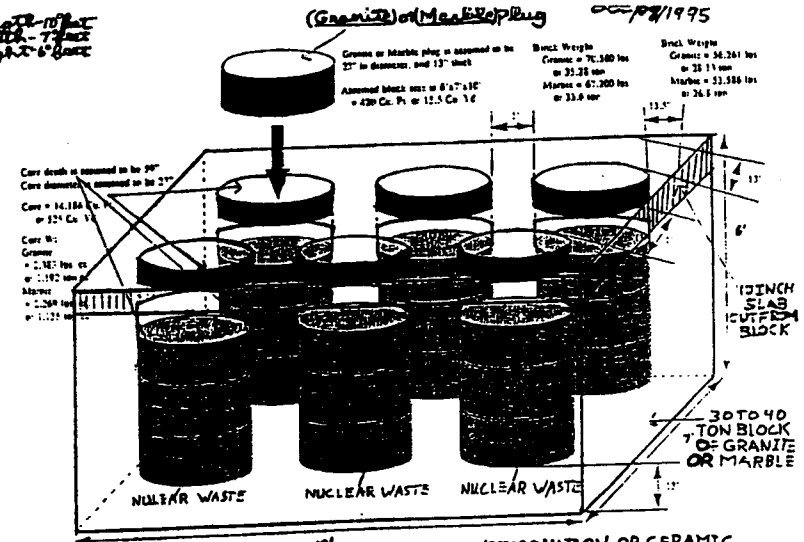

VITIRIFED IN BOROSILICATE GLASS OXIDATION/DISSOLUTION OR CERAMIC IMMOBILIZATION OF ALL PLUTONIUM AND SNM METAL AND OXIDE MATERIALS ENCAPSULATED IN 40 TON BLOCK'S OF (GRANITE) IN THE CENTER OF THE FLATOP PYRAMID

DESIGNED BY Kenneth F Werth

CO-001

WESTINGHOUSE SAVANNAH RIVER CO., AIKEN, SC, RICHARD R. TANSKY
PAGE 1 OF 2

Date: Wed, 1 May 1996
Subject: FORUM Form - incoming

#serial_no = 164
#MailTitle = FORUM Form - incoming
#name = Richard R. Tansky
#title = Site Training Manager
#company = Westinghouse Savannah River Co.
#addr1 = 116 Sugarberry Rd.
#addr2 =
#city = Aiken
#state = SC
#zip = 29803
#phone = 803 208-0773
#fax = 803 208-0843
#email = rtansky@csra.net
#ctype = public
#subject = Potential Savmnah River Involvement

** The following is the text of the Author's Comment.

Savannah River Site should be selected for interim and long term Pu and HEU storage for the following reasons: | 1/08.03.01

Site Infrastructure - Continuing investments in the site's infracstructure make SRS a logical choice for locating Pu and HEU.

Community Support - The surrounding community strongly supports the continuation of the use of SRS to support the nation's defense programs involving special nuclear materials.

Workforce Readiness - SRS has demonstrated a commitment to upgrading the knowledge and skills of its workforce and currently had the best trained and therefore the best prepared workforce to take on new missions regardless of the technology used.

Management Commitment to Safe Operations - Both the site's radiological and industrial safety record speak volumes about the ability of the site to safely and reliably carry out complex, high-tech missions with minimum risk to the environment and surround ing population.

Environmental Impact Baseline Knowledge - The investment in understanding and monitoring the ecology of the SRS puts this site in front in terms of being able

E-005

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for SRS. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

WESTINGHOUSE SAVANNAH RIVER CO., AIKEN, SC,
RICHARD R. TANSKY
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to assess environmental impacts and responding to and mitigating them.

Expertise in Fissile Materials - The site experience in the safe production, handling, and storage of both Pu and U, as well as other nuclides, point to SRS as an obvious choice for continuing and expanding this work.

It will be important for the DOE to deal with the disposition issue concurrently with the storage issue in order to overcome the legitimate concerns of the local and state governments that these materials will be accumulated without a certain disposition decision. Therefore, SRS should be chosen for both the disposition and the pit storage missions with the above factors as a basis.

1/08.03.01
cont.

#END comment

E-005

ROCKY FLATS

STORAGE & DISPOSITION OF
WEAPONS-USEABLE FISSILE MATERIALS
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

FORMAL PUBLIC COMMENTS

Westminster City Hall
4800 W. 92nd Avenue
Westminster, Colorado

Tuesday April 30, 1996

M-235

INDEX

Speakers from Audience:

Kenneth Werth - Resident of Arvada, Colorado

Thomas M. Rauch - American Friends Service Committee

Jim Stone - Rocky Flats Cleanup Commission

Tom Marshall - Rocky Mountain Peace Center

Allan Trenary - Rocky Flats Citizens Advisory Board

Sam Cole - Physicians for Social Responsibility

Officiates:

Carl Sykes

Mariane Anderson

P R O C E E D I N G S

MR. SYKES: Well, we're going to go ahead and start tonight's meeting. The purpose of tonight's meeting is to obtain formal comments for the Material Disposition Programmatic Environmental Impact Statement for the Disposition of Fissile Materials. Even though we don't have a whole lot of focus here tonight, the people from the Material Disposition Office have asked me not to interact with anybody but just to get formal comments so that that will facilitate their answering these questions formally.

We do have a court reporter here, so your comments will be recorded verbatim. And essentially what we're going to do is take the transcript from the court reporter and send it on to headquarters, and this will be part of the Material Disposition Programmatic Environmental Impact Statement. It will be part of that, the response document that they will create for that.

After everyone's given their statements, especially with such a small group here, we can certainly talk informally. But for the formal part of this, basically I can--I'm just going to sit here and smile while you read your formal comments. So I apologize, you know, not being able to answer questions.

Go ahead, Mariane.

MS. ANDERSON: Kenneth Werth, please come to the

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(inaudible).

MR. WERTH: Oh, okay.

MS. ANDERSON: Oh, and also, at the beginning of each comment, you need to give your name and state that this is your formal comment for the Storage and Disposition PEIS, okay?

MR. WERTH: Okay. My name is Kenneth Werth and I'm a 60-year resident of Arvada, citizen of Arvada. And I'd like to comment on my vision for the Rocky Flats Environmental Technology Site. I believe that every site that has generated nuclear waste is going to have to take care of their own waste, high-level and low-level nuclear waste. And I've never heard of a concept like I have drawn up in my two and a half years of attending most of Rocky Flats Citizens Advisory Board meetings, and a lot of other ones.

And I've drawn up this flat-top pyramid criteria. It will be an above ground monitored and retrievable storage facility. It would be--the first one would be above ground flat-top pyramid type facility made up of 40-ton blocks of granite, cut 10 feet in length, 7 feet in width, and 6 feet in height. And the engineering feasibilities would be:

A) A 470 by 315 square foot facility situated on approximately base area of 3.40 acres, would incorporate 7,410 blocks, is a total number of 40-ton blocks of granite.

1/14.00.00

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14 00 00 Comment Number 1

The Department of Energy appreciates the commentor's submission of the conceptual design of the flat-top pyramid storage facility. However, one of the screening criteria for storage, technical viability, calls for a high degree of confidence that the facility must provide safe and secure storage of nuclear materials for at least 50 years. The structural integrity of this design is not proven, and the size and shape of the facility could attract unwanted attention. Since there is an urgent need for implementation of the Proposed Action, and existing facilities and design can accomplish the storage mission, it would not be prudent to use additional time and cost to develop and demonstrate new designs.

And it would encapsulate 291,416 cubic yards of low-level, low-level mix, level, and transuranic waste in bulk form, leaving the facility center as a place to store 64 high-level nuclear waste capsules of plutonium and highly enriched uranium.

B) would be a 500 by 460 square foot facility situated on approximately a base area of 4.85 acres, would incorporate 9,960 total number of 40-ton blocks of granite, and encapsulate 521,432 cubic yards of low-level, low-level mix, level and transuranic waste in bulk form, and the same number of 64 high-level nuclear waste capsules.

And C) a 900 by 868 square foot facility situated on an approximate base area of 18 acres, would incorporate 35,684 total number of 40-ton blocks of granite, and encapsulate 1,968,237 cubic yards of low-level, low-level mix, level, and transuranic waste in bulk form, and also incorporate a higher number than the 64 high-level nuclear waste capsules. 1/14.00.00 cont.

And I'm just coming to the calculation of this project. It would be in a six-year sequence of getting the program started, excavating the roads and the ramps. And a structure like this, if you had a lower number of nuclear waste that you would have to store, you could cut out a couple levels of the structure, flat-top structure. And I'm basing this structure on seventeen levels, and the two lower

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levels would be built above ground and they would be solid blocks of interwinding floors on the first and second levels. And then as you could start on the third level, going up the sixteen levels, 120 feet high, you could get this, especially 900 by 868 square foot facility, you could put over 1,961,000 cubic yards in it. And this would be an above ground facility.

And now I'm talking about the cost. If you would lay it out in a six-year sequence, this here one, 900 by 868, that would incorporate 35,684 total number of 40-ton blocks, would encapsulate 968,237 cubic yards. And based on a six-year building time frame, that there structure could be built for about--probably about $300 million at $9,000 a block. And I think that there's a quarry up in Wyoming right now that has 800 quarry all kinds of granite that they could quarry these here blocks between $9,000 and $10,000 a block.

1/14.00.00 cont.

And as stated, is the cost realistic? Really, if you look at--see, you're also going to have to address the low-level nuclear wastes. People ain't going to let that sit out there and be driven downstream from the Rocky Flats site with these 100-mile-an-hour winds to Westminster or Arvada, Edgewater, Lakewood, Golden, Douglas County. See, the citizens just ain't going to sit downstream from that and let you bury that waste.

I haven't completed all my analysis of this scheme,

but I think it would be worth looking at.

MS. ANDERSON: Thank you, Mr. Werth.

Next is Tom Rauch.

MR. RAUCH: My name is Thomas M. Rauch, R-A-U-C-H. I'm on the staff of the American Friends Service Committee in Denver. These are my comments for the Draft Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement. Amen.

I'm very grateful to the Department of Energy for scheduling this second public comment hearing in order to provide more time for citizens to review the Draft Storage and Disposition of Weapons-Usable Fissile Materials PEIS prior to offering their comments. I'm very disappointed there are not more people here tonight and very grateful that you've come out on another evening to give another evening of your time for this.

I have four main points I would like to make, and I'll present a written copy of my statements to the reporter.

First, a major priority is that plutonium and highly enriched uranium be stored and disposed of in ways that pose least threat to human health and the environment. The health and safety of the persons charged with handling these materials should be given special attention. I want to emphasize this point, not because I think Department of Energy employees and contractors will do their work in a way

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that is dangerous to themselves, but because I fear that the federal government, especially the Congress, will cut funds for storing and disposing of these materials just as the Congress is presently making substantial cuts in funds for waste management and environmental restoration at DOE nuclear weapons facilities. The current attitude in Washington is to increase funds for DOE weapons programs while cutting funds for dealing with the legacies of 50 years of the nuclear arms race. This attitude is immoral, short-sighted, and very dangerous for people and the environment. The Department of Energy must have as its primary goals effective and safe waste management, effective and safe environmental restoration, and effective and safe storage and disposition of weapons-usable fissile materials. The DOE should cease all efforts at research, development, testing, engineering, and production of new nuclear weapons--activities that are proposed in the DOE's Stockpile Stewardship and Management Program.

Secondly, a major--second major priority is to assure that the weapons-usable fissile materials are stored and disposed of in ways that make them most resistant to the possibility of nuclear weapons proliferation. I'm not an expert on these technical issues, but I think I can suggest that materials from retired weapons should be treated in such a way, perhaps contaminated or diluted or both, that makes

2/01.06.00

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01 06 00 **Comment Number 2**

That is the goal of this effort.

their reuse for weapons difficult and/or dangerous.

My third point, storage and disposition options should be chosen so as to minimize the waste generated by these activities. The vast quantities of waste produced by nuclear weapons production and still awaiting safe storage and disposition remind us of the folly of producing additional wastes if this can be avoided. So I urge the DOE to put more resources into testing the viability of glassification as a means of disposing of plutonium. My sense is that the DOE has up to this point put most of its resources into the option of using these fissile materials as fuel in reactors for commercial purposes. Such use, I am concerned, would create even more waste materials and would also involve proliferation risks. 3/08.03.01 4/05.00.07

Number 4: The present administration has declared certain amounts of plutonium and highly enriched uranium to be "surplus" and a waste. I urge that all of the materials in the present stockpile be declared "surplus" so that the United States may move expeditiously, along with other nuclear powers, to fulfill the commitment made in 1970 in the Nuclear Non-Proliferation Treaty. Article VI of that treaty, which was continued in force indefinitely at the 1995 renewal conference, states: "Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an 5/01.00.00

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08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

05 00 07 **Comment Number 4**

Comment noted.

01 00 00 **Comment Number 5**

Comment noted.

early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control."

Twenty-six years have passed since the United States and other nuclear powers made that commitment to nuclear disarmament. If the United States were to declare all of its present fissile materials "surplus," such a declaration would signal the U.S.'s intention to move toward nuclear disarmament and would also encourage the U.S. to step up the pace of multilateral disarmament efforts.

My final point is to Department of Energy headquarters and the secretary. The Department of Energy as a participant on the Nuclear Weapons Council, which makes decisions about the size and shape of the U.S. nuclear weapons arsenal, can and should play a lead role in calling for even lower stockpile numbers than the stockpile of 1,000 nuclear weapons, which is presented as an option in the Draft PEIS for Stockpile Stewardship and Management. I commend the DOE for listing this option, which is much lower than the START II protocol of 3,500 weapons. But I urge that even lower options, including a zero option in line with a declaration that all weapons-usable fissile materials are "surplus," be considered in all present and future planning.

The Department of Energy, by its role on the policy-making Nuclear Weapons Council, does not simply "fill

orders" given by the Department of Defense and approved by Congress and the president. The Department of Energy participates in making nuclear weapons policy and so cannot avoid responsibility for decisions about numbers of weapons in the present and future arsenals. I urge the Department of Energy to press for lower stockpile numbers, including a zero option, in Nuclear Weapons Council deliberations.

Again, I thank the Department for this additional hearing, and thank you, especially, for your presence here tonight.

MS. ANDERSON: Thank you, Mr. Rauch.

Mr. Stone, Jim Stone.

MR. STONE: Good evening, ladies and gentlemen, my name is Jim Stone, I am the technical advisor of the Rocky Flats Cleanup Commission.

I have finished reading the PEIS on the stewardship of fissile material and also the storage and disposition of fissile material. And I wasn't going to come to this meeting, but at the last minute it occurred to me that I had a couple of things to get straight in my mind.

DOE has been authorized to surplus tons of plutonium and high-level uranium. Now, the high-level uranium has a value on the power market, so there's no mention of destroying it or putting it in any kind of a permanent disposal mode. But there is a number of tons,

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maybe 10 percent of our inventory of plutonium, that is going to be surplused. It seems to me it is logical to take that much tonnage out of Rocky Flats, and maybe some other small site that doesn't have the capability of storing this material properly, and dispose of it. 6/08.03.00

Now, when you get through with this public presentation or participation on this PEIS, you're going to review it for a couple months and then decide where you're going to ship it, because in the PEIS documents it lists Rocky Flats as "no action". So we're obliged to store it properly, because we're in a very dangerous mode with the proximity of a large metropolitan area. So we've got to do something with it.

Planning to modernize Building 371 and maybe a number of other schemes I'm not familiar with. But that is wasted money when you think that it's going to be temporary, hopefully months, not years, but it may be years. But we do know that at least that amount of plutonium that is stored at Rocky Flats is going to be surplused and going to be permanently disposed of somewhere.

I ask DOE to consider allowing--giving Rocky Flats the latitude to dispose of it there, cut the cost, get it done with, and so that we can get on with the cleanup. Maintaining this material is really a bottleneck to the cleanup operation. We have a lot of serious work to do at

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08 03 00 Comment Number 6

In accordance with existing agreements, DOE is moving toward the removal of all weapons-usable fissile materials from RFETS. This is the reason that all alternatives for long-term storage in the PEIS include the environmental impacts of the removal of the materials from RFETS.

Rocky Flats, and this only impedes progress and wastes a lot of money.

Now, let's see. I will write this up and send it in at a later date, before the 7th, but that's my general concern.

I really wanted to ask you, what is your time schedule, but since you're not authorized to make a reply, I won't get that answered. I doubt if it's established yet. And then after the six months or two months of review time, you may come up with a different answer. So we've got to wait on that. 7/07.00.00

But we don't have to wait to say we know you're going to dispose of at least 20 tons of plutonium. Rocky Flats has 14 tons, get rid of it any way you can. We'll honor your suggestions and get on with it so that you don't have to delay your cleanup program.

Thank you. Any questions?

MR. SYKES: I'll let M.D. formally reply to your comments, but if you do stick around, we can talk about the time tables after the meeting's over.

MR. STONE: Alright, thank you.

MR. SYKES: Um-hmm. Thank you.

MR. STONE: Incidently, Stone Environmental Engineering Services, which I'm the vice president of engineering, would be glad to give you a design on how that

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07 00 00 **Comment Number 7**

Generally, the goal is to complete disposition within 25 years after the ROD. The storage decision will be for long-term storage, up to 50 years. Schedule data, along with technical and cost data, were provided in Technical Summary Reports of both storage and disposition beginning in late July 1996.

can be disposed of. We have focused too narrowly on the concepts that come out of headquarters. They don't have a hell of a lot of imagination there, in my estimation. I don't doubt that they've got the technology, but they don't have much imagination, and I suggest that we expand on that a bit. Thank you.

MS. ANDERSON: Thank you, Mr. Stone.

Is there anyone else who would like to offer formal comment at this time?

(Pause.)

MS. ANDERSON: Would you please state your name and that this is your formal comment for Storage and Disposition of Fissile Materials PEIS?

MR. MARSHALL: How long do I have?

MS. ANDERSON: A week to ten days.

MR. MARSHALL: I can do as long as I want here, till they shut down tonight?

MS. ANDERSON: We've got water.

MR. MARSHALL: What's that?

MS. ANDERSON: We've got water.

MR. MARSHALL: Oh, good. Okay.

MS. ANDERSON: Start with your name, please.

MR. MARSHALL: I thought I was going to have a little while to prepare.

My name's Tom Marshall, I work with the Rocky

Mountain Peace Center in Boulder, Colorado. These comments are on the Department of Energy's Draft Programmatic Environmental Impact Statement for Storage and Disposition of Weapons-Usable Fissile Materials. These comments are not intended to be exhaustive. We will be submitting further written comments. I did, however, want to touch on a few points this evening.

The first of these, and the primary point that I would like to make, is that what we have here is not really a Programmatic Environmental Impact Statement on Storage and Disposition of Surplus Fissile Materials. We do not have any viable disposition options outlined in this PEIS. There are problems with every--with all of the disposition options listed, the MOCS option, the immobilization option, and the deep borehole option.

We have a serious challenge in front of us. I'm going to go back to these options and talk a little bit about some of the deficiencies. But we have a serious challenge in front of us right now. We have a window of opportunity in which the U.S., working with Russia and the other former Soviet Union states, can move to remove a good portion of the fissile materials, and therefore eliminate, to a certain degree, concerns about proliferation of these materials, making the world overall a safer place. If we had a viable disposition option at this time, it would be wise to take it,

but we don't, as I said.

The MOCS option is the worst of those listed and it should be rejected outright. Some of the problems with the MOCS option are: that it's costly, it's going to cost more than other options listed; it would take longer than the immobilization option to implement; it will generate a lot of high-level waste that we don't currently have an answer for; it's dependent upon a repository that we don't have and we have no idea when we're going to have it; it creates numerous opportunities through the processes that it will have to go through for theft of plutonium; and perhaps the most--the worst part of this option is that it could--it stands to set up a plutonium economy, it creates the illusion that there is some value in this material and could encourage other countries to use it as--to see it and use it as a resource. It would send the wrong message to the rest of the world. What we need to be doing at this point is telling the rest of the world that this material is dangerous material, it needs to be taken out of circulation, and that it is a waste. This option doesn't do that.

The immobilization option also has problems as a disposition option.

The one thing I didn't mention about the MOCS option, all of these options can be reversed. There's not one of them that can't be reversed. Under the MOCS option,

you can reprocess the spent fuel and extract those. So any country can do that. It would obviously be harder for a sub-national group.

Same goes with the immobilization option. Either vitrified or ceramified material could be--the plutonium in that could be extracted. So as a disposition option, at this point it's not a proven option. It, too, at this point is dependent upon a repository that we don't have.

The deep borehole option needs far more research, and conceivably, that option, too, could be reversed.

So what we're left with, then, is a long-term storage EIS, and that's not bad. I think that what we need to do is recognize that we don't have viable options for disposition right now, and we need to identify ways to store our surplus fissile materials in a manner that reduces the risk of proliferation as much as possible.

One fault of the PEIS in analyzing long-term storage is that it looks at only one sort of container, what's commonly called the 50-year can. We should not be limited in that way of thinking. And if we are admitting that we don't currently have viable disposition options, that raises a whole host of alternatives. And what we have in front of us right now, currently considered a disposition option, is immobilization. Immobilization should be looked into further as a long-term storage option which would reduce

the risk of proliferation.

And the few technologies that should be considered are vitrification and ceramification. We have a fair amount of research done on that. We can move quickly to implement that. The electrometallurgical processing should be rejected because it would involve bringing plutonium to a metal state, which if we're thinking about proliferation concerns is not wise. It is also a complicated process which is not congruent with the notion of safety for workers and protection of workers' health.

It would be wise at this point for the U.S. Government to set up at least one pilot plant, one pilot scale facility, to test vitrification of plutonium and one to test ceramification of plutonium. It might be wise to set up more than one of each. But that is what should be done, at a minimum.

So to review, there should not be an option selected under disposition. The MOCS option should be rejected immediately. We should be looking at long-term storage options. We should consider immobilization options as long-term storage options. There is further research needed on these options to determine just how we do that, whether we mix highly radioactive substances, such as cesium, in with them, whether we add other poisons, such as alpha emitters, whether we put a highly irradiated jacket around

8/08.03.00

9/08.03.01

10/08.03.01

M-235

08 03 00 **Comment Number 8**

The Department of Energy acknowledges the commentor's support for continued storage of surplus Pu (No Action Alternative). Decisions on disposition will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 9**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 10**

The Department of Energy acknowledges the commentor's support for the Immobilization Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

the glass or ceramic matrix rather than mixing that in. And in order to make these determinations, we need to establish pilot plants to further develop the technology. We should move quickly on this option while further exploring final disposition options. 11/01.00.00

Thanks. As I said, we will be submitting further written comments.

MS. ANDERSON: Thank you, Mr. Marshall.

Is there anyone else that would care to make formal comment at this time?

(Pause.)

MR. WERTH: Oh, I would like to comment on Tom Marshall's--if I'm able.

MS. ANDERSON: Okay, Mr. Ken Werth.

(Inaudible conversation outside the range of the microphone.)

MR. WERTH: I got this comment form for the Storage and Disposition of Draft PEIS, and I would voice Tom Marshall's concern. And I find two of the three alternatives, deep borehole and reactors, unacceptable in the storage and disposition of plutonium and S and M metals and outside materials. Comment: deep boreholes, if we are ever going to solve this nuclear waste problem, this Government of the United States should relax its single-minded focus on irreversible geological burial and turn to some form of 12/08.03.01

01 00 00 **Comment Number 11**

Comment noted.

08 03 01 **Comment Number 12**

The Department of Energy acknowledges the commentor's opposition to the disposition alternatives. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

secure storage and disposition that allows both continuous monitoring--and I've looked at this monitoring. Why couldn't the United States have spy satellites that's been placed in the stationary orbit 22,000 miles above the earth, and they can pinpoint this kind of structure that we'd be looking at, and we could have continually monitored surveillance of this here facility? And it should be retrievable, if it had to be. (Inaudible) borehole burial does not resolve waste management problems for our children, grandchildren, and future generations, but ironically, that entombment does precisely the reverse.

Reactors: The conclusion of plutonium and highly enriched uranium as a reactor fuel used as a United States option would be a serious hindrance to achieving an internal global halt to reprocessing or to non-proliferation goals, long time frame and high technical uncertainties. The United States has already given up civil use of plutonium for non-proliferation, as well as for economic reasons.

If we are ever going to translate our position to a global leadership role over Russia and China on this crucial issue, it would be wise for the United States to look at all the security concerns. That leaves no currently feasible solutions to rid these materials for good that present problems of potentially increasing proliferation threats, creating new environmental problems, and/or aggravating old

ones at huge costs, in the billions of dollars.

I would then suggest that the United States formally declare excess plutonium a security economically and environmentally liability and foreswear its reuse in weapons. I would support two concepts, and that would be one in the building of a flat-top pyramid type facility above ground that would encapsulate all the plutonium and highly enriched uranium materials by 40-ton blocks of granite. And it would be a concept for the complete storage, disposition, containment, and transportation of plutonium and highly enriched uranium vitrified in glass or ceramic immobilization in six to eight hollowed out cores of 40-ton blocks of granite. This concept would solve all the storage, disposition, and containment problems and then be transported by rail or truck to remote areas of the southwestern desert region or the Salt Flats of Utah, stacked five or six high, would provide a low-cost, low-maintenance, and long-term storage disposition and containment method for all this high-level nuclear waste. 13/14.00.00

You could--there is thousands of tons of spent nuclear fuel rods that the United States Government is going to also have to look into, and this would be an ideal method to address that, too. But I'm concerned about all the high-level waste out there.

We should also start considering what we're going

M-235

14 00 00 **Comment Number 13**

Comment noted.

its use will save billions of dollars without diverting construction materials such as concrete from its additional use in continuing the development of our infrastructure. Work could begin almost immediately in one or more places and could be completed in a shorter period of time than with conventional methods and materials.

An above-ground pyramid will provide safe storage of spent nuclear fuel, plutonium, and highly enriched uranium, and will be seen to be the first state-of-the-art facility, on-site storage facility, in the world. And I mentioned a 900-foot by 868-foot above-ground pyramid proposed on only 18 acres of land. Then it's more than 120 acres that's needed for an underground waste dump. You call it cells, but I call it a waste dump. And that's the way it should be looked at.

If estimates of waste quantity are not accurate, the pyramids can be kept at a lower level or additional levels can be added if more waste is accumulated out there. Pyramids can be sized for each site based on the estimated quantity of waste to be stored.

The last one. The work site in New Mexico will be stalled for years by public outcry, litigation concerning transportation, and other issues that will doom this project, if it hasn't done so already.

That's all I've got to say.

MS. ANDERSON: Thank you, Mr. Werth.

Any further public comment?

(Pause.)

MS. ANDERSON: Mr. Marshall.

MR. MARSHALL: Tom Marshall, Rocky Mountain Peace Center. Just one small point--well, one quick point, it's not a small point, that I forgot to mention before. When Mr. Canter was out at a previous hearing, the issue of cost estimates for the MOCS option was brought up, and we were told at that time that those are still being developed and that they will be factored into the final PEIS. And I'd simply like to lodge a complaint about that at this point. Any factors which are going to go into the decision-making on this PEIS should be out for full public review so that the public can make informed comment on that. That's it, I just wanted to make sure that that point got into the record. Thanks.

MS. ANDERSON: Thank you.

MR. SYKES: Well, unless someone else shows up for formal comments, I'd like to talk to a few of you all, and we can now just have informal conversations, I guess, unless someone else shows up.

(Off the record.)

MR. SYKES: I want to make one point, and that is the Office of Material Disposition did ask that the comments

be non-interactive, so we ask you to go ahead and make your formal comments, and then afterwards we can certainly discuss things, answer questions, and have interaction. But as for the formal comment, just you state it and--

MR. TRENARY: I've only got a--

MS. ANDERSON: He's in a hurry.

MR. SYKES: --very short period of time here that I can attend this meeting tonight. I regret having missed the other comments that were made earlier by other people, since I couldn't be here earlier due to baby-sitting problems I had tonight.

My name is Allan Trenary and I live over by Rocky Flats, I live off of 100th and Simms. I'm very concerned about the cavalier attitude that the government has taken in many instances when it comes to nuclear weapons and fissile materials in general. Sometimes I feel in my heart that they--that the government's got the attitude, "Well, hey, we were going to have a nuclear war with this stuff and we'd never be responsible for it anyway, so carry on and do what you have to do." And I realize that there are a lot of people who are wholeheartedly and honestly working on this to come up with a good solution to our problems.

I work with some Russian people, and one of them is a civil engineer from Kiev, and he helped with the evacuation of the people from around Chernobyl. And talking to this man

is a very sobering and frightening experience, because their numbers of refugees were in the tens of thousands. In the event that something terrible is to happen at Rocky Flats, it would be millions of people that would have to be moved. And the costs are just so astounding to clean up the messes currently there in a way that there's nothing--if nothing happens, the costs will be astronomical. And I see bickering over these issues, when this is--this is our future. This is our children's future.

And I would really in my heart want to see this addressed in a fashion which is even handed. When you have the EPA arresting a man back east for spilling apple juice in the sewer and not reporting it in his paperwork and we have all this transuranic waste that's slated to go into either WIPP or Yucca Mountain or wherever, and these things I've been hearing about for years that haven't happened yet and, you know, people don't want it to go across their state lines and people don't want it on their highways, so they're not going to want it in their state. I want to see some serious efforts made in containing these materials.

The hydrogen gas building up in the tanks in Building 371 is a very frightening concept to me should something happen. Sure, it might not directly contaminate the people here, but it will have a further--a larger mortgage on Building 371. And these tanks, as I understand,

are in a contaminated room which are--you have to have breathing apparatus to get to it, and just recently have begun to be tapped and analyzed. Well, how long have these tanks been sitting idle? Why wasn't this addressed sooner?

When I talked to Isaac, this man I work with who helped clean up after Chernobyl, the vastness of this issue just--it's tremendous. And we really need to ask the government to focus a little bit more attention on getting this taken care of. I see them meddling with regulations and stuff concerning the EPA, and they don't seem to hold themselves accountable to these laws. I want to see the government starting to be accountable to themselves to the level which they consider the private citizens to be required to be accountable for environmental damage and things like this that are just cavalierly thrown out. 14/01.00.00

The Leiden-Wignight Mine (phonetic), whoever put 16 billion cubic feet of natural gas, our entire natural gas supply for the Denver metropolitan area, is stored in a coal mine which is in very close proximity to Rocky Flats. This is strategic insanity. If there was actually a war and somebody hit that thing in the middle of winter, we'd all freeze to death, not to mention the possibility of what else could happen with the proximity to Rocky Flats. I've been told that there are radionucleides and radioactive contamination in the water that seals the bottom of this 15/09.04.07

M-235

01 00 00 **Comment Number 14**

Comment noted.

09 04 07 **Comment Number 15**

Groundwater, including radionuclide-contaminated groundwater, would not come into contact with natural gas used for home utilities. Therefore, any contaminated groundwater at the mine would not affect the local natural gas supply.

mine. Is this affecting our natural gas that we all use to heat our homes and to heat our water? 15/09.04.07 cont.

Sometimes I feel as though the government has gotten to the point of criminal negligence when it comes to the hazards that are out there at Rocky Flats for the citizens. I know I'm using some strong language in these statements, but how else are we to feel at times. I'm very thankful for the opportunity to be able to speak with you on these issues and thankful for the opportunity to be involved with the Rocky Flats Citizens Advisory Board. And I just sincerely hope that it's for real and it's not just a show, that we're actually causing some impact by what we do by coming out here and talking to you people.

When Leroy tells me that the monitoring has gone down, or at least the reporting on the monitoring of the emissions from Rocky Flats are not being regularly received or something. When I went up to Rocky Flats recently, the low-level waste containment buildings, which are like these heavy plastic greenhouses, were all in shards and the wind was blowing them and they were flapping, I have to wonder if this might not have something to do with the reason why the monitoring might be slacking off a little bit as the fact that we might be getting a little bit more stuff going around right now because of the damage to these facilities.

You know, I don't want to ramble, I realize there

are other people that need to speak, and once again, I would like to thank you all for allowing me to participate and put forward my views. But once again, I really want to emphasize that it's time to start seeing these government agencies having to toe the line that we, the private citizens, are expected to toe when it comes to these environmental protection laws.

And you can't tell me that in the name of national security we shouldn't know these things, or in the name of national security that we should accept toxic levels of contamination as just something that we have to live with in order to be safe, as I don't accept that, and I'd hope that you don't accept that. And hopefully everything will go find and we'll eventually get these materials out of here. But in the meantime, please, let's get them stored in a way to where they're not--we don't have plutonium vulnerabilities at Rocky Flats.

Let's--you know, it's very frightening to me to think that it's been since 1989 or so since this has all been shut down and we're now getting around to it seven years later, doing something cohesive about it. You'd think that it would have started right now, you know, but it's taken this long. Hopefully, by the year 2015 or so, it will be all gone. I have that--I hold that as being a real possibility, and I appreciate that there is a day.

Thank you very much, I appreciate your time.

MS. ANDERSON: Thank you, Mr. Trenary.

Mr. Cole.

MR. COLE: My name is Sam Cole, I'm the director of the Colorado Chapter of Physicians for Social Responsibility, here tonight to comment on the Draft PEIS on the Storage and Disposition of Special Nuclear Material.

I appreciate the DOE's willingness to listen to the community about what's going to be done with plutonium at Rocky Flats. I just wish the community was here. And I just think it's too bad that they aren't--that more people aren't here and we aren't hearing from more people. I think that it's an issue that concerns people, but I don't know why they're not here. And I'd like to see the DOE do a better effort to getting turnout.

First thing that I would like to say in regards to the disposition of the plutonium that we have out at Rocky Flats, there are three guiding principles that I think the DOE should abide by: number one, that the plutonium should be disposed of or dispositioned in a way that least harms the environment, least--there is the least public exposure to prevent any sort of health effects or environmental contamination; number two, that whatever disposition option the DOE chooses that it--that the plutonium is regarded with no use, in other words, the option makes plutonium--or treats

16/01.00.00

01 00 00 **Comment Number 16**

Comment noted.

plutonium as a waste, and not as anything that's an asset or has any use; and the third guiding principle is that whatever option DOE chooses, that option should prevent as much as possible the reuse of plutonium in nuclear weapons and no, in DOE's words, "proliferation," as proliferation-resistant as possible. 16/01.00.00 cont.

And we support the National Academy of Sciences' recommendation that surplus plutonium abide by the spent fuel standard, abide by the stored weapons standard, but we also support that it adopt the nuclear waste standard, meaning that whatever option is chosen produces the least waste out of all the options.

And that leads me to the option that the Department of Energy is considering, which is using plutonium--to turn it into a fuel to be used in reactors. That would produce a very diluted but a still radioactive waste of much greater magnitude than we should have to bear. Therefore, that's one reason why the fuel option should be rejected. 17/08.03.01

Another reason is it gets plutonium some legitimacy, it gives it a use, it makes it an asset. That's a real mistake if you want to prevent the proliferation of nuclear weapons around the world, because you start legitimizing the use of plutonium and other countries are saying that they're using their plutonium for civil purposes, it's going to be very hard to know if they may be using it

08 03 01 **Comment Number 17**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternatives. However, NEPA requires that DOE look at all reasonable alternatives and, therefore, reactor burning must be considered. Decisions on the disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

for military purposes. So we don't think it's worth the risks that the fuel option would entail.

And that leads me into, well, what should you do with the plutonium? And we support immobilizing the plutonium, possibly vitrifying it. This stabilizes the plutonium, it treats it as a waste, it prevents--it prevents the reuse of plutonium as much as the reuse of plutonium can be prevented by embedding it in glass, and therefore addresses the proliferation aspect in a way that the fuel option does not. 12/08.03.01 cont.

And as far as Rocky Flats goes, we think that issues around Rocky Flats should be addressed in the PEIS, since plutonium will be at Rocky Flats for years to come. I call it the long term, and I think that the DOE should waste no time in considering the disposition options for plutonium while it's at Rocky Flats, such as start vitrifying it, start doing something that will make it more proliferation resistant and more stable.

Thank you.

MS. ANDERSON: Thank you.

Are there any other formal comments at this time?

(No audible response.)

MS. ANDERSON: Thank you for coming.

(Whereupon, the public comments portion of the meeting was concluded.)

REPORTER'S CERTIFICATE

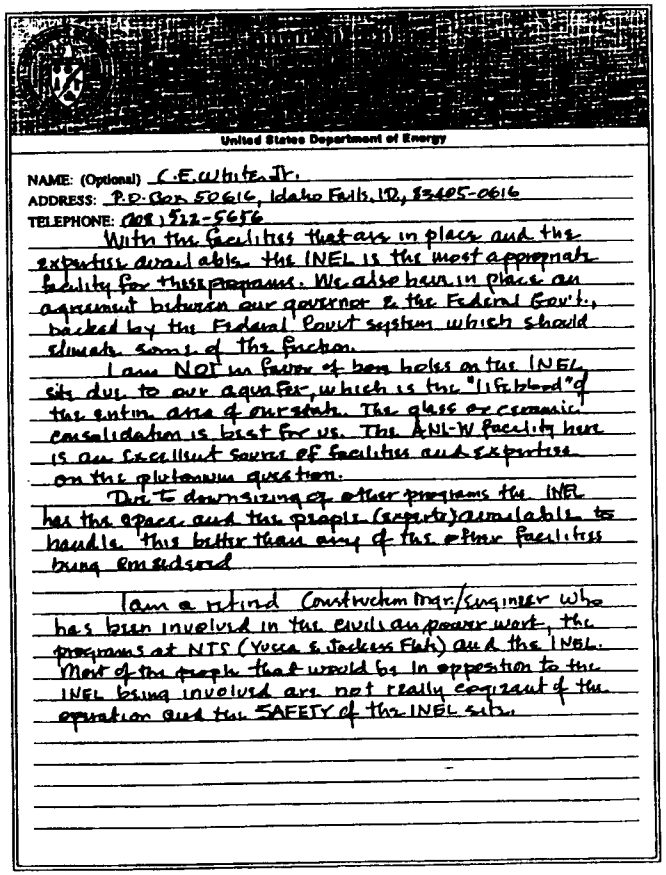
I, LYNNE DERBY, do hereby certify that I was present at and recorded the proceedings in the foregoing matter; that I thereafter reduced my recorded tapes to typewritten form, comprising the foregoing transcript; further, that the foregoing transcript is a full and accurate record of the proceedings in this matter on the date set forth.

Dated in Denver, Colorado, this 5th day of May, 1996.

Lynne Derby

M-235

WHITE, C. E., JR., IDAHO FALLS, ID
PAGE 1 OF 1



United States Department of Energy

NAME: (Optional) C.E. White Jr.
ADDRESS: P.O. Box 50616, Idaho Falls, ID, 83405-0616
TELEPHONE: (208) 522-5656

With the facilities that are in place and the expertise available, the INEL is the most appropriate facility for these programs. We also have in place an agreement between our governor & the Federal Gov't., backed by the Federal Court system which should eliminate some of the friction.

I am NOT in favor of bore holes on the INEL site due to our aquifer, which is the "lifeblood" of the entire area of our state. The glass or ceramic consolidation is best for us. The ANL-W facility here is an excellent source of facilities and expertise on the plutonium question. 1/08.03.01

Due to downsizing of other programs the INEL has the space and the people (experts) available to handle this better than any of the other facilities being considered. 2/08.03.01

I am a retired Construction Mgr./Engineer who has been involved in the civil & power work, the programs at NTS (Yucca & Jackass Flats) and the INEL. Most of the people that would be in opposition to the INEL being involved are not really cognizant of the operation and the SAFETY of the INEL site.

M-047

08 03 01 Comment Number 1

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for additional missions at INEL. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

WILCOX, ROBERT H., MARTINEZ, GA
PAGE 1 OF 1

711 Pevero Abbey Circle
Martinez, GA 30907
May 3, 1996

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C.20026-3786

I appreciate receiving a copy of DOE/EIS-0229-D, "Storage and Disposition of Weapons-Usable Fissile Materials - Draft Programmatic Environmental Impact Statement", dated February 1996. I wish to make a few comments on the subject, which I believe are most pertinent to DOE decisions on plutonium storage and disposition:

1. In regard to material which is being preserved for possible future weapons use, it would be advisable not to store it all in one place. The national security interests should take precedence over other considerations and the uncertainties of the long term future would suggest that we do our utmost to preclude relatively easy targeting by some particular adversary of this most valuable national resource. | 1/08.03.01

2. Plutonium is a most valuable commodity. That which is not needed for weapons should, under appropriate safeguards, be made available to fuel power reactors, a concept which is already well along in development at many places outside our borders. (In other words, those options which implicitly or explicitly regard it as a waste should not be pursued.) | 2/08.03.01

3. While there are no doubt pros and cons to using plutonium in each different type of reactor, DOE would be well advised not to decide which type will get its plutonium. Rather, it should fashion a broad-scoped program to permit the private sector (again, under appropriate safeguards), in the U.S. and possibly beyond, to utilize the world's excess plutonium as an alternative fuel to U-235 in commercial reactors of all possible types. | 3/06.00.09

4. Last, but by no means list, DOE should embrace and implement the recommendations of the American Nuclear Society's Special Panel Report of August 1995. History will judge it harshly if it does not do so. | 4/01.00.00

Sincerely,

Robert H. Wilcox

Robert H. Wilcox

M-138

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Collocation Alternative. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

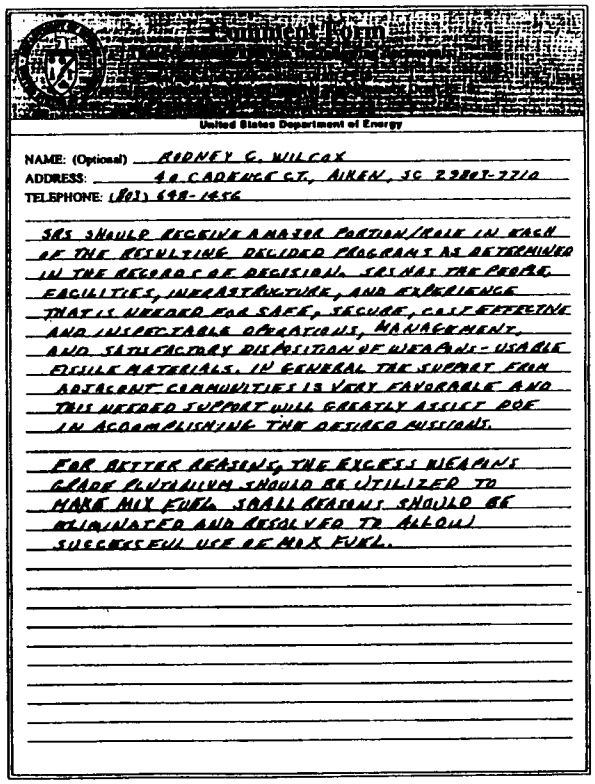
The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

06 00 09 **Comment Number 3**

Comment noted.

01 00 00 **Comment Number 4**

The Department of Energy appreciates the effort of the American Nuclear Society's Plutonium Panel and has taken many of the ideas and suggestions presented into consideration.



Comment Form

United States Department of Energy

NAME: (Optional) RODNEY C. WILCOX
ADDRESS: 40 CADENCE CT, AIKEN, SC 29803-7710
TELEPHONE: (803) 648-1656

SRS SHOULD RECEIVE A MAJOR PORTION/ROLE IN EACH OF THE RESULTING DECIDED PROGRAMS AS DETERMINED IN THE RECORDS OF DECISION. SRS HAS THE PROPER FACILITIES, INFRASTRUCTURE, AND EXPERIENCE THAT IS NEEDED FOR SAFE, SECURE, COST EFFECTIVE AND INSPECTABLE OPERATIONS, MANAGEMENT, AND SATISFACTORY DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS. IN GENERAL THE SUPPORT FROM ADJACENT COMMUNITIES IS VERY FAVORABLE AND THIS NEEDED SUPPORT WILL GREATLY ASSIST DOE IN ACCOMPLISHING THE DESIRED MISSIONS.

FOR BETTER REASONS, THE EXCESS WEAPONS GRADE PLUTONIUM SHOULD BE UTILIZED TO MAKE MIX FUEL. SMALL REASONS SHOULD BE ELIMINATED AND RESOLVED TO ALLOW SUCCESSFUL USE OF MOX FUEL.

SR-001

1/08.03.01

2/08.03.01

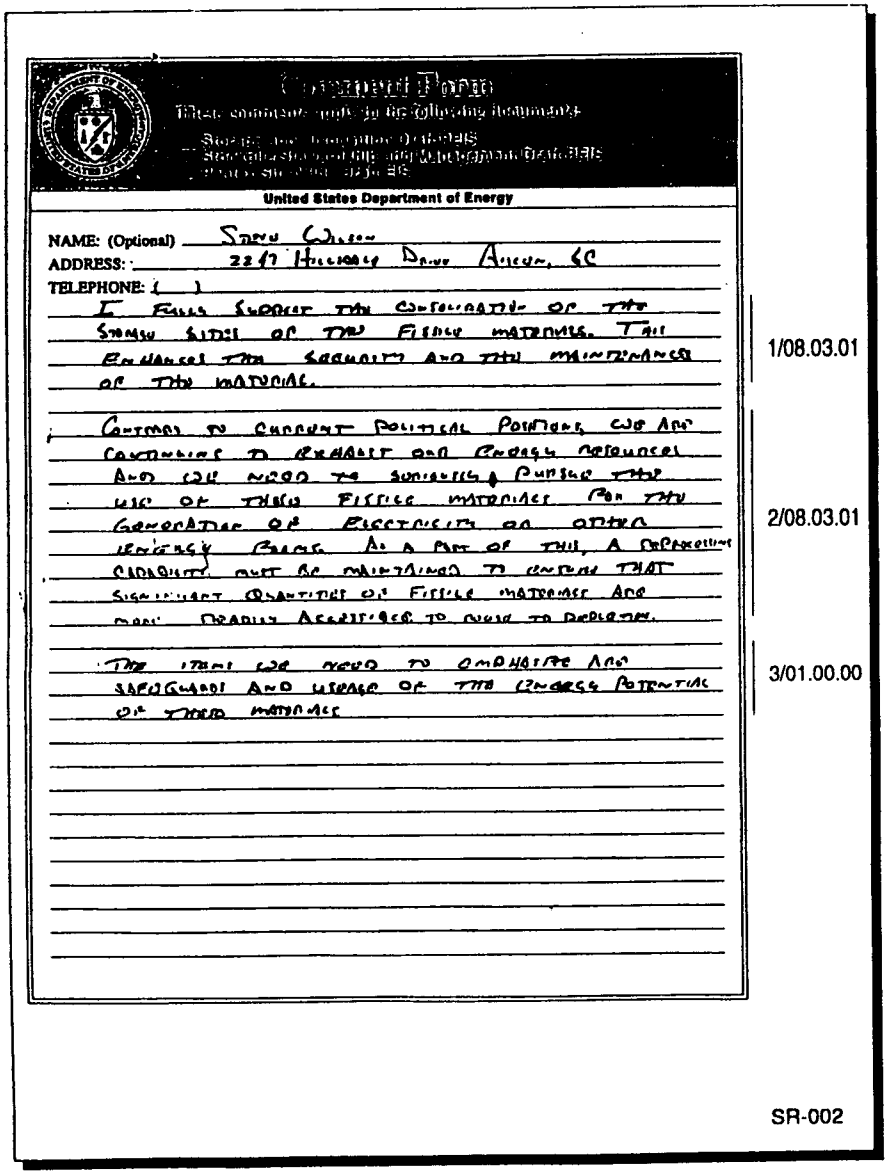
08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's support for SRS. Decisions on storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 Comment Number 2

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

WILSON, STEVE, AIKEN, SC
PAGE 1 OF 1



Comment Form

United States Department of Energy

NAME: (Optional) Steve Wilson
ADDRESS: 2217 Hillsdale Drive Aiken, SC
TELEPHONE: ( )

I FULLY SUPPORT THE CONSOLIDATION OF THE SPENT SIDE OF THE FISSILE MATERIALS. THIS ENHANCES THE SECURITY AND THE MAINTENANCE OF THE MATERIAL. 1/08.03.01

CONTINUE TO CHALLENGE POLITICAL POSITIONS, WE ARE CONTINUING TO RESEARCH AND ENERGY RESOURCES AND WE NEED TO SUBSIDIZE & PURSUE THE USE OF THESE FISSILE MATERIALS FOR THE GENERATION OF ELECTRICITY OR OTHER ENERGY SOURCES. AS A PART OF THIS, A DEPENDENT CAPABILITY MUST BE MAINTAINED TO ENSURE THAT SIGNIFICANT QUANTITIES OF FISSILE MATERIALS ARE MORE READILY ACCESSIBLE TO NUCLEAR POWER. 2/08.03.01

THE ITEMS WE NEED TO CONSIDER ARE SAFEGUARDS AND USEAGE OF THE ENERGY POTENTIAL OF THESE MATERIALS 3/01.00.00

SR-002

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's support for the Consolidation Alternative. Decisions on the storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

01 00 00 **Comment Number 3**

Analyses of the technology, cost, schedule, and Nonproliferation Policy impacts of the reasonable alternatives discussed in this PEIS are presented in separate documents to support the DOE's ROD. The cost, schedule, and technical analyses were made available for public review beginning in July 1996. The nonproliferation analysis was made available to the public beginning in October 1996.

Anna Marie Wink
17201 FM 245
Amarillo, Texas 79107

May 6, 1996

To the United States Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

I am sure you recive all sorts of pleas from Pantex employees and Amarillo business people to expand Pantex activities in any manner. Why not? These employees could not earn comparable wages at any other place, and this does bring residents to the business community.

Great minds produced Atomic energy of which they had no knowledge of its long time affects on human life or the environment. Thus every area of nuclear production was and is contaminated - some uninhabitable sacrificial zones of wastelands.

My point is enough of this United States has been sacrificed to the Nuclear Process. Use plants and resources already in use. Make do with what you have. Do not mess up or use up more land or water resources. Pantex Plant sits on the Ogallala Aquifer, the only source of water to many people and agribusinesses in a semi state area of great agricultural production. Nothing should be done to risk contamination to the water or environment of so great an area of Gods good earth. 1/08.03.01 2/09.00.04

Thank you for your time.
Anna Marie Wink, 72 year resident of Carson and Potter counties

M-156

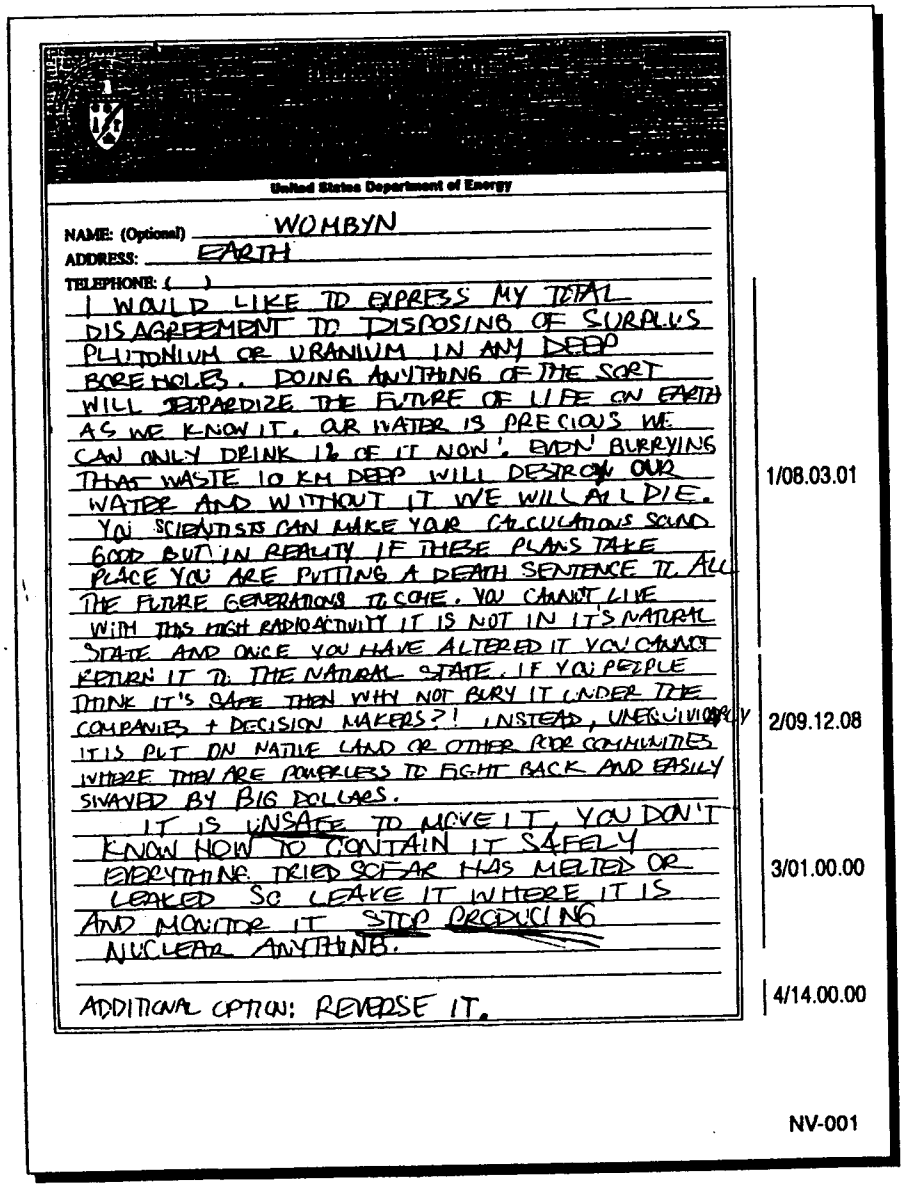
08 03 01 **Comment Number 1**

Comment noted.

09 00 04 **Comment Number 2**

Current and future operations at Pantex are not expected to affect the water quality of the Ogallala Aquifer. However, since this aquifer is being depleted (that is, the current withdrawal is exceeding the current recharge), Pantex operations contribute to the depletion of the Ogallala Aquifer and are analyzed in the PEIS. Also, current and future operations at Pantex are not expected to impact the soil used for agriculture and farming in the Pantex region.

WOMBYN
PAGE 1 OF 1



United States Department of Energy

NAME: (Optional) WOMBYN
ADDRESS: EARTH
TELEPHONE: ( )

I WOULD LIKE TO EXPRESS MY TOTAL DISAGREEMENT TO DISPOSING OF SURPLUS PLUTONIUM OR URANIUM IN ANY DEEP BOREHOLES. DOING ANYTHING OF THE SORT WILL JEOPARDIZE THE FUTURE OF LIFE ON EARTH AS WE KNOW IT. OUR WATER IS PRECIOUS WE CAN ONLY DRINK 1% OF IT NOW! BURYING THAT WASTE 10 KM DEEP WILL DESTROY OUR WATER AND WITHOUT IT WE WILL ALL DIE. YOU SCIENTISTS CAN MAKE YOUR CALCULATIONS SOUND GOOD BUT IN REALITY IF THESE PLANS TAKE PLACE YOU ARE PUTTING A DEATH SENTENCE TO ALL THE FUTURE GENERATIONS TO COME. YOU CANNOT LIVE WITH THIS HIGH RADIOACTIVITY IT IS NOT IN IT'S NATURAL STATE AND ONCE YOU HAVE ALTERED IT YOU CANNOT RETURN IT TO THE NATURAL STATE. IF YOU PEOPLE THINK IT'S SAFE THEN WHY NOT BURY IT UNDER THE COMPANIES + DECISION MAKERS?! INSTEAD, UNFORTUNATELY IT IS PUT ON NATIVE LAND OR OTHER POOR COMMUNITIES WHERE THEY ARE POWERLESS TO FIGHT BACK AND EASILY SWAYED BY BIG DOLLARS.

IT IS UNSAFE TO MOVE IT, YOU DON'T KNOW HOW TO CONTAIN IT SAFELY EVERYTHING THEY SO FAR HAS MELTED OR LEAKED SO LEAVE IT WHERE IT IS AND MONITOR IT STOP PRODUCING NUCLEAR ANYTHING.

ADDITIONAL OPTION: REVERSE IT.

1/08.03.01

2/09.12.08

3/01.00.00

4/14.00.00

NV-001

08 03 01 **Comment Number 1**

The Department of Energy recognizes the commentor's concern with the Borehole Alternatives. Decisions on the disposition alternatives will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

09 12 08 **Comment Number 2**

None of the Proposed Alternatives would involve burying nuclear waste on native land or poor communities. All of the storage alternatives are proposed for siting on existing DOE sites and do not involve burial of waste materials. None of the DOE sites have been analyzed as a repository for disposal in this document. If any of the sites were to be used as a repository, further NEPA documentation would be performed, as required.

01 00 00 **Comment Number 3**

Comment noted.

14 00 00 **Comment Number 4**

Comment noted.

WOMEN STRIKE FOR PEACE, WASHINGTON, DC,
KATHRYN A. CRANDALL
PAGE 1 OF 3

To: USDOE Office of Fissile Materials

From: Women Strike for Peace

Date: May 7, 1996

RE: Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement

Women Strike for Peace was founded on Nov. 1, 1961 as a one day strike to protest the arms race. Many of the 100,000 women who came out of their kitchens and left their jobs to strike were concerned about the threat to children's health from Strontium 90 - a radioactive fallout from nuclear weapons' testing. Today, we continue our fight against nuclear, and other, threats to our children, ourselves and future generations.

While it is good news that plutonium is being removed from weapons and the process of disarmament has begun, keeping plutonium out of weapons and the environment is a formidable task. The U.S. should work to meet our obligations under the Nuclear Nonproliferation Treaty by working toward disarmament. This means the plutonium stockpile from dismantled weapons will grow, so we must analyze how to effectively deal with plutonium. Unfortunately, this PEIS so far is an inadequate analysis that does not facilitate informed public participation. Women Strike for Peace is especially concerned that DOE is also considering alternatives, like the use of plutonium in reactors, that exacerbate nuclear proliferation problems.

The Problems With MOX

Plutonium in MOX can still be diverted into nuclear weapons. The International Atomic Energy Association (IAEA), considers MOX to be of "direct use" in nuclear weapons. This means that plutonium in MOX can be transformed much too easily to plutonium in a nuclear warhead. Also, in the storage, transport and use in reactors, MOX must be secured and handled as weapons material.

Using MOX in reactors is against stated U.S. Nonproliferation policy. President Clinton has stated that "The United States does not encourage the civil use of plutonium and, accordingly does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes." (Sept. 1993) Developing MOX would drastically alter this policy, and encourage other countries to further develop plutonium use in reactors. Already there is a developing international MOX industry, operating hand in hand with reprocessing. Before the U.S. jumps into the fray, we ought to consider whether we want increasing use of MOX all over the world, even in countries like North Korea, or Iraq.

1/01.06.00

The US has no facility to develop a MOX fuel that could be run in a commercial reactor. A MOX fabrication facility would have to be built, or a current facility adapted. The costs of such a facility has not been adequately analyzed and presented to the public. All of the transportation impacts have not been thoroughly considered in the PEIS. Potentially plutonium from around the country, and perhaps other countries, would be brought to a fabrication facility. If multiple reactors, or foreign reactors such as Canada's CANDU were to use MOX, then there is also concern about transport of MOX to those reactors. Also, because there is currently no U.S. MOX fabrication facility, the PEIS assumes that if an existing light water reactor in the U.S. were to use MOX fuel, a "timely supply" of MOX fuel would have to be sought while an U.S. fabrication facility is developed. This means DOE would send U.S. plutonium to Europe where MOX fuel would be developed and then sent back to the U.S. reactors (PEIS Summary pp. 15, 32).

F-036

01 06 00 **Comment Number 1**

The President's Nonproliferation Policy says the United States will not recycle Pu. Burning weapons Pu in reactors does not utilize the recycling process because the Pu in the spent fuel from this process will not be extracted for reuse in new fuel. This is consistent with U.S. policy since no Pu is being recycled. After a once-through fuel cycle, the Pu would be converted to a nonproliferation form as spent reactor fuel.

WOMEN STRIKE FOR PEACE, WASHINGTON, DC,
KATHRYN A. CRANDALL
PAGE 2 OF 3

MOX in commercial reactors is a concern. Because MOX is a direct use weapons grade fuel, its use in commercial reactors would turn many utility nuclear energy plants into de facto weapons facilities. Increased security to prevent diversions of plutonium would be required. — 2/08.03.01

High Level Waste generated from MOX is likely to be a serious problem. Commercial Spent Fuel generated from MOX reactors is supposed to go to a waste repository. The Development of a repository has been fraught with difficulty. There is no guarantee that a suitable repository will exist for even more high level waste generated from MOX reactors. Simply stating that it will go to a repository, which does not yet exist, is not good enough. Currently overburdened sites in USDOE's nuclear weapons complex are likely to end up with this waste if a repository is not available. — 3/09.11.08

One alternative in the PEIS is to use Canadian CANDU reactors. According to the PEIS, Canada would then be responsible for the waste generated from the reactors. This encourages international commerce in plutonium (as does any alternative calling for plutonium or MOX shipment to and from Europe.) It may also set a dangerous precedent for the U.S. to give up control of weapons material to other countries, and it brings up a question of fairness : Why should Canadian citizens take plutonium and waste that they did not develop?

Instead of MOX, plutonium should be declared a waste and immobilization alternatives developed.
We should declare plutonium a waste and ensure that it is not used in weapons, or in reactors. By doing this in the U. S. we can also take a leadership role in preventing an international industry and commerce in plutonium that would be increasingly difficult to control. — 4/01.04.00

Immobilization technologies should be vigurously pursued because these technologies provide the greatest ability to isolate plutonium from the environment, and prevent proliferation of weapons material. Immobilization technologies should be developed and shared with other countries. Meanwhile, storage of plutonium should maintain plutonium so as to prevent harm to the environment and diversion into weapons. This means that transportation and its risks, especially international transportation, should be avoided.

Public Participation and Openness in the PEIS Process
This PEIS lacks credibility because DOE has not furthered informed public participation in the process.

DOE secretively solicited the nuclear industry in pursuit of MOX. In December, 1995, DOE included in a Request For Expressions of Interest for Tritium Production, a solicitation in pursuit of commercial reactors that would like to use MOX. This action, taken between the Plutonium Disposition PEIS Scoping Hearings and the draft PEIS, was done without notice to the public or incorporation into the PEIS. Not until March 29, 1996 were Expressions of Interest (EOI's) released. This solicitation indicates a substantial furtherance of MOX despite the fact that DOE has not chosen a preferred alternative. No EOI process has been followed for any of the other disposition alternatives. — 5/08.00.00

DOE is not including cost studies and nonproliferation studies for public scrutiny along with the PEIS. Cost studies and nonproliferation studies are going on outside of this PEIS process. Since these studies will effect the outcome of the PEIS, they must be made publicly available so that citizens can make informed comments on the PEIS. Given that the need for action on plutonium disposition is based upon proliferation concerns (PEIS Summary, S-1 to S-4, and PEIS pp.1-4 to 1-6), there is an appalling lack of consideration of proliferation impacts throughout this PEIS. Full cost analyses of all PEIS alternatives should be done and available for public comment. — 6/08.00.00

DOE should extend the comment period and hold hearings in additional locations. Additional time is needed for the public to fully consider the PEIS, especially with additional cost and nonproliferation information. — 7/08.01.00

F-036

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's concern about the disposition of Pu using existing LWRs (commercial). Decisions on the disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

09 11 08 **Comment Number 3**

The PEIS acknowledges the fact that constructing and operating a MOX fuel fabrication facility would increase the wastes generated at any site selected for analysis. The wastes generated for the MOX fuel fabrication facility are presented in Section E.3.2.3. The impacts associated with operating the MOX fuel fabrication facility are presented in Section 4.3.5.1.10.

01 04 00 **Comment Number 4**

Comment noted.

08 00 00 **Comment Number 5**

The Preferred Alternative for Pu disposition, as stated in the Final PEIS, includes Reactor Alternatives. Should a Reactor Alternative be selected at the ROD, DOE would issue a Request for Proposal to interested parties to solicit MOX fuel fabrication facility design and construction proposals.

08 00 00 **Comment Number 6**

In the interest of openness and more informed decisionmaking, DOE released Technical Summary Reports to the public as soon as they became available. Cost data, along with technical and schedule data, were provided in Technical Summary Reports of both storage and disposition in the summer of 1996. Results of the nonproliferation analysis were made available in the fall of 1996. Each of these analyses, along with the environmental analysis and public input, will be integrated into DOE's decisionmaking process.

Hearings ought to be held in additional locations. For example actions at Hanford should require hearings throughout the Northwest (Seattle, Portland, Spokane etc.) Now that some of the potential reactor sites for MOX are known, hearings in those areas should be considered. | 8/08.02.00

These comments were prepared by: Kathryn A. Crandall, J.D.
for
Women Strike for Peace
110 Maryland Ave. NE, #102
Washington D.C. 20002

(202) 543-2660

Please inform Women Strike for Peace of any extension in the comment period.

F-036

08 01 00 Comment Number 7

At the request of several organizations and individuals, the public comment period was extended to a total of 92 days.

08 02 00 Comment Number 8

To obtain public comments on the Draft PEIS, DOE held meetings near each of the potentially affected sites and a national meeting in Washington, DC. DOE also participated in meetings, open to the public, sponsored by different organizations at which the sponsor collected public comments which were forwarded to DOE. DOE created and advertised a number of methods for submitting comments for members of the public who could not attend a public meeting. These methods included fax, oral comments using a toll-free telephone number, mail, and the Internet.

WOOD, M. R., SEATTLE, WA
PAGE 1 OF 2

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): M R Wood
Address (optional): 608 W Mercer Place
Seattle 98119

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1, **Materials Immobilization/Vitrification** - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.
It seems to me more readily recoverable in this manner than mixing with fuels. 1/08.03.01

2. **Deep borehole disposal** - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.
Probably necessary

3. **Reactor Options** - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.
This seems to be the best. The audience is worried about the wrong problems - our real dangers are starvation and wars due to the world's running out of oil and natural gas in a few decades, really during the lives of living children. 2/08.03.01

4. **Storage Options** - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.
This is too dangerous over long periods, even 50 years or 100 years 3/08.03.01

M-225

08 03 01 **Comment Number 1**

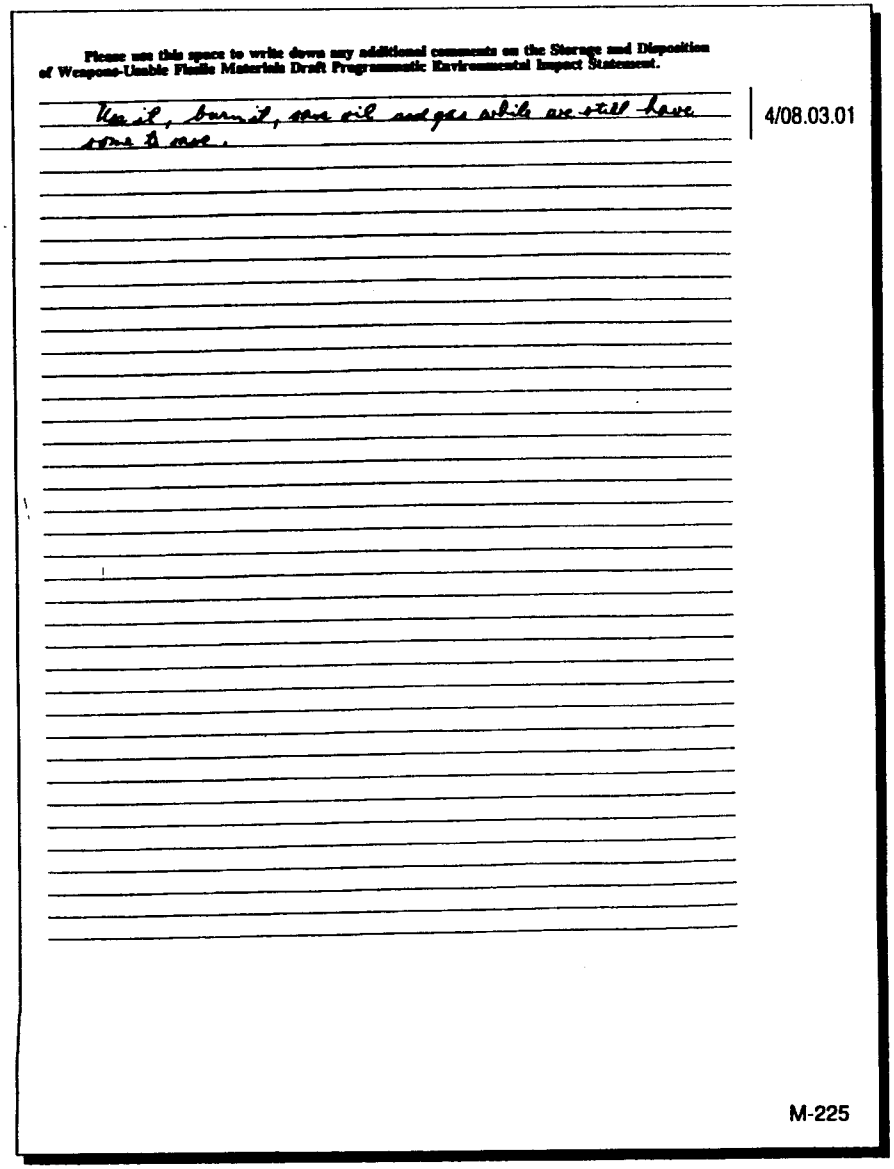
The Department of Energy acknowledges the commentor's support for the Vitrification Alternative. Decisions on disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 2**

The Department of Energy acknowledges the commentor's support for the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be based on environmental analyses, technical and economic studies, national policy considerations, and public input.

08 03 01 **Comment Number 3**

The Department of Energy acknowledges the commentor's opposition to long-term storage. Decisions on storage of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.


Please use this space to write down any additional comments on the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement.

We oil, burn it, use oil and gas while we still have some to use.

4/08.03.01

M-225

08 03 01 **Comment Number 4**

The Department of Energy acknowledges the commentor's support for Pu disposition in reactors. Decisions on disposition will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

YEVSIKOV, VICTOR V., AND WELL, NIKITA I., BETHESDA, MD
PAGE 1 OF 7

Victor V. YEVSIKOV, Ph.D., Nikita I. Wells, N.E.

5904 River Road
Bethesda, MD 20816

Phone: 202-244-5041
FAX: 301-320-9622

Mr. J. David Nulton
Director
Office of NEPA Compliance and Outreach
Office of Fissile Materials Disposition
U.S. Department of Energy
1000 Independence Ave., SW
Washington, D.C. 20585

Re: Plutonium Conversion Project

May 3, 1996

Dear Mr. Nulton,

As you well know, ever larger quantities of plutonium are being accumulated in Russia from the dismantling of nuclear weapons. Problems of plutonium storage arouse great concern all over the world. Scientists are expressing extreme concern about the unreliable and deplorable state of storage and accountability of fissionable materials as well as the poor security of nuclear facilities in Russia. It is very likely that terrorists, local thieves, or hostile nationalists may succeed in well organized thefts of plutonium of sufficient quantity to manufacture a nuclear bomb. 1/01.00.00

The unstable political situation in Russia may allow extremist political figures to receive access to fissionable materials. The poor economic situation of the country could force these politicians to sell the nuclear materials to third-world countries, regardless of international agreements. To prevent theft and sales of weapons-grade plutonium (WGP) it is necessary to transfer it, at the earliest possible time, into a form unsuitable for the manufacture of nuclear weapons, and reprocessing of which back into WGP would be extremely difficult. 2/13.00.00

In light of the above, it is very timely to consider the Russian process of converting WGP into mixed mononitrides (MMN). The exploitation of this process is fully supported by Victor Mikhailov, the Minister of the Russian Federation on Atomic Energy (MinAtom). The ease, safety, cleanliness of the conversion process, the benefit of long term storage, together with the overwhelming advantages of MMN over MOX are strong arguments in favor of mononitrides. Especially, we want to stress, that it is very hard to reconvert from MMN back to plutonium metal 3/14.00.00

The last few months have turned up a number of questions and respective alternative solutions on possible WGP disposition considerations both in the U.S. and Russia, as well as it applies to global involvement. As far as we can see, no clear cut solutions on this problem have yet been obtained.

The MMN option should be considered as an alternative to the generally accepted process of WGP conversion to oxides. MMN is not to be used as a fuel in water cooled reactors, since, at temperatures greater then 300° C, MMN begins to react with the water to produce hydroxides, which are soluble in water. In the case a fuel rod 3/14.00.00 cont.

F-017

01 00 00 Comment Number 1

Comment noted. An intent of DOE's Proposed Action is to serve as an example for Russia and other nations on how to conduct Pu disposition in a safe, secure, and timely manner. The United States currently is engaged in a joint study with the Russians to assess the technical feasibilities of the reasonable alternatives for Pu disposition, and is planning for a joint demonstration of some of the disposition technologies to remove uncertainties in viability.

13 00 00 Comment Number 2

The Department of Energy agrees. This is the purpose of DOE's Proposed Action.

14 00 00 Comment Number 3

During the screening process to select reasonable alternatives for evaluation in the PEIS, several Advanced Reactor Options, including mononitride reactors, were considered. However, because the technology of the mononitride reactors needs further development which would involve time and cost, this option was considered less reasonable than other reactor options using existing or more mature technologies.

rupture fuel hydroxides will appear in the cooling water. One has to remember that the MMN option is specifically aimed to convert Russian WGP to a safe form for interim storage or for ready made fuel (in the form of pellets) to be utilized in future generation reactors. MMN storage is superior to MOX both in time (MOX starts to deteriorate before 10 years) and in its physical/chemical/radiation storage properties.

The U.S. should consider picking up this Russian technology as an alternative, limited to the interim storage and conversion of MMN to MOX at a required time for utilization as fuel. It is important to consider the overall affordability of this project.

3/14.00.00 cont.

We propose that a feasibility study on the above stated process should be carried out including an in dept comparison of the pros and cons of MMN versus MOX, investigations on the chemistry of the processes, storage, safety, economics, ecological consideration, etc. Our suggestion is, therefore, to convert the plutonium to MMN for interim storage till the required time for conversion into MOX (and subsequent utilization as fuel in water cooled reactors). The first phase involves only a paper study and an overview of the process. The second phase carries out tests on the existing pilot plant (10 kg Pu per day capacity) which is to be relocated at the "Mayak" facilities.

We are looking forward to future discussions on this project, including the feasibility study mentioned above, and any appropriate financial support that may be required.

Yours very truly,

Victor Yevsikov

Nikita Wells

F-017

Victor V. Yevsikov, Ph.D, Nikita Wells, N.E.

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PROCESSING AND STORAGE OF WEAPONS-GRADE PLUTONIUM.

Introduction

At present there are large quantities of plutonium from the dismantling of nuclear weapons. Russia is presently known to have more then 180 metric tons and will have 200 tons by the year 2000. As a comparison, one needs to have only 4.7 kilograms of weapons-grade plutonium (WGP) in order to attain the critical mass for a nuclear bomb (250 cm³ in volume). Problems of plutonium storage arouse great concern all over the world. Both Russian and American scientists as well as government officials are expressing their extreme distress about the unreliable and deplorable state of storage and accountability of nuclear fissionable materials as well as the poor security of nuclear facilities in Russia. It is very likely that terrorists, local thieves as well as Chechen (or other) nationalists may succeed in well organized thefts of metallic plutonium of sufficient quantity to manufacture a nuclear bomb. In addition, the political situation in Russia is unstable, where certain extremist political figures could come to power and receive access to fissionable materials. The poor economic situation of the country could force the extremist to sell the nuclear materials to third-world countries, regardless of international agreements.

To prevent theft and sales of WGP it is necessary to transfer it as the earliest possible time into a form unsuitable for the manufacture of nuclear weapons, and reprocessing of which back into WGP would be extremely difficult.

We propose to investigate a unique process for the conversion of Russian WGP to a secure and stable form. This process (as fully supported by MinAtom's Minister Mikhailov) would convert WGP into a plutonium-uranium (or zirconium)-nitride mixture: mixed mononitrides (MMN), which can be pressed into pellets for fuel elements (for use with liquid metal and gas cooled reactors) and briquettes for easy long term storage. It is estimated that the MMN can be stored for at least 50 years. The Russians already have firm experience of MMN storage for 30 years. As a comparison, MOX can barely reach 10 years without decomposition. This interim span of 50 years would provide ample time to come up with new, appropriate, well thought out policies in the future processing, storage, and use of WGP.

Disposition Alternatives.

Several disposition alternatives for WGP are now being considered both in the U.S. and Russia. These include disposal in geological formations (deep borehole), immobilization including vitrification, ceramic immobilization, burn-out in different types of reactors for the generation of electrical power, and interim or long term storage.

The vitrification and disposal of WGP in geological formations options, however, are not acceptable for Russia. Russia has decided to use WGP as fuel for the generation of electricity.

This brings out a number of important problems which need immediate clarification. First, the presence of the large amount of Russian WGP presents a threat and must be converted to a benign form unsuitable for weapons. It must be placed into interim storage for future use as fuel since facilities for plutonium burn up are not yet operational. This storage has to be in an acceptable, benign form to meet non-proliferation and safety standards. Secondly, the Russians have no commercial water cooled reactors which can utilize of WGP in the form of MOX. MOX is a suitable fuel

F-017

for water cooled reactors as considered in the U.S., but cannot be used in existing Russian LWRs without considerable facility upgrade. The operational liquid metal cooled reactor (BN-600) can utilize WGP as mixed mononitride fuel, but cannot use MOX due to safety considerations (since MOX can react with the liquid metal coolants in the case of accidental fuel element damage). Construction of the advanced design BN-800 reactors, which will be perfect for MMN use, unfortunately has been stopped due to financial problems. High temperature gas cooled reactors which can use both MOX as well as MMN, are only in the design stages (MinAtom and General Atomics joint project).

To summarize: Russian WGP should be stored in a safe form for up to 50 years in order to allow time for the design and construction of facilities for plutonium fuel production and utilization. Thus, if the storage time is up to 10 years, WGP can be stored in an oxide form to produce MOX fuel. But if the required storage time is up to 50 years - WGP should be stored in a MMN form which can be burned directly as fuel in advanced reactors or converted to other forms of fuel at the appropriate time.

Technology of Process

This process was developed initially in the Soviet Union in the beginning 1970's (no parallel developments were carried out in the US since there was no need to reprocess spent nuclear fuel). Since 1970's the process has been improved, simplified, made safe and efficient, cost and energy effective. The process has only recently been declassified (approximately 3 years) and now presents us with a unique opportunity to examine the advantages provided by the mononitrides for the easy handling, long term storage and use as a fuel in future generation reactors.

The manufacture of MMN is a continuous, ongoing process with its inherent multiple stages operating simultaneously. In the first stage of the process the weapon-grade plutonium is melted down with depleted uranium-238. The critical mass increase is maximized with the consumption of plutonium from 15 to 30%. Immediately the plutonium is transformed into a state with a high critical mass which allows the safe operation of the process. MOX preparation technology does not allow the fast increase in critical mass in the initial stage. WGP does not need purification to remove alloying materials or long-life radioactive elements (including Am).

The second stage of the process performs hydrogenation of the mixed Pu and U with an argon-hydrogen gas mixture at a temperature of 250°C. The reaction starts instantaneously and provides complete destruction of the metal structure. A black powder is obtained with particles from 0.3-0.6 mkm. This stage can be written as follows:

$$2\,Pu_{0.3}U_{0.7} + 3\,H_2 \xrightarrow{\approx 250^{\circ}C} 2\,Pu_{0.3}U_{0.7}H_3$$

The third stage provides nitration. The product is carried by a feeder through a furnace for the nitration by a nitrogen-argon gas mixture. As a result MMN is produced in a form of powder with a controlled dispersion. The size of the particles depends upon the temperature and can be produced up to 500 mkm. The nitration process can be written as:

$$2\,Pu_{0.3}U_{0.7}H_3 + n\,N_2 \xrightarrow{200^{\circ}C - 500^{\circ}C} 2\,(Pu_{0.3}U_{0.7})N_n + 3\,H_2$$

The forth stage is briquetting or pelleting. The powder of the mixed nitrides is pressed with the help of a fast acting press, burned and sintered in a nitrogen environment at the temperature of about 700 and 1400-1600°C correspondingly. The briquettes obtained are ready for storage. The maximum weight of the briquette is determined by the critical mass. In the opinion of the Russians, the most convenient storage shapes are cylinders with the mass of 30-40 kgs with a high content of Pu mass. From 25-27% more plutonium is contained in MMN then in MOX.

The fifth stage is the loading of the manufactured products into the containers, their sealing, seal inspection and shipment to the storage facility for long term storage. If necessary porous membranes can be installed in the containers to release helium.

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Existing Facilities

The Russian presently have 3 operating test facilities and one high capacity pilot plant for the conversion of plutonium to MMN. The test facilities can process from 0.2 kg to several kilograms capacity. The pilot plant has a capacity of 10 kgs Pu per day (3.2 tons plutonium per year). Ideally only 1 year is required to convert all the Russian WGP into storage form utilizing just 30 of these pilot plants. Total cost is about 10 million dollars. But, more realistically, and economically feasible, 10 plants can do the job in three years. About a half-year is required for the manufacture of the first plant. The series production of the 30 plants requires about 2 years.

The pilot plant consists of 15 interconnected glove boxes containing ovens, furnaces, presses, spiral conveyers, filter systems, etc. and sophisticated instrumentation (mass spectrometers, gas analyzers, vacuum and radiation monitoring, etc.). The total cost of the pilot plant is estimated conservatively at $ 300 K. The area that is occupied by the entire system is about 2,700 sq. feet (300 sq. m). The facilities of this class can be produced out of standard parts with the standard equipment by an ordinary machine fabrication plant. Russians have design documentation and production equipment. All of the processing equipment can be easily transported and can be delivered directly to the weapon dismantling site.
The pilot plant is movable, requires only 3 trucks, and may be transported and installed at the weapons-grade plutonium storage site. The containers with MMN can be stored on the same storage site.

Ecological Aspects of the Process

The processing procedure, compared to hydro-metallurgical and other techniques, is ecologically friendly. There are no liquid or gaseous wastes. Since the velocity of the working gases is low, radioactive wastes in the form of finely dispersed dust are easily captured by standard filters and then reprocessed and returned into the cycle. The Russians can produce MMN powder with particle size up to 500 mkm, which excludes dust formation that accompanies the oxides production process. It is very important that the gas cycle is closed. All the gases used (H_2, N_2 and Ar) are subjected to complete purification and returned into the process.

MMN Storage Advantages.

WGP storage in MMN form meets all the Russian requirements for storage with specific advantages as listed below:

- The reverse process of Pu extraction from the MMN form is much more complicated than from MOX. MMN goes through several additional stages as compared to MOX. Each stage contains liquid radioactive wastes. All long-life radioactive isotopes from the MMN crystalline structure are transferred to the reaction volume when MMN is dissolved. A direct MMN reduction process into metal Pu is unknown, but oxides can be reduced directly by Ca metal.
- Direct production of weapons (or a bomb) is impossible due to the high critical mass of more then 120 kilograms, which greatly exceeds the limits of bomb parameters.
- MMN provides suitable long-term storage (greater than 50 years).
- MMN may directly be used as a fuel for fast-neutron commercial reactors after storage with no further reprocessing. Fission products are not released during the fuel production process (milling, pressing and sintering) and remain in the MMN crystalline lattice.
- MMN fuel as pellets can be stored inside the fuel elements. The Russians have 8 years experience in this process.
- MMN storage is safe and well understood by the Russians who possess 30 years experience.
- MMN has stable chemical and physical properties, thus making storage safer compared to that of MOX.
- MMN has a high thermal conductivity. MMN contains about 27% more plutonium than that in MOX. Contact with water at temperature up to 200°C produces a dense protective oxide film.
- MMN is characterized by good radiation stability:
  - MMN releases of several tens of times less cesium and iodine as compare to MOX.
  - MMN captures fission products by a factor of 4-5 times greater than MOX.
  - α-radiation does not damage the MMN lattice, and Am, Np, Cm remain in the crystalline lattice.

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Utilization of MMN as Nuclear Fuel after Storage.

MOX fuel may be successfully used in water-cooled reactors. The use of MOX in liquid metal cooled reactors is prohibited because it reacts with the metal coolants. Alternatively, MMN should not be used with LWR, but is excellent fuel for liquid metal reactors. MMN possesses a series of properties that are superior to that of MOX as shown below. This makes its use as fuel highly desirable.

- MMN is very compact with a high plutonium content. It contains more plutonium than MOX and can provide 25% more Pu burn-out.
- The use of Pu-Zr in MMN fuel in fast reactors provides up to 50% burning of Pu in the fuel.
- The storage area for MMN containers or fuel assemblies are about 25% smaller than that for MOX - this is economically favorable.
- MMN has high thermal conductivity, which increases with temperature. It is 10 to 18 times greater than that of MOX. This makes the process efficient and safe.
- MMN is chemically stable and does not react with metal coolants and stainless steel at high temperatures. MOX releases fission products, especially Cs, which interacts with stainless steel of the fuel elements.
- MMN has minimal gas release during fuel operation - several times less then that of MOX
- New design of reactors with MMN fuel prohibits the reproduction of Pu.
- After storage MMN can be used directly for metal-cooled reactors, as well as for reactor-burners, gas-cooled reactors, etc., without any further reprocessing.
- Actinides and fission products formed during storage are trapped in the MMN crystalline lattice and can be burned together with MMN fuel in fast reactors.

Conclusions.

Based on the facts and analyses as presented above, the Russian conversion process of WGP into MMN demonstrates its critical position in the international WGP non-proliferation arena. The international nuclear power community should seriously consider MMN's merits and advantages as an alternative form to be considered for interim and long term storage and future use as a nuclear fuel (especially for the consideration of WGP in Russia).

The above stated conclusion makes sense when one considers the following facts:

- No political decision concerning methods of plutonium management has yet been made either in U.S. or Russia.
- At present Russia has no facilities for utilizing WGP.
- The above process provides a possibility to solve the problem of safe and low-cost storage of WGP in compact form. Only MMN meets the requirements of long-term storage and subsequent WGP utilization.
- MMN production is highly efficient, safe, ecologically clean and economically advantageous.
- MMN storage is inexpensive, safe, long-term and ecologically clean.
- After storage MMN can be used directly as fuel or converted into any other types of fuel including MOX.
- During storage long-lived isotopes (including Am, Np, Cm) are formed in the MMN, but remain inside the crystalline lattice to be burned up together with the Pu in reactors.
- Although further investments are needed for completion of the Russian plutonium conversion facilities, the MMN option will provide the most economical solution.

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YEVSIKOV, VICTOR V., AND WELL, NIKITA I., BETHESDA, MD

PROPOSED TASKS

Conversion of weapons-grade plutonium to mixed mononitrides (MMN)

Stage 1. Feasibility Study

- **Task 1: Data Collection**

Assemble detailed technical data on the plutonium conversion into mixed mononitrides (MMN), details of the process, MMN interim and long term storage, including full documentation of the of existing and proposed facilities. This information will be obtained from existing data sources and through the on-site interviews with system developers.

- **Task 2: Technical Review**

The analyses and technical review of the plutonium nitride conversion: viability of the conversion process; focusing on the details of the formation MMN, material handling, interim and long term storage. Additional consideration will include facilities safety and environmental considerations. A determination of a cost estimate will be included.

- **Task 3: Generation of Report**

Preparation of a final report that will contain analysis, results, assessments and recommendations for each of the tasks performed under this project. Independent experts (National Laboratories, Universities, etc.) will be consulted as required.

Stage 2. Practical Implementation

- **Task 1: Consolidation, Verification, Examination of Available Equipment and Instrumentation**
- **Task 2: Transport of Equipment and Instrumentation to the "MAYAK" Facility.**
- **Task 3: Installation of Equipment and Instrumentation at "MAYAK". Implementation of any Additional Requirements.**
- **Task 4: On site Equipment Testing Using Depleted Uranium.**
- **Task 5: Test Run Using Plutonium.**
- **Task 6: Optimization and Fine Tune of process.**
- **Task 7: Full Operation of System at Maximum Capacity (10 kg Pu/day).**

Dr. Victor Yevsikov, Nikita Wells - Phone (202) 244-5041, FAX (301) 320-9622

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Gentlemen:
Kindly take note of my request not to allow use of mixed oxide fuel in commercial reactors, an extraordinarily irresponsible proposal, fraught with danger in transport, storage, and use as a processed fuel.
I'd be pleased to learn that your EIS will not be implemented as proposed: (Storage and disposition of weapons usable fissile materials)
Will await such word from your office.

1/08.03.01

Sincerely,
Faith Young

Faith Young
[illegible]

June 6, 1996

M-270

08 03 01 **Comment Number 1**

The Department of Energy acknowledges the commentor's opposition to the Reactor Alternative using MOX fuel. Decisions on disposition of weapons-usable fissile materials will be made based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

YOUNGHANS, LORRAINE, BEATTY, NV
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Date Received: 03/27/96
Comment ID: P0001
Name: Lorraine Younghans
Address: P.O. Box 833
Beatty, Nevada

Transcription:

My name is Lorraine Younghans, P.O. Box 833, Beatty, Nevada, and I don't think that you should be making a dump out of the Nevada Test Site. I think you oughta just shut it down and not do any more storage of nuclear wastes or any material thereof. Thank you. Goodbye. | 1/08.03.01

P-001

08 03 01 Comment Number 1

The Department of Energy acknowledges the commentor's opposition to new missions at NTS. Decisions on the storage and disposition of weapons-usable fissile materials will be based upon environmental analyses, technical and economic studies, national policy considerations, and public input.

Date Received: 04/03/96
Comment ID: P0003
Name: Myra Zeller
Address: No address given

Transcription:

This is Myra Zeller. I'm calling because I think it's just ridiculous for us to keep stockpiling nuclear weapons. I don't see any reason at all that we need to keep doing this horrendous thing that is so inhumane to keep building up and building up weapons that are just intolerable. And I think that we're leading the world in the wrong direction. We're setting a poor example. We're spending $6 billion, which should be spent in other ways. I think that it's a bad idea. I think that we need to destroy those weapons. We don't need to stockpile them, and I definitely don't think we need to build any more tritium reactors. Thank you.

1/15.00.00

P-003

15 00 00 **Comment Number 1**

Comment noted.

ZEPEDA, BARBARA, SEATTLE, WA
PAGE 1 OF 1

Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (PEIS) Public Comment Form

Name (optional): BARBARA ZEPEDA
Address (optional): 1937 16 EAST SEATTLE WA 98112

Please write down your comments and drop this form in the marked boxes before you leave tonight. These forms will be submitted to the Department of Energy as part of the formal comment on this PEIS. If you are unable to complete this form tonight, written comments can be mailed to:

Department of Energy
Office of Fissile Materials Disposition
P.O. Box 23786
Washington, D.C. 20026-3786

or, you can call this toll-free number to leave comments by phone: 1-800-820-5156. Comments must be submitted by May 7, 1996.

The Department of Energy has identified three types of technologies as options for disposing of weapons-usable fissile materials. The Department has also considered a "no action alternative" which would result in long-term storage of these materials. Please write down your comments on the following three types of options for disposal and the storage option.

1. Materials Immobilization/Vitrification - Immobilize fissile materials by mixing them with glass, glass bonded zeolites, or ceramics.

SHOULD BUILD FUND UN & IAEA SO THAT INTERNATIONAL AGENCIES CAN ESTABLISH A TRANSPARENT & US CORPORATIONS HAVE MADE ENOUGH MONEY ON WEAPONS & WIPPSS BY MAKING THE MESS BIGGER. OBJECTIVELY AND AVOID LONGTHAUTIONS & BAD MAKE BE ESTABLISHED BY AGENCIES THAT DON'T PROFIT FROM THEIR MISTAKES.

2. Deep borehole disposal - Materials would be disposed in boreholes at least 2.5 miles deep, in geologically stable formations. Materials could be disposed directly into the deep borehole, or materials could be immobilized first, and then deposited into the deep borehole.

SEE UN CONVENTIONS ON PRESERVATION (ECOLOGY) & IDENTIFICATION OF SUCH PRESENT & FUTURE EFFECTS.

3. Reactor Options - Surplus plutonium/highly enriched uranium would be made into MOX fuel for use in nuclear reactors, destroying by fission a major portion of the weapons grade materials.

WHERE ARE THERE ANY EXAMPLES OF A SAFE/COST EFFECTIVE NUCLEAR PLANT OVER 20-50 YEARS LET ALONE THE 1000's OF YEARS OF RADIOACTIVE HAZARD

4. Storage Options - USDOE would continue existing storage practices for weapons-usable fissile materials at current locations and/or consolidate that storage at one or more of the designated sites.

NEED IAEA PROTOTYPE STANDARDS & RECORDS IF US IS TO SET A STANDARD OF PRACTICE THAT WE WANT THE REST OF THE WORLD TO MAKE AVAILABLE TO ALL COUNTRIES AND TO ALL US CITIZENS IN WE ARE TO IMPLEMENT THE WEAPONS DISPOSITION RECOMMENDATIONS FROM THE ANS SEABORG REPORT (9 more pages, 43, 44, 45, 46, 47. AND PAGES 3 & A. (KEY CONCLUSIONS AND RECOMMENDATIONS)

OBSCURE.

1/15.00.00

M-226

15 00 00 **Comment Number 1**

Comment noted.